April - June 2024 Vol. 12 Issue 2

ISSN 2319-6432 (Print)
ISSN 2349-4433 (Online)

NAAS RATING
4.95
w.e.f.
01.01.2024

JOURNAL OF KRISHI VIGYAN

A Quarterly Publication of Society of Krishi Vigyan

www.iskv.in

www.indianjournals.com

SOCIETY OF KRISHI VIGYAN

Manuscripts: Offered for consideration should be uploaded on the society's website www.iskv. in after remitting a non refundable processing feeof Rs. 500/-

Editorial Office:

Krishi Vigyan Kendra, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh.

Chief Editor: Dr. Manoj Sharma, Principal Extension Scientist, Animal Science, Directorate of Extension Education, Punjab AgriculturalUniversity, Ludhiana.

Subscription fee:

Fee for 1 year-Rs. 1500/- and Life Membership (10 Year) Rs. 7500/-

Edited and published by: Dr. Manoj Sharma on behalf of Society of Krishi Vigyan at M/S Dewa Enterprises, Jabalpur, M P.

LIST OF SCIENTISTS WHO JOINED AS LIFE MEMBERS

6542024. Senior Scientist and Head, Krishi Vigyan Kendra, Jagatsinghpur, (Odisha).

6552024. Senior Scientist and Head, Krishi Vigyan Kendra, Baliapal (Odisha).

6562024. Rohit Shukla, Subject Matter Specialist, Horticulture, Krishi Vigyan Kendra, Serchhip (Mizoram).

6572024. Raj Kumar, Senior Scientist cum Head, Krishi Vigyan Kendra , Kafligair Distt.- Bageshwar (Uttarakhand)

6582024. Monica Suresh Singh, Senior Scientist cum Head, ICAR-KVK, West Garo Hills, ICAR-RC for NEH Region, Tura (Meghalaya).

6592024. Asem Ameeta Devi, Sr Scientist cum Head , ICAR KVK, Chandel (Manipur).

6602024. Puchono Kweho, Subject Matter Specialist, Agronomy KVK, Kohima (Nagaland)

6612024. Gita Jayantilal Bhimani, Scientist Home Science, Krishi Vigyan Kendra, Navsari Agricultural University, Athwa Farm, Surat (Gujarat)

6622024. Vandana Kanwar, Associate Professor Human Development and Family Studies, PAU, Ludhiana (Punjab)

6632024. Lalit Upadhyay, Subject Matter Specialist, Agro-forestry, Krishi Vigyan Kendra, Reasi, SKUAST-Jammu (J&K)

TABLE OF CONTENTS

DOI : 10.5958/2349-4433.2024.00040.1

J Krishi Vigyan 2024, 12(2) : 210-213

Career Preferences among the Undergraduate Final-Year Veterinary Students

Arul Sabareeswaran T A[1*], Alimudeen S[1], Chethan G N[2], Induja T R[1], Senthilkumar R[3] and Bimal P Bashir[4]

Department of Veterinary and Animal Husbandry Extension Education,
College of Veterinary and Animal Sciences, Pookode, Wayanad
Kerala Veterinary and Animal Sciences University, Wayanad – 673576

ABSTRACT

A study was undertaken with the aim to identify the career preferences of undergraduate final-year veterinary students of College of Veterinary and Animal Sciences, Pookode, Kerala Veterinary and Animal Science University. The data were collected by convenient sampling method using a semi-structured pre-tested interview schedule from 30 boys and 30 girl students pursuing final year B.V.Sc. and A.H constituted the total sample size of 60. A set of 20 careers options were listed relevant to veterinary students and rated on a 4-point Likert scale (4-Highly preferred, 3-Preferred, 2-Least preferred, 1-Not preferred). The total weighed score (TWS) and weighed mean score (WMS) were calculated for each career choice and based on WMS ranks were assigned by using a simple rank order technique. The job of Government Veterinary Surgeon was identified as the most preferred choice by both the categories of students. Becoming research scientists were the second most preferred career choice by male respondents followed by military service, private practice and administrative service. The female respondents preferred career as doctors in milk plants, food system management, private practices and meat inspection officers in that order. Extension service and political career were the least preferred choice by both genders. There was a significant difference in preference among male and female respondents in administrative service ($p<0.05$) and military service ($p<0.01$).

Key Words: Career preference, Job, Kerala, Under-graduates, Veterinary Surgeon.

INTRODUCTION

Career choice is seen as an important aspect that has a significant impact on a student's life and determines potential future work schedules (Bharadwaj *et al,* 2017). There are several factors that influence the career choices of the students such as the availability of resources, social and cultural identity, personality, gender, interests of the students. The veterinary and animal husbandry sectors have been increased to a greater extent in India, so the role of veterinarians has also evolved to support these developing sectors of India. Since veterinarians are not only involved in animal health care practices, they also provide better managemental practices to the farmers, so it is important for undergraduate veterinary students to select the right career choices as per their field of interest with a promising scope for his/ her better future (Krishna and Sharma, 2016). Improper or poor selection of careers may lead to low job satisfaction for young veterinary graduates and also affect their profession in long term (Tomlin *et al*, 2010). The present study focuses on the career preferences of final-year undergraduate students based on their gender.

MATERIALS AND METHODS

The exploratory research design was adopted, and final-year students from the College of Veterinary and Animal Sciences, Pookode were purposively selected for this study. A semi-structured interview schedule was developed, and it was pre-tested among the non-sampling study population and necessary modifications were made before actual data collection. Data were collected by convenient sampling method from 30

Corresponding Author's Email - arulsabareeswaran1997@gmail.com

1-M.V.Sc. Scholar, 2- Ph.D. Scholar, 4- Assistant professor and Head i/c, Department of Veterinary and Animal Husbandry Extension Education, College of Veterinary and Animal Sciences, Pookode, KVASU, Kerala.

3- Director, KVASU Academic Staff College, Thrissur, Kerala- 680615

boys and 30 girl students of final year B.V.Sc. and A.H constituted the total sample size of 60 students. Data collection was made by using google forms. As per Krishna *et al* (2017) a set of 20 career options were listed as relevant to veterinary students and were rated on a 4-point Likert scale (4-Highly preferred, 3-Preferred, 2-Least preferred, 1-Not preferred). The Total Weighed Score (TWS) and Weighed Mean score (WMS) were calculated. The Total Weighted Score (TWS) was calculated for each career choice as per the standard method and WMS was calculated by using the following formula

$$\text{Weighed Mean Score} = \frac{\text{Highly preferred} \times 4 + \text{Preferred} \times 3 + \text{Least preferred} \times 2 + \text{Not preferred} \times 1}{\text{Total number of responses}}$$

Based on WMS, ranks were assigned by using a simple rank order technique.

RESULTS AND DISCUSSION

The career preferences of undergraduate veterinary students showed that most respondents prefer government veterinary surgeons as their choice of career by both genders and this might be due to fact that government jobs often offer job security, attractive benefits, stable work hours, pension plans, career advancement and success in life (Table 1). Tanwar *et al* (2022) was also opined that succeed in life by setting a greater goal was most important among undergraduate students. Working as extension agent and political career were the least preferred choice by both genders and this may be as a result that political career demands different lifestyle, ethical challenges public scrutiny. Becoming research scientists were the second most preferred career choice by male respondents followed by military service, having a small animal clinics, administrative service, professor in educational institute, working in farms in abroad, managers in milk plants, eco-jobs like wild life ecologist or zoo veterinarian, working in central government farms, having large animal clinics, meat inspection officers, research in multinational companies, food system management / consulting service officers in food processing and retail companies, technical officers in insurance companies, quarantine units – central government, technical officers/ marketing executive and managers in dairy/poultry/ pharmaceutical industry, technical officers in banks.

Becoming managers in milk plants were the second most preferred career choice by female respondents followed by food system management / consulting service officers in food processing and retail companies, having a small animal clinic, meat inspection officers, professor in educational institute, research scientists, working in central government farms, technical officers/ marketing executive and managers in dairy/poultry/pharmaceutical industry, having large animal clinics, working in farms in abroad, eco-jobs like wild life ecologist or zoo veterinarian, administrative service, technical officers in banks, military service, research in multinational companies, technical officers in insurance companies, quarantine units – central government in the same order as male respondents.

There was a significant difference in preference among male and female respondents in administrative service ($p<0.05$) and military service ($p<0.01$). This significant difference might be due to the reason like stereotypes, historical roles, and societal norms may all relate to gender preferences in the military or in administration positions. Choices can be driven by traditional gender roles. These choices may also be shaped by institutional biases and cultural norms. However, individual interests and motives differ greatly.

CONCLUSION

It was concluded that male respondents preferred government's jobs more than the female respondents. Both the genders were less aware about political careers and extension works. So, for proper choosing of career options by the students, colleges must provide career guidance and advices to their students through career guidance cell, Student mentors/ members should be introduced to provide advice and guidance to the students during their undergraduate period. Veterinary incubation centres should be established to convert ideas into commercial products and to promote entrepreneurial ideas of the students.

Table 1. Career choice preferences among final year veterinary students.

Sr. No	Job	MALE				FEMALE				Mann-Whitney U	Z Value
		TWS	WMS	SD	RANK	TWS	WMS	SD	RANK		
1	**Government Careers** Govt. Veterinary Surgeon	110	3.67	0.48	1	106.00	3.53	0.57	1	-0.873^{NS}	0.382
2	Meat inspection officer / (Slaughter houses in municipalities and corporations of state govt.)	85	2.83	0.95	12	90.00	3.00	0.83	5	-0.685 ^{NS}	0.493
3	Administrative services	94	3.13	0.68	5	78.00	2.60	0.93	13	-2.351*	0.019
4	Education – Asst. Prof. – State Vety. / Agri. Universities SAU/ SVUs)	93	3.10	0.88	6	89.00	2.97	0.85	6	-0.801 ^{NS}	0.423
5	Research Scientists in ICAR and other central research organisations.	102	3.40	0.67	2	89.00	2.97	0.93	7	-1.923 ^{NS}	0.055
6	Military service (RVC in Indian army, Indo-Tibetan boarder posts (ITPB) (Assistant Command in SSB)	99	3.30	0.75	3	74.00	2.47	1.04	15	-3.193*	0.001
7	Eco-Jobs – Wild life ecologist or conservation scientists, Zoo veterinarian-state central govt.	91	3.03	0.76	9	79.00	2.63	0.96	12	-1.849 ^{NS}	0.065
8.	Quarantine units – central government	77	2.57	0.77	16	68.00	2.27	0.87	18	-1.358 ^{NS}	0.175
9.	Central Govt. Farms	90	3.00	0.64	10	84.00	2.80	0.96	8	-0.665 ^{NS}	0.506
10.	**Semi-Government / Public sector Undertaking Careers** Managers / Doctors in milk plants (co-operatives)	91	3.03	0.56	8	93.00	3.10	0.66	2	-0.458 ^{NS}	0.647
11.	Insurance companies – Technical officers	80	2.67	0.76	15	70.00	2.33	0.99	17	-1.534 ^{NS}	0.125
12.	Bank – technical / field officers	75	2.50	0.68	18	76.00	2.53	1.11	14	-0.383 ^{NS}	0.702
13.	**Private sector careers** Private practice – small animal clinics	95	3.17	0.70	4	90.00	3.00	0.64	4	-0.929 ^{NS}	0.353
14.	Private practice – large animal clinics	87	2.90	0.61	11	81.00	2.70	0.84	10	-0.986 ^{NS}	0.324
15.	**Private sector jobs** Technical officers/ Marketing executive and managers in dairy, poultry, pharmaceutical industry and ante-mortem inspector in slaughter houses	76	2.53	0.78	17	82.00	2.73	0.74	9	-1.042 ^{NS}	0.298
16.	Extension agents / Technical officers in NGOs	68	2.27	0.87	19	66.00	2.20	0.81	19	-0.143 ^{NS}	0.887
17.	Research in Private and Multinational companies	83	2.77	0.82	13	71.00	2.37	0.93	16	-1.711 ^{NS}	0.087

18.	Food system management / consulting service officers in food processing and retail companies	81	2.70	0.75	14	91.00	3.03	0.72	3	-1.673 ^{NS}	0.094
19.	Other careers Abroad – farm consultants / Scientists	92	3.07	0.74	7	81.00	2.70	0.84	10	-1.669 ^{NS}	0.095
20.	Political career	45	1.50	0.86	20	43.00	1.43	0.90	20	-0.653 ^{NS}	0.514

**significant at 5 % level (p<0.05)*
***highly significant at 1 % level (p<0.01)*
^{NS} *non significant*

REFERENCES

Bharadwaja M K, Sharma G R K and Channappagouda B (2017). Prospective career dimensions of undergraduate Veterinary students in Andhra Pradesh. *Int J Livest Res* **7** (2): 144-147**.**

Krishna B M and Sharma G R K (2016). Factors influencing career choices among undergraduate Veterinary students in AP. *Int J Sci Environ Technol* **5** (6): 4418-4421.

Krishna B M, Sharma G R K, Harilal R and Suresh J (2017). A study on the career preferences of undergraduate Veterinary students in relationship to their sex and level of mass media exposure. *Int J Sci Environ Technol* **6** (1): 655-661.

Ramesh N, Sagar M P, Singh B P, Yadav R and Pathade S S (2019). Factors influencing career preferences of agriculture and animal sciences undergraduates in Telangana state. *Haryana Vet* **58** (1): 117-118.

Tanwar N K, Sharma K C and Kumawat N K (2022). Gaps in time management skills of the students of Sri Karan Narendra Agriculture University, Jobner. *J Krishi Vigyan* **10** (2): 179-183.

Thilakar P, Tripathi H and Senthilkumar G (2014). Career preferences of Veterinary science students in India. *Indian Vet J* **91**(6): 40-43.

Received on 7/3/2024 Accepted on 15/4/2024

DOI : 10.5958/2349-4433.2024.00041.8

J Krishi Vigyan 2024, 12(2) : 214-219

Constraints Perceived by the Shareholders of Livestock Based Farmer Producer Organizations in Kerala

T R Induja[3*], R Senthilkumar[1], Bimal P Bashir[2], P Reeja George[1] and V L Gleeja[2]

Department of Veterinary and Animal Husbandry Extension
College of Veterinary and Animal Sciences, Pookode, Wayanad
Kerala Veterinary and Animal Sciences University, Wayanad – 673576

ABSTRACT

Farmer Producer Organizations (FPOs) is a collectivisation of small, marginal and landless farmers that provide support and services to the shareholders, including marketing services, technical assistance, processing, and inputs supplies. The concept of collectivisation through the local-level organisation is very important for the empowerment of small, marginal and landless farmers both in the agricultural and livestock sectors. An *ex post facto* research was conducted among the livestock-based FPOs in Kerala state to analyse the constraints faced by the selected FPOs. As per the National Bank for Agriculture and Rural Development (NABARD), Kerala Regional Office, region-wise, there were 11, 7 and 10 FPOs operating in the Northern, Central and Southern Kerala, respectively. A total of 12 FPOs were chosen based on the number of FPOs in each stratum. A multistage random sampling method was adopted to sample the entire sampling population, which included 120 respondents. A semi-structured interview schedule was utilised as a tool to collect the data from the shareholders of FPO. Undeveloped storage facilities, lack of timely, inexpensive and high-quality feed and fodder, lack of the accurate market information, low price of the produce, mobilisation of the farmers and lack of sufficient funds for recurring expenditure were the significant challenges faced by the FPOs under various domains such as technical, marketing, organisational, and economic constraints respectively.

Key Words: Constraints, Farmer Producer Organisations, Livestock, Shareholders.

INTRODUCTION

The agricultural sector currently constitutes almost 13.00 per cent of the nation's gross domestic product (GDP), additionally accounting for approximately 55.00 per cent of overall employment. According to the Agricultural Census 2021-22, 86.00 per cent of the operational land holdings in India were owned by small and marginal farmers. The situation of small and marginal farmers was further complicated by their inability to get credit facility and secure insurance, susceptibility to climate change, low bargaining power, non-remunerative prices for the farm output, challenges related to transportation of the commodities, unorganised conventional markets, exploitation by middlemen and other risks.

The situation in animal husbandry is also no exception to these pitfalls as the majority of them are marginal and small farmers (Shingate, 2018). In addition, high feed and labour cost, shortage of fodder and grazing facilities makes the livestock farming not profitable. Further, the marketing of the livestock produce involves special problems such as the output is mostly a raw resource that requires additional processing, bulkier and highly perishable, seasonal production, the quality and quantity of the livestock products are influenced by the breed, season, type of feeds, climate and management practices, due to the variations in quality and quantity there is an imbalance in supply and demand of the livestock products, fluctuation in prices and challenges in applying uniform standards of quality, and inelastic demand.

To collectivize farmers, a variety of strategies, including cooperatives have been tried. It was considered that greater flexibility was needed to allow farmers' organizations to function

Corresponding Author's Email - indujatr@gmail.com

as commercial entities in a competitive market, considering previous experiences with the functioning of traditional cooperatives in India. As a result, producer companies were established when Section 581 of the Companies Act of 1956 was amended per the Y K Alagh Committee's suggestions. With the implementation of the Companies (Amendment) Act 2002 in February 2003, farmer producer companies (FPCs) became a viable catalyst for social progress and farmer empowerment (Alagh, 2007).

Farmer Producer Organisations (FPOs) is indeed an umbrella term used to denote various forms of farmer collectivization, including cooperatives, producer companies, trust, societies and Self-Help Groups (SHGs). The motive for creating FPOs is to establish and broaden organisations that are composed of producers, aiming for their development through economic benefits. In India, 7,374 registered FPOs have been established so far. In Kerala, 170 FPOs are operating in the state of which only 28 FPOs are engaged in livestock related activities as on 13th May 2022. Compared to FPOs in the agricultural sector, the functioning of livestock-based FPOs is meagre in the state. According to Khandave *et al* (2019), the FPOs successfully developed forward linkages with the marketing board for marketing, whereas, for storage, processing and value addition FPOs developed backward linkages with the private sector. The organisational structure of FPOs has a significant impact on the extent to which the organisation function. It facilitates division of labor and co-ordinate the efforts among the shareholders for achieving the objectives of an organisation (Singh *et al*, 2022). The structure of the FPOs includes the General Body (GB), Executive Body (EB), Board of Directors (BoD), General Manager (GM), FPO staff and local resource persons. The planning, implementation and monitoring done by the BoD, GM, staffs and local resource persons. Like various other farmer collectivization, FPOs shareholders have experiencing numerous constraints, studying those constraints and rectifying it would find a path for smooth functioning of FPOs. Therefore, this research work was designed and carried out to address the aforementioned research query as objectively; with the aim of identifying the constraints experienced by shareholders of Livestock based Farmer Producer Organizations functioning in Kerala. Also, the findings of present study would be useful for policymakers and other stakeholders for critical evaluation of existing FPOs and also for establishing livestock based FPOs.

MATERIALS AND METHODS

A sample size of 120 respondents were selected using the stratified multi-stage sampling method comprising of 60 office bearers and 60 members from the FPOs identified from the state. The 14 districts of the state were divided into three strata, *viz.* Southern Kerala, Central Kerala and Northern Kerala. In the first stage of sampling, the districts were selected purposively based on the highest number of FPOs operating in that particular stratum. As per the NABARD, there were 28 livestock based FPOs registered in Kerala. Region-wise there were 11, 7 and 10 FPOs operating in the Northern, Central and Southern Kerala, respectively. Malappuram and Wayanad districts from Northern Kerala, Palakkad district from Central Kerala and Thiruvananthapuram and Kollam districts from Southern Kerala were selected. In the second stage of sampling, a total of 12 FPOs were selected from the districts identified in the first stage, proportionate to the number of FPOs in each stratum. Accordingly, five FPOs from Northern Kerala (Malappuram and Wayanad), three FPOs from Central Kerala (Palakkad) and four FPOs from Southern Kerala (Thiruvananthapuram and Kollam) were selected. In the third stage of sampling, from each FPO, five office bearers and five members were selected as final respondents using simple random sampling method.

To achieve the objectives of the research work, a structured interview schedule was developed in consultation with subject matter specialists from the relevant field, reviewing available literatures, reports, journals and reputed online sources. A pilot study was conducted to pre-test the structured schedule among a non-sampling population in the study area. Suitable modifications were made based on the inputs obtained from the pilot study before actual data collection.

For the purpose of the current study, the constraints were operationalised as those factors which inhibited the successful operation of FPOs as perceived by the respondents from the selected FPOs. The constraints experienced by the shareholders were noted and categorised under four major domains *viz.*, technical, marketing, organisational and economical constraints. Constraints that were apparently relevant to the present study were listed and respondents were asked to assign ranks for each constraint. By using Garret ranking technique (1969) the perception of the respondents about various constraints were identified.

RESULTS AND DISCUSSION

Table 1. Constraints perceived by the shareholders of FPOs. (n=120).

Sr. No	Constraint	Farmers		Office bearers	
		Score	Rank	Score	Rank
1	Technical constraints	48.56	IV	39.43	IV
2	Marketing constraints	49.17	III	41.71	III
3	Organizational constraints	50.04	**I**	43.08	II
4	Economic constraints	49.91	II	47.55	**I**

The constraints were grouped into four domains such as technical, marketing, organisational and economic constraints (Table 1). Among the respondents, the farmers perceived the organisational constraints as the most challenging problem (score- 50.04), followed by economic constraints, marketing constraints and technical constraints. Instead, the office bearers were given first rank for economic constraints (score-47.55), followed by organizational, marketing and technical constraints. Similar findings were reported by Tiwari and Upadhyay (2021), who reported that the economic and operational constraints were the significant constraints faced by the FPOs.

Table 2. **Technical constraints perceived by the shareholders of FPOs (n=120)**

Sr. No	Constraint	Farmers		Office bearers	
		Score	Rank	Score	Rank
1	Lack of timely, inexpensive and high-quality feed and fodder	60.78	I	46.48	III
2	Undeveloped storage facilities	55.28	II	49.93	I
3	Undeveloped processing facilities	55.02	III	47.05	II
4	Lack of skilled labourers	44.73	V	33.54	V
5	Unawareness of scientific animal husbandry practices	44.38	VII	39.91	IV
6	Lack of availability of training	40.56	VI	29.63	VI
7	Lack of Computer literacy (which makes them unable to derive benefits of the available ICT resources)	39.16	VII	29.50	VII

In the case of technical constraints (Table 2), the farmers perceived the lack of timely, inexpensive and high-quality feed and fodder as their main problem. The other most significant constraints perceived by the farmers were undeveloped storage facilities, followed by undeveloped processing facilities. The challenges faced by the office bearers were inadequate storage facilities in the first place, followed by undeveloped processing facilities, and then lack of timely, inexpensive and high-quality feed and fodder. Lastly, the farmers and office bearers ranked lack of computer literacy. The findings of Patel *et al* (2023) partly supported this result, who reported that undeveloped storage facilities and inadequate processing facilities were the primary technical constraints faced by the FPOs.

Table 3. Marketing constraints perceived by the shareholders of FPOs (n=120)

Sr. No	Constraint	Farmers		Office bearers	
		Score	Rank	Score	Rank
1	Lack of accurate market information	57.95	I	48.18	II
2	Low price of produce	55.33	II	48.22	I
3	High cost of transportation	53.38	III	47.20	III
4	Lack of proper advertisement	46.89	IV	36.10	VI
5	Lack of value addition of the produce	46.54	V	38.44	V
6	Irregular procurement	43.39	VI	39.18	IV
7	Delayed payment	40.72	VII	34.61	VII

The farmers believed their primary issue, considering marketing limitations (Table 3), was the lack of proper marketing information. The farmers identified the low price of the produce, high cost of transportation, and a lack of proper advertisement as the other main obstacles. The first three challenges encountered by the office bearers include the low price of the produce, inadequate market information, and the high cost of transportation. Similar findings were reported by Jose and Meena (2019), who concluded that the low price of milk was the main problem faced by dairy based FPOs.

Table 4. **Organizational constraints perceived by the shareholders of FPOs (n=120)**

Sr. No	Constraint	Farmers		Office bearers	
		Score	Rank	Score	Rank
1	Lack of proper decision -making ability	52.61	I	42.16	VII
2	Poor professional management	51.65	II	43.25	IV
3	Ineffective co-ordination of different group activities	51.53	III	43.00	VI
4	Bias between members	51.31	IV	43.34	III
5	Lack of connection with financial organizations	49.32	V	40.84	VIII
6	Inefficient monitoring by the implementing agency	48.48	VI	43.21	V
7	Political interventions	48.38	VII	43.43	II
8	Mobilization of farmers	47.04	VIII	45.38	I

The data (table 4) showed that the farmers perceived that the biggest issue faced by the FPOs was lack of proper decision-making ability, followed by poor professional management, ineffective co-ordination of different group activities and inefficient monitoring by the implementing agencies. Whereas, the challenges faced by the office bearers were the mobilisation of the farmers, political interventions, bias between the members and poor professional management. Venkattakumar *et al* (2017) observed similar findings that mobilising the member was the primary limitation for the FPOs. Kujur *et al* (2019) reported poor professional management as one of the constraints of the FPOs. The poor professional management might be attributed to the inability of the FPOs to hire the professionals. Gorai (2020) reported that political intervention and middlemen were the major problems faced by the FPOs.

Table 5. **Economic constraints perceived by the shareholders of FPOs (n=120)**

Sr. No	Constraint	Farmers		Office bearers	
		Score	Rank	Score	Rank
1	Lack of sufficient fund for recurring expenditure	59.32	I	53.95	I
2	High cost of labour	52.64	II	50.15	II
3	Lack of proper government price policy	50.20	III	49.02	III
4	Lack of proper animal insurance facilities	48.55	IV	46.81	IV
5	Unavailability of credit/ subsidiary facilities from government institution.	45.38	V	39.73	VI
6	Lack of awareness of credit facilities	43.39	VI	45.63	V

The data (Table 5) revealed the economic constraints faced by the respondents. Both the farmers and the office bearers perceived the most critical challenges faced by the FPOs were lack of sufficient funds for the recurring expenditure, followed by poor professional management and lack of proper government price policy. The farmers and office bearers ranked the unawareness of the credit facilities and lack of proper animal insurance facilities as the least severe problems. Similar results were observed by Venkatesan *et al* (2020) and Navaneetham *et al* (2019), who explained that the inability to mobilise funds was a constraint faced by the FPOs.

FPOs could implement various strategies to address these constraints, including capacity-building programmes to enhance farmers' skills and knowledge in technical, marketing and organizational management. Economic constraints could be overcome by implementing effective financial management practices that can help FPOs better manage their funds, allocate resources efficiently and seek alternative funding sources such as grants or loans. In addition, investing in infrastructure improvements, such as upgrading storage and processing facilities, can enhance productivity and value-addition capabilities, addressing technical and marketing constraints. Besides, FPOs can advocate for supportive policies at the government level to address economic challenges, such as access to credit facilities, subsidies and price stabilization mechanisms. Collaborating with government agencies, NGOs and other stakeholders can help FPOs to overcome organizational challenges by leveraging resources, expertise and networks.

CONCLUSION

This study highlights the challenges experienced by the shareholders of livestock-based farmer producer organizations (FPOs) in Kerala. The findings highlight the multifaceted problems encountered by FPOs in the region, such as Undeveloped storage facilities, lack of timely, inexpensive, and high-quality feed and fodder, lack of accurate market information, low price of

the produce, mobilization of the farmers, and lack of sufficient funds for recurring expenditure were the significant challenges faced by the FPOs under various domains such as technical, marketing, organizational, and economic constraints, respectively.

REFERENCES

Alagh Y (2007). On producer companies, paper presented at the workshop organized by PRADAN on Linking Small Producers to Markets through Producer Companies on December 20, 2007 at New Delhi.

Gorai S K (2020). *Group stability of farmer producer organizations: an exploratory study in West Bengal. M.Sc. Thesis*. Division Of Agricultural Extension Icar-Indian Agricultural Research Institute New Delhi. 200p.

Jose E and Meena H R (2019). Profile of Farmer Producer Company (Dairy based) Members in Kerala. *Indian J Ext Edu* **55.** 47-51.

Khandave S, Shaik M S R and Dedun V S (2019). Backward and forward linkages developed by Farmer Producer Organisations in Western Maharashtra. *J Krishi Vigyan* **7**(2): 28-31.

Kujur P, Gauraha A K and Netam O M (2019). The socio-economic impact of Farmer Producer Organizations in Chhattisgarh plains. *J Ent Zool Stud* **7**(6): 1104-1106.

Navaneetham B, Mahendran K and Sivakumar S D (2019). Analysis of constraints for performance improvement of FPCs in Tamil Nadu. *Int J Farm Sci* **9**(2): 12-18.

Patel R R, Gupta B P, Mishra D, Shukla G, Kalia A and Verama A P (2023). Constraints Perceived by the Members of FPOs in Varanasi District, Uttar Pradesh, India. *Asian J Agril Ext Econ Soc* **41**: 659-665.

Shingate V K (2018). A study of role of farmer producer companies in marketing of agricultural produce with special reference to Pune district. *Ph.D Thesis*. Pimpri Chinchwad Education Trust's S B Patil Institute of Management Pradhikaran, Nigdi, Pune. 317p.

Singh M, Tiwari D and Rana R K (2022). Role of Organizational Structure and Behaviour for Ensuring Sustainability of Farmer Producer Organisations in Punjab. *J Krishi Vigyan* **10** (2): 283-289.

Tiwari N and Upadhyay R (2021). Constraints faced by the members of the farmer producer organizations in Udaipur district of Rajasthan. *Pharma Inn* **10**: 320-324.

Venkattakumar R, Mysore S, Khandekar N, Narayanaswamy B and Balakrishna B (2017). Farmers Producers Company and Broad-based Extension Services: A Case of Ayakudi Guava Producers in Dindigul District of Tamil Nadu. *Indian Res J Ext Edu* **17**: 33-38.

Venkatesan P, Sontakki B S, Shenoy N S, Sivaramane N and Sivakumar P S (2020). Impact of farmer producer organizations in fostering community entrepreneurship. *Indian J Ext Edu* **56**: 111-117.

Received on 31/3/2024 Accepted on 30/4/2024

DOI : 10.5958/2349-4433.2024.00043.0

J Krishi Vigyan 2024, 12(2) : 220-225

Development Programmes for enhancing Technical Knowledge and Skill competency of the Tribal people in Mayurbhanj district of Odisha

Jagannath Patra[1] and Rabindra Kumar Raj[2]

Krishi Vigyan Kendra, Mayurbhanj-1 (OUAT),
At/P.O. Shamakhunta, Dist- Mayurbhanj, Odisha

ABSTRACT

There are various agencies like ITDA, DWO, Lodha and Mankadia development agency working for the development of tribal people. In spite of that majority of tribal people use land only in kharif season and migrated to other places for alternative occupation in lean period. The study was conducted to analyse the development programme of these agencies in Mayurbhanj district of Odisha purposefully as the district enriched with most number of tribal people. Four blocks were selected randomly each one from four sub divisions and three villages were selected randomly from each block totaling to twelve villages. Fifteen tribal people were selected from each village with sample size of 180. The findings showed that majority of the respondents knew very well about the Mahatma Gandhi National Rural Employment Guarantee Act programme which was most useful developmental programme for the benefit of tribals. The extent of facilities availed by the respondents reflected that the respondents got maximum facility from Antodyoya Anna Yojana or popularly known as BPL rice. Regarding the availability of technical support from the departments in farm activities, it was found that maximum support came from the agriculture departments. The respondents availed the seed from department as critical input most of the times. About the benefit of the developmental schemes, it was found that District Primary Education Programme had a major role for the change in knowledge. With regards to the extent of demand for different departments for the development in the agriculture and allied sector, it was found that there was intense demand for the service from agriculture department.

Key Words: Developmental programme, Occupational mobility, Tribal, Technical support.

INTRODUCTION

The tribal people are relatively isolates, encysted, tradition bound, inward looking and less enterprising. During the post independence period, they have been experiencing induced social change through planned development and interventions. There are various agencies working for the development of tribal people like ITDA, DWO, Lodha and Mankadia development agency including line departments and non government organisation. But in spite of such endeavor, the rate of progress and development are not commensurate with the expectations. Although due to intervention of different extension activities, the situation has been improving, still there are some areas of concern to be looked into specifically for the overall development. The tribals, therefore go for other vocations particularly to work in non agricultural sectors and work as unskilled labourers. Even if they do not hesitate to leave their house including all other resources and migrated to other districts and continue to work as labourer for the rest period of their life. Enough technology in the field of agriculture has been developed in all land situations which are enough profitable. If all these technologies are used by the tribals perhaps they stay in their village and develop economic condition. The occupational mobility in the present context refers to the transition from one occupation to that of another. This may occur in two different directions, horizontally and vertically.

The mobility of the tribal people mainly depends on the availability of work/job, job satisfaction, relative economic advantage etc.

Corresponding Author's Email - jpatraouat@rediffmail.com
1Senior Scientist and Head, KVK, Mayurbhanj--1, OUAT, Bhubaneswar, Odisha; and
2Former Professor, Department of Extension Education, OUAT, Bhubaneswar.

Table 1. Extent of Knowledge of the respondents about the farming activities (n=180)

Sr. No.	Activity	Extent of Knowledge				Mean score
		Very Good	Good	Average	Poor	
		Number	Number	Number	Number	
1	Crop production	15	54	64	47	1.26 (I)
2	Poultry farming	03	66	27	84	0.93 (II)
3	Goat rearing	0	57	18	105	0.73 (III)
4	Horticultural plantation	03	21	09	147	0.33 (IV)
5	Sabai grass rope making	0	18	21	141	0.32 (V)
6	Operation of Farm machinery	0	15	18	147	0.27 (VI)
7	Rural handicrafts	0	18	0	162	0.20 (VII)
8	Dairy management	0	03	27	150	0.18 (VIII)
9	Collection of non-timber forest produce	0	03	27	150	0.18 (VIII)
10	Bee keeping	0	06	09	165	0.12 (IX)
11	Mushroom cultivation	0	06	04	170	0.09 (X)
12	Sericulture	0	0	06	174	0.03 (XI)

**The figures mentioned in the parentheses indicate the rank order.*
**Maximum obtainable score- 3*

Kailash (1993) revealed that there was a positive impact of various development programmes on the socio-economic, cultural and behavioural patterns of the tribal communities. He had clearly examined the relationship between the socio-economic profiles and the extraneous development forces such as education, modern technology, urbanisation and social interaction.

Considering the above facts the study was carried out with the objective of analysing the different developmental programme through the existing extension system for the benefit of the tribal people of the district in transferring and equipping technical knowledge and skill competency of the tribal people.

MATERIALS AND METHODS

The study was conducted in Mayurbhanj district of Odisha purposefully as the district enriched with most number of tribal people. The districts and sub divisions were selected purposively whereas random sampling technique was followed to select blocks, villages and respondents. Four blocks were selected randomly each one from four sub divisions like Shamakhunta from Baripada Sadar, Kaptipada from Kaptipada, Bijatala from Rairangpur and Jasipur from Karanjia. Three villages were selected randomly from each block. Likewise twelve villages in total were selected randomly. Fifteen tribal people were selected from each village as respondents randomly totaling sample size of 180.

Table 2. Knowledge of the respondents about the agriculture development programme (n=180)

Sr. No.	Programme	Extent of Knowledge			Mean value
		Fully known	Partially Known	Not Known	
		Number	Number	Number	
1	MG National Rural Employment Guarantee Act	136	44	0	1.76 (I)
2	Mid Day Meal	87	93	0	1.48 (II)
3	Antodyoya Anna Yojana/BPL Rice	75	105	0	1.41 (III)
4	District Primary Education Programme	70	101	09	1.34 (IV)
5	PM Gram Sadak Yojana	61	102	17	1.24 (V)
6	Integrated Child Development Program	52	79	49	1.02 (VI)
7	Swarnajayanti Gram Swarojagar Yojana	58	64	58	1.00 (VII)
8	RG Gramin Bidyut Yojana	52	75	53	0.99 (VIII)
9	Integrated Tribal Development Agency	31	73	76	0.75 (IX)
10	National Rural Health Mission	25	66	89	0.64 (X)
11	Agriculture Technology Management Agency	36	34	110	0.59 (XI)
12	Krushak Sahayata Kendra	21	45	114	0.48 (XII)
13	Pani Panchayat	24	37	119	0.47 (XIII)
14	National Horticulture Mission	18	34	128	0.39 (XIV)
15	Watershed Development Programme	09	43	128	0.34 (XV)
16	PM Employment Generation Programme	13	30	137	0.31 (XVI)
17	Backyard Region development Fund	13	27	140	0.29 (XVII)
18	NABARD WADI/Krushak Club	06	37	137	0.27 (XVIII)

**The figures mentioned in the parentheses indicate the rank order*
**Maximum obtainable score- 2*

RESULTS AND DISCUSSION

The extent of knowledge of the respondents indicated that majority of the respondents had better knowledge in crop production followed by poultry farming and goat rearing than other enterprises. This is probably due the compatible with their traditional occupation. They had very little knowledge in sericulture and mushroom cultivation. However the respondents had some knowledge on horticultural plantation, sabai rope making, operation of farm machinery, rural handicraft and collection of non-timber forest produce.

The findings showed that majority of the respondents knew very well about the Mahatma Gandhi National Rural Employment Guarantee Act programme, probably this is due to operated at grass root level and most of tribal people are the beneficiaries to this programme. They had also sufficient knowledge in Mid Day Meal, Antodyoya Anna Yojana, District Primary Education Programme, PM Sadak Yojana, and ICDS due to its wide coverage in the rural pocket. They had very little knowledge in NABARD/ WADI project, PMEGS, Backward Region Development Fund due to its limited implementations.

Majority of the respondents opined that MG National Rural Employment Guarantee Act was most useful developmental programme for the benefit of tribals followed by Mid Day Meal and District Primary Education Programme which was found from the table.3. As per the opinion of the respondents the programme like NABARD/WADI, watershed development programme, Krushak Sahayata Kendra, Pani Panchayat, PMEGP were perceived as least useful as compared to other programmes.

The maximum support came from the agriculture departments due to its wide spread coverage in terms of subsidy and inputs from different schemes. Secondly the respondents opined about availability of support from horticulture department probably due to introduction of different subsidy schemes. The

Development Programmes for enhancing Technical Knowledge and Skill competency

Table 3.Opinion of the respondents regarding the benefit of the developmental programme. (n=180)

Sr. No.	Programme	Opinion				Mean Value
		Very much useful	Useful	Somewhat useful	Not Useful	
		Number	Number	Number	Number	
1	MG National Rural Employment Guarantee Act	91	83	06	0	2.47 (I)
2	Mid Day Meal	66	85	29	0	2.20 (II)
3	District Primary Education Programme	61	92	27	0	2.19 (III)
4	Antodyoya Anna Yojana/BPL Rice	39	98	43	0	1.98 (IV)
5	RG Gramin Bidyut Yojana	45	71	42	22	1.77 (V)
6	Integrated Tribal Development Agency	49	46	67	18	1.70 (VI)
7	Swarnajayanti Gram Swarojagar Yojana	52	30	89	09	1.69 (VII)
8	PM Gram Sadak Yojana	37	66	55	22	1.65 (VIII)
9	Integrated Child Development Programme	39	55	64	22	1.62 (IX)
10	National Rural Health Mission	30	55	55	40	1.42 (X)
11	Backyard Region development Fund	10	52	78	40	1.18 (XI)
12	Agriculture Technology Management Agency	15	51	56	58	1.13 (XII)
13	National Horticulture Mission	15	33	74	58	1.03 (XIII)
14	Pradhan Mantri Employment Generation Programme	28	30	39	83	1.02 (XIV)
15	Pani Panchayat	12	46	39	83	0.93 (XV)
16	Krushak Sahayata Kendra	15	42	34	89	0.90 (XVI)
17	Watershed Development Programme	03	18	71	88	0.64 (XVII)
18	NABARD/WADI programme	03	15	70	92	0.60 (XVIII)

**The figures mentioned in the parentheses indicate the rank order*
**Maximum obtainable score- 3*

Table 4. Opinion of the respondents about technical support availed in farm activities from different departments. (n=180)

Sr. No.	Activity	Opinion over the technical support availability				Mean Value
		Strongly agree	Agree	Disagree	Strongly Disagree	
		Number	Number	Number	Number	
1	Crop production	15	49	60	56	1.13 (I)
2	Horticultural plantation	03	21	0	156	0.28 (II)
3	Operation of Farm machineries	0	15	09	156	0.22 (III)
4	Poultry farming	03	0	27	150	0.20 (IV)
5	Sabai grass rope making	0	18	0	162	0.20 (IV)
6	Dairy management	03	0	18	159	0.15 (V)
7	Bee keeping	0	06	09	165	0.12 (VI)
8	Mushroom cultivation	0	10	0	170	0.11 (VII)
9	Goat rearing	0	09	0	171	0.10 (VIII)
10	Rural handicrafts	0	0	09	171	0.05 (IX)

**The figures mentioned in the parentheses indicate the rank order*
**Maximum obtainable score- 3*

Table 5. Methods followed by the line departments for transfer technology to the respondents. (n=180)

Sr. No.	Method	Extent of methods followed			Mean Value	Rank Order
		Regularly	Occasionally	Never		
		Number	Number	Number		
1	Training	61	70	49	1.07	I
2	Farm and home visit	37	67	76	0.78	II
3	Group meeting	24	49	107	0.54	III
4	Demonstration	15	58	107	0.49	IV
5	Supply of printed material	15	42	123	0.40	V
6	Film and video shows	03	42	135	0.27	VI
7	Exhibition	03	36	141	0.23	VII
8	Field day	03	24	153	0.17	VIII
9	Exposure visit	03	15	162	0.12	IX

**Maximum obtainable score- 2*

Table 6. Availability of different agricultural inputs from developmental departments as perceived by the respondents. (n=180)

Sr. No.	Input	Extent of availability			Mean Value	Rank order
		Regularly	Occasionally	Never		
		Number	Number	Number		
1	Seeds	54	61	65	0.94	I
2	Marketing of the produce	15	39	126	0.38	II
3	Plant protection chemicals	09	45	126	0.35	III
4	Healthcare for animals	03	154	123	0.33	IV
5	Chicks	0	39	141	0.22	V
6	Credit facilities	03	27	150	0.18	VI
7	Planting material	06	18	156	0.17	VII
8	Nutrients	0	24	156	0.13	VIII
9	Post harvest management	0	09	171	0.05	IX

**Maximum obtainable score- 2*

support from farm machineries operation comes in the third rank as government had extended much subsidies and schemes in these sectors in some past years.

The line department extension personnel were following different extension method for technology transfer. Among them training was the most adopted method as per opinion of the respondents which was stated in the above table. This was followed by the farm and home visit, group meeting, demonstration, supply of printed material.

Proper input and its availability are very much crucial in case of the agricultural activities. The data (Table 6) showed that the respondents availed the seed as critical input most of the times followed by the marketing of produce, plant protection chemicals, health care for animals, chicks, credit facilities, planting material and nutrients. The post harvest management was least

Development Programmes for enhancing Technical Knowledge and Skill competency

Table 7. Extent of demand by the respondents for technical support from different departments. (n=180)

Sr. No.	Department	Extent of demand			Mean value	Rank order
		Regularly	Occasionally	Never		
		Number	Number	Number		
1	Agriculture department	76	39	65	1.06	I
2	Animal resource department	39	48	93	0.70	II
3	Agriculture University/KVK	15	49	116	0.44	III
4	Horticulture department	24	18	138	0.37	IV
5	Industry department	03	18	159	0.13	V
6	Soil conservation department	0	15	165	0.08	VI

**Maximum obtainable score- 2*

availed by the respondents.

It was found that there was intense demand for the service from agriculture department followed by the animal resource department, KVK, horticulture department and industry departments. The extent of knowledge of the respondents on farming activities indicated as majority had better knowledge in crop production followed by poultry farming and goat rearing than other enterprises.

CONCLUSION

The findings showed that majority of the respondents knew very well about the Mahatma Gandhi National Rural Employment Guarantee Act programme followed by Mid Day Meal, Antodyoya Anna Yojana. Regarding the availability of technical support from the departments in farm activities, it was found that maximum support came from the agriculture departments. Among the different extension methods followed by the line department extension personnel, training was the most adopted method followed by the farm and home visit. The respondents availed the seed from department as critical input most of the times. With regards to the extent of demand for different departments for the development in the agriculture and allied sector, it was found that there was intense demand for the service from agriculture department followed by the animal resource department. On the basis of the finding it was suggested for checking mobility of the tribal people from agriculture to non-agriculture sector like enhancing the knowledge and skill level among the tribal people to increase their efficiency and better understanding of the scientific agriculture.

REFERENCES

Kailash (1993). *Tribal Education and Occupation: Dynamics of Impact and Change*, Volume. Xv: 192. *http:// www.vedamsbooks.in/no8371*

Planning Commission Report (2007-2012) on Working Group Report of the Development of Education of SC/ST/Minorities/Girls and other Disadvantaged Groups, For 11th, Five Year Plan. *http:/ /planipolis. iiep. unesco. org/ upload/ India/ India_ wg11_scst.pdf.* Accessed on Nov, 2010

Received on 21/3/2024 Accepted on 22/4/2024

DOI : 10.5958/2349-4433.2024.00044.7

J Krishi Vigyan 2024, 12(2) : 226-232

Description of Native Chicken in Belgaum Division of Karnataka State

B G Veeranna Gowda[1], B U Umesh, G M Satheesha , Hemanth Gowda , M M Venkatesh and M Bharat Bhushan

Veterinary College, Vinobanagar, Shivamogga

Karnataka Veterinary Animal and Fisheries Sciences University, Bidar, Karnataka, India

ABSTRACT

The production of native chickens in India constitutes approximately 42% of the total chicken production and contributes around 24% to the overall meat and egg production. Identifying and characterizing non-descript indigenous chicken breeds is crucial. A recent comprehensive study was conducted in the Belgaum division of Karnataka State, India, to address this need. Hatching eggs were sourced from 180 villages across Bijapur, Belgaum, and Dharwad districts within the Belgaum division. These eggs were then hatched and reared separately using the deep litter system and following standard management practices. Phenotypic characterization was conducted according to NBAGR guidelines when the birds reached 20 weeks of age. The average shank length of male birds ranged from 93.66±0.55 to 96.91±1.72 mm, while in female birds, it ranged between 81.53±0.65 to 83.08±0.31 mm. Significant differences ($P<0.05$) were observed among the three districts studied. Similarly, the average keel length of male birds varied from 114.04±0.67 to 123.75±1.67 mm, and in female birds, it ranged from 112.79±0.33 to 119.90±0.50 mm, with significant differences noted ($P<0.05$). The average breast angle of male birds ranged from 79.29±0.22° to 80.85±0.25°, while in female birds, it varied between 77.78±0.29° to 81.06±0.39°, showing significant differences ($P<0.05$). Furthermore, the average body weight at 20 weeks for male birds ranged from 1577.58±11.99 to 1669.04±9.20 g, and for female birds, it ranged from 1054.11±5.25 to 1063.43±4.92 g, also displaying significant differences ($P<0.05$).

Key Words: Breast angle, chicken, Comb type and color, Keel length, Phenotypic characterization, Plumage pattern, Shank length.

INTRODUCTION

India possesses rich biodiversity, including a diverse range of poultry genetic resources, with 19 indigenous breeds and numerous subtypes among the 72 breeds found in Asia, contributing significantly to the country's rural economy (Padhi *et al,* 2016). Indigenous chicken breeds are reservoirs of genetic diversity, hosting various genomes and important genes relevant to tropical conditions. India and its neighbouring countries are recognized as the native habitat of the Red Jungle Fowl (*Gallus gallus*), the ancestor of present-day domestic poultry.

Recognizing the significance of indigenous poultry breeds within backyard farming systems, efforts are underway to characterize, document, and utilize these breeds to enhance the socio-economic status of rural communities (Pundir *et al,* 2013). Conserving these breeds is crucial as they serve as a source of genetic variation for future poultry breeding programs. Moreover, native germplasm holds great potential for backyard poultry production in India. The current study focuses on systematically analyzing the morphological characteristics and economic traits of indigenous chicken from the Belgaum division of Karnataka. This research aims to uncover the potential of indigenous chicken breeds in developing new varieties with improved adaptability and production capacity, characterized by multicolored plumage, long legs for predator evasion, and resemblance to native birds.

MATERIALS AND METHODS

The aim of this study was to characterize and classify indigenous chicken breeds from three districts within the Belgaum division of Karnataka State based on their morphological features.

Corresponding Author's Email - bgvgbgvg@gmail.com

Table 1. Shank length (mm), Keel length (mm), Breast angle (º) and Body weight (gm) at 20 weeks of age in indigenous chicken.

Parameter	Sex	District			
		Bijapur	Belgaum	Dharwad	Overall Mean
Shank length (mm)	Males	96.91±1.72 [b]	95.97±0.53 [ab]	93.66±0.55 [a]	95.51±0.63
	Females	81.53±0.65 [a]	82.02±0.54 [ab]	83.08±0.31 [b]	82.20±0.30
	Combined sex	89.22±1.20	88.99±0.80	88.37±0.62	88.86±0.52
Keel length (mm)	Males	123.75±1.67 [b]	121.81±0.82 [b]	114.04±0.67 [a]	119.87±0.74
	Females	111.90±0.50 [a]	113.66±0.29 [b]	112.79±0.33 [ab]	112.78±0.22
	Combined sex	117.83±1.05 [b]	117.74±0.60 [b]	113.42±0.38 [a]	116.32±0.43
Breast angle (º)	Males	79.29±0.22 [a]	80.85±0.25 [b]	80.43±0.23 [b]	80.19±0.14
	Females	77.78±0.29 [a]	81.06±0.39 [b]	80.63±0.24 [b]	79.82±0.21
	Combined sex	78.54±0.20 [a]	80.96±0.23 [b]	80.53±0.16 [b]	80.00±0.12
Body weight (gm)	Males	1669.04± 9.20 [b]	1604.17±10.62 [a]	1577.58±11.99 [a]	1616.93±7.59
	Females	1063.43±4.92	1063.38±4.29	1054.11±5.25	1060.30±2.79
	Combined sex	1154.28±17.70	1144.50±15.82	1132.63±15.58	1143.80±9.45

Males (N=50), Females (N=50) and Combined sex (N=150).
Means bearing at least one common superscript within a column not differ significantly (P≤0.05)

Hatching eggs of native chicken were collected from 180 selected villages across Bijapur, Belgaum, and Dharwad districts in Karnataka, where the indigenous chicken population was approximately 0.27 million, 0.66 million, and 0.13 million respectively. A total of 1979 chicks were hatched, wing-banded, and reared separately under the deep litter system with standard management practices.

Phenotypic evaluation was conducted by recording morphometric traits in both male and female birds at 20 weeks of age, following guidelines from ICAR-NBAGR, Karnal. Shank length was measured as the distance between the hock joint and the tarso metatarsus using digital Vernier calipers with an accuracy of 0.1mm. Keel length was measured from the tip of the keel bone to the joint of the sternum, also using digital vernier calipers with an accuracy of 0.1 mm. Breast angle was measured using a breast meter or protractor with an accuracy of one degree, taken at the midpoint of the breast region.

Additional morphological characteristics included feather morphology, presence of structural variations in feathers such as normal, frizzled, and silky feathers, feather distribution, plumage color, plumage pattern, skin color, shank color, ear lobe color, eye color, comb type, comb color, presence or absence of wattles, and body weights. The collected data underwent statistical analysis according to the methods outlined by Snedecor and Cochran (1984) using the SPSS 17.0 statistical package.

RESULTS AND DISCUSSION

Shank length in Male birds

At the 20th week of age, the shank length varied from 93.66±0.55 mm in Dharwad district to 96.91±1.72 mm in Bijapur district. There was a significant difference observed between the birds from Bijapur and Dharwad districts. These findings align with those of Rajakumar (2013) who also noted similar results in the Bangalore division, with values ranging from 86.06±0.44 mm to 97.56±1.29 mm. In contrast, Gopinath (2013) reported lower values in the Mysore division, ranging from 82.98±0.94 mm to 92.61±0.26 mm. The longer shank length observed in our study was attributed to the narrower width of the shank and lighter body weight, which showed a negative correlation with shank length. This longer shank length enables native birds to swiftly evade predators while foraging in field conditions.

Shank length in females

At the 20th week of age, shank length varied from 81.53±0.65 mm in Bijapur district to 83.08±0.31 mm in Dharwad district, with Dharwad district birds showing a significant difference from those in Bijapur district. These findings contrast with those of Rajakumar (2013), who reported lower values in the Bangalore division, ranging from 69.02 mm to 77.20±0.49 mm. Similarly, Gopinath (2013) also reported lower values in Mysore division birds, ranging from 72.82±0.53 mm to 75.76±0.65 mm.

Keel length in male birds

At the 20th week of age, the average keel length of males varied from 114.04±0.67 mm in Dharwad district to 123.75±1.67 mm in Bijapur district. Birds from Bijapur and Belgaum districts exhibited significant differences compared to those from Dharwad district. These findings differed from those of Rajakumar (2013), who reported values in the Bangalore division that were similar to Dharwad district, ranging from 122.61±0.69 mm in Ramanagar district to a higher value of 132.43±2.29 mm in Bangalore Rural district. Gopinath (2013) reported lower values than those observed in the present study, ranging from 75.78±0.87 mm to 83.06±0.24 mm. The variation in keel length measurements may be attributed to differences in chicken types, nutrition, and management practices in the present study.

Keel length in female birds

At the 20th week of age, the average keel length ranged from 111.90±0.50 mm in Bijapur district to 113.66±0.29 mm in Belgaum district. Birds from Belgaum district exhibited a significant difference from those in Bijapur district. These findings were consistent with Rajakumar's (2013) observations in the Bangalore division, where values ranged from 108.45±0.64 mm to 116.95±0.81 mm. In contrast, Gopinath (2013) reported lower values than those found in the present study for birds in the Mysore division, ranging from 66.14±0.52 mm to 68.65±0.65 mm. The variations in keel length may be attributed to the bird types in the Belgaum region and the management practices implemented.

Breast angle in male birds

At the 20th week of age, the average breast angle (º) of males ranged from 79.29±0.22º in Bijapur district to 80.85±0.25º in Belgaum district. Birds from Belgaum and Dharwad districts exhibited a significant difference compared to those from Bijapur district. These findings were consistent with those of Rajakumar (2013). Gopinath (2013) reported slightly higher values in the Mysore division, ranging from 84.38±0.46º to 85.21±0.28º.

Breast angle in female birds

At the 20th week of age, the average breast angle (º) ranged from 77.78±0.29º in Bijapur district to 81.06±0.39º in Belgaum district. Birds from Belgaum and Dharwad districts exhibited a significant difference compared to those from Bijapur district. These findings were consistent with those of Gopinath (2013). Rajakumar (2013) reported slightly higher values in the Bangalore division, ranging from 78.62±0.66º to 86.81±0.64º.

Body weight at 20th weeks of age in male birds

At the 20th week of age, the average body weights of males were 1669.04±9.20 gm, 1604.17±10.62 gm, and 1577.58±11.99 gm in Bijapur, Belgaum, and Dharwad districts, respectively. Birds from Bijapur exhibited significantly higher body weights compared to those from Belgaum and Dharwad districts. Rajakumar (2013) reported lower body weights in indigenous chicken from the Bangalore division, ranging from 1249.76±19.71 gm to 1480.14±43.93 g. Similarly, Gopinath (2013) also reported lower body weights in indigenous chicken from the Mysore division, ranging from

1250.00±28.58 gm to 1366.06±24.33 g. Thakur *et al* (2006) reported even lower body weights in Kadaknath breed (906.21±8.11 gm), while Haunshi *et al* (2009) reported 1297.83±20.85 gm in males of the Miri type of chicken.

Body weight at 20th weeks of age in female birds

At the 20th week of age, the body weights of females ranged from 1054.11±5.25 gm in Dharwad district to 1063.43±4.92 g in Bijapur district, with no significant differences observed among the three districts. These findings were consistent with those of Gopinath (2013). Rajakumar (2013) reported values in the Bangalore division, ranging from 944.29±14.70 g to a higher value of 1131.19±28.30 g in Chikkaballapur district. The results of the present study indicated higher values compared to those reported by Thakur *et al* (2006) for Kadaknath (846.02±6.49 g).

Morphological Features

Feather morphology

In the male birds of Belgaum division, it was observed that 91.66 per cent exhibited normal feather morphology, while 8.33 per cent showed frizzle feather morphology. Among females, 92.64 per cent displayed normal feather morphology, while 7.35 per cent exhibited frizzle feather morphology. In contrast, Gopinath (2013) found that all birds, regardless of sex, in the Mysore division displayed 100 per cent normal feather morphology. Similarly, Rajakumar (2013) reported that all birds in the Bangalore division exhibited 100 per cent normal feather morphology.

Feather distribution

In the male birds of Belgaum division, 87.4 per cent exhibited normal feather distribution, while 12.49 per cent showed naked neck distribution. Among females, 94.11 per cent displayed normal feather distribution, while 5.88 per cent exhibited naked neck distribution. In contrast, Gopinath (2013) found that in the Mysore division, the combined sex had 93.27 per cent normal feather distribution and 6.71 per cent naked neck distribution. Similarly, Rajakumar (2013) reported in the Bangalore division that in males, the values were 96.55 per cent normal, 3.14 per cent naked neck, and 0.30 per cent feathered shank, while in females, it was 97.39 per cent normal, 2.33 per cent naked neck, and 0.27 per cent feathered shank. The majority of birds evaluated in the present study displayed normal feather distribution, with a lower per centage showing naked neck distribution under farm conditions.

Plumage color and plumage pattern

Plumage color and patterns in poultry are influenced by sex, known as sexual dimorphism. In the current study, male birds in the Belgaum division exhibited six predominant plumage color groups, with brown being the most common (33.33%), followed by red (23.61%), multi-color (22.22%), black (15.28%), white (4.17%), and blue (1.39%). Similarly, females predominantly displayed brown plumage (35.54%), followed by red (23.28%), black (18.87%), multi-color (17.65%), white (3.68%), and blue (0.98%).

Regarding plumage patterns, male birds were categorized into seven groups, with solid being the most predominant (54.16%), followed by dull (41.6%), barred (9.71%), mottled (6.94%), striped (5.55%), spotted (5.55%), and patchy (4.16%). Females showed similar patterns, with solid being predominant (43.87%), followed by dull (19.6%), patchy (12.25%), mottled (10.29%), barred (6.86%), striped (5.87%), and spotted (1.22%). These results align with those of Rajakumar (2013), with similar findings reported in the Mysore division by Gopinath (2013).

Feathers were also examined for secondary plumage patterns, categorized into

seven groups. The most predominant pattern in males was self-red (43.05%), followed by self-black (24.99%), mottled (16.66%), barred (5.55%), self-white (4.16%), self-blue (2.77%), and lasing (2.77%). In females, self-red was also predominant (40.92%), followed by mottled (26.22%), self-black (21.07%), lasing (5.14%), barred (2.69%), self-white (2.44%), and self-blue (1.46%). These findings were consistent with Rajakumar (2013) and Gopinath (2013) in the Mysore division, who reported similar secondary plumage patterns.

Skin color

In the overall population consisting of 72 males and 408 females, 91.66 per cent of males had yellow skin, while 8.33 per cent had white skin. Among females, 96.07 per cent had yellow skin, and 3.91 per cent had white skin. These findings were consistent with those reported by Rajakumar (2013). However, Gopinath (2013) reported contradictory values in the Mysore division, where the combined sex showed 83.11 per cent yellow skin and 16.87 per cent white skin. According to NBAGR (2011), the Ghagus breed is known for having white skin, while other indigenous chicken populations have been documented to have white and/or yellow skin colors (Nthimo, 2004; Vijh *et al*, 2005a; Vij *et al*, 2006a; Kumar and Kumar, 2007). The pigmentation of non-feathered tissues such as skin and shank involves carotenoids and melanins, responsible for yellow and black colours respectively.

Shank color

In the indigenous chicken population of the Belgaum division, yellow was the predominant shank color, with 83.33 per cent in males and 91.42 per cent in females, followed by white at 4.16 per cent in males and 1.46 per cent in females, black at 9.72 per cent in males and 5.63 per cent in females, and green at 2.77 per cent in males and 1.46 per cent in females. These findings were consistent with those reported by Rajakumar (2013) and Gopinath (2013).

Ear lobe color

In the current study, all male and female birds in the Belgaum division exhibited red ear lobes. These results were consistent with findings by Gopinath (2013) and Rajakumar (2013), and they align with the breed descriptor provided by NBAGR (2011), where the Aseel and Ghagus breeds are noted for having red ear lobes.

Comb color

All indigenous chickens in the Belgaum division were observed to have red-colored combs in this study, consistent with observations by Gopinath (2013) and Rajkumar (2013). Other comb colors have been documented by Ravikumar (2011) and Faruque *et al* (2010).

Eye color

In male birds, eye color was observed in three variants: grey (41.66%), brown (55.55%), and black (2.77%). Among females, it was grey (28.67%), brown (59.55%), and black (11.76%). These findings were consistent with those reported by Rajakumar (2013) and Gopinath (2013). The breed descriptor by NBAGR (2011) notes red-colored eyes in the Ghagus breed.

Comb type

In the study, comb types were categorized into three varieties: single (80.55%), pea comb (16.66%), and rose comb (2.77%) in males, and single comb (86.02%), pea comb (11.76%), and rose comb (2.20%) in females. These results were consistent with those reported by Gopinath (2013) and Rajakumar (2013). The breed descriptor by NBAGR (2011) indicates that the Ghagus breed typically has a single comb.

Presence/absence of wattles

Wattles were present in 59.72 per cent of male birds and absent in 40.27 per cent, while in females, they were present in 41.41 per cent and absent in 58.57 per cent of birds in the Belgaum division. These findings were consistent with those reported by Rajakumar (2013), but not with

Gopinath (2013). The breed descriptor provided by NBAGR (2011) notes that the Ghagus breed typically has smaller, red-colored wattles. Wattle color is inherited as a polygenic trait involving variations in pigmentation of carotenoid and melanin pigments.

CONCLUSION

The observations on skin, shank, and ear lobe color in this study align with the typical characteristics of the Asiatic class. The slight variations in morphological traits across different genotypes within various districts suggest natural adaptations to local conditions. Particularly, the performance of indigenous chickens in terms of body weight was notably better in Bijapur and Belgaum districts.The significant variations observed among the indigenous chickens across the studied districts indicate genetic diversity within the local population. This diversity can be further explored and utilized through improved management practices and breeding strategies. By conserving these birds and selectively breeding them, new varieties and strains can be developed to better meet the needs of rural poultry farming, including organic production.

Further investigation, particularly molecular characterization and assessment of genetic similarity/divergence with other Indian breeds, is warranted for the indigenous chickens from all three districts evaluated in this study. Efforts should be made to officially recognize these birds as distinct breeds and conserve their genetic diversity.

REFERENCES

Acharya R M and Bhat P N (1984). Livestock and poultry genetic resources in India. *Research Bulletin,* No. 1, IVRI, Izatnagar, Uttar Pradesh, India.

Agarwal C K and Sapra K L (1972). Collection and evaluation of native germ plasma, efficiency of feed conversion, egg production and egg size in desi, Black Bengal, Naked neck and Aseel. *Indian Vet J* **49**: 187-190.

Amitava Roy, Partha Sarathi Roy, Nilanjan Mandal, Sandeep Kumar and Pankaj Kumar Biswas (2018). Comparative performances of improved poultry breed under intensive condition in Murshidabad district of West Bengal, India. *Int J Curr Microbiol App Sci* (2018) **7** (6):1504-1508.

BAHS (2019). Basic Animal Husbandry Statistics (2019). Basic Animal Husbandry Statistics, Department of Animal Husbandry, Dairying and Fisheries, Government of India.

Gopinath (2013). *Characterization and performance evaluation of indigenous chicken in the Mysore division of Karnataka State,* Ph.D. thesis, submitted to Karnataka Veterinary Animal and Fisheries Sciences University, Bidar.

Hailu Assefa and Aberra Melesse (2018). Morphological and morphometric characterization of indigenous chicken populations in Sheka Zone, South Western Ethiopia *Poul Fish Wildl Sci* **6**: 200.

Haunshi S Niranjan M Padhi M K Reddy M R Sunitha R Rajkumar U and Panda A K (2010). Characterization of two Indian native chicken breeds for production, egg and semen quality, and welfare traits *Poult Sci* **90**:314-320 doi:10.3382/ps.2010-01013.

Kalitha N Gavande S S and Barua N (2009). Production and reproduction performance of indigenous chicken of Assam under rural condition. *Indian J Poult Sci* **44 (2)**:253-255

Kumar S Sharma R K and Kumar A (2018).

Documentation and conservation of indigenous poultry germplasm with special reference to Uttara. *In proceedings of XXXV Annual conference of Indian Poultry Science Association held at ICAR-CIARI, Port Blair, A & N Islands. Pp 42-46.*

Newton O Otecko Irene Ogali Said I Ngang'a David H Mauki Stephen Ogada Grace K Moraa Jacqueline Lichoti Bernad Agwanda Min-Shen Peng Sheila C Ommeh And Ya –Ping Zhang (2019). Phenotypic and morphometric differentiation of indigenous chickens from Kenya and other tropical countries augments perspectives for genetic resource improvement and conservation. *Poult Sci* **98**: 2747-2755.

Rajakumar Nagarahalli (2013). *Characterization and performance evaluation of indigenous chicken in the Bangalore division of Karnataka State,* Ph.D. thesis submitted to Karnataka Veterinary Animal and Fisheries Sciences University, Bidar.

Sharma R K Shive Kumar Anil Kumar Singh D V and Kumar D (2018). Uttara: A new breed of chicken from Uttarakhand. *In the proceedings of National conference on "Native chicken production: opportunities for conservation, productivity enhancement and commercial exploitation in view of global warming" on 19-20th December, 2018, held at TANUVAS, Chennai, Pp74.*

Received on 28/2/2024 Accepted on 22/4/2024

DOI : 10.5958/2349-4433.2024.00045.3

J Krishi Vigyan 2024, 12(2) : 233-237

Effect of Different Packaging on Broccoli Quality in Room Conditions

Chingtham Chanbisana*, Asis Kumar Banik and Pukhram Bhumita
College of Horticulture, Central Agriculture University (Imphal), Thenzawl, Mizoram

ABSTRACT

A research work was carried out to discuss the effect of different packaging materials on the quality of broccoli stored in room condition. In Horticultural Research Station, Mondouri, the crop was grown which was harvested at tight and compact stage of broccoli for storage studies in room conditions. Broccoli were kept without any packaging material (T1), packaging with 0.5% perforation polypropylene bag (T2), 1% perforation polypropylene (PP) bag (T3) and polypropylene bag without any perforation (T4) and stored in room condition. During the storage period, the change in physico-chemical characteristics based on physiological loss in weight (PLW), marketability, yellowing %, ascorbic acid, total soluble solids and chlorophyll content were studied at regular intervals in order to identify the changes in quality during the room storage. The maximum weight loss (17.97%) occurred in broccoli without any packaging material while the minimum weight loss (2.49%) was recorded in broccoli without any perforation. Maximum TSS was recorded in broccoli heads packed with 1% perforation PP bag (T3) while the minimum was recorded in unpacked broccoli heads (T1). The maximum ascorbic acid content in non perforated packaging (T4) was 93.67 while minimum content in unpacked broccoli was 54% on the 3rd day. The highest value of chlorophyll content of 293 µg/g on the day of storage declined to 271.33 µg/g on the 3rd day of storage in non-perforated package (T4). Unpacked broccoli showed maximum yellowing which increased to 97.67% on while broccoli packed with no perforation (T4) resulted with least yellowing of 2% on the 3rd day of storage. So, the best packaging method in broccoli for room storage is T4 during the 3 days storage in room condition.

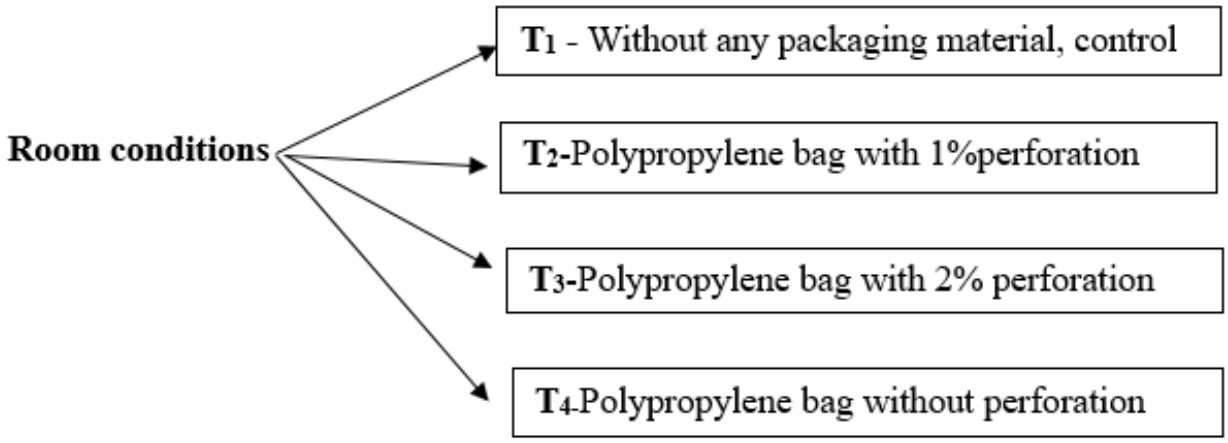
Key Words: Ascorbic acid, Broccoli, Chlorophyll, Shelf life, Yellowing.

INTRODUCTION

Broccoli (*Brassica oleracea var italica*) is a cool season crop belonging to the family Brassicaceae and grows in temperature range of 18-23°C maturing in about 75 to 95d after planting depending upon the cultivar, season and planting date. Broccoli can grow well during winter season in India so there is good scope for export during this period to the Gulf and other developed countries where the climatic conditions are unfavourable (Thanburaj and Singh, 2003). The main sugars present in broccoli includes glucose, fructose, sucrose, maltose and lactose. Broccoli is a good source of ascorbic acid among vegetables containing on an average of 34-185mg/100g fresh weight, while broccoli leaves and stalk contain on average 93.2mg ascorbic acid/100g fresh weight. Broccoli consists of glucosinolate compounds, which shows characteristic flavour of this vegetable. An average amount 1.20-6.24µmol of glucosinolates/g of fresh weight of broccoli is present (Song and Thornalley, 2007). Consumer prefers broccoli with sweet,crisp with characteristic flavour instead of intense bitter broccoli. It has been found that lower bitter pungent flavours was related with 30-35mg/100g fresh weight or less of glucosinolate content in broccoli (Bruckner *et al*, 2005). Kundu *et al* (2018) have demonstrated that this high value crop has a good scope to grow in the prevailing climatic condition of the West Bengal with potential for export.

Inspite of the rich nutritional value of broccoli, the high respiration rate of broccoli is responsible for the short shelf life of broccoli. Packaging to give proper protection against mechanical damage and moisture is necessary. The most important external factor that affects post harvest deterioration of crops is temperature (Wills *et al*, 2007). The main aim of the work was to enhance the shelf life of this perishable crop by using packaging of different perforations and reduce the post harvest loss to increase the benefit of the broccoli growers.

Corresponding Author's Email - chanbi.sana44@gmail.com



MATERIALS AND METHODS

The study was carried in Bidhan Chandra Krishi Viswavidyalaya in the department of Post Harvest Technology of Horticultural Crops in Mohanpur, West Bengal. Broccoli was cultivated in the Horticultural Research Station, Mondouri, West Bengal which falls under sub tropical humid (Indo-Gangetic) agro climatic zone with 9.75m above mean sea level, 23.5^{0}N latitude and 89^{0}E longitude where the soil type is sandy loam and sufficiently deep soil with pH 6.0 to 6.8. Harvested broccoli heads were precooled in room condition followed by removing the leaves and packed with polypropylene bags with different level of perforations while the unpacked heads were kept as control for comparison. Storage was done at four different conditions as stated below:

Completely randomised design was used to analyse the data with three replications for each treatment. Analysis in data recorded on PLW%, ascorbic acid content, Total soluble solids, content of chlorophyll (µg/g), yellowing (%). These data were recorded daily basis for the entire storage period.

Analysis of Physico-chemical parameters:

Physiological loss in weight (PLW)%

PLW is calculated based on the initial weight (before storage) and loss in weight recorded at the time of sampling during storage (Nath *et al*, 2011).

$$PLW = \frac{\text{initial weight} - \text{finalweight}}{\text{initial weight}} \times 100$$

Ascorbic acid (mg/100g)

It is calculated by titration method using 2, 6-dichlorophenol indophenols (blue colour) where the a pink colour appearance denotes the end point since the blue dye is pink coloured in acid medium. Ascorbic acid (mg/100 g)

$$= \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made up}}{\text{Aliquot of extract taken for estimation} \times \text{Wt: or vol: of the sample taken for estimation}} \times 100$$

Chlorophyll

Spectrophotometric method is used to determine the chlorophyll content. The supernatant volume is made up with acetone 80% and value of optical density value is measured against blank through wavelength 660nm and 642.5nm in a colorimeter. The total chlorophyll content is calculated by the formula:

Total chlorophyll (a+b), µg/ ml = (7.12 × OD at 660nm) + (16.8 × OD at 642.5nm)

(TSS) Total soluble solids in °Brix

Broccoli juice sample was used to determine the TSS in degree brix (°B). For this purpose (Erma Hand Refractrometer I.S.O 2173)

is used where thebroccoli juice is placed on face of the prism and the reading in °Brix will be noted.

Yellowing %

The broccoli head can be imaginarily divided into four parts out of 100 per cent. The area which becomes yellow are will be recorded as per the division of the whole head.

RESULTS AND DISCUSSION

The storage studies in room condition was done for 3days. The highest PLW was 4.90 to 17.97% in unpacked broccoli while the lowest PLW was recorded in broccoli packed without perforation (0.79 to 2.49%) throughout the storage period. Loss in weight increased during broccoli storage in the room condition.

Table 1. Change in physiological loss in weight (%) of broccoli during storage.

Treatment	Days in storage		
	Day 1	Day 2	Day 3
T1(no packaging)	4.90(12.78)	11.77(20.05)	17.97(25.07)
T2(PP+0.5%perforation)	0.43(3.74)	2.72(9.49)	4.58(12.36)
T3(PP+1% perforation	1.14(6.13)	3.33(10.52)	4.67(12.48)
T4(PP+ no perforation)	0.79(5.11)	1.58(7.22)	2.49(9.07)
SEm±	0.03	0.08	0.07
CD(P=0.05)	0.10	0.27	0.24

Note: Values in bracket denote angular transformed data

Regarding TSS (Table 2), it increased gradually in all the broccoli with different level of packagings. Broccoli in non perforated packaging showed the highest TTS content while minimum content was recorded in non packed broccoli heads which may be due to the varying rate of respiration in the packed and non packed broccoli.

Table 2. Change in TSS (^{o}B) of broccoli during storage.

Treatment	Days in storage			
	At harvest	Day 1	Day 2	Day 3
T1(no packaging)	7.13	7.77	7.80	7.43
T2(PP+0.5%perforation)	7.20	7.43	7.70	7.93
T3(PP+1% perforation	7.13	7.53	8.00	8.17
T4(PP+ no perforation)	7.20	7.57	7.99	8.00
SEm±	0.13	0.12	0.08	0.05
CD(P=0.05)	NS	NS	NS	0.16

Note: NS= non significance

The highest ascorbic acid content was found in non perforated packaging followed by packaging with 0.5% perforation while the least effective treatment was in the unpacked broccoli with minimum ascorbic acid content. This occurred due to change in atmosphere in package leading to vitamin C retention due to the increase in CO_2 with the reduction in O_2 amount (Barth and Zhuang, 1996).

Table 3. Change in ascorbic acid (mg/g) of broccoli during storage.

Treatment	Days in storage			
	At harvest	Day 1	Day 2	Day 3
T1(no packaging)	129.67	82.33	69.00	54.00
T2(PP+0.5%perforation)	127.00	102.67	82.33	69.00
T3(PP+1% perforation	127.67	106.67	79.67	60.67
T4(PP+ no perforation)	128.00	116.67	103.00	93.67
SEm±	2.63	1.42	1.31	1.62
CD(P=0.05)	NS	4.72	4.35	5.38

Broccoli packed with no perforation showed the highest chlorophyll content which reduced from 287.33 to 271.33 µg/g during the storage followed by those packed with 0.5% perforation PP bag while the minimum chlorophyll content was recorded in unpacked broccoli which decreased from 267 to 121 µg/g during the storage study. The total chlorophyll a+b content followed decreasing trend for all the cases where the rate of decrease was slower in lower temperature along with no perforation. This was in line with finding of Serrano *et al* (2006) where the total chlorophyll content reduced drastically control floral part of broccoli with similar reduction in macro perforated packaged broccoli.

Table 4. Change in chlorophyll (µg/g) of broccoli during storage.

Treatment	Days in storage			
	At harvest	Day 1	Day 2	Day 3
T1(no packaging)	296.00	267.00	170.00	121.400
T2(PP+0.5%perforation)	294.67	271.33	183.33	176.67
T3(PP+1% perforation	296.67	278.33	243.33	117.67
T4(PP+ no perforation)	293.33	287.33	281.00	271.33
SEm±	3.09	2.86	13.25	8.55
CD(P=0.05)	NS	9.46	43.87	28.33

Note: NS= non significance

Yellowing started from day 2 with maximum yellowing (91.67%) in unpacked broccoli followed by 88.33% in broccoli packed with 0.5% perforation while minimum yellowing occurred in broccoli packed with no perforation with 1.33 and 2.00% on 2 and 3 days after storage respectively.

Table 5. Change in yellowing (%) of broccoli during storage.

Treatment	Days in storage	
	Day 2	Day 3
T1(no packaging)	91.67(73.37)	97.67(82.96)
T2(PP+0.5%perforation)	88.33(70.08)	98.33(82.63)
T3(PP+1% perforation	80.33(63.65)	90.00(71.53)
T4(PP+ no perforation)	1.33 (6.53)	2.00(8.13)
SEm±	1.24	1.93
CD(P=0.05)	4.11	6.39

Note: Values in bracket denote angular transformed data

CONCLUSION

The least physiological loss in weight was shown by polypropylene (PP) packed broccoli with no perforation which was responsible to maintain the texture of fresh broccoli along with high retention of ascorbic acid (93.67%) and the highest chlorophyll retention during the three days storage period while the unpacked one is not desirable due to wilting problem. Though there was only slight yellow part in the broccoli (T4) packed with no perforation. So it can be concluded that among the various packaging, broccoli in (T4) which is packed in PP without any perforation resulted in maximum desirable character whereas broccoli in (T1) without any packaging started yellowing and wilting fast during the 3 days study in the room condition.

REFERENCES

Barth MM and Zhuang H (1996). Packaging design affects antioxidant vitamin retention and quality of broccoli florets during postharvest storage. *Postharvest Biol Technol* 9:141-150.

Bruckner B Schnohof I Kornelson C and Schrodter R (2005). Multivariate sensory profile of broccoli and cauliflower and consumer preference. *Italian J Food Sci* **1**:17-32.

Kundu P Mukherjee A and Sahu NC (2018). Suitable cultivars of Broccoli, Red Cabbage, Capsicum and French Bean for Alluvial Tracts of West Bengal. *J Krishi Vigyan* **7**(1):197-202

Nath A Bagchi B Misra LK and Bidyut C Deka (2011). Changes in post-harvest phytochemical qualities of broccoli florets during ambient and refrigerated storage. *Food Chem* 127: 1510-14

Song L and Thornalley J (2007). Effect of storage, processing and cooking on glucosinolates contents of Brassica vegetables. *Food Chem Toxicol* 45:216-224

Thamburaj S and Singh N (2003). *Vegetables, Tuber Crops and Spices*. Indian Council of Agricultural Research (ICAR), New Delhi.

Wills, R.B.H., McGlasson, W.B., Graham, D. and Joyce, D.C. (2007). Postharvest: an Introduction to the Physiology and Handling of Fruit and Vegetables and Ornamentals. CABI, Oxfordshire, UK. p.9-10.

Received on 7/2/2024 Accepted on 10/4/2024

DOI : 10.5958/2349-4433.2024.00046.X

J Krishi Vigyan 2024, 12(2) : 238-245

Effect of Environment, Irrigation and Fertigation on Growth, Yield and Water Use Efficiency in Red Cabbage

Vishal Pandey[1], N N Firake[2] and S D Gorantiwar[3]
Dr. A. S. College of Agricultural Engineering and Technology,
Mahatma Phule Krishi Vidyapeeth, Rahuri – 413 722 (India)

ABSTRACT

A study was conducted on red cabbage at the Precision Farming Development Centre, Mahatma Phule Krishi Vidyapeeth in Rahuri, Maharashtra, India. The research compared two growing environments: inside a polyhouse and in an open field. It also tested three different irrigation levels (0.90 ETc, 0.75 ETc, and 0.60 ETc) and three fertilizer application rates (125% of the recommended dose (RD), 100% RD, and 75% RD). The results showed that red cabbage yielded the best under polyhouse conditions with the highest irrigation level (0.90 ETc) and the highest fertilizer rate (125% RD). Additionally, the highest water use efficiency was achieved with a slightly lower irrigation level (0.75 ETc) but still with the highest fertilizer rate (125% RD) inside the polyhouse.

Key Words: Environment condition, Fertigation regimes, Irrigation regimes, Polyhouse, Red cabbage

INTRODUCTION

Indian Government is promoting exotic vegetables, of which market value and nutrient content is quite higher than traditional vegetables. In this situation, to acquire proper knowledge of a particular vegetable, i.e. how the variety of that vegetable is responding to Indian climate and to the irrigation and fertigation regimes as well. A research experiment of red cabbage was under taken at Precision Farming Development Centre, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India. Red cabbage is new crop recently introduced in India. The native of this crop is Southern Europe, which requires cooler climate for its well development. It is proved by several researchers that there is significant role of environment, irrigation and fertigation on the growth and yield of crop. (Harel et al, 2014; Ojha et al, 2016; Umesha et al, 2011) Bhosale and Sonawane (2016) and (Santosh et al, 2017) reported similar results for different vegetables. (Paksoy, 2006) conducted a research experiment on different varieties of red cabbage with different methods of irrigation and reported that highest yield was obtained under drip irrigation, followed by sprinkler and furrow irrigation. (Kumar *et al* 2010), and (Gopala Reddy et al, 2017) also specified that drip irrigation was the most efficient and profitable method among all irrigation methods.

MATERIALS AND METHODS

The site of experiment was situated at 19^0 47' N latitude and 74^0 37' E longitudes at 657 m above mean sea level, in the central campus of Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India. The experiment was carried out in polyhouse and open field in split-split plot design with 18 treatments comprising of two environmental conditions i.e. polyhouse (E_1) and open field (E_2), three irrigation regimes 0.90 (I_1), 0.75 (I_2) and 0.60 (I_3) of crop evapo-transpiration and three fertigation regimes 125 (F_1), 100 (F_2) and 75 (F_3) % of RDF (recommended dose of fertilizer) with three replications. The size of the polyhouse was 25 × 20 m and open field was 20 x 18 m. The size of each raised beds in polyhouse and open field were 2.7 x 0.75 m and 4.5 × 0.75 m, respectively, with 0.3 m height and 0.5 m buffer strip was provided between two beds. Silver colour at top and black colour at bottom polyethylene mulch was used commonly in all the treatments. The width of mulch and thickness

Corresponding Author's Email - vishalpandey945.vp@gmail.com
1.Senior Research Fellow, MPKV, Rahuri
2.Head, Department of Irrigation and Drainage Engineering, MPKV, Rahuri
Head, Agricultural Engineering, MPKV, Rahuri

Table 1. Effect of different environmental condition, irrigation regimes and fertigation regimes on plant height, stem girth, E-W spread and N-S spread at harvest (120 DAT) of red cabbage plant

Treatment	At harvest, 120 DAT			
	Plant Height, cm	Stem girth, mm	E-W spread, cm	N-S spread, cm
A. Environmental factor				
E_1: Polyhouse	33.46	14.76	46.43	50.30
E_2: Open field	29.13	16.40	38.55	43.03
S.E.m±	0.13	0.26	0.15	0.26
C.D. at 5%	0.81	1.57	0.92	1.60
B. Irrigation level (I)				
I_1: 90% ETc	31.87	18.07	43.26	47.68
I_2: 75% ETc	31.55	15.40	42.55	46.88
I_3: 60% ETc	30.47	13.26	41.65	45.44
S.E.m±	0.06	0.14	0.36	0.39
C.D. at 5%	0.21	0.44	1.18	1.26
C. Fertigation level (F)				
F_1: 125% RD	32.63	16.67	43.29	48.54
F_2: 100% RD	31.19	15.32	42.68	46.65
F_3: 75% RD	30.08	14.74	41.49	44.81
S.E.m±	0.11	0.06	0.49	0.63
C.D. at 5%	0.33	0.18	1.44	1.84
C. Interaction (E X I)				
S.E.m±	0.09	0.19	0.51	0.55
C.D. at 5%	0.29	0.63	NS	NS
D. Interaction (E X F)				
S.E.m±	0.16	0.09	0.70	0.89
C.D. at 5%	NS	0.26	NS	NS
E. Interaction (I X F)				
S.E.m±	0.19	0.11	0.86	1.09
C.D. at 5%	0.57	0.32	NS	NS
F. Interaction (E X I X F)				
S.E.m±	0.28	0.15	1.21	1.55
C.D. at 5%	0.80	0.45	NS	NS

were 1.20 m and 25 micron respectively. The recommended dose of fertilizers of red cabbage in open field cultivation was 80:40:40 kg/ha (N: P: K). In the experiment, drip irrigation system was used for daily irrigation. Average emission uniformity of drip irrigation system was observed in the range of 89.16 % to 93.12 %.

RESULTS AND DISCUSSION

The maximum plant height (35.87 cm) was observed under $T_1 = E_1I_1F_1$ (Polyhouse x 0.90 ETc x 125 % RDF), which was significantly superior over other treatments. However, the minimum plant height was (25.91 cm) under $T_{18} = E_2I_3F_3$ (Open field x 0.60 ETc x 75 % RDF) treatment (Table 1). The effect of different factors i.e. environment, irrigation and fertigation are depicted in Fig. 1(a), (b) and (c) respectively and interaction of all three factor is depicted in Fig. 1(d) (Table 2). The maximum stem girth (20.66 mm) was observed under $T_1 = E_2I_1F_1$ (Open field x 0.90 ETc x 125 % RDF), which was significantly

Table 2. Interaction effect of different environmental condition, irrigation regimes and fertigation regimes on plant height (cm) at harvest (120 DAT) of red cabbage plant

Treatment	E_1: Polyhouse			E_2: Open field		
	I_1:0.9 ETc	I_2:0.75 ETc	I_3:0.6 ETc	I_1:0.9 ETc	I_2:0.75 ETc	I_3:0.6 ETc
	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
F_1: 125% RDF	35.87	34.33	33.99	31.01	30.79	29.79
F_2: 100% RDF	33.27	33.85	32.44	29.58	29.21	28.78
F_3: 75% RDF	32.87	32.61	31.93	28.64	28.51	25.91
S.E.± = 0.28				CD at 5 % = 0.80		

Table 3. Interaction effect of different environmental condition, irrigation regimes and fertigation regimes on stem girth (mm) at 120 DAT (at harvest) of red cabbage plant

Treatment	E_1: Polyhouse			E_2: Open field		
	I_1:0.9 ETc	I_2:0.75 ETc	I_3:0.6 ETc	I_1:0.9 ETc	I_2:0.75 ETc	I_3:0.6 ETc
	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
F_1: 125% RDF	18.78	15.10	13.45	20.66	17.11	14.92
F_2: 100% RDF	16.78	14.18	12.29	18.56	16.49	13.65
F_3: 75% RDF	15.89	13.77	12.58	17.78	15.72	12.68
S.E.± = 0.15				CD at 5 % = 0.45		

Table 4. Effect of environmental condition, irrigation regimes and fertigation regimes on the yield, equatorial and polar diameter of red cabbage

Treatments	q/1008 m^2	Equatorial diameter	Polar diameter
A. Environment Condition (E)			
E_1: Polyhouse	32.65	201.13	278.73
E_2: Open field	18.95	128.38	90.18
S.E.m±	0.31	2.65	1.89
C.D. at 5%	1.88	16.11	11.53
B. Irrigation level (I)			
I_1: 90% ETc	31.88	197.91	227.66
I_2: 75% ETc	27.70	168.44	186.30
I_3: 60% ETc	17.83	127.92	139.41
S.E.m±	0.36	0.61	1.45
C.D. at 5%	1.18	1.97	4.73
C. Fertigation level (F)			
F_1: 125% RD	28.18	174.96	199.03
F_2: 100% RD	25.96	165.72	189.68
F_3: 75% RD	23.27	153.58	164.65
S.E.m±	0.28	1.14	1.21
C.D. at 5%	0.81	3.33	3.53

Treatments	q/1008 m^2	Equatorial diameter	Polar diameter
D. Interaction (E X I)			
S.E.m±	0.51	0.86	2.05
C.D. at 5%	1.68	2.79	6.69
E. Interaction (E X F)			
S.E.m±	0.39	1.61	1.71
C.D. at 5%	1.14	NS	4.99
F. Interaction (I X F)			
S.E.m±	0.48	1.97	2.10
C.D. at 5%	1.40	5.76	6.12
G. Interaction (E X I X F)			
S.E.m±	0.68	2.79	2.96
C.D. at 5%	1.98	8.14	8.65

Table 5. Interaction effect of different environmental condition, irrigation regimes and fertigation regimes on yield (q/1008 m^2), head diameter (equatorial diameter in mm) and head diameter (polar diameter in mm), of red cabbage plant

Treatment	E_1: Polyhouse			E_2: Open field		
	I_1:0.9 ETc	I_2:0.75 ETc	I_3:0.6 ETc	I_1:0.9 ETc	I_2:0.75 ETc	I_3:0.6 ETc
	Yield, q/1008 m^2					
F_1: 125% RDF	43.74	36.74	26.09	25.95	22.18	14.39
F_2: 100% RDF	37.92	36.22	24.56	24.12	20.41	12.52
F_3: 75% RDF	37.18	32.48	18.94	22.37	18.15	10.49
S.E.± = 0.68				CD at 5 % = 1.98		
Equatorial head diameter, mm						
F_1: 125% RDF	243.33	221.65	172.23	165.77	138.54	108.24
F_2: 100% RDF	235.36	202.36	165.89	161.43	131.17	98.14
F_3: 75% RDF	232.19	190.82	146.34	149.38	126.09	76.68
S.E. ± = 2.79				CD at 5 % = 8.14		
Polar head diameter, mm						
F_1: 125% RDF	332.18	308.55	255.34	136.31	88.28	73.50
F_2: 100% RDF	331.45	293.03	238.91	129.53	85.65	59.52
F_3: 75% RDF	309.31	256.82	182.96	127.16	85.45	26.22
S.E.± = 2.96				CD at 5 % = 8.65		

superior over other treatments. However, the minimum stem girth was (12.58 mm) under T_9= $E_1I_3F_3$ (Polyhouse x 0.60 ETc x 75 % RDF) treatment (Table 1). The effect of different factors i.e. environment, irrigation and fertigation are depicted in Fig. 2(a), (b) and (c) respectively and interaction of all three factor is depicted in Fig. 2(d) (Table 3). There was no significant difference was noticed in plant spread in N-S and E-W direction under different treatments (Table 1).

The maximum yield per 1008 m^2 area of polyhouse was 43.74 q was observed under T_1= $E_1I_1F_1$ (Polyhouse x 0.90 ETc x 125 % RDF), which was significantly superior over other treatments. However, the minimum yield per 1008 m^2 area of polyhouse was 10.49 q under T_{18}= $E_2I_3F_3$ (i.e. open

Table 6. Total depth of irrigation water applied over the growth period of red cabbage

Treatment No.	Treatment	Total water required, mm	Water use efficiency, kg/m^3
T_1	Polyhouse x 90 % ETc x 125% RDF	356.47	20.11
T_2	Polyhouse x 90 % ETc x 100% RDF	356.47	17.44
T_3	Polyhouse x 90 % ETc x 75% RDF	356.47	17.10
T_4	Polyhouse x 75 % ETc x 125% RDF	297.05	20.28
T_5	Polyhouse x 75 % ETc x 100% RDF	297.05	19.99
T_6	Polyhouse x 75 % ETc x 75% RDF	297.05	17.93
T_7	Polyhouse x 60 % ETc x 125% RDF	237.64	17.995
T_8	Polyhouse x 60 % ETc x 100% RDF	237.64	16.94
T_9	Polyhouse x 60 % ETc x 75% RDF	237.64	13.06
T_{10}	Open Field x 90 % ETc x 125% RDF	362.29	11.74
T_{11}	Open Field x 90 % ETc x 100% RDF	362.29	10.91
T_{12}	Open Field x 90 % ETc x 75% RDF	362.29	10.12
T_{13}	Open Field x 75 % ETc x 125% RDF	311.60	11.67
T_{14}	Open Field x 75 % ETc x 100% RDF	311.60	10.74
T_{15}	Open Field x 75 % ETc x 75% RDF	311.60	9.55
T_{16}	Open Field x 60 % ETc x 125% RDF	260.91	9.04
T_{17}	Open Field x 60 % ETc x 100% RDF	260.91	7.87
T_{18}	Open Field x 60 % ETc x 75% RDF	260.91	6.59

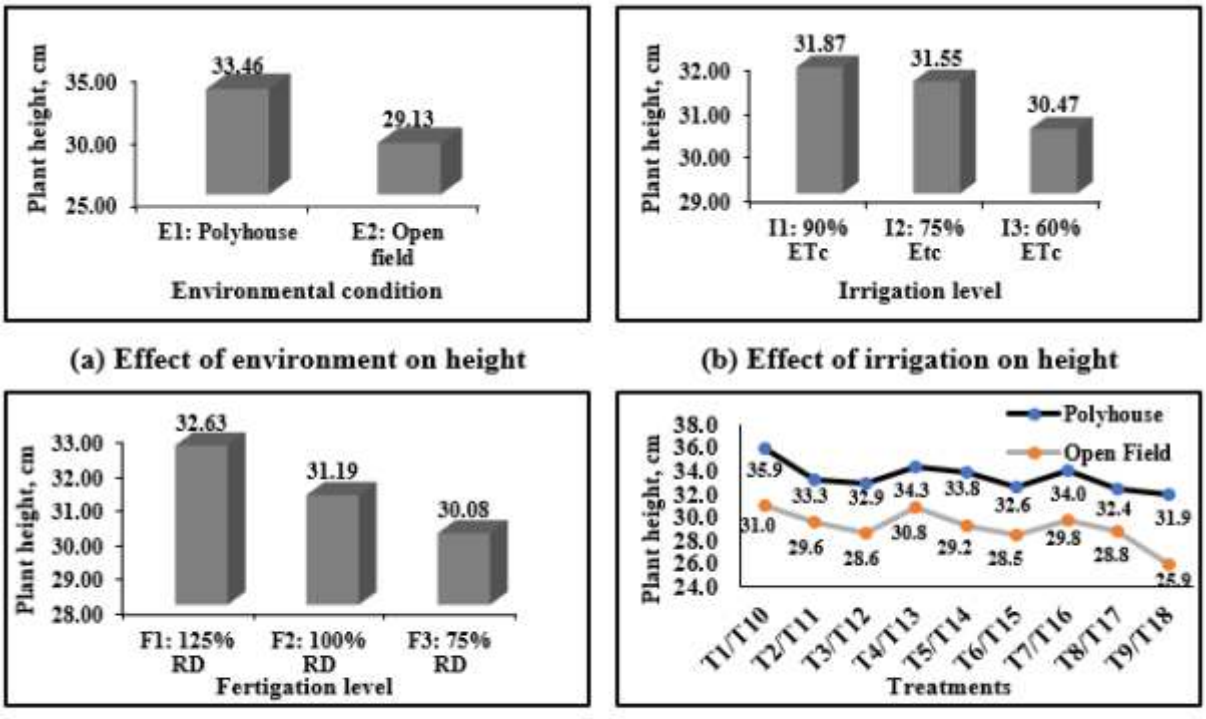
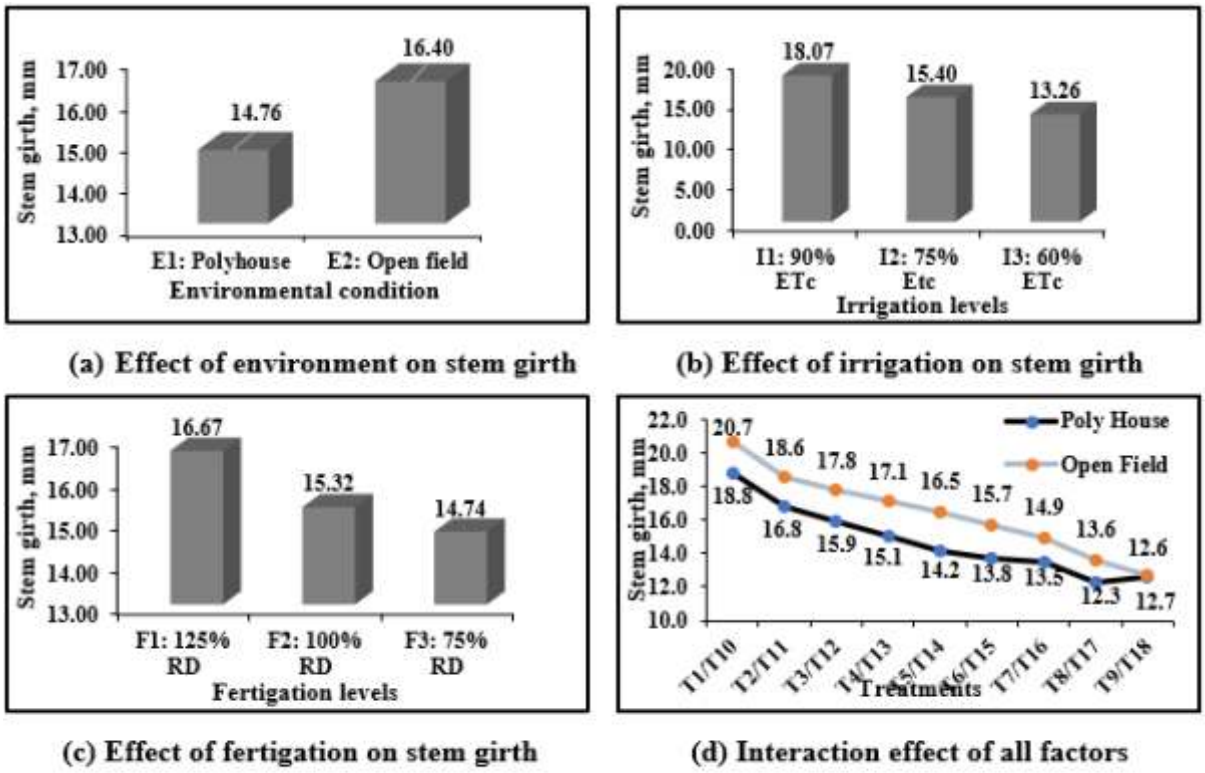


Fig. 1 Effect of treatments on an average height of red cabbage plant at harvest



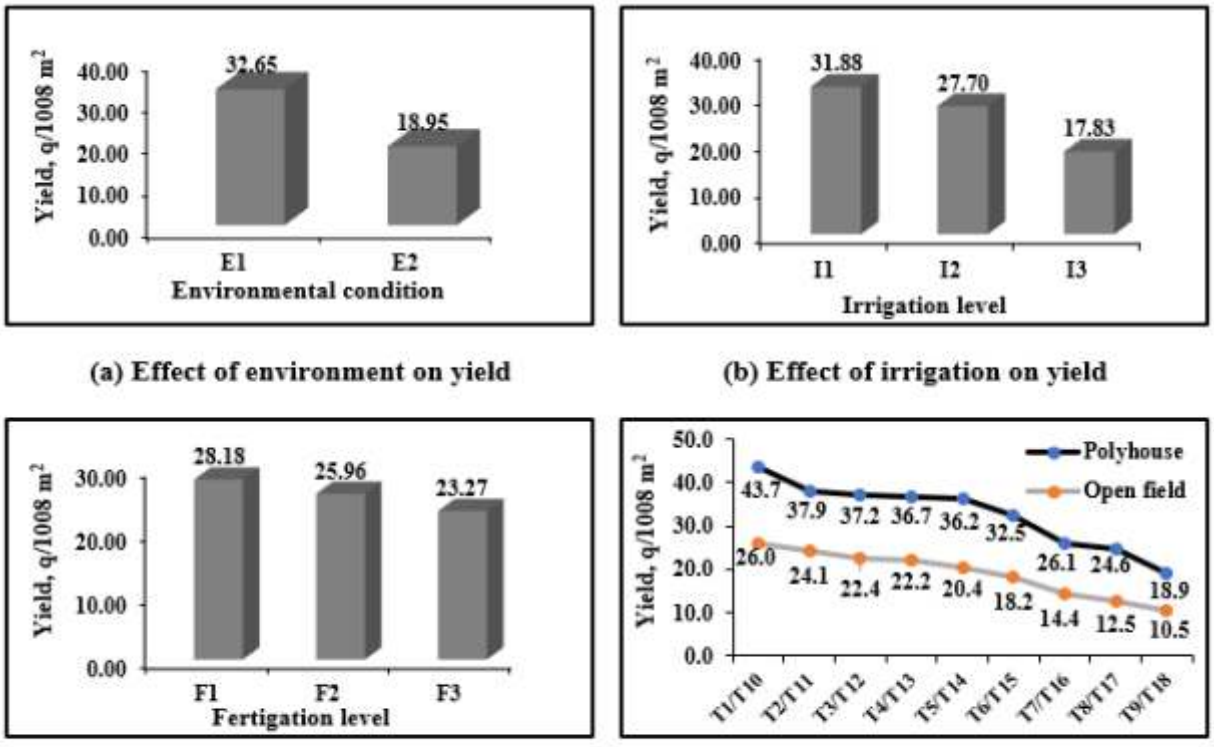
(a) Effect of environment on stem girth

(b) Effect of irrigation on stem girth

(c) Effect of fertigation on stem girth

(d) Interaction effect of all factors

Fig. 2 Effect of treatments on an average stem girth of red cabbage plant at harvest



(a) Effect of environment on yield

(b) Effect of irrigation on yield

(c) Effect of fertigation on yield

(d) Interaction effect of all factors

Fig. 3 Effect of treatments on an average yield of red cabbage plant

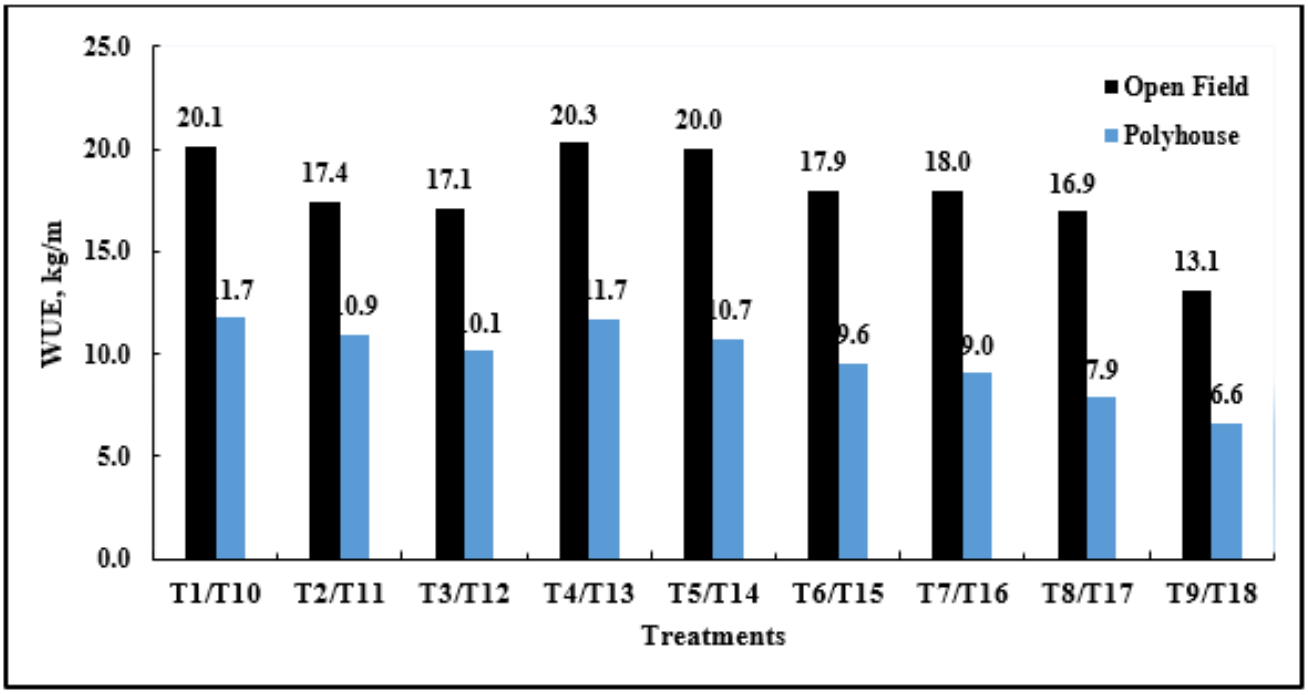


Fig. 4 Water use efficiency (WUE) of red cabbage as affected by treatments

field x 0.60 ETc x 75 % RDF) (Fig. 3) (Table 4). The maximum equatorial diameter (243.33 mm) was observed under T_1= $E_1I_1F_1$ (Polyhouse x 0.90 ETc x 125 % RDF), which was significantly superior over other treatments and the minimum (76.68 mm) was noticed under T_{18}= $E_2I_3F_3$ (Open field x 0.60 ETc x 75 % RDF) treatment (Table 4). The maximum polar diameter (332.18 mm) was observed under T_1= $E_1I_1F_1$ (Polyhouse x 0.90 ETc x 125 % RDF), which was significantly superior over other treatments while the minimum was (26.22 mm) under T_{18}= $E_2I_3F_3$ (Open field x 0.60 ETc x 75 % RDF) (Table 4).The maximum depth of water (362.29 mm) was applied in treatment I_1 (0.90 ETc) in open field and minimum (237.64 mm) in treatment I_3 (0.60 ETc) in polyhouse (Table 6). The highest water use efficiency (20.28 kg/m) was found in treatment T_4= E_1 x I_2 x F_1 (Polyhouse x 0.75 ETc x 125 % RDF) whereas the lowest water use efficiency (6.59 kg/m^3) in treatment T_{18}= $E_2I_3F_3$ (Open field x 0.60 ETc x 75 % RDF) (Table 6). The water use efficiency of red cabbage due to different treatment is depicted in Fig.(4).

CONCLUSION

The study revealed that, there was significant effect of environment, irrigation and fertigation on the yield and some growth factors, on the red cabbage. Cultivation of red cabbage under polyhouse with drip irrigation at 0.90 ETc and fertigation at 125 % RDF resulted in 59.50 % higher yield and 57.63 % higher water use efficiency was resulted under polyhouse with drip irrigation at 0.75 ETc and fertigation at 125 % RDF, over that of best treatment of open field cultivation. However, in case of open field condition with drip irrigation of 0.90 ETc and fertigation at 125 % RDF resulted in maximum yield and water use efficiency of red cabbage.

REFERENCES

Bhosale S and Sonawan S S (2016). Automated monitoring and controlling of yhouse environment. *Int J Ad Res Com Engg and Tech (IJARCET)* **5**(8) :2333-2338

Gopala Reddy A R, Santosh D T, and Tiwari K N (2017). Effect of Drip Irrigation and Fertigation on Growth, Development and Yield of Vegetables and Fruits. *Int J Curr Microbiol App Sci* ***6***(2), 1471–1483. https://doi.org/10.20546/ijcmas.2017.60

2.165.

Harel D, Fadida H, Slepoy A, Gantz S, and Shilo K (2014). The effect of mean daily temperature and relative humidity on pollen, fruit set and yield of tomato grown in commercial protected cultivation. *Agron* **4**:167-177.

Kumar D S and Palanisamib K (2010). Impact of Drip Irrigation on Farming System: Evidence from Southern India. Department of Agricultural Economics, Tamil Nadu Agricultural University, Tamil Nadu. *Agric Econ Res Rev* **23**: 265-272.

Ojha R K, Abhivyakti A, Kumari P, and Job M (2016). Effect of plastic mulches on soil temperature and tomatoyield inside and outside the polyhouse. *Agric Sci Dig - A Res Jl* **36**(4): 333-336. https://doi.org/10.18805/asd.v36i4.6479

Paksoy B (2006). Effect of irrigation methods on red cabbage (Brassica oleracea L. var. capitata Subvar. F. rubra) yield and some plant characteristics. *Pak J Biol Sci* **9**(13): 2531–2534.

Santosh D T, Tiwari K N, and Singh V K (2017). Influence of different protected cultivation structures on water requirements of winter vegetables. *Int J of Agric Envir and Biotech*, **10**(01), 93-103. https://doi.org/10.5958/2230-732X.2017.00004.3

Gopala Reddy A R, Santosh D T, and Tiwari K N (2017). Effect of Drip Irrigation and Fertigation on Growth, Development and Yield of Vegetables and Fruits. *Int J Curr Microbiol App Sci* ***6***(2), 1471–1483. https://doi.org/10.20546/ijcmas.2017.602.165

Harel D, Fadida H, Slepoy A, Gantz S, and Shilo K (2014). The effect of mean daily temperature and relative humidity on pollen, fruit set and yield of tomato grown in commercial protected cultivation. *Agron* **4**:167-177.

Kumar D S and Palanisamib K (2010). Impact of Drip Irrigation on Farming System: Evidence from Southern India. Department of Agricultural Economics, Tamil Nadu Agricultural University, Tamil Nadu. *Agric Econ Res Rev* **23**: 265-272.

Ojha R K, Abhivyakti A, Kumari P, and Job M (2016). Effect of plastic mulches on soil temperature and tomatoyield inside and outside the polyhouse. *Agric Sci Dig - A Res Jl* **36**(4): 333-336. https://doi.org/10.18805/asd.v36i4.6479

Paksoy B (2006). Effect of irrigation methods on red cabbage (Brassica oleracea L. var. capitata Subvar. F. rubra) yield and some plant characteristics. *Pak J Biol Sci* **9**(13): 2531–2534.

Santosh D T, Tiwari K N, and Singh V K (2017). Influence of different protected cultivation structures on water requirements of winter vegetables. *Int J of Agric Envir and Biotech*, **10**(01), 93-103. https://doi.org/10.5958/2230-732X.2017.00004.3

Umesha B, Vjyalaxmi and Reddy M (2016). Effect of Weather Parameters on Growth and Yield Parameters of Tomato under Natural Poly House. *Indian J Nat Sci* **1** (9):654-662.

Received on 21/10/2023 Accepted on 15/4/2024

DOI : 10.5958/2349-4433.2024.00047.6

J Krishi Vigyan 2024, 12(2) : 246-251

Effect of *Moringa olifera* Leaf meal on Production Performance and Egg Quality Characteristics of *Swarnadhara* Breeders

B U Umesh*, M BharatBhushan, T Thirumalesh, B G Veeranna Gowda, G M Satheesha and M M Venkatesha

Department of LFC, Veterinary College, Shivamogga, Karnataka Veterinary Animal and Fisheries Sciences University, Bidar, Karnataka, India-577204.

ABSTRACT

An experiment was carried out to investigate the effects of supplementing *Moringa oleifera* leaf meal (MOLM), as a protein replacement for soyabean meal on production performance of Swarnadhara breeders. Three different graded levels of *Moringa oleifera* leaf meal were used in formulating the diets; T1 (Control- 0% MOLM), T2 (5% MOLM), T3 (10% MOLM) and T4 (15% MOLM). One hundred and twelve *Swarnadhara* breedersof aged thirty weeks were randomly allocated to the four treatment diets containing MOLM at 0, 5, 10, and 15% levels replacing crude protein of soyabean meal. Feed intake, hen-day egg production, egg weight, Feed conversion ratio, fertility, hatchability and egg quality characteristics were measured among different dietary treatments. Among different treatments where MOLM was included in the feed replacing CP of soyabean meal, there was an improvement seen in hen day egg production in all the treatment groups when compared to control. There was no significant difference in egg weight, egg mass and egg quality characteristics like shell thickness, haugh unit and yolk index. Therefore, as per present study *Moringa olifera* leaf meal can replace soyabean meal upto 15% level and can be a promising protein source in *swarnadhara* breeders.

Key Words*:* Fertility, Hatchability, Hen day egg production, *Moringa oleifera* leaf meal, *Swarnadhara* breeder.

INTRODUCTION

The major constraints that tend to restrict growth of poultry industry are availability of ingredients and rising cost of feed. Because of the increasing cost of common protein ingredient (soybean meal, groundnut cake, and fish meal), stockholders have little access to such resources. With the present trend of rising prices of feedstuffs, alternative locally available and cheap non-conventional feedstuffs like leguminous trees are increasingly being used as a substitute of conventional resources in the formulation of poultry diets. Due to rising demand brought on by the global expansion of the cattle industry and the manufacturing of ethanol, soybean meal—a significant source of protein for poultry feeding is becoming more expensive (Ayssiwede *et al*, 2011). Replacing cereals and expensive less available agro-industrial by-products by unconventional source of raw materials, is one of the solutions to reduce cost of production even in backyard and hybrid varieties of poultry. Therefore, *Moringa olifera* leaf meal (MOLM) is of special importance and can be a solution to reduce cost of production. Swarnadhara, a hybrid chicken variety popular throughout Karnataka state was used for the study. Vitamins, flavonoids, and carotenoids included in moringa leaves not only provide vital nutrition but also enhance the colour of chicken meat and eggs and heighten the colour of the shanks and egg yolk (Melesse *et al,* 2011). Various cultivable varieties of *M. Oleifera* like Bhagya and PKM-1 are also available for better yield (Rajamanickam and Arokiamary, 2022).

M. Oleifera leaf meal can be included in the feed to promote certain qualities in pullets. Research by Teteh *et al* (2016) demonstrated that feeding moringa leaves to Isa brown laying hens increased both egg production and weight. Similar tendencies have been observed on the internal quality of eggs, especially on yolk coloration

Corresponding Author's Email - umeshbu71@gmail.com

Table 1. Proximate composition of Moringa oleifera leaf meal.

Proximate composition	**Unit** (g/100g)
Moisture	7.60
Crude Protein	24.91
Ether Extract	6.52
Ash	11.08
Minerals	**Unit** (mg/100g)
Calcium	2462
Phosphorus	252

Table 2. Ingredient composition (% as is basis) of diets used in *Swarnadhara* breeders

Ingredient	**T1 (MLM 0%)**	**T2 (MLM 5%)**	**T3 (MLM 10%)**	**T4 (MLM 15%)**
Moringa Leaf meal	0	1	2	3
Soya bean meal	20	19	18	17
Maize	55	55	56	56
DORB	8.4	8.4	7.4	7.4
Sun Flower cake (Doc)	6	6	6	6
Lime Stone Powder	2	2	2	2
Di calcium Phosphate	0.65	0.65	0.65	0.65
Stone grit	8	8	8	8
Salt	0.5	0.5	0.5	0.5
Vitamin mix	0.005	0.005	0.005	0.005
Livertonic	0.1	0.1	0.1	0.1
Trace min	0.1	0.1	0.1	0.1
Methione	0.1	0.1	0.1	0.1
Lysine	0.05	0.05	0.05	0.05
Threonine	0.1	0.1	0.1	0.1
Total	100.005	100.005	100.005	100.005
Nutrients (%)				
CP	17	17	17	17
ME(Kcal/kg)*	2613	2603	2600	2592
Calcium	3.75	3.77	3.79	3.81
Total phosphorus	0.51	0.63	0.75	0.62
Methionine*	0.4	0.4	0.4	0.4
Lysine*	0.97	0.97	0.97	0.97

* - Calculated values

[1] – One gram of Vitamin AB_2D_3K supplement contained 82500 IU of Vitamin-A, 50 mg of Vitamin-B_2, 12000 IU of Vitamin-D_3 and 10 mg of Vitamin-K.

[2] – One gram of B-Complex supplement contained 8 mg of Vitamin-B_1, 16 mg of Vitamin-B_6, 80 mcg of Vitamin B_{12}, 80 mg of Vitamin-E, 120 mg of Niacin, 8 mg of Folic acid, 80 mg of Calcium pantothenate, 120 mg of Calcium and 300 mg of Phosphate.

[3] – One gram of Trace Minerals contained 54 mg of manganese, 52 mg of zinc, 20 mg of iron, 2 mg of iodine and 1 mg of cobalt.

Table 2. Effect on moringa leaves on swarnadhara breeder hen's performance (30-58 weeks).

Parameter	T1	T2	T3	T4	SEM	P value
Feed intake (g/ day/hen)	159.69	161.86	165.34	162.98	0.79	0.699
Egg weight (g)	60.07	59.03	59.07	59.69	0.27	0.447
Hen day egg production (%)	68.69 [b]	71.06 [a]	70.95 [a]	65.11 [c]	0.62	0.033
FCR	3.91	4.01	3.91	4.01	0.12	0.111
Fertility (%)	92.46	92.07	91.41	88.34	1.27	0.047
Hatchability (%)	82.17	81.78	81.56	78.2	0.77	0.047
Egg shell thickness.	0.35	0.38	0.36	0.38	0.01	0.176
Yolk index	0.41	0.41	0.42	0.41	0.01	0.241
Haugh unit.	84.300	79.000	86.070	80.980	1.550	0.410

(Tesfaye et al, 2014). Less research has examined the possibility of moringa leaves in breeder diets, despite their nutritional value. Therefore, the aim of the current study was to assess the effect of *M. oleifera* leaf on *Swarnadhara* breeder performances and hatching egg traits.

MATERIALS AND METHODS

Mature leaves of *Moringa oleifera* plants were collected and dried under the shade up to a moisture level of ≤ 12%, then ground and stored in polythene bags in a cool and dry place until further proximate analysis and feed formulation. Additionally, a chemical analysis (macronutrients) of the leaf meal was performed (Table.1). The 28 week study was conducted on 112 *Swarnadhara* breeders (30 week old). The birds were randomly assigned to four treatments (4 replicates of 7 birds (6+1 each) containing *Moringa oleifera* leaf meal at 0, 5, 10, and 15% levels replacing soyabean meal (Table 2). During the study, percent egg production, egg weight, feed conversion ratio, fertility and hatchability during laying period (30-58 weeks) among different dietary treatments. the feed to promote certain qualities in pullets. Research by Teteh *et al* (2016) demonstrated that feeding moringa leaves to Isa brown laying hens increased both egg production and weight. Similar tendencies have been observed on the internal quality of eggs, especially on yolk coloration (Tesfaye *et al*, 2014). Less research has examined the possibility of moringa leaves in breeder diets, despite their nutritional value. Therefore, the aim of the current study was to assess the effect of *M. oleifera* leaf on *Swarnadhara* breeder performances and hatching egg traits.

RESULTS AND DISCUSSION

Effect of *Moringa oleifera* leaf meal on breeder hens

The effect *Moringa oleifera* leaf meal on swarnadhara breeder hens performances are presented in Table 2.

Egg production

The overall mean of egg production percentage and egg weight were increased for hens fed on MOLM compared with the control group. Breeder hens in T3 and T4 groups corresponded with higher egg production when compare to Control and T2 groups. This Increased egg production may be due to the role of Moringa in the digestive tract of chickens which can increase feed digestibility and is caused by the presence of phytochemical compounds in Moringa leaves. Moringa leaves are also a source of vitamin A, riboflavin, nicotinic acid, folic acid, pyridoxine, ascorbic acid, β-carotene, calcium, iron, and α-tocopherol as reported by Prasad and Ganguly (2012). According to Ayssiwede *et al* (2011), feeding birds a meal containing 24% moringa leaves reduces their intake. On the other hand, Kakengi *et al* (2007) observed an increase in feed intake in layers when 15% or 20% of dehulled sunflower seed meal was replaced by MOLM. The discrepancy in feed intake could be further explained by the lower or higher energy content of MOLM relative to the dietary components it

replaced in different studies. The current results suggested that a supplementation level of MOLM up to 15% did not have negative effect on feed intake.

Egg weight

Moringa inclusion levels did not influence egg weight at different magnitude in the present study. This supports the results of Olugbemi et al. (2010), who found that supplementation of MOL up to 10% did not affect egg weight.

Feed efficiency

The results showed that the FCR of breeder hens were not significantly improved in response to the increase of dietary MOLM supplementation. Moringa leaf extract can be useful to be used as an effective feed supplement in poultry to improve feed efficiency in poultry (Akhouri *et al* 2013) This result was in contrary with Teteh *et al.,(* 2013), who reported that the high use of Moringa leaves in feed can cause increased levels of saponin which can reduce digestion and absorption of nutrients, especially lipids.

Hatchability and fertility

The data (Table 2) showed the effect of MOL on Fertility and hatchability of fertile eggs. Fertility and hatchability of fertile eggs were numerically improved in swarnadhara breeder chickens. Similar results were seen by Moyo *et al* (2011), who found that hens fed MOLM 70% had better fertility and hatchability of viable eggs than those fed MOLM 0%. Fertility and hatchability of fertile eggs were actually improved in chickens fed MOLM70%, compared with those on MOLM0%. According to Moyo *et al* (2011), MOLM has elevated zinc and vitamin E levels, but Park *et al* (2004) reported that zinc and vitamin E could play a beneficial role in the hatchability of eggs. The result obtained in the current study was inconsistent with the finding of Etalem *et al* (2014) using M. oleifera leaf meal as an alternative feed ingredient in the layer ration which showed non-significant effect of MOLM on fertility, hatchability and embryonic mortality. Park *et al* (2004) and Moyo *et al* (2011) reported that higher concentrations of zinc and vitamin E found in *M. oleifera* leaves may improve an egg's capacity to hatch.

Egg quality parameters

It was observed that the egg weight, egg shell thickness, Yolk index and Haugh unit of the eggs laid by hens fed diets with added MOLM were similar during the experimental period (Table 2). These findings showed that feeding eggs up to 15% moringa leaf meal has no negative effects on the eggs' internal or exterior characteristics.These results were consistent with Swain *et al* (2016) who reported in Vanaraja laying hens; the egg quality characteristics *viz.* albumen (%), yolk (%), shell (%), shape index and shell thickness were similar in all the groups.

CONCLUSION

This present study provides credible information on the performance of swarnadhara breeder hens at different levels of MOLM. The results showed a better egg production where as there are no significant improvement in feed intake and feed conversion ratio of birds at 5%, 10% and 15 % of MOLM. Similarly, it was hereby concluded that the *M. oleifera* leaf meal could be included in the diet of swarnadhara breeder hens up to a level of 15% by replacing soyabean meal for better egg production, egg weight, feed intake and feed efficiency without any adverse effect on

production performance. The results of the present study showed that the *Moringa oleifera* used as a feed ingredient improves the production performance and the health status of swarnadhara breeder hens. Among different treatments where *Moringa olifera* leaf meal was included in the feed at 0,5,10 & 15 % levels replacing CP of soyabean meal, there was an improvement seen in hen day egg production and FCR in all the treatment groups when compared to control. There was no significant difference in egg weight, egg mass and egg quality characteristics like shell thickness, haugh unit and yolk index. Cost of egg production was less in all treatment groups compared to control. Therefore, *Moringa olifera* leaf meal can replace soyabean meal upto 15% level and can be a promising protein source in *swarnadhara* breeders. Moringa oleifera leaf meal can be added to Japanese quail diet up to 15% as partial replacement for soybean meal with no adverse effects on egg quality, fertility and hatchability.

REFERENCES

Akhouri S, Prasad A and Ganguly S (2013). Moringa oleifera leaf extract imposes better feed utilization in broiler chicks. *J Biol Chem Res* **30** (2)**:***447-50.*

Ayssiwede SB, Dieng A, Bello H, Chrysostome CAAM, Hane MB and Mankor A (2011). Effects of Moringa oleifera (Lam.) leaves meal incorporation in diets on growth performances, carcass characteristics and economics results of growing indigenous senegal chickens. *Pakistan J Nutr* ***10 (12):****1132-45.*

Etalem T, Getachew A, Mengistu U and Tadelle D (2014). Cassava root chips and Moringa oleifera leaf meal as alternative feed ingredients in the layer ration. *J Appl Poult Res* ***23****:614–24.*

Kakengi AMV, Kaijage JT, Sarwatt SV, Mutayoba SK, Shem MN, and Fujihara T (2007). Effect of Moringa oleifera leaf meal as a substitute for sunflower seed meal on performance of laying hens in Tanzania. *Livestock Res for Rural Dev* ***19(8):****120.*

Melesse A, Tiruneh W and Negesse T (2011). Effects of feeding Moringa stenopetala on nutrient intake and growth performance of Rhode Island Red Chicken under tropical climate. *Trop and Subtrop Agroeconomics* ***14****:485-492.*

Moyo B, Masika P J, Hugo A and Muchenje V (2011). Nutritional characterization of Moringa (*Moringa oleifera* Lam.) leaves. *African J Biotechno* ***10(60),*** *12925–12933. https ://doi.org/10.5897 /AJB10.1599.*

Olugbemi T S, Mutayoba S K and Lekule F P (2010). Evaluation of Moringa oleifera leaf meal inclusion in cassava chip-based diets fed to laying birds. *Livest Res Rural Dev* ***2(118).*** *http://www.lrrd.org/ lrrd22/6/olug22118.htm.*

Park S, Kim WK, Birkhold SG, Kubena LF, Nisbet D J and Ricke S C (2004). Using a feed-grade zinc propionate to achieve molt induction in laying hens and retain post-molt egg production and quality. *Biol Trace Element Res* ***101****:165–179.*

Prasad A and Ganguly S (2012). Promising medicinal role of Moringa oleifera: a review. *J Immunol Immunopathol.* ***14(1):****1-5.*

Rajamanickam C and Arokiamary S, 2022. Assessment of Moringa varieties for growth and yield characters. *J Krishi Vigyan, **11 (1)** : 7-10. DOI : 10.5958/2349-4433.2022.00094.0.*

Teteh A, Gbeassor M, Decuypere E and Tona K (2016). Effects of Moringa oleifera leaf on laying rate, egg quality and blood parameters. *Int J Poul Sci* **15**(7):*277-282 DOI:* 10.3923/ijps.2016.277.282.

Tesfaye E B, Animut G M, Urge, M L and Dessie T A (2014). Cassava root chips and *Moringa oleifera* leaf meal as alternative feed ingredients in the layer ration. *J Appl Poul Res **23**(4):614–624. https ://doi.org/10.3382/japr.2013-00920***.***

Swain B K, Naik P K, Chakurkar E B and Singh N P (2016). Effect of supplementation of *Moringa oleifera* leaf meal (MOLM) on the performance of Vanaraja laying hens. *Indian J Anim Sci **87 (3)**: 353–355.*

Received on 27/3/2024 Accepted on 24/4/2024

DOI : 10.5958/2349-4433.2024.00048.2

J Krishi Vigyan 2024, 12(2) : 252-257

Effect of Paper Mill Effluent Irrigation and Compost Application on Soil Nutrients and Yield of Groundnut

V Dhanushkodi[1] and R Balamurugan[2]

[1]ICAR-Krishi Vigyan Kendra, TNAU, Needamangalam-614 404
Thiruvarur District, Tamil Nadu

ABSTRACT

The investigation was carried out to investigate the impact of paper mill effluent irrigation and compost application on yield of groundnut and soil fertility during *kharif* 2023 with well water and treated paper mill effluent at varying concentrations, at 0% (well water), 25%, 50%, 75% and100% enriched by organic manures (main plot 12.5 t/ha of farm yard manure and 5 t/ha of press mud compost) in groundnut cv VRI 10. The results indicated that among chemical properties, soil pH ranged from 7.40 to 7.97, with variations during different growth stages of the groundnut. The soluble salts in the experimental soil ranged from 0.28 to 0.43 dSm^{-1} during the entire crop duration. Available nutrients in soil generally showed higher concentrations with paper mill effluent irrigation and organic amendments, with values ranging from 184.3 to 198.3 kg/ha for nitrogen, 7.6 to 8.7 kg/ha for phosphorus, 186.0 to 205.5 kg/ha for potassium and 3.5 to 4.6 mg/kg for sulphur. Haulm yield ranged from 2016 to 3133 kg/ha and pod yield ranged from 1440 to 1934 kg/ha, indicated a 25.5% (494 kg/ha) increased yield at 75% paper mill effluent irrigation combined with press mud compost application over control (well water irrigation). The findings from this study indicated that the use of treated paper mill effluent, particularly when combined with organic manures, can be a sustainable approach for crop production.

Key Words: Groundnut, Irrigation, Organics, Soil Nutrients, Wastewater.

INTRODUCTION

Water is a precious and indispensable natural resource in the world base of all life on the earth. The availability of water per person per year was calculated to be 1545 m^3 in 2001 and 1816 m^3 in 2011. In 2021 and 2031 these numbers could further drop to 1486 m^3, and 1367 m^3, respectively (PIB, 2020). Over the past 20 years, water availability has decreased and demand in many industries has increased, making it a crucial economic, social, and political concern. More than 50% of all water used in agriculture, is penalized. In India, wastewater irrigation of crops is a widely used practise (Arora et al, 2008). The paper mill is the top water consumers as well as top producers of wastewater in the world. In India, about 700 paper mills are functioning (Kumar et al, 2017). To produce one tonne of paper typically it requires 273-450 m^3 of water (Hazarika et al, 2007) that consequently, generates 300 m^3 of waste water. Treated wastewater includes additional amount of nutrients that is helpful for crop growth. Wastewater reuse in agriculture offers the widest range of potential applications because it frequently possesses the ability to satisfy the increasing water demands, preserve potable resources, minimize pollution discharge into lakes and rivers, permit lesser costs for wastewater treatment, and boost their income of farmers due to decreased rates of fertilizers application. Consequently, farmers divert and use wastewater in a partially treated, diluted, or untreated form to grow a variety of crops (Murtaza *et al,* 2010). Since it provides a supply of nutrients, this frequently minimize the need for fertilizer application. As a result, recently some nations are focusing on increasing the use of treated

Corresponding Author's Email - dhanushkodi@tnau.ac.in

[1]ICAR-Krishi Vigyan Kendra, TNAU, Needamangalam-614 404 Thiruvarur District, Tamil Nadu

[2]Anbil Dharmalingam Agricultural College and Research Institute, Navalurkuttappattu - 620 027, Tiruchirappalli Tamil Nadu

wastewater for both environmental preservation and agricultural productivity.

Groundnut playing a crucial role in the Indian economy, groundnut is the second most important oilseed crop in India. India is the top three producers of groundnuts worldwide (Raghunatha Reddy, 2022). In 2022, the production of groundnut in India was 10 million MT. It contributes about 13-15% of the world's oilseeds area 8-9% of the world's oilseeds output and 10-11% of the world's vegetable oil consumption and 90% of the crop's total area. Inadequate and imbalanced use of nutrients is a major reason for low yields on groundnut world-wide and nutritional disorder cause yield reduction from 25-40% depending upon the soil types, fertility level of soil and groundnut varieties used. Groundnut is a crop that removes a significant amount of macro and micronutrients. In India, groundnut is grown under rainfed condition because of irrigation water scarcity. The rising use of treated or untreated wastewater worldwide is a result of the increased demand for water for irrigation (Ruma and Sheikh, 2010). Due to the high levels of macronutrients as well as other essential nutrients, wastewater irrigation has recently grown to be an important way to use wastewater and effluent irrigation can reduce water shortage and the need for chemical fertilizer and could enhance soil fertility. The experiment was conducted with the objectives- to study the effect of paper mill effluent irrigation and compost application on yield of groundnut; and to study the effect of paper mill effluent irrigation and compost application on changes in soil properties.

MATERIALS AND METHODS

The study was carried out at Mondippatti village in Manapparai taluk, Tiruchirappalli district, Tamil Nadu under Tamilnadu Newsprint and Papers Ltd.sponsored project sanctioned during 2019-2023 in a groundnut crop of 0.20 ha. The paper mill effluent (treated) from the TNPL-II paper board industry exhibited key characteristics, including light brown colour, a slightly alkaline pH of 7.74 and electrical conductivity ranging from 2.58 to 2.71dSm^{-1}. The effluent exhibited a biological oxygen demand (BOD) of 31.04 mg L^{-1} and a chemical oxygen demand (COD) of 92.08 mg L^{-1}(Akoteyon *et al*, 2011). It contained 15.2 mg L^{-1} of nitrogen (Bremner method), 1.3 mg L^{-1} of phosphorus (spectrophotometry method) and 12.7 mg L^{-1} of potassium (flame photometry method). Among the cations, sodium (Na^{+}) was the dominant ion, with concentrations of 763.06 mg L^{-1}, followed by calcium (Ca^{2+}) (135.96 mg L^{-1}) and magnesium (Mg^{2+}) (94.28 mg L^{-1}) (Versenate method).

The experiment involved irrigating groundnut crop (sub plot) with a mixture of paper mill effluent (treated)and well water at varying concentrations, specifically at 0%(well water) (S1), 25% (S2, 50% (S3), 75% (S4) and100% (S5). Additionally, the soil has been enriched without compost (M1) and compost farmyard manure 12.5 t/ha (M2) and 5 t/haof press mud compost (M3). Dry pods obtained from the observational plants were weighed and recorded per hectare basis. Soil samples were taken from each plot, shade dried, and then sieved using a 2 mm nylon sieve before being placed in polythene bags for additional examination. The data were analysed using the conventional "Analysis of variance" method (Panse *et al,* 1945). The standard error of the means (S.E.m+) was calculated for every factor and interaction. The critical difference (C.D.) was calculated (at 5 per cent) for any results that were deemed significant. Graphs and figures were used appropriately to illustrate the data at the relevant points.

RESULTS AND DISCUSSION

Pod and haulm yield was assessed and showed significant improvements with paper mill effluent application in combination with farmyard manure (FYM) and press mud compost (Fig.1&2). The Haulm yield ranged from 2016 to 3133 kg/ha and pod yield varied from 1440 to 1934 kg/ha, showing a 25.5% (494 kg/ha) increased yield at 75% paper mill effluent irrigation combined with

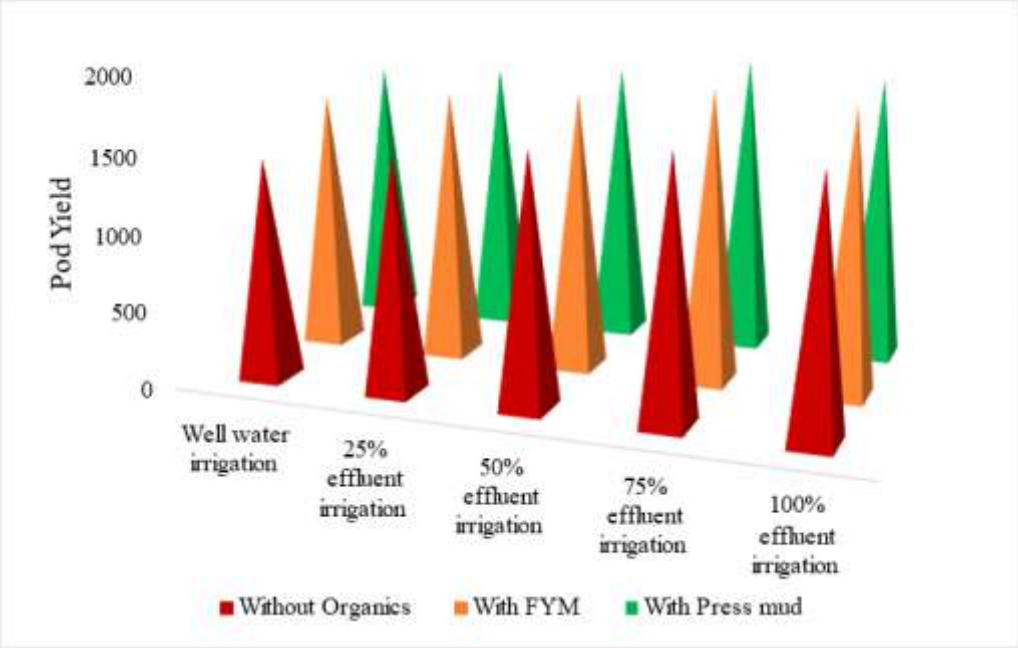


Figure 1. Paper mill effluent and organics app lication on pod yield (kg ha^{-1})

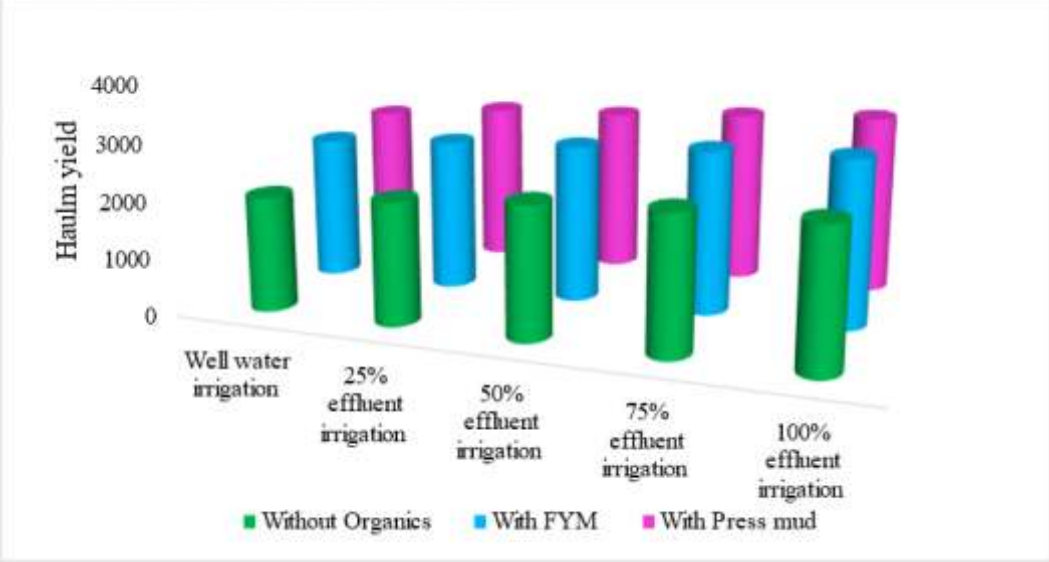


Figure 2. Paper mill effluent and organics application on haulm yield (kg ha^{-1})

press mud compost application over control (well water irrigation). These results demonstrated significant variations in yield, clearly indicating that paper mill effluent can serve as substitute for irrigation. These results are in proximity with the findings obtained by Singh *et al* (2020) and Rashid *et al* (2021). These results are attributed to the combined use of effluent with enriched press mud compost provides an adequate supply of nutrients and creates a favourable physical and microbiological environment. This environment is conducive to better peg formation and enhancing groundnut yield. Improved yield is also a result of the addition of farmyard manure, which improves the biological conditions of the soil, and effluent irrigation, which provides vital nutrients. The combined use of effluent irrigation and additives

Table 1. Influence of paper mill effluent irrigation and organics application on soil reaction.

Treatment	pH				EC (dS m^{-1})			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_1	7.71	7.60	7.60	7.64	0.32	0.31	0.30	0.31
S_2	7.82	7.60	7.70	7.71	0.34	0.33	0.32	0.33
S_3	7.83	7.90	7.90	7.88	0.38	0.37	0.36	0.37
S_4	7.93	7.80	7.90	7.88	0.40	0.39	0.37	0.39
S_5	7.90	7.90	7.80	7.87	0.43	0.41	0.39	0.41
Mean	7.84	7.76	7.78		0.37	0.36	0.34	
	M	S	M at S	S at M	M	S	M at S	S at M
SEd	0.08	0.08	0.16	0.15	0.004	0.004	0.007	0.007
CD (P=0.05)	NS	0.18	NS	0.31	0.012	0.008	NS	0.014

Table 2. Influence of paper mill effluent irrigation and organics application on soil nutrients status.

Treatment	Nitrogen (kg /ha)				Phosphorus (kg /ha)				Potassium (kg /ha)				Sulphur (kg / ha)			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_1	184.3	191.2	194.4	190.5	7.6	8.3	8	8.07	186	195.5	198.2	193.2	3.5	3.9	4.2	3.9
S_2	186.1	194.1	194.0	190.8	7.9	8.2	8.2	8.10	188.1	197.3	198.3	194.5	3.6	4.1	4.5	4.1
S_3	189.2	197.5	196.2	194.3	7.7	8.2	8.4	8.10	189.2	196.2	201	195.4	3.8	4.2	4.3	4.1
S_4	189.5	194.2	195.3	193.0	7.9	8.4	8.7	8.23	190.4	199.4	203.4	197.7	3.6	4.5	4.5	4.2
S_5	191.4	198.3	195.0	194.9	7.8	8.5	8.6	8.30	191.4	201.2	205.5	199.3	3.8	4.4	4.6	4.3
Mean	188.1	195.0	194.9		7.78	8.32	8.38		189.0	197.9	201.2		3.7	4.2	4.4	
	M	S	M at S	S at M	M	S	M at S	S at M	M	S	M at S	S at M	M	S	M at S	S at M
SEd ±	0.63	0.63	1.17	1.1	0.096	0.091	0.171	0.159	0.07	0.13	0.22	0.23	0.049	0.044	0.085	0.077
CD (P=0.05)	1.75	1.32	2.66	2.28	0.266	NS	0.392	0.328	0.21	0.28	0.48	0.48	0.138	0.092	0.196	0.159

has also been shown in earlier research to have good impacts on the growth parameters of a variety of crops, including sorghum, maize, sunflower, and peanuts. Similar results were obtained by Gandhi *et al* (2010).

The soil reaction exhibited values, from 7.60 to 7.93 at post-harvest stage, respectively. Similarly, the electrical conductivity (EC) in the soil ranged from 0.30 to 0.43 dSm^{-1} during a post-harvest stage. Notably, irrigation with paper mill effluent had no discernible effect on the soluble salts in the soil or the soil reaction. Plots that received greater irrigation concentrations of paper mill effluent showed higher pH and EC values. The buildup of soluble salts brought in by the irrigation of paper mill effluent is probably the cause of this increase in pH and EC. In contrast, control plots that were irrigated with well water exhibited lower pH and EC levels, mainly because they received fewer soluble salts compared to the paper mill effluent-irrigated plots. Dhumgond (2014), Udayasoorian and Ponmani (2009) and Giri *et al* (2014) also reported that paper mill effluent application increases the pH and EC in post-harvested soil.

The concentrations of available macronutrients, namely nitrogen, phosphorus, potassium, and sulphur, were generally higher in most of the treatments, ranging from 184.3 to 198.3 kg/ha for nitrogen, 7.6 to 8.7 kg/ha for phosphorus, 186.0 to 205.5 kg/ha for potassium and 3.5 to 4.6 mg /kg for sulphur (Table 2). Generally, as the effluent was diluted, there was a reduction in available nitrogen content. Improvement in available nitrogen might be due to a more rapid mineralization of suspended solids within the effluent. Another possibility is that the transformation of organically bound nitrogen into inorganic forms was aided by the growth of soil bacteria. The results indicated the soil available phosphorus and potassium levels also increased noticeably in proportion to the concentrations of paper mill effluent. Singh *et al* (2021) and Kumar *et al* (2010) also reported

similar results by the application of raw coffee pulp effluent and paper mill effluent. This rise might be due to the solubilization of unavailable phosphorus, which is made possible by the organic acids released during the acidic mineralization of suspended particles and root exudates.

CONCLUSION

It is possible to grow crops using paper mill effluent after treatment and compost manures without experiencing any negative effects on crop yield. The results of effluent application in groundnut crop have shown greater uptake of the nutrients by the crop plants and kernel and an increase of available nutrient in the irrigated soils as well. The results indicated that haulm yield ranged from 2016 to 3133 kg $ha^{-1}$and pod yield ranged from 1440 to 1934 kg ha^{-1}, indicated a 25.5% (494 kg ha^{-1}) increased yield at 75% paper mill effluent irrigation combined with press mud compost application over control (well water irrigation). Positive changes in yield in response to effluent application are observed at even higher concentrations of effluents. Additionally, it was noted that effluent had no discernible effect on groundnut yield, suggesting that crop plants were able to withstand the physiological stress caused. However, it is imperative to carry out long-term irrigation studies with effluent to have a clear scenario of effects on crop plants and soil fertility and decide the optimum loading rate of effluents for a crop and soil type.

REFERENCES

Akoteyon I A, Omotayo O, Soladoye and Olaoye H (2011). Determination of water quality index and suitability of urban river for municipal water supply in Lagos-Nigeria. *European J Scient Res* **54**(2):263-271.

Arora M B, Kiran S, Rani A, Rani B and Kaur Mittal N (2008). Heavy metal accumulation in vegetables irrigated with water from different sources. *Food Chem* **111**(4):811-815.

Dhumgond P (2014). *Studies on the effect of paper mill effluent on soil properties, growth and yield of rice in rice-rice cropping system.* University of Agricultural Sciences, GKVK.

Gandhi M, Sanjeeva, Udayasoorian C and Venkatesh Meda (2010). Biological treatment of pulp and paper mill effluent using immobilized *Bacillus subtilis*. *Indian J Biol Sci JBS* **1**(2):131-140.

Giri Jitendra, Anjana, Srivastava S P and Pachauri Srivastava P C (2014). Effluents from paper and pulp industries and their impact on soil properties and chemical composition of plants in Uttarakhand, India. *J Environ Waste Manage* **1**(1):26-32.

Hazarika Samarendra N C, Talukdar K, Borah N, Barman B K, Medhi D and Thakuria Barooah A K (2007). Long-term effect of pulp and paper mill effluent on chemical and biological properties of a heavy textured acidic soil in Assam. *J Indian Soc Soil Sci* **55**(1):45-51.

Khaskhoussy K M, Hachicha B. Kahlaoui B. Messoudi-Nefzi A. Rejeb O and Jouzdan Arselan A (2013). Effect of treated wastewater on soil and corn crop in the Tunisian area. *J Appl Sci Res* **9**(1):132-140.

Vinod Kumar A K, Chopra Chakresh Pathak and Sachin Pathak (2010). Agro-potentiality of paper mill effluent on the characteristics of *Trigonellafoenum-graecum* L.(Fenugreek). *New York Sci J* **3**(5):68-77.

Muamar A, Tijane M H, Shawqi E, El Housni A, Zouahri A and Bouksaim M (2014). Assessment of the impact of wastewater use on soil properties. *J Mater Environ Sci* **5**(3):747-752.

Murtaza G, Ghafoor A, Qadir M, Owens G, Aziz M and Zia M (2010). Disposal and use of sewage on agricultural lands in Pakistan: A review. *Pedosphere 20*(1):23-34.

Panse Vinayak, Govind Pandurang and Vasudeo Sukhatme (1954). *Statistical methods for agricultural workers.*

PIB (2020). PIB Per Capita Availability of Water. *Ministry of Jal Shakti*. 2020. https://pib.gov.in/PressReleasePage.aspx?PRID=1604871 (accessed 2 March 2022).

Raghunatha Reddy G (2022). Crop outlook report of Andhra Pradesh. Published by ANGRAU, Guntur, Andhra Pradesh.

Rashid Ruhma, Iqrash Shafiq, Parveen Akhter, Muhammad Javid, Iqbal Murid and Hussain (2021). A state-of-the-art review on wastewater treatment techniques: the effectiveness of adsorption method. *Environ Sci and Pollution Res* **28**:9050-9066.

Ruma M M and Sheikh A U (2010). Reuse of wastewater in urban farming and urban planning implications in Katsina metropolis, Nigeria. *African J Environ Sci and Technol* **4(1):**28-33.

Singh, Uma Shankar, Suresh Panwar, Jain R K and Tripathi Y C (2020). Physicochemical analysis of effluents from agro-based paper mill in Uttarakhand State of India. *Int J Chem Tech Res* **13**:174-180.

Udayasoorian C and Ponmani S (2009). Effect of treated paperboard mill effluent irrigation on soil health and yield of vegetable crops. *J Environ Res Dev* **3** (3):879-889.

\

Received on 20/4/2024 Accepted on 30/5/2024

DOI : 10.5958/2349-4433.2024.00049.9

J Krishi Vigyan 2024, 12(2) : 258-262

Evaluation of Genotypes for high Yield and Quality in Bitter Gourd (*Momordica Charantia* L.) under Sodic Soils of Tamil Nadu

K R Vijayalatha*, V Jegadeeswari and A Sabir Ahamed
Horticulture College and Research Institute for Women, Tiruchrappalli – 620027

ABSTRACT

Bitter gourd (*Momordica charantia* L.), a monoecious annual vine of Cucurbitaceae family is cultivated for its edible fruits. The experiment was carried out at Department of Vegetable Science, Horticulture College and Research Institute for Women, Tiruchirappalli during 2021-2023 with 31 bitter gourd genotypes laid out in randomised block design. Genotypes were evaluated under the sodic soils for the growth characters *viz.,* vine length (cm), number of node at first male flower emergence, number of node at first female flower emergence; yield characters *viz.,* number of days for first harvest, single fruit weight (g), fruit yield (g vine^{-1}), number of fruits per plant and quality parameter *viz*., total phenol content (mg GAE g^{-1}) and vitamin C content (mg 100g^{-1}). The results envisaged that among the 31 genotypes, the genotype MCPKM-04 observed for higher yield per vine (2422.80 g). The genotype MCPKM-19 was superior in terms of earliness (61.00 DAT) while MCPKM-05 performed better for vitamin C content (102.34 mg 100g^{-1}) and total phenol content (34.13 mg GAE g^{-1}) under sodic conditions. Selection of bitter gourd among the diverse genotypes with higher yield and quality necessarily help in various crop improvement programs.

Key Words: Bitter gourd, Genotypes, Growth, Sodic soil, Total phenol

INTRODUCTION

Bitter gourd botanically known as *Momordica charantia* L. is cultivated under the tropical and subtropical areas. In India, Madhya Pradesh, Chhattisgarh, Andhra Pradesh, Tamil Nadu and Orissa are the leading producer of bittergourd contributing more than half of the nation's total production. Fruits are the rich source of vitamins and minerals such as thiamine, beta-carotene, folate, riboflavin, zinc and potassium. Bioactive compounds such as polypeptides, alkaloids, minerals and vitamins were present in the fruit. The bitter principle present in the fruits are charantin, karavilosides, glycosides, vicine and along with plant insulin and polypeptide-p. They work as hypoglycemic agents as they raise blood sugar levels by stimulating the fat cells, muscles and liver to absorb more glucose and synthesize more glycogen. (Harinantenaina *et al,* 2006).

The genus *Momordica* consist about 59 number of species where 47 species were from Africa and 12 species were from Asia and Australia (Schaefer and Renner, 2010). Among the different species, charantia and muricata types were commercially cultivated. Sodicity is one among the serious abiotic stress factor that could limit the production. In India, salt-affected soils make up about 67.3 lakh hectares of land, of which 29.6 lakh hectares were impacted by sodicity. Due to aberration in the soil physical property, the crop production under sodic soil is hindered greatly that causes poor aeration and poor root development. Development of a good resistant variety for sodic soil will be the ideal solution. Naturally bitter gourd is sensitive to sodicity and there exist a need to evaluate the various genotypes under sodic soil to identify the best performing line. Evaluation of genotypes is the prerequisite for genetic diversity studies and helps in identifying best parents for further hybridization program. The experiment focuses on the evaluation of different bitter gourd genotypes under sodic soil to identify the best performing genotypes.

Corresponding Author's Email - Email:vijayalatha.kr@tnau.ac.in

MATERIALS AND METHODS

The experiment was carried out at Department of Vegetable Science, Horticulture College and Research Institute for Women, Tiruchirappalli during 2021-2023. The site receives an annual rainfall of about 841.90 mm with annual mean temperature of 25˚C to 32˚C. The experiment consists of 31 genotypes laid out in Randomised block design and each were replicated thrice. Table 1 depicts the number of genotypes and their source of collection. The seeds were sown under protray and transplanted uniformly in the main field of 0.40 ha at the spacing of 2.00 m x 1.50 m. The plants were irrigated through drip at daily interval until germination and later irrigated at an interval of three days. Nutrients were supplied through fertigation technique at the rate of 200:100:100 kg/ha. The production practices followed were as per TNAU crop production guide. The texture of the soil was sandy loam texture with 9.2 pH. The observations *viz.,* vine length (cm), number of node at first male flower emergence, number of node at first female flower emergence, number of days for first harvest, single fruit weight (g), fruit yield (g vine^{-1}), number of fruits per plant, total phenol content (mg GAE g^{-1}) and vitamin C content (mg 100g^{-1}) were recorded. Five plants were selected random for all treatments in each replication. Vitamin C content was analysed as per the procedure mentioned in Ranganna (2001). The phenol content in the fruit was determined using Spectrophotometer as mentioned by Horax *et al* (2005). Two seasons data were pooled and analysed statistically (Panse and Sukhatme, 1985) using ANOVA table to determine the significant differences among the genotypes.

RESULTS AND DISCUSSION

The data (Table 1) showed that significant variation exist for vine length (cm), number of node at first male flower emergence, number of node at first female flower emergence, number of days for first harvest, single fruit weight (g), fruit yield (g vine^{-1}), number of fruits per plant and total phenol content (mg GAE g^{-1}) among the genotypes since the analysis of variance exhibited significant difference for the genotype mean sum of square (Table 2). This inferred that there exists significant scope for crop improvement in bitter gourd. All the above characters in bitter gourd greatly influenced the growth, yield and quality. The present observations were similar with Yadav *et al* (2013) in bitter gourd.

Vine length

Vine length decides the growth of a crop and is an important criterion in the selection of variety. It was found that genotype MCPKM-12 attained the highest vine length of 540.00 cm followed by MCPKM-23 of 485.00 cm while the lowest vine length was recorded in HC RI (W) Try-2 (268.50 cm). This was in agreement with findings of Saranyadevi *et al* (2017).

Earliness

Earliness is one among the desirable trait in any of the crop improvement program. The adaption of crop to a new environment and new cropping system relies on the earliness of a crop (Kumar and Abbo, 2001). The response of a crop to various biotic and abiotic stress also depends upon the earliness (Owusu *et al,* 2022). The occurrence of first male flower was observed on the 6th node for the genotypes *viz.,* MCPKM-5, MCPKM-12, MCPKM-19, MCPKM-26 followed by 7th node for the genotypes *viz.,* MCPKM-4, MCPKM-9, MCPKM-23 and MCPKM-24 while the genotype MCPKM-16 recorded the first male flower appearance at the 17th node. The occurrence of first female flower was noticed at 10th node in MCPKM-04 followed by the occurrence of first female flower at 11th node in MCPKM-12 whereas the occurrence of female flower was noticed at 23rd node in HC&RI (W) Try-2.

The genotype MCPKM-19 found for the early harvest (61.00 DAT) followed by MCPKM-23 (61.50 DAT) while the genotype MCPKM-18 recorded maximum days for harvest (78.50 DAT). This inferred that MCPKM-19 adapted well to the changing environment and exhibits some level of tolerance towards abiotic and biotic stress.

Yield

The crop yield is one among the primary trait in any crop improvement program. Single fruit weight, fruit yield and number of fruits per plant are the yield contributing attributes and hence decides the superiority of a crop. The increased number of fruits per plant was noticed in genotype MCPKM-04 (18.00) followed by 16 numbers of fruits in four genotypes *viz.,* MCPKM-01, MCPKM-05, MCPKM-19, MCPKM-24. The lowest number of fruits (9.00) were exhibited in two genotypes *viz.,* MCPKM-09, MCPKM-10. The findings in ridge gourd by Prabha *et al* (2007) attained similarity with the present results.

Single fruit weight recorded maximum in the genotype MCPKM-26 (140.80 g) followed by MCPKM-05 (137.50 g). The genotype MCPKM-22 recorded for the minimum single fruit weight of 46.00 g. Singh *et al* (2017) reported the same in bitter gourd. Fruit yield increased in the genotype MCPKM-04 (2422.80 g/vine) followed by the genotype MCPKM-05 (2200.00 g $vine^{-1}$) whereas the fruit yield decreased in the genotype MCPKM-22 (414.00 g $vine^{-1}$). The decreased fruit weight might be the reason for minimum fruit yield in MCPKM-22. Fruit yield depends on the single fruit weight and number of fruits per plant. The same was reported in bitter gourd by Chaubey and Ram (2004), Behera *et al* (2006) and Rani (2014); sugar beet by Sanghera *et al* (2016) and bottle gourd by Sharma *et al* (2019).

Vitamin C content observed highest in the genotype MCPKM-05 (102.34 mg/100g) followed by MCPKM-04 (99.76 mg/100g). The lowest vitamin C content was observed in MCPKM-22(67.24 mg/100g). The findings of Singh *et al* (2017) in bitter gourd was in accordance with the present results. Bitter gourd is rich in phenols where the major phenolic compounds were gallic acid and caffeic acid (Kubola and Siriamornpun, 2008). They were mostly accumulated in the flesh, aril and seeds of bitter gourd. These phenolic compounds considered as the ideal antioxidant source and so could be used in food system. The total phenol content observed the highest in MCPKM-05 (34.13 mg GAE g^{-1}) followed by MCPKM-19 (32.46 mg GAE g^{-1}) whereas the total phenol content observed lowest in MCPKM-22 (13.24 mg GAE g^{-1})

CONCLUSION

The present investigation concluded that the genotypes *viz.,* MCPKM-04, MCPKM-05, MCPKM-19 and MCPKM-26 exhibited for the superior performance over other genotypes for the growth, yield and quality traits under sodic soils. These genotypes could be recommended as the best lines for the future hybridization works.

REFERENCES

Behera T K, Dey S S and Sirohi P S (2006). DBGy-201 and DBGy-202; two gynoecious lines in bitter gourd (*Momordica charantia* L.) isolated from indigenous source. *Indian J Genet* **66**: 61-62.

Chaubey A K and Ram H H (2004). Heterosis for fruit yield and its components in bitter gourd (*Momordica charantia* L.). *Veg Sci* **31**(1): 51-53.

Harinantenaina L, Tanaka M, Takaoka S, Oda M, Mogami O, Uchida M and Asakawa Y (2006). *Momordica charantia* constituents and antidiabetic screening of the isolated major compounds. *Chem Pharm Bull* **54**: 1017

Horax R, Hettiarachchy N and Islam S (2005). Total phenolic contents and phenolic acid constituents in 4 varieties of bitter melons (*Momordica charantia*) and antioxidant activities of their extracts. *J Food Sci* **70**: C275–C280.

Kubola J and Siriamornpun S (2008). Phenolic contents and antioxidant activities of bitter gourd (*Momordica charantia* L.) leaf, stem and fruit fraction extracts in vitro. *Food Chem* **110**: 881-890.

Table 1. Performance of the genotypes under sodic soil.

Genotype	Vine Length (cm)	Number of node at first male flower emergence	Number of node at first female flower emergence	Number of days for first harvest	No. of Fruits per plant	Single Fruit Weight (g)	Fruit yield (g vine^{-1})	Vitamin C content (mg 100g^{-1})	Total phenol content (mg GAE g^{-1})
MCPKM-01	346.00	8.00	16.00	71.20	16.00	81.00	1296	90.34	28.11
MCPKM-02	353.00	8.00	16.00	69.60	12.00	97.42	1169.04	86.82	24.43
MCPKM-03	402.00	8.00	17.00	73.00	9.00	76.33	686.97	87.22	21.12
MCPKM-04	408.00	7.00	10.00	67.00	18.00	134.60	2422.8	99.76	30.44
MCPKM-05	426.00	6.00	12.00	66.50	16.00	137.50	2200	102.34	34.13
MCPKM-06	401.00	8.00	18.00	72.30	9.00	87.50	787.5	73.50	18.75
MCPKM-07	248.00	9.00	16.00	69.40	10.00	83.50	835	70.67	15.45
MCPKM-08	402.00	9.00	14.00	70.20	8.00	132.33	1058.64	79.11	20.11
MCPKM-09	438.00	7.00	21.00	71.10	7.00	106.00	742	83.25	23.91
MCPKM-10	392.00	9.00	18.00	69.00	7.00	60.00	420	82.58	25.73
MCPKM-11	333.00	13.00	15.00	70.00	9.00	67.50	607.5	77.90	17.11
MCPKM-12	540.00	6.00	11.00	65.00	15.00	132.32	1984.8	97.62	31.32
MCPKM-13	363.00	13.00	20.00	72.30	9.00	130.33	1172.97	90.15	25.11
MCPKM-14	396.00	9.00	21.00	75.30	14.00	93.00	1302	89.54	20.51
MCPKM-15	363.00	11.00	17.00	72.60	8.00	99.33	794.64	85.72	22.41
MCPKM-16	373.00	17.00	22.00	75.80	10.00	102.00	1020	88.10	26.73
MCPKM-17	391.00	13.00	18.00	71.30	14.00	50.00	700	75.83	24.65
MCPKM-18	335.00	13.00	18.00	78.50	9.00	103.33	929.97	79.45	29.11
MCPKM-19	427.00	6.00	12.00	61.00	16.00	132.00	2112	96.50	32.46
MCPKM-20	366.00	12.00	18.00	70.00	9.00	87.00	783	92.10	29.42
MCPKM-21	340.00	6.00	15.00	72.30	8.00	129.50	1036	84.83	20.98
MCPKM-22	363.00	15.00	15.00	74.10	9.00	46.00	414	67.24	13.24
MCPKM-23	485.00	7.00	12.00	61.50	15.00	131.33	1969.95	70.11	29.99
MCPKM-24	411.00	7.00	13.00	67.50	16.00	134.60	2153.6	90.51	30.01

Table 2. ANOVA for different characters of bitter gourd genotypes.

Character	Replication MSS	Genotype MSS	Error MSS
Vine Length	10.10	12689.90**	98.30
Number of node at first male flower emergence	0.04	32.722**	0.07
Number of node at first female flower emergence	0.13	31.68**	0.13
Number of days for first harvest	5.76	49.30**	3.66
Number of fruits per plant	0.01	30.77**	0.11
Single Fruit Weight	2.33	2361.33**	8.65
Fruit yield	348.00	984425.00**	1553.00
Vitamin C content	8.13	223.53	3.65
Total phenol content	0.68	89.03**	0.38

MSS- Mean Sum of Squares
**- significant at 0.01

Kumar J and Abbo S (2001). Genetics of flowering time in chickpea and its bearing on productivity in semiarid environments. *Adv Agron* **72**: 107–138.

Owusu E Y, Kusi F, Kena A W, Akromah R, Attamah P, Awuku F J, Mensah G, Lamini S and Zakaria M (2022). Genetic control of earliness in cowpea (*Vigna unguiculata* (L) Walp). *Heliyon* **8**(7): 1-12

Panse V G and Sukhatme P V (1985). *Statistical Methods for Agricultural Workers*. ICAR, New Delhi. pp.145-156.

Prabha JR, Padmalatha T, Ravi Sankar C and Srinivasa Rao V (2007) Varability, heritability and genetic advance in ridge gourd (*Luffa acutangula* (Roxb) L.). *The Andhra Agric J* **54** (1&2):104-106

Ranganna S (2001). *Hand book of analysis and quality of fruit and vegetable products*. Second edition. Tata Mc Graw Hill, publishing company Ltd, India, pp. 112.

Rani R (2014). Performance of bitter gourd genotypes for yield and earliness. *Ann Plant Soil Res* **16**(4): 330-333

Sanghera G S, Singh R P, Kashyap L, Tyagi V and Sharma B (2016). Evaluation of sugarbeet genotypes (*Beta Vulgaris* L.) for root yield and quality traits under subtropical conditions. *J Krishi Vigyan* **5**(1):67-73

Saranyadevi G, Lakshmanan V and Rohini N (2017). Performance evaluation and correlation analysis in mithipagal genotypes (*Momordica charantia var. muricata*). *EJPB* **8**(2): 652-659.

Schaefer H and Renner S S (2010). A three-genome phylogeny of *Momordica* (Cucurbitaceae) suggests seven returns from dioecy to monoecy and recent long-distance dispersal to Asia. *Mol Phyloge Evol* **54**: 553–560.

Sharma M, Singh Y and Suryavanshi P (2017). Assessment of Bottle Gourd (*Lagenaria siceraria*) varieties for fruit yield and component traits in Mohali District of Punjab. *J Krishi Vigyan* **8**(1):5-7

Singh V, Rana DK and Shah KN (2017). Genetic variability, heritability and genetic advance in some strains of bitter gourd (*Momordica charantia* L.) under subtropical conditions of Garhwal Himalaya. *Plant Arch* **17**(1): 564-568.

Yadav M, Pandey T K, Singh D B and Singh G K (2013). Genetic variability, correlation coefficient and path analysis in bitter gourd. *Indian J Hort* **70**(1): 144-149.

Received on 30/3/2024 Accepted on 25/4/2024

DOI : 10.5958/2349-4433.2024.00050.X

J Krishi Vigyan 2024, 12(2) : 263-269

Evaluation of Rheological Properties of Millet Flour and Standardization of Muffin: A Bakery Product

Jothilakshmi K.[1] and Gayathry G[2]*

Krishi Vigyan Kendra, Vridhachalam - 606 001, (Tamil Nadu)

ABSTRACT

The investigation on the rheological properties of muffin flour, development of muffin, physico-chemical composition and sensory evaluation was carried out in Community Science College and Research Institute, Madurai, Tamil Nadu, India. The different treatment combinations and proportions involving flour from refined wheat (RW), finger millet, kodo millet and cowpea flour were evaluated for the rheological properties such as water absorption, viscosity and gelatinization temperature. Muffin were developed and assessed for loaf volume, loaf weight, moisture, pH, TSS, total sugar, reducing sugar, protein, calcium, phosphorus and vitamins. Sensory evaluation was done using 9 point hedonic scale method. The water absorption rate of the muffin was high in cowpea + RW flour (1.538 g) followed by kodo millet + cowpea +RW flour (1.435g) when compared to that of RW flour alone (1.014g). The finger millet + RW flour combination had a lower viscosity of 61.75 ml/sec and gelatinization temperature of 85°C and highest score for cowpea+ RW flour of 228.42 ml/sec. The overall acceptability scores were higher of 87.5% for finger millet + RW flour combination. Nutrient parameters were statistically significant for finger millet +cow pea+ RW flour with protein content of 11.80 g, calcium116.25 mg, 326.20 mg phosphorus and 2.56 mg of iron/100gm. Hence, both the rheological and physico-chemical properties were highly suitable for 25:25:50 treatment combination of finger millet + cowpea + RW flour and offers a convenient mixing proportion for development of muffin, both in terms of rheology and sensory characteristics.

Key Words: Cowpea, Flour, Millet, Muffin, Nutrients, Rheology, Sensory evaluation.

INTRODUCTION

The popularity of bakery products such as bread, biscuits, cakes, muffin, pastries *etc*., is increasing tremendously. The development in the bakery industry involving the use of millet flour which is non-gluten protein is most important for low glycemic index food for the diabetic people. Owing to the importance of the millet in the food industry the current research was focused for the production of millet flour and based convenience bakery food called as muffin Deshmukh and Soans, 2019.

Bakery products solely use refined wheat flour and whole wheat flour which is high in gluten protein to have a bulky structure. Gluten is a major protein component of wheat, which is responsible for flour processing characteristics in bakery industry and contributes in the structure of the baked products. (Farrell and Kelly, 2002; Martins *et al,* 2017). They can be made from gluten free millets such as the finger millet, pearl millet, foxtail millet.

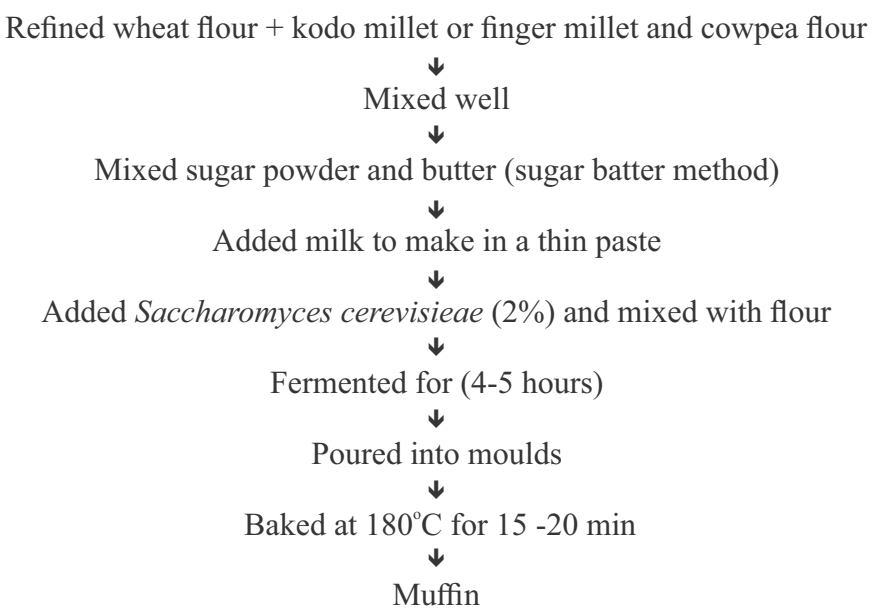
Muffin is a type of semi - sweet cake or quick bread that is baked in appropriate portion, high calorific value, appreciated among the consumers of all age groups due to its good taste and soft texture. Wheat flour, as in other bakery products, is the most important ingredient of muffin due to its gluten content. But most baked goods are high in calories due to their high sugar and fat content. The wise choice to incorporation of millet in bakery foods is becoming popular due to the awareness of low calorie foods among the people. Use of millet flour in bakery products enriches them in fiber and micronutrients which enhance the nutrient content. The millets are known for their superior nutritive values along with several health benefits (Kumar *et al,* 2021a).

Corresponding Author's Email - Email:gayathryg@tnau.ac.in

1Assistant Professor, Food Science and Nutrition, Community Science College and Research Institute, Madurai – 625 104, Tamil Nadu, India

2*Assistant Professor (Agricultural Microbiology), Krishi Vigyan Kendra, Vridhachalam - 606 001, Tamil Nadu, India

Fig.1. Flowchart of development of millet flour muffin



Millets are also proved for their salutary health goods like antioxidant exertion, anti-diabetic, anti-cancer, atherosclerogenic goods, and antimicrobial parcels (Kumar *et al,* 2021b).

However, muffin have a low nutrient density, as they are high in sugar and fat and low in dietary fiber. Hence, this study is planned to make nutri-dense muffin with the ingredients such as finger millet, kodo millet and cowpea flour to prepare and evaluate nutri-dense muffin along with addition of yeast namely *Saccharomyces cerevisieae* provider tenderness, taste and flavor to the muffin.

MATERIALS AND METHODS

Processing of raw material

The ingredients used for development of millet muffin such as refined wheat flour, Finger millet flour, kodo millet flour and cowpea flour, baking powder, milk and butter were purchased from local market. Sieving of all dry flour (80 mesh sieve) along with baking powder was done to remove suspended impurities for muffin development and butter and milk stored at refrigeration temperature.

Rheological properties of millet flour

Measurement of water absorption of millet flour

Water absorption characteristics were determined by mixing one gram of sample with 10ml of water in a graduated centrifuge tube. The mixture was allowed to stand for 30 min and then centrifuged at 5000 rpm for 10 min. The volume of supernatant was discarded and the sediment after discarding the supernatant was recorded. Thus, the difference between the weight of the sample before adding water and the weight of the sample after discarding the supernatant gives the amount of water absorbed per gram. (Crosbie and Ross, 2007).

Viscosity and gelatinization temperature of millet flour

Rapid Visco Analyzer (RVA) 3D model was switched on to run for 30 min to warm up. The associated computer was run for the RVA control software. Accurate sample weight and the water were added to determine the moisture content, to give a constant solid content of the moisture. Ideal temperature was set at 50°C, for 30 minutes and time between readings was 4 sec. About 3.00g of millet flour with 12% moisture was weighed and transferred in to canister of an RVA computer. About 3.5 mlof 98% ethanol was poured on top of the flour and stirred with a non-stick stirrer until no lumps remained. Distilled water 20 ml add water was added to flour/ethanol cover canister with an inverted stopper and shaken vigorously. The material adhering to the can sides was scrapped

Table 1. Water absorption rate of flour for preparation of muffin.

Sr. No.	Treatment combination	Water absorption (g)
1.	T_0 - Refined wheat flour - Control	1.014
2.	T_1- Finger millet + Refined wheat flour	1.295
3.	T_2- Kodo millet + Refined wheat flour	1.333
4.	T_3- Cowpea + Refined wheat flour	1.538
5.	T_4- Kodo millet + cowpea + Refined wheat flour	1.435
6.	T_5- Finger millet + cowpea + Refined wheat flour	1.244

Table 2. Rheological properties of millet muffin flour

Particulars	T_0	T_1	T_2	T_3	T_4	T_5
Viscosity (ml/sec)	61.00	61.75	222.67	228.42	226.58	227.58
Gelatinization Temperature (°C)	85.05	85.05	85.00	85.00	85.00	84.65

down using the paddle. Paddle was placed into the canister and inserted into the instrument to initiate the measurement cycle by depressing the motor tower of the instrument. All the peak viscosities and temperature were recorded. The second peak viscosity and temperature was noted. This value was the final reading of the wheat flour ethanol index (AACC, 2007).

Development of millet muffin

Muffin was developed using refined wheat flour, finger millet flour, kodo millet flour, cowpea flour. Millet muffin was developed by inoculating the pure cultures of *Saccharomyces cerevisieae* at 2% percent level by using of sugar batter method. In this method all fats are creamed together followed by addition of sugar during creaming process next to it addition of flour with baking powder and essence (Neelam Khetarpaul *et al* 2021)

For development of muffin the following treatments were T_0 control 100 percent of RW flour T_1 - Finger millet + Refined wheat flour (50:50), T_2 - Kodo millet + Refined wheat flour (50:50), T_3 - Cowpea + Refined wheat flour (50:50) , T_4 - Kodo millet + cowpea + Refined wheat flour (25:25:50) and T_5 - Finger millet + cowpea + Refined wheat flour (25:25:50) tried .

Physical and biochemical characteristics of millet muffin

The physico-chemical parameters such as loaf volume, loaf weight, and moisture, protein, AOAC(2005). pH, TSS, AOAC(2000). Total sugar, reducing sugar, calcium, phosphorus, iron, manganese and zinc, were analyzed as per the procedures of AOAC (2016).

Sensory analysis

According to Meilgaard *et al* (2007), the sensory evaluation was carried out.

Statistical analysis

The data obtained from the different treatments were subjected to statistical analysis to find out the impact of different treatments. The data for various biochemical parameters were analyzed using analysis of variance (ANOVA).

RESULTS AND DISCUSSION

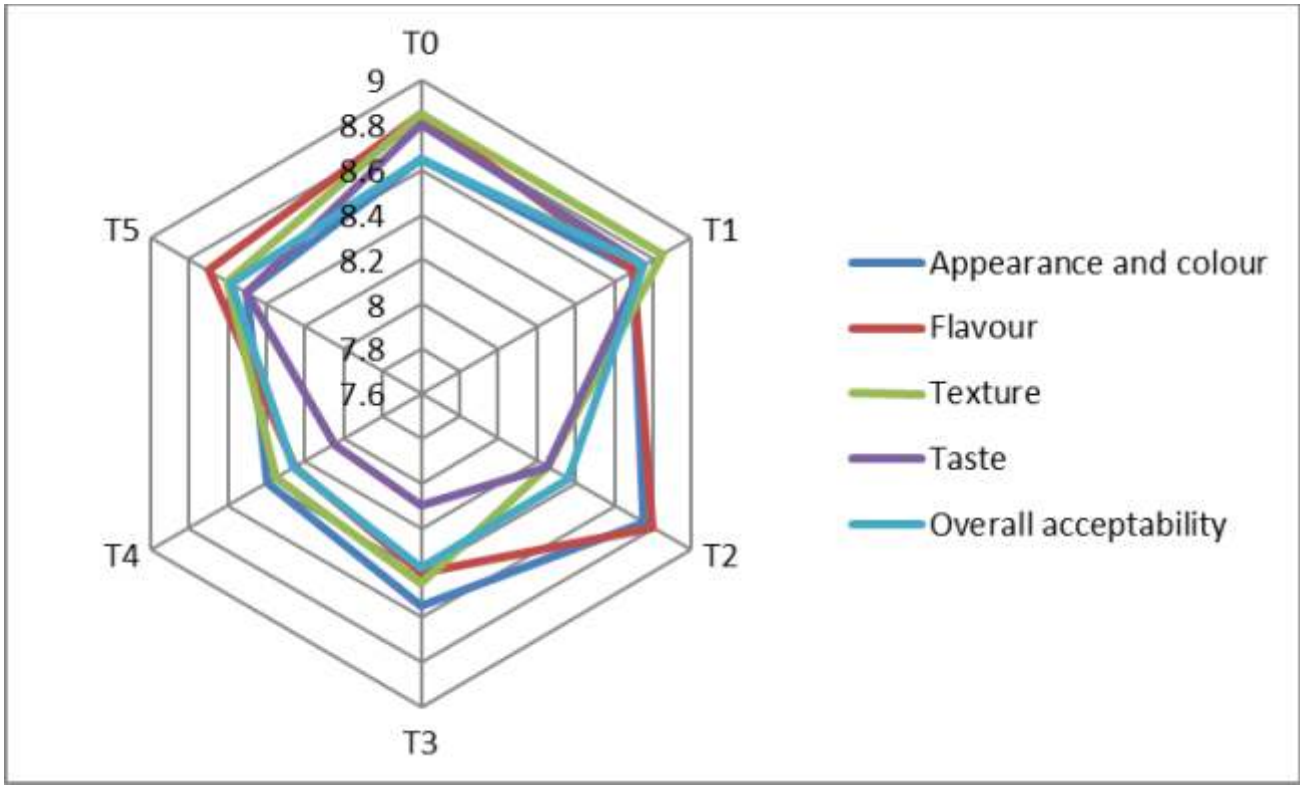
Rheological properties of the selected treatments of muffin flour

Rheological properties for all the selected treatments were done. The details of water absorption for selected treatment are given in table.1

The water absorption rate of the muffin was high in T_3 (1.538g) followed by T_4 (1.435g) when compared to that of control (1.014g). The high water absorption of the muffin flour shows that the carbohydrates and protein content was found to be high which helps the dough to attain smooth consistency. Prathyusha and Nirmala Devi, (2024) stated high in carbohydrates are holding high water absorption capacity 266.91±0.29% in tapioca flour which makes it useful for persons with calorie deficiency and it also has a high functional value.

Viscosity of millet muffin flour

The viscosity and gelatinization



temperature were estimated as per the procedure. The results of the different treatments presented in table 2.

From the data (Table 2), it was found that the decrease in gelatinization temperature leads to increase in viscosity (61.75 - 228.42). The finger millet + refined wheat flour (T_1) had a lower viscosity (61.75) when compared to all other treatments. The peak viscosity was expressed as Brabander Units (BU). The Temperature at peak viscosity were 85.05°C at control and T_1 and 85°C at T_2, T_3, T_4 and gradually decreased to 84.65°C in T_5. During the test, the starch was gelatinized with consequent rise in viscosity, subject to high temperature and controlled shear during which its stability was revealed, and then cooled to provide an indication of setback during gelatinization.

Bhaduri (2013) also correlated the replacement of wheat flour with gluten-free rice and quinoa flour in the muffin formulation with the decreased viscosity of muffin batter which further resulted into a decrease in hardness, cohesiveness, and gumminess. Rajiv *et al* (2011) also reported a decrease in cohesiveness, chewiness, and springiness values of the muffin with increasing level of finger millet flour blend.

Gelatinization temperature was highest in control and T_1 when compared to that of T_2, T_3, T_4 and T_5 treatments which might be due to the addition of refined wheat flour which makes the flour to attain smooth consistency. The viscosity increases with the water holding capacity. Hence viscosity and water holding capacity are related to each other which makes the muffin flour to attain dough strength which is get raised by using a combination of leaving agents and by using yeast (*Saccharomyces cerevisieae*).

Sensory evaluation of millet muffin

The organoleptic evaluation of muffin was done by the panel of trained judges using 9 point hedonic scale. Statistical analysis of muffin showed no significant difference in organoleptic evaluation between treatments at 5 % level.

A result of sensory evaluation of millet and pulse flour muffin with 9 point hedonic scale showed that sample control (T_0) having highest score than millet and pulse flour muffin ($T_1 - T_5$). The higher scores for colour were found in sample T_2 due to the incorporation of 50 % kodo millet flour and 50 % refined wheat flour. Incorporation of finger millet flour that imparts reddish brown colour to muffin. Evaluation with respect to texture

Table 4 . Physical and biochemical parameter of millet muffin.

Physical parameter							CD
	To	T_1	T_2	T_3	T_4	T_5	
Loaf volume (ml)	65.0	64.0	63.0	63.0	63.0	64.0	0.3178
Loaf weight (g)	25.0	24.0	24.0	24.5	24.7	25.0	0.6068
Biochemical parameters							
Moisture (%)	40.2	40.4	40.3	40.3	40.4	40.4	12.341
pH	4.80	5.80	5.50	5.70	5.60	5.60	4.7014
TSS ^{0}Brix	24.0	26.0	26.0	25.0	26.0	26.0	0.5989
Total sugar (g)	6.10	6.20	6.30	6.20	6.10	6.10	0.0486
Reducing sugar (g)	7.10	7.30	7.60	7.20	7.00	6.90	0.5215
Protein (g)	3.75	7.80	8.60	15.30	11.40	11.80	0.6068
Calcium (mg)	6.20	181.50	23.00	48.30	36.20	116.25	0.1213
Phosphorus (mg)	23.75	198.30	143.20	256.30	311.50	326.20	0.4054
Iron (mg)	2.40	2.47	2.20	2.78	2.60	2.56	0.1214
Manganese (mg)	0.20	0.79	0.79	0.89	1.10	3.98	0.0655
Zinc (mg)	4.00	4.33	13.00	14.0	16.0	14.0	0.0635

showed that sample T_0, T_1 and T_5 got higher score than other samples because texture was obtained well by incorporation of finger millet flour and same results obtained in taste of muffin also. The same results found in barnyard millet incorporated muffin, product is also reported for barnyard millet based cookies (Surekha *et al* 2013) and biscuits (Anju and Sarita 2010).

Physical and biochemical changes of muffin were given in table 4. The loaf volume of the muffin for different treatments range from 63ml to 65ml respectively. The loaf volume seems to be maximum in control (65 ml) due to the without incorporation of millet and pulse flour. It was evident that in all treatments the loaf volume was low. The loaf weight of the muffin was maximum in control and T_5 (25) T_0, T_2 and T_5 treatments had an average of 18 g loaf weight. This result indicated millet and pulse incorporated muffin got equal weight to the control sample, hence this millet muffin has high acceptance on physical parameters.Loaf weight of the muffin (25 g) was noticed in control sample and finger millet flour + cowpea flour incorporated muffin and little weight reduction was noticed in kodo millet and cow pea flour incorporated muffin. The same result was confirmed with barn yard millet flour muffin. The highest weight loss due to baking was observed in the muffin sample prepared from the 100 g/100 g BMF flour blend (11.78 g/100 g) lowest being in the control muffin (11.28 g/100 g) (Bhaduri, 2013)

The control muffin had the highest volume, and the height and volume decreased significantly ($p < 0.05$) with the addition of KBP. Martinez-Cervera *et al* (2011) observed a lowered muffin height with increasing cocoa fiber. Volume and form are important characteristics of baked goods. The decreases in final volume and height of the bakery product caused by the addition of fiber might be explained by the dilution of the gluten. The weight of the muffins increased significantly with the addition of KBP, and the baking loss rate decreased accordingly.

The moisture content of millet flour incorporated muffin (40.3 to 40.4 %) increased due to the concentration of dietary fiber presents in millets compared with refined wheat flour muffin (40.2 %). The pH level in the muffin was maximum in T_1 (5.8) and followed by T_3, T_4, T_5, T_2 and control sample. Lowering of the pH is an

indication of faster multiplication of the yeast culture, which produces more CO_2 and increase the loaf volume.

The total and reducing sugar of the muffin varied between 6.1g to 6.3g, 6.9 g to 7.6g in all treatments including control samples respectively. The protein content was maximum in T_3 (15.30 g). This may be due to the incorporation of 50 per cent cow pea flour. It is interesting to note that the protein content was on an average 10 per cent high when compared to control (3.75 g). The calcium was maximum in T_1 (181.5 mg) and T_5 (116.25 mg) due the finger millet incorporation. Phosphorous and iron content of the muffins are ranged from 23.75 mg to 326.20 mg and 2.4 mg to 2.78 mg /100 g (T_3) kodo millet incorporated muffin .The manganese and zinc content of the muffin was maximum in T_5. The statistical analysis of the muffin showed that the millet and pulse flour incorporated was found to be highly significant. The manganese and zinc content were found to be significant between treatments at 5% level.

Paneria and Agarwal (2023) studied the nutritional analysis of gluten free millet muffin and the results showed that the moisture content - 23.2, fat content - 20.4 gm% and calcium content – 166 mg% were higher in amaranth millet muffin. Ash content - 2.66 gm% and crude fiber content - 3.33 % were higher in Barnyard millet muffin. Iron content - 4.06 mg% was higher in Proso millet flour which was more liked by panel members. They also stated that millets are also rich in other micronutrients like calcium, zinc, lipids and high-quality proteins. The incorporation of millets and pulse increased the nutrient content of the treatment muffins (T_1 –T_5) when it was compared with control muffin (T_0).

Hundred percent replacement of RW flour in muffin formulation with barnyard millet flour increased the mineral content which was evident from the higher ash content of 100 g/100 g barnyard millet flour blend muffins (1.75 g/100 g) when compared with control muffin (0.69 g/100 g). This was due to barnyard millet is rich in minerals (1.35 g/100 g) as compared to that of wheat flour. Both the muffin samples; control and BMF muffins contained more or less equal amount of total carbohydrates; 75.11 and 75.28 g/100 g, respectively. A higher crude fiber content of 100 g/100 g barnyard millet flour muffin (2.09 g/100 g) than that of control muffin (0.14 g/100 g) may be attributed to the fiber richness of barnyard millet (6.5 g/100 g). The enhanced nutritional value in terms of dietary fiber was also reported when barnyard in traditional foods such as rice, idli, dosa, roti and chakhi and biscuits (Anju and Sarita, 2010). The culture inoculation gave a well finished product with high overall acceptability. The nutrient content was also maximum in the inoculated treatments. It was inferred that inoculation of yeast helps in the formation of volatile compounds and carbohydrate cleaving enzymes which have an important impact on the flavour of the baked products. From the organoleptic, physical, biochemical of the muffin showed that the treatment T_5 performed with culture was found to be best among all the other treatments.

CONCLUSION

Formulation of muffin with finger millet flour, kodo millet flour, cowpea flour and refined wheat flour in appropriate proportion makes nutri-rich muffin. From the experiment, it was realized that both the rheological and physico-chemical properties were highly suitable for 25:25:50 treatment combinations of finger millet + cowpea + refined wheat flour and offers a convenient mixing proportion for development of muffin. The flour combinations could be used to prepare good quality of muffin with a good sensory property. The developed muffin are the good source of protein, calcium, phosphorus and iron which are important to maintain health and provide health benefits.

REFERENCES

AACC (2007). *Approved Methods of Analysis*.76-22.01. Pasting properties of Oat-rapid viscosity analysis. 11th Edition.

Anju T and Sarita S (2010). Suitability of Foxtail millet (*Setaria italica*) and Barnyard millet (*Echinochloa frumentacea*) for development of low glycaemic index biscuits. *Malay J Nutr* **16** (3): 361-368

AOAC (2000). Described the, pH and acidity. *Official Methods of Analysis* 18th edition. Association of Official Analytical Chemists, Washington, D.C., U.S.A..

AOAC (2005). Determination of ash, moisture, protein and fat. Official Methods of Analysis 18th edition. Association of Official Analytical Chemists, Washington, D.C., U.S.A.

AOAC (2016). Described the iron. *Official Methods of Analysis* 20th edition. Association of Official Analytical Chemists, Washington, D.C., U.S.A..

Bhaduri S (2013). A comprehensive study on physical properties of two gluten-free flour fortified muffins. *J Food Process Technol* **4**(7): 251. http:// dx.doi.org/10.4172/2157-7110.1000251.

Crosbie G and Ross A (2007). *The RVA Handbook AACC international*; ISBN13:978-1-891127-54-0: Library of Congress Catalog Card No.: 2006938818.

Deshmukh Sajis and Soans Oliver (2019). Study of marketing function in bakery industry in India. *J Adv and Scholarly Res in Allied Edu* **16** (8) : 212-219.

Farrell RJ and Kelley CP (2002). *Food Colorimetry. Theory and Applications* .Westport .USA.AVI Publishing company Inc.

Kumar A, Tripathi M K, Joshi D, and Kumar V (2021a). *Millets and Millet Technology.* ISBN 978-981-16-0676-2 Springer Nature : P 438. 0.1007/978-981-16-0676-2

Kumar A, Tripathi MK, Joshi D, and Kumar V (2021b). *Millets and Millet Technology.* ISBN978-981-16-0675-5.SpringerNature. https://link.springer.com/book/10.1007/978-981-16-0676-2.

Martinez-Cervera S, Salvador A, Muguerza B, Moulay L and Fiszman, SM (2011). Cocoa fibre and its application as a fat replacer in chocolate muffins. LWT. *Food Sci and Technol* **44** (3) : 729-736.

Martins ZE, Pinho O, and Ferreira. IMPLVO (2017). Food industry by-products used as functional Ingredients of bakery products. *Trends Food Sci Technol* **67 :** 106- 128.

Meilgaard MC, Carr BT, and Carr BT (2007). *Sensory Evaluation Techniques* (4th ed.). CRC Press. ISBN 9780429195143. https://doi.org/10.1201/b16452

Neelam Khetarpaul, Raj Bala Grewal and Sudesh Jood (2021). *Bakery Science and Cereal Technology.* Astral International (P) Limited ISBN 9788170353508.Daya Publishing house : P 319

Paneria P and Agarwal S (2023). Development of gluten free muffins based on millets. *Int J Engg Res* **11** (8): 39-48

Prathyusha A and Nirmala Devi G (2024). Physicochemical and functional properties of Tapioca (*Manihot esculenta*) flour. *J Krishi Vigyan* **12(**1): 132- 137

Rajiv J, Soumya C, Indrani D, and Venkateswara Rao G (2011). Effect of replacement of wheat flour with finger millet flour (*Eleusine coracana*) on the batter microscopy, rheology and quality characteristics of muffins. *J Texture Stud* **42** (6): 478- 489.

Surekha N, Ravikumar S N, Mythri S, and Rohini D (2013). Barnyard millet (*Echinochloa frumentacea*) cookies: development, value addition, consumer acceptability, nutritional and shelf life evaluation. *J Environ Sci Toxicol Food Technol* **7**(3) : 01 – 10.

Received on 22/4/2024 Accepted on 20/5/2024

DOI : 10.5958/2349-4433.2024.00051.6

J Krishi Vigyan 2024, 12(2) : 270-273

Existence of Antimicrobial Activities in *Mentha arvensis* Against Some Pathogenic Bacteria

Uma Sharma[1], Rajendra Sharma[2] and Seema Bhadauria[3]
Department of Botany, SLS, Khandari , Agra (Uttar Pradesh)

ABSTRACT

Mentha plant is erect, perennial branched herb which is used to treat various types of human disorders. Ethanolic and aqueous extracts of *M. arvensis* (L.) were tested to their actions against two selected bacteria namely *Citrobacter freundii (gram-)* and *Micrococcus luteus (gram+)*. The antibacterial effects was assessed by using method of disc diffusion at various concentrations. The findings showed that ethanol was finest solvent used to extraction as compared to aqueous for testing the antibacterial properties of leaf and stem extracts. *Mentha arvensis (L.)* extract showed maximum zone of inhibition against both bacterial strains. Highest zone of inhibition 19.0mm was found in *Citrobacter freundii* at highest concentration, while maximum inhibition by 12.5mg/ml ethanolic stem extract was 11mm against *Citrobacter freundii and* maximum inhibition of *Micrococcus luteus was 9 mm* due to an ethanolic leaf extract of *Mentha arvensis* (L.), and 7.3mm by 12.5 mg/ml ethanolic stem extract. The results also revealed that ethanolic leaf extract of *Mentha arvensis* (L.) inhibited the population of tested pathogens considerably as compared to other ethanolic extract. The findings suggested that more research should be done on these plants and support their application in traditional medicine.

Key Words: *Mentha arvensis* (L.), Antimicrobial properties, Medicinal plant, Disc diffusion method, Ethanolic extract.

INTRODUCTION

In tropical and subtropical areas, infectious illnesses brought on by bacterial and fungal infections are the main causes of death. (Zhang et al,2015). India is one of the wealthiest nations in the world when it comes to the genetic resources of medicinal plants. Its topography and climate vary greatly, which has an impact on the vegetation and floristic makeup of the region. Furthermore, the agroclimatic conditions are favourable for bringing in and domesticating new exotic plant types. (Martins *et al,* 2001). Medical plants are living, irreversible resources that may be depleted if overused but can be sustained if used carefully and wisely. In the past, people have neglected the value of medicinal herbs. Nevertheless, nowadays, medicinal plants are valued as both a source of economical health treatment and a source of money (Purohit and Vyas, 2004). Secondary metabolites are responsible for the plant therapeutic effects. These metabolites provide plants used in the food and pharmaceutical sectors with colour, taste, and scent (Vivek *et al,* 2009 ; Nascimento *et al,* 2010; Alami *et al,* 2022; Wei *et al*, 2023). *Mentha arvensis* often called menthol mint, is a perennial herb with upright branches that can reach a height of 75 cm. It has flowing rootstocks and inflexible branching stems. Asthma, jaundice, and illnesses of the liver and spleen are all treated with this herb. Natural menthol is produced from menthol mint, an essential oil-bearing crop, and is used extensively in the pharmaceutical, cosmetic, and flavouring sectors. (Chand *et al,* 2004; Vivek *et al,* 2009; Nascimento etal,2010; Thawkar *et al,* 2016; Nazim *et al*,2020). Consequently, the purpose of the current study was to examine the possible antibacterial activity of Mentha arvensis (L.) against two harmful microorganisms, *Citrobacter freundii* and *Micrococcus luteus*.

MATERIALS AND METHODS

Collection of *Mentha Arvensis*

Mentha arvensis (L.) aerial parts were collected in the Agra area of Uttar Pradesh. The

Corresponding Author's Email - Umasharma1988mtr@gmail.com

plants individual sections were meticulously chopped with a cutter to remove any contaminating bits. The harvested plant components were then placed in plastic bags and sealed. A refrigerator was used to retain the specimens that were collected and delivered to the lab. In accordance with Srinivasan *et al* (2004), plant material were carefully transferred to H_2O , sterilised in chemicals includes 0.1% HgCl2, dried, pulverised, and packaged (Fig. 1).

Fig 1: *Mentha arvensis* (L.)

Extraction of Active Constituents

Aqueous Extract

Using mechanical method to prepare aqueous extracts. Different plant components, such as the leaf and stem, were individually homogenized before being filtered through muslin fabric. Further straining was done using Whattman No. 1 filter paper to produce the filtrate. At room temperature, the extraction was done. (Zore *et al,* 2004).

Organic Extract (Soxhlet Extraction)

The shade dried plant material was evenly transferred to thimble and placed in an chamber situated beneath a condenser & above the flask containing ethanol. The powdered material weighed about 100g in this extraction chamber. Once the flask reached 65 °C, the ethanol evaporated, changed into a liquid in the condenser and then pours in chamber containing the plant material. Every time solvent level surrounding the sample exceeded a predetermined threshold, the extraction chamber was designed to overflow and trickle back into the boiling flask. After the extraction process was complete, the extract flask taken out & remaining traces of ethanol was removed by rotary evaporator. Then, the extract was stored at 4°C in the refrigerator.(Okeke *et al*, 2001).

Test Micro-Organisms

Two selected pathogenic bacterial strains: *Citrobacter freundii* and *Micrococcus luteus* were taken from Institute of Microbial Technology, Chandigarh. A nutrient agar slant was used to maintain the typed bacterial culture, which was then kept at 40^{o} C until it was needed.

Antibacterial Activity Screening

Disc diffusion procedure was used to assess the in vitro antibacterial activity of a chosen plant extract. (Mukherjee *et al*, 1995). Plant extract solutions with varied concentrations (12.5 mg/ml, 6.25 mg/ml, 3.12 mg/ml, and 1.56 mg/ml) were generated by serial dilution to test susceptibility. Plant extract was diluted in preferred solvent. 6 mm-sized sterile discs were pouring in 25 µl of each successively diluted extract solution. A nutrient broth was combined with a few colonies from the pure culture. A cotton swab dipped in culture was used to inoculate this broth throughout the whole surface of the nutrient agar plate. With the use of sterile forceps, plant extracts containing discs were applied to the agar plate's infected surface. 24 hours at 37°C were spent incubating these plates. The measurement of the antibacterial activity was assessed by calculating the diameter of the zones of inhibition surrounding disc in petri plates. Mean value of zone of inhibition was determined in millimeter.

RESULTS AND DISCUSSION

In present study, disc diffusion method was used to evaluate the antibacterial effects of *Mentha arvensis* (L.) at various concentrations. Table 1–3 shows the effects of various doses of crude leaf and stem extracts, demonstrate that both aqueous and ethanolic extracts of leaves and stems were effective at preventing bacterial growth.

Table 1. Antibacterial activity of the aqueous extracts of *Mentha arvensis* (L.) against *Citrobacter freundii and Micrococcus luteus.*

Plant name	Aqueous extract against *Citrobacter freundii*	
Mentha arvensis (L.)	Leaf (zone of inhibition)	Stem (zone of inhibition)
	7.6 mm	6.3 mm
	Aqueous extract against *Micrococcus luteus*	
	Leaf (zone of inhibition)	Stem (zone of inhibition)
	7.5 mm	6.4 mm

Table 2. Antibacterial activity of the ethanolic extracts of *Mentha arvensis* (L.) against *Citrobacter freundii.*

Plant name	Different concentrations of Ethanolic extracts			
Mentha arvensis (L.)	Leaf extract against *Citrobacter freundii*			
	12.5 mg/ml	6.25mg /ml	3.12mg /ml	1.56 mg /ml
	19 .3	9.0	7.0	6.5
	Stem extract against *Citrobacter freundii*			
	12.5 mg /ml	6.25mg /ml	3.12mg /ml	1.56 mg /ml
	11	9.0	8.0	6.0

Table 3. Antibacterial activity of the ethanolic extracts of *Mentha arvensis* (L.) against *Micrococcus luteus*

Plant name	Different concentrations of Ethanolic extracts			
Mentha +arvensis (L.)	Leaf extract against *Micrococcus luteus*			
	12.5 mg/ml	6.25mg /ml	3.12mg /ml	1.56 mg /ml
	9.0	8.0	7.0	6.5
	Stem extract against *Micrococcus luteus*			
	12.5 mg	6.25mg /ml	3.12mg /ml	1.56 mg /ml
	7.3	6.8	6.2	6.0

As compared to aqueous extracts, *Mentha arvensis* (L.) shown considerable inhibitory action in ethanol extracts .Because (1) certain active chemicals were found in water extracts, albeit in small amounts, and (2) bio-active were soluble in organic solvents and hence absent from water extract. The plant extracts in the current investigation were shown to function in a dose-dependent way, exhibiting their highest level of activity at a dosage of 12.5 mg/ml.The above findings of our investigation showed that leaf extract from the test plant significantly inhibits the development of both test bacteria when compared to stem extract. Because most bioactive compounds are abundant in leaves that have been shown to have therapeutic effects as well as physiological and antibacterial properties. The above results was also showed that *Mentha arvensis* (L.) extracts significantly inhibited the growth of tested pathogens.

CONCLUSION

Plant extracts have a lot of promise as antimicrobial agents against bacteria and can be utilised to treat infectious diseases brought on by hard-to-treat germs.Several natural organic compounds had to be screened in order to find the

active agents because effective result –molecules estimation & identification of drugs will be beneficial in the drug development process.

REFERENCES

Alami MM ,Ouyang Z , Zhang Y,Shu GS , Yang Z, Mei and Wang X (2022). The current developments in medicinal plant genomics enabled the diversification of secondary metabolites' biosynthesis. *Int J Mol Sci***23**:15932.

Chand S, Patra NK, Anwar M and Patra DD (2004). Agronomy and uses of menthol mint (Mentha arvensis) Indian Perspective. Proc. *Indian Natl Sci Acad* B **70**. 3 **:** 269-297.

Nascimento MM, Rodrigues FG ,Campos AR, Cost GM (2010). Phytochemical prospection, toxicity and antimicrobial activity of *Mentha arvensis* (Labiatae) from northeast of Brazil. *J Young Pharm* **2**:1:210-2.

Nazim M, Sadiq QUA , Aamir N, Anjum S, Ali M and Maryam H (2020). Mentha arvensis, a medicinal and aromatic plant, has high nutritional value and several-uses: *A review Buletin Agroteknologi* **1**(2):37-49

Okeke M I, Iroegbu C U, Eze E N, Okoli A S and Esimone C O (2001). Evaluation of extracts of the root of *Londolphia owerrience* for antibacterial activity. *J Ethanopharmocology* **78**: 119 – 127.

Purohit SS and Vyas SP (2004). *Medicinal plant cultivation, A Scientific Approach.* Published by *Agrobios* (India).

Srinivasan V, Nam HM, Sawant AA, Headrick SI, Nguyen LT and Oliver SP (2007). Distribution of tetracycline and streptomycin resistance genes and class 1 integrons in enterobacteriaceae isolated from dairy and non dairy farm soil. *Microbial Ecology* **55** (2): 184-193.

Thawkar **BS,** Amol G, Jawarkar , Kalamkar PV, Pawar KP **and** Kale MK **(2016).**Phytochemical and pharmacological review of Mentha arvensis. *Int J Green Pharmacy* **10** (2) : 71

Vivek S, Nisha S , Harbans S, Devendra S ,Vijaylata P and Bikram S (2009). Comparative account on GC-MS analysis of Mentha arvensis L. "Cornmint" from three different locations of north India. *Int J Drug Dev Res* **1**:1-9.

Wei H, Kong S,Jayaraman V,Selvaraj D , Soundararajan P and Manivannan A (2023). Review Mentha arvensis and Mentha × piperita-Vital Herbs with Myriads of Pharmaceutical Benefits. *Horticulturae* **9**: 224.

Zhang LSG, Xu W, Liang J, Mei YY Di , Lan H H, Yang Y , Wang WW ,Luo YY and Wang H Z (2015).Antibacterial Activity and Mode of Action of Mentha arvensis Ethanol Extract against Multidrug-Resistant *Acinetobacter baumannii*. *Tropical J Pharmaceutical Res* **14** (11): 2099-2106

Zore G B, Surwase B S and Karuppayil S M (2004). Antifungal activity of into two medicinal plants. *J Mycol Pl Pathol***34** (2): 543 – 545.

Received on 11/2/2024 Accepted on 10/4/2024

DOI : 10.5958/2349-4433.2024.00052.2

J Krishi Vigyan 2024, 12(2) : 274-277

Extent of Mass Media Utilization among the Rural Youth of Andhra Pradesh

Sudhamini Yedida [1], Deepika M[2], Arun Kumar G[3]*, Selvarani G [4],
Department of Agricultural Extension and Rural Sociology, Tamil Nadu Agricultural University, Coimbatore, (Tamil Nadu), India.

ABSTRACT

The present study deals with the mass media utilization by rural youth. The rural youth cover about seventy-five percent of the total youth population in India. They are the soul of nation's development. It delivers a need to study about the characteristics of the rural youth. An Ex-post facto research design was adopted for the study. Tirupathi and Kuppam mandals from Chittoor district and Kakinada Rural and Rajahmundry Rural mandals from East Godavari district were selected as they occupy the first two places in the context of rural population of the district. A sample size of 240 was selected for the study. From each district 120 respondents were selected. The study revealed that that three-fourth of the respondents (75.41 %) have medium level of mass media utilization, little more than one-eighth of the respondents (14.17 %) have low level of mass media utilization and only one-tenth of the respondents (10.42 %) have high level of mass media utilization

Key Words: Mass Media, Mass Media Utilization, Rural Youth.

INTRODUCTION

India is one of the countries with youngest population with about more than fifty percent of the population were under 25 years of age and above sixty five percent under the age of 65 years. India relies on its young minds for the progress and development. This fact infers the need to study the characteristics of youth. Youth can be categorized into rural and urban based on their living habitat. Rural youth constitute nearly 70 per cent of the total youth in India. The present study deals with the extent of mass media utilization among the rural youth. Mass media utilization refers to the active utilization of various mass media resources like newspapers, radio, television, magazines and social media by the youth. Chinchmalatpure and Tekale (2019) in a study on aspiration of rural youth towards agriculture revealed that above two-thirds of the rural youth (70.83 %) had medium level of mass media exposure followed by little above one-fifth of them (21.67 %) had low level of mass media exposure and very meagre amount of them (07.50 %) had high level of mass media exposure. Kavinila (2020) in her study on assessment of entrepreneurship among rural youth revealed that nearly half of the rural youth entrepreneurs (49.50 %) had medium level of mass medium exposure followed by equal quantity of the rural youth entrepreneurs (25.20 %) possessed with high and medium level of mass medium exposure. Deenadayalan (2021) in his study on extent of participation of farm youth in chrysanthemum cultivation indicated that above two-third of the farm youth (71.67 %) had medium level of mass media exposure followed by nearly an equal number of farm youth with low (15.00 %) and high level of mass media exposure (13.33 %). Hence, the present study was conducted to study the mass media utilization by rural youth in Andhra Pradesh.

MATERIALS AND METHODS

An Ex-post facto research design was adopted for the study. The ex-post facto research design is a systematic empirical enquiry in which

Corresponding Author's Email - Email:arunnpandiyan8542@gmail.com
1,3, Ph.D. Scholar, (Agrl. Extension), Department of Agricultural Extension and Rural Sociology, Tamil Nadu Agricultural University, Coimbatore, (Tamil Nadu), India.
2 Ph.D. Scholar, (Agrl. Extension), Department of Agricultural Extension and Rural Sociology, Agricultural College and Research Institute, Madurai, (Tamil Nadu), India.
4 Assistant Professor (Agricultural Extension), Agricultural College and Research Institute, Madurai, (Tamil Nadu), India.

Table 1. Frequency of Utilization of different Mass media sources by the respondents. (n=240)

Sr. No.	Mass media source	Extent of Utilization							
		Regular		Occasional		Never		Total	
		No.	%	No.	%	No.	%	No.	%
1.	Reading Newspaper	127	52.92	80	33.33	33	13.75	240	100.00
2.	Listening Radio	12	5.00	129	53.75	99	41.25	240	100.00
3.	Watching TV	92	38.33	121	50.42	27	11.25	240	100.00
4.	Reading Farm Magazines	71	29.58	106	44.17	63	26.25	240	100.00
5.	Using social media	162	67.50	65	27.08	13	5.42	240	100.00

No. - Number; % - Per cent

Table 2. Extent of Utilization of respondents over different mass media sources.

Sr. No	Mass Media Source	Mean Score	Rank
1.	Using social media	2.621	I
2.	Reading Newspaper	2.392	II
3.	Watching TV	2.271	III
4.	Reading Farm Magazines	2.033	IV
5.	Listening Radio	1.638	V

Figure 1. Extent of Utilization of respondents over different mass media sources

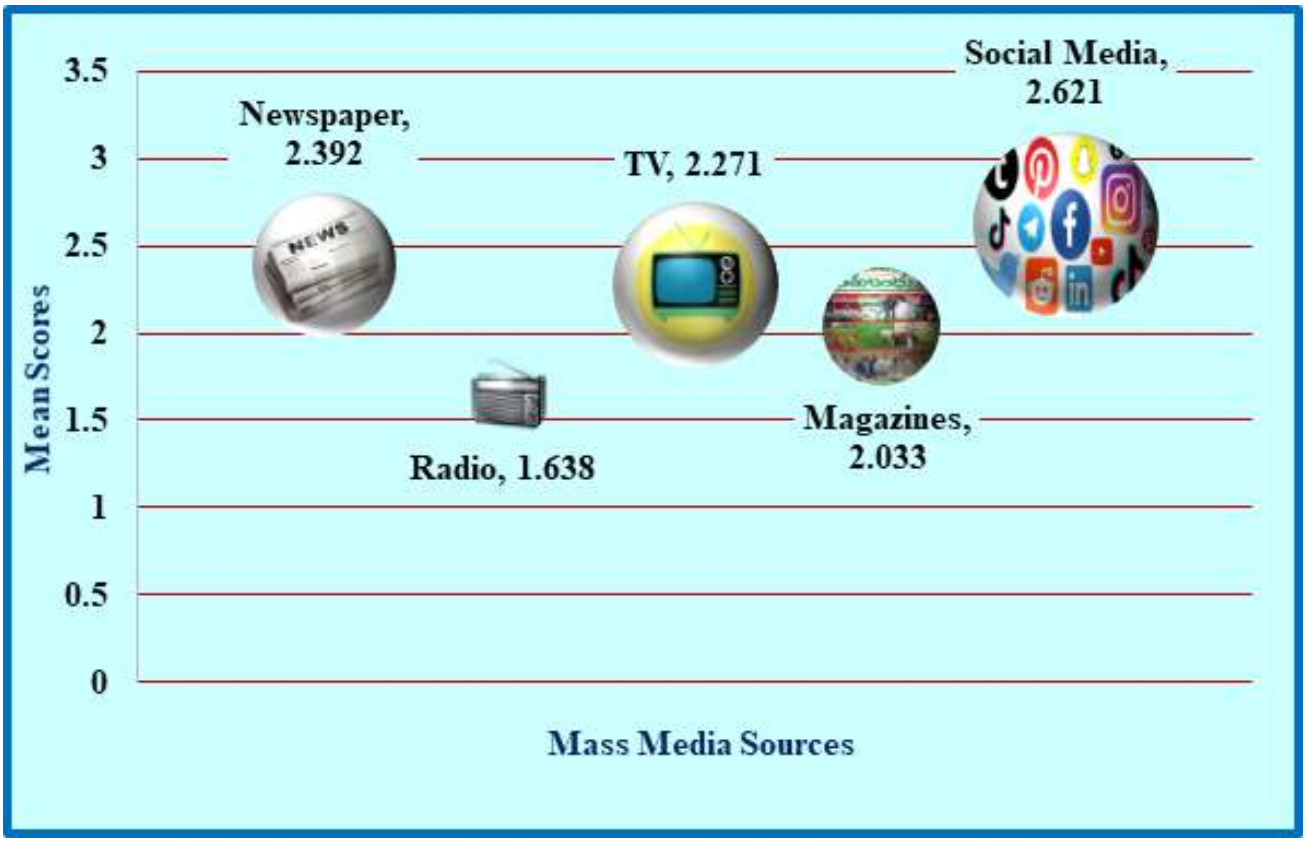


Table 3. Distribution of respondents according to their Mass media utilization. (n=240)

Sr. No.	Category	Number	Per cent
1.	Low	34	14.17
2.	Medium	181	75.41
3.	High	25	10.42

Mean=10.954; S.D.= 2.114

the researcher does not have any direct control of independent variables and are not manipulable. Andhra Pradesh state comprises of majorly two regions namely, Coastal Andhra and Rayalaseema. Coastal Andhra is comprised of 9 districts and Rayalaseema with 4 districts. Two districts were selected for the study each from Coastal Andhra and Rayalaseema. East Godavari district was selected from Coastal Andhra and Chittoor district was selected from Rayalaseema purposively.

Two mandals from each district were purposively selected for the study based on the rural population. Tirupathi and Kuppam mandals from Chittoor district and Kakinada Rural and Rajahmundry Rural mandals from East Godavari district were selected as they occupy the first two places in the context of rural population of the district. Five villages from each mandal were purposively selected based on the same criteria followed for the mandal selection. Thus, a total of 20 villages were selected from the four mandals of the two districts. Respondents in the present study were rural youth between the age group of 15-35 yrs having a viable livelihood. A sample size of 240 rural youth was selected for the study. From each district 120 respondents were selected. The respondents were selected using proportionate random sampling method from the mandals and villages based on the rural population. Mass media utilization of the rural youth was operationalized as the degree of using various mass media sources like newspapers, radio, television, magazines and social media by the rural youth to obtain information regarding various aspects. The degree of usage was measured as regularly, occasionally and never and was scored as 3, 2, and 1 respectively.

There are a total of 5 items in the mass media utilization. The minimum score that can be obtained by a respondent was 5 and maximum score was 15. Based on the overall score obtained in all the items, respondents were categorized into low, medium and high with regard to their Mean and S.D

RESULTS AND DISCUSSION

Mass media utilization of the rural youth was the degree of usage of various mass media sources like newspapers, radio, television, magazines and social media by the rural youth to obtain latest information regarding various aspects. The degree of usage was measured as regularly, occasionally and never over 5 different mass media sources such as newspaper, radio, television, farm magazines and social media. The findings of the study were depicted in Table 1.

The frequency of utilization of the rural youth was measured as regularly, occasionally and never and scores of 3, 2, and 1 were allotted respectively. Mean score of each item was calculated and the items were ranked based on their mean score and presented in the Table 2 and graphically represented in Figure 1.

A perusal of the Table 3 depicted that three-fourth of the respondents (75.41 %) have medium level of mass media utilization, little more than one-eighth of the respondents (14.17 %) have low level of mass media utilization and only one-tenth of the respondents (10.42 %) have high level of mass media utilization.

A critical view of the above table exhibited that a lion's share of the respondents (85.83 %) had medium to high level of mass media utilization. The possible reason for this trend might be that rural youth being fervent to knew

latest information and updated details on issues in the current scenario utilize mass media in an enormous way. The present findings were in consonance with results of Chinchmalatpure *et al* (2019) and Deenadayalan (2021)

CONCLUSION

The study illuminated that majority of the respondents possessed medium level of mass media utilization. This depicts the need to further increase the utilization of different mass media sources to equip them with latest information. The levels may be improved by increasing the awareness of rural youth on the merits on increased utilization of these sources coupled with strengthened efforts of extension agencies in delivering credible and valuable information.

REFERENCES

Chaudhary R, Janjhua Y, Sharma N, Sharma D, Pathania A and Kumar K (2019). Factors determining rural youth participation in agriculture-based livelihood activities: A case study of Karsog in Himachal Pradesh. *Int J Econ Pl* **6 (2)**:85-89.

Chinchmalatpure U R and Tekale V (2019). Aspiration of rural youth towards agriculture. *Indian J Ext Edu* **55 (2):**25-30.

Deenadayalan S (2021). *Extent of participation of farm youth in Chrysanthemum cultivation*. M.Sc (Ag.) Thesis, TNAU, Coimbatore.

Kavinila M (2020). *Assessment of entrepreneurship skills among rural youth in agricultural sector*. Ph.D. (Ag.) Thesis, AC&RI, Madurai.

Mubeena M (2020). *Development of strategies for attracting rural youth towards agripreneurship.* M.Sc. (Ag.) Thesis, Acharya N G Ranga Agricultural University, Andhra Pradesh.

Varalakshmi C, Srivani N and Srinivasa Rao P (2019). An empirical study on youth perception towards entrepreneurship with reference to Vijayawada city. *Int J Adv Res* **7 (1):**12-22.

Received on 22/3/2024 Accepted on 10/4/2024

DOI : 10.5958/2349-4433.2024.00053.9

J Krishi Vigyan 2024, 12(2) : 278-284

A Genetic Interrelationships among Quantitative Characteristics in Notable Okra Genotypes

Yogesh Kumar[1*] and Udit Joshi[2]

[1]Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Ayodhya, 224229, (Uttar Pradesh), India

ABSTRACT

Okra is prominent vegetable crop cultivated in various parts of the world. In vegetable breeding there is a continuous need for identification of traits which can aid selection process. Hence, the current experiment was conducted during *Kharif* 2019 for studying the extent of the path and correlation coefficient for resolving indirect and direct effect of several characters on yield of fruit involving thirty genotypes of okra at ANDUA&T, Ayodhya, Uttar Pradesh. During study, the most crucial character i.e., yield of fruit per plant manifested high and positive phenotypic correlation with marketable yield of fruit per plant and fruit circumference while, days taken to fruit harvest, plant height and days to 50 percent flowering showed significant and negative correlation with marketable yield of fruit per plant. The highest extent of phenotypic path coefficient positive direct effect on total fruit yield per plant was applied by marketable yield of fruit per plant subsequently by branches per plant while, direct negative effects on total fruit yield was exerted by total soluble solid subsequently by plant height. Hence, it might be concluded that the choices made on the basis of traits viz., marketable yield of fruit per plant, fruit circumference, branches per plant might be more beneficial during formulating selection indices in okra breeding and advancement programmes.

Key Words: Correlation, fruit yield, genotype, okra, path coefficient, vegetable.

INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench] having chromosomes as 2n=130 is a crucial crop economically, being cultivated in sub-tropical and tropical, for its immature fruits (Mishra *et al,* 2015; Manu *et al,* 2021). Being a short duration crop, it fits well in multiple cropping systems (Ray *et al,* 2022). The cultivation of okra, which began in Ethiopia along the Nile River and was first grew by the early Egyptians in the 12th century, expanded throughout the North Africa and Middle East (Reddy *et al,* 2012). It is a crop that is frequently cross-pollinated; with outcrossing occurs to a degree of 4 to 19 percent and highest upto 42.2 percent assisted with insect driven pollination (Raval *et al,* 2019). Okra's commercial varieties and hybrids are widely accessible in the seed markets, however the majority of these are not suitable for all of the country's growing regions hence farmers face difficulty in region wise availability of the suitable germplasm (Joshi *et al,* 2020; Joshi *et al,* 2021). Any breeding programme should logically begin with evaluating the current genetic variabilities and genotypes, which generally forms the foundation of any crop development and improvement programme. Therefore, it is crucial to have a complete understanding of the complexion and level of heritability, variability, and associations between the several traits before beginning any breeding project (Kerure *et al,* 2017). An analysis of the correlation between various quantitative characteristics offers a notion of interconnection which might be successfully used for developing picking and selection plans for enhancing yield and related attributes. It would be beneficial to take into account the proportional degree of correlation of different features with yield for any efficient

Corresponding Author's Email - upyogeshkumar@gmail.com

selection plan (Raval *et al,* 2017). The values of correlation just indicate the strength and value of link among character pairs. Separating the genotypic association of component qualities into indirect and direct effects is necessary in order to execute effective selection which is performed by the path coefficient analysis (Prajna *et al,* 2015). Therefore, using path and correlation analysis, the current experiment was designed to investigate the link between traits as well as the indirect and direct effects of different yield components on yield of fruit in the cultivars and genotypes under evaluation.

MATERIALS AND METHODS

The current experiment was conducted for studying the interrelationship among characters and the extent of path coefficients analysis among 30 genotypes and cultivars of okra including three checks (Pusa Makhmali, Parbhani Kranti and Pusa Sawani) in the Randomized Complete Block Design (RCBD) with three replicates and every genotype and cultivar with three rows with spacing of 30 cm. The study was carried out in *Kharif* 2019 at Department of Vegetable Science, Main Experimental Station, A.N.D.U.A&T, Ayodhya, Uttar Pradesh, India. As recommended by Gomez and Gomez (1984), the data were determined using ANOVA (One way analysis of variance). The correlation was formulated by the method given by Johnson *et al* (1955), and the path by Dewey and Lu, 1959. The SAS was also used for statistical analysis, with means being compared using the crucial difference (CD) at 0.05. The techniques given by Ranganna (2010) were used to record the fruit's chemical properties and TSS. The characters studied under the present investigation were node to 1st flower appearance, days to 50% Flowering, plant height, crop duration, number of branches per plant, days to first fruit harvest, number of nodes per plant, total soluble solid, fruit length, fruit circumference, average fruit weight, number of fruits per plant and marketable fruit yield per plant.

RESULTS AND DISCUSSION

Correlation coefficient analysis

The genotypic and phenotypic correlation coefficient between 13 different traits is presented in Table 1. The amplitude of genotypic correlations was greater than the comparable values of phenotypic correlation coefficients, indicating a strong innate link between distinct pairs of traits. Umrao *et al* (2015) had also reported the same in their studies.

Genotypic correlation coefficient

In the case of genotypic correlation coefficient, the most significant characteristic was the total fruit yield per plant, which showed a strong positive association with the amount of marketable fruit produced per plant, followed by the fruit circumference, while, plant height, days to first fruit harvest and days to 50% flowering possessed significant negative correlation with the marketable fruit yield per plant. Fruit circumference showed a highly substantial and positive association with marketable yield of fruits per plant, while, significant and negative correlation with plant height and average fruit weight. Days to first fruit harvest, days to 50% flowering, and plant height were significantly and negatively connected with the number of fruits per plant, but extremely significantly and positively correlated with total soluble solid, number of branches per plant, and number of nodes per plant. The average fruit weight showed a substantial and negative link with the number of nodes per plant, but a highly significant and positive correlation with plant height, crop duration, and node to first bloom appearance. Likewise, Simon *et al* (2013) and Swamy *et al* (2013) also find out a strong and negative association between the number of nodes per plant and the number of days until 50% flowering. Fruit length showed a substantial and negative link; however, fruit circumference showed a highly significant and positive correlation with marketable fruit yield per plant. Fruit length showed a strong and positive phenotypic association with crop duration, but a substantial and negative link with total soluble solid and the number of branches per plant. Total soluble solid showed a substantial and negative phenotypic association with plant height, but a highly significant and positive correlation with the number of nodes per plant. The phenotypic association between the number of nodes per plant and total soluble solids was found to be highly non-significant, however the correlation between plant height and crop duration was shown to be

Table 1. Estimate of phenotypic and genotypic correlation coefficient between fourteen characters of okra germplasm.

Character		Node to 1st flower appearance	Days to 50% Flowering	Plant height (cm)	Crop duration	Number of branches per plant	Days to first fruit harvest	Number of nodes perplant	Total soluble solid (°B)	Fruit Length (cm)	Fruit circumference (cm)	Average fruit weight (g)	Number of fruits perplant	Marketable fruit yield per plant (g)	Correlation with total fruit yield per plant (g)
Node to first flower appearance	P	1.000	0.098	0.064	0.159	- 0.089	0.136	-0.101	0.035	0.058	-0.070	0.209*	0.102	0.092	0.085
	G	1.000	0.114	0.011	0.191	-0.151	0.140	-0.100	0.036	0.055	-0.042	0.252*	0.114	0.134	0.113
Days to 50% Flowering	P		1.000	0.252*	0.013	- 0.014	0.932**	-0.057	0.137	-0.119	-0.042	0.037	-0.249*	-0.158	-0.232*
	G		1.000	0.262*	0.054	0.002	0.983**	-0.059	0.142	-0.125	-0.037	0.055	-0.277**	-0.196	-0.249*
Plant height (cm)	P			1.000	0.231*	0.077	0.290**	-0.528**	-0.294**	0.105	-0.194	0.519**	-0.189	-0.357**	-0.377**
	G			1.000	0.269*	0.065	0.294**	-0.547**	-0.311**	0.105	-0.198	0.582**	-0.217*	-0.379**	-0.389*
Crop duration	P				1.000	-0.134	0.045	-0.344**	-0.159	0.234*	-0.124	0.355**	-0.048	-0.032	-0.014
	G				1.000	-0.175	0.100	-0.385**	-0.184	0.265*	-0.124	0.408**	-0.033	-0.025	-0.010
Number of branchesper plant	P					1.000	-0.043	0.117	-0.032	0.309**	-0.160	-0.069	0.323**	-0.044	0.047
	G					1.000	-0.033	0.123	-0.039	-0.325**	-0.189	-0.075	0.349**	-0.035	0.057
Days to first fruitharvest	P						1.000	-0.074	0.144	-0.078	-0.141	0.055	-0.263*	-0.161	-0.237*
	G						1.000	-0.072	0.159	-0.087	-0.142	0.072	-0.289**	-0.186	-0.259*
Number of nodes per plant	P							1.000	0.232*	-0.047	-0.028	- 0.582**	0.229*	0.033	0.048
	G							1.000	0.234*	-0.045	-0.032	-0.607**	0.236*	0.029	0.046
Total soluble solid (°B)	P								1.000	-0.220*	-0.043	-0.152	- 0.354**	0.142	-0.020
	G								1.000	-0.225*	-0.046	-0.162	-0.364**	0.140	-0.020
Fruit Length (cm)	P									1.000	-0.205	-0.006	0.038	0.059	0.090
	G									1.000	-0.208*	-0.003	0.038	0.060	0.093
Fruit circumference(cm)	P										1.000	0.037	-0.197	0.294**	0.257*
	G										1.000	0.035	-0.207	0.306**	0.267*
Average fruit weight(g)	P											1.000	-0.120	-0.241*	-0.178
	G											1.000	-0.123	-0.255*	-0.193

*, ** significant at 5% and 1% level, respectively

Table 2. Direct and indirect effects of thirteen characters on total fruit yield (g) at phenotypic and genotypic level in okra.

Character		Node to 1st flower appearance	Days to 50% Flowering	Plant height (cm)	Crop duration	Number of branches per plant	Days to first fruit harvest	Number of nodes perplant	Total soluble solid (°B)	Fruit Length (cm)	Fruit circumference (cm)	Average fruit weight (g)	Number of fruits per plant	Marketable fruit yield per plant (g)	Correlation with total fruit yield per plant (g)
Node to first flower appearance	P	0.055	-0.001	-0.017	-0.0021	-0.017	-0.006	-0.006	-0.010	0.003	0.005	0.028	-0.025	0.077	0.085
	G	0.035	0.129	-0.003	0.0002	-0.022	-0.168	-0.015	-0.013	0.001	0.012	0.063	-0.044	0.113	0.113
Days to 50% Flowering	P	0.005	-0.015	-0.066	-0.0002	-0.003	-0.042	-0.003	-0.038	-0.007	0.003	0.005	0.061	-0.133	-0.232*
	G	0.004	0.132	-0.071	0.0001	0.000	-0.183	-0.009	-0.051	-0.003	0.011	0.014	0.108	-0.201	-0.249*
Plant height (cm)	P	0.004	-0.004	-0.260	-0.0031	0.014	-0.013	-0.029	0.081	0.006	0.013	0.068	0.046	-0.299	-0.377**
	G	0.000	0.296	-0.271	0.0003	0.009	-0.354	-0.083	0.111	0.002	0.059	0.145	0.084	-0.389	-0.389**
Crop duration	P	0.009	0.000	-0.060	-0.0135	-0.025	-0.002	-0.019	0.044	0.014	0.008	0.047	0.012	-0.027	-0.014
	G	0.077	0.062	-0.073	0.0012	-0.025	-0.120	-0.058	0.066	0.006	0.037	0.102	0.013	-0.026	-0.010
Number of branchesper plant	P	-0.005	0.000	-0.020	0.0018	0.185	0.002	0.006	0.009	-0.018	0.011	-0.009	-0.079	-0.037	0.047
	G	-0.005	0.003	-0.018	-0.0002	0.145	0.040	0.019	0.014	-0.007	0.056	-0.019	-0.136	-0.036	0.057
Days to first fruitharvest	P	0.008	-0.014	-0.076	-0.0006	-0.008	-0.045	-0.004	-0.040	-0.005	0.009	0.007	0.064	-0.135	-0.237*
	G	0.005	0.113	-0.080	0.0001	-0.005	-0.204	-0.011	-0.057	-0.002	0.042	0.018	0.112	-0.191	-0.259*
Number of nodes per plant	P	-0.006	0.001	0.138	0.0047	0.022	0.003	0.055	-0.064	-0.003	0.002	-0.077	-0.056	0.028	0.048
	G	-0.003	-0.066	0.149	-0.0005	0.018	0.087	0.152	-0.084	-0.001	0.010	-0.151	-0.092	0.030	0.046
Total soluble solid (°B)	P	0.002	-0.002	0.077	0.0021	-0.006	-0.006	0.013	-0.274	-0.013	0.003	-0.020	0.087	0.119	-0.020
	G	0.001	0.160	0.084	-0.0002	-0.006	-0.192	0.035	-0.357	-0.005	0.014	-0.040	0.141	0.144	-0.020
Fruit Length (cm)	P	0.003	0.002	-0.027	-0.0032	-0.057	0.004	-0.003	0.060	0.058	0.014	-0.001	-0.009	0.050	0.090
	G	0.002	-0.141	-0.029	0.0003	-0.047	0.105	-0.007	0.080	0.021	0.062	-0.001	-0.015	0.061	0.093
Fruit circumferen ce(cm)	P	-0.004	0.001	0.051	0.0017	-0.030	0.006	-0.002	0.012	-0.012	-0.067	0.005	0.048	0.246	0.257*
	G	-0.001	-0.042	0.054	-0.0002	-0.027	0.171	-0.005	0.017	-0.004	-0.297	0.009	0.080	0.314	0.267*
Average fruit weight (g)	P	0.012	-0.001	-0.135	-0.0048	-0.013	-0.002	-0.032	0.042	0.000	-0.002	0.132	0.029	-0.202	-0.178
	G	0.009	0.062	-0.158	0.0005	-0.011	-0.086	-0.092	0.058	0.000	-0.010	0.249	0.048	-0.262	-0.193
Number of fruits per plant	P	0.006	0.004	0.049	0.0007	0.060	0.012	0.013	0.097	0.002	0.013	-0.016	-0.245	0.159	0.155
	G	0.004	-0.314	0.059	0.0000	0.051	0.348	0.036	0.130	0.001	0.061	-0.031	-0.388	0.211	0.168
Marketable	P	0.005	0.002	0.093	0.0004	-0.008	0.007	0.002	-0.039	0.003	-0.020	-0.032	-0.047	0.838	0.806**

Phenotypic residual effect = 0.264,*, ** significant at 5% and 1% level, respectively

Genotypic residual effect = 0.157,*, ** significant at 5% and 1% level, respectively

significant and negative. Days till first fruit harvest showed a non-significant and negative phenotypic association with the number of branches per plant, but a highly significant and positive link with days to 50% flowering and plant height. Plant height showed a highly significant and positive phenotypic association with crop duration, however, the number of branches and fruits per plant and the marketable yield per plant showed a non-significant and negative link. While Goswami *et al.* (2012), Patel *et al.* (2014), and Chandramouli *et al.* (2016) likewise revealed non-significant and negative connection, plant height showed a substantial and positive genotypic link with days to 50% flowering.

Phenotypic correlation coefficient

Regarding the phenotypic correlation coefficient, the data indicated that the most noteworthy attribute, the total fruit production per plant, exhibited a significant negative correlation with plant height, days to 50% flowering, and days to first fruit harvest, but a strong positive phenotypic correlation with fruit circumference and marketable yield of fruit per plant. The phenotypic association between fruit circumference and marketable fruit production per plant was found to be highly significant and positive, however there was a substantial and negative link between fruit weight and plant height. There was a substantial and negative correlation found between the number of fruits per plant, total soluble solid, days to first fruit harvest, and days to 50% flowering, and the number of branches and nodes per plant. The average fruit weight showed a substantial and negative phenotypic association with the number of nodes per plant, but a highly significant and positive correlation with plant height, crop duration, and node to first bloom appearance. Fruit length showed a strong and positive phenotypic association with crop duration, but a substantial and negative link with total soluble solid and the number of branches per plant. Total soluble solid showed a substantial and negative phenotypic association with plant height, but a highly significant and positive correlation with the number of nodes per plant. Marketable fruit production per plant was positively correlated with the number of nodes on the plant, although there was a substantial negative association with plant height and crop duration. Days till first fruit harvest showed a non-significant and negative phenotypic association with marketable fruit output per plant, number of nodes per plant, and fruit circumference, but a highly significant and positive correlation with days to 50% flowering and plant height. Plant height showed a highly significant and positive phenotypic association with crop duration, whereas fruit circumference, number of nodes per plant, and marketable fruit output per plant showed non-significant and negative correlations. In contrast to the non-significant and negative association with fruit circumference, plant height showed a highly significant and favourable phenotypic correlation with days to 50% flowering.

Path Coefficient Analysis

The path analysis (Table 2), offers a way to distinguish between the direct and indirect effects of different traits on fruit yield at the phenotypic and genotypic levels. Regarding the direct effects of phenotypic path coefficient, it was determined that marketable fruit production per plant and number of branches per plant exhibited the largest positive direct path coefficient effects on total fruit yield per plant. The remainder of the features, such as fruit weight, fruit length, number of nodes per plant, and node to first flower appearance, had relatively little positive direct effects. Likewise, Dhall *et al* (2000) found a strong positive direct relationship between the total fruit production per plant and the marketable fruit yield per plant. The total soluble solid had a significant negative direct influence on the total fruit yield per plant, followed by the height of the plant and the number of fruits per plant. The other features, such as fruit circumference, plant height, and days till first fruit harvest, had relatively little negative direct effects. Days to 50% flowering had a negative direct impact on the overall fruit output, as documented by Adiger *et al* (2011). On the other hand, it was found that the fruit circumference and flesh number of fruits per plant, total soluble salt, node to first flower appearance, and number of nodes per plant displayed indirect positive effects via marketable fruit yield per plant on total fruit yield per plant in the case of the indirect effects of phenotypic path coefficient. Plant height, on the

other hand, had a strong negative and significant indirect effect on the total fruit production per plant through the marketable fruit yield per plant. The marketable fruit yield per plant had an indirect negative impact on the total fruit yield per plant, as did the average fruit weight, the number of branches per plant, the days to 50% flowering, the days to the first fruit harvest, and the length of the crop. The average fruit weight revealed negative indirect impacts on the total fruit produce per plant through plant height.

Marketable yield of fruit per plant and average fruit weight exhibited the largest positive direct path coefficient impacts on total fruit yield per plant in the case of the direct genotypic path coefficient effect. However, the remaining characteristics i.e., number of nodes per plant, number of branches per plant, and days to 50% flowering had very little positive direct effects. The number of fruits per plant and total soluble solid had the greatest negative direct influence on the total fruit production per plant. The remainder of the features, such as fruit circumference, plant height, and days to first fruit harvest, had relatively little negative direct consequences. In contrast, fruit circumference, followed by the number of fruits on each plant, total soluble solid, the node to the first flower appearance, fruit length, and the number of nodes on each plant revealed indirect positive effects through marketable fruit yield per plant on the total fruit yield per plant in the case of the indirect path coefficient effects. Plant height, on the other hand, had a strong negative and significant indirect effect on the total fruit production per plant through the marketable fruit yield per plant. The study found that the average fruit weight, number of branches per plant, days to 50% flowering, days to first fruit harvest, and crop length had indirect negative effects on the total fruit production per plant.

CONCLUSION

It was revealed that while days to first fruit harvest, plant height, and days to 50% flowering all showed significant negative correlations with marketable fruit yield per plant, total fruit yield per plant showed a highly significant and positive correlation with both fruit circumference and marketable yield of fruit per plant. The marketable fruit yield per plant and average fruit weight had the greatest degree of positive direct path coefficient effects on the total fruit yield per plant. The number of fruits per plant and total soluble solid had the largest negative direct effect on the total fruit production per plant. Plant height, on the other hand, had a strong negative and significant indirect effect on the total fruit yield per plant through the marketable yield of fruit per plant. Therefore, it can be concluded that the characteristics that can be taken into account during breeding and selection for strong selection process include fruit yield per plant, number of fruits per plant, fruit circumference, and plant height.

REFERENCES

Adiger S, Shanthkumar G, Gangashetty P and Salimath P M (2011). Association studies in okra [*Abelmoschus esculentus* (L.) Moench]. *El J Pl Breed* **2**(4): 568-573.

Chandramouli B, Shrihari D, Rao A V D and Rao M P (2016). Studies on genetic variability, heritability and genetic advance in okra [*Abelmoschus esculentus* (L.) Monech] genotypes. *Pl Arch* **16**(2): 679-685.

Dewey D R and Lu K H (1959). A correlation and path coefficient analysis of components of crusted wheat grass seed production. *Agron J* **51**: 515- 518.

Dhall R K, Arora S K and Mamta R (2003). Studies on variability, heritability and genetic advance of advanced generations in okra [*Abelmoschus esculentus* (L.) Moench]. *J Res Punjab Agri Univ* **40**(1): 54-58.

Gomez K A and Gomez A A (1984). Statistical Proceedings for Agriculture Research (2nd edn.), *John Wiley and Sons Inc.* New York.

Goswami A, Singh B, Kumar A and Bhadana G (2012). Genetic divergence in okra [*Abelmoschus esculentus* (L.) Moench]. *Prog Agric* **12**(2): 407-411.

Johanson H W, Robinson H E and Comstock R E (1955). Estimation of genetic and environmental variability in soybean. *Agron J* **47**: 314-318.

Joshi U, Rana D K, Bisht T S and Singh V (2021). Varietal evaluation in okra for yield and yield attributing traits under mid-hill

conditions of garhwal himalayas. In: Siddiqui N A, Bahukhandi K D, Tauseef S M and Koranga N. (eds) Advances in Environment Engineering and Management.

Joshi U, Rana D K and Singh V (2020). Characterization study based on the morphology of various okra [*Abelmoschus esculentus* (L.) Moench.] genotypes. *J Emerg Tech Inn Res* **7**(5): 701-710.

Kerure P, Pitchaimuthu M and Hosamani M (2017). Studies on variability, correlation and path analysis of traits contributing to fruit yield and its components in okra [(*Abelmoschus esculentus* (L.) Moench)]. *El J Pl Breed* **8**(2): 620-625.

Manu C R, Yadav, P P I and Sathyan S (2021). Management of yellow vein mosaic disease of okra using suitable resistant varieties. *J Krishi Vigyan* **10**(1): 168-170.

Mishra A, Mishra H N, Senapati N and Tripathy P (2015). Genetic variability and correlation studies in okra (*Abelmoschus esculentus* (L.) Moench). *El J Pl Breed* **6**(3): 866-869.

Patel R, Sengupta S K and Verma A (2014). Studies on genetic parameters in okra [*Abelmoschus esculentus* (L.) Moench]. *Trends in Biosci* **7**(14): 1808- 1811.

Prajna S P, Gasti V D and Evoor S (2015). Correlation and path analysis in okra [*Abelmoschus esculentus* (L.) Moench]. *Hort Flora Res Spect* **4**(2): 123-128.

Ranganna S (2010). Handbook of Analysis and Quality Control for Fruit and Vegetable Products, Tata McGraw Hill Publishing Company Ltd., New Delhi.

Raval V, Patel A I, Vashi, J M and Chaudhari B N (2017). Correlation and path analysis studies in okra (*Abelmoschus esculentus* (L.) Moench). *Int J Chem Stud* **7**(1): 1230-1233.

Raval V, Patel A I, Vashi J M and Chaudhari B N (2019). Correlation and path analysis studies in okra (*Abelmoschus esculentus* (L.) Moench). *Acta Sci Agri* **3**(2): 65-70.

Ray S K, Debnath B, Das B and Mishra V K (2022). Early seasonal okra (*Abelmoschus esculentus*) cultivation provides better returns to farmers. *J Krishi Vigyan* **11**(1): 68-71.

Reddy M T, Haribabu K and Ganesh M (2012). Genetic divergence analysis of indigenous and exotic collections of okra (*Abelmoschus esculentus* (L.) Moench). *J Agri Tech* **8**(2): 611-623.

Simon S Y, Gashua I B and Musa I (2013). Genetic variability and trait correlation studies in okra [*Abelmoschus esculentus* (L.) Moench]. *Agric Bio. J N Am* **4**(5): 532-538.

Swamy B N, Singh A K and Sravanthi B (2013). Correlation and path coefficient analysis studies for quantitative traits in okra [*Abelmoschus esculentus* (L.) Moench]. *Env Eco* **32**(4B): 1767-1771.

Umrao V, Sharma S K, Kumar V, Kumar R, Sharma A and Kumar J (2015). Correlation and path coefficient analysis of yield components in okra [*Abelmoschus esculentus* (L.) Moench]. *Hort Flora Res Spect* **4**(2):139-143.

Received on 25/3/2024 Accepted on 16/5/2024

DOI : 10.5958/2349-4433.2024.00081.0

J Krishi Vigyan 2024, 12(2) : 285-291

Green Manuring – A Cost Effective And Farmer Friendly Alternative For Farm Yard Manure

Thulasi V, Moossa P P *Santhosh P P, Drishya D S, Nisha N S and Raji P
Regional Agricultural Research Station, Pattambi
Kerala Agricultural University

ABSTRACT

Long-term fertilizer experiments are an integral tool for comprehending how intensive cropping and continuous fertilizer application affect soil characteristics and crop performance. It paves the way for the evaluation of sustainable agriculture practices. The aim of the current study was to monitor how fertilizers and manures consistently affected the productivity of a rice-rice cropping system in a lateritic soil. *In situ* green manuring was identified as a practical and affordable technology. Integrated nutrient management with FYM and *in situ* green manuring with daincha (*Sesbania*) recorded higher grain and straw yields across years. In comparison to the plot receiving solely inorganic nutrients, the soil's organic carbon content and biological properties were higher in the 100% NPK+ FYM plot and the 100% NPK+ *In situ* green manured (daincha) plot. The economic analysis of the demonstrations in farmers' field during 2019-22 indicates the cost effectiveness of the technology.

Key Words: Farm yard manure,Fertilizer, Green manuring, Nutrient, Management.

INTRODUCTION

Long-term fertilizer studies are crucial for determining how continuous cropping and fertilizer or manure application affect crop output sustainability (Manna et al., 2007). Since the rice-rice cropping system predominates in Kerala's lateritic belts, yield, nutrient absorption, and nutrient dynamics in soil brought on by ongoing fertilizer or manure application assume significant importance for the sustainability of this cropping system. As part of the LongTerm Fertilizer Experiment (LTFE), which has been running at the Pattambi centre of the All India Co-ordinated Research Project (AICRP) since 1997, an analysis of the long-term effects of *in situ* green manuring as an integrated nutrient management technology on productivity in the rice-rice cropping system was attempted in this study.

MATERIALS AND METHODS

At the Regional Agricultural Research Station, Pattambi, Kerala Agricultural University, the current study was conducted to track the long-term impacts of fertilizer and organic manures on production after completion of 25 cycles of rice-rice system in the lateritic soil. The usual lateritic soil in the area has a pH in the acid range. One of the 18 LTFE centers throughout the nation, the Long Term Fertilizer Experiment (LTFE) Pattambi Centre was established in Kerala in 1997. It followed a rice- rice cropping system with rice variety Aiswarya in RBD with 12 treatments such as T1-50% NPK of 90:45:45 (kg N: P_2O_5:K_2O per

Plate 1 *In situ* green manuring using daincha

Corresponding Author's Email - thulasi.v@kau.in
* Sreekrishna College Guruvayoor

Table 1. The effect of long term application of nutrient management practices on grain and straw yields of rice.

Treatment	Yield (kg/ha)	
	Grain yield	Straw yield
T1 (50% NPK)	2811	3341
T2 (100% NPK	3472	4041
T3 (150% NPK)	4104	4707
T4 (100% NPK+Lime)	3770	4263
T5 (100% NPK)	3515	3993
T6 (100% NP)	2974	4015
T7 (100% N)	2175	3135
T8 (100% NPK+FYM)	4650	5562
T9 (50% NPK+FYM)	3713	4678
T10 (100% NPK+ Daincha)	4256	5228
T11 (50% NPK+ Daincha)	3453	4198
T12 (Absolute control)	2141	2384
CD (0.05)	493.6	484.2

ha) (KAU recommendation), T2-100%NPK, T3-150% NPK, T4-100%NPK +600 kg lime, T5-100%NPK, T6-100%NP, T7-100%N, T8-100%NPK +FYM@5 t/ha in *Kharif* season, T9-50%NPK + FYM@5 t/ha in *Kharif* season, T10-100%NPK+ in situ green manuring in *Kharif* , T11-50%NPK + *in situ* green manuring in *Kharif* and T12-Control with 4 replications. On December 2, 2020, the LTFE plot's Kharif crop for the 2020–21 growing season was manually harvested, and grain yield and straw yield were noted. Field-collected soil samples were examined for urease activity (Bremner and Douglas, 1971) and soil organic carbon (Walkley and Black technique). The approach outlined by Eivazi and Tabatabai (1977) and Tabatabai and Bremner (1970) was used to determine the phosphatase activity. By using the chloroform fumigation and extraction procedure, the amount of microbial biomass carbon in the soil was calculated (Jenkinson and Powlson, 1976). According to the method published by Casida and coworkers (1964), dehydrogenase activity was evaluated colorimetrically using a spectrophotometer with triphenyl tetrazolium chloride extraction and triphenyl formazan estimation.

To popularise the technology of *In situ* green manuring using daincha, demonstrations on the ground were held in the fields of farmers in padasekharams (long stretch of paddy fields), and an economic analysis was done.

RESULTS AND DISCUSSION

During the *kharif* and *rabi* seasons, there was a noticeable impact of treatments on grain output.

The data (Table 1) showed the impact of continuous use of various nutrient management techniques on the grain yield and straw yields of rice harvested during the virippu crop of 2020. The results showed that the treatments' differences in grain yield ranged between 2141 and 4650 kg/ha. The treatment T8 (100% NPK+FYM) greatly outperformed all other treatments, and its mean yield was comparable to that of the treatment T10 (100% NPK + in situ growth of *Sesbania aculeata*). It was noted that the continuous application of organic manures and inorganic fertilizers greatly enhanced rice grain production compared to the control. The treatments in LTFE that used Integrated Nutrient Management techniques had greater grain yields. The physical,

Table 2. The effect of long term application of nutrient management practices on biometric parameters of rice.

Treatment	Plant height (cm)	No. of tillers/ hill	No. of panicles/ hill	No. of seeds/ hill	Weight of the panicle (g)	Test weight (1000 seed weight in g)
T1 (50% NPK)	96.8	10.56	10.50	830	2.02	25.53
T2 (100% NPK	96.9	10.53	10.07	950	2.55	26.57
T3 (150% NPK)	104.6	11.50	11.07	1075	2.6	26.17
T4 (100% NPK+Lime)	103.9	10.83	10.40	1019	2.53	25.57
T5 (100% NPK)	106.4	10.53	9.77	941.3	2.47	25.63
T6 (100% NP)	105.6	9.8	9.20	706.7	1.81	22.87
T7 (100% N)	94.4	8.16	6.97	699.7	2.29	22.77
T8 (100% NPK+FYM)	111.9	11.73	10.77	1149	2.98	26.60
T9 (50% NPK+FYM)	104.3	10.86	10.00	856.7	2.20	25.40
T10 (100% NPK+ Daincha)	102.8	12.36	11.37	1054	2.41	25.80
T11 (50% NPK+ Daincha)	97.2	10.83	10.37	896	2.21	25.23
T12 (Absolute control)	93.2	7.96	7.60	548.7	1.61	21.5
CD (0.05)	7.61	0.941	0.73	128.8	0.278	0.916

chemical, and biological qualities of the soil are improved by organic manures, ensuring a balanced supply of nutrients and a healthier environment for plant growth. According to the statistics, rice had a grain yield that varied from 2141 to 4650 kg/ha. The T8 treatment, which administered 100% NPK+FYM, had the highest yield. Under treatments for integrated nutrient management that included in situ green manuring and FYM, crop yields were discovered to be comparable. The soil gained an extra 21.25 kg/ha of N, 7.4 kg/ha of P, and 22.05 kg/ha of K from the integration of 5 t FYM, whereas the soil gained 136.9 kg/ha of N, 22.61 kg/ha of P, and 47.83 kg/ha of K from the seeding of daincha seeds at 12.5 kg/ha and their subsequent biomass incorporation. In a study by Vinodkumar et al. (2017) on the impact of integrated nutrient management on rice yield and its lasting effects on wheat in lowland rice-wheat systems, the highest grain and straw yields (45.04 and 72.0 q/ha) were significantly recorded. These yields were followed by 75% RDF as inorganic fertilizers as well as green manuring of sunhemp *in situ* incorporated in alternate years and 100% RDF. A similar positive effect of INM was also reported in the LTFE maintained at Pattambi (Thulasi *et al*, 2020). Straw yields of the LTFE experiments followed the same trend as the grain yields with respect to the treatment effects. The highest straw yield was recorded by the treatment involving 100 per cent NPK and FYM @ 5 t/ha. This treatment was shown to be comparable to treatment T10, which involved cultivating *Sesbania aculeata in situ* and using 100% NPK. Combining the use of organic manures with inorganic fertilizers has been shown to increase straw yields while decreasing nitrogen losses through the formation of organic mineral complexes that assure continuous supply of N to rice plants.

According to the results (Table 2), there was a substantial difference between various treatments in terms of biometric characteristics. It was found that treatments using combined application of inorganic fertilizers and organic manures had high values for all plant growth metrics. In comparison to the treatments using only inorganic fertilizers, the treatments T8 and T10 were generally better.

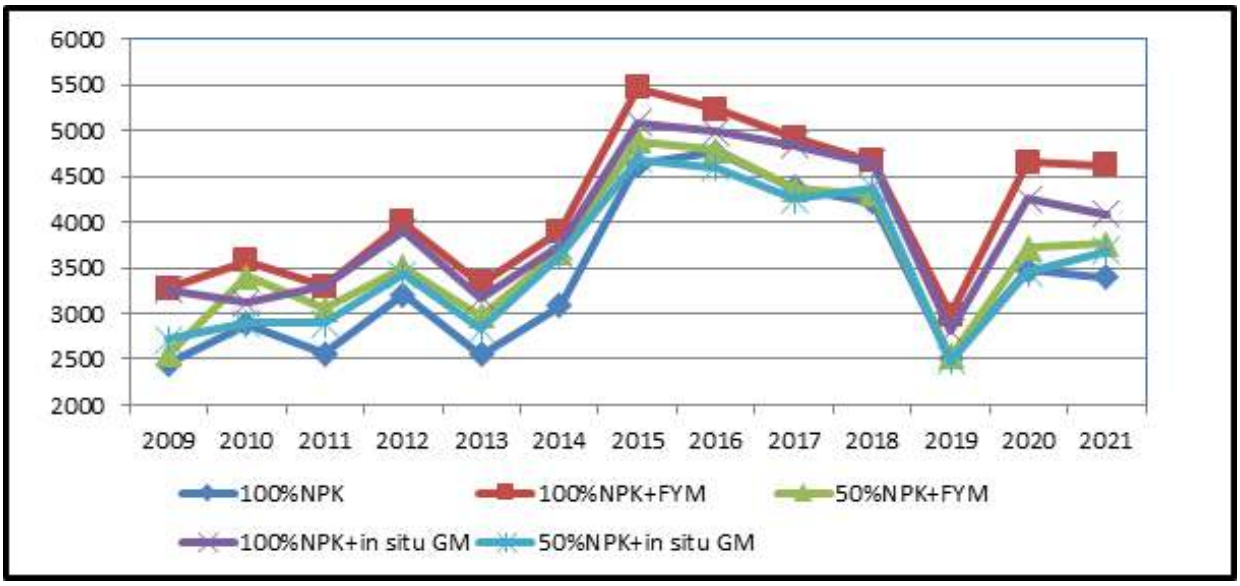


Fig 1 Grain yield (kg/ha) under LTFE at Pattambi over years

Between treatments, there was a considerable variation in the number of panicles per hill. In treatment T7, 100% N alone was administered, the least amount of panicles were seen on each hill. The absolute control (T12), in which no fertilizers or manures were applied, came next. The development and quantity of productive tillers were facilitated by the quick release of nitrogen from fertilizers and the increased soil physical, chemical, and biological qualities brought about by the application of organic manures (Thulasi *et al,* 2022; Dhillon and Singh , 2019)

From the graph with the yield data over years presented below (Fig 1), it was evident that *in situ* green manuring (Daincha) is recognized and popularised as a practical and farmer-friendly method. The graph displays the average Paddy grain yield throughout the course of years (averaged for *kharif* and *rabi*).

The crop yields under in situ green manuring and integrated nutrient management were found to be comparable. Green manure seeds were sown and integrated *in situ* to minimise cultivation costs relative to the field application of FYM, making the crop more economically viable (Beena *et al*, 2002). A frequently used method for managing soil health in terms of the addition of organic matter, *in situ* green manuring using Dhaincha yields an average of 35 mt of green matter per hectare.

Effect of *in situ* green manuring on soil organic carbon and biological properties

The percentage of organic carbon in soil that was determined after 25 years of continuous cropping using the Walkley and Black technique, as reported by Jackson in 1973, varied from 1.19 to 1.96 between the treatments.

Soil organic carbon

The analysis of the enzyme activity and soil organic carbon demonstrated the superiority of the INM treatments. The 100% NPK+ FYM plot and the 100% NPK+ *In situ* green manure (daincha) plot had greater soil organic carbon contents (%) than a plot that only received inorganic nutrients. It was in accordance with the finding of Brar *et al.* (2000) and Beena *et al*. (2002). Thus, it was evident that the enrichment of soil organic carbon by organic manures led to an improvement in soil quality. However, the 100% NPK+ FYM plot saw more of the beneficial effects of organic manuring than the 100% NPK + *In situ* green manured plot. Moreover, the 50% NPK+FYM plot's soil had less organic carbon than the 100% NPK+FYM plot. This showed unequivocally that the use of inorganic fertilizers also helped to increase soil organic carbon, one of the key indicators of soil quality.

Enzyme activities

The dehydrogenase enzyme, which is

Table 3. The effect of long term application of nutrient management practices on soil biological properties.

Treatment	Total SOC (%)	Microbial biomass C (µg/g soil)	DHA ((µg TPF hydrolysed g-1 soil s 24 hr-1)	Urease (g-1 soil hr-1)	Acid phosphatase (µg p-nitrophenol g-1 soil hr-1)	Aryl sulfatase (µg p-nitrophenol g-1 soil hr-1)
T1 (50% NPK)	1.56	211.5	160.7	172.0	19.94	9.048
T2 (100 % NPK)	1.59	233.3	137.8	242.1	18.15	8.885
T3 (150% NPK)	1.68	270.5	132.7	274.2	17.54	8.170
T4 (100% NPK+ lime)	1.49	269.7	209.5	285.4	23.65	10.423
T5 (100% NPK)	1.57	233.8	143.8	252.5	19.56	8.815
T6 (100% NP)	1.51	219.1	182.7	183.5	17.56	9.135
T7 (100% N)	1.41	214.8	146.7	199.0	16.89	8.105
T8 (100% NPK+ FYM)	1.96	319.0	302.6	303.7	33.17	11.22
T9 (50 % NPK+ FYM)	1.71	299.8	286.9	271.7	28.27	10.02
T10 (100% NPK+ in situ GM)	1.82	291.5	286.3	285.4	26.87	10.12
T11 (50% NPK+ in situ GM)	1.73	278.9	227.9	192.0	27.50	10.05
T12 (Control)	1.19	193.6	201.4	155.4	14.86	8.020
CD (0.05)	0.169	16.86	19.55	15.09	2.294	0.735

known to oxidise soil organic materials, is a frequently used indication of biological activity in soil. The soil's dehydrogenase activity ranged from 132.7 g TPF hydrolyzed/g soil/24 hr in the plots that received 150 percent NPK (T3) to a maximum value of 302.6 g soil/24 hr in the plot that received 100 percent NPK+FYM. According to Shikha Verma *et al*. (2022), the introduction of an inorganic nitrogen source promoted the development of bacteria that used the natural pool of organic carbon as a substrate for dehydrogenase. In our study, it was shown that when inorganic fertilizer treatment levels increased from 50% NPK to 150% NPK, the activity of the dehydrogenase enzyme reduced. The soil's dehydrogenase activity was boosted by applying lime with 100% NPK. The dehydrogenase activity was boosted in several treatments when inorganic fertilizers and organic manures were applied together (Sumayya, 2017). In treatments that combined the use of organic manures and chemical fertilizers, there was an increase in urease activity. This could be because the healthy microbial community in soil contributes large quantities of urease. The soil's urease activity was likewise enhanced by the treatments using higher doses of inorganic nitrogen fertilizer. The treatment T12 (absolute control), which used no fertilizers or manures, reported the lowest level of urease. The phosphatase activity of soil varied from 14.86 to 33.17 µg p-nitrophenol /g soil /hr. The treatment T12 (absolute control) showed the lowest degree of phosphatase activity. In the rice-rice cropping system, various nutrient management techniques had a stronger influence on soil quality, notably on biological metrics. These soil enzymes were the important parameters for soil quality assessment.

Microbial biomass carbon

The transformation of nitrogen, phosphorus, sulphur, potassium, calcium, magnesium, manganese, and zinc into forms that plants can utilise depends on the microbial biomass. The MBC of the soil is greatly influenced by the management practices in LTFE soil. The treatment

Table 4. Net profit per hectare per year (B:C ratio) over three years

Year	100% NPK	100%NPK+5t FYM	100% NPK+ *in situ* green manuring
2019-20	88500 (1.59)	118750 (1.67)	129750 (1.89)
2020-21	99840 (1.66)	139040 (1.78)	148450 (2.01)
2021-22	119291 (1.79)	150647 (1.84)	181470 (2.23)

T8 (100% NPK+FYM) had the greatest amount of microbial biomass carbon in the soils, which was 295.2 g/g. This treatment was determined to be comparable to the treatment T10 (100% NPK + *in situ* growth of *Sesbania aculeata* (for Virippu crop). Nikhil (2013) and Sumayya (2017) both reported similar results.

***In situ* green manuring identified as a cost effective technology in farmers' fields**

Technology demonstrations were conducted in farmers' fields also during 2019-2022. *In situ* green manuring with daincha was identified as the most appropriate technology for substituting farm yard manure addition in soils of Kerala.

CONCLUSION

Long term fertilizer experiments provide an opportunity to evaluate the sustainability of agricultural practices. The maintenance or improvement of important soil fertility parameters, such as soil organic carbon, nutrient availability, etc., as well as steady or growing crop yields over time would be proof of sustainability in continuous rice production systems. Since the rice-rice cropping system predominates in Kerala's lateritic belts, changes in the soil's physical, chemical, and biological characteristics as well as its ability to absorb nutrients are crucial to the long-term viability of this cropping system. *In situ* green manuring with daincha produced improved grain and straw yields and was selected as a cost-effective and farmer-friendly method in long-term fertilizer studies and demonstrations in farmers' fields.

REFERENCES

Shikha Verma, Agarwal, B K, Mahapatra, Shahi, D K, Singh, C S., Pragyan Kumar, Arvind Kumar, Reshma Shinde and Jai Prakash Kumar (2022) Long term effect of fertilizers, manure and lime on biological health of an acid soil *Ann Plant Soil Res*. **24**(2):208-215

Beena C, Balachandran P V and Veena Vidyadharan (2002) *In situ* green manuring-a substitute for FYM in low land rice cultivation. Proceeding of the national symposium “Priorities and

strategies for rice research in high rainfall tropics" RARS Pattambi. 10-12 Oct. 2002

Brar BS, Randhawa P S, Chhina H S and Dhillon N S (2000). Long term effect of organic and inorganic fertilizers on sustaining crop yield and soil health presented in Symposium-Sustainable agricultural production in the 21st century, held at New Delhi, Feb.14-18 2000.

Bremner J M and Doglas L A (1971). Inhibition of urease activity in soils. *Soil Biol. Biochem*. **3** (4): 297-307.

Casida Jr L E, Klein D A and Santoro T (1964). Soil dehydrogenase activity. *Soil Sci*. **98** (6): 371-376.

Dhillon Iqbal Singh Didar(2019). Effect of integrated nutrient management on productivity and economics of rabi onion *(Allium cepa* L.) *J. Krishi Vigyan* **8** (1): 87-91

Eivazi F and Tabatabai M A (1977). Phosphatases in soils. *Soil Biol. Biochem*. **9**(3): 167-172.

Jackson M L (1973). Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi.

Jenkinson D S and Powlson D S (1976). The effects of biocidal treatments on metabolism in soil-V: a method for measuring soil biomass. *Soil Boil. Biochem*. **8**(3):209-213.

Manna M C, Swarup A, Wanjari R H and Mishra B (2007). Long term fertilization, manure and liming effects on soil organic matter and crop yields. *Soil Till. Res*. **94**: 397-409.

Nikhil K (2013). *Biological profile of ferralitic alluvial paddy soils under long term differential fertilizer application*. M.Sc.(Ag) thesis, Kerala Agricultural University, Thrissur, 112 p.

Sharma A R and Mittra B N (1988). Effect of green manuring and mineral fertilizer on growth and yield of crops in rice-based cropping on acid lateritic soil. *J Agric Sci*. **110** (3): 605-608.

Sumayya Sulaiman (2017). *Sequestration of carbon as influenced by nutrient management practices under long term fertilizer experiments*. M. Sc (Ag) thesis, Kerala Agricultural University, Thrissur.

Tabatabai, M.A. and Bremner, J.M. (1970) Arylsulfatase Activity of Soils. Soil Sci Soc Am J 34, 225-229

Thulasi V, Moossa P P and Muneshwar Singh (2020). Rice growth and yield under twenty years of cropping in a long term fertilizer in central laterites of Kerala. *Asian J. Soil Sci.* **15** (1):41-45.

Thulasi V, Moossa P P AND Sumayya S(2022). *Effect of continuous application of nutrient management options on crop yields in rice-rice cropping system J. Krishi Vigyan* **10** (2) : 88-93

Vinodkumar T, Kumar Singh G and Singh R A (2017). Effect of integrated nutrient management on yield of rice and its residual effect on wheat in rice-wheat system under lowland. *Ann. Plant Soil Res*. **19**(4):360-365.

Received on 27/3/2024 Accepted on 20/5/2024

DOI : 10.5958/2349-4433.2024.00054.5

J Krishi Vigyan 2024, 12(2) : 292-295

Growth and Yield Attributes of Tomato during Off-Season

Vanlalliani* **and C Lalfakawma**
Krishi Vigyan Kendra, Lawngtlai District, Lawngtlai - 796891, Mizoram, India

ABSTRACT

Tomato is one the world's most used and popular vegetable crops. It is one of the vegetables with its highest production in Mizoram and growers used as a source of income due to its cash value nature. Tomato variety Arka abhed is a high yielding F_1 hybrid with multiple disease resistance to tomato leaf curl disease, bacterial wilt, early blight and late blight. It is suitable for summer, *kharif* and *rabi* cultivation. Unlike other part of the country, Mizoram receives a high rainfall during monsoon which leads to higher incidence of foliar and fruit rot diseases in tomato. As such, these diseases incidence resulted in low crop productivity and affects the farmers' income during off-season. Therefore, KVK Lawngtlai District is taking up cultivation of multiple disease resistant tomato variety Arka abhed during off-season (May - September) to help the farmers increase tomato production with higher rates. A field experiment was conducted at different locations during 2020-23 as off season crops with an objective to determine the growth and yield attributes of tomato during off season. The present result indicates that indeterminate tomato type can produce high fruit yield during off season.

Key Words: Yield Attributes, Off Season, Summer Tomato.

INTRODUCTION

The tomato (*Lycopersicon esculentum* Mill.*),* a member of the family Solanaceae and belonging to the relatively small genus *Lycopersicon* is one of the most important vegetable crops grown throughout the world. The leading tomato growing countries in the world are the China, India and Turkey. In India, tomato has become the leader of all the vegetable crops in terms of commercialization of fresh production, utilization in processing and hybrid seed production. Tomato production is increasing every year. According to the F.A.O (2023) report tomato is produced worldwide on an approx. 5.05 million hectares land with fruit production of 186.82 million metric tonnes per year.

Production of tomato can provide higher incomes, and reduce malnutrition (Ferdous *et al*, 2016; Weinberger, 2013). It can be grown on a small scale in the kitchen garden, where a few plants yielding fruits for the whole family and a commercial scale as a cash crop by the vegetable growers (Gentilcore, 2010). Growing vegetables during the off-season has a lot of prospects for export in foreign countries as well as a good earn by the farmers. Among different off-season vegetables, tomato has prime importance as its demand persists throughout the year. It is also the most important horticultural crop worldwide (FAO, 2006; Brown *et al,* 2005).

In Mizoram, the demand for tomato is constantly high throughout the year and cultivated in an area of 2.8 ha with a total production of 27.10 tonnes (Anonymous, 2023). However, the production is limited during off-season months, particularly in extreme dry (February-March planting) months or wet (June-July planting) months in Mizoram. Tomato production is high during the cooler months (October to February), which is the regular growing season. Keeping in view the impact of cultivation of off-season summer tomato on the economic returns, a field demonstration was conducted in Lawngtlai District.

MATERIALS AND METHODS

The present experiment was carried out by Krishi Vigyan Kendra, Lawngtlai District during *Kharif* season at three farmers' fields in three locations namely, Chawnhu, Lawngtlai and Bualpui NG. The treatments comprised of T_1 technology demonstrated (Arka abhed) and T_2 farmers' practice (Arka rakshak). The total

Corresponding Author's Email - vielm2011@gmail.com

Table. Growth and Yield Performance of Arka abhed and Arka rakshak during Off-Season.

Parameter	T_1 Technology demonstrated (Arka a bhed)	T_2 Farmers' Practice (Arka r akshak)	SE (m)	$CD_{0.05}$	CV
No. of Fruits/plant	58	46	1.225	8.024	4.079
Fruit Weight (g)	98.1	92.4	0.636	4.169	1.157
Plant Height (cm)	110	123	1.633	10.698	2.428
Yield (q/ha)	144	134	1.080	7.076	1.346
Crop Duration (Days)	120	138	2.550	16.702	3.423
Net return (Rs.)	6,33,198	2,88,358	-	-	-
BC Ratio	6.8:1	3.6:1	-	-	-

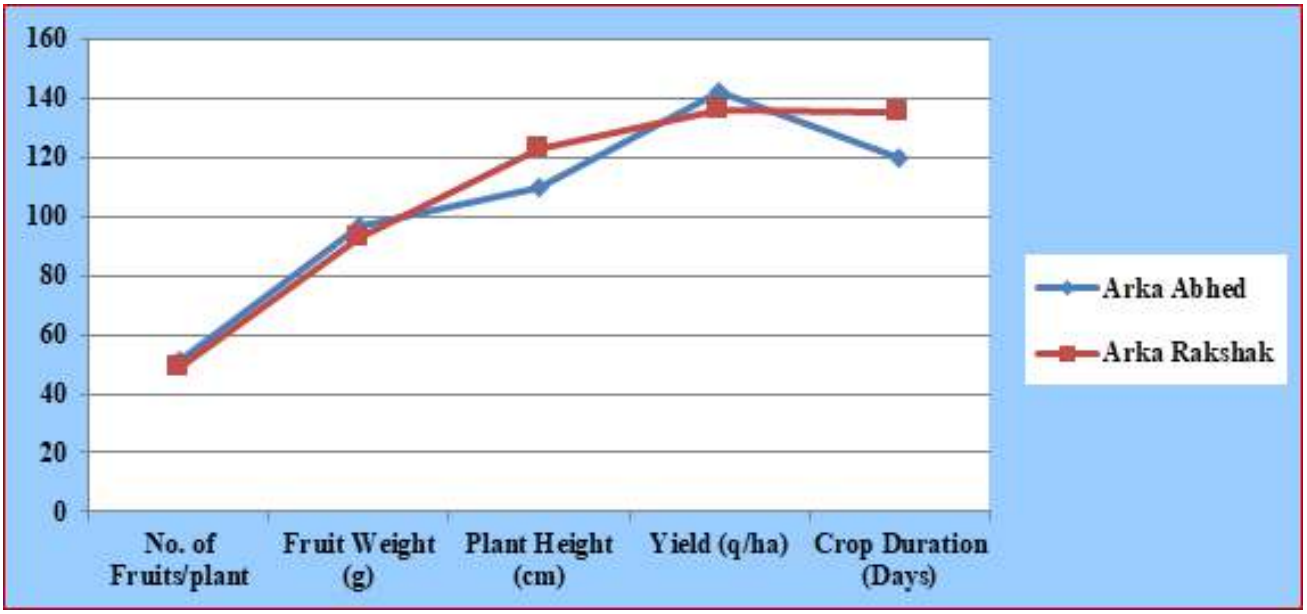


Fig.: Growth & Yield Performance of Arka abhed & Arka rakshak during Off-Season

experimental area was 0.1 ha having sandy loam soil. The tomato seeds were purchased from IIHR, Bangalore, India through online seed portal. Other inputs such as fertilizers and plant protection chemicals for nursery soil and planting materials treatment were purchased from local store *i.e.,* Tuallawt Enterprise, Lawngtlai, Mizoram.

Tomato nursery was raised at experimental field itself during May. The nursery bed was treated with Chlorpyriphos and Carbendazim as a prophylactic measures before sowing. The tomato seedlings were ready for transplanting after 21 days from sowing. Pits were prepared in the field at a spacing of 45 cm between plants and 60 cm between rows. Before transplanting the pits were thoroughly prepared by filling with well decomposed farmyard manure and insecticide and fungicide were sprayed. Transplanting was done during June. All the agronomic and plant protection measures were followed as per the package of practices. All the observations were recorded from 20 randomly selected plants. Economic analysis such as cost of cultivation (Rs/ha) was calculated considering the prevailing charges of agricultural operations and market price of inputs involved. Gross returns were obtained by converting the harvest into monetary terms at the prevailing market rate during the course of studies. Gross return (Rs/ha) = (fruit yield x price), Net returns were obtained by deducting cost of cultivation from gross return. The benefit: cost ratio was calculated by dividing Gross returns (Rs/ha) and cost of cultivation (Rs/ ha).

RESULTS AND DISCUSSION

The number of fruits per plant recorded in Arka abhed was 58 whereas 46 in Arka rakshak. The fruit weight was found to be 98.1 g and 92.4 g in Arka abhed and Arka rakshak, respectively. Arka abhed and Arka rakshak recorded plant height of 110 cm and 123 cm, respectively. Different responses to plant height might be due to genetic characteristic of genotypes and adaptability to a particular environment (Khan *et al,* 2013). The fruit yield of Arka abhed (144 q/ha) was comparatively higher than Arka rakshak (134 q/ha). The potential yield of the genotypes during rainy season often depends on their tolerance or resistance to particular diseases and pests. More yields in different genotypes may be due to optimum plant survival, which ultimately contributed significantly towards final yield (Khan *et al,* 2013). The performance of a cultivar mainly depends on interaction of genetic makeup and environment. The crop duration of 120 and 138 days were observed in Arka abhed and Arka rakshak, respectively.

It is necessary to know the economics of the experiment as no technology can be suggested while not knowing its profit and loss (Sadique Rahman *et al,* 2020). It can be seen that higher net return was obtained in Arka abhed as compared to farmers' practice or Arka rakshak. The data revealed that Arka abhed tomato recorded higher net monetary returns (Rs 6,33,198/-) than Arka rakshak (Rs 2,88,358/-). The higher benefit cost ratio was obtained with treatment Arka abhed (6.8) as compared to Arka rakshak (3.6). Due to higher income off-season tomato growers were able to spend more on consumption. Ali *et al* (2017) indicated that off-season tomato cultivation is profitable. Karim *et al* (2009) also indicated that off-season tomato growers were able to increase their socioeconomic status due to higher income.

CONCLUSION

It could be concluded that appropriate management of tomato from nursery stage till harvest with variety selection could be practiced to increase the yield and quality of tomato plant during off season. Thus, Tomato (Arka abhed variety) growers around the study area can be benefited if they cultivate during off season (May-September). It may be concluded that among the two varieties studied, Arka abhed was found to obtain superior quality attributes with higher net return and benefit cost ratio than Arka rakshak, thereby making it suitable for cultivation during off-season. Efforts are needed to disseminate the off-season tomato cultivation technique to different parts of the country. Cost of production is higher for off-season tomato cultivation compared to winter season tomato cultivation.

REFERENCES

Ali Q, Ashfaq M and Khan M T I (2017). An economic analysis of off-season tomato production in Punjab. *The J Anim Pl Sci* **27**(1): 294-301

Anonymous (2023). Department of Agriculture and Farmers Welfare. CEIC Data.

Brown P, Lumpkin T, Barber S, Hardie E, Kraft K, Luedeling E, Rosenstock T, Tabaj K, Clay D, Luther G, Marcotte P, Paul R, Weller S, Youssefi F and Demment M (2005). Global Horticulture Assessment. ISHS. Gent-Oostakker, Belgium.

FAO (2006). Agricultural data FAOSTAT. Food and Agriculture Organization of the United Nations. Rome, Italy from "Gautam I P, Khatri B and Paudel G P (2006). Evaluation of Different Varieties of Onion and Their Transplanting Times for Off-Season Production in Mid Hills of Nepal. Nepal Agric Res J 7:21-26" "Evaluation of Different Varieties of Onion and Their Transplanting Times for Off-Season Production in Mid Hills of Nepal" as "Evaluation of different varieties of onion and their transplanting times for off-season production in Mid Hills of Nepal."

FAO (2023). World Food and Agriculture - Statistical Yearbook 2023. Rome. https://doi.org/10.4060/cc8166en

Ferdous J, Datta A, Anal A K, Anwar M and M R Khan A S M (2016). Development of home garden model for year-round production and consumption for improving resource-poor household for food security in Bangladesh. *NJAS-Wagen J Life Sc* **78**:103–110. doi: 10.1016/j.njas.2016.05.006.

Gentilcore D (2010). *A History of the Tomato in Italy*. Columbia University Press. pp 25-31

Karim M R, Rahman M S and Alam M S (2009). Profitability of summer BARI hybrid tomato cultivation in Jessore district of Bangladesh. *J Agri and Rural Dev* **7**(1&2):73-79. DOI: 10.3329/jard.v7i1.4424

Khan T N, Ramzan A, Jillani G and Mehmood T (2013). Morphological performance of peas (*Pisum sativum*) genotypes under rainfed conditions of Potowar region. *J Agric Res* **51**(1): 51-59

Sadique Rahman Md, Manjira S, Majumder M K and Rahman S (2020). Socio-economic determinants of off-season summer tomato cultivation. *Int J Veg Sci* **27**(3), 252–259. DOI: 10.1080/19315260.2020.1771503

Weinberger K (2013). Home and community gardens in southeast Asia: Potential and opportunities for contributing to nutrition-sensitive food systems. *Food Secur*ity **5**:847–856. doi: 10.1007/s12571-013-0299-z.

Received on 16/2/2024 Accepted on 25/4/2024

DOI : 10.5958/2349-4433.2024.00055.1

J Krishi Vigyan 2024, 12(2) : 296-303

Growth Performance of Black Bengal Goats by Feeding Different Levels of Mustard Oilseed Cake

M K Das[1*], J K Chatterjee[2], B Das[1] and K Paul[1]

[1]Krishi Vigyan Kendra Jalpaiguri, West Bengal University of Animal and Fishery Sciences, Ramshai, Jalpaiguri- 735219, West Bengal, India.

ABSTRACT

Black Bengal Goat farming business in one of the most profitable and promising entrepreneurship venture for rural youths and livestock farmers in Jalpaiguri district. The goat farmers make their earnings through trading of castrated male goats. However, they normally do not include mustard oilseed cake in the feed of these goats to enhance their body weight. This study included twenty-four (24) randomly selected Black Bengal castrated male goats from the farmer's field of uniform age and weight. The objective of the study was to find out the effect of four types of formulated concentrate feeds containing varying proportions of mustard oilseed cakes (MOC) on average body weight growth of goats. Four groups T1, T2, T3 and T4 based on MOC inclusion level (0%, 12%, 18% and 24%) in formulated concentrate feed were prepared. The goats were fed the feed for 90 days period. The consumption of prepared feed was significantly ($p \leq 0.05$) higher (205.36 g/ day) in T3 group than other groups. The dry matter intake (DMI) during the study period was increased in T1, T2, and T3 groups but decreased for the T4 group with no significant variation. Daily Crude Protein Intake (CPI) and total live weight gain were found significantly ($p \leq 0.05$) higher in T3 group of goats. The result explained that the Black Bengal castrated goats might have better body weight gain average when fed with 18% mustard oilseed cake included in specific concentrate mixture.

Key Words: Black Bengal goats, Body weight, Concentrate feed, Mustard oilseed Cake, Growth.

INTRODUCTION

Goat farming stands as the predominant livestock rearing practice among rural farmers across India, spanning various socio-economic classes. Integral to a sustainable rural economy, goat husbandry plays a crucial role in providing affordable nutrition, serving as an important source of protein. Goats constitute a significant portion of India's total livestock population, accounting for 148.88 million, or 27.70%, as per 20th Livestock Census in 2019. In West Bengal alone, the total goat population amounts to 16.30 million, with the Black Bengal goat comprising nearly 51% of this figure.

Goat farming holds significant importance as it provides essential resources such as milk, meat, skin, and manure, fulfilling crucial human needs. In developing countries, it serves as a vital tool in poverty alleviation and offers A sustainable source of income for rural communities and landless farmers (Hassan *et al,* 2007, Singh *et al,* 2016, Mahfuz *et al,* 2018). In Jalpaiguri district, goat farming is primarily conducted by marginal and small farmers, with land holdings which usually range from 0.05 to 1 ha. On average, each family owns 2 to 3 castrated male goats. However, the escalating market price and demand for Black Bengal goat meat are driving unemployed rural youths and livestock farmers towards goat farming as a means of livelihood and entrepreneurship development. Major part of profit through goat husbandry comes from trading of castrated male goats. The most of the farmers in this district rear their castrated male goats primarily through free grazing, supplemented with only a small amount of concentrate feed provided by a minority of farmers. However, this practice often prolongs the

Corresponding Author's Email - das.manasvet2011@gmail.com

1Krishi Vigyan Kendra Jalpaiguri, West Bengal University of Animal and Fishery Sciences, Ramshai, Jalpaiguri- 735219, West Bengal, India.

2Dept. of Animal Science, Palli Siksha Bhavana, Visva Bharati Biswavidyalaya, Bolpur- 731204, West Bengal, India.

Table 1. The composition of experimental concentrate mixtures (per 100 kg basis).

Sr. No.	Ingredient	C1 (0% MOC)	C2 (12% MOC)	C3 (18% MOC)	C4 (24% MOC)
1	Crushed Maize	42	31	28	28
2	Wheat bran	26	26	24	25
3	Rice bran	28	27	26	19
4	Mustard Oilseed Cake	0	12	18	24
5	Salt	02	02	02	02
6	Mineral mixture	02	02	02	02
	Total	100 kg			

time required for castrated male goats to reach marketable weight, thereby delaying returns for the farmers.

Inadequate feed availability round the year through grazing is another limiting factor for shortfalls in animal production level in sub tropical region of India. Rashid *et al* (2016a) also reported goats which are reared on natural browsing only cannot fulfill their nutrient requirements for growth and productivity. Ferdous *et al* (2011) reported relying solely on grazing may not be adequate for achieving weight gain in goats. They suggested that supplementing with concentrates proportionately according to the dry matter could enhance goat productivity. Tiwari et al. (2015) also revealed that protein content in ruminant diets is critical for their growth and productivity. Mustard oilseed cake (MOC) is an easily accessible and protein-rich feed option for animals.

Mustard oilseed cake contains 30-35% oil and 34-39% crude protein (CP), with a reasonable balance of essential amino acids and a comparatively high methionine concentration (Kumar et al., 2002). Mustard oilseed cakes are frequently utilized in the diet of cattle by the farmers of Jalpaiguri district but the report of feeding of Mustard oilseed cake in goats is not available.Considering this scenario, the current study aimed to explore the impact of incorporating varying levels of protein through inclusion of Mustard Oilseed Cake (MOC) in concentrate feed. The research focused on assessing the growth performance of castrated Black Bengal male goats to determine the most suitable level of MOC inclusion for achieving optimal feeding outcomes and enhancing production efficiency.

MATERIALS AND METHODS

Area of study

The study was conducted at one adopted village of Jalpaiguri KVK at Salbari area (26.5615° N, 89.0830° E) of Dhupguri block in Jalpaiguri district. Eight resourceful farmers from this village which were randomly selected on the basis of criteria who were having required castrated male goats. These farmers were provided proper training to develop the skill for participation in this experiment.

Experimental animals

Twenty four Black Bengal castrated male goats (approximately 7- 9 m of age weighing at an average 10.25 ± 0.76 kg) were taken under study. These castrated goats were physically sound and out of any kind of sickness and were maintained in their respective farms under similar housing and other managerial practices. Using a complete randomized design, these animals were divided randomly and equally into four groups with 6 animals in each group each, based on the diet they were permitted to consume. The goats were tagged through neck and were properly dewormed with anthelmintics before vaccination with PPR vaccines. The experimental animals were allowed to stride for exercise in a fenced area for 2-3 hours during day time.

Concentrate mixture formulation

The concentrate mixture used as experimental diet was prepared by mixing proportionate amount of maize, wheat bran, rice bran, mustard oilseed cakes, salt and mineral mixtures designed to incorporate varying (0%, 12%, 18% and 24% inclusion) levels of Mustard Oilseed Cake (MOC). These prepared concentrate mixtures were iso-energetic with difference in their crude protein value. The composition of

Table 2. The chemical composition of local feed components and Napier grass

Feed ingredient	DM	g/ 100 gm DM (Mean ± SD)				
		OM	CP	CF	EE	TA
Crushed Maize	90.48 ± 0.89	96.34 ± 0.81	8.86 ± 0.58	2.52 ± 0.37	4.59 ± 0.66	2.83 ± 0.72
Wheat Bran	86.87 ± 0.65	94.72 ± 1.20	16.52 ± 0.95	10.64 ± 1.17	3.27 ± 0.59	5.56 ± 0.94
Rice bran	87.90 ± 0.83	89.72 ± 2.62	10.87 ± 0.76	5.25 ± 0.57	4.87 ± 0.79	9.89 ± 0.66
Mustard Oilseed Cake	90.57 ± 1.47	90.61 ± 1.59	33.28 ± 1.14	10.28 ± 0.45	9.65 ± 0.84	9.63 ± 1.67
Napier grass	25.37 ± 0.34	91.21 ± 1.98	8.34 ± 0.73	30.41 ± 1.15	2.37 ± 0.34	9.87 ± 1.17

prepared experimental concentrate mixtures is provide in following (Table 1).

Experimental diet

The goats involved in the research were equally and randomly divided into four treatment groups T1, T2, T3 and T4. The experimental concentrate mixtures namely C1, C2, C3 and C4 were given to the goats of each treatment group for their intake in the order at the rate of 3% average body weight. The goats were also allowed to take ad lib. Hybrid Napier grass along with concentrate mixtures (Rashid *et al,* 2016a).

The goats under study were allowed to stall fed twice a day with ad lib. napier grass during day time. The experimental diet was offered 50 % after first forage feeding in day time and the rest 50% was offered after 4 pm when they returned to their respective sheds after their exercise. Individual separate feeders for both roughages and concentrates were used for each goat. These castrated goats were allowed to adapt with the experimental feeds for 7 days prior to initiation of the trial.

Observation recording

After seven days of adaptation period the left over feeds in the feeders for all treatment groups were recorded on next morning for estimation of daily feed intake during 90 days trial period. The goats' body weights were recorded in the morning before the feeding trials began, and their body weights were measured each day in the morning before feeding. The dry matter (DM), organic matter (OM), crude protein (CP), crude fibre (CF), ether extract (EE) and total ash (TA) in the trial feed mixtures were determined using proximate analysis (AOAC 2004) and the avaerage was recorded for data.

Statistical analysis

The experimental data of body weights with feed intake and other relevant data were critically analyzed using SPSS version 23. The difference among groups was then calculated by one-way ANOVA analysis in completely randomized design (Snedecor and Cochran, 2004). The levels of significance were defined at $p \leq 0.05$.

RESULTS AND DISCUSSION

Chemical composition of the green forage and prepared concentrate feed

The result of proximate analysis of the locally accessible feed ingredients utilized for preparing the concentrate mixtures is provided in (Table 2).

Analysis of Treatment Diets

These four treatments category of concentrate mixtures during the trial was formulated based on the studies reported by Ullah *et al* (2009), Khandaker *et al* (2011) and Rashid *et al* (2016b). In these studies the formulated experimental diets were iso-energetic with different CP content for observing the effect of CP on performance and digestibility of goats and cattle as well.

The analyzed mean proximate values of the prepared concentrate mixtures have been presented in (Table 4). The price of raw materials like crushed maize, wheat bran, rice bran, mustard oil cake, salt and mineral mixture used for preparing the concentrate feed were Rs. 28.00, Rs. 34.00, Rs. 12.00, Rs. 38.00, Rs. 10.00 and Rs.

Table 3. Chemical composition of formulated concentrate mixture (% DM basis)

Particular	Concentrate mixtures (Mean ± SD)			
	C1	C2	C3	C4
DM (g/100gm)	85.20 ± 2.23	85.24 ± 1.56	85.34 ± 2.10	85.49 ± 1.24
OM ((g/100gm)	90.21 ± 1.52	89.59 ± 1.86	89.35 ± 1.88	89.45 ± 1.12
ME (MJ/ Kg. DM)	11.66 ± 1.14	11.69 ± 1.28	11.53 ± 1.11	11.24 ± 1.74
CP (g/ 100 gm DM)	11.06 ± 2.09	13.89 ± 1.75	15.15 ± 1.94	16.51 ± 1.84
CF (g/ 100 gm DM)	5.29 ± 1.25	6.20 ± 1.79	6. 47 ± 1.36	6.83 ± 1.57
EE (g/ 100 gm DM)	4.14 ± 1.87	4.75 ± 1.34	5.07 ± 1.36	5.34 ± 1.66
TA (g/ 100 gm DM)	5.40 ± 0.87	6.15 ± 0.94	6.43 ± 1.71	6.37 ± 1.48
Cost (Rs./ kg)	30.40	32.36	32.40	32.56

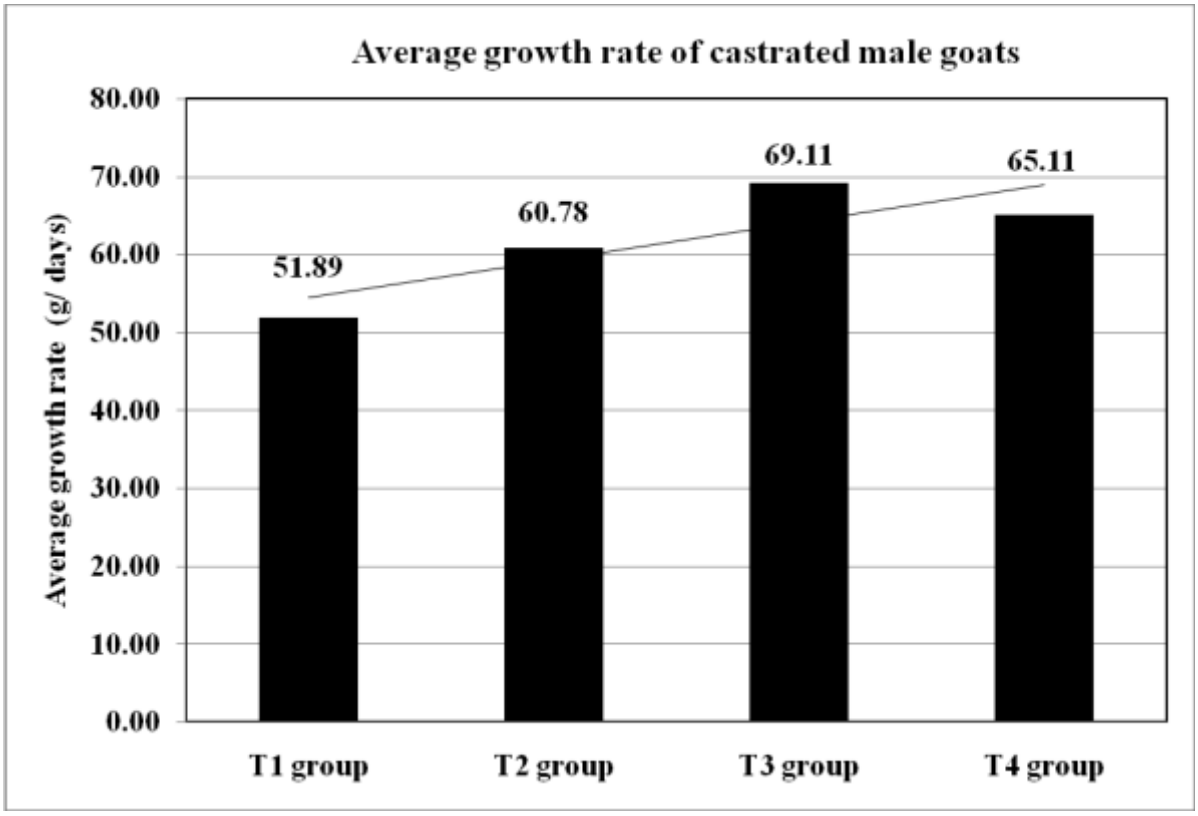


Fig 1.Average Growth rate (g/ day) of Castrated Black Bengal male goats

200.00 per Kg respectively. The average cost of prepared concentrate mixtures was found to be Rs. 31.93 per kg.

The estimated DM, CP, CF, EE and Total Ash value of different ingredients like crushed maize, wheat bran, rice bran, mustard oilseed cake (MOC) which were used for preparing the concentrate feed mixture in this experiment were much close to the reports of Mahfuz *et al* (2018), Tiwari *et al* (2015), Sarker *et al* (2015), Sultana *et al* (2012) & Moniruzzaman *et al* (2002). Tiwari *et al* (2015) reported high CP value in mustard oilseed cake along with lower DM, CF and TA. The present data of Napier grass (Table 3) in this study was similar to the results of Mahfuz *et al* (2018). The noticed effect of the study showed a few minor changes in some parameters that may be expected due to the effect of geographical location, climate and other environmental factors.

Growth performance of castrated male goats

The dry matter intake (DMI) by the goats in those four trial groups, the final live weight of these castrated goats along with their total live

Table 4. Feed intake and growth performance of the castrated male goats.

Parameter	Dietary Treatment groups				Level of Significance @ 0.05
	T1	T2	T3	T4	
Mean Initial live weight (Kg)	10.30 ± 0.72	10.26 ± 0.83	10.24 ± 0.95	10.21 ± 0.78	NS
Final live weight (Kg)	14.97 ± 1.25	15.73 ± 1.86	16.46 ± 1.43	16.07 ± 1.64	NS
Total Live weight gain (Kg)	4.67 ± 0.33^{c}	5.47 ± 0.68^{b}	6.22 ± 0.32^{a}	5.86 ± 0.26^{b}	*
Average Live Weight gain (g/ day)	51.89 ± 2.75^{d}	60.78 ± 2.76^{c}	69.11 ± 3.28^{a}	65.11 ± 3.14^{b}	*
Concentrate Feed Intake (g/ day)	165.69 ± 11.62^{c}	179.35 ± 14.87^{b}	205.36 ± 15.98^{a}	182.68 ± 12.84^{b}	*
Fodder grass intake (Fresh) (g/ day)	1258.63 ± 164.24	1241.87 ± 137.27	1239.65 ± 163.41	1236.42 ± 158.23	NS
Dry Matter Intake (DMI) (g/ day)	460.48 ± 25.31	467.93 ± 15.56	489.75 ± 20.34	469.85 ± 18.74	NS
Total Dry Matter Intake (90 days) (TDMI) (Kg)	41.44 ± 2.74	42.11 ± 2.15	44.08 ± 3.25	42.29 ± 3.17	NS
Dry Matter intake from grass (g/ day)	319.31 ± 12.65	315.06 ± 14.47	314.50 ± 13.74	313.68 ± 15.24	NS
Dry matter intake from concentrate feed (g/ day)	141.17 ± 10.35^{c}	152.87 ± 9.54^{b}	175.25 ± 12.30^{a}	156.17 ± 11.65^{b}	*
Crude Protein Intake (g/ day)	42.24 ± 2.14c	47.52 ± 4.25^{b}	52.78 ± 3.87^{a}	51.95 ± 4.14^{b}	*
Total Crude protein Intake (Kg)	3.80 ± 0.12	4.28 ± 0.34	4.75 ± 0.45	4.68 ± 0.26	NS

Different Superscript within a row indicates significant variation (p≤ 0.05)

weight gain (90 days) and average live weight gain (g/ day) is illustrated in (Table 4). The result showed significant (p≤ 0.05) variation of the gain in total live weight among the four treatment groups. The maximum growth in weight was observed for T3 group followed by T4, T2 and T1 groups. The average live weight gain (g/ day) of the goats for four treatment dietary groups was presented in figure 1. The growth rate of the goats in different groups depicted increasing pattern from T1 to T3 treatment groups. Although the growth rate of T4 group of goats was higher than T1 and T2 group, yet it was lesser than T3 treatment group that might be due to higher intake of crude protein and dry matter intake of T3 dietary cluster goats than others.

The average live weight gain for castrated Black Bengal male goats in present study was found higher than results reported by Ullah *et al,* (2009) and Ferdous *et al,* (2011). Kumar *et al,* (2002) reported significantly higher (p≤ 0.05) daily and total body weight gain with 50% mustard oilseed cake replacement in concentrate mixture in growing lambs. The present study also confirmed the reports according to Rashid *et al,* (2016b) that higher weight gain average for Black Bengal goats was found significantly high (P≤ 0.01) due to standard and high energy diets.

Dry Matter Intake (DMI) and Crude Protein intake (CPI)

The concentrate feed intake (g/day), fresh fodder grass intake (g/ day), DMI from grass (g

/day) and from prepared concentrate feeds (g/day), total DMI for 90 days (kg) along with Crude Protein Intake per day (g/day) and Total crude protein intake (Kg) for different treatment groups were presented in (Table 4) above. The total dry matter intake in this experiment was found to be 4.02, 4.10, 4.30 and 4.14% (DM% of live weight) for these Black Bengal castrated goats under T1, T2, T3 and T4 treatment groups respectively. There was significant ($p \leq 0.05$) variation among treatment diets for DMI from concentrate feed (g/day). The highest DMI from concentrate feed (g/day) was found for T3 group with 18% MOC inclusion that may be because of the enhanced palatability and flavor with improved acceptability of feed. The highest Dry matter intake from concentrate feed for different treatment diets by Black Bengal goats found in this trial was nearly similar to the findings of Ullah *et al* (2009) and Tiwari *et al* (2015). The DMI from fodder roughage was found closely similar to the findings of Rashid *et al* (2016b) but the same differed from the result reported by Ullah *et al* (2009) and Tiwari *et al* (2015). The TDMI found in this experiment for four types of concentrate feed for different treatment diets was found almost similar to the findings of Ullah *et al* (2009), Sultana *et al* (2012) and Rashid *et al* (2016b) but it was found less than the results reported by Kumar *et al* (2002) and Tiwari *et al* (2015).

The significant variation in Crude protein intake observed in the study might be because of the presence of different CP content in the formulated dietary mixtures. However highest CPI found for T3 group (with CP content 15.15 ± 1.94 g/ 100g DM) of animals might be due to enhanced palatability and flavor of the feed for better feed preferences among other formulated feeds. Similar reports of daily crude protein intake for Black Bengal goats were reported by Ullah *et al* (2009) and Rashid *et al*(2016a). The non significant variation in Total CPI might be due to a fewer days of feeding period of the animals. Feeding of the same to the Black Bengal castrated goats for a longer period might bring significant variation in Total CPI. Ullah *et al*(2009), Sultana *et al* (2012) and Mahfuz *et al* (2018) found a lower crude protein intake, whereas Tiwari *et al* (2015) reported higher occurrence of daily CPI in Black Bengal goats.

Feed and protein conversion efficiency

The best feed conversion efficiency (FCE) was found to be 7.09 ± 0.66 for T3 dietary group of goats followed by T4 (7.22 ± 0.71), T2 (7.70 ± 0.54) and T1 (8.87 ± 0.87) dietary groups. The best Protein conversion efficiency (PCE) was also found highest in T3 dietary group of goats (0.76 ± 0.012) followed by T2 (0.78 ± 0.009), T4 (0.80 ± 0.006) and T1 (0.81 ± 0.004) dietary groups. Feed conversion efficiency indicated that feeding of optimum crude protein through concentrate feed along with more DMI intake from both forage and feed may increase the feed conversion efficiency (FCE) and protein conversion efficiency (PCE) as well. The result also showed 18% inclusion of MOC in concentrate feed had excellent effect on FCE and PCE for the Black Bengal castrated goats. Similar report of FCE and PCE was found by Mahfuz *et al* (2018), whereas similar PCE was reported by Sultana *et al* (2012) in Black Bengal Goats. The higher FCE was reported by Rashid *et al* (2016a) and Sultana *et al* (2012) in goats.

CONCLUSION

The present experiment revealed that there was significant variation ($P \leq 0.05$) in average growth rate, total live weight gain, concentrate feed intake, dry matter intake from concentrate feed and daily crude protein intake by the Black Bengal castrated goats for different treatment groups. These traits were observed highest in T3 group of animals which were provided with C3 concentrate mixture with 18% mustard oilseed cake inclusion. Therefore, it may be suggested that the castrated Black Bengal male goats fed with ad lib. Napier grass and concentrate mixture made with 18% mustard oilseed cake inclusion at the rate of 4% of its average body weight may improve the average growth rate and total live weight gain of the animals.

ACKNOWLEDGEMENT

The authors of this manuscript are grateful to the support and responsiveness of the adopted farmers of Salbari area of Dhupguri block, Jalpaiguri district for their tireless effort to get field

data and the lab technician at Jalpaiguri KVK for providing all kind of technical and mechanical support for proximate analysis of the concentrate feeds.

REFERENCES

All India Report of 20th Livestock Census (2019). Department Of Animal Husbandry & Dairying (Animal Husbandry Statistics Division. Government of India, Ministry of Fisheries, Animal Husbandry & Dairying,)

AOAC (2004). *Official Methods of Analysis* (13th edition). Association of Official Analytical Chemists. Washington, D.C.

Ferdous M R, Khan M J, Rashid M A and Kamruzzaman M (2011). Effect of different levels of concentrate supplementation on the performance of Black Bengal goat. *Bangladesh J Anim Sci* **40**: 40-45. doi:10.3329/bjas.v40i1-2.10789.

Hassan M M, Mahmud S M N, Islam S K M A and Miazi O F (2007). A comparative study on reproductive performance and productivity of the Black Bengal and crossbreed goats at Atrai, Bangladesh. *Univ J Zool Rajshahi University* **26**: 55-57. doi:10.3329/ujzru.v26i0.699.

Khandaker Z H, Uddin M M, Sultana M S T N and Peters K J (2012). Effect of supplementation of mustard oil cake on intake, digestibility and microbial protein synthesis of cattle in a straw-based diet in Bangladesh. *Trop Anim Health Prod* **44**:791–800. doi:10.1007/s11250-011-9969-z.

Kumar G K A, Panwar V S, Yadav K R and Sihag S (2002). Mustard cake as a source of dietary protein for growing lambs. *Small Rum Res* **44(1)**:47–51. doi:10.1016/S0921-4488(02)00034-2.

Mahfuz S U, Islam M SD, Chowdhury M R, Islam S, Hasan MK and Uddin M N (2018). Influence of concentrate supplementation on production and reproduction performance of female Black Bengal goat. *Indian J Anim Res* **52(5)**:735-739. doi: 10.18805/ijar.v0iOF.8485.

Moniruzzaman M, Hashem M A, Akhter S and Hossain M M (2002). Effect of feeding systems on

feed intake, eating behavior, growth, reproductive performance and parasitic infestation of black bengal goat. *Asian Australas J Anim Sci* **15**: 1453-1457. doi:10.5713/ajas.2002.1453.

Rashid M A, Khan M J, Khandoker M A M Y, Akbar M A and Monir M M (2016)a. Study on the effect of feeding different levels of energy in compound pellet on performance of growing black bengal goat. *J Agri Vet Sci* **9.2(II)**: 43-50. doi: 10.9790/2380-09224350.

Rashid M A, Khan M J, Khandoker M A M Y and Monir M M (2016)b. Feeding different forms of ration including compound pellet and performance of growing black bengal goat. *J Agri Vet Sci* **9.5(I)**: 01-08. doi: 10.9790/2380-0905010108.

Sarker A K, Saha D, Begum H, Zaman A and Rahman M M (2015). Comparison of cake compositions, pepsin digestibility and amino acids concentration of proteins isolated from black mustard and yellow mustard cakes. *AMB Express* **5**:22. doi:10.1186/s13568-015-0110-y.

Singh P K, Bhat A S, Ganai A M, Sarkar T K, Khan H M and Isalm R (2005). Effect of substitution of groundnut cake with mustard cake on the growth performance and nutrients utilization of corriedale lambs. *Anim Nutr Technolo* **5**: 163-170.

Singh S, Pathak A K, Khan M and Sharma R K (2016). Effect of tanniferous leaf meal mixture based multi nutrient blocks on nutrient utilization and biochemical profile of *Haemonchus contortus* infected goats. *Indian J Anim Res* **50 (5)**: 725-732. doi: 10.14202/vetworld.2015.572-579.

Snedecor G W and Cochran W C (2004). *Statistical Methods*. 8th Edition. Oxford and IBH publishing company, Kolkata, India.

Sultana S, Khan M J, Hassan M R and Khondoker M A M Y (2012). Effects of concentrate supplementation on growth, reproduction and milk yield of Black Bengal goats (Capra hircus). *The Bangladesh Vet* **29(1)**: 7 –16. doi:10.3329/bvet.v29i1.11884.

Tiwari M R, Ghimire R P, Adhikari D, Adhikari D P and Ghimire S H (2015). Response of heat treated mustard cake feeding on growth performance of growing female goats in fodder-based basal diet. *Nep J Agri Sci* **13**: 14-20.

Ullah M B, Islam K M S, Akbar M A, Khaleduzzaman A B M and Debi M R (2009). Effect of levels and sources of protein on the performance and nutrient digestibility in Black Bengal goat. *Bangladesh J Anim Sci* **38 (1&2)**: 53 – 60. doi:10.3329/bjas.v38i1-2.9912.

Received on 7/5/2024 Accepted on 20/5/2024

DOI : 10.5958/2349-4433.2024.00056.8

J Krishi Vigyan 2024, 12(2) : 304-309

Impact of Technological Interventions on Doubling Farmer's Income in Hingoli District

P P Shelke* and Atul M Murai
Krishi Vigyan Kendra, Hingoli (Maharashtra)

ABSTRACT

Hingoli district is in Marathwada region of Maharashtra state. The district has 4,24,589 ha area in *Kharif* season spread over 610 villages, however it reduces to 18,739 ha in *Rabi* Seasons with 101 villages. The major crops of the district are soybean, turmeric, cotton, pigeon pea and gram. The district suffers from various natural calamities like climate change, flood, droughts and non-seasonal rainfall, changes in temperature, urbanization, and fragmented land holding. For resolving above problems in agriculture there is need to commercialize agriculture, change is farming system, cropping pattern and adoption of allied agricultural related activities to ensure an all-round development of farming families and improving standard of living of farmers in Hingoli district. Keeping in view the above, 110 farmers were selected in nineteen villages of Kalamnuri, Aundha Nagnath and Hingoli block of the district for intervention under doubling farmer's income during 2020-2021. The data were collected using a well-structured and pretested interview schedule by covering all dimensions. The study reflected that a total of 71.82 per cent of respondents were middle aged (36 to 55 yrs), while 92.73% of respondents were male. The respondents were having middle school (41.82) % to 10th standard education levels (34.55%), 34.55 % had marginal land holding (less than 1.0 ha), 44.55 per cent had medium to high net income (Rs. 62162/-224900/-) per annum. It was noticed that income from field crop increased by 182.24% due to technological interventions with the contribution of 47.95% in additional income.

Key Words: Impact, Technological, Intervention , Farmers Income

INTRODUCTION

Agriculture is backbone and primary source of livelihood for both men and women in India. The agriculture can be considered as a system where crop is grown, and other enterprise are compatible and complementary with each other. The farming system includes all components of land such as soil, crop, livestock, water, insect, labour, and other resources. The district has 424589 ha area in *Kharif* season spread over 610 villages, however, 18739 ha in Rabi season under 101 villages. The average annual rainfall received in district is about 908 mm. The climate of region is hot and dry with temperature ranging from 11.2 °C to 41.6 °C. The district suffers from various natural calamities like climate change, flood, droughts and non-seasonal rainfall, changes in temperature, population explosion, urbanization and fragmented land holding in rural areas. The Krishi Vigyan Kendra, Hingoli is working in district to provide need-based information to farmers and to bring sustainable development. The sector specific interventions in 2016-2020 conducted by KVK Hingoli are detailed below.

Sector Specific Interventions Conducted by KVK Hingoli

Field crops

Introduction and Adoption of the integrated farming system has enhanced crop productivity in Hingoli district. KVK has introduced KDS-726 and JS-335 varieties for soybean, BDN-716 and BDN-711 for Pigeon pea, Phule Vikram and JAKI-9218 for chickpea. For management of wilt disease in chickpea was emphasized by treating them with Bio Capsules. Pheromone traps, bird perches, and pod borer pheromones are included in integrated pest management packages. Broad bed furrow method in soybean was popularized to increase yield, maintain plant population, and soil moisture.

Corresponding Author's Email - kvkhingoli@gmail.com

Table 1. List of selected villages for study.

Sr. No	Village Name	Taluka	Respondents	Sr. No.	Village Name	Taluka
1.	Kurtadi	Kalamnuri	48	11.	Yedud	Aundha Nagnath
2.	Warud	Kalamnuri	29	12.	Bhosi	Kalamnuri
3.	Baur	Kalamnuri	9	13.	Dandegaon	Kalamnuri
4.	Waranga	Kalamnuri	5	14.	Kandli	Kalamnuri
5.	Tondapur	Kalamnuri	3	15.	Dongarkada	Kalamnuri
6.	Bhategaon	Kalamnuri	2	16.	Salapur	Kalamnuri
7.	Wanjola	Hingoli	2	17.	Shenodi	Kalamnuri
8.	Ankhali	Aundha Nagnath	1	18.	Tondapur Tanda	Kalamnuri
9.	Rupur	Aundha Nagnath	1	19.	Yedshi	Kalamnuri
10	ShiradShahapur	Aundha Nagnath	1			

Table 2. Profile of Doubling Farmers' Income.

Sr. No	Variable	Category	Frequency	Per cent
1.	Age (Years)	Young (Up to35)	16	14.55
		Middle (36 - 55)	79	71.82
		Old (56 and above)	15	13.63
2.	Sex	Male	102	92.73
		Female	08	7.27
3.	Education	Primary School (I to IV Std.)	11	10.00
		Middle School (V to X th)	46	41.82
		High School (XI to XII th)	38	34.55
		Graduate (Above XII th)	15	13.63
4.	Land Holding	Marginal (<1.0 ha)	39	35.45
		Small (1-2 ha)	38	34.55
		Medium (2-4 ha)	16	14.55
		Large (>4 ha)	17	15.45
5.	Net Income 2016	Low (Up to 62161.86)	41	37.27
		Medium (62162 -224900)	49	44.55
		High (224901.86 and above)	20	18.18
6.	Net Income 2021	Low (Upto177149.69)	45	40.91
		Medium (177145 -605882)	43	39.09
		High (605883.69 and above)	22	20.00

Table 3. Level and Change in household Income.

Crops and enterprises	Net income (Rs/household at current prices)		Increase in income. (%)	Share in total. income (%)		Share in additional income (%)
	2016-17	2020-21		2016-17	2020-21	
Field crops	154036	228000	182.84	64.62	58.06	47.95
Horticulture	61091	118669	41.10	25.63	30.23	37.33
Livestock	4245	16276	204.18	1.78	4.15	7.80
Farm and non - farm enterprises	18990	29672	142.34	7.97	7.56	6.92
Overall	245605	558349	210.96	100	100	100

Horticultural Crops

For doubling of farmer's income, introduction of sequence cropping system with short duration vegetables crops was done. Similarly, conducted front line demonstrations of turmeric varieties Salem, IISR Pratibha, and Bhima Shakti of onion. Integrated Nutrient Management practice such as spray formulation "IIHR turmeric special," (micronutrient mixture) in turmeric, "vegetable special" in tomato and "banana special," integrated Pest and Diseases Management for management of rhizome fly, white grub, and rhizome rot in turmeric. Swapping out chickpea for rajma and encouraging muskmelon to be covered with crop cover was done.

Animal Husbandry

Management of animal health for improving quality & productivity of milch animals through Integrated Dairy Management was done. To overcome the problems of fodder scarcity, establishment of fodder cafeteria of improved varieties Phule Jayant, Yashwant, DHM-lucerne, berseem, Maize etc. Rearing and demonstration of improved goat breed (Osmanabadi), Cow (Gir), Poultry (Giriraj/Vanraj/Gram Priya). Encouraging farmers to adopt balanced nutrient management through enrichment of fodder, silage making and azolla.

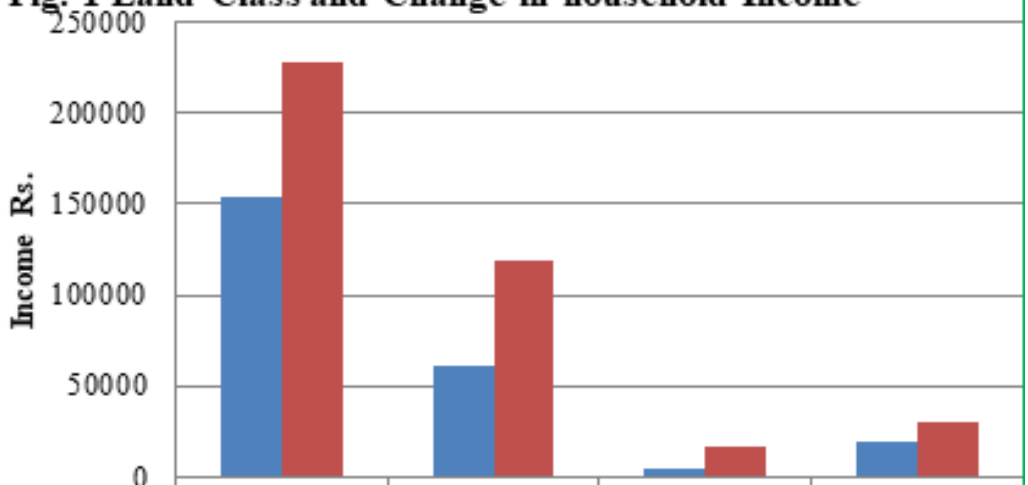
Farm and Non-Farm Enterprises

Production of soybean seeds. Encourage the self-help group in the community to get involved in activities that will generate cash and jobs, such as producing papad, making turmeric powder and preparing items made from millets. Kitchen gardening contributes to food security for households. Raise awareness and show off a solar conduction dryer for vegetables.

MATERIALS AND METHODS

The present study was conducted in Hingoli district of Marathwada region of Maharashtra. The Hingoli district comprises of 5 blocks namely Hingoli, Kalamnuri, Sengaon, Aundha Nagnath, Basmat from these Kalamnuri, Aundha Nagnath and Hingoli blocks selected purposively. Thus, 110 KVK farmers were selected from nineteen villages for the study. The data were collected using a well-structured interview schedule and analysed by using various statistical tools and methods.

Fig. 1 Land Class and Change in household Income



	1	2	3	4
Net income 2016-17	154036	61091	4245	18990
Net income 2020-21	228000	118669	16276	29672

RESULTS AND DISCUSSION

The study revealed that a total of 71.82 per cent of respondents were middle age (36 to 55 yrs), while 92.73% of respondents were male. The respondents were having middle (41.82) % to matric education levels (34.55%), 34.55 % had marginal land holding (less than 1.0 ha), 44.55 percent had medium to high net income (Rs. 62162-224900/-) per annum.

Impact on Household Income and change in household income by land class.

It was seen that technological interventions contributed 47.95% of the additional income from field crops, increasing it by 182.24%. In contrast, crop income from horticulture increased by 41.10 per cent, with a portion of additional income of 37.33%, income from animal component of 204.18%, and additional income of 7.80%. However, there was a 142.34% rise in income and a 6.92% share of additional income in farm and non-farm enterprises.

The use of varietal demonstration, adoption of integrated agricultural systems, introduction of new varieties, and the application of integrated pest management techniques in crops could be the cause. The income of farmers increased by 41.10% in horticulture crops, and their share of the additional income increased by 37.33%. On the other hand, the raising and breeding

It was revealed from Table 3. 35.45 % is share in total household of Marginal farmers (4 ha) and 14.54% Medium (2-4 ha) is share in total household income, respectively. As observed in change in household income 182.36 % in Marginal farmers followed by 172.15Medium, 166.81Small and 165.48 % change in household income of large farmers.

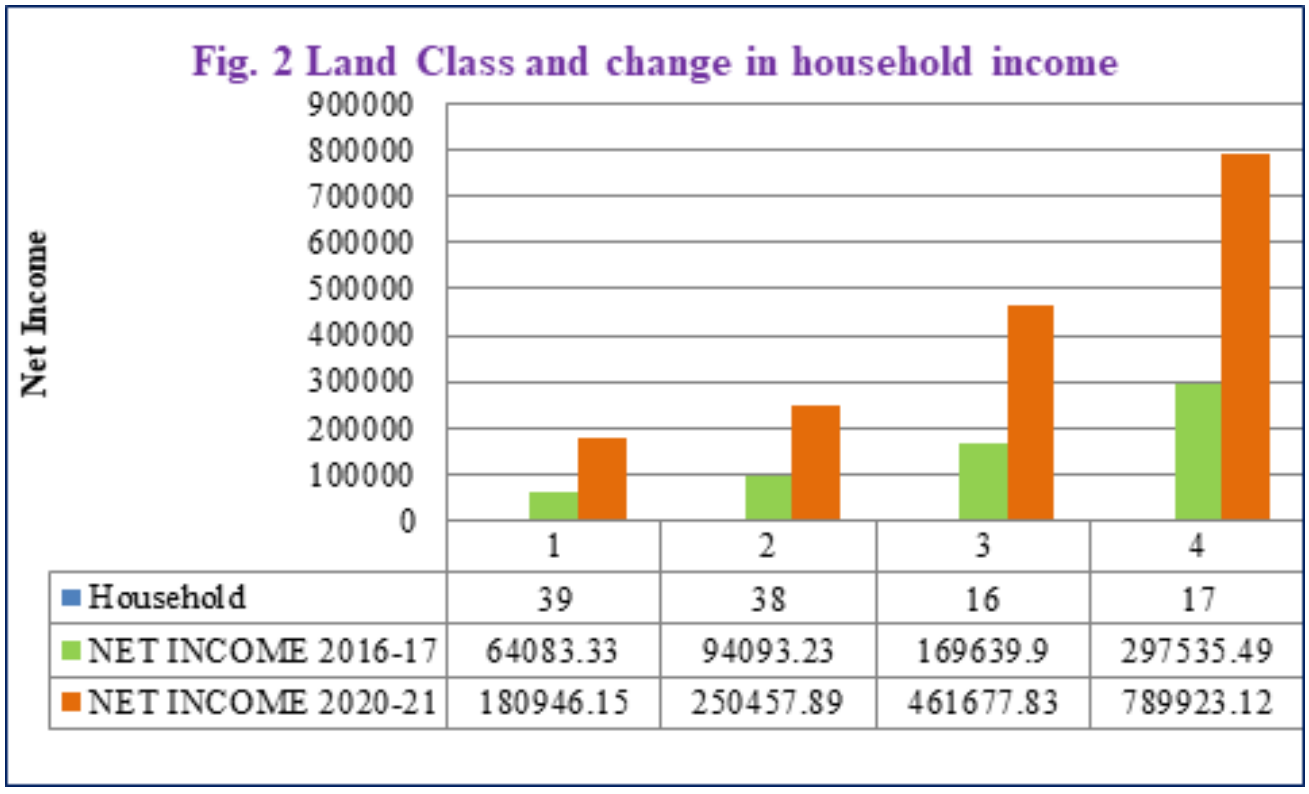
Adoption of integrated farming system helps in enhancement of productivity, employment creation, income generation and nutritional security for human and livestock. The components of system have complementarities with waste products of one hand and becoming source of food as well as energy on other hands. Thus, intervention disseminated by KVK, with active participation of farmers is economically viable, feasible, having potential to create employment opportunity and increases income of farmers.

CONCLUSION

The socioeconomic development of farmers in the Hingoli district has been significantly impacted by the minimum support

Table 4. Income level and change in household income by land class.

Land class	Households (No.)	Share in total household. (%)	Net income (Rs/household)		Change in household Income (%)
			2016-17	2020-21	
Marginal (<1.0 ha)	39	35.45	64083.33	180946.15	182.36
Small (1-2 ha)	38	34.54	94093.23	250457.89	166.81
Medium (2-4 ha)	16	14.54	169639.90	461677.83	172.15
Large (>4 ha)	17	15.45	297535.49	789923.12	165.48
Total	110	99.98	625351.96	1683005.01	169.12



price for crops, the reduction of drudgery in farm operations due to the adoption of technology, integrated pest and disease management, and frontline demonstrations conducted by Krishi Vigyan Kendra, Hingoli. Changes in cropping patterns, adoption of alternative agricultural systems and appropriate animal husbandry ensure farmers receive a considerable income for starting a new business. The overall income from various combinations is correlated with the cost of production and cultivation of various crops. Under the strict supervision of Extension Professionals, Agricultural Scientists and Subject Matter Specialists, frontline demonstrations on a variety of crops should be conducted with sufficient financial assistance from planners and policy makers.

REFERANCES

Mynavathi V S and Jayanthi C (2015). Dry land integrated farming system - A Review. *Agri Review* **36** (1) 67-72.

Patil S S, Mahale M M and Chavan S S (2018). Impact of frontline demonstrations (FLDs) on oilseed crops in South Konkan Coastal Zone of Maharashtra. *Curr Agri Res J* **6** (3) 355-364.

Shelke P P and Murai Atul M (2023). Study of constraints in cultivation of major crops of Hingoli District. *J Krishi Vigyan* **11**. 270-272.

Received on 24/3/2024 Accepted on 28/4/2024

DOI : 10.5958/2349-4433.2020.00199.2

J Krishi Vigyan 2024, 12(2) : 310-314

Impact of Training Program on Knowledge and Awareness Levels of Goat Farmers in Kandi Area of District Hoshiarpur in Punjab

Gagandeep Singh*, Hujaz Tariq and R K Sharma

Regional Research and Training Centre, Talwara, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana

ABSTRACT

In recent years, a growing number of goat farmers in the villages of *Kandi* area have turned to goat rearing as a means of generating income. However, many of these farmers lacked scientific knowledge about proper goat husbandry practices, leading to lower return on investment. To address this issue, training sessions were organized for the farmers with the aim of enhancing their understanding and awareness of goat rearing practices and thereby increasing their income. A questionnaire was prepared on four different aspects *viz.,* feeding, general management, disease prevention and control and reproductive management aspects and the farmers were assessed both prior and post training to check the increase in knowledge levels of goat farmers. Prior to the training, it was observed that farmers had limited knowledge regarding feeding (39%), general management (47 %), disease prevention and control (46 %) and reproductive management (86 %). However, following training sessions, a significant improvement was observed by around 49, 48 51 and 11 % in the farmers' understanding on these critical goat rearing aspects for feeding, general management, disease prevention and control and reproductive management respectively. From this study, it can be concluded that, scientific knowledge and awareness regarding the various aspects of goat farming is very important for the farmers for better return on investment.

Key Words: Awareness, Goat farming, Impact, Training.

INTRODUCTION

In the *Kandi* area, the convergence of challenges such as small and marginal landholdings, undulating terrain, and limited water availability often results in diminished fodder production, subsequently leading to sub optimal agricultural productivity. This predicament, in turn, restricts the economic opportunities available to farmers (NAIP, 2014). Against the backdrop of an evolving agricultural landscape, recent years have witnessed a substantial upswing in Beetal goat farming in the Kandi area, emerging as a beacon of promise for sustainable livelihoods and presenting a potential source of employment (Rathore, 2023). The impetus behind this surge can be ascribed to several advantages, encompassing a low initial capital investment, a terrain replete with forests providing an ample source of tree leaves for goat fodder, minimal land requirements, heightened feed conversion efficiency, superior economic returns, and reduced fodder demands compared to cattle and buffalo farming (Singh *et al*, 2019). Despite these positive trends, farmers in the region grapple with various challenges, including inadequate genetic resources and a lack of scientific knowledge in goat rearing. Furthermore, limited exposure to modern farming tools often translates into a lower return on investment.

Within this dynamic agricultural sector, the pivotal impact of farmer training programs on the growth and development of goat farming cannot be overstated. Regional Research and Training Centre (RRTC), Talwara designs tailored training programs to meet the specific needs and socio-economic profiles of diverse groups, with a focus on optimizing effectiveness through guiding trainees in applying acquired skills (Keshava, 2002).

To comprehensively evaluate the impact of the goat farming training programs conducted by RRRTC, Talwara, a study was undertaken to meticulously scrutinize the overall changes in knowledge and awareness levels among goat farmers and delve into the economic benefits derived from the training.

Corresponding Author's Email - gssudan84@gmail.com

MATERIALS AND METHODS

The study was conducted on trainees from *Kandi* area of District Hoshiarpur, Punjab who participated in various specialized goat farming training programs at the Regional Research and Training Center, Talwara, affiliated with Guru Angad Dev Veterinary and Animal Science, Ludhiana, Punjab, between year 2022 and 2023. A total of 50 trainee farmers participated in the study, responding to a meticulously prepared questionnaire based on the expert consultation primarily involved to train the farmers during the requisite course before these training programs. Following the successful completion of these training sessions, the farmers were reevaluated to gauge the impact on their knowledge and awareness. The training primarily consisted of lectures held in various villages and RRTC, Talwara classroom supplemented by on-farm practical demonstrations conducted at farmers' doorsteps with groups of farmers.

The questionnaire covered four distinct categories: general management, feeding management, disease prevention and control and reproductive management. Data were collected, assessed, and presented using statistical measures such as frequencies and percentages to facilitate interpretation. To evaluate the knowledge gain, the trainees' knowledge scores during the pre-test were compared with their current scores. Changes in goat management practices were determined through focused group discussions and observations at the farmers' fields. The collected data were analysed using frequencies and percentages for interpretation.

RESULTS AND DISCUSSION

The results pertaining to impact of various trainings on knowledge awareness on different aspect of goat farming has been presented in Table 1. Overall, the result indicated an increase in awareness level of knowledge among the trainee post training.

Feeding management

Efficient feeding management is fundamental for successful goat farming, as it forms the cornerstone of balanced and economical feeding. Around 70% of total expenses in livestock rearing, particularly in goat farming, are attributed to feed. Therefore, prioritizing effective feeding practices is essential for maximizing profitability and ensuring the prosperity of goat farming operations (Hundal et al, 2016). The questionnaire for feeding management covered six different aspects namely colostrum, creep feed, mineral mixture, fodder, flushing and overall dry matter intake requirement of animals. Overall, the knowledge level for feeding management was found average (39 %) which improved significantly post training to 87.5 %. These results were found in concurrence with the findings of Meena *et al* (2023) and Hundal *et al* (2016) who observed similar improvements in knowledge levels on feeding managements of goat farmers after training. Although, the farmers were aware regarding the colostrum feeding but it was observed that they had limited knowledge regarding the quantity and importance of early feeding as evident during discussion. Further, it was observed that only few farmers had knowledge regarding flushing (34 %; extra feeding during breeding season), creep feed (12 %) and dry matter (34 %) and fodder requirement (44%). Lastly, farmers were mainly aware regarding importance of mineral mixture (62 %) in feeding regime of goats. Post training the knowledge level were found to be improved by 38 %, 78, 32 % , 42 %, 56 % and 48 % for colostrum, creep feeding, mineral mixture, fodder requirement, flushing and overall dry matter intake requirement of animals

General management

Knowledge level of various general management practices is another crucial parameter for goat farming to ensure optimal production, prevent infections, and maintain farm profitability (Arora et al, 2006). Proper housing management is essential to prevent goats from extreme weather and maintain the heath and production of animals (Sejian *et al*, 2021). In this study it was observed that farmers had little knowledge regarding the housing requirements (22%). On the hands farmers were found comparatively aware for breed characteristics (76 %) and weaning age of Beetal goats (70 %).

Table 1 Impact of training on knowledge level of farmers regarding goat farming

Characteristic	Mean correct response (Frequency)		Correct % response Percentage)	
	Pre training	Post training	Pre training	Post training
Feeding Management				
Colostrum feeding	27	46	54	92
Creep feed	6	45	12	90
Importance of mineral mixture	31	47	62	94
Fodder requirement	22	43	44	86
Flushing	14	42	28	84
Dry matter intake requirement of goats	17	41	34	82
Average	19.5	44	39	88
General management practices				
Age determination of goats	21	49	42	98
Breed characteristics	38	47	76	94
Body weight measurement	18	47	36	94
Weaning age	35	47	70	94
Age of castration	17	41	34	82
Housing floor space requirement	11	38	22	76
Average	23.33	44.83	46.67	89.67
General disease management				
Udder hygiene	29	47	58	94
Deworming schedule	31	43	62	86
Vaccination schedule	12	41	24	82
Metabolic diseases	16	42	32	84
Zoonotic diseases	28	45	56	90
Average	23.2	43.6	46.4	87.2
Reproductive management				
Estrous cycle length	43	48	86	96
Age of puberty	39	48	78	96
Gestation length	46	50	92	100
Estrous signs	43	47	86	94
Average	42.75	48.25	85.5	96.5

Further, the farmers were found moderately aware for the age of castration (34 %), age determination (42 %) and body weight measurement of goats (36 %). Overall, the farmers were found to have low knowledge level on general management practices prior to training (47 %) which significantly improved post training (90 %). These were similar to the findings of Singh et al (2023a) who observed improved knowledge in dairy farmers of kandi area after training. Similar observations were found by Senthilkumar *et al* (2013) and Ravi et al (2022) who found improved knowledge levels of farmers post training in goat and sheep farmers.

Disease prevention and Control

Ensuring the health and well-being of goats relies on effective disease prevention and control measures. These encompass maintaining proper udder hygiene, deworming schedule, administering vaccinations, preventing metabolic diseases and zoonotic diseases (Singh *et al,* 2023a). Deworming is essential for managing internal parasite infestations, which can significantly impact goat health, reproduction, and productivity. Furthermore, addressing ecto parasites like ticks and lice is crucial, as they can transmit protozoan diseases and impede goat production. Vaccinations are equally pivotal in safeguarding goats from infectious diseases, requiring adherence to a carefully planned schedule. Various metabolic diseases like pregnancy toxemia, milk fever, udder edema and ketosis can occur in goats during transition period which can affect the productivity and health of animals (Singh *et al,* 2023b). Lastly, managing zoonotic diseases is critical, given their potential transmission between animals and humans, underscoring the necessity of comprehensive disease management on the farm. After training the knowledge level of farmers improved significantly which is similar to Singh *et al* (2023a) Arya *et al* (2021) and Meena *et al* (2020). Post training the knowledge level were found to be improved by 36 %, 24 %, 58 %, 52 %, and 34 % for udder hygiene, deworming schedule, vaccination schedule, metabolic diseases and zoonotic diseases of animals.

Reproductive management

Managing reproductive performance is key parameter for successful goat farming business as it determines the farm profitability. The evaluation of pre questioner showed that farmers were better aware for reproductive parameter knowledge such as age of puberty, estrous signs, gestation length and length of estrous cycle as compared to other topics such as feeding, general and disease management. It is presumed that this knowledge might be acquired by the farmers during the rearing of the goats. Further there was an improvement in knowledge level by 12% in reproductive management after the completion of training programs. It is similar to findings of Hundal *et al* (2016) and Singh *et al* (2023a) who observed similar findings in goat and dairy farmers of Punjab.

CONCLUSION

Farmers showed awareness of proper feeding techniques, the importance of disease vaccination, insights into reproductive behaviors, and other vital management practices. Thus, conducting training can be used to provide farmers with scientific knowledge and awareness in goat farming which can mitigate economic losses and ensure the sustainability of goat farming endeavors.

REFERENCES

Arora AS Kumar A Bardhan D and Dabas YPS (2006) Adoption of improved animal husbandry practices as risk management strategies. *Indian J Ext Edu* **42** (3&4): 41-46.

Arya V Yadav SC Yadav MP Khandelwal S and Mali HR (2021) Impact analysis of trainings on goat production technology. *J Krishi Vigyan* **10**(1): 142-145.

Hundal JS Singh UC Navdeep N S Kansal SK and Bhatti JS (2016) Impact of training on knowledge level of goat farmers in Punjab. *Haryana Vet* **55** (1): 47-49

Keshava (2002). Managing farmers' training for sustainable agriculture development. *Indian J Training and Dev* **XXXII** (4): 64-71.

Meena GS Kumar D Mahajani K Bairwa RK Singh R Meena AK and Meena RK (2023) Impact of Training on Knowledge Levels of Goat Rearing Farmer's in Bundi District of Rajasthan. *J Krishi Vigyan* **11**(2): 192-195.

NAIP (2014) Final report: NAIP Component-3 Sub-project (Sustainable Livestock-based farming system for livelihood security in Hoshiarpur district of Punjab). Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. 4: 91.

Rathore R (2023) Dairy entrepreneurship in Kandi region of Punjab: Prospects and constraints. *Int J Bio-res Stress Manag* **14**(3): 450-456.

Ravi S Muralidharan P Arathy J (2022) Impact of adoption of climatic resilient practices in goat farming in Kuttanad region of Kerala. *J Krishi Vigyan* **10**(2):198-203.

Sejian V Silpa MV Reshma Nair MR Devaraj C Krishnan G Bagath M Chauhan SS Suganthi, RU Fonseca VF König S and Gaughan JB (2021) Heat stress and goat welfare: Adaptation and production considerations. *Animals* **11**(4): 1021.

Senthilkumar K Devaki K and Subramanian R (2013) Impact of Krishi Vigyan Kendra's trainings on knowledge and adoption of sheep and goat farming technologies. *Indian J Small Ruminants* **19**(2): 228-231.

Singh G Sharma RK and Tariq H. (2023a) Impact of Training on Knowledge and Awareness Levels of Dairy Farmers in Kandi Area of Hoshiarpur District of Punjab. *Int J Vet Sci Ani Husband* **S-8**: 2-19.

Singh G Sharma RK and Tariq H. (2023b) Therapeutic management of udder edema in goat in field conditions: A case report. *The Pharma Innov* J **SP-12**(7): 374-376.

Singh G Sharma RK Verma HK and Singh J (2019) Livestock management practices followed by Kandi farmers of Hosiarpur district of Punjab, India. *Int J Curr Microbiol App Sci* **8**(11): 982-990.

Received on 4/4/2024 Accepted on 15/5/2024

DOI : 10.5958/2349-4433.2024.00057.4

J Krishi Vigyan 2024, 12(2) : 315-319

Influence of Social Media on Buying Behaviour of Consumers of Organised Retail Markets

K Nagarjuna[1], K S Purnima[2], A Lalitha[3] and B Suneetha[4]
College of Agribusiness management,
Acharya N.G. Ranga Agricultural University, Lam, Guntur (Andhra Pradesh)

ABSTRACT

Social media marketing had indeed become a critical aspect of the overall marketing strategy for organizations, including Indian retailers. A well-defined social media marketing strategy acts as a blueprint that guides the entire process from formulation of products to implementation and evaluation. The study aimed to investigate and analyse the impact of social media on the marketing of food commodities through organized retail markets. With the rapid growth of social media platforms and the increasing popularity of organized retail markets, it becomes essential to understand the relationship between these two phenomena and their influence on consumer buying behaviour and food commodity sales. Consumers were selected from five selected retail markets using simple random sampling. From each retail market, 20 respondents were selected. The data were collected from various age groups, income groups and gender groups. A total number of 100 customers were interviewed. The results revealed that social media highly influenced 'Alternatives evaluation' component of consumer behaviour followed by 'Information search', 'Purchase decisions', 'Post purchase behaviour' and 'Need Recognition'. The results indicate that the highest mean score was observed for "Alternatives evaluation" with a mean of 3.80, suggesting that social media significantly impacts consumers' evaluation and comparison of different options before making a purchase decision. Following closely, "Information search" and "Purchase decision", both showed substantial mean scores of 3.41 and 3.21, respectively. This signifies that social media plays a crucial role in helping consumers gather information about products or services and influences their behaviour for deciding to purchase. The socio-psychological variables selected for the study *viz.,* Age, Occupation, Annual income had no significant relationship with buying behaviour while Education ,Social media readiness, Social media skills and Social media interaction pattern significantly influenced the buying behaviour of consumers.

Key Words: Alternatives, Consumer buying behaviour, Information search, Need, Purchase decisions, Social media.

INTRODUCTION

Social media is made up of modern tools and technology that enable people to interact, aid in developing relationships with customers, and generate fresh opportunities. The effectiveness of social media in retail marketing is enormous as it allows for two-way connection between the retailer and the customer. Consumers seek information from customers with whom they are familiar with, have a relationship, and have built trust. The art of listening first, understanding the consumer, and then engaging the customer in multiple conversations regarding the products and the company as a whole are key components of social media (Bashar, 2012). Retailers engage their customers and encourage them to join in dialogues using a variety of media like Facebook, LinkedIn, Twitter, and blogging in an effort to create a connection that will result in a final sale for the retailer. In India today, the majority of businesses utilise social media to spread their message, interact with, and work with the millions of people that are logged in all the time. Nevertheless, this medium still has a lot of unrealized promise in terms of what it can provide for its audience.

Corresponding Author's Email - purnimanaiduguntur@gmail.com
1. Research Scholar, College of Agribusiness management, ANGRAU,
2. Associate Professor ,Open and Distance Learning Centre, ANGRAU and
3. Senior scientist(Extension),AI&CC,ANGRAU
4. SMS (Home science),KVK, Amadalavalasa,Srikakulam district.

Table 1. Social Media Influence on Buying Behaviour of Consumers. (n=125)

Sr. No.	Statement	Agree		Undecided		Disagree		Mean scores
		No.	%	No.	%	No.	%	
	Need Recognition							
1.	Visual elements attracted towards the product/service	81	81.00	18	18.00	1	1.00	1.30
2.	Freshness of the advertisement on the product/service	80	80.00	19	19.00	1	1.00	1.79
3.	Timely Update of information on product/service	59	59.00	32	32.00	19	19.00	1.56
4.	Interaction on the product (Likes and comments)	76	76.00	18	18.00	6	6.00	1.70
5.	Unfelt needs are sometimes recognised	66	66.00	29	29.00	5	5.00	1.51
6.	Frequency of advertisement	59	59.00	32	32.00	19	19.00	1.56
	Information search							
1.	Relevant information on the product/service	90	90.00	8	8.00	2	2.00	2.88
2.	Seeking and collecting information was easier than excepted	85	85.00	11	11.00	4	4.00	2.81
3.	Information search can be handled from home or work place	78	78.00	19	19.00	3	3.00	3.75
4.	Information on various models and prices at one time search	73	73.00	19	19.00	8	8.00	3.65
5.	Searching for information was fun and exciting	70	70.00	23	23.00	7	7.00	2.63
6.	Credibility of information that was found	70	70.00	18	18.00	12	12.00	2.58
	Alternatives evaluation							
1.	More information is gained while evaluating	89	89.00	9	9.00	2	2.00	3.87
2.	Information needed to evaluate and compare the different options is available	78	78.00	21	21.00	1	1.00	4.07
3.	Comparing the different alternatives is exiting	79	79.00	16	16.00	5	5.00	3.74
4.	Can be done at our convenience	79	79.00	16	16.00	5	5.00	3.94
5.	Availability of numerous alternatives is motivating	82	82.00	8	8.00	10	10.00	3.72
6.	Evaluating and comparing the various options is easy and less time consuming	70	70.00	19	19.00	11	11.00	3.59
	Purchase decision							
1.	Provision for offers and Discounts	83	83.00	14	14.00	3	3.00	2.90
2.	Reviews/Opinions can be considered before purchase	83	83.00	13	13.00	4	4.00	2.79
3.	Comfortable Price range motivates buying	78	78.00	17	17.00	5	5.00	3.73
4.	Less time and energy is consumed	76	76.00	16	16.00	8	8.00	2.68
5.	Accurate and reliable information helped me make my purchase decision	62	62.00	32	32.00	6	6.00	2.56
6.	Confidence is more while purchasing online	83	83.00	14	14.00	3	3.00	2.80
	Post Purchase decision							
1.	There is provision for return or exchange	85	85.00	13	13.00	2	2.00	1.83
2.	Repeat buying is made easy	84	84.00	11	11.00	5	5.00	1.79
3.	Immediate feedback can be given	80	80.00	17	17.00	3	3.00	2.77
4.	Post purchase evaluation of product can be done	80	80.00	14	14.00	6	6.00	1.74
5.	Purchase points can be scored	70	70.00	24	24.00	6	6.00	1.64
6.	Buying Satisfaction is more	68	68.00	27	27.00	5	5.00	1.63

Table 2. Overall influence of Social media influence on buying behaviour of consumers.

Sr. No.	Factor	Mean
1.	Need Recognition	1.71
2.	Information search	3.41
3.	Alternatives evaluation	3.80
4.	Purchase decision	3.21
5.	Post Purchase Behaviour	2.10

Table 3. Influence of the selected socio-personal characteristics of the respondents on their buying behaviour.

Sr. No	Personal characteristic	r value
1.	Age	0.053NS
2.	Education	0.073*
3.	Occupation	-0.018NS
4.	Annual income	0.025NS
5.	Social media exposure	0.145**
6.	Social media readiness	0.185**
7.	Social media operating skills	0.478**
8.	Social media interaction pattern	0.128**

In view of the growing social media explosion in the retail marketing sector especially in organised retail marketing, it is beneficial to understand the impact generated by social media strategies in influencing the buying behaviour of consumers and its effectiveness in promoting sales in organised retail markets. Hence, the present study was conducted with the objective to study the influence of social media on the buying behaviour of consumers.

MATERIALS AND METHODS

Andhra Pradesh was purposively chosen for the study. The food retailing sector in Andhra Pradesh has also embraced social media platforms to reach a wider audience and enhance their marketing efforts. Consumers were selected from five selected retail markets in Tirupati city using simple random sampling. From each retail market, 20 respondents were selected. Data were collected from various age groups, income groups and gender groups to study the influence of social media on buying behaviour. A total number of 100 customers were interviewed and collected data. The Influence of social media on the buying behaviour of consumers was studied under 5 different components i.e., Need Recognition, Information search, Alternatives evaluation, Purchase decision and Post purchase behaviour. Different components were analysed on a five point scale of strongly agree (SA), agree (A), neutral (N), disagree (DA), strongly disagree (SD). The data collected through structured interview schedule was analyzed using Likert's scale technique, mean scores and correlation.

RESULTS AND DISCUSSION

The data (Table 1) revealed that social media highly influenced 'alternatives evaluation' component of consumer behaviour followed by 'information search', 'purchase decisions', 'post purchase behaviour' and 'need recognition'. This could be due the rising competitiveness in social media marketing, consumers are looking for alternatives with wide price ranges and for more available models. The results also revealed that in

the need recognition component consumers were highly influenced by freshness of the advertisement on the product/service (Mean score=1.79) followed by Interaction on the product -Likes and comments (Mean score= 1.70) (Madni, 2014). Social media campaign and advertisements on media tools especially WhatsApp and You tube were attracting consumers towards unfelt needs. With regard to the Information search components, majority were influenced by information search can be handled from home or work place (Mean score=3.75) followed by Information on various models and prices at one time search (Mean score=3.65).This may be because of the convenience felt by the consumers Regarding Alternatives evaluation component, consumers were highly influenced by Information needed to evaluate and compare the different options is available (Mean score=4.07) followed by can be done at our convenience (Mean score= 3.94). This component was regarded the most significant as availability of choices always influences the decision making positively (Ioanas,2020). With regard to the purchase decision component, majority were influenced by comfortable price range motivates buying (Mean score=3.73) followed by provision for offers and discounts (Mean score= 2.90). The consumers felt that online prices are more comfortable than in shops and can be easily accessed. Immediate feedback was rated highest for post purchase decisions with a Mean score of 2.77 because feed-back and comments significantly influences the buying behaviour of other customers (Ramanathan, 2017).

The analysis indicated that the highest mean score was observed for "alternatives evaluation" with a mean of 3.80, suggesting that social media significantly impacts consumers' evaluation and comparison of different options before making a purchase decision. Following closely, "information search" and "purchase decision" both show substantial mean scores of 3.41 and 3.21, respectively. This signifies that social media plays a crucial role in helping consumers gather information about products or services and influences their behaviour for deciding to purchase.

Need recognition" and post purchase behaviour factors also receive notable mean scores of 1.71 and 2.10, respectively, indicating that social media has a considerable impact on consumers' recognition of needs and their ultimate purchase decisions (Varghese,2021).

Pearson product moment correlation was used to assess the relation between the independent variables (socio-personal characteristics) and dependent variable (consumer behaviour). Results (Table 3) revealed that the age, occupation and annual income had no significant relationship with consumer buying behaviour while education, social media exposure, social media readiness, social media operating skills and social media interaction pattern showed high level of positive significance. This implied that the social media variables that significantly influenced the behaviour of those consumers who were literate and also exposed to social media especially WhatsApp, You tube Face book, Instagram and Twitter in that order. (Annu Devi Gora,2021)

CONCLUSION

Social media marketing had indeed become a critical aspect of the overall marketing strategy for organizations, including Indian retailers. A well-defined social media marketing strategy acted as a blueprint that guided the entire process, from formulation to implementation and evaluation. In view of the growing social media explosion in the retail marketing sector especially in organised retail marketing, it is beneficial to understand the impact generated by social media strategies in influencing the buying behaviour of consumers and its effectiveness in promoting sales in organised retail markets. The study threw light on the most important areas that influence buying behaviour of consumers such as Availability of numerous alternatives, evaluate and compare the different options is available, It Can be done at our convenience and Comfortable Price ranges. Thus, with proper planning and strategies social media can have a significant impact on consumers buying behaviour.

REFERENCES

Bashar A, Ahmad I and Wasiq M (2012). Effectiveness of social media as a marketing tool: An Empirical Study, *Int J*

Market, Financial Services and Manage Res **1**(11); 88-99.

Ioanăs E and Stoica I (2020). Social media and its impact on consumers behavior. Part 2. *J Kesehatan Prima* **1**(1); 1-5.

Madni G R (2014). Consumer's behavior and effectiveness of social media. *Global J Manage and Busi Res: E Marketing* **14**(8); 56-62.

Ramanathan U, Subramanian N, Parrott G (2017). Role of social media in retail network operations and marketing to enhance customer satisfaction. *Int J Operat and Prod Manage* **37** (1); pp.105-123.

Varghese M S and Agrawal M M (2021). Impact of social media on Consumer Buying Behavior. *Saudi J Business and Manage Stud* **6**(3); 51-55.

Annu Devi Gora and Sisodia S S (2021). Utilisation pattern of social media among post graduate students. *Int Res J Ext Edu* **21**(2&3): 26-32.

Received on 10/1/2024 Accepted on 12/3/2024

DOI : 10.5958/2349-4433.2024.00058.0

J Krishi Vigyan 2024, 12(2) : 320-326

Income, Expenditure and Saving Pattern of Peasantry in Punjab

G Singh, G Kaur and V K Sharma
Punjab Agricultural University, Ludhiana, Punjab, 143401

ABSTRACT

The present study covered 270 respondents. Multistage sampling technique was adopted to collect relevant data. The results showed that the agricultural revolutions had a significant impact on agricultural labourers' incomes, but the farmers' incomes increased more significantly. In order to meet the economic turning point, agricultural labour wages did not increase sufficiently. Farm workers are compelled to take out loans during the lean season at rates below market value in order to pay for their future services. Demand for labour decreased overtime due to more capital-intensive agriculture and there is no significant industrial hub that might accommodate extra farm labourers. There is also no work during the off-season because farm operations are seasonal. As a result, the working class's income is reduced, which pushes more people below the poverty line. The major source of income for farm labourer is the casual and contractual work with approximately 30 per cent of the total income and the much-hyped central employment scheme MGNRGA contributes only 6 per cent. On an average ₹10616 was the monthly income and ₹11493 was the expenditure of agricultural labourer. The drug and medical expenses were making big toll on farm labourer. There was less income inequality among the farm households then higher income groups with Gini ratio /coefficient of 0.25 per cent. There was a negative average propensity to saving. It was concluded that effective oversight of this MGNRGA is required. To address the current and changing nature of agriculture's labour and wage structures there is need to create and amend regulations.

Key Words: Agricultural labour, Income, Consumption, MGNRGA, Gini Ratio.

INTRODUCTION

The provision of food for the population, expansion of exports, transfer of labour to non-agricultural sectors, contribution to capital formation, and security of markets for industrialization are the ways that agriculture contributes to economic development (Tejwani and Boopathi, 2019). Over the past few years, Punjab's agriculture industry has started to slow down. From 2007–2008 to 2013–2014, the agriculture sector growth rate remained far below 2 per cent, turning negative in 2009–2010 and 2012–2013 (Anonymous, 2019).

Since the Green Revolution began in the middle of the 1960s, Punjab's agriculture has seen considerable structural changes (Satish, 2006). With only 2.5 per cent of the country's arable land, Punjab produces around 18 per cent of the nation's wheat, 11 per cent rice, 5 per cent cotton, 10 per cent milk, 20 per cent honey, and 48 per cent mushrooms. In the state, food grain production Increased from 11.71 MT in 1980–1981 to over 31.66 MT in 2017–18. According to a recent study, out of 9.9 million workers in Punjab, 35.6 per cent were employed in the agricultural sector as either cultivators or agricultural labourers (Singh and Bhogal, 2020). Agricultural labourer played important role in the development of agricultural sector. The process of farming with new production methods has increased the farmers' financial needs. The Punjabi peasantry, particularly the small farmers, were unable to finance agricultural investments out of their own money in order to convert traditional agriculture into scientific farming (Singh and Toor, 2005).

Corresponding Author's Email - gurlal-aes@pau.edu
1*2 Research Fellow, Department of Agricultural Economics and Sociology, Punjab Agricultural University, Ludhiana, India
3 Principal Economist, Department of Agricultural Economics and Sociology, Punjab Agricultural University, Ludhiana India

There is note-worthy increase in agricultural wages in recent times due to many factors like development of non-farm employment sector, surge in payments for migrant labourer, introduction of Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) and high reservation wages (Kaur and Kaur, 2020). The practice of rising wages and labour shortage is uneven across the states. The escalating wages have severe implications for the farm sector. It is certain that the technical aspects such as cropping intensity, cultivated area, higher use of inputs, etc. increased labour usage while automation and utilization of chemicals specially herbicides significantly reduced employment (Kaur et al, 2022). The relationship of these factors declined the agriculture labour requirements in agricultural operations. In reply to mounting wages, there is improved farm mechanisation which shifts cropping pattern from labour intensive to labour saving (Singh and Singh, 2016).

The rural economy also practiced these changes in terms of escalating real wages, increased rural-urban migration, labour scarcity for farming, enlarged non-farm incomes compared to farm incomes, better share of non-farming in both employment and income, increasing input costs including labour cost and broader acceptance of farm mechanisation. The use of hired labour depends upon the nature of crops grown, size of holding, level of technology adopted, supply of farm labour etc. (sharma, 2016). The tendency of labour to employing themselves on permanent basis is decreasing due to high daily wage allurements, during the peak season. Farm labourer was facing crises of financial exclusion due to less saving. Income inequalities among the agricultural labourers is not as severe as in higher income groups of society. This study was conducted to analysis the current situation of peasantry and to formulate polices accordingly.

MATERIALS AND METHODS

Primary data collection

The primary data were collected in the time period of 2019-20. Multistage sampling technique was adopted to collect the relevant data from all the zones as the agro climate affects the economic conditions of the people living in these zones differently. In the process, three districts from each zone according to census population of agricultural labourer and cropping pattern of the region were taken. Hoshiarpur from zone I, Amritsar from zone II and Ferozepur from Zone III. The selection of blocks was done at random from the list of 122 blocks as per the ranking by Economic and Statistical Organization (ESO), Punjab. Nine blocks were selected, three from each district. One village from each block was selected at random. To analyze the nature and extent of rural labour, a complete agriculture labour household census survey of the selected nine villages was prepared. The total number of households, in all the 9 villages, comes out to be 1520. All the agricultural labour households were studied with the help of village Sarpanch. As of total, 270 respondents were randomly selected for the study, 30 from each village.

Analytical tools

Formulation of labour days for different gender and age group

Labour days of women and children are converted into man days equivalents by using standard conversion factors of 0.67 and 0.50, respectively (Sidhu and Grewal, 1990). All the labourers (male or female) below the 14 years were enumerated as a child labour.

Measuring of inequality in income and consumption

Deciles Groups: Per household income and consumption of the agricultural labourers were arranged in-ascending order and the divided into ten classes containing 10 per cent of each sample. These classes were denoted as deciles, showed the concentration of income and consumption among the different groups of labourers.

Lorenz Curve Comparison: It is the graph showing the percentage of income earned by the percentage of the agricultural labourers. These curves were plotted by taking the cumulative percentage of households as shown on the OX-axis, whereas the percentage of income is given on the OY-axis. For the comparison of income and

Table 1. Source of income from the farm labour households in Punjab (₹ Per Month)

Particulars	Zone I		Zone II		Zone III		Punjab	
	Amount	per centage	Amount	per centage	Amount	per centage	Amount	per centage
Casual and contractual labour	3609	41	2656	26.02	3112	26.02	3126	29.44
Permanent labour/crop sharing bases	1449	16	1998	19.58	2153	19.58	1867	17.58
Other family member income	2022	23.02	2638	25.85	2226	25.85	2295	21.62
MGNRGA	30	0.35	73	0.72	1953	0.72	686	6.46
Dairy/livestock/poultry	663	7.55	596	5.84	560	5.84	606	5.71
Social security	36	0.41	66	0.64	363	0.64	155	1.46
Non-farm income	189	2.16	1342	13.15	1646	13.15	1059	9.98
Ad-hoc income	782	8.91	833	8.16	840	8.16	818	7.71
Total income	8785	100	10205	100	12857	100	10615	100

Table 2. Income variation of agricultural labour households of Punjab.

Region	Average income (₹/ year)	Standard deviation	Coefficient of variation
Zone I	105420	3698	34.29
Zone II	122469	4813	39.99
Zone III	154284	10046	67.58
Punjab	127391	6758	54.23

consumption. These curves were drawn in the different zones and in different categories for agricultural labour.

Co-efficient of variation: co-efficient of variation was derived by the following formula

$$C.V=\sigma/X \times 100$$

Where C.V = coefficient of variation

σ = Standard deviation

The diagonal line is the equal distribution line, that indicates the equal percentage of labourers receiving the equal income and consumption, but the difference from this diagonal line indicates the variation of income and consumption among these sections of population. The curve close to the diagonal line indicates the minimum inequality in distribution of income and consumption and the curve away from the diagonal line indicates the greater inequality. The area between the lines of equal distribution and the curve of concentration called the area of concentration. It is the degree of concentration. The larger of this area will mean more of inequality in the distribution of income and consumption. The more of the distance of Lorenz curve from the line of equal distribution would mean the more concentration of income and consumption in a few households.

RESULTS AND DISCUSSION

The data depicted the average monthly income from different sources of the agricultural labour households in Punjab. It was observed that, the income from permanent labour and crop sharing was ₹1867 per month. In respect of zones ₹1449, ₹1998 and ₹2153 being earned in zones I, II and III, respectively by the farm labourers. The average monthly income was higher in Zone III and minimum in Zone I. Income from casual and contractual labour was highest among all the sources of income for farm labour. As most of the labourers performing casual and contractual

Table 3. Consumption expenditure of agricultural labour in Punjab (₹/ year)

Category	Zone I	Zone II	Zone III	Punjab
Cereals	3253	3666	3775	3565
Pulses	3731	3510	4567	3940
Vegetable	4982	6731	8108	6600
Edible oils	6643	5936	6175	6262
Beverages	364	326	252	315
Opium, liquor, etc.	10147	13244	7363	10246
Fish, meat, eggs, etc	3276	4039	4916	4075
Sugar and Gur (Jaggery)	4368	3973	3379	3914
Fruits	1001	1244	2433	1558
Spices	2346	3046	2763	2716
Milk and milk products	16608	17274	20131	18014
Packed food/candy, snakes	510	1041	1584	1042
Sweets	273	473	1165	636
Food item total (A)	57501	64503	66610	62881
Clothing	2412	3122	6929	4149
Education	1138	1561	3705	2131
House rent	59	0	699	253
Fuel/gas	1879	2076	2018	1992
Electricity bill (summer)	9100	7095	10252	8835
Electricity bill (winter)	3640	2933	3495	3364
Conveyance	7326	8798	9036	8384
Health care	19110	23650	16986	19910
Ad-hoc expenditure	6825	8514	10513	8612
Footwear	819	473	699	667
Social ceremony	6274	5676	8388	6787
Repayment of debt	8190	9460	4380	7347
Misc. (Mobile, TV recharge etc.)	2730	2129	2936	2604
Non-food items total (B)	69501	75486	80036	75034
Total expenditure (A+B)	127002	139989	146646	137915
Ginni ratio	0.22	0.20	0.26	0.23

labour, they earned 3126 monthly. In respect of three agro-climatic zones the labourers were earning maximum in Zone I (₹3609) followed by Zone III (₹3112) and Zone II (₹2656) respectively. It was found that a significant percentage i.e. 21.62 percent was contributed by the member other than main earner in the household income. Zone-wise observation stated that ₹2022, ₹2638 and ₹222 earned in zones I, II and III, respectively.

Zone-wise per household variation of

Table 4. Surplus household income in different zones of Punjab (₹/month)

Particular	Zone I	Zone II	Zone III	Punjab
Income	8785.02	10205.79	12857.05	10615.95
Expenditure	10583.49	11665.76	12220.46	11492.93
Surplus/saving	-1798.47	-1459.97	636.59	-876.97
APC	120.47	114.31	95.05	108.26
APS	-20.47	-14.31	4.95	-8.26

Table 5. Concentration of household income in different zones of Punjab

Deciles Group	Zone I	Zone II	Zone III	Punjab
10	19.23	17.72	21.54	20.18
20	33.33	31.65	36.92	33.94
30	44.87	43.04	47.69	45.87
40	55.13	53.16	58.46	56.88
50	65.38	62.29	69.23	66.97
60	74.36	60.41	76.92	75.69
70	82.05	69.87	84.62	82.57
80	89.74	79.72	92.31	90.37
90	94.74	93.67	98.46	96.33
100	100	100	100	100
Gini Ratio	0.222	0.190	0.303	0.247

income of agricultural labourers was presented in table 2. To compare the variation in income of labourers, the coefficient of variation was computed which was found to be 54.23 per cent which showed that variation of income of the farm labourers was reasonably high. The highest coefficient of variations found to be in Zone III followed by Zone I and Zone II. The reason behind this was the variation in economic development among the zones.

The relative share of consumption indicates the level of development of farm labourers. In the developed societies, the relative share of expenditure on the food item was minimum whereas it was maximum on the items of the comfort and luxuries whereas reverse to this happened in low-income groups.

This segment deals with the expenditure pattern on different agro-climatic zones of Punjab as shown in table 3. It was clear that a large share of expenditure was incurred on non-food items in all the zones individually as well as state level. In term of magnitude an average farm household in the state spent ₹137915 per annum for consumption purposes. Out of this, ₹62881was spent on food item and ₹75034 spent on non-food items. Amongst the food items, it was shocking to observe that ₹10246 was spent on the drugs i.e. opium, liquor, medicinal drugs etc. The zone-wise analysis of this aspect revealed that the farm laborer's household of Zone III spent the highest amount as consumption expenditure with ₹146646 whereas the farm households of Zone I spent the minimum amount with ₹127002. Among the food items, the expenditure on milk accounted highest on food items in all zones. Overall, the expenditure of farm labourers remains equal among zones due to equality in the employment opportunities. Ginni ratio for zone I recorded as (0.22) followed by for zone II (0.20) and zone III (0.26) represents the equality among the zones for consumption expenditure.

It is essential to establish a shared platform where one can readily learn about revenue, expenses, and surplus savings in order to do a comparison analysis as can be seen in table 4. The

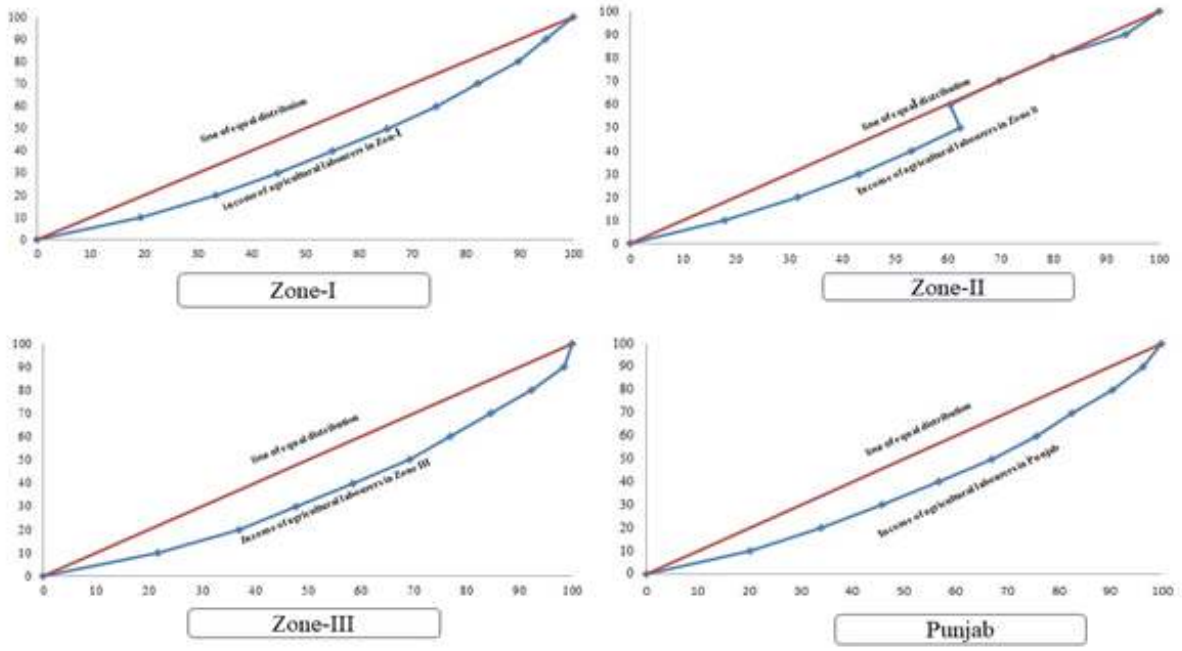


Fig 1: Lorenz curve depicting cumulative per cent income among agricultural laboures in Zone I, Zone-II, Zone -III and Punjab

data depict that ₹10615 was the annual income of farm labourers in Punjab, out of this ₹11492 was the expenditure and by deducting the consumption expenditure from income the study found negative savings to the tune of ₹876. Average propensity to consume of farm labourers was 108 per cent in Punjab where as in was highest in zone I (120.47per cent) and lowest in zone III (95.05per cent) concluded that farm labourers were spending more than their income. The average propensity to save (APS) was also observed negative i.e. 8.26 per cent. It was -20.47, -14.31 and 4.95 per cent in zones I, II and III, respectively. The APS was found very low and it was observed that it goes on increasing with the increase in income. APS of zone III was found positive than the other zones.

In order to know the share of various segments of the farm labourers in the total income, concentration of income was examined by working out the share of each deciles group and the concentration of coefficients as a whole. The trend showed Zone III was having comparatively worst distribution of income as relate to other zones of the state. As can be seen from Table 5, Zone II was the best distributed income zone among the others. The magnitude of Gini Ratio reaffirmed the distribution pattern.

The highest magnitude of Gini ratio recorded was 0.303 in zones III followed by Zone I and II with 0.222 and 0.190, respectively. This trend confirmed that the distribution of income was relatively better in Zone II and I in comparison to Zone III of the state of Punjab. It was concluded that the distribution of income among the agricultural labourers was not as worst as in other categories due to equal opportunities of employment and lower income level.

Lorenz curve is a graphical representation of distribution of income among agricultural labourers. The shape of Lorenz curves in Fig 1 indicated that inequality among the agricultural labourers in different zones was not threatening. The curve in the graph showed the proportion of overall income among farm labourers.One straight line represents the line of equal income distribution and the other against this to find a conclusive variation in the income. More the difference between these two lines more will be the income gap. It was overserved form the fig 1 that the income inequality for farm laboures was not as bad as for the higher income communities.

CONCLUSION

It was inferred that, there has been a considerable drop in the demand for agricultural labour adoption over the past three decades in the majority of the zones. This leads to non-institution loans at higher interest rate. The consumption of drugs, liquor was more than cereals which indicates the addictiveness of drugs among farm laboures. On an average a single farm house stands ₹20000 thousand of medical expenses which was much higher for small earning community.The level of consumption of farm sector labour was very stumpy. The APC is meagerly positive for zone III and negative for other regions. This is dangerous and effect the survival of farm labourers by putting them below poverty line. Most of their income was spent on the non-food items and a small amount was spent for food items. The income inequality among farm laboures was not as bad as for the higher income communities. Regulations must be created that take into account the current and changing nature of agriculture's labour and wage structures.

REFERENCES

Anonymous (2019) Statistical abstract of Punjab 2019. Economic and Statistical Organsiation, Government of Punjab, India.

Kaur G and Kaur A (2020). Poverty amongst agricultural labourer, marginal and small farmers in central Punjab. *J Agri Dev Pol* 30(1):34-39.

Kaur S Kaur M Saini R and Kingra H S (2022) Income and expenditure pattern of agricultural labour households in South-Western region of Punjab. *J Krishi Vigyan* **10** (2):204-210.

Satish P (2006). Institutional credit, indebtedness and suicides in Punjab. *Econ Polit Wkly* ***41***(26): 2754-2761.

Sharma H (2016). Seasonal employment: A study of agricultural labourers in Punjab, India. *Indian J Agric Econ* 6(6): 8024-8028

Sidhu R S and Grewal S S (1990). Factors affecting demand for human labour in Punjab agriculture: An econometric analysis. *Indian J Agric Econ* ***45***(902-2018-2754):125-133.

Singh G and Singh K (2016). Employment pattern among agricultural labourers in rural Punjab. *Social Change* 46(3):409-427.

Singh S P and Bhogal S (2020). Punjab's agricultural labourers in transition a longitudinal study of three decades. *Econ Polit Wkly* **55**(21), 21-28.

Singh S and Toor M S (2005). Agrarian crisis with special reference to indebtedness among Punjab farmers. *Indian J Agric Econ* ***60***(3):335-346.

Tejwani S and Boopathi S (2019). Employability of Vocationally Qualified Workers in MSME Units in Lucknow: *An Empirical Study*. *Edu creation Publishing*. Employability of Vocationally Qualified Workers in MSME Units in Lucknow: An ... - Smita Tejwani, S Boopathi - Google Books

Received on 1/3/2024 Accepted on 30/3/2024

DOI : 10.5958/2349-4433.2024.00059.7

J Krishi Vigyan 2024, 12(2) : 327-332

Integrated Approaches for the Management of *Helicoverpa armigera* in Hyacinth Bean [*Lablab purpureus* (L.)]

Prasad Y P*, Vinay G M, Shamraj and Divya H V
ICAR JSS Krishi Vigyan Kendra, Suttur, Mysuru, 571129, Karnataka, India

ABSTRACT

Gram pod borer *(Helicoverpa armigera) is* one of the major pest infecting field beans in Mysore district results in more than 80 per cent crop loss. The pest mainly infects the pods which in turn reduces the crop yield and market acceptance. To control this pest, the farmers are using chemicals indiscriminately which increase the cost of production and also harmful to the ecosystem. The present experiment was conducted at 10 farmers field at Hulyalu village, Hunsuru Taluk and introduced the integrated management of gram pod borer technology which involved installation of pheromone traps 20/ha at flowering stage, application of Azadiractin 10000ppm @ 2 ml/l and need based application of Emamectin benzoate 5%SG 0.5 gram per liter. The experimental results indicated that the demonstrated fields were recorded with an average 6.50 per cent pod damage by the pod borer larvae compare to 70 per cent in uncontrolled farmer's field. Meanwhile the significantly a greater number of pods (75.80) per plant were observed in treated plots with yield of 92.10 q/ ha compared to 52.60 pods and 61.30 q/ha in untreated fields, respectively. The overall results and farmers feedback implies that the adoption of integrated pest management technologies for the management of gram pod bore in field bean reduced the cost on pest management by 50 per cent by reduction in the number of sprays (total number of sprays-3) and also improves the yield by 33.44 per cent and market acceptability.

Key Words: Field bean, Gram pod borer, Integrated approaches for pest management, crop yield and economics

INTRODUCTION

Lablab purpureus (L.), commonly known as field bean is one of the ancient leguminous crops cultivated mainly in southern parts of India. It is a perennial herbaceous plant, primarily grown for green pods, while dry seeds are used in vegetable and culinary preparations. The immature pods are eaten as vegetables; they are high in carbohydrates (55%) and proteins (22.4–31.3%) and can serve as a great alternative to animal proteins (Snafi, 2015). In Karnataka, field bean is cultivated in 0.6 lakh ha with an annual production and productivity of 0.5 lakh tones and 892 kg/ha, respectively. Mysuru district is situated in the southern part of the Deccan Peninsula and it forms the southernmost district of Karnataka State in the Indian Union. The district comprises two Agro climatic regions *viz.,* Southern Dry Zone and Southern Transition Zone. Field bean crop is mainly grown in Hunsuru taluk of Mysore district which belong to Southern Transition Zone (Zone 7). The total area under cultivation in Mysore district is 20,069 hectors with average production of 7.66 q/ha (*Anonymous,* 2018).

The major drawback in achieving the potential yield in field bean at Mysore district is the insect pest's damage. Many insect pests severely ravage bean crop's buds, flowers and maturing seeds of bean crop which finally resulting in crop loss and unmarketable. Earlier studies reported that around 55 species of insects and one species of mite feeding on the crop from seedling stage till the harvest in Karnataka (Govindan, 1974). Of these, pod borers are the most important pests regularly causing crop loss to the extent of 80-100% (Reddy *et al,* 2017; Katagihallimath and Siddappaji, 1962), and thus a key Barrier for production and productivity of the crop. The field bean inflorescence is attacked by several species of borers, of which *Exelastis atomosa*, *Adisura atkinsoni* and *Helicoverpa armigera* have been considered as major pests (Mallikarjuna, *et al,*

Corresponding Author's Email - prasuhortico@gmail.com

Table 1. Components of gram pod borer management.

Sr. No.	Particular	Dosage
01	Installation of Pheromone traps at the level of crop canopy	20/ha
02	Azadiractin (Nimbecidine 10000 ppm)	2 ml/liter
03	Emamectin benzoate 5% SG	0.5 gram/liter

2012). Helicoverpa species are polyphagous pests of at least 181 plant species from 49 families including cotton, corn, soybeans, tobacco, tomato, Dolichos bean and chick-pea etc., (Sivakumar *et al,* 2007). The damage inflicted by *H. armigera* is generally limited to flower buds, seeds and pods. High polyphagy, mobility, reproduction rate, and diapause are major factors contributing to its serious pest status and the pest mainly feeds on reproductive structures, growing points such as buds, corn ears, sorghum head and pods of legumes. The damage to these structures will have a direct influence on yield.

The indiscriminate use of the pesticides will lead to development of insecticide resistance, pest resurgence, accumulation of pesticide residue in the final product etc., in order to save the farmers income, to get a good quality produce and for a sustainable agriculture there is a need of integrated pest management in the crop production. This will help the farmers to save their cost and to save the environment. The cryptic behavior of larvae's makes chemical insecticide-based management of pod borers is difficult and challenging. By considering the seriousness of damage caused by the pod borer it is felt necessary to manage major pod borer of field bean by integrated approach. The objective of the present study included demonstration of integrated approaches for the management of gram pod borer by installation of pheromone traps and need based application of insecticides.

MATERIALS AND METHODS

The present investigation was carried out in selected farmer's field at Hulyalu village, Hunsuru Taluk, Mysore district during *Kharif* 2023-24. Hunsuru is situated in Agro climatic region Southern Transition Zone (Zone-7) of Karnataka. All the recommended routine agronomic practices except plant protection measures were followed for raising the field bean crop. The details of the integrated management strategies were mentioned below (Table 1).

The Green funnel pheromone traps were installed @ 20/ha with Heli lure to collect male moths of gram pod borer H. armigera. Polythene cover was tied at the bottom by folding and fastened with stick to prevent the escape of insects. Count was taken by removing the thread at the bottom. Lure was placed in the provision provided for it in the lid of the trap at the center. The spays were initiated after flowering or when there is peak collection of moths in green funnel trap. The bio-pesticide Azadiractin 10000ppm @ 2 ml per liter and Emamectin benzoate 5% SG was sprayed 3 times at 15 days intervals.

In the present study the observation was recorded in each plot on 10 randomly selected and tagged plants. Number of H. armigera larvae was counted on flowers and pods in each selected plant from flowering till the harvest at weekly intervals. The numbers of moths cached by pheromone traps were recorded at weekly interval. For recording observations on pod damage, total and damaged pods from the selected plants were counted at each picking. Pods which are shrunken, deformed and shriveled were considered as damaged pods. Then, the per cent damage was calculated by using below mentioned formula. The yield of green pods was recorded plot wise during each picking, and plot-wise yield obtained was converted into kg/ha.

$$\text{Per cent Pod Damage} = \frac{\text{Number of damaged pods/plants}}{\text{Total Number of pods/plants}} \times 100$$

RESULTS AND DISCUSSION

The results revealed that, green funnel traps installed at the level of crop canopy recorded maximum of 321moths / 8 traps were collected from the flowering to harvest stage in the farmer field. The average maximum number of caches

Fig. 1: Number of *Helicoverpa armigera* moths catches by pheromone trap

Table 2. Average number of moth catches by pheromone traps during *kharif* 2023-24 in relation to Standard Meteorological Week (SMW).

Month	Standard Meteorological Week (SMW)	Average Number of moths caches
October	40	8.20
	41	16.40
	42	13.50
	43	22.90
Oct-Nov	44	35.90
	45	72.70
	46	57.20
	47	36.20
Nov-Dec	48	23.10
	49	14.40
	50	7.50

72.7 moths were recorded among 10 farmers field at 45th Standard Meteorological Week (SMW) coincides with peak flowering to pod formation stage (Table 2). Whereas the minimum number of caches 7.50 were notices during 50th SMW this coincides with pods maturity stage (Figure 1). At the peak flowering stage, we initiated the spraying of Azadiractin 10000 ppm and Emamectin benzoate 5% SG 0.5 gram/liter. The results are in contrast to the findings of Mallikarjuna *et al* (2012) reported that the incidence of *H. armigera* started from beginning of flowering i.e. from bud formation stage to pod maturation stage and it reached peak during third week of November (Pod maturing stage) 2008 with a mean of 80.5 larvae per 10 plants, significantly higher from other weeks. Similarly, Rekha and Mallapur (2007) noticed the peak activity of the gram pod borer pest on field bean during November month. Shinde *et al* (2017) also observed peak incidence of *H. armigera* during second week of November (45th SW) on pigeon pea. Thus, the observations on incidence of *H. armigera* during the study are in accordance with the above reports.

In the present study the per cent pod damage was observed more in farmers plots

Fig. 2: Pod yield and per cent reduction in number of larvae per pod

Table 3. Overall competition between percentage of pod damage and reduction in larvae per plant between farmers practice and technology demonstrated.

Treatment	Before spray	First spray	Second spray	Third spray	Per cent reduction over control
Demonstrated plot	39.72	28.87	17.25	6.50	83.63
Check (farmers practice)	40.84	52.60	68	82	-
Percentage reduction in larval population					
Demonstrated plot	63.50	42.96	64.64	80.09	26.12
Check (farmers practice)	62.68	-	-	-	-

compared to demonstrate one. 3 Sprays were taken in demonstrated plots at 15 days interval and observations were recorded. Before spray the per cent pod damage was 39.72 per cent and it was reduced to 28.87, 17.25 and 6.50 per cent after 1st, 2nd and 3rd spray respectively (Figure 2). The results are in contrast with the findings of Ahmed *et al.* (2020) found Emamectin benzoate @ 1.0 g/ l as the most effective against *M. vitrata* and *H. armigera*. Spinosad 45SC @ 75 ml/ ha followed by Emamectin benzoate 5SG @ 200 ml/ ha were effective against pod borers in lablab and green gram reported by Haripriya *et al* (2021).

The number of larvae per pod was also less in demonstrated plots, whereas maximum number of larvae per plant were observed in untreated control that leads to yield loss and reduces market acceptability. The results of per cent reduction in the larval population for 10 plants reveals that the pre-treatment population varied from 4.3 to 4.8 larvae/plant. The insecticide and botanical/biopesticide sprays at 15 days interval gives best result over control in reducing the larval population of pod borer. After 1st, 2nd and 3rd spray, the maximum larval population reduction was 42.96, 64.64 and 80.09 per cent respectively (Table 4). The results are in accordance with the findings of Khan *et al* (2023) they have observed that installation of pheromone traps 5/ha + need based two sprays of Indoxacarb 14.5 SC@ 1ml/liter showed less fruit infestation of *Helicoverpa armigera* in tomato with increased yield(530q/ha) and BC ratio (1:2.40). Similarly, Shivaraju *et al* (2008), Chittibabu *et al* (2009) and Sonune *et al* (2010) reported that the peak larval activity coincided with peak flowering stage in

Table 4. Yield performance and the cost economics between farmers practice and technology demonstrated.

Particular	Days taken for first harvest	Pods per plant (No.)	Damaged pods (No.)	Pods yield per plant (gm)	Yield (t/ha)	Cost of Cultivation (Rs. /ha)	Gross Return (Rs. /ha)	Net Return (Rs. /ha)	B:C Ratio
Demonstrated plot	56	75.80	9.4	88.5	9.21	55000	180000	125000	3.27
Check (farmers practice)	71	52.60	15.9	64	6.13	65800	132000	66200	2.01

black gram. The present study results were also in conformity with Thejaswi *et al* (2008) they noticed that the incidence of pod borers is peak from second fortnight of November to December first fortnight in field bean at Karnataka and maximum number of larvae per plant were observed at that time.

The yield parameters like number of pods per plant, pod weight and yield per hector are considered for evaluation. During each picking, the yield of green pods was recorded plot wise and was converted into kg/ha. The maximum number of pods per plant (75.80), pod weight (52.60) and average maximum yield was recorded in field beans cultivated by adapting integrated pest management strategies whereas less yield and less number of pods per plant was noticed in untreated control plots. The maximum yield of 92.1 q/ha was recorder in demonstrated plot compare to 61.3 q/ha in untreated plot. The per cent increase in yield over control was 33.44 % (Table 4). The highest benefit cost ratio was recorded in demonstrated fields compared to untreated control plots with 1:3.4 B:C ratio. The similar result was reported by Vaidik *et al* (2023) maximum pod yield was obtained with Emamectin benzoate 5SG (21.75 q/ ha) compare to control 11.11 q/ha. This may be due to less intervention/ minimum number of chemical sprays were taken in the demonstrated plots where in normal farmers plots, they usually take 6 to 8 sprays that will result in more cost incurred in the production. Meena *et al* (2018) obtained maximum yield (16.49 q/ha) in the plots treated with indoxacarb (1.0 ml/lit.) followed by NSKE @ 5.0 ml/lit. (12.22 q/ha). However, the yield obtained from NSKE was comparable to all other treatments but superior than control.

CONCLUSION

Upsurge of pod borer moths' population during November season coincides with peak flowering and pod formation and the effective management of pod borer moths/adults by using pheromone traps helps to manage the pest under economic threshold level without any harmful effects on environment**.** The use of integrated pest management strategy at right time will help to reduce the number of sprays and also reduces the cost of production**.** Reduced pod borer per cent damage and improves pod quality**.** The overall results from the present study indicated that, adaption of integrated pest management strategies will save the cost incurred in production, reduces the harmful effects on environmental flora and fauna, avoid insecticide resistance and improves crop yield as well as farmers income.

ACKNOWLEDGMENT

Very much thankful to ATARI Bengaluru, IIHR Bengaluru and ICAR JSS KVK Senior Scientist and Head in helping me to conduct the present study in the farmers' field and also very much graceful to farmers who are involved in this study and given very much interest and full support during the study.

REFERENCES

Ahmed R N, Uddin M M, Haque M A and Ahmed K S (2020). Field evaluation of microbial derivatives for management of legume pod

borer, *Maruca vitrata (F)*. in yard long bean. *J Entom Zool Stud* **8** (3): 162-166.

Anonymous (2018). https://des.karnataka.gov.in/english.

Govindan R (1974). *Insects of the field bean, lablab niger var. lignosus medikus with special reference to the biology and ecology of the pod borer, A. atkinsoni Moore (Leipdoptera: Noctuidae)*. M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Bengaluru. pp. 1-34.

Haripriya K, Jeyarani S, Mohankumar S and Soundararajan R P (2021). Evaluation of biorational methods against spotted pod borer *Maruca vitrata* (F.) in lablab and green Gram. *Indian J Ento* **83**(2): 269-272.

Katagihallimath S S and Siddappaji C (1962). Observations on the incidence of lepidopteran pod borers of Dolichos lablab and the results of preliminary insecticidal trails to control them. *2nd All India Congress of Zoology* p. 59.

Khan I, Yadav B L, Rathore S S and Singh R (2023). Evaluation of insecticide and pheromone trap efficacy for management of fruit borer (*Helicoverpa armigera*) in Tomato. *J Krishi Vigyan* **11**(Supple): 81-84

Mahalakshmi M S, Sreekanth M, Adinarayana M, Reni Y, Pushpa RAO Y, Koteswara and Narayana E (2016). Incidence, bionomics and management of spotted pod borer [*Maruca vitrata* (Geyer)] in major pulse crops in India-*A review. Agric Rev* **37**(1): 19 - 26.

Mallikarjuna J, Kumar A C T, Chakravarthy A K and Santosh R (2012) Seasonal incidence and abundance of pod borers in Dolichos bean, *Lablab purpureus* L. (Sweet) in Bengaluru, Karnataka, South India. *Current Biotica* **6**(1): 107 - 112.

Rekha S and Mallapur C P (2007). Studies on insect pests of Dolichos bean in northern Karnataka. *Karnataka J Agric Sci* **20**(2): 407 - 409.

Shinde S V, Kadam D R, Sonkamble M M and Kadam B S (2017) Seasonal incidence of pigeon pea pod borers in relation to weather parameters *Agric Update* **12**(3): 648 - 652.

Snafi A E (2015). Therapeutic properties of medicinal plants: A review of plants with anti-inflammatory, antipyretic and analgesic activity. *Int J Pharmacy* **5**(3): 125 - 147.

Vaidik D M, Patel D R and Sankhla P M (2023) Efficacy of insecticides against pod borers of Indian bean. *Indian J Ento* **85**(4): 1012-1015.

Sivakumar S, Rajagopal R, Venkatesh G R, Srivastava A and Bhatnagar R K (2007). Knockdown of aminopeptidase-N from *Helicoverpa armigera* larvae and in transfected Sf21 cells by RNA interference reveals its functional interaction with *Bacillus thuringiensis* insecticidal protein Cry1Ac. *J Biol Chem* **282**: 7312-7319.

Received on 20/4/2024 Accepted on 24/5/2024

DOI : 10.5958/2349-4433.2024.00060.8

J Krishi Vigyan 2024, 12(2) : 333-337

Meat Consumption Pattern among Students of Veterinary College and Research Institute, Tirunelveli

R Jayanthi[*1], V Chandirasekaran [2] and M Boopathy Raja [3]
Department of Livestock Products, Veterinary College and Research Institute,
TANUVAS, Tirunelveli-627 358

ABSTRACT

The present study was conducted at the Veterinary College and Research Institute, Tirunelveli to study the meat consumption pattern among the students with a sample size of 295 respondents. Preference for red meat and white meat has more impact on the meat consumption pattern. As well as the age factor has a valuable influence on meat consumption patterns. Age of the students involved in the study was 17 yrs to 24 yrs old. The results revealed that the most preferred choice of meat was chicken (76.6%) followed by Chevon (11.2%) and mutton (9.5%). The frequency of meat consumption revealed that most of the students consume meat once a week (49.5%) followed by twice a week (25.1%). Most of the students (73.9%) were aware of processed meat with the choice of preference to consume (32.9%). Whereas 41.7% of the students did not prefer to consume processed meat products. 42.7% of students expressed their reason for meat consumption as taste (42.7%) followed by nutrition (42.4%).

Key Words: Consumption pattern, Meat, Meat Products, Processed meat, Students.

INTRODUCTION

Food of animal origin with protein contents is the first in the food chain in which meat occupies the major position (Chemnitz and Becheva, 2014). In India, the availability of meat is comparatively lower than in other developing countries. India is providing only about 15 g/person/day against the ICMR recommendation of 30 g/person/day in the year 2016 (Islam *et al,* 2016). Jackson *et al* (2016) reported that there was a promising relationship between meat intake and iron status. The production and consumption data are tremendously increasing even though traditions and culture influence meat consumption to a great extent in India.

Culture, traditions, customs, taboos and finally the quality of the available meat products influence the consumption pattern of meat and meat products, in all levels of Indian society. Nutritional, functional and hygienic attributes of available market meat products determine its acceptability. Therefore, maintaining the optimum quality of meat products should always be the priority of both processors and retailers engaged in the meat business. Structured information on meat consumption patterns and existing market meat products quality in a particular area is very much necessary to develop future strategies for face lifting of meat processing industries in that area because in the present world, the supply of quality food to the consumer in its safest form is the biggest challenge to the food processors (Talukder and Mendiratta, 2017). Meat is the most important food commodity of animal origin food. It contains quality protein, tastiness enhancing fat, energy providing carbohydrates, vitamins as well as essential fatty acids and micronutrients which make it a balanced diet for most people in all age groups (Sharma *et al,* 2018). Meat is a good source of energy and some essential nutrients including protein and micronutrients such as iron, zinc, and

Corresponding Author's Email - jayvet1212@gmail.com
1 Assistant Professor, Department of Livestock Products Technology,
Veterinary College and Research Institute, TANUVAS, Tirunelveli-627 358. Contact No: 7418404924
2 Professor and Head, Department of Livestock Products Technology,
Veterinary College and Research Institute, TANUVAS, Tirunelveli-627 358. Contact No: 8667375720
3 Assistant Professor, Department of Animal Husbandry Extension Education, Veterinary
College and Research Institute, TANUVAS, Tirunelveli-627 358. Contact No: 9688806000

Table 1. Demographic information of the students/ respondents.

Particular	Frequency (n=295)	Percentage %
Age (Year)		
17	16	5.4
18	68	23.1
19	59	20.0
20	32	10.8
21	25	8.4
22	54	18.3
23	38	12.9
24	3	1.0
Sex		
Female	188	63.7
Male	107	36.3
Family size		
<5	200	67.8
5	69	23.4
>5	26	8.8
Family Income		
50,000-1,00,000	158	53.6
1,00,000-2,00,000	44	14.9
>2,00,000	93	31.5

vitamin B12—although it is possible to obtain a sufficient intake of these nutrients without eating meat if a wide variety of other foods is available and consumed (Godfray *et al,* 2018).

The majority of meats consumed in India are chicken, chevon, mutton, pork and beef. In the Indian context, culture, traditions, customs, and religious taboos influence meat consumption to a great extent (Devi *et al,* 2014). However, urbanization and globalization have an impact over lifestyle as well as food habits. The consumption pattern of livestock products like meat and meat products has changed a lot with the purchasing power and availability of a variety of meat products. In earlier days the price of meat and meat products were a major concern, but in recent days many factors like age, sex, family size and income are involved in the expenditure on meat and meat products.

Generally, the food consumption pattern changes among the sex. Men consume heavily food than women. Likewise, the preference for meat, place of meat and meat products consumption, and place of meat purchase is also varying depends upon the generation or age factor. During this period, young people love to eat at fast foods, street foods and restaurants whereas old age people always prefer homemade foods. These kinds of factors influence the meat consumption pattern among people. The knowledge about food demand and consumer behaviour towards food is essential for finding answers to various policy development issues like improvement in nutritional status, food subsidy, and sectoral, etc. Therefore, to assess the food security-related policy issues an analysis of food consumption patterns and how these patterns are likely to shift due to changes in income and relative prices are required (Mittal, 2020). Hence, this study was planned to get data on meat consumption patterns among the students, so that the choice of preference of meat and more information regarding meat consumption will be obtained to determine the meat consumption pattern.

Table 2. Data on meat consumption pattern.

Preference of meat		
Type of meat	**Frequency (n=295)**	**Percentage (%)**
Beef	8	2.7
Chevon	33	11.2
Chicken	226	76.6
Mutton	28	9.5
Pork	-	-
Frequency of meat consumption		
Frequency	**Frequency (n=295)**	**Percentage (%)**
Daily	7	2.3
Weekly once	146	49.5
Weekly twice	74	25.1
Monthly once	68	23.1
Awareness on processed meat		
Choices	**Frequency (n=295)**	**Percentage (%)**
Yes	218	73.9
No	77	26.1
Opinion on processed meat consumption		
Choices	**Frequency (n=295)**	**Percentage (%)**
Preferred	97	32.9
Not Preferred	123	41.7
No idea	75	25.4
Reason for meat consumption		
Reason	Frequency (n=295)	Percentage (%)
Cheap	-	-
Forced (by parents)	11	3.7
Habituated	33	11.2
Nutrition	125	42.4
Taste	126	42.7
Family annual income		
Annual Income	**Frequency (n=295)**	**Percentage (%)**
50,000-1,00,000	158	53.6
1,00,000-2,00,000	44	14.9
>2,00,000	93	31.5

MATERIALS AND METHODS

The study was conducted as a pilot study among the students of Veterinary College and Research Institute, Tirunelveli, Tamil Nadu using exploratory research design in the year 2023. 295 respondents were involved in this study to provide basic information on meat consumption pattern and their preference towards meat and meat products through the Google Forms platform. The responses have been collected from first year to final year students. The obtained results were subjected to statistical analysis. The least significant differences were calculated at the appropriate level of significance following analysis of variance.

RESULTS AND DISCUSSION

The demographic information of the students is presented in Table 1. A collective of questions were asked through google forms to every individual. The data were presented by frequency and percentage in table 2.

The results of the demographic information showed that the age group involved in this study was 17-24 years old. The age is the important factor in the meat consumption pattern determination since, the choice of meat and amount of meat consumption influences the data predominantly. The female respondents were 63.7% and male respondents were 36.3%. The sex factor was also influencing the meat consumption pattern mainly by the choice of preference of meat. 67.8% of the respondents were from the family size of less than 5 members. The frequency of meat consumption and different types of meat consumption was more in small size families when compared to large size families. Most of the respondent's family annual income was less than 1 lakh (53.6%) followed by more than 2 lakh (31.5%) and between 1-2 lakh (14.9%). The purpose of this question was to acquire the data on the influence of status on meat consumption pattern. In that aspect, Akinwumi *et al,* (2011) indicated that cost, availability, and income have the most limiting factors of meat preference.

The meat consumption pattern of the students is given in Table 2. It revealed that most of the respondents were preferred chicken meat (76.6%) when compared to chevon (11.2%), mutton (9.5%), beef (2.7%) and pig (0%). This trend was in line with Priyadharsini *et al* (2016); Desilva *et al* (2010); Teklebrhan (2013); Srinivasa *et al* (2010); Babu *et al* (2010). They also indicated in their study that, most of the respondents preferred chicken (50%) followed by chevon (40%) and least preference was given to mutton and seafoods (5%). None of the respondents preferred pork and beef. The less preference over the beef and pig meat is may be due to the religious taboos.

The frequency of meat consumption was reported mostly as weekly once (49.5%) followed by weekly twice (25.1%), monthly once (23.1%) and daily (2.3%). This was mainly based on the economic status as well as the interest in having nonveg for its taste. The awareness about processed meat and meat products was comparatively high with the results of 73.9% of respondents having knowledge and exposure to processed meat and meat products. Whereas, the preference towards processed meat and meat products was comparatively less. Around 41.7 % of the respondents have not preferred processed meat foods whereas 32.9% of the respondents were the choice of preference on processed meat products. This result was in agreement with Tzimithra (1997). Kiran *et al* (2018) also observed that consumer awareness about frozen meat was very low compared to fresh meat in Southern India. The lack of awareness and interest in processed meat was mainly due to the unavailability of processed meat. The results of reasons for meat consumption were mainly by taste (42.7%) followed by nutrition (42.4%), habituation (11.2%) and forced by parents (3.7%). Even though the students are well knowledgeable in the nutritional status of the meat, as a human being the taste plays a major role. As per the statement revealed based on the milk consumption pattern study of Ahuja and Sharma (2014) it could be possible to consume meat and meat products only when the price of livestock products is low.

CONCLUSION

It can be concluded that the students consume meat and meat products a maximum of once a week. Even though they have accessibility to nearby restaurants/ fast food outlets apart from the hostel mess, the frequency of meat consumption is comparatively very less due to the cost of meat and meat products. Hence, it was found that cost is the major factor that influences the meat consumption pattern among students of Veterinary college and research institute.

ACKNOWLEDGEMENT

The authors are thankful to The Dean, Veterinary College and Research Institute, Tamil Nadu Veterinary and Animal Sciences University, Tiruneleveli, for providing the necessary permissions to carry out the survey work.

REFERENCES

Ahuja A K and Sharma M (2014) Milk consumption pattern among rural farm women of district Kapurthala. *J Krishi Vigyan* **3**(1): 48-53

Akinwumi A O, Odunsi A A, Omojola, A B, Aworemi. J R and Aderinola O A (2011). Consumer perception and preference for meat types in Ogbomoso area of Oyo State, Nigeria. *Int J Appl Agric Res* **7**(1-2):96-106.

Babu A J, Sundari A R, Triveni G and Indumathi J (2010) Study on meat consumption patterns in rural households of Chittoor District of Andhra Pradesh. *Tamilnadu J Vety Anim Sci* **6**(4):183- 187.

Chemnitz C and Becheva S (2014). Meat Atlas. Retrieved 24 February 2014 from: www.foeeurope.org/meatatlas.

De Silva, P H G J, Atapattu, N S B M and Sandika A L (2010). A study of the socio: cultural parameters associated with meat purchasing and consumption pattern: A case of southern province, Sri Lanka. *J Agri Sci* **5**(2):71-79.

Devi S M, Balachandar V, Lee S I and Kim I H (2014). An outline of meat consumption in the Indian population-A pilot review. *Korean J Food Sci Anim Res* **34**(4): 507-515.

Godfray H C J, Aveyard P, Garnett T, Hall J W, Key T J, Lorimer J, Pierrehumbert R T, Scarborough P, Springmann M and Jebb S A (2018). Meat consumption, health, and the environment. *Sci* **361**, 243:1-8

Islam M M, Anjum, S, Modi, R J. and Wadhwani K N (2016). Scenario of livestock and poultry in India and their contribution to the national economy. *Int J Sci Env Technol* **5**: 956-965.

Jackson J, Williams, R, McEvoy, M, MacDonald-Wicks, L and Patterson A (2016). Is higher consumption of animal flesh foods associated with better iron status among adults in developed countries? A systematic review. *Nutr* 8,89:1-27.

Kiran M, Prabhu M K N, Paramesha S C, Rajshekar T, Praveen, M P and Punitkumar C (2018). Consumption pattern, consumer attitude and consumer perception on meat quality and safety in Southern India. *Int Food Res J* **25**(3):1026-1030.

Mittal S (2020). *Structural shift in demand for food: Projections for 2020*. Working Paper No. 184, Indian Council for Research on International Economic Relations, New Delhi 2006.

Priyadharsini S, Kathiravan, G., Thirunavukkarasu, P and Ganpat W (2016). Evaluation of determinants influence for consumption of livestock products in second tier cities of Tamil Nadu, India. Bangladesh. *J Anim Sci* **5**(3):25-30.

Sharma S, Pathak V, Singh V P, Awasthi M and Bharti S (2018). Comparative quality assessment of meat nuggets prepared from meat of different food animals. *Int J Livest Res* **8**(1): 139-148

Srinivasa R M and Thammiraju D (2010). Meat consumption pattern in Hyderabad city. *Indian J Anim Res* **44**(4): 248-253.

Talukder S and Mendiratta S (2017.) Exploring purple leaf sand cherry (Prunus cistena) extracts based indicator to monitor meat quality during storage at 10 ± 1° C. *Int J Livest Res* **7**(8): 214-220.

Teklebrhan T (2013). Consumer Perceptions and Preferences of Meat Types in Harar and Haramaya Towns, Ethiopia, *J. Microbiol Biotechnol and Food Sci* **2**(3):959-969.

Tzimitra K (1997). Greek consumer behavior to meat. *Agricoltura Mediterranea*. **127**:61-69.

Received on 8/5/2024 Accepted on 30/5/2024

DOI : 10.5958/2349-4433.2024.00061.4

J Krishi Vigyan 2024, 12(2) : 338-341

Motivational Factors in Adherence to Act, Rules and Guidelines Given by CAA for Shrimp Farming: A Study from North Konkan Region, Maharashtra

P P Yadav, S V Patil*, K J Chaudhari, B V Naik, B M Yadav, S M Wasave, V G Yewale, G S Vankar and S C Kamble

College of Fisheries (Dr. B. S. Konkan Krishi Vidyapeeth), Ratnagiri, Maharashtra

ABSTRACT

The study was carried out to investigate the motivational factors in adherence to act, rules and guidelines given by Coastal Aquaculture Authority (CAA) in shrimp farming. Information was collected randomly from 108 shrimp farmers from North Konkan region, Maharashtra using interview schedule. The weighted average technique was used to understand various motivational factors in adherence to act, rules and guidelines given by CAA in shrimp farming. The study revealed that, the top motivating factors were practicing environmentally responsible and socially acceptable coastal aquaculture, minimize impacts on local water resources and minimize impacts on surrounding resource user. Reducing the risks associated with shrimp diseases, utilizing land and water resources for sustainable shrimp farming and following better management practices and maximizing economic returns on investment within a reasonable time frame was least motivating factor in adherence to sustainability. The motivation can be enhanced by conducting awareness among shrimp farmers about act, rules and guidelines given by CAA.

Key Words: Adherence, Motivation, Maharashtra, Shrimp farmers, Sustainable practices.

INTRODUCTION

Aquaculture has been the world's fastest-growing food production system for decades and contributes to half of all global seafood production, reducing pressure on natural fishing, and maintaining an average growth rate of 4.5% per year in 2011–2018 (FAO, 2020; Pradeepkiran, 2019). However, a rapid growth of pond areas and lack of production area planning have led to undesirable environmental and social impacts (FAO, 2020). To minimize the adverse effects of harmful existing shrimp aquaculture practices, better management practices given in CAA guidelines have been implemented through the issuance of legal frameworks in India.

Globally, White leg shrimp *Litopenaeus vannamei* is considered as an important aquaculture species with high export potential and profit margins (Singh, 2020). Shrimp aquaculture farming system was selected as it is an important farm enterprise, contributing significantly to the nutritional, food security, employment and socio-economic development of coastal communities (Patil and Sharma, 2023).

Maharashtra is the third largest state in the country in terms of area and population, with a coastline of 720 km. Among all the coastal states, Andhra Pradesh ranks first with a total shrimp production of 7,88,708 MT followed by West Bengal with total shrimp production of 69,595 MT (MPEDA, 2022). Maharashtra ranked sixth in terms of cultured shrimp production with production of 4,777 MT during 2021-22 (MPEDA, 2022).

In 1997, the Global Aquaculture Alliance (GAA) was founded with the mission of fostering a sustainable future for the aquaculture industry. During an Aquaculture Industry conference in 1996, it was collectively decided that sustainability hinges not solely on production intensity, but rather on the quality of the site, effective management practices, and the compatibility of technology with both site conditions and management strategies. (Phornprapha, 2020). Geographic location, socio-demographic variables, institutional structures and other factors significantly influence a farmer's motivations which in turn may also affect that farmer's economic decisions (Meuwissen *et al*, 2001).

Corresponding Author's Email - sandeshpatil17@gmail.com

Table 1 Motivational factors in adherence to act, rules and guidelines given by CAA for shrimp farming. (N = 108)

Sr. No.	Motivating factors in adherence to sustainability in shrimp farming	Weighted Average	Rank
1	Environmentally responsible and socially acceptable coastal aquaculture	1.46	I
2	Minimize impacts on local water resources	1.46	I
3	Minimize impacts on surrounding resource user	1.46	I
4	To ensure orderly development of shrimp aquaculture	1.44	II
5	Conserve sensitive aquatic habitats and ecosystem function	1.44	II
6	Avoid escape of exotic species into the environment	1.43	III
7	Responsible use of chemicals, probiotics and pharmaceuticals	1.43	III
8	Reduce the risk of shrimp diseases	1.41	IV
9	Use of land and water for sustainable shrimp production	1.41	IV
10	Follow Better Management Practices (BMPs)	1.41	IV
11	Maximize return on investment within a reasonable time frame	1.38	V

Therefore, present study was undertaken to understand the motivational factors in adherence to sustainable practices in shrimp aquaculture.

MATERIALS AND METHODS

The state of Maharashtra includes seven coastal districts *viz*. Palghar, Thane, Greater Mumbai, Mumbai suburban, Raigad, Ratnagiri and Sindhudurg popularly known as 'Konkan region'. North Konkan region comprising Palghar and Raigad district were selected purposefully as these districts contribute significantly in the brackishwater shrimp production and has 198 operational shrimp farms. A total of 108 shrimp farms were randomly selected for the study comprising of 58 shrimp farms from Palghar district and 50 shrimp farms from Raigad district. The act, rules and guidelines given by Coastal Aquaculture Authority (CAA) was used as base to understand various motivational factors in adherence to sustainable shrimp farming practices by shrimp farmers.

In order to prioritize various motivational factors in adherence to sustainable shrimp farming practices by shrimp farmers, weighted average technique was carried out (Patil and Sharma, 2021). The weighted average score for every motivational factor was calculated by multiplying frequency of every motivational factor with respective weight or score. The weights used for calculating the weighted average were agree = 2, neither agree nor disagree =1 and disagree =0. The following formula is used for calculating the weighted average:

Weighted average score= Sum (X1. W1 + X 2.W2 + X3. W3 / Sum (W1+W2 +W3)

Where,

Frequency of the respective motivational factors is X1, X2, X3

Weighted values i.e., 2, 1, 0 = W1, W2, W3.

RESULTS AND DISCUSSION

Motivational factors

This section covers the motivational factors in adherence to act, rules and guidelines given by CAA for shrimp farming and same is presented in Table 1.

The results revealed that practicing environmentally responsible and socially acceptable coastal aquaculture, minimize impacts on local water resources and minimize impacts on surrounding resource user was ranked as first motivating factor for adherence to sustainable shrimp farming practices. The second ranked motivating factors were ensuring orderly development of shrimp aquaculture and conservation of sensitive aquatic habitats and

ecosystem function. Preventing escape of non-native species into the environment and the responsible use of chemicals, probiotics and pharmaceuticals was ranked third motivating factor in adherence to sustainable shrimp farming practices.

Phong *et al* (2021) studied motivation of farmers to accept good aquaculture practices and reported that market pressures (expanding pond size and more stocking) drive the farmers to increase productivity in shrimp farming. He also reported that, provision of a consistent market for their output and the opportunity for price premiums can serve as strong motivation for farmers to adopt and maintain Good Aquaculture Practices. Insurance for aquaculture has the potential to motivate farmers to adopt Good Aquaculture Practices by reducing the level of risk they face (Hadnes and Czura, 2014; Pongthanapanich *et al*, 2019). Dewan (2011) reported that 70% respondents engaged in shrimp farming because they believed that it offered higher income potential compared to other agricultural activities.

CONCLUSION

The study concluded that following better management practices was not top ranked factor of motivation in adherence to sustainability. It is very much important to understand the factors that motivate the farmer in adherence sustainability because this motivation plays an important role in enhancing both productivity and sustainability in shrimp farming. Additionally, this will help government in formulating new schemes or policies for the benefit of shrimp farmers. The study suggested that the motivation can be enhanced by conducting awareness among shrimp farmers about act, rules and guidelines given by CAA.

REFERENCES

Dewan A A (2011). Farmers' motivations, risk perceptions and risk management strategies in a developing economy: Bangladesh experience. *J Risk Res* **14** (3): 325-349.

FAO (2018). *The State of World Fisheries and Aquaculture. Meeting the sustainable development goals*. License: CC BY-NC-SA 3.0 IGO. Food and Agricultural Organization of United Nations, Rome, Italy, 227 p.

FAO (2020). *The State of World Fisheries and Aquaculture 2020*. Sustainability in Action. Food and Agriculture Organization of the United Nations (FAO), 206 p.

FAO (2022). The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation. Rome, Italy, 266 p.

Hadnes M and Czura K (2014). Evaluation of governmental pilot program on aquaculture insurance in Ca Mau Province for the period of 2011 till 2013. *Ho Chi Minh City, Viet Nam: Integrated Coastal Management Programme* (ICMP).

Meuwissen M P M, Hurine R B M and Hardaker J B (2001). Risk and risk management: An empirical analysis of Dutch livestock farmers. *Live Prod Sci* **69**: 43–53.

MPEDA (2022). Annual Report 2021-22. *The Marine Products Export Development Authority*. Cochin, India, 379 p.

Patil S V and Sharma A (2023). Profile of fisheries officials of Maharashtra and information sources used by them in shrimp farming. *J Krishi Vigyan* **11**(2): 298-303.

Patil S V and Sharma A (2021). Constraints faced and test of agreement among shrimp farmers of Palghar district in Maharashtra. *J Krishi Vigyan* **9** (2): 22-28.

Phong T N, Thang V T and Hoai N T (2021). What motivates farmers to accept good aquaculture practices in development policy? Results from choice experiment surveys with small-scale shrimp farmers in Vietnam. *Econ Anal Policy* **72** : 454-469.

Phornprapha W (2020). *Shrimp Farming in Thailand: A pathway to Sustainability*. Pomona Senior Theses. 208 p.

Pongthanapanich T, Nguyen K A T, Jolly C M (2019). Risk Management Practices of Small Intensive Shrimp Farmers in the Mekong Delta of Viet Nam (Report No. FAO Fisheries and Aquaculture Circular No. C1194). Food and Agriculture Organization of the United Nations (FAO), 1-20.

Pradeepkiran J A (2019). Aquaculture role in global food security with nutritional value: A review. *Transl Anim Sci* **3**(2): 903–910.

Singh P, Tyagi A and Kumar B T (2020). Impact of shrimp farming technology for economic upliftment of rural societies in inland saline areas of Punjab. *J Krishi Vigyan* **9** (SI): 172-179.

Received on 25/3/2024 Accepted on 18/5/2024

DOI : 10.5958/2349-4433.2024.00062.0

J Krishi Vigyan 2024, 12(2) : 342-350

Nutritional, Biochemical and Sensory Properties of Snack Bars Enriched with Fish Protein Powder

Parmeet Kaur[1], Ajeet Singh[1*], Vijay Kumar Reddy Surasani[1], Nitin Mehta[2]
Department of Fish Processing Technology
College of Fisheries
Guru Angad Dev Veterinary and Animal Science University, Ludhiana (Punjab) 141004

ABSTRACT

Ready-to-Eat (RTE) and Ready-to-Cook (RTC) are the new concepts in the food industry to define how quickly and conveniently food can be prepared and relished. Trials were conducted to develop a nutrition bar supplemented with fish protein powder extracted from carp (*Labeo rohita*) to improve protein in snack bar. The nutrition bar without Fish Protein Powder (FPP) was considered as control (C), whereas Fish Protein Powder was added @ 2.5% in T1, 5.0% in T2, 7.5% in T3, 10.0% in T4, and 12.5% in T5. Nutrition bars were analysed for proximate composition; the moisture content of the nutrition bars ranged between 6.22-6.25%, Protein 13.79% (in control) to 27.70% (T5). Fat 10.82% (T5) to 12.10% (control), Ash 2.51% (Control) to 2.87% (T5), and carbohydrate 52.36% (T5) to 65.33% (control). 'L*' & 'a*' values of colour analysis were increased, whereas 'b*' value decreased with the addition of FPP. Hardness of the nutrition bar was also increased due to the addition of Fish Protein Powder. Among all the treatments T3 (7.5% FPP) was highly accepted by the sensory evaluators. It can be concluded that FPP can be added to the nutrition bar up to 7.5% without significantly altering its sensory acceptability.

Key Words: Fish Protein Powder, Nutrition bar, Proximate Composition, Sensory properties Textural.

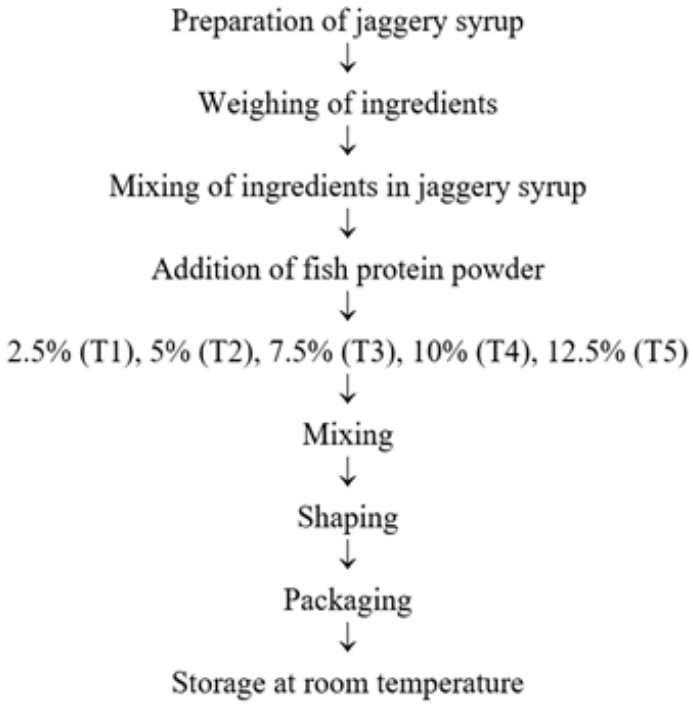
INTRODUCTION

A growing global population, combined with factors such as changing socio-demographics, is putting increased pressure on the world's resources to produce more production. Simultaneously, the supply of nutritious food is also a big challenge. Protein is such essential nutrient required for growth, body maintenance, enzyme formation, hormone synthesis, immunity, acid-base regulation, and fluid balance. Protein-energy malnutrition (PEM) remains one of the biggest nutritional challenges worldwide. Approximately 1 billion people worldwide do not get enough protein in their diets, leading to stunted growth and development (Wu *et al*, 2014). Malnutrition, mainly due to protein deficiency, is a problem worldwide. Proteins are essential biopolymers that can be obtained from both animal and plant sources. The outstanding bioactivities, as well as functionalities, have been studied in recent years, and these have gained more popularity by contributing to health promotion and food processing industries (French *et al*, 2016 and Rehman *et al,* 2019).

Fish is considered an excellent source of protein due to the presence of essential amino acids and the demand for fish protein ingredients including dried fish protein is gradually increasing. Proteins from aquatic animals usually play important roles in improving cardiovascular and other associated health conditions (Torris *et al,* 2018). Fish protein is known for containing essential amino acids (i.e., tryptophan, cystine, lysine, methionine, and threonine), as well as for improving digestibility. However, the presence of peptides and essential amino acids is much higher in proteins of aquatic animals than proteins in terrestrial animal meat such as lysine and methionine (Tacon and Metian, 2013). The composition and digestibility of protein ranging from 77.0 to 98.7% were determined by comparing it with the standard protein

Corresponding Author's Email - azeet2singhh@rediffmail.com
1Department of Fish Processing Technology College of Fisheries, Guru Angad Dev Veterinary and Animal Science University, Ludhiana (Punjab) 141004
2Department of Livestock Products Technology, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Science University, Ludhiana (Punjab) 141004

Fig. 1 Flow diagram for preparation of carp (*Labeo rohita*) fish protein powder supplemented nutrition bar.



recommended by the World Health Organization (WHO).

Fortification of protein, to food products available most commonly in nearby areas can help to cater to such issues. Several new protein ingredients including fish protein powder (FPP) have been used as a source of protein energy to make diet nutritious. Several factors, including increased working hours, modern living, and rapid urbanisation, are influencing the way individuals consume food (Singh *et al*, 2023). Snack bars (SBs), also referred to as cereal bars or nutrition bars, are widely consumed because they give instant energy, can be a source of intake of beneficial nutrients, such as fiber, protein, minerals, and vitamins, and are easy to carry and transport (Zulaikha *et al*, 2021). The inclusion of fish protein can be a good alternative to improve the nutritional quality of available cereal bars. Further, in addition to improving their nutritional value, the inclusion of fish protein could promote fish consumption (Vitorino *et al*, 2020). The bars offer a readily available convenient food source that requires no preparation, and a reasonably long shelf life at ambient temperature. Hence bars are popular as convenient food and can be consumed in between meals or along with lunch or dinner or even as meal substitutes (Constantin and Istrati, 2018) and can be a substitute to supply nutritious food to consumers.

In this regard, the trials were conducted to develop a nutrition bar supplemented with fish protein powder extracted from carp (*Labeo rohita*) which will help to serve as a healthy and nutritious alternative to the consumers.

MATERIALS AND METHODS

For the present study, fish protein powder was extracted from rohu (*Labeo rohita*) fish, which was procured from the Experimental cum Research Unit of the College of Fisheries, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. Fishes were beheaded, eviscerated, de-scaled, de-skinned, and cut to obtain fillets. Further, the fillets were thoroughly washed and then it was passed through a locally

Table 1. Proximate composition (%) of fish protein powder extracted from rohu fish

Nutrient	Quantity (%)
Moisture	4.14
Protein	86.54
Fat	2.89
Ash	3.51
Carbohydrate	2.84

fabricated deboning machine to obtain bone-free mince. The mince was treated with 0.5% citric acid and washed twice with chilled water and then the mince was dried in a hot air oven at 55°C. After drying, meat was grounded mechanically in a grinder and sieved to obtain fish protein powder.

The bar was prepared by adding the ingredients jaggery @ 40.5% mixture of roasted peanut powder, oats flakes and corn flakes (1.5:1.4:1.0) @ 39%, roasted almond powder, cashew powder, sesame seed, dextrin @ 5% each and common salt 0.5% in control, whereas fish protein powder was added @ 2.5% in T1, 5.0% in T2, 7.5% in T3, 10.0% in T4, and 12.5% in T5 replacing mixture of roasted peanut powder, oats flakes and corn flakes (1.5:1.4:1.0). Shape of bar was maintained with the help of food-grade stainless steel bar frame. Method of carp (*Labeo rohita*) fish protein powder supplemented nutrition bar formation is given in Fig. 1.

The proximate composition of fish protein powder and bar prepared (Control and T1-T5) w.r.t. moisture, protein, fat, and ash were analysed as per AOAC, 2022 method, whereas carbohydrate content was calculated by numerical formula [(Carbohydrate (%) = 100 – (Moisture % + Protein % + Fat % + Ash %]. The biochemical parameters including pH, Free Fatty Acids (FFA), and Peroxide Value (PV) were analysed following the standard methodology described by Trout *et al* (1992) for pH and Koniecko (1979) for free fatty acid and peroxide value. Colour analysis of the nutrition bar was performed using Konica Minolta (Model: Chroma meter CR 400) to obtain colour values as L*, a* and b*. The Texture Profile Analysis of the bars was performed using TA-XT plus texture analyser (Stable Micro Systems, Surrey, UK). The sensorial attributes were evaluated by following the 9-point hedonic scale (Like extremely-9, Like Very Much-8, Like Moderately-7, Like Slightly-6, Neither Like nor Dislike-5, Dislike Slightly-4, Dislike Moderately-3, Dislike Very Much-2, and Dislike Extremely-1) as per the methodology suggested by Popper *et al* (2004). The data were statistically analysed for Analysis of variance (ANOVA) using Duncan's Multiple Range Test (SPSS v. 20.0 for Windows, SPSS Inc., Illinois, USA) to determine the significant difference in treatments.

RESULTS AND DISCUSSION

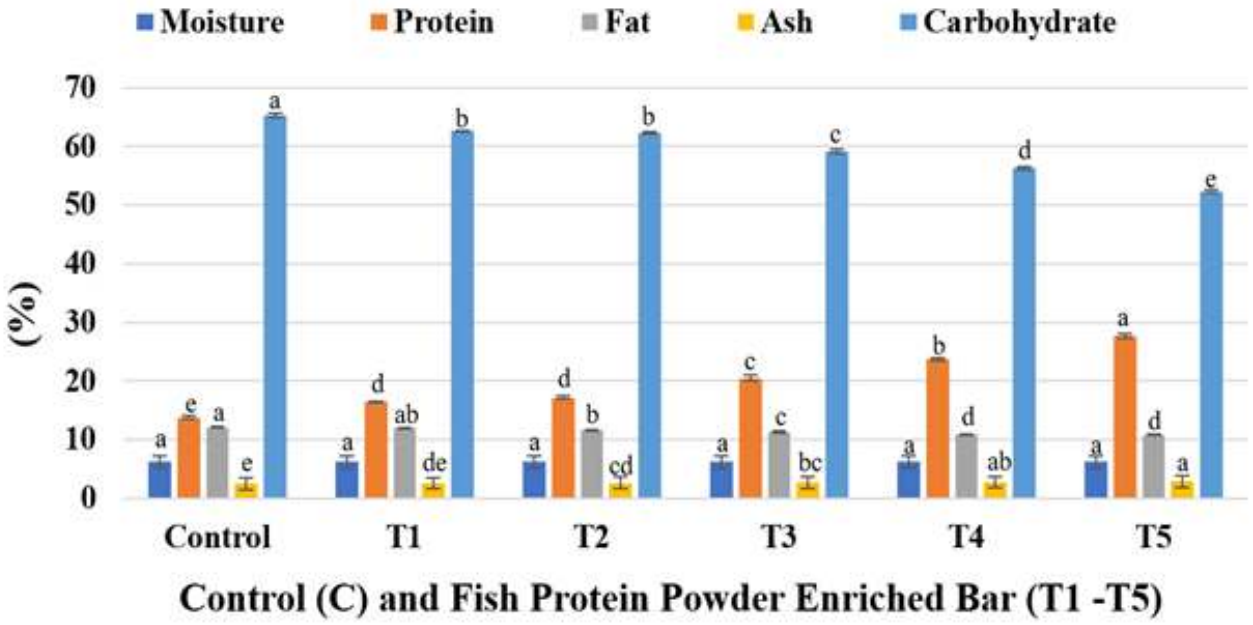
Protein content in fish protein powder was recorded 86.54%, fat 2.89%, Ash (as minerals) 3.51% and carbohydrate 2.84%. Details of the proximate composition of fish protein powder extracted from rohu fish are given in Table 1.

Jahan *et al* (2017) reported protein 66.90%, 68.46%, 62.18%, fat 19.33%, 15.71%,18.65%, minerals 0.24%, 0.44%, 0.36%, and carbohydrate 1.75%, 4.85%, 1.98% in rohu, mrigal and silver carp respectively. Kabir (2022) quantified protein content in tilapia and silver carp fish powder as 63.6% and 73.5%, respectively. Kasozi *et al* (2018) analysed the nutrient composition of fish protein powder extracted from *Brycinus nurse* and reported 50.4% protein. Shaviklo *et al* (2012) reported 94.04% protein in freeze-dried saithe (*Pollachius virens*) protein isolate. According to Shaviklo (2015), the protein content in fish protein powder chiefly depends on the type of fish, moisture, and other additives, but it contains at least 65% protein. In the present study, the high protein content in fish protein powder may be due to the thorough washing and acid treatment which may help to improve the protein content in FPP, drying also plays a major role in the quantity of protein in the product.

Proximate Composition of Nutrition Bars

The proximate composition w.r.t moisture, protein, fat, ash, and carbohydrate content in the nutrition bar is given in Fig.2.

Fig. 2 Proximate composition of bar control (C) and enriched with fish protein powder (T1-T5).



Moisture content

Moisture content is an important parameter that plays a crucial role in shelf life and modifies the textural properties of the product. In the present study, moisture content was recorded 6.22% in control (C), 6.21% in T1, 6.23% in T2, 6.25% in T3, 6.22% in T4, and 6.24% in T5, and No-significant ($P<0.05$) difference was recorded among the treatments. Moisture is a key influencing factor responsible for the shelf life of the product (Steele, 2004). Moisture content below 10 g/100 g is the normal requirement for dried fish powder products (Abbey *et al,* 2017; Kasozi *et al*, 2018 and Mahmud *et al,* 2019) and in the present study, moisture content was much lower than the suggested quantity by Abbey *et al* (2017), which indicates that the product was well dried.

Protein content

Significant ($P<0.05$) variation in the protein content of the nutrition bar was recorded, it was highest in T5 (27.70%) and lowest in control (C) i.e., 13.79%. The quality and characteristics of fish protein ingredients are highly dependent on the source of the raw materials and the processing methods (Arason *et al,* 2010). The FPP is a dried and stable fish product, intended for human consumption, in which the protein is more concentrated than in the original fish flesh (Shaviklo *et al,* 2015). It is well documented that the addition of FPP in conventional products improves the protein content in carbohydrate-rich processed products (Souza *et al,* 2017; Desai *et al,* 2019; Vitorino *et al,* 2020).

Fat content

The fat content showed a reducing trend from 12.10% in control (C) followed by T1, T2, T3, T4, and T5 (10.82%) in decreasing order. The reason behind the reduction in fat content in the bar w.r.t. increased quantity of addition of the FPP may be that the FPP contains very low levels of fat. Fat is an important nutrient of food, and products and affects the textural, sensorial, and other quality characteristics of the product. The amount of fat in the nutrition bar mainly comes from the ingredients added to it during formulation. Ash content was significantly high in T5 (2.87%) and low in control (C) (2.51%) and the trend shows that as the quantity of fish protein powder increases, the quantity of ash also increases.

Total Ash

Ash is an inorganic residue remaining after the water and organic matter have been removed through burning in the presence of oxidizing agents, which provides a measure of the total amount of minerals within a food. Elnovriza *et al* (2019) reported 4.44% ash content in the fish bar

Table 2. Biochemical parameters of nutrition bar control and enriched with fish protein powder

Parameter	Treatment					
	Control (C)	T1	T2	T3	T4	T5
pH	6.20±0.01^{a}	6.16±0.03^{a}	6.18±0.02^{a}	6.17±0.07^{a}	6.20±0.07^{a}	6.18±0.09^{a}
Free Fatty Acid (% Oleic acid)	0.098±0.002^{a}	0.088±0.002^{b}	0.083±0.002^{bc}	0.078±0.001^{cd}	0.071±0.002^{de}	0.066±0.002^{e}
Peroxide value (meq/kg)	0.198±0.00^{a}	0.198±0.00^{a}	0.197±0.00^{a}	0.198±0.00^{a}	0.197±0.00^{a}	0.195±0.01^{a}
Texture (Hardness as kg force)	3761.66±0.74^{f}	3861.20±0.50^{e}	4245.33±0.33^{d}	4918.06±0.43^{c}	5518.06±0.43^{b}	6918.73±0.41^{a}

when 50% bilih fish flour was added to them. The low ash content in the present study may be due to the addition of a high amount of jaggery which is high in carbohydrate and contains low levels of minerals.

Carbohydrate

Carbohydrate content was recorded 65.33% in control (C), 62.68, 62.26, 59.21, 56.33, and 52.36% in T1, T2 T3, T4, and T5, respectively. Jaggery and dextrin were the main sources of carbohydrates, which was reduced as the percent share of FPP increased in the bar. Fish is a very poor source of carbohydrates and that too stored mainly in the form of glycogen. Normally, a live fish contains glycogen at a level varying from 0.1 to 1%. However, carbohydrates can be said to be relatively stable in processing and storage compared to sensitive nutrients browning (Dandago, 2009). In the nutrition bar, high levels of carbohydrates were mainly because of the type and quantity of ingredients added, particularly jaggery and dextrin.

Biochemical Parameters and Hardness of Nutrition Bar

The biochemical analysis of the bar (Control and FPP enriched) was analysed for pH, free fatty acids, and peroxide value, and the details are given in Table 2. The pH value of bars raged between 6.16 – 6.20 and no significant ($P<0.05$) differences were recorded. Free fatty acid (% oleic acid) was recorded significantly ($P<0.05$) low in T5 (0.066% oleic acid) and high in control (C) (0.098 % oleic acid). The free fatty acids formation itself does not lead to nutritional losses but such molecules are more susceptible to oxidative rancidity (Okaka and Okaka, 2001). Peroxide value which is an indicator of rancidity varied between 0.195 to 0.198 meq/kg, minimum and maximum. Peroxides are the precursors of breakdown products that cause rancid flavors in fat. Lipid oxidation produces off-flavor components called hydroperoxides and peroxides which react chemically with fat-soluble vitamins rendering them nutritionally useless. Oils with peroxide values well below 10 meq/kg are considered fresh. When it is above 30 meq/kg, a rancid flavour becomes apparent (Gilbraith *et al,* 2021). Important factors influencing peroxide formation include oxygen, fatty acid composition, temperature, and the presence of metals.

Texture

The textural properties of bars were tested as Texture Profile Analysis (TPA) (*two-cycle compression test)* using a TA.XT Plus Texture Analyzer (Stable Micro Systems Ltd., Surrey, UK), with a 50-kg load cell. A 75-mm-diameter compression platen was used with a speed of 1 mm/s throughout the process. A blade set (HDP/BSW) was used with a speed of 2 mm/s to measure the hardness of the bar. Texture value w.r.t. hardness was recorded maximum in T5 (69.18.73 kg force) and minimum in Control (C) (3761.66 kg force) and the hardness of the bar increases with the increase in quantity of added FPP (Table 2). The texture profile method has been widely used as the standard method (ISO 11036) (Kohyama, 2020). The addition of protein affects the texture very much, a small quantity of protein may cause the formation of a liquid and ductile bar mass. On the other hand, overdosing the protein will result in a loose and crumbling structure (De la Fuente, 2002).

Colour Analysis of Nutrition Bar

Details of L*, 'a*' & 'b*' values in the nutrition bar are given in Fig.3. In between the treatments, significantly ($P<0.05$) high L and 'a' value was recorded in T5 followed by T4, T3, T2, T1 and control (C) in reducing order, which indicates that when the amount of extracted fish protein powder increased in the nutrition bar, the product became lighter in colour and tint of the bar

Fig. 3 Colour profile of bar control (C) and enriched with fish protein powder (T1-T5)

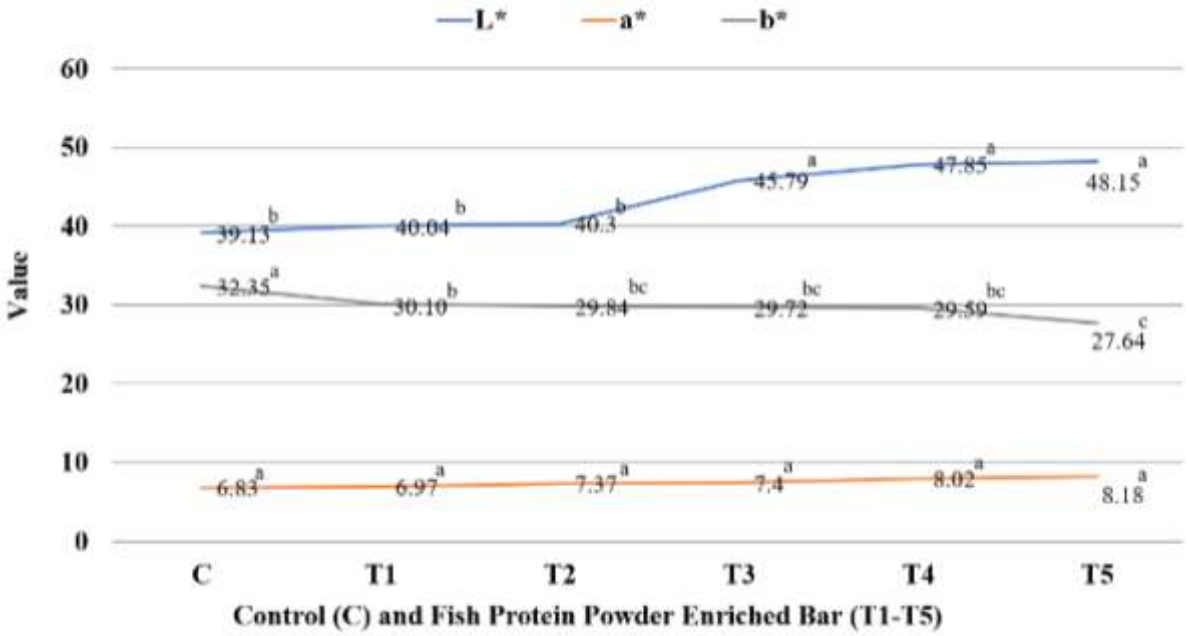
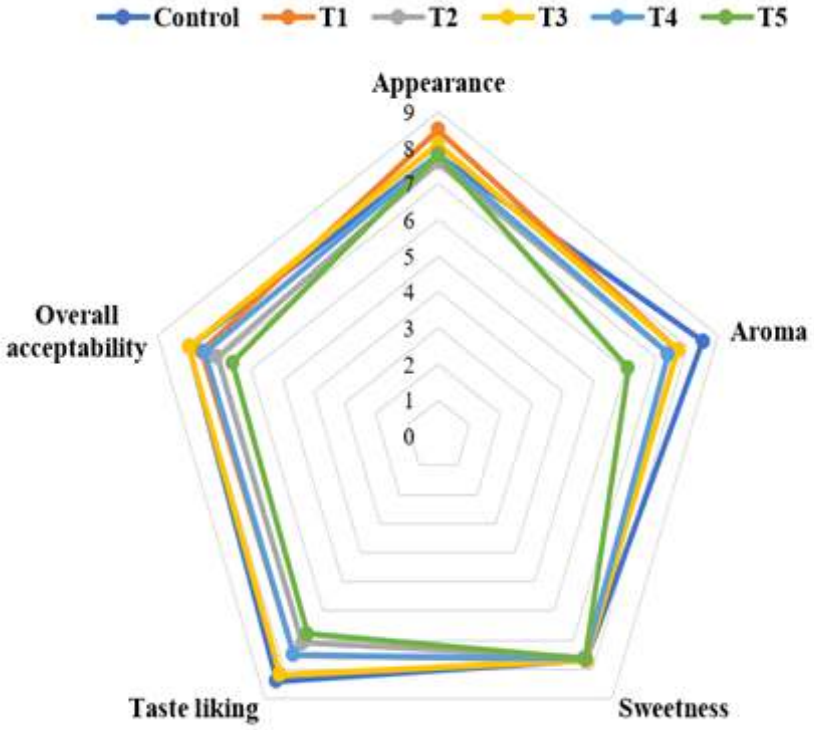


Fig. 4 Sensory attributes of bar control (C) and enriched with fish protein powder (T1-T5)



shifted from red to the greener side. The 'b' value in between the treatments reduced significantly ($P<0.05$) and the value was maximum in control (C) followed by T1, T2, T3, T4, and T5 in reducing order, which indicated that the addition of extracted fish protein powder significantly decreased the 'b' vale in the nutrition bar. The surface colour of a food product is the first quality parameter that is observed by the consumers and based on colour of the surface, consumers will accept or reject a food product (Leon *et al,* 2006).

Sensory Properties of Nutrition Bar

The sensory acceptability of bars was evaluated based on colour appearance, fishy aroma, sweetness, taste liking, and overall acceptability. Overall highest acceptability was recorded for control (C) and T3, followed by T4, T1, T2, and the least acceptability was recorded for T5. Details of the sensory properties of the nutrition bar are given in Fig 4. Akram *et al* (2020), studied the hedonic response of bars enriched with encapsulated fish and flaxseed oil and studied sensory attributes like colour, taste, flavour, crispiness, and overall acceptability based on a nine-point hedonic test scale. In the present study, the highest acceptability of the FPP incorporated bar was 7.5% (T3) and the protein content was also relatively good. Although protein content was maximum and carbohydrate was minimum in T5 and based on sensory parameters it was not much acceptable.

CONCLUSION

The nutrition bar enriched with FPP is acceptable, among nutrition bars, the highest acceptability was recorded for T3 (7.5% fish protein powder) as compared to control. In T3, protein content was recorded as 20.49%, fat 11.31%, ash 2.73%, and carbohydrate 59.21%. The protein and ash were 48.5% and 8.7% higher, respectively, whereas fat and carbohydrate were 7.6% and 9.6% lower, respectively as compared to control (C) Fish protein bars can play an important role in mitigating the issue of malnutrition among nutrition, particularly protein deficient population of the society.

ACKNOWLEDGMENT

Authors express their sincere thanks to Dean, College of Fisheries, Guru Angad Dev Veterinary and Animal Science University, Ludhiana for support during the study.

Abbreviations

FPP	-	Fish Protein Powder
PEM	-	Protein-energy malnutrition
WHO	-	World Health Organization
SBs	-	Snack bars
FFA	-	Free Fatty Acids
PV	-	Peroxide Value
ANOVA	-	Analysis of variance
TPA	-	Texture profile analysis
kg	-	Kilogram
ISO	-	International Organization for Standardization
%	-	Percentage

REFERENCES

Abbey L, Glover-Amengor M, Atikpo M O, Atter A and Toppe J (2017). Nutrient content of fish powder from low value fish and fish byproducts. *Food Sci Nutr* **5(3):** 374-379.

Akram S, Butt M S, Shukat R and Zia M A (2020). Physicochemical and hedonic response of bars enriched with encapsulated fish and flaxseed oil. *Pakistan J Agric Sci* **57(3):** 753-762.

AOAC (2019). *Official Methods of Analysis* 21st edn. Association of Official Analytical Chemists, Gaithersburg (MD).

Arason S, Karlsdottir M, Valsdottir T and Slizyte R (2010). Maximum resource utilisation-value added fish by-products. *Digitala Vetenskapliga Arkivet* 128.

Constantin O E and Istrati D I (2018). Functional properties of snack bars. In *Functional foods*. Rijeka, Croatia: Intech Open 47-60.

Dandago M A (2009). Changes in nutrients during storage and processing of foods; a review. *Technol Sci African* **3:** 24-27.

De la Fuente M A, Singh H and Hemar Y (2002). Recent advances in the characterisation of heat-induced aggregates and intermediates of whey proteins. *Trends Food Sci Technol* **13(8):** 262-274.

Desai A (2019). *The effect of fish protein powder on the physiochemical, nutritional and*

sensory properties of cereal-based products. Ph.D. Thesis, Lincoln University.

Elnovriza D, Riyadi H, Rimbawan R, Damayanthi E and Winarto A (2019). Development of fish bars as a high zinc and calcium snack made from bilih fish (*Mystacoleuseus padangensis Blkr*) flour. *Jurnal Gizi Dan Pangan* **14(2):** 83-90.

French K M, Somasuntharam I, Davis M, Somasuntharam E and Davis M E (2015). Self-assembling Peptide-based Delivery of Therapeutics for Myocardial Infarction. Adv. *Drug Delivery Rev* **96:** 40-53.

Gilbraith W E, Carter J C, Adams K L, Booksh K S, Ottaway J M (2021). Improving prediction of peroxide value of edible oils using regularized regression models. *Molecules* **26(23):** 7281.

Jahan S N, Bayezid M A, Islam B, Siddique M A B, Karmokar P K, Flowra F A (2017). Biochemical quality assessment of fish powder. *Am J Food Nutr* ***5*(3):** 110-114.

Kabir M I, Ove T A, Kamal M M, Karim S, Hasan S M, Haque M R and Akhter M (2022). Production and Evaluation of Quality Characteristics of Edible Fish Powder from Tilapia (*Oreochromis mossambicus*) and Silver carp (*Hypophthalmichthys molitrix*). *J Food Quality* 1–11.

Kasozi N, Asizua D, Iwe G and Namulawa V T (2018). Nutrient composition of fish protein powder developed from *Brycinus nurse* (*Rüppell, 1832*). *Food Sci Nutr* **6(8):** 2440-2445.

Kohyama K (2020). Food Texture–sensory evaluation and instrumental measurement. Textural Characteristics of World Foods. John Wiley & Sons Ltd, Hoboken, NJ, United States, Pp 1-13.

Koniecko E S (1979). Handbook for meat chemists. Wayne: Avery Pub. Analytical Techniques in Meat Science; CRC Press: Boca Raton, FL, USA, 68-69.

Leon K, Mery D, Pedreschi F and Leon J (2006). Color measurement in L* a* b* units from RGB digital images. Food Res Int 39(10): 1084-1091.

Mahmud N, Al-Fuad S, Satya S I, Al Mamun A, Ahmed S, Karim A, Islam S, Sakib N and Yeasmin J (2019). Development and biochemical composition assessment of fish powders from Bangladeshi indigenous fish species and shelf-life characteristics evaluation during 90 Days of room temperature (27°C-30°C) storage. *Food Nutr Sci* **10(08):** 963.

Okaka J C and Okaka A N C (2001). Food composition, spoilage and shelf-life extension. OCJANCO Acad. Publishers, Enugu, Nigeria. Pp 225-226.

Popper R, Rosenstock W, Schraidt M and Kroll B J (2004). The effect of attribute questions on overall liking ratings. *Food Qual Pref* **15:** 853–858.

Rehman A, Tong Q, Jafari S M, Assadpour E, Shehzad Q, Aadil R M, Iqbal M W, Rashed M M A, Mushtaq B S and Ashraf W (2020). Carotenoid-loaded Nanocarriers: A Comprehensive Review. Adv. *Colloid Interface Sci* **275:** 102048.

Shaviklo A R (2015). Development of fish protein powder as an ingredient for food applications: a review. *J Food Sci Technol* **52(2):** 648-661.

Shaviklo G R, Thorkelsson G, Arason S, Sveinsdottir K (2012). Characteristics of freeze-dried fish protein isolated from saithe (*Pollachius virens*). *J Food Sci Technol* **3:** 309-318.

Singh A, Surasani V K R and Kumar S (2023). Evaluation of proximate composition, oxidative stability and sensory characteristics of ready to eat fish balls prepared from Rohu (*Labeo rohita*) mince stored at refrigeration temperature. *J Krishi Vigyan* **11:** 85-90.

Souza M L R, Vitorino K C, Chambo A P S, Coradini M F, Mikecha J G, Gasparino E (2017). Inclusion of protein concentrates

from marine and freshwater fish processing residues in cereal bars. *Int J Latest Res in Sci and Technol* **6(2):** 1-4.

Steele R (ed) (2004). Understanding and measuring the shelf-life of food. Woodhead Publishing. Pp 24–40.

Tacon A G and Metian M (2013). Fish Matters: Importance of Aquatic Foods in Human Nutrition and Global Food Supply. Rev. *Fish. Sci* **21(1):** 22-38.

Torris C, Smastuen M C, Molin M (2018). Nutrients in fish and possible associations with cardiovascular disease risk factors in metabolic syndrome. *Nutrients*, **10(7):** 952.

Trout E S, Hunt M C, Johnson D E, Claus J R, Kastner C L and Kropf D H (1992). Characteristics of low-fat ground beef containing texture-modifying ingredients. *J Food Sci* **57(1):** 19-24.

Vitorino K C, Chambo A P S, Coradini M F, Matiucci M A, Graton Michka J M, Goes E S D R, Goncalvs A A and Souza M L R D (2020). Cereal bars flavoured with fish protein concentrate from different species. *J Aquatic Food Product Technol* **29(1):** 65-72.

Wu G, Fanzo J, Miller D D, Pingali P, Post M, Steiner J L and Thalacker-Mercer A E (2014). Production and supply of high-quality food protein for human consumption: sustainability, challenges, and innovations. *Annals of the New York Academy of Sciences* **1321(1):** 1-19.

Zulaikha Y, Yao S H and Chang Y W (2021). Physicochemical and functional properties of snack bars enriched with Tilapia (*Oreochromis niloticus*) by-product powders. *Foods* **10(8):** 1908.

Received on 28/3/2024 Accepted on 20/4/2024

DOI : 10.5958/2349-4433.2024.00063.7

J Krishi Vigyan 2024, 12(2) : 351-355

Performance of Carrot (*Dacus carota* L.*)* Varieties for Yield and its Associated Characters

Ajay Kumar
Krishi Vigyan Kendra, Nag Kalan-Jahangir, Majitha Road, Amritsar-143601(Punjab)

ABSTRACT

The experiments were conducted to study the performance of three carrot varieties PCP-2, PCY-2 and Punjab Black Beauty during *Rabi* season of 2020-21 at four locations of district Tarn Taran and three varieties PCO-4, Arka Suraj and Early Nantes in district Amritsar during *Rabi* season of 2021-22 using randomized block design for yield and its contributing traits. The root colour of variety PCP-2 was purple with orange flesh, PCY-2 was yellow and for variety Punjab Black beauty it was purple. The varieties PCO-4, Arka Suraj and Early Nantes were orange in colour. Maximum average root yield was recorded in variety PCP-2 (517.54 q/ha) which also showed less forking (0.69%) followed by variety PCY-2 (508.40 q/ha) and variety Punjab Black Beauty (473.10 q/ha) in district Tarn Taran. The varieties PCO-4 showed maximum average yield (441.66q/ha) less forking (0.49%) followed by varieties Early Nantes (392.00q/ha) and Arka Suraj (362.33q/ha) at district Amritsar.

Key Words: Carrot, Colour, Forking, Root, Variety, Yield.

INTRODUCTION

Carrot (*Daucus carota* L.) is an important root vegetable crop which is taken raw as well as in cooked form. Main states where carrots are grown in India are Uttar Pradesh, Karnataka, Assam, Punjab, Haryana and Andhra Pradesh. The varietal selection for sowing at optimum time is the important factor for successful carrot growth and production (Latha *et al*, 2014).The area under root crops in Punjab is about 28.07 thousand ha with production of 699.61 thousand tones. (Anonymous, 2023).The yield and growth of carrots varieties are affected by cultivar performance and change in climatic conditions of the area, and accordingly suitable cultivar and their sowing time are most important criteria which should be given into consideration by the varieties, that influence the growth of vegetative traits, its yield, quality and chemical compositions of carrot crop (Ladumor *et al*, 2020).The selection of right cultivars for sowing at right time is the important factor for successful production of carrot (Latha *et al,* 2014).

The climatic conditions in the several crops, its growing seasons and locations may affect the adaptability and stability of those cultivars. The selection of carrot varieties which is heat tolerant and resistance to diseases and insect pests has resulted in an increase in crop production area in regions (Resende *et al,* 2016). Carrots are grown both in Tarn Taran and Amritsar district of Punjab. At Tarn Taran, it is grown in various places like Chabhal, Patti, Tarn Taran and Khadoor Sahib blocks, whereas at Amritsar it is grown in Attari block. Most of the farmers in these places use local seed or self made seed of previous crop grown in area as local germplasm.

The objectives of this study include evaluation of different varieties of carrot showing good response in terms of yield and its associated characters at districts Tarn Taran and Amritsar of Punjab.

MATERIALS AND METHODS

The present study was conducted with two different experiments in which three different varieties of carrot were evaluated at four different locations of district Tarn Taran during 2020-2021 and Krishi Vigyan Kendra Amritsar during 2021-2022. The Tarn Taran district is located in semi arid region of Punjab located at 30.9°N 75.85°E with a mean height of 244 m (798 ft). The first experiment was conducted at Tarn Taran. Three varieties of carrot were PCP-2, PCY-2 and Punjab black beauty were evaluated during *Rabi* season of

Corresponding Author's Email - ajayk@pau.edu

2020-21 at four different locations of Tarn Taran.

The Amritsar district is located in sub humid region of Punjab at 32.02°N and 75.24°E with a mean height of 241 m (791 ft). The Amritsar, city is located in northern Punjab state of India at north western side. The second experiment was conducted at Amritsar. Three varieties PCO-4, Arka Suraj and Early Nantes were evaluated at Krishi Vigyan Kendra Amritsar during 2021-2022. The carrot crop requires seed rate of 10 to 12.5 kg for one hectare of area. The seeds were sown at distance of 45 cm between row to row and 7.5 cm between plants to plants. The crop spacing is regulated by thinning at the proper time of main leaf formation. Thinning of carrot has been done for production of superior quality roots. About 37.5 t of farmyard manure 137.5 kg of urea, 187.5 kg of single superphosphate and 125 kg muriate of potash were applied per hectare. All the fertilizers were applied at sowing time. Carrot grows slowly in the beginning and cannot compete with weeds. The unwanted weeds were controlled by 2-3 hoeing. The type of soil of the experimental field was almost loam sand at all the locations and has well irrigated facilities. The data of ten randomialy selected plants about various observations were recorded for different characters like plant height, days to maturity, root yield, number of leaves on the per plant basis, core thickness, root weight, root length, root diameter, forking and root color. Since the two experiments were conducted during different years, the data recorded on various observations for each treatment were analysis as per "Analysis of variance" as recommended by Panse and Sukhatme (1984) using randomized block design with two factors and one factor for first experiment and second experiment, respectfully.

RESULTS AND DISCUSSION

The result of first experiment at four different locations of Tarn Taran is presented in Table 1. The plant height of different carrot varieties ranges from 63.71 to 97.86 cm. The maximum plant height was recorded by variety Punjab Black Beauty *i.e.,* 79.12cm, 75.49cm and 74.48cm in locations 1,2 and 3 while variety PCY-2 recoded maximum plant height 97.86 cm in location 4. The variation in plant height of varieties may be due to genotypic as well as phenotypic structure of cultivars in carrot and radish as reported by Latha *et al* (2014) and Malek and Mohammed (2011).

The days to maturity ranged from 90.99 to 97.87 d. A maximum day to maturity was recorded by variety PCY-2 which was 97.87, 97.71, 97.67 and 98.45 d, respectively in all the four locations. The number of leaves ranged from 7.45 to 8.81. Maximum numbers of leaves were recorded by variety Punjab Black Beauty which was 8.41 and 8.57 in location 1 and 4, while variety PCY-2 which was 8.60 in location 2 and variety PCY-2 showed 8.81 leaves in location 3, respectively. The difference of number of leaves per plant as affected by the time of sowing was due to the variation in the climatic conditions during growth period (Kabir *et al*, 2013) and also the sowing of early carrot which imparts maximum photosynthesis with longer growth period as compared to the crop sown late (Lavanya *et al*, 2014).

The weight of roots of different varieties ranged from 1008.43g to 1144.20g. The variety PCP-2 recorded maximum fruit weight of 1144.20g, 1139.40g, 1139.60g and 1143.06g at all the four locations. The root length varied from 22.40 to 26.54 cm. The maximum root length was recorded by variety PCP-2 which were 26.54 cm, 26.00cm, 25.91 cm and 25.37cm at all the four locations.

The diameter of roots varied from 3.03 cm to 3.54 cm. The maximum root diameter was recorded by variety Punjab Black Beauty which was 3.38 cm in location 1while variety PCY-2 showed 3.54cm, 3.37cm and 3.54 cm of root diameter in location 2, 3 and 4 respectively. The present results were supported by Kabir *et al* (2013), Kandil *et al* (2013) and Ali *et al* (2016).

The yield of different varieties of carrot roots were 471.23q/ha to 526.72 q/ha. The maximum root yield was recorded by variety PCP-2 which were 526.723q/ha, 521.23q/ha,511.31q/ha and 510.89q/ha in all the four locations, respectively. The minimum root yield was recorded by variety Punjab Black Beauty which were 473.24q/ha,471.23q/ha,475.10q/ha and

472.82q/ha, respectively in all the locations. Such results were obtained on account of favorable conditions available during the growing period and also early sowing possibly attributed to maximum photosynthesis with longer growth period than the later plantings (Ladumor *et al*, 2020). Present results were in conformity with findings of Dahiya *et al* (2007), Latha *et al* (2014) in carrot and Kumar (2022) in French beans and Cluster beans.

The forking in carrot is considered as undesirable character and it ranged between 0.60 to 2.63. The minimum forking was recorded by variety PCP-2 which were.0.88, 0.65, 0.60 and 0.63, respectively in all locations. The root colour of variety PCP-2 was Purple with orange flesh, PCY-2 it was yellow and for variety Punjab Black beauty it was purple.

The variety PCP-2 yielded best in all the location of district Tarn Taran followed by variety PCY-2 and Punjab Black Beauty. These varieties also showed less forking and doubling which is considered as undesirable root character in carrot. This difference due to varieties was associated with vigorous growth, development and sound genetic makeup of the variety (Latha *et al*, 2014). Such variability in root yield per hectare of carrot is also in confirmity with the earlier findings reported by Pervez *et al* (2003) Ladumor *et al* (2020) in carrot. The yield in all the varieties is due to good plant stand attributed the favourable climatic conditions during growth and development of roots (Lavanya *et al*, 2014). The results showing similar findings was also reported by Dahiya *et al* (2007), Latha *et al* (2014) and Ladumor *et al* (2020) in various varieties of carrot. Al-Sayed *et al* (2012) investigated about harvest dates effect on sugar beet for the root yield and quality of various sugar beet varieties. Pervez *et al* (2003) studied various radish varieties which were grown during the years 2001 and 2002 to compare their yield potential and to find out high yielding better cultivar.

The data (Table 2) represented interaction effects of locations and variety showing mean values. In this table the grouping were done as represented by group A, group B, group C, group CD, group D, group E, group F, group fg and group g. The interactions with same letters were not significantly different from each other. Thus, the variety PCP-2 at location 3, 4, and 2 were grouped in CD was not differing significantly, while others differ significantly.

The results of second experiment conducted at Amritsar is presented in Table 3 which indicated that maximum plant height was obtained by variety Early Nantes 64.85cm while minimum of variety PCO-4 62.24cm. The minimum days to maturity was obtained by variety PCO-4 90.95 days and maximum days 94.66 days for Early Nantes. The number of leaves was maximum for variety Early Nantes 8.36 while minimum for variety Arka Suraj 7.92. The root weight was minimum for variety Arka Suraj 1010.93 g while maximum for veriety PCO-4 1149.46g. The root length was minimum for variety Aka Suraj 26.23 cm while maximum for varity PCO-4 28.03cm. The root diameter was minimum for variety Early Nantes 3.47 cm while maximum for varity PCO-4 3.70cm.

The root yield of different varieties ranges from 362.33 to 441.66q/ha. The maximum root yield was obtained in variety PCO-4 having average yield of 441.66 q/ha. These varieties also showed less forking (0.49%) which is considered as undesirable root character in carrot. This difference due to varieties is associated to healthy growth and potential genetic structure of the variety.

CONCLUSION

It was concluded that the variety PCP-2 was more favorable variety at different locations of district of Tarn Taran. This variety showed purple colour with orange flesh and yielded best. The variety PCO-4 showed highest yield having orange colour in district Amritsar. In both of districts most of the desi varieties were growth by farmers and these varieties showed colour variation, high yield and less forking as compared to other varieties.

Table1. Effect of different varieties under different locations for yield and its and its associated characters of carrot in district Tarn Taran.

Varieties	Plant Height (cm)	Date of Maturity	Number of Leaves	Root Weight (g)	Root Length (cm)	Root Diameter (cm)	Root Yield (q/ha)	Core Thickness (cm)	Forking (%)
Location 1									
Punjab black beauty	79.12	90.47	8.41	1079.56	24.60	3.38	473.24	0.98	2.53
PCP-2	69.12	94.20	7.70	1144.20	26.54	3.11	526.72	0.84	0.88
PCY-2	67.62	97.87	8.24	1019.33	23.60	3.31	512.56	0.93	1.16
Location 2									
Punjab black beauty	75.49	91.37	8.49	1074.83	24.68	3.31	471.23	0.93	2.63
PCP-2	68.66	91.49	8.02	1139.40	26.00	3.32	521.23	0.75	0.65
PCY-2	67.33	97.71	8.60	1017.8	23.36	3.54	509.98	0.85	1.28
Location 3									
Punjab black beauty	74.48	91.25	8.54	1067.30	23.64	3.30	475.10	0.95	2.48
PCP-2	66.22	92.39	7.45	1139.60	25.91	3.36	511.31	0.84	0.60
PCY-2	63.71	97.67	8.81	1008.43	22.40	3.37	508.87	0.85	1.15
Location 4									
Punjab black beauty	90.47	90.99	8.57	1074.50	25.04	3.03	472.82	0.98	2.50
PCP-2	70.20	92.58	7.87	1143.06	25.37	3.53	510.89	0.85	0.63
PCY-2	97.86	98.45	8.42	1013.30	23.71	3.54	502.20	0.85	1.41
SE(d)	0.44	0.61	0.26	0.63	0.35	0.22	1.60	0.02	0.12
SE(m)	0.31	0.43	0.18	0.44	0.25	0.16	1.13	0.01	0.09
CV	0.73	1.37	3.89	0.07	3.57	8.30	3.32	3.12	10.48

Table 2. Interaction effects of treatments (Location x Varieties) under different locations in district Tarn Taran.

Interactions	Mean	Groups
LOC1_PCP -2	526.72	A
LOC2_PCP -2	521.23	B
LOC1_PCY -2	512.56	C
LOC3_PCP -2	511.31	CD
LOC4_PCP -2	510.89	CD
LOC2_PCY -2	509.98	CD
LOC3_PCY -2	508.87	D
LOC4_PCY -2	502.20	E
LOC3_BLACK BEAUTY	475.10	F
Loc1_black beauty	473.24	fg
Loc4_black beauty	472.82	fg
Loc2_black beauty	471.23	g

*** Location x Varieties with same letters are not significantly different**

Table 3. Effect of different varieties on yield and its and its associated characters of carrot in district Amritsar.

Varieties	Plant Height (cm)	Days to Maturity	Number of Leaves	Root Weight (10 roots)	Root Length (cm)	Root Diameter (cm)	Root Yield (q/ha)	Core Thickness (cm)	Forking (%)
Arka Suraj	62.39	92.90	7.92	1010.93	26.23	3.60	362.33	0.87	1.16
Early Nantes	64.85	94.66	8.36	1080.33	29.95	3.47	392.00	0.94	1.47
PCO-4	62.24	90.95	8.03	1149.46	28.03	3.70	441.66	0.88	0.49
SE(d)	0.85	0.53	21.67	1.09	0.29	0.34	0.66	0.02	0.01
SE(m)	0.60	0.37	15.32	0.77	0.20	0.24	0.47	0.02	0.00
CV	1.66	0.70	158.24	0.12	1.28	11.67	0.20	3.94	1.23

REFERENCES

Ali J,Abdurrab, Muhammad H,Ali M, Rashid A, Shakoor A, Khan A, Khan J, Jamal A and Khan H (2016).Effect of sowing dates and phosphorous levels on growth and bulb production of onion. *Pure Appl Biol* **5**(3): 406-417.

Al-Sayed H M, Usama A, El- Razek, A, Sarhan H M and Fateh H S (2012). Effect of harvest dates on yield and quality of sugar beet varieties. *Aust J Basic and Applied Sci* **6**(9): 525-529.

Anonymous (2023). *Package of Practices of Vegetable Crops*. Punjab agriculture University Ludhiana

Dahiya, M S, Yadav Y C, Singh Y P and Malik Y S (2007). Effect of time and method of sowing on root quality of carrot cv.Hissar Garlic. *Haryana J Hort Sci* **36**(3&4):377-378.

Kabir A,Ali A, Waliullah M H, Rahman M M M U and Rashid A (2013). Effect of spacing and sowing time on growth and yield of carrot (*Dacus carrota* L.). *Int J Sust Agri* **5**(1):29-36.

Kandil. A A, Sharief A E and Fathalla F H (2013). Effect of transplanting dates of some onion cultivars on vegetative growth, bulb yield and its quality. *ESci J Crop Pro* **2**(3):72-82.

Kumar A (2022) Performance of Cluster beans (*Cyamopsis tetragonoloba* L.*)* for yield and its contributing traits. *J Krishi Vigyan* **10** (2): 241-244

Kumar A (2022) Assessment of French bean (*Phaseolus vulgaris* L.) genotypes for yield traits. *J Krishi Vigyan* **11** (1): 1-6

Ladumor R G, Nandre B M, Sharma M K, Wankhade V R and Joshi P C (2020). Performance of different varieties of carrot (*Daucus carota* L.) with respect yield, quality chemical compositions under varying sowing times. *Int J Curr Microbio App Sci* **9**(2):126-132.

Latha P M, Reddy S S. Vani S and Reddy R (2014). Studies on the effect of sowing dates on growth and root yield of certain carrot (*Daucus carota* L.) cultivars. *Agriculture: Towards a New paradigm of Sustainbility*: 116-119.

Lavanya, AVN, Vani V S, Reddy S S and Chaitanya K (2014). Effect of sowing dates and spacing on growth and root yield of radish cv. Pusa chetki. *Pl Archives* **14**(1):619-623.

Malek, S. and Mohammed. (2011) Effect of variety and age of stecklings on yield and quality of carrot seed. *J. Agrofor Environ* **5**(2): 93-96.

Pervez M A, Ayyub, C M. Iqbal, M Z and Saleem B A (2003). Growth and yield response of various radish (*Raphanus sativus* L.) cultivars under Faisalabad conditions. *Pakistan J Life Soc Sci* **1**(2):155-157.

Panse V G and Sukhatme PV (1984). *Statistical Methods for Agricultural Workers*. Fourth Edition. ICAR Publication, New Dehli.

Resende, G M, Yuri J E and Costa N D (2016). Planting times and spacing of carrot crops in the Sao Francisco valley, Pernambuco state, Brazil. *Rev. Caatinga*, *Mosssoro* **29:** 581-593.

Received on 01/04/2024 Accepted on 10/05/2024

DOI : 10.5958/2349-4433.2024.00064.3

J Krishi Vigyan 2024, 12(2) : 356-361

Performance of Dual Culture of Amur Carp and Jayanti Rohu in Imphal East District, Manipur

M A Salam[1] and Laishram Soniya Devi[2]

[1]Krishi Vigyan Kendra, Andro, Imphal East, Central Agricultural University, Imphal, Manipur-795004, India

ABSTRACT

A dual culture of Amur common carp and Jayanti rohu were demonstrated for the first time in Imphal East district, Manipur. The trial was conducted in five farmers' ponds of a total 2 ha area for eight months period. Conventional feed like mustard oil cake (MOC) and rice bran (RB) @ 1:1 ratio was fed to the fish @ 3-6 percent of body weight per day in two installments by the farmers. Water quality parameters and plankton analysis were done during the culture period. Water temperature was found in the range of 20.4 to 27.7°C, pH was maintained in the optimum range of 7.2 to 7.6 and plankton analysis appeared between 0.4 to 6.3 mg/l. After eight months of the culture period, the average body weight (standard length) of Amur carp and Jayanti rohu were recorded as 751 g (20.46 cm) and 562.5 g (19.72 cm), respectively. Moreover, Amur carp observed a better growth rate as compared to Jayanti rohu.

Key Words: Amur Common Carp, Dual culture, Imphal East, Jayanti Rohu, Manipur Performance.

INTRODUCTION

Manipur has rich potential fisheries resources witnessing an estimated total area of 63,616 ha mainly contributed by wetlands (39,124 ha), rivers/streams (16,677 ha), waterlogged (3525 ha), and aquaculture ponds (2643 ha) (Anonymous, 2020). Due to the availability of freshwater resources, the state is exclusively prevalent in freshwater fish production. Fish production from marginal fish farms is dominant compared to small, medium, and large farms (Singh *et al,* 2018). According to Umesh *et al* (2012), Manipur reported 45 species which used as food fish. While currently, nearly about 13-15 species are being cultured as food fish by the fish farmers in the state. In Manipur, aquaculture of Indian major carps (IMC) and exotic carps such as common carp, grass carp, silver carp, and other commercially important species tilapia and pangasius are widely cultured and contributed to inland aquaculture production (Singh *et al,* 2018).

Inspite of having huge potential of fish production from the above resources, Manipur is not self-reliant to meet state demand. The total fish production of Manipur during 2019-20 was estimated to be 32,000 t (Anonymous, 2020). However, the estimated fish requirement in the state was 52,000 t in 2019-20 against the state-owned production of 32,520 t, indicating a 19,480 t shortage needed to import from other states for domestic consumption (Anonymous, 2020-21).

To narrow the supply-demand gap, Manipur depends on fish imported from other neighbouring states. Hence, improved candidate species like Amur carp, Jayanti rohu, etc, need to be introduced which can grow in this environment and also increase production scale to overcome fish shortage in Manipur. Amur carp (*Cyprinus carpio*) is an improved variety of wild common carp of Hungarian origin (Basavaraju *et al,* 2003; Das *et al,* 2017). It has appreciable realistic significance in low-input aquaculture systems as a result of its better growth performance, late maturing, hardy, accepts artificial feed, and parallel food habits to that of existing stock of common carp (Basavaraju and Reddy, 2013; Vijayakumar *et al,* 2019). Besides, Jayanti rohu is an improved strain of rohu over the normal rohu developed by ICAR-CIFA, Bhubaneswar to improve farm productivity. The improved rohu

Corresponding Author's Email - salam555@rediffmail.com

[1]Krishi Vigyan Kendra, Andro, Imphal East, Central Agricultural University, Imphal, Manipur-795004, India

[2]ICAR-Central Institute of Fisheries Education (CIFE), Mumbai-400061, India

also proved to be significantly higher growth efficiency over the local rohu, reduction in the rearing period along with the increase in the yield, feed neutral and effective under all culture practices which have earned high acceptance level from the fish farmers and hatchery owners (Das *et al,* 2017; Jayasankar *et al,* 2018). Hence the present study was undertaken with the objective to demonstrate the growth performance of improved varities fish like Amur carp and Jayanti rohu

MATERIALS AND METHODS

The present study was carried out at farmers' pond covering a total area of 2 ha, selected in four villages of Imphal East district of Manipur namely, Andro, Takhel, Waiton, and Yumnam Patlou to demonstrate the growth performance of Amur carp (AC) and Jayanti Rohu (JR). Seeds of Jayanti rohu and Amur carp ranging between (0.19- 0.247) gm in weight and (2-2.5) cm in length were purchased from a certified seed farm and stocked in the farmers' ponds following proper acclimatization with the surrounding initial temperature. The fish fry were stocked in the farmers' pond during June, 2018 to January, 2019. The size of the pond ranged between 0.25 to 0.5 ha with a water depth of 1-1.5 meter. Stocking ratio (AC: JR) was 1:3. Stocking density/ha were varied from one location to another ranging from 10000 to 30000 fry/ha. Physio-chemical parameters of the water of the ponds were managed by applying agricultural lime along with pond fertilization with organic manure from cattle as well as inorganic fertilizers like urea and single super phosphate during the culture period of eight (8) months. Besides fertilization, fishes were also provided with supplementary pellet feed@ 3-6 percent of body weight per day given in two instalments that is one in the morning and another in the evening hours. Conventional feed like mustard oil cake (MOC) and rice bran (RB) @ 1:1 ratio was used by farmers. In all the ponds, water quality parameters like temperature, depth, transparency and pH were monitored at monthly interval. Frequent health monitoring was done by giving appropriate treatment, as and when required to maintain for better health condition of the fishes. Fish sampling by netting out a minimum number of ten fish from each pond of different location were also recorded at the monthly interval in all the ponds to evaluate the performance of Amur carp and Jayanti rohu. Final harvesting was performed after 8 months of culture in all ponds. The average body weight gain and the body length gain (cm) were analysed. The data collected were processed for selected statistical parameters including mean, range, and standard error for drawing a specific conclusion using the data processing software SPSS-25.

RESULTS AND DISCUSSION

Water quality parameters such as temperature, depth, transparency and pH analysis were determined to be in the acceptable range all round the culture periods as shown in table 1. The better growth performance of Amur carp and Jayanti Rohu have been observed in all the demonstrated ponds as shown in Figures 1-2 and Tables 2-3. The average body weight of Amur common carp and Jayanti rohu have been recorded as 751 g (20.46 cm) and 562.5 g (19.72 cm) respectively in eight months of culture period, which was statistically significant ($P<0.05$). Similarly, Hussain *et al* (2020) recorded that the average growth for Amur carp was 543.3 g in polyculture system with three Indian major carps (IMC) namely, Catla (*Catla catla*), Rohu (*Labeo rohita*), Mrigala (*Cirrhinus mrigala*) and two Chinese carps viz., Grass Carp (*Ctenopharyngodon idella*) and Silver carp (*Hypophthalmichthys molitrix*) during the culture period of 12 months. However, Bordoloi *et al* (2020) reported that Amur carp gained an average weight of 1010 g (30.5 cm) although the local common carp achieved a size of 920 g (27 cm) in twelve (12) months of culture period and also the Amur carp showed better growth than local carp in all the demonstrated ponds in Barak Valley Zone of Assam. In this study, Amur carp was recorded faster growth rate when compared to Jayanti rohu, which was supported in a study of polyculture system of Amur carp with other carps in polyculture system (Hari and Sagar, 2018).

Table 1 Water quality parameters noticed during the culture period.

Sr. No	Pond No.	Water Temperature (ºC)	Water depth (m)	Transparency (cm)	Av. Water pH
1	Pond 1	20.4 -27.7	1-1.37	28-43	7.6
2	Pond 2	20.4 -27.4	1-1.37	22-35	7.5
3	Pond 3	20.4 -27.4	1-1.37	21-39	7.2
4	Pond 4	20.4 -27.4	1-1.52	23-52	7.4
5	Pond 5	20.4 -27.4	1-1.37	21-36	7.4

Table 2 Net weight and length gain in Amur carp

Sr. No	Location	Average weight (g)		Net weight gain (g)	Average length (cm)		Net length gain (cm)
		Initial weight	Final weight		Initial length	Final length	
1	Andro	0.247	815	814.753	2.5	21.7	19.2
2	Yumnam Patlou	0.247	910	909.753	2.5	22.1	19.6
3	Waiton	0.247	650	649.753	2.5	18.4	15.9
4	Ngariyan	0.247	550	549.753	2.5	18	15.5
5	Takhel	0.247	830	829.753	2.5	22.1	19.6

Table 3. Net weight and length gain in Jayanti Rohu.

Sr. No	Location	Average weight (g)		Net weight gain (NWG) (g)	Average length (cm)		Net length gain (NLG) (cm)
		Initial weight	Final weight		Initial length	Final length	
1	Andro	0.19	720	719.81	2	22.5	20.5
2	Yumnam Patlou	0.19	650	649.81	2	19.7	17.7
3	Waiton	0.19	470	469.81	2	17.5	15.5
4	Ngariyan	0.19	410	409.81	2	16.9	14.9
5	Takhel	0.19	710	709.81	2	22	20

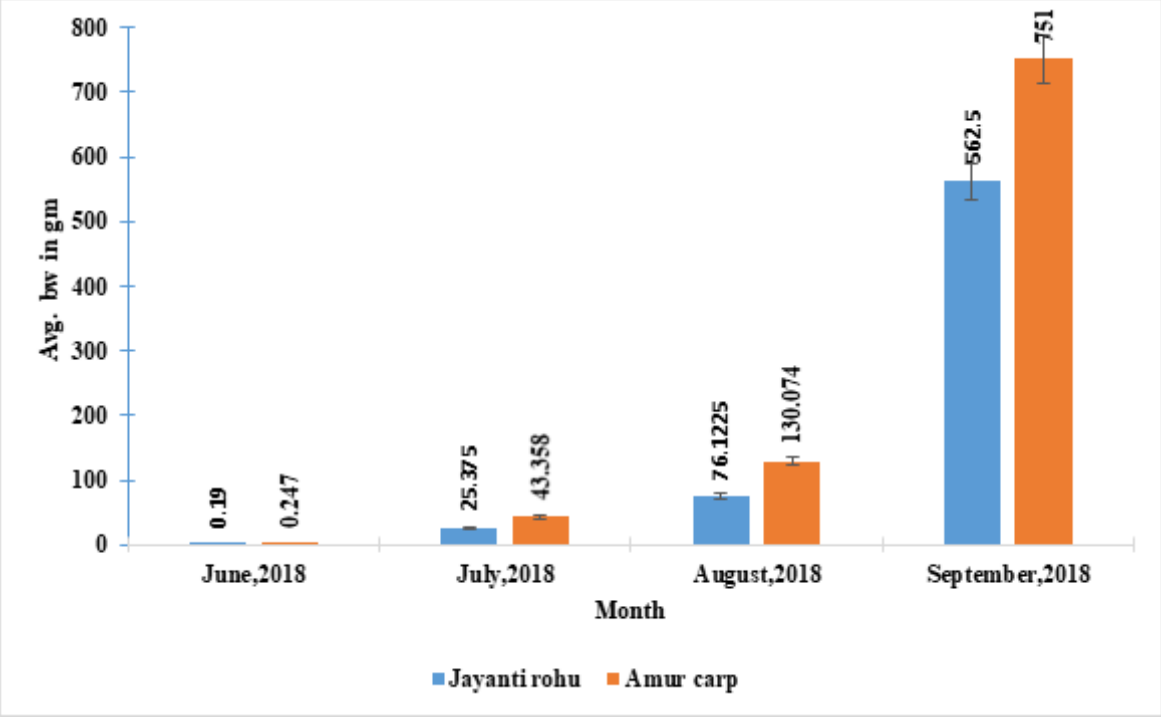


Fig 1 Comparison of body weight gain during 4 months culture periods

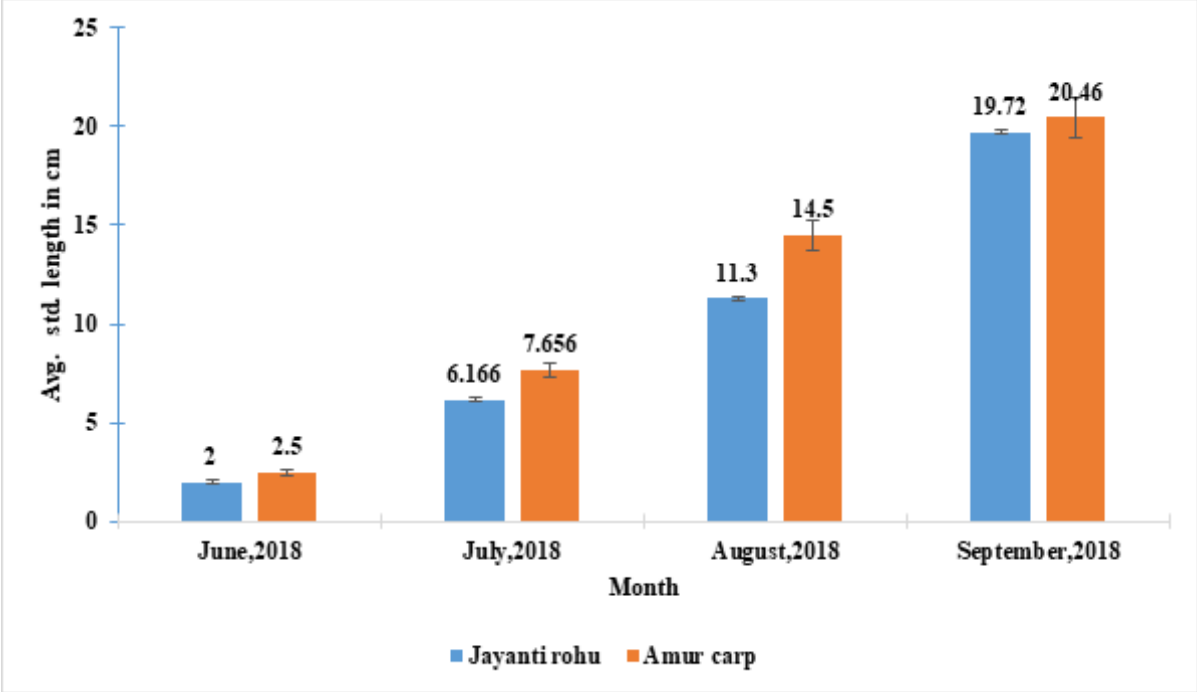


Fig 2 Comparison of length (cm) gain during 4 months culture periods

Moreover, Saikia *et al* (2020) also reported Amur Carp and Jayanti Rohu showed a remarkable higher growth in comparison to locally available Rohu (Labeo rohita) and Common Carp (Cyprinus carpio) in every farmers' pond in 11 months of culture in Extensive Polyculture System.

Sharma *et al* (2022) revealed that Amur carp performs better in a polyculture system than major and minor carps in 5 months of culture. Basavaraju and Reddy (2013) exhibited its superior growth performance over common carp, catla, grass carp and silver carp in both mono and polyculture over a period of 24 weeks in low-input aquaculture systems. Das (2017) also reported that amur carp is superior over the existing local breed of common carp in farmers' ponds under the mid hill conditions in 15 months under monoculture. Amur carp appeared a better growth compared to Catla at polythene-lined farm ponds for 10 months culture period (Vijayakumar *et al,* 2019).

CONCLUSION

Due to the hardy nature, disease resistance and better growth rate, Amur carp and Jayanti rohu can be considered as one of the opted candidate species in aquaculture. Further, both fish species can be considered as economically viable and also socially acceptable to be cultured in Manipur. Amalgamation of Amur Carp and Jayanti Rohu in poly-culture aquaculture systems was highly advisable to raise the overall production of fish and for improving the livelihood of the rural small and marginal farmers.

REFERENCES

Anonymous (2020). *Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying Government of India*, New Delhi November, 2020. 176 pp.

Anonymous (2021). *Economic Survey Manipur 2020-21*. Directorate of Economics & Statistics Government of Manipur.

Basavaraju Y, Penman D J and Mair G C (2003). Stock evaluation and development of a breeding program for common carp (*Cyprinus carpio*) in Karnataka, India: progress of a research project. NAGA, *World Fish Center Quarterly* 26(**2**): 3032.

Basavaraju Y and Reddy A N (2013). Growth performance of Amur strain of common carp in southern Karnataka. *Mysore J Agril Sci* 47(**1**): 119-123.

Bordoloi R, Dutta M P, Mishra H, Talukdar B and Pathak B (2020). Feasibility of Amur common carp at Barak valley zone of Assam. *J Krishi Vigyan* **9** *(*SI): 103-105.

Das S K (2017). Performance of an improved breed of common carp- Amur (Hungarian strain) in the Northeastern Hill state Meghalaya, India. *Indian J Fish* **67**: 33-38.

Hari O V and Sagar C M (2018). Evaluation of growth performance of amur common carp (*Cyprinus carpio*) and mrigal (*Cirrhinus mrigala*) with major carps in polyculture system. *J Ento and Zoology Study* **6** (2):2277- 2281.

Hussain S M, Baruah D and Pathak M (2020). Performance of Amur common carp breed in East Siang District of Arunachal Pradesh. *J Krishi Vigyan* **9** *(*SI): 244-247.

Jayasankar P (2018). Present status of freshwater aquaculture in India-A review. *Indian J Fisheries* **65**: 157-165.

Vijayakumar S, Khavi M, Atnur V, and Rajanna K B (2019). Comparative study on the

growth performance of amur common carp (*Cyprinus carpio*) and catla (*Catla catla*) at polythene-lined farm ponds of Vijayapur district, Karnataka. *J Entomol and Zool Stud* **7**(6): 499-502

Rahman M M (2015). Role of common carp in Aquaculture system. *Frontier in Life Sci* **8** (4): 54-59.

Saikia D, Bhuyan M K and Das N (2020). Growth performance of Jayanti Rohu and Amur Common carp in extensive polyculture system. *J Krishi Vigyan* **9** *(*SI): 152-155.

Sharma A, Ghorai T, Kumar S, Srivastava P P and Ram R K (2022). Comparative study of somatic growth performance of amur carp with Indian major carps in North Bihar, India. *The Pharma Innov J* **11**(**7**): 3503-3506

Singh N D, Krishnan M, Singh N R, and Satyasai K J S (2018). Resource use pattern, institutional arrangements and socio-economic analysis of fish farming in Manipur, India. *Int J Fish and Aquatic Stud* **6** (4): 456-462.

Umesh C G, Sudip K B, Dilip B, Konthoujam S, Bishnupriya S, and Kimneilam C (2012). Fish diversity of North East India, inclusive of the Himalayan and Indo Burma biodiversity hotspots zones: A checklist on their taxonomic status, economic importance, geographical distribution, present status and prevailing threats. *Int J Biodiversity and Conserv* **4** (15): 592-613.

Received on 8/4/2024 Accepted on 22/5/2024

DOI : 10.5958/2349-4433.2024.00065.X

J Krishi Vigyan 2024, 12(2) : 362-367

Reproductive Health Problems faced by the Female Sugarcane Cutters

Bhalerao VS and Mane SA
Department of Human Development and Family Studies,
College of Community Science, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani

ABSTRACT

This research paper investigated the reproductive health issues faced by female sugarcane cutters randomly selected from ten villages of five talukas of Beed District of Maharashtra. An exploratory study was conducted, which included interviews of 80 female sugarcane cutters who had undergone hysterectomy and who had not undergone hysterectomy (40 each). The data were collected on the basis of the structured open ended interview schedule and by using the socio-economic status scale. Large strata of female sugarcane cutters were undergoing hysterectomy in between 22-38 yrs age range, which are very critical and sensitive years of life influencing their overall health at higher risk. Almost all of them reported that the major health issues because of which they went for hysterectomy were resolved but with this, they started with new problems regarding physical and emotional issues. In view of these concerns, a digital mobile app was developed to create awareness among these respondents to reduce the chances of hysterectomy. It can be concluded that the developed digital technology application helped in enhancing the reproductive health awareness and well being of female sugarcane cutters. By providing accessible information, this digital technology application Aarogyadnyan contributed to empowering these female sugarcane cutters with knowledge essential for making informed decisions about their reproductive health.

Key Words: Awareness, Female, Sugarcane, Mobile digital application, Reproductive health.

INTRODUCTION

Sugarcane harvesting work is extremely intensive, skillful and risky too which includes cutting, binding the bundles, their loading and transporting it to the factories via bullock carts, truck and tractors. It is the most laborious farm work where the laborers have to bend for hours, pick up very heavy cane bundles and mount them at risky heights even during the night time (Chaudhari and Jaggi, 2020). Almost 50% of the migrant sugarcane workers are women who migrate with their children. Majority of these workers came from schedule castes, scheduled tribes, minority section, poor sections from OBC, who work in sugarcane harvesting and transport workers (Jadhav, 2016).

Living area, living condition of the tanda where the sugarcane cutters live are horrible. They live in a very poor and insufficient shelter named khopi. Basic facilities like drinking water, bathroom, toilet, hygiene and sanitation, firewood, electricity are not available to them. Women loose their most of the energy in bringing the water and collecting the firewood. The women and children have to face different kinds of diseases due to lack of nutritional food and proper sanitation. Their living tents are surrounded by mosquitoes, flies, different types of insects and also by poisonous snakes. They have no time for rest at least at moment. So the women face different diseases/problems like malaria, typhoid, hyper tension, mental stress. No medical service is made available to them, so they ignore their diseases/condition and engage in work (Khadse, 2016).

The sugarcane cutter migrants cut the sugarcane to make a sugar but at the same time they themselves face the number of the problems. (Mane and Tadakhe, 2013). These women are found hardly with wombs in these villages. These are villages of womb less women. Women in vanjarwadi, where the 50% of the women have had hysterectomies, it is the norm in the villages to remove the uterus after having 2-3 children. Can

Corresponding Author's Email - manesushama16@gmail.com, veenabhalerao71@gmail.com

Table 1 Reproductive health problems encountered by female sugarcane cutters before undergoing hysterectomy

Reproductive health problems	Frequency of female sugarcane cutters		Z value
	Not undergone hysterectomy (n=40)	Undergone hysterectomy (n=40)	
Severe abdominal pain	25(62.50)	38(95.00)	3.99**
Vaginal discharge	10(25.00)	23(58.00)	3.17**
Unbearable pain during menstruation	17(43.00)	27(68.00)	2.32*
Excessive and longer bleeding during menstruation	14(35.00)	30(75.00)	3.92**
Urinary tract infection	3(7.50)	5(12.50)	6.52**
Swelling on uterus	4(10.00)	15(38.00)	3.10**
Fibroid/cyst in uterus	3(7.50)	10(28.00)	4.14**
Pelvic infection	2(5.00)	3(8.00)	2.96**
Prolapse uterus	1(2.50)	2(5.00)	2.96**
Symptoms of chances cancer of ovary/uterus/cervix	2(5.00)	4(2.50)	4.33**

Figures in parenthesis indicate percentages *P<0.05level **P<0.01level NS –Non -significant

cutting is a vigorous process and if the husband or wife takes a break for a day due to the health reasons, the couples have to pay a fine of Rs. 500 per day to the contract for every break (Jadhav, 2016). These women are the worst off as they carry large loads and are forced to work even during their menstrual cycles and pregnancies. To avoid these complications of pregnancies and menstrual periods in the field, the women have to undergo hysterectomy.

The female workers find it difficult to spend money on buying sanitary napkins and therefore resort to using the old cloth during menstruation. Lack of sanitary facilities lead to improper disinfection of the menstrual cloth further increases the chances of reproductive diseases. Additionally the increase in hysterectomies is also driven by a deeply rooted belief that the womb of a women is futile one she has produced children, who are seen as a form of surplus labour force (Chadha,2019). Many women, who get their uterus removed in their 20s and 30s, complain of backache and abdominal pain. This also increases the chances of serious psychological problems, further hindering their ability to carry out their day -to- day work (Shukla and Kulkarni, 2019). To get hysterectomy done, many of them take a loan about Rs 50,000 from the contractor. Surgeries, often performed by quacks, may lead to serious health hazards like abdominal pains, vaginal infections, cervical problems and also cancer at young age.

As per Yasmeen, (2020) the information collected by various organizations on the basis of personal interviews of victims, it was revealed that women can cutters have to undergo hysterectomy due to shocking reasons such as, poverty and non literacy remains the major cause of undergoing hysterectomies, menstrual periods hinder work as women may miss a day or two of working due to their periods, and if it happens they have to pay fines, menstruation is still considered as a taboo, cane cutting contractors are unwilling to hire women who menstruate, as they have target of

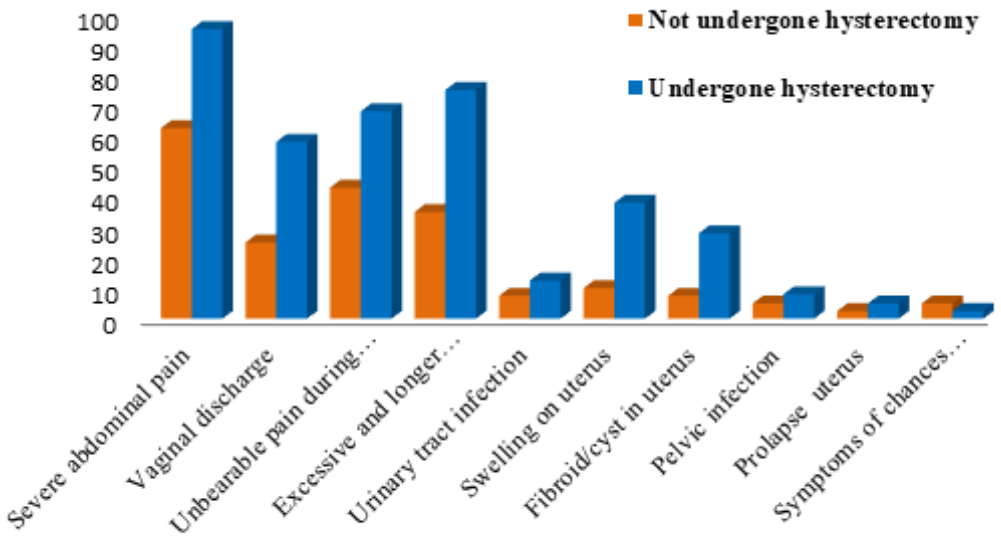


Fig Reproductive health problems encountered by female sugarcane cutters before undergoing hysterectomy

work to be completed within a time frame so hysterectomies have become the norm, the contractor (mukadam) is keen to have women without wombs in his group of cane cutters, doctors also encourage them to go through hysterectomies whenever they are consulted for health issues.

There is no doubt that the female sugarcane labourers of Maharashtra undertake an extremely challenging form of employment. The tough and arid conditions of their home districts, together with lack of education and difficulty in securing alternative forms of employment, often leave these workers with little to no option but to partake in seasonal occupational migration. Dropping out of the schooling system during their youth, getting married in their teenage years and giving birth to several children before they hit their early twenties, further pushes these women and their families into this never ending cycle poverty (Phull, 2023).

MATERIALS AND METHODS

The research study was carried out in randomly selected 10 villages from 5 talukas of Beed district on the basis of percentages of female sugarcane cutters namely parli, Majalgaon, Wadvani, Beed and Georai from Marathwada region of Maharashtra. A study was conducted by taking in depth interview of 80 female sugarcane cutters (22-45yrs) who had undergone hysterectomy (n=40) and who had not undergone hysterectomy (n=40) with the help of structured interview schedule, informal talks and observations during the sugarcane harvesting season (October to March). Z test was applied to compare percentages of the various responses of the different parameters with regard to the involvement of female sugarcane cutters who had undergone hysterectomy and who had not undergone hysterectomy as per standard procedure given by Sharma (2005).

Table 1 reveals the information on reproductive health problems encountered by female sugarcane cutters before undergoing hysterectomy. The female sugarcane cutters who had not undergone hysterectomy expressed major issues of severe abdominal pain (62%), unbearable pain during menstruation (43%) followed by excessive and longer period bleeding during menstruation (35%) and vaginal discharge (25%).

The corresponding percentages for these problems among female sugarcane cutters who had undergone hysterectomy were 95 %,68%,75%, 58% respectively. A considerable percentage of female sugarcane cutters showed problem of swelling on uterus (38%) and fibroid

Reproductive Health Problems faced by the Female Sugarcane Cutters

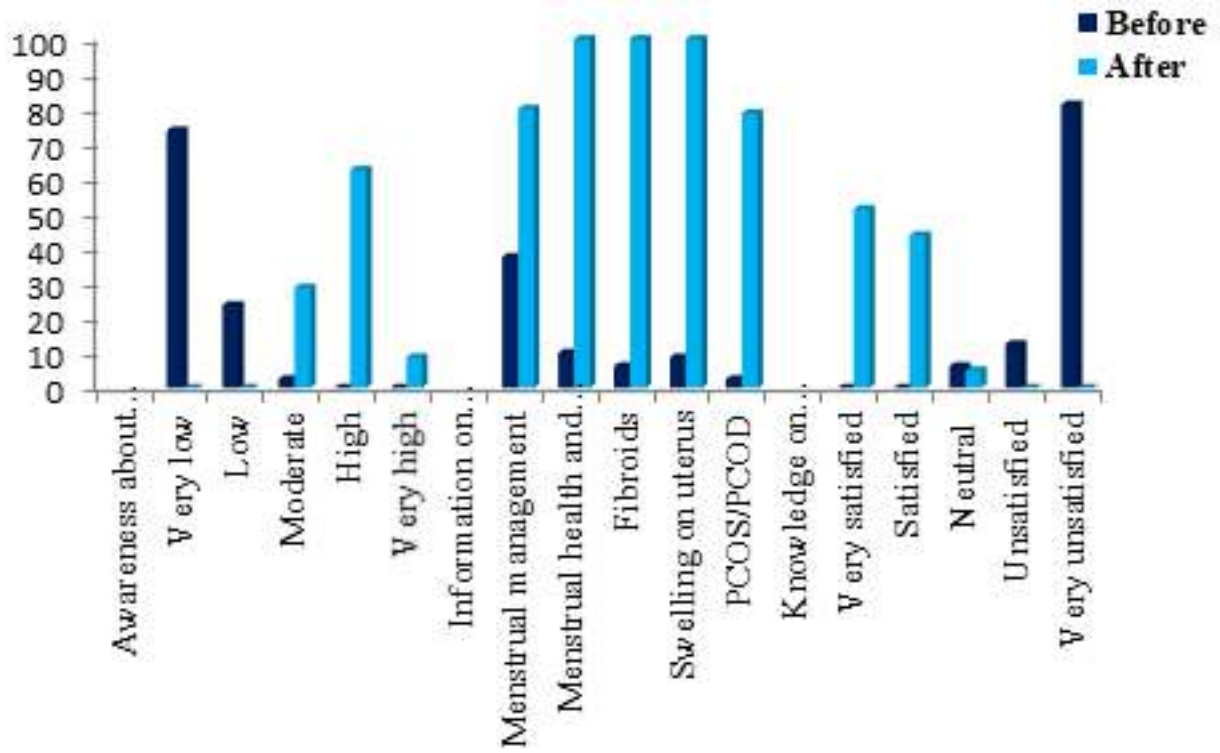


Fig. 2: Perception utility of developed digital application for female sugarcane cutters regarding reproductive health

Figures in parenthesis indicate percentages *P<0.05level **P<0.01level NS –Non -significant

/cyst on or in uterus (28%). The female sugarcane cutters also complained for urinary tract infection 2.57%),

pelvic infection (8%), prolapse of uterus (5%), chances for cervical, uterine or ovarian cancer (10%) before undergoing hysterectomy.

The significant differences were noted for all the enlisted parameters of reproductive health problems among the two groups of female sugarcane cutters.

It was revealed that long working hours, exposure to harsh weather conditions and inadequate breaks contribute to physical stress and fatigue, potentially impacting reproductive health of female sugarcane health cutters. Poor sanitation and hygiene in the workplace increase the risk of reproductive infections and other issues.

Perception utility of developed digital technology application for female sugarcane cutters regarding reproductive health is indicated in Table 2. The majority of the respondents (62%) expressed high level of awareness about reproductive health. All of them gained information on reproductive health in terms of menstrual management, menstrual hygiene, fibroids, swelling on uterus, PCOS/PCOD (78%). More than half of them (56%) expressed high satisfaction level toward knowledge on reproductive health.

Reproductive health issues were major health issues that noticed in female sugarcane cutters but after use of this digital technology application these women get aware about it. It can be concluded that the developed digital technology application helped in enhancing the reproductive health awareness and well being of female sugarcane cutters. By providing accessible information this digital technology application Aarogyadnyan contribute to empowering these female sugarcane cutters with knowledge essential for making informed decisions about their reproductive health.

The utility of developed digital technology application become a pivotal in fostering positive changes in female sugarcane cutters day to today life.

Table 2. Perception utility of developed digital application for female sugarcane cutters regarding reproductive health .

Figures in parenthesis indicate percentages *P<0.05level **P<0.01level NS –Non -significant

Reproductive health	Frequency of female sugarcane cutters		Z value
	Before (n=80)	After (n=80)	
Awareness about reproductive health			
Very low	59(73.75)	..	..
Low	19(23.75)	..	..
Moderate	2(2.50)	23(28.75)	4.94**
High	..	50(62.50)	..
Very high	..	7(8.75)	..
Gained information on reproductive health			
Menstrual management	30(37.50)	64(80.00)	6.13**
Menstrual health and hygiene	8(10.00)	80(100)	26.8**
Fibroids	5(6.25)	80(100)	35.4**
Swelling on uterus	7(8.75)	80(100)	30.3**
PCOS/PCOD	2(2.50)	63(78.75)	15.5**
Satisfaction level toward knowledge on reproductive health			
Very satisfied	..	41(51.25)	..
Satisfied	..	35(43.75)	..
Neutral	5(6.25)	4(5.00)	0.22*
Unsatisfied	10(12.50)	..	..
Very unsatisfied	65(81.25)	..	..

*Figures in parenthesis indicate percentages *P<0.05level **P<0.01level NS –Non -significant*

CONCLUSION

It was revealed that long working hours, exposure to harsh weather conditions and inadequate breaks contribute to physical stress and fatigue, potentially impacting reproductive health of female sugarcane health cutters. Poor sanitation and hygiene in the workplace increased the risk of reproductive infections and other issues. The utilization of a mobile digital application has proved a promising approach for addressing reproductive health concerns among female sugarcane cutters. By providing accessible and tailored health information, the application effectively increased awareness, promoted healthy behavior and empowered these women to take control of their reproductive well-being. The study revealed the importance of innovative technological solutions in bridging the gap in healthcare access and education for vulnerable populations, contributing to overall improvement in public health outcomes. Future efforts should focus on scaling up such initiatives and integrating them into broader healthcare strategies to maximize their impact and reach.

REFERENCES

Chaudhari M and Jaggi R (2020). Documenting Migrant Lives of Sugarcane Harvesting Labourers in Maharashtra–Autoethnographic Reflections. *RupkathaJ Interdisciplinary Stud in Humanities* **12**(5):

Chadha N (2019). Constructing the female laboring body: A case study of Beed district of Maharashtra. Hysterectomies in Beed district raise questions for India. The Lancet, 394(10154),202. Retrieved from https://sprf.in/wp-content/uploads/2021/01/Constructing-the-FemaleLabouring-Body.pdf

Jadhav S (2016) Labour law and struggles of migrant sugarcane workers in Maharashtra. Retrieved from https://www.cwds.ac.in

Khadse S (2016). Gender and development: Problems of sugar cane cutter women worker. A case study of Rajarambapu Patil Sugar Factory,Islampur. *Historicity Res J* **2**(10): Page number ISSN:- 2393-8900

Mane C and Tadakhe S (2013). Problems and prospects of Sugar cane cutter migrants in Taluka of satara District (Maharashtra): A Case study of Sahayadri Sahakari. *Weekly Sci Res J* 1(11): www.weeklyscience.org. ISSN 2321-7871.

Sharma H (2005). Basic Statistical Methods with Application. Agrotech publishing Academy,Udaipur.78,261,306,331.

Shukla K, Sharma L, Awasthi K and Pathak D (2017). Sugarcane in India. Package of practices for different agro–climatic zones, All Indian Coordinated Research Project on Sugarcane, IISR Lucknow, Uttar Pradesh, 1-64.

Yasmeen S (2020). Unwarranted hysterectomies and health issues of women cane cutters in Maharashtra's Beed district. I*nternational Journal of Creative Research Thoughts (IJCRT)* **8**(2). ISSN-2320-288

Received on 18/2/2024 Accepted on 15/4/2024

DOI : 10.5958/2349-4433.2024.00066.6

J Krishi Vigyan 2024, 12(2) : 368-371

Revealing Cauliflower (*Brassica oleracea* var. *botrytis*) Genotypes for Seed Yield and its Contributing Characters on Different Sowing Dates

Navdeep Singh and Gurdeep Singh

Department of Horticulture

Guru Kashi University, Talwandi Sabo, Bathinda-151302, Punjab, India

ABSTRACT

The experiments were conducted during the successive season 2022 at Vegetable farm, Guru Kashi University, Talwandi Sabo to evaluate the Cauliflower (*Brassica oleracea* var. botrytis) genotypes for seed yield and its contributing characters sown on different sowing dates. The results revealed that improved PSC 117-118 genotype recorded earliest days to 50% flowering (95.66d), number of leaves 24.45 by Kartiki genotype, breadth of leaf 24.23 cm in PSC104, maximum polar diameter 18.27 cm by Noval and maximum length of leaf 42.17 cm, maximum equatorial diameter 27.15 cm, minimum days to siliqua maturity 156.66d, pod length 7.64 cm, pods per plant 712, 1000 seed weight 1.78 g, grains per pod 12.44, highest seed yield per plant 12.35 g was recorded in Super 70 as compared with the other cauliflower genotypes. The combined effect of sowing dates and genotypes showed that crop sown on 8th September with PSC104, PSC117-118, Noval, Kartiki genotypes performed well in respect of growth characters and Super 70 genotype in seed yield parameters were found to be the best from all other varieties.

Key Words: Cauliflower, Genotypes, Siliqua, Sowing date, Yield.

INTRODUCTION

The genetic constitution of the plants determines their yielding ability but the extent to which the potential actually depends is suitable environment in which they grow. It's a well-known fact that a crop when sown at optimum time is able to exploit all the environment factors efficiently in the process of dry matter accumulation. The date of sowing is governed mainly by temperature, sunlight intensity, duration and rainfall. These are the crucial factors that can decide establishment, growth and performance of crop through changing morphological system, physiological functioning and time available for the crop to complete its life cycle. Seeds of cauliflower are produced in the country in a small scale but the maximum amount of seeds of cauliflower is imported from other countries. Cauliflower requires optimum temperature and humidity conditions for seed production. The optimum temperature for cauliflower withstands is 10 to 15 0C (Din *et al*, 2007). Lavanya *et al* (2014) recommended that optimum temperature is suitable treatment combination for higher seed yield. Refai and Hussan (2019) concluded that performance of cauliflower declined gradually in each successive delay of transplanting date among the four transplanting dates (1st July, 15th July, 1st August and 15th August). So, planting improved Assiut genotype at 1st July recorded the highest yield. Meanwhile, planting the same genotype at 15th July is more efficient for using the heat and radiation. Sharma *et al* (2018) studied that maximum temperature exhibited significant negative correlation (r=-0.472) with seed yield which indicates that rise in maximum temperature, affects seed production adversely while forenoon humidity exhibited positive correlation (r=0.411) with cauliflower seed yield. Kumari *et al* (2019) concluded the plant height, leaf area, polar diameter, equatorial diameter, number of bolters/plant, number of siliqua/plant, number of seed/siliqua, seed yield/plant and 1000 seed weight were found significant when seeds were

Corresponding Author's Email - navdeep.brar50@gmail.com

sown on 10th August. The present study was undertaken with objectives to evaluate the different cauliflower genotypes in various environments for growth parameters and seed yield parameters.

MATERIALS AND METHODS

The experiment carried out in Guru Kashi University Research Farm comprised of two main parameters, namely the sowing dates 8th September (first date) and 10th October (Second date) and the cultivars were Kanchan, Noval, Golden 1100, PSC 105A, Krishma, PSC106A, PSC104, PSC666, PSC117-118, PSC 107 A (117-118), Super 70, Kartiki and 666F2. The experiment consisted of 26 treatment combinations, and was laid out in randomized complete block design (RCBD) with three replications. The whole experimental area was divided into three equal blocks. A distance of 45 cm was maintained between the ridges and 45 cm between the plants within the each plot. The blocks were kept to facilitate different intercultural operations. The crop was raised by following the package of practice recommended by PAU, Ludhiana. The observations recorded during the course of investigation were number of leaves per plant, leaf length (cm), breadth of leaf, equatorial diameter (cm), polar diameter (cm), days to 50% flowering, days to siliqua maturity, pod length (cm), pods per plant, 1000 seed weight (g), grains per pod and seed yield per plant (g) of three randomly selected plants was recorded and average was calculated. The data from the experimental field were analyzed separately for each experiment for different growth characters and yield attributes with the help of OPSTAT (Statistical Software Package for Agricultural Research Workers) (Sheoran *et al*, 1998).The critical difference at 5% level of implication was calculated to equate the mean different treatments.

RESULTS AND DISCUSSION

The number of leaves was recorded significantly highest 24.45 in Kartiki genotype which was at par with PSC 105A (24.33) and followed by Krishma with 23.52 number of leaves, the crop which was sown on Ist date. The maximum number of leaves were shown by PSC 105A (22.34) sown on 2nd date. It was observed that highest leaf length (42.17 cm) was noticed in super 70 genotype with sowing date 8th September. The crop sown on 2nd date, Super 70 genotype showed significantly maximum 40.35 cm leaf length. The result was in conformity with the earlier findings of Kumar *et al* (2002). It was recorded that there was significant increase in breadth of leaf 24.23 cm in PSC104 genotype followed by PSC106 A with 22.30 cm leaf breadth sown on Ist date. The crop sown on 2nd date, the significantly maximum leaf breadth 22.67 cm was recorded in PSC104 genotype.

There was a wide variation among vegetative growth of the different genotypes of cauliflower (Zaki *et al*, 2012; Meena, 2017). Significantly maximum equatorial diameter 27.15 cm and 25.46cm was recorded in Super 70 and PSC106A genotype when crop was sown on Ist date and 2nd date, respectively. Polar diameter were markedly enhanced by sowing seeds on Ist date in comparison with the late sowing crop. In the early sowing date polar diameter was 18.27 cm while in the late sowing date polar diameter was 17.17 cm with Noval genotype. On Ist date sown crop, minimum days required for days to 50% flowering (95.66) were recorded in the PSC117-118 and the crop sown on 2nd date, minimum 96.34 days to 50% flowering was noted in PSC117-118 and was at par with PSC666 (96.35 days). on Ist date sown crop, minimum days required for siliqua maturity (156.66 days) were recorded in the Super 70 and minimum 158 days to siliqua maturity was taken by PSC 666 genotype and was at par with PSC 117-118 (159 days) in the crop which was sown on 2nd date. Maximum 7.64 cm pod length was noted in Super 70 and was at par with PSC117-118 (6.95 cm) in crop which was sown on Ist date. Sown crop on 2nd date, the maximum 6.76 cm pod length was recorded in PSC105A genotype.

The highest pods per plant were decidedly enhanced by sowing seeds on early date in contrast with the late sowing crop. In the early sowing date, pods per plant was 712 and 707 in Super 70 genotype in late sown crop. The 1000 seed weight was recorded significantly highest 1.78 gm under Super 70 genotype and was at par with PSC 117-118 (1.76 gm) when sown on Ist date. The 1000

Table 1. Effect of sowing dates on number and length of leaf (cm), breadth of leaf (cm), equatorial diameter (cm) and polar diameter (cm) in cauliflower.

Parameter	Number of leaves (No.)		Length of Leaf (cm)		Breadth of leaf (cm)		Equatorial diameter (cm)		Polar diameter (cm)	
Genotypes	8th September	10th October	8th September	10th October	8th September	10th October	8th September	10th October	8th September	10th October
KANCHAN	22.15	20.12	30.38	29.56	18.65	17.34	21.65	19.78	13.4	11.13
NOVAL	21.48	19.34	33.15	31.45	17.93	16.34	24.39	23.17	18.27	17.17
GOLDEN 1100	20.29	18.12	38.83	36.57	17.85	16.25	23.63	21.47	16.57	15.34
PSC 105A	24.33	22.34	36.1	34.35	19.46	18.56	23.25	21.36	15.57	14.37
KRISHMA	23.52	21.45	33.77	31.23	21.46	19.34	24.25	23.45	14.45	13.25
PSC106A	21.11	19.45	35.48	31.78	22.3	21.12	26.11	25.46	17.17	16.34
PSC104	22.48	20.35	38.43	35.37	24.23	22.67	20.71	19.74	16.26	15.46
PSC666	23.22	21.23	40.15	38.49	19.82	17.23	25.84	23.67	14.22	14.26
PSC117-118	21.29	18.23	41.34	39.29	21.09	19.58	22.49	20.37	15.36	15.13
PSC 107 A(117-118)	20.41	18.26	39.63	37.59	17.83	16.26	25.63	23.27	14.81	14.25
SUPER 70	19.48	17.78	42.17	40.35	17.53	16.58	27.15	25.37	14.47	14.12
KARTIKI	24.45	21.89	33.66	30.66	15.82	14.26	24.56	23.43	14.72	14.45
666 F2	23.11	20.24	32.48	30.12	16.82	15.26	23.11	21.25	15.23	14.11
CD at 5%	0.219	0.19	0.135	0.15	0.065	0.063	0.089	0.086	0.26	0.24

Table 2. Effect of sowing dates on days to 50% flowering, days to siliqua maturity, pod length (cm), pods per plant and 1000 seed weight (g.) in cauliflower.

Parameter	Days to 50% flowering		Days to siliqua maturity (days)		Pod length (cm)		Pods per plant (No.)		1000 seed weight (g.)	
Genotypes	8th September	10th October	8th September	10th October	8th September	10th October	8th September	10th October	8th September	10th October
KANCHAN	118.66	119.35	173	175	4.32	4.23	412.66	414	1.56	1.54
NOVAL	97.66	97.34	158	160	5.95	5.25	709.33	704	1.71	1.61
GOLDEN 1100	104.66	104.35	168	170	6.33	6.12	271	698	1.67	1.56
PSC 105A	98.33	97.24	160	163	6.04	6.76	705	700	1.68	1.58
KRISHMA	108.66	107.34	163	165	5.82	5.34	293	291	1.65	1.54
PSC106A	113.66	112.13	156	164	6.63	6.23	271	268	1.61	1.53
PSC104	108.66	107.35	168	171	5.26	5.12	274	268	1.42	1.35
PSC666	97.33	96.35	158	158	6.9	6.46	291	284	1.47	1.42
PSC117-118	95.66	96.34	158	160	6.95	6.34	286	279	1.76	1.65
PSC 107 A(117-118)	108.66	107.36	168	159	5.99	6.45	281	272	1.52	1.61
SUPER 70	96.33	97.32	156	161	7.64	5.24	712	707	1.78	1.68
KARTIKI	108.33	107.14	158	160	5.23	6.01	279	273	1.61	1.49
666 F2	107.33	106.24	166	168	5.09	4.89	284	275	1.55	1.49
CD at 5%	0.95	0.93	1.59	1.34	0.059	0.054	1.58	1.23	0.02	0.04

Table 3. Effect of sowing dates on grains per pod (No.) and seed yield per plant (g.) in cauliflower.

Parameter	Grains per pod (No.)		Seed yield per plant (gm.)	
Genotypes	8th September	10th October	8th September	10th October
KANCHAN	9.64	8.23	7.34	7.11
NOVAL	11.72	10.24	10.33	9.6
GOLDEN 1100	6.74	7.25	9.19	7.4
PSC 105A	11.14	10.02	7.16	7.03
KRISHMA	9.75	9.14	6.25	5.68
PSC106A	10.08	9.25	6.47	5.12
PSC104	7.83	7.15	6.31	5.12
PSC666	7.36	7.13	5.36	5.12
PSC117-118	11.83	10.24	11.93	9.12
PSC 107 A(117-118)	8.33	8.23	6.34	5.89
SUPER 70	12.44	11.79	12.35	10.13
KARTIKI	8.64	8.15	5.41	5.12
666 F2	8.91	8.40	5.747	5.65
CD at 5%	0.102	0.98	0.12	0.19

REFERENCES

Din M, Qasim M and Jan N E Faridullah (2007). Response of different sowing dates on the growth and yield of cauliflower. *Sarhad J Agric* **23**: 289-291.

Kumar P T, Babu S D and Aipe K C (2002). Adaptability of cauliflower genotypes in the high ranges of Kerala. *J Trop Agric* **40**: 45−47.

Kumari R, Singh, V K, Kumar S, Shree S and Kherwa R S (2019). Effect of sowing date and plant geometry on seed yield of early Cauliflower (*Brassica oleracea* var. botrytis L.) cv. Sabour Agrim. *Curr Appl Sci Technol* **33**(2): 1-7.

Lavanya A V N, Sudhavani V, Reddy P S and Chaitanya, K (2014). Effect of sowing dates and spacing on growth and root yield of radish cv. Pusa chetki. *Plant Archives* **14**: 619-623.

Refai E F S and Hassan A M A (2019). Response of some genotypes of cauliflower to different planting dates under Assiut conditions. *Middle East J Appl Sci* **9**(1): 231-240.

Sharma P, Singh M, Bhardwaj S K and Gupta R (2018). Impact of long term weather parameters on seed production of cauliflower. *J Pharm Innov* **7**(7): 521-523.

Sheoran O P, Tonk D S, Kaushik L S, Hasija R C and Pannu R S (1998). Statistical Software Package for Agricultural Research Workers. Recent Advances in information theory, Statistics & Computer Applications by D.S. Hooda & R.C. Hasija Department of Mathematics Statistics, CCS HAU, Hisar, pp. 139-143.

Zaki M F, Tantawy A S, Saleh S A and Helmy Y I (2012). Effect of bio-fertilization and different levels of nitrogen sources on growth, yield components and head quality of two broccoli cultivars. *J Appl Sci Res* **8** (8): 3943-3960.

Kumar, Chauhan R, Kumari A, Shiwani R, Thakur K, Thakur P, Nalwa N and Cherry (2023). Effect of transplanting dates and locations on the performance of Broccoli under wet temperate Himalayas. *J Krishi Vigyan* **11** (2): 89-92.

Received on 1/4/2024 Accepted on 20/5/2024

DOI : 10.5958/2349-4433.2024.00067.2

J Krishi Vigyan 2024, 12(2) : 372-378

Reviving Soils with Leaf Litter Composts for Enhanced Yields in Amaranthus

Harishma S J, Sheeba Rebecca Isaac* and Devika Viswanathan
College of Agriculture, Vellayani, Thiruvananthapuram 695 522, Kerala
Kerala Agricultural University

ABSTRACT

Leaf litters are potential organic nutrient inputs and assume prime importance in the present era of eco-friendly farming. An experiment was conducted at College of Agriculture, Vellayani to evaluate the efficacy of composted litter as nutrient source in Amaranthus and the changes elicited in soil properties. The treatments included litter composts of jack and coconut leaves prepared with different enhancers of decomposition and enriched with PGPR Mix I biofertilizers and were laid out in RBD replicated thrice. Litter compost application was found to have favourable influences on soil available nutrient status and microbial population. Vegetable yields (20.20 Mg/ha) and economic returns (B:C ratio- 1.92. were significantly higher in the substitution of 50% RDN with coconut leaf litter compost [composting inoculum (liquid) + earthworms]. The increase in yields ranged from 3 to 46 per cent with compost application over the control. Hence, it was concluded that conversion of leaf litter to valuable organic manures through composting and inclusion in production package of amaranthus ensures reduction of chemical nitrogen input usage by 50 per cent, triggers microbial activity and sustains fertility in soil.

Key Words : Amaranthus, Coconut, Compost, Jack, Leaf litter, Soil, Yield

INTRODUCTION

Soil is the most important natural resource base for crop production. Organic and inorganic inputs are critical in agriculture and a balanced use is proclaimed as the most effective means of ensuring sustainable production. The search for alternative nutrient inputs brings to focus the organic manures that are locally available. Apart from the biowastes generated in the livestock and poultry sector, those generated in the different cropping systems can also be effectively utilized in crop production.

Leaf litter in tree-based ecosystems serves as a mulch and adds to the soil nutrient status on decomposition. Even so, under non-farm situations, the litter is a menace (Vasanthi et al, 2013) and are often removed by burning, a practice that attenuates air pollution. Nutrient accretion from leaf litter on decay have been documented, but natural decomposition is a time consuming process and might take from five months to even more than a year for the release of nutrients (Isaac and Nair, 2006). However, composting converts the litter into a valuable nutrient input in crop production. The research work aimed to assess the efficacy of coconut (*Cocos nucifera*) and jack (*Artocarpus heterophyllus*) litter composts in amending soil properties and effect on the vegetative growth and yield of the leafy vegetable, Amaranthus (*Amaranthus tricolor*).

MATERIALS AND METHODS

The experiment was carried out in the Instructional Farm, College of Agriculture Vellayani, Thiruvananthapuram, Kerala. The site located at 8° 30'N latitude, 76° 54' E longitude and at an altitude of 29 m above mean sea level enjoys a warm humid tropical climate. A total of 288.5 mm rainfall was received during the period of study. The mean minimum and maximum temperatures recorded were 24.70 and 32.62° C respectively.

Leaf litters of coconut and jack collected from bearing trees were cleaned of extraneous material and composted, based the technologies

Corresponding Author's Email - sheebarebecca@yahoo.co.in
Present address : Regional Agricultural Research Station, Kumarakom, Kottayam 686 563

Table. 1 Composting methods adopted (Harishma, 2017)

Treatments	Composting method	
T_1	Jack leaf litter + poultry manure	Co-composting- litter mixed with poultry manure @ 10% w/w
T_2	Jack leaf litter + Composting inoculum (CI) powder + earthworms	CI powder (*Lactobacillus*, *Pseudomonas putida*, *Bacillus subtilis*, *Isaria farinosa*, *Trichoderma viride* and *Pencillium griseofulvum*) was added @ 20g/ kg litter mixture*, and earthworms were released 2 weeks later
T_3	Jack leaf litter (CI) liquid	CI (*Bacillus subtilis*) was added to the litter mixture*, @ 1000mL m^{-3}
T_4	Thermochemical jack leaf litter compost	Chemical decomposition of well ground, litte with HCl(0.25 N) followed by KOH (0.5 N) at 100° C and ambient pressure
T_5	Coconut leaf litter + poultry manure	Co-composting of litter with poultry manure @ 10% w/w
T_6	Coconut leaf litter + CI (liquid) + earthworms	CI (*Bacillus subtilis*) was added to coconut litter + fresh cow dung*, @ 1000mL/m^3 and earthworms were released 2 weeks later
T_7	Coconut leaf litter + CI (powder)	CI (powder) added to litter + fresh cow dung mix*, @ 20g/kg litter
T_8	Thermochemical coconut leaf litter compost	Chemical decomposition of well ground, litte with HCl (0.25 N) followed by KOH (0.5 N) at 100° C and ambient pressure

*litter was mixed with fresh cow dung in 4:1 ratio

found best for coconut and jack litters (Harishma, 2017) as detailed in Table 1. The prepared composts were dried in shade, sieved and enriched with the biofertilizer, Plant Growth Promoting Rhizobacteria (PGPR Mix I) @ 10g/kg and rock phosphate @ 150g/kg. The consortium contained N fixers, *Azospirillum lipoferum, Azotobacter chroococcum,* P solubilizer, *Bacillus megaterium,* and K solubilizer, *Bacillus sporothermodurans*. In addition, leaf litter composted by thermo-chemical digestion (Sudharmaidevi et al, 2017) was also included as treatments in the field experiment.

The experiment followed the randomised block design, and comprised nine treatments in three replications. Soil was sandy clay loam in texture and according to the ratings of Kerala Agricultural University (KAU, 2016), was very strongly acidic, medium in organic carbon and available potassium (K), low in nitrogen (N) and high in available phosphorus (P). Liming was done @ 350 kg/ha to correct soil acidity. At the time of final land ploughing, farm yard manure was incorporated @ 50 t/ha uniformly in all plots. Seedlings of Amaranthus red, variety 'Arun', were transplanted at six leaf stage at a spacing of 30 cm between rows and 20 cm between plants in a row. The composts were used to substitute 50 per cent of the recommended dose of N (RDN) *i.e*., 100 kg N/ha and the remaining half, through chemical fertilizer, urea (46 % N). Phosphorus and K @ 50 kg/ha each were given as Rajphos (20% P_2O_5) and muriate of potash (60% K_2O). In the control treatment, chemical fertilizers alone were used. The crop was raised following the package recommendations (KAU, 2016). First harvest was taken 30 days after transplanting (DAT) and subsequent harvests, as and when the leaves were of satisfactory growth for consumption. The yields at each harvest was recorded, summed to compute total yields and expressed in Mg/ ha.

Table 2. Effect of enriched litter compost on soil chemical and biological properties

Treatment	pH	EC (dS/ m)	Soil organic carbon (%)	Available nutrients (kg/ ha)			Microbial count (cfu / g soil)		
				N	P	K	Bacteria (x 10^6)	Fungi (x 10^4)	Actinomycetes (x 10^5)
T_1 - Jack leaf litter + poultry manure	5.53	0.43	0.89	213.25	128.03	265.93	35.6	24.3	13.5
T_2 - Jack leaf litter + CI (powder) + earthworms	5.70	0.57	0.85	267.61	144.21	219.82	41.3	23.5	15.3
T_3 -Jack leaf litter + CI (liquid)	5.80	0.60	0.76	221.61	132.06	315.37	42.1	20.3	12.3
T_4 - Thermochemical jack leaf litter compost	6.10	0.53	0.74	271.79	161.60	365.92	44.6	20.3	11.5
T_5 - Coconut leaf litter + poultry manure	5.83	0.53	0.83	237.06	140.16	156.05	42.6	22.8	15.7
T_6 - Coconut leaf litter + CI (liquid) + earthworms	5.40	0.57	1.12	239.51	142.78	186.46	67.8	24.7	14.8
T_7 - Coconut leaf litter + CI (powder)	5.70	0.57	0.92	288.62	134.62	199.02	45.6	21.3	11.6
T_8 - Thermochemical coconut leaf litter compost	5.97	0.57	0.75	225.79	153.14	377.07	33.7	15.5	12.1
T_9 - Control	5.40	0.60	0.71	244.14	141.61	241.01	42.6	16.5	10.5
SE m ±	0.43	0.086	0.07	12.68	18.65	63.99	4.9	1.5	1.0
CD(0.05)	-	-	0.142	-	-	97.515	10.44	3.31	2.26

Table 3. Effect of enriched litter composts on growth, yield and economics of cultivation

Treatment	Plant height (cm)				LAI			Total yield (Mg/ha)	Net returns ₹ /ha	B: C ratio
	30 DAT	45 DAT	60 DAT	At final harvest	30 DAT	45 DAT	60 DAT			
T_1 - Jack leaf litter + poultry manure	44.70	59.70	29.67	32.67	0.84	0.87	0.27	16.22	92264	1.61
T_2 - Jack leaf litter + CI (powder) + earthworms	43.33	54.80	34.17	37.57	0.66	0.84	0.30	17.96	110136	1.69
T_3 -Jack leaf litter + CI (liquid)	40.33	53.60	28.07	31.67	0.67	0.74	0.24	14.91	66483	1.42
T_4 - Thermochemical jack leaf litter compost	42.70	53.47	30.47	33.50	0.66	0.79	0.27	14.20	49526	1.30
T_5 - Coconut leaf litter + poultry manure	46.87	57.80	32.57	35.93	0.74	0.80	0.29	14.58	67991	1.45
T_6 - Coconut leaf litter + CI (liquid) + earthworms	47.63	59.80	35.03	38.10	0.79	0.86	0.33	20.20	144874	1.92
T_7 - Coconut leaf litter + CI (powder)	43.33	54.53	29.43	31.97	0.66	0.74	0.24	14.48	63829	1.42
T_8 - Thermochemical coconut leaf litter compost	42.03	53.60	31.37	33.87	0.70	0.71	0.28	15.29	68115	1.42
T_9 - Control	41.67	53.47	26.23	28.63	0.61	0.63	0.21	13.77	63436	1.45
SE m ±	1.42	1.17	2.08	2.48	0.05	0.05	0.03	1.53	22891	0.15
CD (0.05)	3.008	2.473	4.404	4.627	0.119	0.105	0.050	3.236	48528.2	0.319

Soil samples collected were initially dried in shade, sieved and then oven dried at 105° C. These were subjected to analysis by adopting standard procedures. *viz*., available N (Subbiah and Asija, 1956), organic C, available P and K (Jackson, 1973) and microbial counts (Johnson and Curl, 1972). The data were statistically analysed and where ever variations were found to be significant, critical differences were computed (Snedecor and Cochran, 1975) for comparison.

RESULTS AND DISCUSSION

Impact on soil properties

The perusal of the data on soil chemical and biological properties (Table 2) revealed significant improvements with litter compost application. Soil organic C content varied significantly with the treatments. The organic carbon C (1.12%) was the highest in the soil treated with coconut leaf litter composted with CI (liquid) + earthworms (T_6) and was superior, while the lowest (0.71%) was assessed in the control (T_9).

The variations in available nutrient content in the soil were found to be non significant, except for K. (Table 2). However, the status was found improved from the initial values. Soil K content varied significantly with different treatments, and was the highest (377.07 kg/ha) in the thermochemical digested coconut leaf litter (T_8) application on par with T_4 (thermochemical jack leaf litter compost) and T_3 [jack leaf litter + CI (liquid)] The lowest soil K status (186.46 kg/ha) was noted in T_6 (coconut leaf litter composted with CI (liquid) + earthworms.

Total microbial count (bacteria, fungi and actinomycetes) in soil varied significantly with the nutrient sources applied (Table 2) and the counts were significantly the highest in T_6 except actinomycetes which was maximum in T_5 but on par with T_6. Among composts, thermochemically digested jack and coconut litter composts (T_4 and T_8) and the treatment without compost (T_9) recorded the lowest counts.

Growth and yield in amaranthus

The litter composts exerted significant influence on the plant height in Amaranthus (Table 3). Coconut litter compost prepared using CI (liquid) + earthworms (T_6) produced taller plants at all the growth stages, while at 30 and 45 DAT, T_6 it was on par with T_5 (coconut leaf litter + poultry manure) and T_1 (jack leaf litter + poultry manure). At 60 DAT and at final harvest, T_6 was found on par with T_2, T_5 and T_8. Plants were shortest at all stages in the control (T_9), which was given 100 per cent RDN as inorganic fertilizers.

The variations in leaf area index (LAI) were significant at 30, 45 and 60 DAT (Table 3). Maximum LAI was recorded in T_1 (jack leaf litter + poultry manure) treated plants at 30 and 45 DAT (0.84 and 0.87 respectively) and was on par with T_6 (0.79) and T_5 (0.74) at 30 DAT and on par with T_6 (0.86), T_2 (0.84), T_5 (0.80) and T_4 (0.79) at 45 DAT. The lowest LAI values at 30 and 45 DAT were observed in control, T_9 (0.61 and 0.63, respectively). At 60 DAT, the LAI recorded highest in T_6 (0.33) and lowest in T_9, control (0.21).

Amaranthus leaf yield (20.20 Mg/ha) was the highest in plants manured with coconut litter compost prepared using CI (liquid) + earthworms the highest yield, on a par with jack litter composted with CI (powder) + earthworms (17.96 Mg/ha). Plants treated with thermochemical digested litter of jack and coconut also showed lower yields (14.20 and 15.29 Mg/ha respectively).The significantly lowest yield of 13.77 Mg/ha was recorded in 100 per cent inorganic fertilizer applied plots (T_9). Economic analysis also revealed the application of coconut leaf litter composted with CI (liquid) + earthworms maximum to be more profitable, with net returns of ₹144874/ ha and a benefit cost ratio of 1.92.

Substitution of the N dose with litter composts proved beneficial in Amaranthus in terms of growth and yield compared to the package recommendation. Yields were nearly 3 to 46 per cent per cent higher than in control. The addition of compost in soil instead of chemical fertilizers triggers microbial activity, mineralisation, improves aeration, soil moisture status, regulates soil temperature (Jagadeesha *et al,* 2019) all of which favours nutrient uptake and plant growth. This holds true for all treatments in which compost was used to substitute the chemical fertilizer.

Organic manures are regarded as sources of all essential nutrients (Sharma *et al,* 2022) and the organic nature of the material has favourable influences on soil properties. The addition to the root zone also enhances rhizosphere activities, the key regulators of plant growth and nutrition. The amelioration with compost application are evident from the data in Table 2.

Among the treatments, T_6 [coconut leaf litter + CI (liquid) + earthworms] was found to recorded the highest yield (20.20 Mg/ha), on par with jack litter composted with CI (powder) + earthworms, (17.96 Mg/ha), 45 and 35 per cent greater than in control. The better performance could be attributed to the properties of the vermicomposted litter. Vermicompost, in addition to being an organic fertilizer, is rich in microbial populations and diversity, growth hormones, enzymes and of homogenous consistency (Sinha, 2009). The nutrient availability from vermicompost is also rated as high. It was evinced that the application of earthworm worked litter promoted the dissemination of important microorganisms. Maheswarappa *et al* (2014) enumerated the microbial counts in coconut leaf vermicompost and illustrated that it harboured higher population of microorganisms, many of them with plant-beneficial attributes. This coupled with the NPK bio fertilizers with enrichment, would have favourably influenced Amaranthus growth. The economic part of the crop is the leaves and shoot, and hence the source itself is the sink. All growth promoting factors thus directly contributes to the yield. Co- composted litter (poultry manure added) could also evoke better growth on account of the nutrient contents in it. The vegetative characters, plant height and LAI were initially higher in co-composted litter applications but declined indicating the lowered regrowth with the cuttings done in these treatments. Nevertheless, it remained the highest in T_6 indicating the prolonged beneficial effect of vermi composting application has on soil. Further the microbial association in these treatments (composting inoculum added as, powder/ liquid) also augmented soil microbial activities in favour of Amaranthus growth until final harvest. The results corroborate the earlier reported better growth and yields with vermicompost application: pseudostem compost in banana (Patel *et al,* 2012), guava litter vermicompost in red gram (Vasanthi *et al*, 2013) and mango litter compost in vegetable cowpea (Das *et al,* 2020).

Exploring the effects of thermochemically digested leaf litter, it was found that the low nutrient contents limited its impacts on soil fertility and hence uptake leading to comparatively lower yields (14.20 and 15.29 Mg/ha) irrespective of the litter species.

The results on the changes in soil properties clearly indicate the amelioration possible with the addition of leaf litter composts. The soil organic carbon build up and increase in available nutrient status from the initial values recorded on application of vermicomposted litter is in consonance with the reports of Maheswarappa *et al* (2014) and Jain and Kalamdhad (2020). Available N and P status remained comparable with different litter composts, but, available K content varied markedly. It was significantly high in soils treated with thermochemical compost which might be due to the KOH used for chemical treatment in thermochemical digestion as reported by Sudharmaidevi *et al* (2017). Leno (2017) also reported the increased K status in the soil with the application of thermochemically digested compost in banana.

The increase in microbial count in soil can be attributed to the presence of the microbes in the compost and the organic material as such would have augmented the population in soil whereas, thermochemically composted litter applied plots recorded the lowest counts as these were acid-alkali digested and did not have much microbes in it other than that inherent in soil. A better actinomycete count what was present in soil. The comparable actinomycete count noted could be due to the affinity of these microbes to multiply under extreme soil condition such as high salinity and alkalinity as reported by Hamdali *et al* (2008).

The maximum B:C ratio realized in Amaranthus with the application of coconut leaf litter compost prepared with the inoculation of CI (liquid) and earthworms was on account of the maximum yields obtained. Thermo-chemically

digested jack litter was the least profitable due to the higher cost incurred in the production. It is interpreted that as the nutrient contents in the thermochemical digest was lower compared to the other composts, it was required in larger quantity which added to the cost, at the expense of the returns.

CONCLUSION

The study has brought to light the prospects of recycling leaf litters of jack and coconut as composts *via* microbial + vermicomposting and the positive influences on soil properties and yields in Amaranthus. The highest yield and returns were realized with the use of coconut litter compost [CI (liquid) + earthworms] to substitute 50 per cent RDN and was on par with the N source of jack litter compost [CI (powder) + earthworms].

ACKNOWLEDGEMENT

The authors gratefully acknowledge Kerala Agricultural University for the physical and financial support rendered for the Master's thesis work of the first author of which this paper is based on.

REFERENCES

Das R, Isaac S R and Thampatti M K C (2020). Efficacy of enriched leaf litter compost as nutrient source in vegetable cowpea (*Vigna unguiculata* sub sp. *unguiculata*). *J Soils Crops* **30**(1): 63-68.

Gopal M, Gupta A, Palaniswami D R and Thomas G V (2010). Coconut leaf vermiwash: a bio-liquid from coconut leaf vermicompost for improving the crop production capacities of soil. *Curr Sci* **98**(9): 1202-1210.

Hamdali H, Hafidi M, Virolle M J and Ouhdouch Y (2008). Growth promotion and protection against damping-off of wheat by two rock phosphate solubilizing actinomycetes in a P-deficient soil under greenhouse conditions. *Appl Soil Ecol* **40**: 510-517.

Harishma S J (2017). *Leaf litter recycling in homestead agroforestry systems*. M.Sc. (Ag) Thesis, Kerala Agricultural University, Thrissur.

Isaac S R and Nair M A (2006). Litter dynamics of six multipurpose trees in a homegarden in southern Kerala, India. *Agrofor Syst* **67**: 203-213.

Jackson M L (1973). *Soil Chemical Analysis* (2nd Edition), Prentice Hall of India, New Delhi, 498p.

Jagadeesha N, Srinivasulu G B, Shet R M, Umesh M R, Kustagi G, Ravikumar B, Madhu L and Reddy V C (2019). Effect of Organic Manures on Physical, Chemical and Biological Properties of Soil and Crop Yield in Fingermillet-Redgram Intercropping System. *Int J Curr Microbiol App Sci* **8**(05): 1378-1386. doi: https://doi.org/10.20546/ijcmas.2019.805.157

Jain M S and Kalamdhad, A S (2020). Soil Revitalization via Waste Utilization: Compost Effects on Soil Organic Properties, Nutritional, Sorption and Physical Properties *Environ. Technol Innov* 18: 100668 https://doi.org/10.1016/j.eti.2020.100668

Johnson L F and Curl E A (1972). *Methods for Research in the Ecology of Soil Borne Plant Pathogen*. Burgers publication Co., Minneapolis, 247p.

KAU [Kerala Agricultural University] (2016). Package of Practices Recommendations: *Crops* (15th Ed.). Kerala Agricultural University, Thrissur.

Leno N (2017). *Evaluation of customized organic fertilizer in relation to labile carbon dynamics nutrient release characteristics and productivity of banana*. Ph.D. (Ag) Thesis, Kerala Agricultural University, Thrissur.

Maheswarappa H P, George V, Thomas S, Gupta A, Bhat R and Palniswami P (2014). Productivity and nutrient status of coconut (*Cocos nucifera*) as influenced by integrated nutrient management with vermicomposted coconut leaves. *Indian J Agron* **59**(3): 455-459.

Patel KK, Anand V, Kaswala AR, Italiya A, Pawar SL, Patel JM, Kolambe BN, and Patil

RG (2012). Comparative performance of FYM, biocompost and banana pseudostem based vermicompost on productivity of banana. *Asian J Hort* **7**(1) : 140-143.

Sharma R, Kandel S, Khadka S and Chaudhary S (2022). Nutrient contents in different sources of organic manures of different farms in Bhaktapur district of Nepal. *J Agric Nat Resour* **5**(1): 150-156.

Sinha R V (2009). Earthworms vermicompost: a powerful crop nutrient over the conventional compost and protective soil conditioner against the destructive chemical fertilizers for food safety and security. *American-Eurasian J Agric Environ Sci* **5**: 1-55.

Snedecor G W and Cochran W G (1975). *Statistical Methods* (16th Ed.). Oxford and IBH Publishing Co., Calcutta, 458p.

Subbiah B V and Asija G L A (1956). A rapid procedure for the estimation of available nitrogen in soil. *Curr Sci* **25**: 259-360.

Sudharmaidevi C R, Thampatti K C M and Saifudeen N (2017). Rapid production of organic fertilizers from degradable waste by thermochemical processing. *Int J Recycling Org Waste Agric* **6**: 1-11.

Vasanthi K, Chairman K and Singh R (2013). Vermicomposting of leaf litter ensuing from trees of mango (*Mangifera indica)* and guava *(Psidium guujuvu)* leaves. *Int J Adv Res* **1**(3): 33-38.

Received on 20/4/2024 Accepted on 19/5/2024

DOI : 10.5958/2349-4433.2024.00068.9

J Krishi Vigyan 2024, 12(2) : 379-385

Role of Anganwadi Workers' Knowledge in the Developmental Milestones of Children at Anganwadi Centers

Manisha Arya And Deepika Vig[1]

College of Community Science, Punjab Agricultural University, Ludhiana-141 004 (Punjab)

ABSTRACT

The study was conducted to determine *anganwadi* workers' (AWs) knowledge levels about children's developmental milestones as well as the information sources they use. Integrated Child Development Services (ICDS) providers (50 *anganwadi* workers from 30 urban and 20 from rural *anganwadi* centres) and their *anganwadi* children of Ludhiana district were studied. It was found that the majority of *anganwadi* workers had an average knowledge level and 10-15 years of experience. A significant finding of the study was that AWs in rural areas were more knowledgeable than their urban counterparts. Compared to children from urban areas, children from rural *anganwadi* centers possess more gross motor skills and have better socio-emotional development. There was a correlation between knowledge of AWs and children's developmental milestones that significantly impacts fine motor skills, cognitive skills, and language skills of urban children as well as gross motor skills and socio-emotional skills in rural *anganwadi* centres.

Key Words: Development, Education, Knowledge, Preschool, Workers.

INTRODUCTION

Children's environment influences their transformation process and a stimulating and caring environment that promotes the children's developmental potential is needed for them to succeed in life later. The term 'developmental milestones' of a child includes the physical, language, cognitive, social and emotional aspect of that serve as indicators of a child's progress through distinct stages of development (Arya, 2023). Each child reaches milestones or performs developmental tasks at his/her own pace and in his/her own way. Children's care is now considered an essential element of the sustainable development goals (SDGs) by 2030. A number of studies and reports have highlighted the importance of early childhood development (ECD) for equity and a student's ability to succeed in school (Arya and Vig, 2023).

The lack of early childhood education may result in emotional, social, intellectual, and physical hardships for a child if he is admitted to primary school without a solid foundation of early childhood education (Arya, 2022). Integrated Child Development Scheme (ICDS) is the only large-scale program in India to assist underprivileged children by providing a variety of services such as immunizations, supplementary nutrition, and preschool education. Non-formal preschool education (NFPSE) is a crucial part of the ICDS programme as it helps lay a foundation for the children's physical, psychological, cognitive, and social development. Preschool education is mainly focused on creating an environment that stimulates and satisfies the curiosity of the child (Arya and Maurya, 2016). It provides a natural, pleasant, and stimulating learning environment that is conducive to optimal development rather than following a rigid curriculum (Jyothi, 2015). The success of the ICDS programme depends upon the effectiveness of the *Anganwadi W*orkers (AW), which depends on their knowledge, attitude, and practice. Knowledge includes facts, information or skills acquired through expressions or education. A sound knowledge of a subject can strengthen the skills and raise the capabilities (Arya *et al*, 2017). The AWs receive hands-on experience working with children, managing preschool environments, and providing learning opportunities. However, early learning has, so far, been largely neglected

Corresponding Author's Email - paran.arya@gmail.com

since nutrition has been prioritized (Limbu and Arya, 2019). It is right that the National Education Policy, 2020 emphasizes how important early childhood care and education is for the cognitive, social, and emotional development of a young child. The National Family Health Survey-5 (NFHS-5) finds, however, that only 13.6% of children attend pre-primary schools. Hence, the nearly 1.4 million *anganwadi* centres (AWC) that provide ICDS in India must supply early childhood care and education (ECCE) to the millions of young children from low-income families.

Admittedly, with its overriding focus on health and nutrition, NFPSE has hitherto been the weakest link of the *anganwadi* system (Ashajyothi *et al*, 2014). Multiple administrative duties have left AWs with little time for ECCE. The existing system at best serves the age group of 3-6 years, ignoring infants and toddlers. Nevertheless, a child's early learning begins at birth, initially through stimulation, play, interactions, non-verbal and verbal communication, and gradually through observation and cues from the immediate environment and increasingly structured activities. Unfortunately, due to a lack of parental awareness compounded by the daily stresses of poverty, disadvantaged households are unable to provide an early learning environment (Arya *et al*, 2023).

To accomplish this, AWC will be re-imagined and re-calibrated so that not only will nutritional aspects of children and mothers be addressed, but also early childhood education will be addressed, especially for children under the age of 6 years, which has been shown to be a foundation for the development of children. Study findings will help identify the gaps in AW knowledge about pre school education and assist *anganwadi* children in paying attention to areas such as preschool education which require more attention.

MATERIALS AND METHODS

The sample for the current study comprised *anganwadi* workers and *anganwadi* children. Among the 606 anganwadi centers established in Ludhiana Urban, there are 213 in Ludhiana Rural, according to the Ministry of Women and Child Development. A total of 30 *anganwadi* workers from three urban blocks and 20 *anganwadi* workers from two rural blocks of Ludhiana district were selected. From each urban block 30 AWCs and each rural block 20 AWCs were randomly selected. By using simple random methods, five 3-6-year-old children were also selected from each of the selected *anganwadi* centers. Those AWCs that were operational were included in the sample. In order to collect information, the knowledge questionnaire, the developmental milestones checklist, and observations were used as a tool. The knowledge scale used were: The self-structured knowledge questionnaire for *anganwadi* workers was used to assess their knowledge about non formal preschool education. The total scores obtained were divided equally across three levels of knowledge i.e. high, average and low. The same procedure was carried out for each AWC under study.

In the selected AWC, the investigator observed random activities conducted during the working period for two hours. In this study, each AWC was observed. Scoring was done based on how much knowledge they had of NFPSE that varied from low to high. One questionnaire took approximately two hours to complete. For assessment of Developmental Milestones Checklist of *anganwadi* children: This schedules developed by taking guidance from Guidebook for Planning and Organization of Preschool Education Activities in *Anganwadi* Centres by NIPCCD (2006). Physical and motor development, cognitive development, language development, and social and emotional development of selected *anganwadi* children were assessed using separate sub-checklists.Worksheets and activities were included in the checklists for the children in the AWC. During the selection and pretesting of both scales, experts in the field were consulted. A pre-testing stage was carried out in order to measure reliability after 78 per cent reliability was achieved, the actual data collection could begin.

Data collection and statistical analyses: The data were collected personally by making a

Table 1. Personal profile of *anganwadi* workers.

Personal information	Urban (n_U =30) *f* (%)	Rural (n_R=20) *f* (%)	Total (n=50) *f* (%)
Age (Yr)			
25-35	6 (20)	5(25)	11(22)
36-45	15(50)	7(35)	22(44)
>45	9(30)	8(40)	17(34)
Education			
High school	6(20)	9 (45)	15(30)
Intermediate	9(30)	6(30)	15(30)
Graduation	10(33.33)	3(15)	13(26)
Post-graduation	5(16.66)	2(10)	7(14)
Work Experience (Yr)			
< 5 yr	0	0	0
5-10 yr	12(40)	4(20)	16 (32)
11-15 yr	15(50)	6(30)	21(42)
>15 yr	3(10)	10(50)	13(26)
Number of Training and Refresher Courses Attended			
1-3	18(60)	10(50)	28(56)
4-6	12(40)	8(40)	20(40)
>7	0	2(10)	2(4)

Table 2. Knowledge level of *anganwadi* workers.

Levels of knowledge	Urban (n_U =30) *f* (%)	Rural (n_R=20) *f* (%)	Total (n=50) *f* (%)
High	4 (13.3 3)	3 (15)	7 (14)
Average	20 (66.67)	13 (65)	33 (66)
Low	6 (20)	4(20)	10 (20)

Table 3. Mean score (±SD) difference of *anganwadi* workers' knowledge level.

Knowledge level	Urban (n_u =30)	Rural (n_r=20)	t-Value
	Mean ± SD	Mean ± SD	
	19.38±5.46	27.26±6.18	4.75**

***Significant at 1%*

personal visit to Urban and rural *anganwadi* centres of different blocks in Ludhiana District. The field work involved the use of several tools to collect the required data. Researchers completed the Developmental Milestones Checklist purely based on observations. Categorical variables were expressed as percentages, mean (SD) for normally distributed continuous variables, and categorical variables were compared between groups using the Z-test and the t-test. The Pearson correlation coefficient was used to assess correlation between groups with normally distributed continuous variables.

RESULTS AND DISCUSSION

Age

The data (Table 1) revealed that a large percentage (44%) of the AWs included in the sample were in the 36-45 age group and 34 per cent

Table 4. The differences among urban and rural *anganwadi* children in developmental milestones across different domains and levels.

Levels and domains of developmental milestones	Urban *anganwadis* (n_u =150)	Rural *anganwadis* (n_r=100)	Z-value
	Frequency (%)	Frequency (%)	
1. Development i n Physical and Motor (i) Gross motor skills			
Low	40(26.67)	8(8)	3.67**
Average	68(45.33)	74(74)	4.48**
High	42(28)	18(18)	1.81 ^{NS}
(ii) Fine motor skill			
Low	25(16.67)	6(6)	2.51*
Average	105(70)	79(79)	1.58 ^{NS}
High	20(13.33)	15(15)	0.37 ^{NS}
2.Cogni tive skill			
Low	19(12.67)	15(15)	0.52 ^{NS}
Average	95(63.33)	72(72)	1.42 ^{NS}
High	36(24)	13(13)	2.15*
3. Language skill			
Low	0	0	0
Average	117(78)	89(89)	2.24*
High	33(22)	11(11)	2.24*
4. Socio-emotional skill			
Low	0	0	0
Average	125(83.33)	92(92)	1.98*
High	25(16.67)	8(8)	1.98*

were belonged to >45 years. Rest 22 per cent belonged to the 25-35 years of age group. The study suggested that AWs has a majority of workers 36 to 45 years old, which makes it easier to work with young children as workers under this age are not mature enough or too young. Similar findings have also been reported by Arya and Vig (2023) who concluded that 36-45 year is a very suitable age for effective functioning of the *anganwadi* workers at the *anganwadi* centres.

Education

Most of the respondents (30%) were high school or intermediate qualified whereas, 26 per cent finished their graduation and 14 per cent completed post-graduation. As part of education, most of the AWs have high school and intermediate so its impact on their children and their performances. These finding have also been reported by Arya *et al* (2018).

Work Experience

It was found that 42 per cent worked between 11-15 years. Thirty two per cent worked between 5-10 years and 26 per cent had served for more than 15 years. None of them were less than five years of experience. It was observed that training part was lacking, as they have not been provided with training by the department or higher authorities, therefore they have little or no knowledge of preschool education (Arya and Vig, 2023).

Number of training and refresher courses

Study results indicate that most anganwadi workers received one or two training courses.

Table 5. Differential mean scores (±SD) of *anganwadi* children based on developmental milestone.

Developmental Milestones Domains	Urban *anganwa dis* (n_u =150)	Rural *anganwadis* (n_r=100)	t-Value
	Mean ± SD	Mean ± SD	
1.(a) Gross motor skill	10.84±2.30	11.52±2.89	2.06*
b) Fine motor skill	12.18±3.17	11.89±3.45	0.68
2. Cognitive skill	11.74±2.91	11.13± 2.84	1.64
3. Language skill	11.47±2.29	10.53±2.26	3.18**
4.Social -emotional skill	17.00±3.62	18.21±3.37	2.71**

**Significant at 0.05 level, **Significant at 0.01 level*

Table 6. Correlation between *anganwadi* workers' knowledge and developmental milestones of children.

Developmental milestones Domains	Knowledge level	
	Urban (n_U=150)	Rural (n_R=100)
Gross motor skills (r)	0.04	0.26**
Fine motor skills (r)	0.21*	0.09
Cognitive skills (r)	0.26**	0.001
Languageskills (r)	0.15*	0.09
Socio-emotionalskills (r)	0.004	0.22*

**Significant at 0.05 level, **Significant at 0.01 level*

Similar results found by Arya *et al* (2018) that most (56%) of the AWWs had received only one or two training sessions.

The findings divulged that percentage distribution of knowledge level of the urban and rural AWs. The overall data elucidated that majority (66%) of the AWs at average level and (20%) were at low level and only (14%) at high level of the AWs in knowledge. It was concluded that *anganwadi* workers' awareness of non-formal preschool education was generally average, which indicates the importance of regular quality training and on-site training. Although *anganwadi* workers have worked in an *anganwadi* centres for 11-15 yrs, their skills have not been trained, so the results indicate that they have the average level of knowledge (Arya and Vig , 2023).

The data (Table 3) present the area-wise mean scores (±SD) of *anganwadi* workers' knowledge level. The data regarding 'knowledge' that maximum mean score (27.26±6.18) of the *anganwadi* workers from centres and minimum mean scores (19.38±5.46) were found in urban *anganwadi* centres. There was a significant difference ($t=4.75$; $p<0.01$) in mean scores between urban and rural *anganwadi* workers' knowledge level. The finding of the study indicated that AWs in rural areas display higher knowledge levels than their urban counterparts, and this was significant.

The data (Table 4) showed that difference mean scores (± SD) of developmental milestones of *anaganwadi* children. In rural *anganwadi* children, gross motor skills were significantly

different at average level (Z=3.70, P0.01) and low level (Z=3.67, P0.01). In fine motor skills, a significant difference was found (Z=2.51, p≤0.05) at the low level. A significant difference was observed in case of cognitive skills (Z=2.15; p<0.05) at high level whereas, as for the language and socio-emotional skills, they were significantly at the higher and average level, respectively.

A significant difference in gross motor skills was observed between rural and urban *anganwadi* children (t=2.06; p=0.01). The finding of the present study was in line with the studies of Arya *et al* (2023) that *anaganwadi* children in rural areas display higher gross motor than their urban children, and this is significant. Additionally, rural *anganwadi* children scored higher mean scores (18.21±3.37) in socio-emotional skills than urban *anganwadi* children by a significant amount (t = 2.71; p<0.05). However, when it comes to language skills, urban *anganwadi* children scored significantly higher than rural *anganwadi* children (t=3.18; P< 0.01). The results signified that children from rural *anganwadi* centers are more likely to possess gross motor skills, and their socio-emotional development is better than that of children from urban areas, but they have better cognitive and language abilities than children from rural areas.

The data (Table 6) depicts the correlation between the between *anganwadi* workers' knowledge and developmental milestones of children. The results revealed that *anganwadi* workers' were positively correlated with the children's fine motor skills (r =0.21; p<0.01), cognitive skills (r =0.26; p<0.01), and language skills (r =0.15; p< 0.05). In case, rural *anganwadi* workers' knowledge level was positively correlated with gross motor skill (r=0.26; p<0.05) along with socio-emotional skills (r =0.22; p<0.05) of the children. This correlation indicates that the level of knowledge of AWs and children's developmental milestones has a significant impact on the fine motor skills, cognitive skills, and language skills of urban children. As a result, urban children are better at reaching, grasping, remembering, paying attention, thinking, and writing. Children from rural AWC have a better understanding of feelings, better relationships with family and friends, and better gross motor skills like running and dancing than children in urban areas.

CONCLUSION

The results indicated that *anganwadi* workers' knowledge of developmental milestones was correlated with better childcare strategies and overall better outcomes for children. A correlation exised between knowledge of AWs and children's developmental milestones, which significantly impacts fine motor skills, cognitive skills, and language skills of urban children, as well as gross motor skills and socio-emotional skills in rural centers. Governments and higher authorities should establish policies that promote skill up gradation and provide training to AWs. Planning, executing activities, and developing appropriate curriculum related to NFPSE should have been included in the AWs, not just in terms of nutrition. Effective transition programmes should be developed for children, parents, and *anganwadi* workers, which emphasize meaningful partnerships.

REFERENCES

Arya M and Maurya S (2016). Relationship between creativity, intelligence and academic achievement among school going children. *Studies on Home and Community Sci* **10** (1-3): 1-7.

Arya M , Maurya S and Chandola A (2017). Studies on creativity and academic achievement among school children. *Int J Family and Home Sci* **13** (3): 379-387.

Arya M and Vig D (2022). Knowledge level of anganwadi workers about non-formal pre-school education of Integrated Child Development Services. *J Krishi Vigyan* **11** (1) : 239-244.

Arya M (2022). *Personal and professional attributes of anganwadi workers as correlates of developmental outcomes in children*. Ph.D. thesis, Punjab Agricultural University, Ludhiana.

Arya M Vig D and Chawla A (2023). Job satisfaction of *anganwadi workers*: comparative study and impact on developmental milestones of children in rural and urban anganwadis of Ludhiana District. *J Commun Mobiliz and Sustain Dev* **18** (1): 52-67.

Arya M and Vig D (2023). Impact of anganwadi *workers*' soft skills on anganwadi children's developmental milestones. *Indian J Ext Edu* **59** (3) : 118-121.

Arya M, Sachan V, Limbu R, Nautiyal P and Papnai G (2018). Effect of training on nutritional knowledge of anganwadi workers of Uttarkashi district in Uttarakhand. *J Krishi Vigyan* **7** (1) : 105-108.

Ashajyothi T, Devi U L and Kiran V K (2014) Impact of ICDS on developmental status of children below 2yrs in telangana. *Inter J Sci Res* **3**: 144-45.

Jyothi T A (2015) *Impact of ICDS on the developmental milestones of children under five in Andhra Pradesh villages*. M.Sc. thesis, Acharya N.G Ranga Agricultural University, Andhra Pradesh.

Limbu R and Arya Manisha (2019). Effect on nutrition education on knowledge level of farm women. *J Krishi Vigyan* **8** (1) : 92-95.

NIPCCD (2006) *Handbook for Anganwadi Workers*. Pp. 4-13.Power Press, New Delhi, India.

Received on 30/4/2024 Accepted on 25/5/2024

DOI : 10.5958/2349-4433.2024.00069.5

J Krishi Vigyan 2024, 12(2) : 386-390

Role of Artificial Intelligence in the Processing of Paddy (*Oryza sativa*)

Aaradhana Patel
Post-Harvest Process and Food Engineering Division, College of Agriculture Engineering
Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur, MP

ABSTRACT

Artificial intelligence (AI) aims to increase production, guarantee safety, and boost overall food processing operations efficiency. AI technologies are becoming more useful for automating post-harvest procedures and decreasing food loss in the food processing sector. Keeping these facts in mind, a system was developed to reduce the broken percent from the processing of paddy (*Oryza sativa*) that is called Ohmic - heating system. In that system temperature sensor and SS electrodes, multi- function meter was used to take reading of temperature, frequency and voltage for uniform heating. Experiments were carried out for paddy variety MTU 1010 with parboiled and raw paddy samples and observations were taken at various voltage - gradients of 24.44, 25, 25.56, 26.11 and 26.67 V/cm in the heating chamber of ohmic system. The milling qualities of paddy obtained by milling of parboiled and raw paddy, the highest head yield of 88.09% and lowest broken yield of 11.90 % at 26.67 V/cm for parboiled samples. Whereas, the raw sample had a head yield of 61.50 and broken of 38.56%. The study concluded that the use of an ohmic-heating system improved the quality of milled paddy that was parboiled. Additionally, it eliminated the need for an entire boiler unit, which reduced the processing cost of parboiled paddy and made the parboiling unit safer and easier to work with.

Key words: Head Rice, Milling ,Ohmic heating, Parboiling, Paddy, Temperature.

INTRODUCTION

The objective of Artificial intelligence (AI) is to ensure safety, enhance productivity and improve the overall efficiency of food processing operations. AI technologies are becoming more operable in automating post-harvest operations and reducing food loss during the processing of food as food losses occur during post harvest processing and management (Sidhu and Mohapatra, 2023). In India, rice processing is the oldest and the largest agro-processing industry. Parboiling (hydrothermal process), where rice is partially cooked while still in the husk. The parboiling of paddy involves three sequential steps-(1) soaking (2) steaming and (3) drying (Anonymous, 2017). In a conventional parboiling plant, the soaked paddy is heated in parboiling tank by directly injecting steam produced in steam boiler, located outside the rice mill in the utility section. The boiler unit comprises a boiler, a fuel tank, water supply system, a water tank and insulated piping extending from the boiler to the parboiling tank. The entire boiler unit requires dedicated maintenance, necessitating the payment of a certified boiler operator and helper year-round, thereby contributing to the processing costs of parboiled rice. If the traditional steam heating, system is replaced with an ohmic-heating system, it would involve simply affixing two electrodes on opposite sides of the parboiling tank. This set-up would facilitate the ohmic/resistant heating of entire mass of paddy soaked in water contained within the parboiling tank. The desired temperature within desired timeframe can be achieved by applying the necessary voltage for the specified distance between two electrodes (Dhingra *et al,* 2012). This will help to eliminate the need of entire boiler unit, water tank piping, fittings, fuel tank, air preheater, economizer, accessories and mountings needed to support operation of boiler. Furthermore, it will lead to elimination of the requirement to pay and maintain a boiler operator and assistant, would also help to lower the processing costs associated with

Corresponding Author's Email - aradhana1910@gmail.com

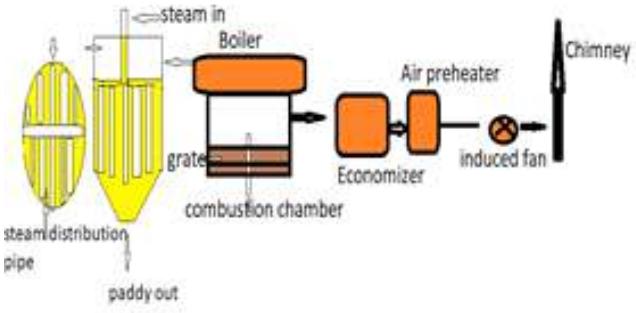


Plate 1. Traditional parboiling system with boiler

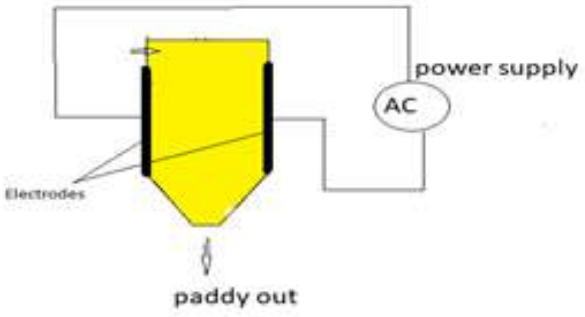


Plate 2. Ohmic-heating system

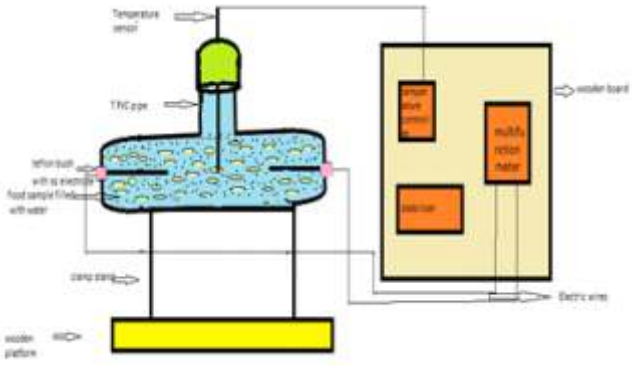


Plate 3.Conceptual drawing for ohmic heating set-up

parboiling paddy and make the parboiling unit more secure and user-friendly. The conceptual drawings given in plate 1 and 2 to explain the concept.

Principle of Ohmic Heating

Ohmic heating operates on the principle of Ohm's law. When an electric current passes through a conductive food material, and generating heat as the electrical resistance of food (Zell et al. 2009).

$$V \propto I$$

$$V = RI,$$

Where V is Voltage (V), I is Current (A), R is Resistance (Ω).

This innovative technology for food processing, known as ohmic heating. represents an excellent alternative heating method, (Sakr and Liu, 2014).

MATERIALD AND METHODS

This study was conducted at the College of Agricultural Engineering, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur. The conceptual drawing (Plate 3) illustrated specific guidance for constructing an ohmic heating set-up for parboiling paddy. Based on this conceptual drawing, an experimental ohmic heating set-up (Plate 4a, 4b) was fabricated for the parboiling process. During the process of parboiling, ten samples were chosen, each consisting of a ratio of 1:3 of paddy and water, with each sample being introduced into the ohmic heating chamber. A total of 10 kilograms of paddy, specifically the MTU1010 variety (medium-sized grain), was utilized for each sample. The power was supplied to the ohmic heating system, and observations were noted at voltage gradients of 24.44, 25, 25.56, 26.11, and 26.67 V/cm within the ohmic heating chamber. These observations were recorded at 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, and 180-minute intervals in the T-type PVC ohmic heating chamber (plate 5). The time taken to reach the temperature of 96˚C for parboiling the paddy was recorded, following which the power supply was turned off, and the sample was allowed to remain in the ohmic- heating chamber for ten minutes.

Plate 4a. Experimental system

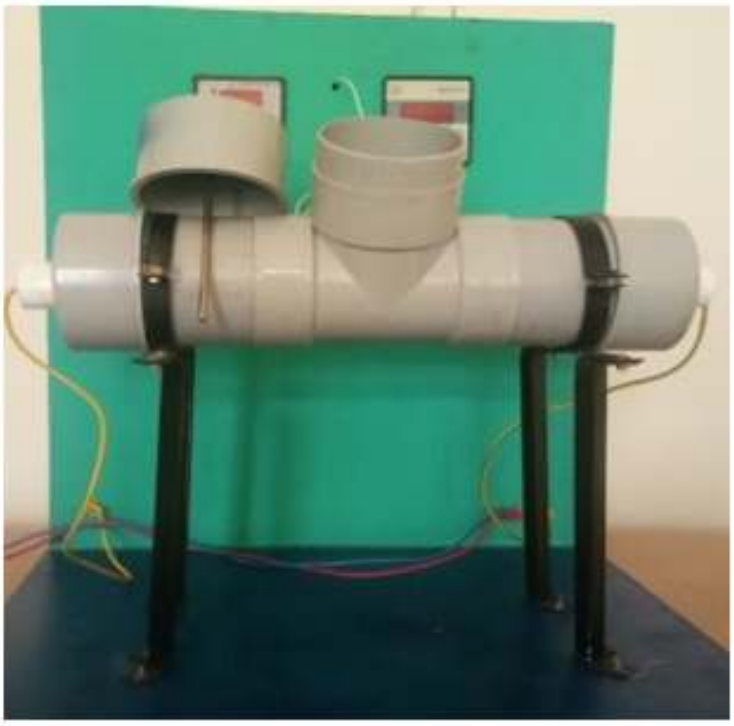


Plate 4b. Temperature sensor in set-up

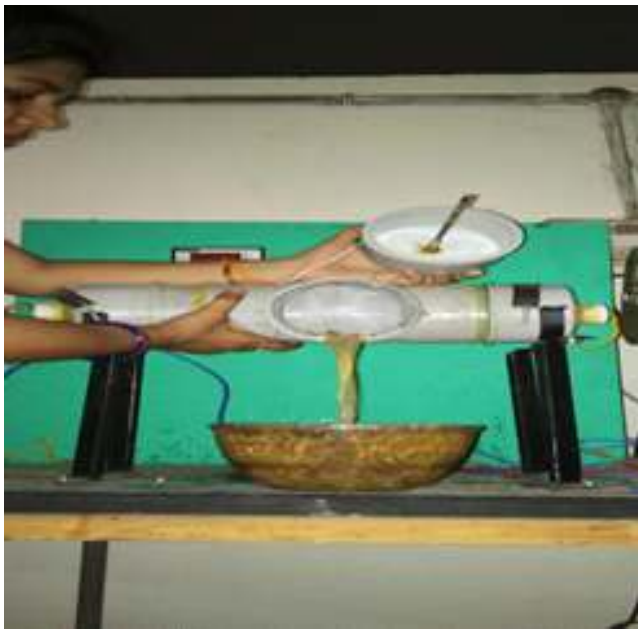


Plate 5.Parboilied paddy with water mixture

Plate 6. Laboratory model of paddy sheller

The paddy was extracted, and the excess water was drained. Observations were taken at every voltage gradient after parboiling the paddy using ohmic heating. The initial sample was sun-dried for one hour in sunlight and subsequently, the process of shade drying was conducted. Samples were dried at 14% mc (wb) before being taken to the milling stage. Milling was performed on the treated paddy at the concluding phase of the process. To determine the milling characteristics, 100g samples of paddy extracted, and experiments were conducted in the laboratory of Food Science department and put, JNKVV, Jabalpur, (M.P.). Plate-6 displays the laboratory model Indosaw

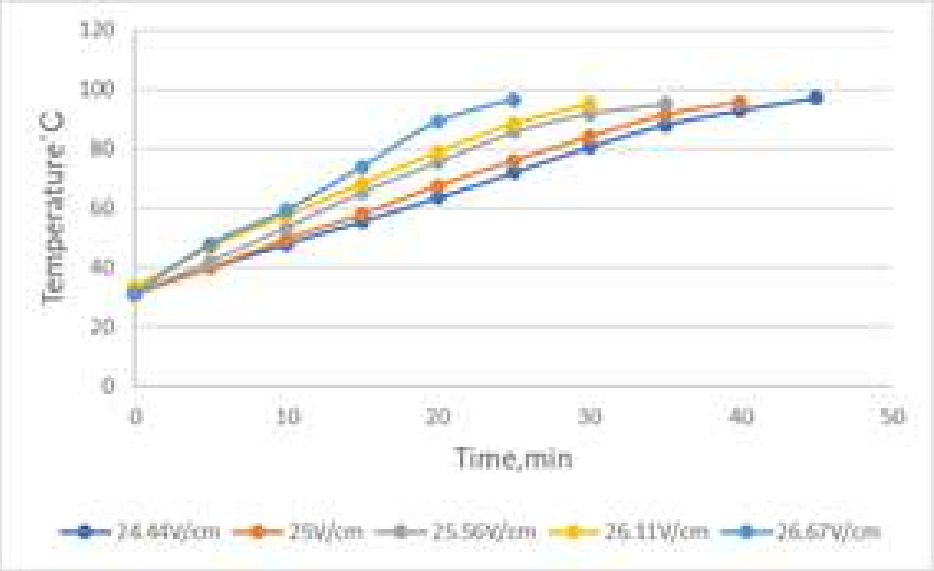


Fig. 1. Relationship between temperature and time at 24.44, 25, 25.56, 26.11 and 26.67 V/cm

rubber roller paddy sheller utilized for de-husking the paddy.The head yield and broken portions were determined by weighing the samples at each milling stage.The output of milled paddy, obtained from various openings (Husk, broken and head rice), was collected and analyzed. This data was then compared with the results of milling raw rice under similar conditions to evaluate the effects and advantages of the ohmic-heating system.

RESULTS AND DISCUSSION

The time and temperature profiles (Fig.1) showed that as the voltage gradient, increased, the temperature also rose, leading to a reduction in the parboiling time of samples. This indicates that the curve's slope for higher was steeper compared to that for lower voltage. At higher voltage, the current flowing through the sample also intensified, resulting in faster heat generation.

Milling analysis of parboiled and raw paddy

The milling efficiency percentage, head rice percent and broken rice percentage of raw paddy and parboiled paddy by ohmic heating were calculated as follows

$$\text{Milling recovery \%} = \frac{\text{Weight of total rice}}{\text{total weight of paddy}} \times 100$$

$$\text{Head rice \%} = \frac{\text{Weight of head rice}}{\text{Weight of milled rice}} \times 100$$

$$\text{Broken rice \%} = \frac{\text{Weight of broken rice}}{\text{weight of milled rice}} \times 100$$

The performance of milling process is judged by total yield, head yield and broken rice percentage (Table 1). Experiments were conducted for variety of MTU 1010 paddy with raw and parboiled samples and observations were taken at voltage gradients of 24.44, 25, 25.56, 26.11 and 26.67 V/cm in the ohmic heating chamber at the time interval of 0, 5, 10, 15, 20, 25, 30, 35 and 40 min in the ohmic heating chamber. The data on milling qualities of paddy obtained by milling of raw and parboiled paddy which indicated the highest head yield of 88.09% and lowest broken yield of 11.90 % with a highest milling efficiency of 74.96% for parboiled samples at 26.67 V/cm. Whereas, the raw sample had a head yield of 61.50 and broken of 38.56% with a milling efficiency of 73.35%. Thus, brown rice head yield of parboiled paddy was found higher (26.66%) than that of raw paddy. These results are in conformity with those of Lbukun (2008) who reported that as the longer the parboiling duration the higher the percentage of breakages of paddy rice during milling.

CONCLUSION

The heating rate increased considerably with the increase in voltage. Both the soaking and steaming process were conducted within the ohmic- heating chamber for parboiling the paddy.

Table 1. Milling efficiency, head rice, broken rice percentage of raw and one hour sun dried parboiled paddy.

Milling analysis	Raw paddy	Parboiled paddy one hour sun dried (26.67 V/cm)
Milling efficiency (%)	73.35	74.96
Head rice (%)	61.50	88.09
Broken rice (%)	38.56	11.90

Paddy milling qualities procured from milling of parboiled and raw paddy, the parboiled samples showed the highest head yield of 88.09% and the lowest broken yield of 11.90% at a voltage gradient of 26.67 V/cm. Whereas, the raw sample had a head yield of 61.50 and broken of 38.56%. The results indicated that there was an improvement in milling quality of parboiled paddy by ohmic heating also reduced the processing cost of parboiling paddy and made the parboiling unit safer and easier.

REFERENCES

Ahmed Sahin (2014). Study of thermal radiation and ohmic heating for steady magneto hydrodynamic natural convection boundary layer flow in a saturated porous regime. *Int J Recent and Innovat Trends in Computing and Communi* **2**(9):2796-2801.

Anonymous (2017). Largest rice producing countries.https://www.worldatlas.com/articles/the-countries-producing-the-most-rice-in-the-world.html.

Assawarachan R (2010). Estimation model for electrical conductivity of red grape juice. *Int J Agric Biol Eng* **3**: 52-57.

Bhattacharya K R (2004). *Parboiling of rice.* In: Rice Chemistry and Technology. ed. By N.E.T. Champagne. American Association of Cereal Chemists, Inc., St. Paul, Minnesota. 329-404.

Lbukun E O (2008). Effect of prolonged parboiling duration on proximate composition of rice. *Scientific Res and Essay* **3**(7): 323-325.

Nair Gopu Raveendran, Divya V R, Prasannan Liji, Habeeba V, Prince M V, and Raghavan G S V (2012). Ohmic heating as a pre-treatment in solvent extraction of rice bran. *J Food Sci Technol* 220-224.

Patel A and Singh M (2018). Development of Ohmic Heating model for Parboiling of *Oryza sativa* L. *Current J Appl Sci &Technol* **27**(6): 1-8.

Patel A and Singh M (2018). Ohmic Heating for Food Products – A Review. *Current J Appl Sci & Technol* **27**(3): 1-7.

Patel A, Singh M, Rai A K, Khan M A and Garg S K (2019). Time – Temperature Combination of Ohmic Heating System for Parboiling of Paddy. *Current J Appl Sci &Technol* **33**(6): 1-9.

Sakr Mohamed and Liu Shuli (2014). A comprehensive review on applications of ohmic heating (OH). *Renew and Sustain Energy Rev* **39**:262-269.

Sidhu, J K and Mohapatra, L (2023). Factors affecting adoption of post-harvest management practices by vegetable growers. *J Krishi Vigyan* **11**(suppl): 91-95.

Zell M, Lyng J G, Cronin D A and Morgan D J (2009). Ohmic heating of meats: Electrical conductivities of whole meats and processed meat ingredients. *Meat Sci* ***83*****:** 563-70.

Received on 18/4/2024 Accepted on 26/5/2024

DOI : 10.5958/2349-4433.2024.00070.6

J Krishi Vigyan 2024, 12(2) : 391-395

Socio-Personal Characteristics of Field Extension Functionaries of Dairy Development Department

B Akhila[1], Subin K Mohan[2*], Anu George[3], R S Jiji[4], and Arun George[5]
Department of Veterinary and Animal Husbandry Extension,
College of Veterinary and Animal Sciences, Mannuthy, Thrissur- (680651)
Kerala Veterinary and Animal Sciences University, Kerala, India

ABSTRACT

The study conducted in Kerala during 2021–2022 aimed to analyze the socio-personal characteristics of field extension functionaries (FEFs) from the Dairy Development Department (DDD). Employing an exploratory research design, a sample of 120 respondents, comprising 60 Dairy Extension Officers (DEOs) and 60 Dairy Farm Instructors (DFIs), were selected using non-proportionate stratified random sampling. Data was collected through structured interviews. The findings revealed a predominantly middle-aged (31-50y), well-educated workforce (undergraduate and above) with a notable representation of women (70%), mostly married (86.7%). Many respondents had limited service experience (below 10 years) and had undergone minimal training. Additionally, a majority lived with their families near their place of work (55%). Addressing socio-personal characteristics of FEFs is essential for a skilled, motivated, and productive dairy workforce, contributing to industry growth and sustainability in Kerala. Improving skills and knowledge among new recruits in the dairy sector is vital, especially through targeted training in new technologies, dairy management, and leadership. Tailored programs, suited to individuals' experience, are key for skill enhancement and career progression. Implementing interventions based on these findings is essential to enhance the effectiveness of FEFs in Kerala. Strategies to attract and retain young talent, promote work-life balance, and support family needs are crucial for sustaining the dairy workforce. Initiatives promoting gender inclusivity and leadership opportunities can create a supportive work environment, ensuring organizational success.

Key Words: Socio-personal , Field extension functionaries, Dairy Development.

INTRODUCTION

Dairying plays a vital role in the economic growth of Kerala's rural population. Kerala ranks 14th though the state produces just 1.5 per cent of the total milk production in India (Anonymous, 2022). Milk procurement by Kerala Cooperative Milk Marketing Federation Limited increased dramatically from 52000 l/d in 1983 to 15.2 lakh l/d in 2021-22 and the average milk sale per day for 2021-22 was 14.29 lakh liters (Anonymous, 2022). During the financial year 2019-20, the milk production in the state was around 25.42 lakh MT and 6.75 lakh MT of milk was procured by dairy cooperatives, thus contributing to about 26.5 per cent. The procurement status in the financial year 2020-21 was around 7.12 lakh MT (DDD, 2021). Per capita availability of milk in the state during the yes 2019-2020 has been 198 g/day (Anonymous, 2020).

The field extension functionaries (FEFs) within the department have significantly contributed to enhancing the dairy cooperative sector through various tasks such as implementing dairy and fodder development programs, advising

Corresponding Author's Email - subin.mohan@kvasu.ac.in
#Part of MVSc thesis submitted to Kerala Veterinary and Animal Sciences University, Pookode, Wayanad, Kerala
1.MVSc Scholar, Department of Veterinary and AH Extension, CVAS, Mannuthy
2.Assistant Professor and Major Advisor, Department of Veterinary and AH Extension, CVAS, Mannuthy
3.Assistant Professor, Department of Veterinary and Animal Husbandry Extension, CVAS, Mannuthy
4.Professor and Head, Department of Veterinary and Animal Husbandry Extension, CVAS, Mannuthy
5.Assistant Professor, Department of Clinical Medicine, Ethics and Jurisprudence, CVAS, Mannuthy

Table 1. Distribution of FEFs based on their socio-personal profile

Parameter	Frequency	Per cent
Age (in years)		
Young (< 30)	24	20.00
Middle age (31-50)	61	50.83
Old (> 50)	35	29.17
Cadre		
Dairy Extension Officer (DEO)	60	50.00
Dairy Farm Instructor (DFI)	60	50.00
Education		
Under graduate (UG)	49	40.84
UG with Diploma	30	25.00
Post graduate (PG)	35	29.16
Doctorate	6	5.00
Gender		
Male	36	30.00
Female	84	70.00
Service experience (in years)		
Low (< 10 y)	71	59.20
Medium (10-20 y)	43	35.80
High (> 20 y)	6	5.00
Training received		
0	13	10.80
1	42	35.00
2	28	23.30
3	18	15.00
4	5	4.20
5	14	11.70
Marital status		
Married	104	86.70
Unmarried	16	13.30
Placement of family		
At the place of posting	66	55.00
Elsewhere	54	45.00

on milk production quality, and fostering connections with other stakeholders. Each employee's competence and performance are crucial for organizational success, especially in dairy organizations vital for economic and social development. Training and guidance provided to trainees have played prime role in influent technological change, besides management orientation (Agrawat and Kumar, 2012). Therefore, evaluating the socio-personal characteristics of FEFs is essential was these traits can influence their perceived performance. This study aimed to assess field extension functionary's socio-personal profiles, encompassing variables like age, experience, training, education, gender, marital status, and family placement, to better understand their roles.

MATERIALS AND METHODS

The study was conducted in Kerala State during 2021-2022, with a total of 120 FEFs chosen at random from the Dairy Development Department. An exploratory research design was adopted. Non-proportionate stratified random sampling was used for this study. DDD categorized the block panchayats of the State into four strata based on their average dairy milk production. Thus, from each stratum, 15 DEOs and 15 DFIs were selected. The total sample comprised of 60 DEOs and 60 DFIs. The interview schedule was developed with all of the items needed to elicit sufficient information in accordance with the study objectives in mind and it was pre-tested with 30 respondents from the non-sample area of the Thrissur district. The structured interview schedule was personally delivered to respondents during monthly conferences and workplace visits. When necessary, Google forms and telephone interviews were used. Secondary data was gathered from reliable sources such as annual reports and government official websites. The data were analysed using appropriate statistical procedures.

RESULTS AND DISCUSSION

The data (Table 1) indicated that a significant portion of the respondents were middle-aged (50.83%), with older respondents comprising 29.17% and younger respondents (20%). This trend may be attributed to the fact that many individuals entered the workforce in their late twenties. These findings were similar to the results of Patel (2015), and Obabire *et al* (2019), who stated that most of the respondents in their organisational study belong to the middle age group. These findings contradict those of Suweidu (2019), who found that majority of the respondents in his study are young. Half of the respondents selected (50%) comprised DEOs with the remaining half (50%) being DFIs. It was found that 40.84% of the FEFs held graduate degrees, while 29.16% possessed postgraduate degrees, and 25% held undergraduate degrees with diplomas. Only 5% held doctorate degrees. Both DEOs (requiring a B Tech in Dairy Science) and DFIs (requiring pre-degree in science subjects along with a valid degree in any subject) necessitate graduation as a mandatory qualification for entry. Additionally, to be promoted from DFI to DEO, a diploma in dairy science is obligatory. Remarkably, 40% of respondents possessed only undergraduate degrees, indicating that many FEFs were highly educated, surpassing the academic requirements of their respective positions. Most of the respondents held undergraduate degree, according to Ratnayake (2012), Das and Borua (2017), whose findings were similar with the current research.

It was evident (Table 1) that 70 per cent of the respondents were female and 30 per cent were male. Majority of the respondents were females. This might be indicative of women empowerment in the department. These findings conflict with those of Patel (2015), Obabire *et al* (2019) and Suweidu (2019), who reported that most of the respondents were male in their organisational research study. Observations indicate that 59.20% of the FEFs possessed low service experience, defined as less than 10 years, while 35.80% had medium experience ranging from 10 to 20 years, and 5% had high experience exceeding 20 years. Service experience plays a pivotal role in career advancement, enabling employees to shoulder greater responsibilities and achieve organizational objectives. The prevalence of low service experience among the majority of FEFs may stem from recent appointments made by the department, as corroborated by senior opinions and secondary data. These findings align with Goyal's (2013) study, which similarly noted a predominance of low service experience. However, they contrast with Patel's (2015) findings, which highlighted a majority with medium work experience.

Further, 35% of respondents underwent one training, followed by 23.30%, 15%, 11.70%, and 4.20% who received two, three, five, and four trainings, respectively. Additionally, 10.80% had no training. Most FEFs had undergone one or two trainings, with 10% receiving none. Pre-entry training for DFIs lasts eight months, while DEOs undergo internship training as part of their undergraduate curriculum, potentially explaining why new recruits may lack training, supported by

their low service experience. Introducing more training sessions could enhance FEFs' understanding of current technologies and performance. The majority (86.70%) were married, possibly reflecting their middle-aged status. 55% stayed with families near their workplace, the agricultural scientists residing with their families showed significantly ($p<0.01$) more job performance in comparison to those who were not residing with their families as reported by Yadav *et al* (2012).

CONCLUSION

The socio-personal makeup of FEFs in Kerala's DDD reflects a predominantly middle-aged, educated workforce, with notable female representation. Many enter the workforce in their late 20s and advance gradually. A significant portion has limited service experience, likely due to recent appointments. Most are graduates, some with postgraduate degrees, indicating a highly educated dairy sector workforce. Many possess qualifications exceeding job requirements, highlighting their dedication to education and career growth. The department exhibits significant female representation, signaling progress in women's empowerment. Most FEFs are married and reside near their workplace, potentially impacting their work-life balance. A considerable number have received minimal training, revealing room for improvement in continuous professional development. Additional training opportunities, particularly in new technologies and leadership, could benefit new recruits. Targeted interventions and policies are needed to enhance FEF effectiveness, along with efforts to attract and retain young talent for a sustainable workforce. Encouraging work-life balance and supporting family needs could enhance job satisfaction and retention. Initiatives promoting gender inclusivity and leadership opportunities for women should be implemented, fostering a supportive workplace for all employees. Understanding and addressing FEFs' socio-personal characteristics can lead to a more skilled, motivated, and productive workforce, driving growth and sustainability in Kerala's dairy industry.

ACKNOWLEDGMENT

We gratefully acknowledge the Department of Veterinary & Animal Husbandry Extension and Dean, College of Veterinary and Animal Sciences, Mannuthy, Kerala, for the facilities provided as well as the respondents of the study.

REFERENCES

Ajrawat B and Kumar A (2012). Impact of KVK training programme on socio economic status and knowledge of trainees in Kathua District. *J Krishi Vigyan* **1 (**1) 31-34pp

Anonymous (2020). *Annual report*. Government of India. Available: 395 https://www.nddb.coop/sites/default/files/pdfs/NDDB_Annual_Report_2019_20_Eng.pdf [21st March 2022].

Anonymous (2021) Government of Kerala. Available: 395 https://dairyb-development. kerala.gov.in/ [12th March 2022].

Anonymous (2022). *Economic review 2021-2022*. Government of Kerala. Thiruvananthapuram, Kerala, India. 606p.

Anonymous (2022). Milma. Thiruvananthapuram, Kerala, India. Available: 395 https://www. milma.com/ about/aboutus [9th Aug. 2022].

Das P and Borua S (2017). Socio-economic characteristics of ATMA (Agricultural Technology Management Agency) extension functionaries in Assam and their relationship to their training needs. *Asian J Agri Ext Eco Sociology* **16**:1-5.

Goyal J (2013). *Job performance and job satisfaction of veterinary surgeons in Haryana*. M.Sc. thesis, NDRI, Karnal, 141p.

Obabire I E, Atere O B and Adedapo A O (2019). Assessment of job satisfaction among extension workers in Ondo State Agricultural Development Project, Nigeria. *Int J Innov Sci Res Technol* **4**: 45-49.

Patel D (2015). *Role performance of field extension functionaries in transfer of technology in dairy sector of Bangalore districts.* Doctoral dissertation, M.Sc. thesis, NDRI, Bengaluru, 88p.

Ratnayake T C (2012). *Organisation climate and differential role performances as perceived by veterinary officers of Andhra Pradesh in India.* PhD thesis, NDRI, Karnal, 214p.

Suweidu M S (2019). *Perceived competence, role clarity and job satisfaction of agricultural extension officers in the northern region of Ghana.* Doctoral dissertation, MPhil thesis, University for Development Studies, Ghana, 146p.

Yadav K, Dhillon D S and Dhaliwal R K (2012). Job performance of agricultural scientists of selected state agricultural universities and its relationship with socio-personal characteristics. *J Krishi Vigyan* **1 (**1) 40-45pp

Received on 27/3/2024 Accepted on 25/4/2024

DOI : 10.5958/2349-4433.2024.00071.2

J Krishi Vigyan 2024, 12(2) : 396-400

Standardization of Composting Technique for Cocoa Leaf Waste

Jegadeeswari V and K R Vijayalatha
Horticultural College and Research Institute for Women, Tiruchirappalli (Tamil Nadu)

ABSTRACT

The present investigation was conducted to standardize the protocol for composting of cocoa (*Theobroma cacao L.*) leaf wastes. Cocoa leaf litter is a important waste material from cocoa. Since these wastes are rich in lignin and cellulose, it takes long time for decomposition and hence add nutrients slowly to the soil. In order to decompose the waste quickly, the effectiveness of several decomposing agents, including micro organisms, in degrading the waste of cocoa and the performance of cocoa compost were studied. The treatments included Cocoa leaf waste + cow dung slurry (T1), Cocoa leaf waste + Earthworm(T2), Cocoa leaf waste + TNAU Biomineralizer (T3), Cocoa leaf waste + *Phanerochaete chrysosporium* (T4) and Cocoa leaf waste + *Pleurotus Sajor- Caju* (T5). Physiochemical properties such as changes in temperature, pH and EC were recorded. Among the different days and treatments, the highest temperature of 60.5°C was recorded in cocoa leaf waste inoculated with cow dung slurry (T_1) on 30th day of composting, the lowest pH of 6.09 was recorded in the cocoa leaf waste inoculated with earthworm (T_2) on 120th day of composting and the lowest EC of 0.52 dSm^{-1} was registered in cocoa leaf waste inoculated with *Phanerochaete chrysosporium* (T_4) on 120th day of observation.

Key Words: Cocoa, Composting, Earthworm, Leaf Waste.

INTRODUCTION

Cocoa belongs to the genus *Theobroma*, a group of small trees which occurs in the wild in the Amazon basin and other tropical areas of South and Central America. There are over twenty Species under the genus *Theobroma* and among them *Theobroma cacao* is the only one widely cultivated species widely. Cocoa is the third important beverage crop next to coffee and tea and is the third highest traded commodity in the world after coffee and sugar and it is one of the most important tropical crops.

Continuous crop cultivation causes depletion of organic matter as well as other nutrient contents of the soil. Hence, to harvest crop yields, it becomes necessary to apply organic manures and inorganic fertilizers to enrich the soils. Well-decomposed organic manures have a greater potential to improve the soil's physical conditions in terms of water holding capacity, soil porosity, infiltration rate humus content, and also the microbial status of the soil besides adding nutrients to the soil. According to Phukon et al. (2021), integrating cocoa plants with coconut cultivation has been shown to enhance coconut yields. As a self-mulching plant, cocoa regularly sheds its substantial leaves, which serve as excellent mulch, helping to retain soil moisture and augment organic matter. This process also boosts microbial activities, including nitrogen fixation, phosphate solubilization, and the production of indole-3-acetic acid (IAA) by Aspergillus flavus and Aspergillus fumigatus in the soil. Therefore, intercropping with cocoa is highly advantageous for coconut farming.

Cocoa leaf litter is typically left in the field to facilitate nutrient recycling. As the leaves naturally decompose, they enrich the soil with nutrients, serve as mulch to retain soil moisture, suppress weed growth, and help preserve topsoil, particularly in hilly or sloped areas. Utilizing agro-waste such as cocoa leaf litter holds significant potential for enhancing soil productivity and crop yields by improving the soil's physical, chemical, and microbiological properties. Some farmers also use cocoa pod husks as animal feed. However,

Corresponding Author's Email - jegadeeswari.v@tnau.ac.in

Table 1. Treatment details.

T_1	Cocoa leaf waste + cow dung slurry (100 kg leaf waste + 10 kg cow dung slurry)
T_2	Cocoa leaf waste + Earthworm (100 kg leaf waste + 500 g earthworm)
T_3	Cocoa leaf waste + TNAU Biomineralizer (100 kg leaf waste+500 g TNAU Biomineralizer)
T_4	Cocoa leaf waste + *Phanerochaete chrysosporium* (100 kg leaf waste+PC 5 %)
T_5	Cocoa leaf waste + *Pleurotus Sajor - Caju* (100 kg leaf waste+ *Pleurotus Sajor - Caju* 500g)

Table 2. Standard methods for physico-chemical analysis of cocoa leaf waste.

Parameters	Method	Reference
Temperature	Digital thermometer	Wang *et al* (2014)
pH	1: 2.5 solid waste: distilled water using pH meter	Tyl and Sadler (2017)
Electrical conductivity (EC)	1: 2.5 solid waste: distilled water using conductivity bridge	Bhat *et al* (2017)

there is a lack of research on standardized composting protocols for cocoa waste and the optimal application rates for using these composts as fertilizer for both cocoa seedlings and established plantations.

To boost soil fertility in intercropped cocoa plantations and accelerate the decomposition process, composting techniques for cocoa leaves and pods were employed using cow dung, earthworms, TNAU Bio mineralizer, *Phanerochaete chrysosporium*, and *Pleurotus sajor-caju.* This study aimed to standardize the composting methods for cocoa leaf litter.

MATERIALS AND METHODS

Experiment on composting of cocoa waste which included cocoa leaf waste was conducted during August 2015 to June 2016 in farmer's cocoa plantation at VSR Farm, Sethumadai and Cocoa Nursery, Pollachi, Coimbatore district. Cocoa waste was collected from 13 years old cocoa crop. Cocoa leaf litter is an important waste material from cocoa. Since these wastes are rich in lignin and cellulose, it takes a long time for decomposition and hence add nutrient slowly to the soil. In order to decompose the waste quickly, the effectiveness of several decomposting agents which includes micro organisms in degrading the waste of cocoa and the performance of cocoa compost were studied.

Treatment details

Experimental Design : RBD

Number of treatments : 5

Replication : 4

The plant waste material comprising of cocoa leaves were collected from 13-year-old cocoa crop fields and used for composting. Samples were drawn from compost heaps at thirty days intervals with different treatments and analyzing the sample by the method. Compost samples of cocoa leaf waste were air-dried, powdered, sieved, and analysed for physicochemical properties *viz.,* temperature, moisture, pH, EC by following the standard methods as given below.

RESULTS AND DISCUSSION

The temperature fluctuations play a crucial role in indicating microbial activity and the progress of composting. Typically, the ideal temperature range for composting falls between 40°C and 65°C, as noted by Verma et al. (2014). Temperatures exceeding 55°C are necessary to eliminate pathogenic microorganisms. However, if the temperature surpasses the tolerance threshold of thermophilic decomposers, it can adversely affect the composting process.

Table 3. Changes in temperature during composting of cocoa leaf waste.

Treatment	Temperatures (^{0}C)				
	Sampling periods (Days)				
	30	60	90	120	Mean
T_1	60.5	41.9	34.5	25.4	40.57
T_2	57.9	49.0	35.2	24.9	41.75
T_3	55.8	50.9	36.4	26.9	42.50
T_4	59.1	51.2	39.2	28.1	44.40
T_5	58.6	53.6	37.5	22.0	42.92
Mean	58.38	49.32	36.56	25.46	
SE(d)	0.73	0.71	0.50	0.42	
CD(0.05%)	1.60 **	1.55 **	1.09 **	0.92 **	
** - Highly Significant					

Table 4. Changes in pH values during composting of cocoa leaf waste

Treatment	pH				
	Sampling periods (Days)				
	30	60	90	120	Mean
T_1	7.74	7.14	6.75	6.12	6.94
T_2	7.54	7.09	6.67	6.09	6.85
T_3	7.26	7.15	6.81	6.24	6.87
T_4	7.31	7.1	6.72	6.13	6.82
T_5	7.50	7.06	6.60	6.12	6.82
Mean	7.47	7.11	6.71	6.14	
SE(d)	0.07				
CD(0.05%)	0.15 **	NS	NS	NS	
NS - Non Significant, ** Highly Significant					

Microbial activity diminishes rapidly when temperatures exceed 63°C, leading to suboptimal conditions for various thermophiles, with activity reaching minimal levels at 72°C. According to Sapkota and Poudel (2019), the temperature range of 52°C to 60°C is most conducive to effective decomposition.

In the present investigation, the temperature of cocoa leaf waste after 30 days of compositing ranged from 55.80°C to 60.50°C and then gradually decreased at the final stage (22.0°C to 26.9°C). The average temperature mean of decomposition ranged from 40.57°C to 44.40°C in different treatments. The temperature of cocoa pod husk wastes ranged between 44.40 to 38.50°C after 120 days of composting. The temperature during the initial stages of composting rose rapidly, maintaining levels above 55°C for approximately 20 days before gradually declining. However, throughout the treatment period, temperatures remained above 40°C for 30 days, indicating an extended thermophilic phase (T>40°C), crucial for organic material decomposition, as noted by Tang et al. (2007). The elevated temperature observed within composting waste heaps is attributed to microbial activity, where heat is generated through microbial respiration and accumulates within the pile, as discussed by Tiquia

Table 5. Changes in EC values during composting of cocoa leaf waste.

Treatment	Electrical conductivity (dSm^{-1})				
	Sampling periods (Days)				
	30	60	90	120	Mean
T_1	1.98	1.86	1.24	0.67	1.44
T_2	1.90	1.35	0.85	0.72	1.21
T_3	1.74	1.58	1.29	0.91	1.38
T_4	1.33	1.12	0.74	0.52	0.93
T_5	1.46	1.23	0.78	0.60	1.02
Mean	1.68	1.43	0.98	0.68	
SE(d)	0.020	0.026	0.010	0.013	
CD (0.05%)	0.043 **	0.056 **	0.023 **	0.029 **	
**- Highly Significant					

and Tam (2000). Thermophiles possess cell membranes composed of saturated fatty acids, creating a hydrophobic environment that enables them to thrive at high temperatures by maintaining cell rigidity, as explained by Herbert and Sharp (1992). In this study, the highest recorded temperature initially reached 60.5°C. Microbial activity was notably higher during the middle stages of decomposition across all treatments due to the favorable temperatures observed during this phase.

The pH value ranged from 6.82 (T_5 consisting of cocoa leaf waste inoculated with *Phanerochaete chrysosporium* and with *Pleurotus sajor- caju)* to 6.94 (T_1 consisting of cocoa leaf waste inoculated with cow dung slurry). The pH value ranged from 7.35 (T_5 containing cocoa pod husk waste inoculated with *Phanerochaete chrysosporium* and with *Pleurotus sajor- caju)* to 7.48 (T_1 consists of cocoa pod husk waste inoculated with cow dung slurry). In general, a pH of 6.7–9.0 supports good microbial activity during composting (Meng et al., 2019). The ideal pH range for composting typically falls between 5.5 and 8.0. While pH is not usually a critical factor for composting because most materials naturally fall within this range, it becomes significant in managing nitrogen losses due to ammonia volatilization, especially when pH exceeds 7.5.

The EC value ranged from 0.93 dSm^{-1} (T_5 consist of cocoa leaf waste inoculated with *Phanerochaete chrysosporium*) to 1.44 dSm^{-1} (T_1 consist of cocoa leaf waste inoculated with cow dung slurry). The EC valued from ranged from 1.25 dSm^{-1} in T_5 consist of cocoa pod husk waste inoculated with *Phanerochaete chrysosporium* to 1.44 dSm^{-1} in T_1 consist of cocoa pod husk waste inoculated with cow dung slurry. During the later stages of composting, the electrical conductivity (EC) of the compost may decrease due to the volatilization of ammonia and the precipitation of mineral salts, as observed by Wong et al. (2017).

CONCLUSION

The temperature of the compost was recorded as high at the 30th day, thereafter temperature decreased gradually in both cocoa leaves. Towards the final stage of composting, occurring on the 120th day, all treatments involving cocoa leaf waste compost exhibited slightly lower temperatures, indicating a decline in microbial activity compared to the initial stages of the composting process. The highest temperature of 60.5°C was recorded on the 30th day of composting. The decrease in temperature towards the end of composting is advantageous for utilizing the compost as manure. Initially, during the 30th day of composting, the pH of cocoa leaf waste compost was slightly above neutral (pH 7.74) across all treatments, gradually decreasing thereafter. By the 120th day of composting, all treatments showed pH levels almost reaching neutral (pH 7.0), which is conducive for utilizing

the compost as manure. The electrical conductivity (EC) of cocoa leaf waste compost gradually decreased from the 30th to the 120th day of composting. Among the treatments, the lowest EC (0.93 dSm^-1) was observed in cocoa leaf waste inoculated with Phanerochaete chrysosporium, while the highest EC (1.44 dSm^-1) was recorded in cocoa leaf waste with cow dung slurry.

REFERENCES

Bhat S A, Singh J and Vig A P (2017). Instrumental characterization of organic wastes for evaluation of vermicompost maturity. *J Analyt Sci and Technol* **8**:1-2.

Herbert R and Sharp R (1992). *Molecular Biology and Biotechnology of Extremophiles*. Chapman and Hall, New York, p. 17.

Meng X, Liu B, Zhang H, Wu J, Yuan X and Cui Z. (2019). Co-composting of the biogas residues and spent mushroom substrate: Physicochemical properties and maturity assessment. *Bioresource Technol* ***276***, 281-287.

Phukon R M, Nath J C, Sumitha S, Maheswarappa H P and Elain Apshara S. (2021). Early evaluation of cocoa (*Theobroma cacao* L.) clones as intercrop in coconut gardens under red river region of Assam state, India. *J Plantation Crops* **49**(2): 77-82

Sapkota P, Poudel L. (2019). Heat exchanger for bio-digester under thermophilic range. *J Adv College of Eng and Manage* **13**(5):79-88.

Tang J C, Shibata A, Zhou Q and Katayama A (2007). Effect of temperature on reaction rate and microbial community in composting of cattle manure with rice straw. *J Biosci and Bioengineer* **104**(4):321-8.

Tiquia S M, Wan H C and Tam N F. (2002). Microbial population dynamics and enzyme activities during composting. *Compost Sci and Utilization* **10**(2):150-61.

Tyl C and Sadler G D (2017). pH and titratable acidity. In: Nielsen, S.S. (eds) Food Analysis. Food Science Text Series. Springer, Cham. https://doi.org/10.1007/978-3-319-45776-5_22

Verma R, Maurya B R, Meena V S, Regar K L, Kumar L O, Jat M M and Deewan P (2014). Studies on temperature fluctuation and moisture changes in different methods of composting. *Trends in Biosci* **7**:4085-9.

Wang G, Wang W, Li K and Liu H (2014). A digital thermometer with fast response and high precision. *In 7th International Conference on Biomedical Engineering and Informatics*. (pp. 504-510). IEEE.

Wang Q, Wang S and Huang Y (2008). Comparisons of litterfall, litter decomposition and nutrient return in a monoculture Cunninghamia lanceolata and a mixed stand in southern China. *Forest Ecol and Manage* 255(3-4):1210-8.

Wong J W, Wang X and Selvam A (2017). Improving compost quality by controlling nitrogen loss during composting. *In Current Developments in Biotechnology and Bioengineering*. (pp. 59-82). Elsevier.

Received on 24/4/2024 Accepted on 20/5/2024

DOI : 10.5958/2349-4433.2024.00072.9

J Krishi Vigyan 2024, 12(2) : 401-404

Study on Constraints faced by Farmers in Adoption of Green Technologies in Rice Based Ecosystem

Deepika M[1*] Arun Kumar G[2] and Sudhamini Yedida[3]
Department of Agricultural Extension and Rural Sociology,
Agricultural College and Research Institute, Madurai, (Tamil Nadu), India.

ABSTRACT

The current study was carried out in Madurai and Trichy districts of Tamil Nadu. Two blocks from each district were chosen. The various constraints faced by farmers in adoption of green technologies in rice based ecosystem was measured by using Garret ranking technique. For this study, a total sample size of 240 people was used. It was observed that labour scarcity was ranked as first followed by poor quality of inputs as second and lack of advanced planning about the purchase and application of manures and fertilizers as third. Farmers had lack of knowledge in identifying pests and diseases and applied extra doses of fertilizers which inturn cause harm to themselves as well as to the crops.

Key Words: Constraints, Eco System, Green technologies, Rice.

INTRODUCTION

India is an agricultural nation since almost 70% of its people make their living from farming, which is also their primary form of employment. To fetch better productivity farmers were adopting new innovative technologies. One among the technologies being adopted by the farmers is Green technology. Green technology specifically involves the use of science and technology to decrease the human impacts on the environment. It includes research in agriculture, hydrology, atmospheric science and other fields. Green technology aims to preserve Earth's natural resources, mend environmental harm from the past, and safeguard the environment. The term "green technology" refers to a wide range of environmental restoration techniques. There are numerous initiatives to address regional environmental risks, even though climate change and carbon emissions are currently regarded as two of the most important global challenges. This green technology could be adopted in agriculture for the efficient use of natural resources. In India rice is a major food crop. It requires many critical inputs and resources. The constraints may be defined as the limiting factors that obstruct an individual or item to reach its full capacity. These are the hindrances one encounter in the path of development.

Rice crop is also a potential source of pollution and also affected by many pests and diseases. Utilizing environment friendly management techniques may help to prevent environmental pollution and boost rice output. Hence, the farmers were interested to adopt the green technologies in rice based ecosystem. The present study deals with the constraints faced by the farmers in adopting green technologies in rice based cropping system.

MATERIALS AND METHODS

Constraints faced by farmers in adoption of green technologies in rice based ecosystem was masured by using Garret ranking technique.In Garret ranking technique, the rank given for the constraints by the farmers were converted into per cent position by using the formula,

$$Percent\ position = 100 \times \frac{(R_{ij} - 0.50)}{N_j}$$

Corresponding Author's Email - dpsrish@gmail.com
1 Ph.D. Scholar, (Agrl. Extension), Department of Agricultural Extension and Rural Sociology,
Agricultural College and Research Institute, Madurai, (Tamil Nadu), India.
2, 3 Ph.D. Scholar, (Agrl. Extension), Department of Agricultural Extension and Rural Sociology, Tamil Nadu
Agricultural University, Coimbatore, (Tamil Nadu), India.

Table 1. Constraints faced by farmers in adoption of green technologies in Trichy and Madurai district. (n=240)

Sr. No	Constraints	Garrett Score	Rank
I	**Physical constraints**		
1	Labour scarcity	69	I
2	Poor quality of inputs	50	II
3	Lack of advanced planning about the purchase and application	30	III
II	**Communication constraints**		
1	Lack of training s	75	I
2	Inability to attend training programmes	60	II
3	Lack of information from change agent s	50	V
4	Weak extension services	39	IV
5	Details given by change agents could not be understood	24	V
III	**Personal constraints**		
1	Lack of knowledge to identify bio -agents	72	I
2	Not convinced with the practice	56	II
3	Lack of knowledge to identify pest and disease	43	III
4	Difficulty in using organic manure	27	IV
IV	**Socio -economic constraints**		
1	Lack of credit facilities	72	I
2	High cost of labour	56	II
3	High rate of interest	43	III
4	High cost of inputs	27	IV
V	**Technological constraints**		
1	Lack of technological guidance	72	I
2	Difficulty in using botanical pesticides	56	II
3	Complexity of tools and techniques	43	III
4	Difficulty in maintenance of manures and mixtures	27	IV

Where,

R_{ij} = Ranking given to the i^{th} attribute by the j^{th} individualA

N_j = Number of attributes ranked by the j^{th} individual

Then the Garret score was found based on the calculated value from the Garret ranking conversion table. The Garret score was multiplied with the ranks (number of responses) by the farmers for each factor. The average of the each factor was taken and ranking of constraint was done.

RESULTS AND DISCUSSION

The constraints faced by farmers in adoption of green technologies in Trichy and Madurai district were analysed and presented in Table 1.

Physical constraints

It could be observed that labour scarcity was ranked as first followed by poor quality of inputs as second and lack of advanced planning about the purchase and application of manures and fertilizers as third. Labour scarcity was one of the major problem, as the preparations of these bio manures and bio fertilizers were found to be labour consumption process. Majority of the people migrate to other cities in the need of higher education due to which there is less chance to engage the family in this process. Other wage earner labourers were also not engaged in agriculture nowadays and they have employed themselves in MGNREGA schemes, due to which there is labour scarcity.

Communication constraints

It could be inferred that lack of training ranked as first among the five constraints. Inability to attend training programmes ranked as second followed bylack of information from change agent, weak extension services as fourth and details given by change agents could not be understood as fifth. Training conducted by the extension personnel and department officials were off campus mode normally at the offices. Villages which are little bit far away located from the KVKs and departments, the farmers from that villages faced difficulty in attending the programmes. Sometimes, they were also not able to attend the training if they had their personal work. Farmers must be motivated to participate in various training programmes organized at grassroot level for acquiring the knowledge on green technologies. There is a communication gap between the farmers and change agent. The change agents visit the villages at their scheduled time, by the time they reached, farmers adopted other management practice for their crop. Frequents visits would help the farmers to build a rapport among the change agents.

Personal constraints

It was evident that lack of knowledge to identify to identify bio-agents ranked as first followed by not convinced with the practice as second, lack of knowledge to identify pests and disease as third and difficulty in using organic manure ranked fourth in personal constraints. Proper awareness must be given by the officials in identifying the bio-agents would lead to avoid the destruction of predators in their field. As reported by Mishra (2013) farmers had lack of knowledge in identifying pests and diseases and applied extra doses of fertilizers which inturn cause harm to themselves as well as to the crops. Mostly, the farmers who were not adopting the green technologies reported that they were not convinced the green technology practices as it they couldn't obtain the yield compared to the chemical fertilizers. The reason might be that they lack proper technical knowledge about eco-friendly agricultural practices. The findings are in accordance with Mishra (2013).

Socio-economic constraints

It is ostensible that lack of credit facilities ranked as first followed by high cost of labour as second, high rate of interest as third and high cost of inputs as fourth in socio-economic constraints. There was no separate financial Government support exclusively for adoption of green technologies, due to which farmers faced lack of credit facility as the constraint High cost of labour was the main constraint which can be addressed by possible social capital building and policy formulations. The findings are in line with Muralikrishnan *et al* (2015)

Technological constraints

From the data (Table 1), it was revealed that lack of technical guidance ranked as first , difficulty in using botanical pesticides as second followed by complexity of tools and techniques as third and difficulty in maintenance of manures and mixtures as fourth. The manures and mixtures used for green technology needs special care as it tend get rot soon. Complexity of tools and techniques like maintenance of traps ranked as second most constraint. To address this constraint establishment of impact training in green technology agricultural practices and handling the tools could improve the farmers knowledge on it. The findings of the study is in contrast to findings of Muralikrishnan *et al* (2015)

CONCLUSION

The complexity of utilizing the technology would reduce its appeal and purpose and may decline over a shorter period. The information access to the technology needs improvement and the technologies could be reinvented into a more simplified approach, evading complexity in all the farm visits and trainings. Regarding the price fixation, minimum support price must be provided to farmers and encouraged to go for branding and labelling of products. It may enable them to demand better price from the market forces and improves the chance of better returns for the farmers. Utilizing the positive environment prevailing regarding preference of urban population towards sustainable products, better price should be ensured by channelling the market demand in right direction. This will in turn, encourage more and more farmers to utilize green technologies in their farms gradually.

REFERENCES

Mishra M(2013). Role of eco-friendly agricultural practices in Indian agriculture development. *Int J Agri and Food Sci Technol (IJAFST)* **4** (2):11-15.

Muralikrishnan L, Philip H, Chinnadurai M and Ravichandran V (2015). Constraints in adoption of ecofriendly conservation practices. *J Ext Edu* **27**(3):5494-5498.

Received on 24/4/2024 Accepted on 20/5/2024

DOI : 10.5958/2349-4433.2024.00073.5

J Krishi Vigyan 2024, 12(2) : 405-413

Study on Social Profile of Trawler Operators from Ratnagiri block of Maharashtra

M N Nasre[1], S M Wasave[1]*, K J Chaudhari[1], B M Yadav[1], A S Desai[1], S V Patil[1], S C Kamble[1], D R Palwe[1], and T Biswal[1]

[1]College of Fisheries (Dr. B.S. Konkan Krishi Vidyapeeth),
Ratnagiri, 415 629 (Maharashtra)

ABSTRACT

The socioeconomic study of trawler operators is crucial for comprehending the factors that influence their livelihoods, well-being, and the sustainability of resources. The study was conducted in Ratnagiri taluka of Maharashtra to assess the socioeconomic status of trawler operators. The exploration of socioeconomic status involved scrutinizing demographic features, assets holdings, and housing details. An interview schedule was prepared, and data were collected from 102 trawler operators selected through random sampling from December 2022 to April 2023. Data analysis was performed using Microsoft Excel and SAS software. The findings revealed that the majority of trawler operators belonged to the middle age group (57.84%) and had attained education up to primary and secondary levels (32.35%). Moreover, 93.14% of trawler operators were members of a cooperative society. The study concluded that the socioeconomic status of trawler operators was moderately good, evidenced by access to sanitation facilities, electricity supply in their homes, and ownership of immovable assets such as land, houses, boats, and essential movable assets, which collectively signify the wealth of their families.

Key Words: Fishers, Socio-personal, Trawler operators.

INTRODUCTION

The introduction of mechanized trawlers in the early sixties to Indian coastal fisheries was received enthusiasm because of the high returns and established as one of the dominant fishing techniques to exploit target resources from the sea bottom Menon (1996). Trawl net is one of the main fishing gears used in the world which is a dragged gear towed through the water either at the bottom or subsurface waters, the mouth of which is kept open horizontally using beams or otter boards and vertically through floats and sinkers Sterling (2005). Ratnagiri is one of the coastal districts of the Konkan region of Maharashtra with 167 km of coastline Anonymous (2018). Ratnagiri district has 71,620 fisher folks of which 35,957 are male and 35,663 are female. A total of 14416 active fishermen are residing in Ratnagiri district. Anonymous (2021).

Socio-economic status is a measure of the economic and social positions of an individual or family concerning variables like age, education, income, occupation, assets, social participation, etc. Toraskar *et al* (2018). Socio-economic studies of fishers focus on investigating the crew and owner demographics like age, educational background, experience, fishing activities, fishing methods (fishing vessel, gear, season, duration, catch composition, value chain, and markets); contribution to nutrition, food security, and livelihoods; the role of women; trawling expenses and revenue; catch income sharing agreements; connections to other sector and perspectives (about the resource, participation, compliance, and future). Anonymous (2017), Sharma *et al* (2018).

Trawler operators form a crucial part of fishermen's communities, studying their social profile provides insight into diversity within the fishing community and thus allows us to understand human dimensions of fisheries encompassing demographic trends, and community dynamics. Shedding light, especially on their educational status, occupational status,

Corresponding Author's Email - suhaswasave@gmail.com

and membership in organizations and studying socio-economic disparities such as housing details, and assets holding are essential for designing targeted interventions, policies, and programs that promote sustainable development. However, in the context of limitations, the study was undertaken in a limited study area *i.e.,* Ratnagiri Taluka to assess the social profile of trawl net operators.

MATERIALS AND METHODS

The present study was conducted in Ratnagiri taluka of Maharashtra. The villages selected for the study were Mirkarwada, Rajiwada, Purnagad, Shakartar, Kasarveli, Kalbadevi, and Jaigad. Sampling on Trawler operators and crew was carried out from December 2022 to April 2023 at both their workplaces and homes and also during their leisure time. The respondents were into three age groups: young (<40 yr), middle-aged (41-60 yr) and old (those who were 61 yr and older) Zytoon and Basahel(2017). By employing the purposive random sampling method, a total of 102 participants were studied.

The data were collected by using a cross-sectional study design with the interview schedule. The interview schedule was tested with 10 respondents before it was finalized to ensure its validity and content analysis.

Survey interview schedules were formulated in English and converted into Marathi language to record the responses Yadav *et al* (2020). Data were analyzed using percentage analysis. Gautam *et al* (2020).

RESULTS AND DISCUSSION

Socio-profile

Age

The results revealed that highest (59%) of trawler operators belonged to the middle age group (40-60 yr). Toraskar *et al* (2020), found that 28.92% of the family heads of rampan operators were between the age range of 50 yr and 60 yr. According to Chavan (2019), 31.08% of the retailers were in the 42–50 age range. A higher percentage of fishermen were found to belong to the middle age group as this was the earning group of families.

Gender

A majority (94.12%) of trawl net vessels were owned by males, while only 5.88% by females. Ucherwuhe *et al* (2018) found that the male fishers (84.70%) were higher than the females (15.30%) in Nigeria. In both studies male population dominated because males were observed to be involved in pre-harvest and harvest management as repairing their nets, maintaining the fishing vessels, procuring fishery requisites for fishing operations, managing the fishery activities, conducting fish capture activities, while females were involved in post-harvest management of fishes including cleaning, grading, salting, drying and selling activities.

Educational status

A total of 32.35% of trawler operators had completed their primary and secondary level education, and only (8.82%) were graduated. Only 2.94% of respondents were found illiterate. Saim et al (2020) reported that only 6% of fishermen had primary education, majority 72% of the total samples were illiterate. Results were in accordance with Khode (2018), Toraskar (2018) Ucherwuhe *et al* (2018). In all the studies most, fishermen were educated up to primary or secondary level because fishermen prefer to join their fishery business at an early age of their life as it is the main source of their income generation and livelihood of family.

Religion

It was observed that 34.31% of trawler operators were Hindu, whereas the remaining 65.69% belonged to the Muslim religion. This was due to the fact that selected sampling locations were dominated by Operators of Muslim religion. Results were in accordance with Kumar (2017), the majority of fishermen were of the Hindu religion (75.47), followed by Muslims and Christians. Khandare (2018) revealed that Hindu (62.35%) and Muslim (37.655) were the only religions involved in dry fish retailing.

Category and caste distribution of trawler operators

The majority (83.33%) of trawler operators belonged to the Other Backward Class

Table 1. Socio-personal aspects of trawler operators (N=102)

Sr.no	Characters	Category	Frequency	Percentage
1.	Age group (yr)	Young age < 40	29	28.43 %
		Middle age 40 -60	59	57.84 %
		Old age >60	14	13.73 %
2.	Gender of trawler owner	Male	96	94.12%
		Female	6	5.88%
3.	Educational status	Illiterate	3	2.94%
		Can sign only	9	8.82%
		Primary	33	32.35%
		Secondary	33	32.35%
		Higher secondary	15	14.71%
		Graduated	9	8.82%
4.	Religion	Hindu	34	34.31%
		Muslim	65	65.69%
5.	Category	OBC	85	83.33%
		SBC	17	16.67%
6.	Caste	Kharvi	15	15.69%
		Bhandari	22	21.57%
		Daldi	64	62.75%
7.	Marital status	Unmarried	11	10.78 %
		Married	86	84.31 %
		Widow	4	3.92 %
		Separated	1	0.98 %
8.	Family type	Nuclear	47	46.08%
		Joint	55	53.92%

category, while the remaining (16.67%) belonged to the Special Backward Class (SBC) category. The majority belongs to OBC because the population in the study area belonged to the *Daldi* and *Bhandari* castes, which belonged to the OBC category. Sen and Roy (2015) reported that the majority of fish farmers in Tripura were from the general category (46.9%), followed by scheduled castes (34.4%) and other backward classes (18.8%). Kumar (2017) found that the majority of families fishers of coastal India belong to Scheduled Caste (68.63%).

The trawler operators of Ratnagiri taluka were found to belong to the Daldi caste (62.75%) followed by Bhandari (21.57%) and Kharvi caste (15.69%). Ulamn *et al* (2008) found that the majority of fishermen in the Konkan region were from the Hindu religion Koli (65%), Kharvi (15%), and Bhandari (15%) few fishermen were Muslim (5%).

Marital status

Trawler operators' marital status was divided into four categories: married, unmarried, widowed, and separated. Maximum (84.31%) of trawler operators were married. 10.78% were unmarried. Ucherwuhe *et al* (2018) found that 78% of fisherfolks were married whereas, 21% were single. Sharma *et al* (2018) reported that the majority of fishermen in the Amethi district of Uttar Pradesh were married (66%) and (34%) were single. The majority of fishers were married as individuals may prioritize building a family unit for mutual support.

Table 1. Socio-personal aspects of trawler operators (N=102)

Sr.no	Characters	Category	Frequency	Percentage
1.	Age group (yr)	Young age < 40	29	28.43%
		Middle age 40 -60	59	57.84%
		Old age >60	14	13.73%
2.	Gender of trawler owner	Male	96	94.12%
		Female	6	5.88%
3.	Educational status	Illiterate	3	2.94%
		Can sign only	9	8.82%
		Primary	33	32.35%
		Secondary	33	32.35%
		Higher secondary	15	14.71%
		Graduated	9	8.82%
4.	Religion	Hindu	34	34.31%
		Muslim	65	65.69%
5.	Category	OBC	85	83.33%
		SBC	17	16.67%
6.	Caste	Kharvi	15	15.69%
		Bhandari	22	21.57%
		Daldi	64	62.75%
7.	Marital status	Unmarried	11	10.78%
		Married	86	84.31%
		Widow	4	3.92%
		Separated	1	0.98%
8.	Family type	Nuclear	47	46.08%
		Joint	55	53.92%

Family type

The family type of trawler operators was classified as nuclear and joint. Based on the number of members, nuclear families were found to have less than five members and joint families had more than five members. It was observed that 46.08% had nuclear families while 53.92% of fishers had joint families. There was not much variation between the percentage of joint family and nuclear families, this may be due to the reasons that some move towards family planning, and some families still believe in working and living as a joint family. Similar results were found by, Gupta and Dey (2015) Maximum farmers live in joint families (75.5%) and the remaining (24.5%) live in nuclear families.

Fishing Experience

According to the fishing experience of trawler operators, the majority of operators (23.53%) had experience between 25 and 30 years, and a minimum (1.96%) had experience between 0-5 years. Similar results were reported by Akhand (2022) and Suryawanshi (2007). The experience was found higher among the fishers as the fishers are involved in fishing activities at a young age because of family occupation and due to discontinuation of education at an early stage.

The relationship between the experience and age group of trawler operators and it can be seen that there is a significant difference between the age group and experience as the experience increases with increasing age.

Table 2. Classification of trawler operators according to experience

Sr.No.	Experience	Frequency	Percentage
1	0-5	2	1.96
2	5-10	4	3.92
3	10-15	7	6.86
4	15-20	22	21.57
5	20-25	14	13.73
6	25-30	24	23.53
7	30-35	16	15.69
8	35-40	5	4.90
9	40-45	3	2.94
10	45-50	5	4.90
	Total	102	100.00

Type of Ration Card

The ration card serves as a proxy indicator for the economic status of trawler operators. It was resulted that 92.16% of trawler operators held orange ration cards, 2.94% of operators had yellow representing people who were living below the poverty line, while 3.92% had white ration cards. Khode (2018) observed that 90% of fresh fish sellers had orange cards, 88% had yellow cards, and 1.1% had white cards. Khandare (2018) nearly 84.71% of women working in the dry fish sales sector had yellow cards, while 15.29% had orange-colored ration cards. Observations from the study show that the majority of fishers hold orange ration cards and, thus were living just above the poverty line. As they have orange ration cards, they can get foodgrains at highly subsidized rates from their village ration shops as per the privilege of state government to support the families of low-income groups.

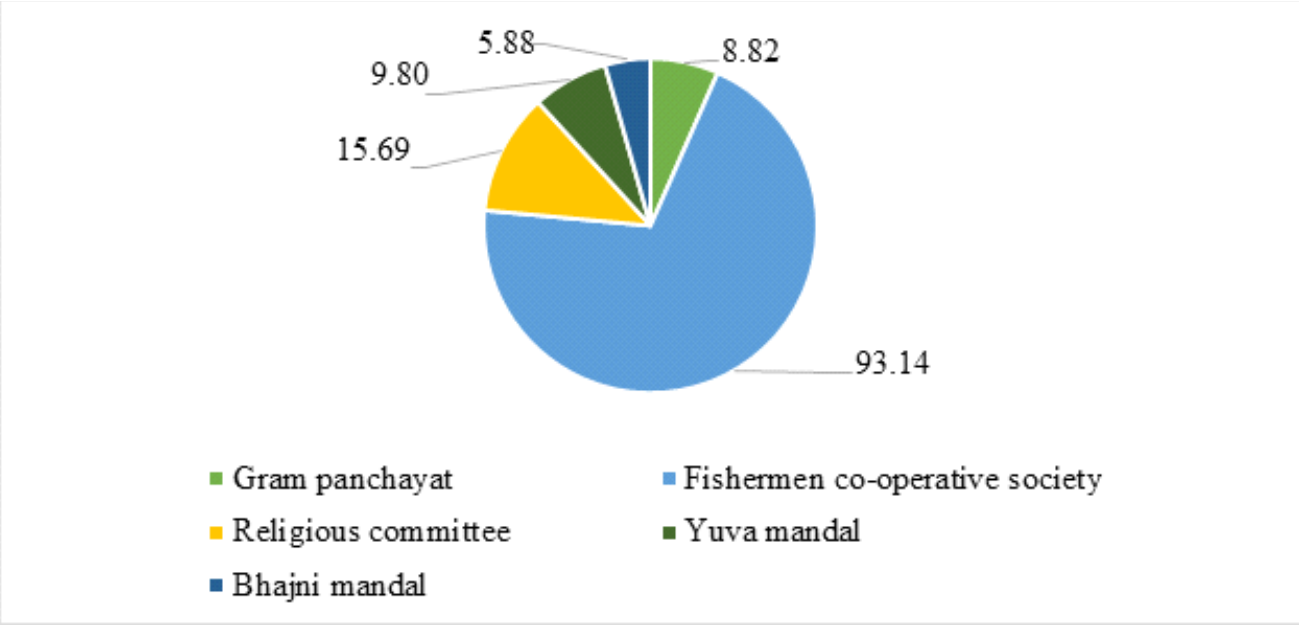
Employment and Occupation

Trawler operators were observed to be employed as owners and crew members. It resulted that 90.20% of trawler operators were the owner and worked on their vessel and 9.80% of respondents were crew. The occupational status included primary and secondary occupations. It was found that 92.16% of trawler operators had fisheries as a primary occupation, and only 4.90% were involved in other occupations such as service (2.90%) and business (1.96%). Gautam *et al* (2020) reported fish farming was the primary occupation of 69.2%, while the secondary occupation of 56.1% of the respondents. Fishers were found to be involved in other occupations such as self-business and daily wage labor. Prabat (2021) in her study revealed that 95.83% of fishers had gillnet fishing as a primary occupation while 4.17% had it as a secondary occupation. Toraskar (2018) found that from overall samples 60% were active fishermen, 23.89% involved in fish marketing, 15.56% were in business, and 0.56% were engaged in service for their livelihood. The maximum fishers were found to be involved in the fishing occupation as the surveyed samples were fishers and their livelihood depends on fishing.

Table 3. Occupational status according to primary and secondary occupation.

Occupation					
Primary	**Frequency**	**Percentage**	**Secondary**	**Frequency**	**Percentage**
Fisheries	95	93.07	Service	3	2.97
			Business	4	3.96
Total	**102**	93.07	**Total**	**102**	6.93

Fig 1. Distribution of membership of trawler operators



Membership

A maximum (93.14%) of trawler operators were found to be members of fishermen's cooperative society. Fig 1. represents distribution of membership of trawler operators. Similar results were observed by Suryawanshi *et al* (2014) and Toraskar *et al* (2020) Fishermen were found to be involved in cooperative societies because these are formed especially for fishers, and provide more benefits to fishermen.

Asset Holding

Assets are classified as immovable and movable assets.

Immovable assets

Every single trawler operator possessed immovable assets in the form of land, houses, and boats. Approximately 1.96%, owned shops, 3.92% had cultivable land, and 15.69% of fishers were found to have tree plantations. Additionally, 7.84% of trawler operators had barren land as one of their immovable assets. Toraskar *et al* (2020) stated that 33.73% of rampan operators possessed agricultural land, followed by 85.54% of rampan operators who owned their own homes, and had their horticulture fruit plantations. Gautam *et al* (2020) found that 71% of respondents possessed agricultural land and 28.9% of farmers were without land. Although the average aquaculture farm area was 0.67 ha, the average pond size was just 0.55 ha, making up the greatest percentage of aquaculture landholders (88.1%).

Movable assets

It was found that gas stoves and cylinders, fans, fishing nets, fishing boats, mobile, and watch/clock, are the movable assets possessed by cent percent of trawler families. While other assets

such as television (58.82%), LCD/LED (36.27%), laptop (26.47%), radio (15.69%), DVD player (2.94%), mixer (77.45%), refrigerator(77.54%), water purifier (26.47%), sewing machine(13.73%), furniture (54.90%), geyser (7.84%), washing machine (43.14%), bicycle (37.25%), two wheeler (95.10%), three-wheeler (5.88%), four-wheeler (33.33%), machine (43.14%), bicycle (37.25%), two-wheeler (95.10%), three-wheeler (5.88%), four-wheeler (33.33%), steel almirah (80.39%), AC/cooler (10.78%), desktop (0.98%) are also possessed by trawler operators families. Himu *et al* (2020) revealed that most common assets owned by fishers were stead/khat (68.3%), showcase/almirah (58.3%) and chair/table (46.7%), mobile phones (56.7%). Most of the fishermen own boat (53.3%) and fishing nets (65%). Khandhare (2018) observed that 100% of families had a fan, and watch clock, followed by gas stoves and cylinders (91.76%), and mobile (89.41%). Few families were seen using laptops and tablets (1.18%). The moveable assets reported in this study are the common needs of the respondents and their families. However, some of the moveable assets are of luxurious category indicating the wealth and prosperity of the fishers under study.

Housing details

Housing details included aspects such as the nature of ownership, land area, house area, house type, number of rooms, source of electricity, source of drinking water, and latrine facilities. The overall analysis of housing details showed that all the interview responders had owned houses with sanitary facilities and they all received electricity from a common source M.S.E.B. The average land area possessed by a family was recorded as 2753.43 sq. ft. along with the average house area as 1451.98 sq. ft. Gautam *et al* (2020) reported that in selected regions of Uttar Pradesh, 30% of fisher families still lacked access to sanitation, although 66.7% did. 14.5% of families use kerosene lamps for lighting, 68.6% of families still cook using firewood, and 88.1% of families get water from tubes or bore wells.

According to housing type, the majority of trawler families (55.88) reside in *pucca* houses, followed by *semi-pucca* houses (17.65%), bungalows (12.75%), apartments (8.82%) and few households reside in *kaccha* houses (4.90%). Gautam *et al* (2020) Fishermen were found to most often reside in semi-pucca houses (44%) and pucca houses (32.1%). Ujjania and Patel (2011) stated that 23.7% of fishermen had pukka houses, compared to 9.6% of kaccha houses and 66.7% of semi-pukka houses.

It had been found that most homes had 3 rooms (29.14%), followed by four (23.53%), five (17.65%), six (12.65%), two (9.80%), and very few houses had seven (3.92%) and eight rooms (2.94%). Toraskar (2018) reported that the majority of rampan operators' population residing along the Sindhudurg district with seven rooms (27.71%) followed by six rooms (25.30%), five rooms (16.87%), eight rooms (14.46%), three and four rooms (7.23%) each. In the study, maximum fishers were found to live in the pucca house and have three or more than three rooms this represents the economic well-being of the surveyed population.

CONCLUSION

The study concluded that the social condition of trawler fishers in the study area was moderately good as all respondents had their own houses with sanitation facilities and the majority of them had assets that represent good economic condition. However, the educational status was found low as only (8.82%) of fishers were graduated as they prefer to join the family business in early age and thus their involvement in service sector is low.

REFERENCES

Akhand D M (2022). *Knowledge and compliance of Maharashtra marine fishing regulation act (MMFRA,1981) by the trawl net operators of the Ratnagiri*. M.F.Sc. Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli.

Anonymous (2017). Food and Agriculture Organization of United Nations Rome. Fisheries and Aquaculture proceedings. ISSN 2070-6103.

Anonymous (2018). Department of Fisheries,

Government of Maharashtra, Mumbai.199p.

Anonymous (2021). Department of fishery government of Maharashtara, Mumbai. 109p.

Anonymous (2022). *Standing Committee on Agriculture, Animal Husbandry and Food Processing.*

Chavan S M (2019). *Socio-economic Status of Fresh Fish Retailers of Mormugao, South Goa*. M.F.Sc. Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli. 86p.

Gupta T and Dey M (2015). Socio economic and cultural profile of fish farmers: A study in and around the Lunding town, Nagaon District of Assam. *Indian J of Environ Sci* **19**: 71-78

Gautam P, Ananthan P S, Krishnan M and Tiwari V K (2020). Socio-economic status of fish farmers in selected regions of Uttar Pradesh. *J Krishi Vigyan* **9** (SI*)* : 267-275

Himu S D, Hussain M A, Sumon T A, Sumon M A A, Ahmad M F, Talukder M R and Kunda M (2020). Socio-economic profile of fishermen: An empirical study from Sunamganj, Bangladesh. *Hindu* **38**: 31-7.

Kumar D K, Ramasubramanian V, Krishnan M, Ananthan P S, Vinay A, and Kumar R S (2017). Socio-economic status of fishers of coastal India. *Int J Curr Microbiol Appl Sci* 6:2267-2280.

Khode P C (2018). *Socio-economic study of fresh fish retailers of Ratnagiri, Maharashtra*. M.F.Sc. Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli.

Kandhare R B (2018). Socio-economic study of dry fish retailers of Ratnagiri, Maharashtra. M.F.Sc. Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli.

Menon N G (1996). Impact of bottom trawling on exploited resources. Central Marine Fisheries Research Institute Indian Council of Agriculture Tatapuram p.o, Cochin-682 014.

Prabat S (2021). *Livelihood analysis of gillnet operators of Ratnagiri, Maharashtra state*. M.F.Sc. Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli.

Sekhar N U, Raju K V, Manasi S, Latha N and Lenin B K (2006). Fisheries in Tungabhadra Basin. India **46**, 7.

Siam H S, Hasan M R and Sultana T (2020). Socio-economic status of fisher community at Nijhum Dwip. *Asian J Med Biol Res* **6**(2): 351-358.

Sterling D J (2005). *Modelling the physics of prawn trawling for fisheries management*. PhD Thesis, Curtin University of Technology, Perth, Australia.

Suryawanshi U A (2007). *Adoption of improved practices by trawl net operators of Ratnagiri coast of Maharashtra state*. M.F.Sc. Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli.

Suryawanshi U, Chaudhari K, Somashekara S, Kumar J (2014). Socio-personal information of trawler owner fishermen for adoption of improved practices in Mirkarwada landing center off Ratnagiri coast, Maharashtra. *J Exp Zool* **17**(2):431-436.

Sen A AND Roy M (2015). Socio-economic status of fish farmers in Tripura, India. *Int J Curr Res* **7:** 17090-17096.

Sharma S, Kumar R, Kumar M, Gupta S, Maurya P K, Singh P (2018). A study on socio-economic status of fishermen of Amethi district, Uttar Pradesh, India. *Int J Fish Aquat Stud* **6**(4), 49-54.

Toraskar D N (2018). *Socio-economic status of rampan operators of Sindhudurg district of Maharashtra.* M.F.Sc. Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli.

Toraskar D N, Wasave S M, Shirdhankar M M, Chaudhari K J, Sawant S S, Wasave S S

and Salunkhe A B (2020). Socio-economic status of rampan operators of Sindhudurg district of Maharashtra. *J Exp Zool India* **23**(1):787-791.

Ulman Y N, Talathi J M, Naik V G (2008). Socio-economic status, income and expenditure pattern of fishermen in Konkan region of Maharashtra. 3:251-254.

Ujjania N C and Patel A N (2011). Socio-economic Status of fishermen Community Fishermen Community of Danti village in Valsad District (Gujarat) India. *Emerging Trends in Dev Res* **18**(1-2): 25-30.

Ucherwuhe S I, Ashiko F T G, and Akang E T (2018). Socio-Economic analysis and fishing practices of the fisherfolks of Abinsi Settlement, Benue State, Nigeria. *Int J Res* **5**(17): 598-601.

Yadav B M, Patil S V, Mandavkar S S, Wasave S M, Shirdhankar M M, Chaudhari K J (2020). Socio-economic Status of Fishers of Ratnagiri, Maharashtra. *Int J Curr Microbiol Appl Sci.* **9** (9):3011–21.

Zytoon M, Basahel A (2017). Occupational Safety and Health Conditions Aboard Small- and Medium-Size Fishing Vessels: Differences among Age Groups. IJERPH [Internet].**14**(3):229. Available from: http://www.mdpi.com/1660-4601/14/3/229

Received on 16/4/2024 Accepted on 25/5/2024

DOI : 10.5958/2349-4433.2024.00074.1

J Krishi Vigyan 2024, 12(2) : 414-423

Technological Interventions for Impact Assessment on Backyard *Vanaraja* Poultry Farming in Two Districts of Arunachal Pradesh, India

M S Baruah[1], M Mokidul Islam[1], K Suraj Singh[2] and S Debbarma[3]
Krishi Vigyan Kendra, West Siang, Indian Council of Agricultural Research Complex for North Eastern Hill Region, Arunachal Pradesh

ABSTRACT

Optimum productive performance of *Vanaraja* poultry under improved technologies in backyard system of rearing was studied from August, 2022 to September, 2023. For this study, a total of 120 farmers with minimum two years of experience for rearing poultry were selected at random from 12 villages in the West Siang and Leparada districts of Arunachal Pradesh, India. The strength, weakness, opportunity and threats (SWOT) analysis revealed backyard poultry farming can always be a source for livelihood improvement for the rural farmers. After technologies demonstrated through FLD, 96.67% farmers adopted scientific housing with a gain of 3400±2.62g adult cock's body weight, whereas in TFP it was recorded as 2650±1.54g. The avg. age of laying first egg under FLD was found to be 24.40±0.32 weeks with a 140.04±1.25 numbers of egg production annually, whereas in case of TFP it was 25.44±0.54 weeks and 112.26±2.10 numbers. The overall mortality percentage of birds after 52 weeks of age was recorded as 6.18±0.14 in FLD whereas in TFP it was 19.47±0.25. The results showed that the former yielded much higher profits than the latter due to enhanced rearing practices.

Key Words: Demonstration, Food Security, Livelihood Improvement, Poultry

INTRODUCTION

Arunachal Pradesh, a state of NE India at Latitude 28°01′31.08″ North and Longitude 94°28′44.04″ East mostly covered by the Himalayan Mountains and has an area of 83,743 km^2. Among the 26 districts of Arunachal Pradesh, the study area comprised West Siang district located between 27°29′N and 29°23′N latitude and 94°02′ E and 95°15′ E longitude and Leparada district located between 27.8865°N and 94.7692°E. For the villagers of these areas, agriculture is the main occupation, but livestock and poultry farming also goes concurrently to support their livelihood, as their daily diet and traditional rituals are not completed without a product from the livestock or poultry (Baruah *et al*, 2021). This custom plays an important role as almost 90% of rural household are engaged in poultry production through backyard farming mostly with the native chicken (Rath *et al*, 2015). But the productivity and their contribution to the total meat and egg output is very low and almost static for the last few decades due to their low production potential (Singh *et al*, 2018). Besides that, few farmers started rearing some improved birds but due to lack of scientific knowledge they are not getting the optimum production as expected. This low and diminishing trend of productivity is an alarming factor which needs an immediate scientific approach to boost the farmers' income and socio-economic status. Keeping the above point in view the Front Line Demonstration (FLD) was conducted on backyard poultry farming with the introduction of improved birds *i.e. Vanaraja* developed by ICAR-Directorate of Poultry Research, Hyderabad, Telangana, India which were suitable for backyard free range farming. Due to the similarity in phonotypical appearance with native birds as well as higher growth rate and egg production potential than that of indigenous chicken, it is well accepted by the tribal farmers of

Corresponding Author's Email - sabiideb@gmail.com
1 Krishi Vigyan Kendra, Ri-Bhoi, Indian Council of Agricultural Research Complex for North Eastern Hill Region, Umiam, Meghalaya, India.
2 Krishi Vigyan Kendra, West Siang, Indian Council of Agricultural Research Complex for North Eastern Hill Region, Arunachal Pradesh Centre, Basar, India.
3 Department of VPE, College of Veterinary Sciences and Animal Husbandry, R. K. Nagar, Tripura (West), India.

these two districts. Hence, the present study was conducted to compare the performance of technology demonstrated through FLD and Traditional Farmers Practice (TFP) on backyard *Vanaraja* poultry rearing. The status of management practices followed by the tribal farmers, impact of interventions made through FLD and the improvement of socio-economic status of the farmers was also evaluated during the study.

MATERIALS AND METHODS

This study was carried out in West Siang and Leparada districts of Arunachal Pradesh, NE India. The study region had 2467 mm of annual rainfall on average, with July receiving the most (469.7 mm) and December receiving the least (22.0 mm). The study area's average relative humidity varied from 70% in the morning to 61% in the evening, with temperatures ranging from 15.9 to 24.2°C. Ten randomly selected villages were picked from six blocks that were chosen from these districts.

From each village, 6 farm families totalling 60 were selected for FLD by snowball sampling techniques based on the criteria that the said families were involved in poultry farming for not less than 4 years. Another 60 farm families from the same localities having minimum of 20 *Vanaraja* poultry were also selected randomly that used to raise poultry under existing low input backyard system and termed as Traditional Farmers Practice (TFP). A strength, weakness, opportunity and threats (SWOT) analysis was conducted as per the technique described by Groenendijk (2002). All the selected farmers under FLD were given hands on training in different groups at ICAR- KVK, West Siang, Arunachal Pradesh, India covering the topics on techniques on scientific poultry farming including disease prevention, first aid treatment both for birds and farm workers, record keeping and calculation of farm economics. The selected farmers under FLD were also given hands on training at their farm site as and when visited to the farmers' field. The farmers were assisted technically for changing their attitudes towards construction of poultry shed from non-scientific housing to low-cost scientific housing with locally available materials. Farmers received 20 numbers of *Vanaraja* chicks of each sex from the hatchery facility of ICAR-KVK West Siang, ICAR Research Complex for NEH Region, Arunachal Pradesh Centre, Basar and from the Government Duck and Poultry farm, Joysagar, Sivasagar, Assam. Day old chicks were kept in brooder house up to 6 weeks of age and concurrently vaccinated with vaccines for *Ranikhet* and *Gumboro* disease following the recommended standard immunisation procedure. At the time of brooding period, chicks of Vanaraja were fed 'Broiler Chicken Starter'. After brooding, *i.e.* at 42 days of age, when the birds attained around 650 to 750 g weight they were ready to let loose at backyard environment in day time for foraging, while at night time shelter was provided to them. Source of clean drinking water should always be provided in such a place that birds can easily access to them. Veterinary care was also given to the birds as and when required or when the farmers were complaining for any disease occurrence. Data on performance of birds were gathered mostly from primary source using a series of well-structured questionnaire aided by an interview schedule to take care of the uneducated respondents. Additionally, information was gathered about the respondents' socioeconomic traits, managerial and cultural practices, expenses and profits, productivity, and the primary obstacles to productive and successful backyard chicken farming. Questionnaires were prepared in such a way that, besides generating the data on various aspects of poultry farming it also generate data on socio-economic profile of the farmers both under FLD and TFP. Data were collected bi-monthly after initial data collection on impact of training, breed introduction, shelter management, health care management including socio-physiological factor. The approximate expense of raising was calculated by adding the fixed costs (land, poultry shed, and equipment cost) and variable costs (cost of day-old chicks, feed, vaccination, medication, and labour). The revenue from selling eggs, cocks, and spent hens was added together to determine the return. The data were examined by using descriptive statistics like percentage, mean and standard deviation for evaluating the economic and social characteristics, managerial techniques and impediment to backyard poultry rearing in the

Table 1. Strength, Weakness, Opportunity and Threats (SWOT) analysis of backyard poultry farming.

Sr. No.	Particular	Findings
1.	Strength	Ability of the birds to survive and produce under adverse husbandry practices.
		Phonotypical similarity of improved birds like *Vanaraja* with native birds' particularly multi -coloured plumage is well adopted by the tribal farmers.
		Increasing demand for poultry meat and eggs.
		Commercialization of poultry rearing gives an egg and meat revolution and thereby provide employment to a large section of the rural youths.
2.	Weakness	Absence of sufficient numbers of breeder farmers nearby for continuous supply of quality chicks.
		Non availability of quality poultry feeds at an affordable price.
		Lack of adequate support from the development and financial bodies to establish poultry-based industries.
		Tendency of the poultry farmers to raise poultry on zero to negligible inputs.
3.	Opportunity	Self-employment particularly for t he rural youth as a poultry entrepreneur.
		Self Help Group (SHG) personnel to be engaged in production of quality poultry chicks by establishing small solar/battery based hatchery units.
4.	Threat	Shortages of affordable quality concentrate feed (> 70%) in the poultry industry.
		Increasing incidence of emerging and reemerging diseases in poultry sector leads to creation of negative views for the budding poultry entrepreneur.

study area and by using standard statistical analysis techniques as per the methodology followed by Snedecor and Cochran (1994) wherever required. For estimation of the cost and benefits from backyard poultry production Gross Margin analysis was used. Then the poultry owners' Net Farm Income (NFI) was calculated according to the procedure outlined by Oladunni and Fatuase (2014).

If Gross margin is > 0 then backyard poultry enterprise is considered as profitable. Lastly, the entire net return was divided by the net cost of production to determine the benefit cost ratio. The Perception Index (PI) of technological intervention on backyard poultry farming was determined by multiplying the frequency count of each cell of a degree of change with its corresponding weigh. The PI score and ranking were obtained concurrently by summing the values of each cell. The PI range is maintained at 0, with 0 denoting no improvement and 100 denoting the greatest improvement brought about by the technical intervention. Technological impact on backyard poultry farming over different factors was assessed using the nonparametric Wilcoxon Z Statistic.

Care for zoonotic diseases

Throughout the study general hygienic practices as per WHO standard were followed before and after handling the birds or their excrement. To minimize the exposure of zoonotic diseases to the owner or poultry handler consumption of food or drinking was avoided near the farm premises.

Ethical approval

The overall well-being of the birds was not harmed throughout the course of this investigation. Relevant authorities gave their approval.

RESULTS AND DISCUSSION

Results of strength, weakness, opportunity and threats (SWOT) of backyard poultry farming

Table 2. Socio-economic status of the poultry farmers (N=120).

Sr. No.	Socio-economic profile	Numbers	Percent
1.	Level of Education		
i.	Illiterate	7	5.83
ii.	Primary level (class I to IV)	51	42.50
iii.	Secondary level (class X)	40	33.33
iv.	Higher secondary level (class XI, XII) and above	22	18.33
2.	Family size		
i.	Small (4 members)	11	9.17
ii.	Medium (5 to 6 members)	60	50.00
iii.	Large (more than 6 members)	49	40.83
3.	Family type		
i.	Joint family	52	43.33
ii.	Nuclear family	68	56.67
4.	Cultivable land holding in Hectare		
i.	Up to 1	53	44.17
ii.	Between 1 to 2	65	54.17
iii.	More than 2	2	1.67
5.	Source of income		
i.	Agricultural crops + livestock	30	25.00
ii.	Agri. crops + livestock + off-farm activities	32	26.67
iii.	Agri. crops + livestock + non -farm activities	18	15.00
iv.	Agri. crops + livestock + off -farm + non -farm activities	40	33.33
6.	Annual Income in INR		
i.	Low (up to 50,000/ -)	22	18.33
ii.	Medium (50,000/ - to 1,00,000/ -)	79	65.83
iii.	High (above 1,00,000/ -)	19	15.83

by the farmers were presented in Table 1.

SWOT analysis showed that besides having many hindrances, backyard poultry farming can be a source for livelihood improvement particularly for the rural youths and school dropouts. It may also acts as a medium for establishing small scale poultry entrepreneur which ultimately helps in doubling farmers' income (Baruah *et al,* 2021).

Among the respondents 42.50% had primary level education whereas, 5.83 % were illiterate of which 50.00% of the families were of medium size, while 56.67 % had nuclear family. About 54.17 % families had land holding between 1 to 2 ha. and major source of income were crop, livestock, off farm and non-farm activities (33.33%) resulting the farmers were in medium income group (65.83%). In many South East Asian countries like India, similar types of low education level and socio-economic structures were also reported earlier (Nath *et al,* 2013) which may be one of the reason for practicing non-scientific farming with minimum or nil inputs (Riedel *et al*, 2012).

Due to technological intervention under FLD, a great impact had observed in the study area. Earlier only 8.33 % farmers had scientific housing, which increases 96.67 % after FLD where farmers were made the poultry shed either with bamboo and roof with corrugated galvanized iron sheet, or low cost locally available materials "*Toko* leaves" (*Livistona jenkinsiana Griff*). Before, majority of farmers (70.00%) had poor surrounding condition where the poultry were

Table 3. Impact of scientific management.

Sr. No.	Measurable indicator	Criteria	TFP (n=60)		FLD (n=60)	
			Number	% over the total	Number	% over the total
1.	Housing	Scientific housing	5	8.33	58	96.67
2.	Reason of rearing	i. Commercial purpose	5	8.33	15	25.00
		ii. Household consumption	55	91.67	45	75.00
3.	Periodical deworming, vaccination, Seeking veterinary aid	i. Deworming	11	18.33	60	100.00
		ii. Vaccination	11	18.33	60	100.00
		iii. Seeking veterinary aid	8	13.33	60	100.00
4.	Hygiene and sanitation maintenance in and around the poultry farm	i. Poor	42	70.00	2	3.33
		ii. Good	15	25.00	37	61.67
		iii. Very good	3	5.00	21	35.00

Figure in parenthesis indicate number of birds

housed but after the FLD, the majority of the farmers (61.67%) maintained good hygiene and sanitation. Similar impact due to technological intervention was also reported by Patel *et al.,* (2014) and Awasthi *et al* (2015).

The average mean age at sexual maturity (23.21±0.69 weeks), age at marketing (13.00±2.2 weeks), age at first egg production (24.40±0.32 weeks) were found to be significantly ($p<0.05$) lower in technologies demonstrated under FLD than that of TFP (24.97±0.59 weeks, 14.00±3.2 weeks and 25.44±0.54 weeks respectively), while body weight at first egg production (1799.42±120 g) under FLD was found to be significantly ($p<0.05$) greater than that of TFP (1616±128). This might be due to the fact that in FLD farmers are adopting better managemental practices including hygiene, sanitation and health care measurements (Patra *et al,* 2018). A variation in the management method, feed supplement, and other environmental conditions might possibly be the cause of the disparity in the results (Patel *et al*, 2018). Vanaraja poultry birds' first egg weights at TFP and FLD were 44.17±0.38 and 45.58±0.43 respectively with no significant difference between the groups. Ghosh *et al* (2005); Niranjan *et al* (2008) were also reported first egg weight of *Vanaraja* birds was 44.86 g. A significantly ($p<0.05$) higher numbers of avg. monthly egg production (11.67±0.13) and annual egg production (140.04±1.25) were recorded in the FLD than that of TFP (9.41±0.32and 112.26±2.10) which might be due to the difference in feed, better farm and rearing condition (Patel *et al,* 2018). A significantly ($p<0.05$) higher mortality rate under TFP at 0 to 8 weeks of age (14.93±0.19) than that of FLD (6.02±0.25) was recorded in the present study which was also reflected in overall mortality pattern in TFP (19.47±0.25) and FLD (6.18±0.14). The higher mortality pattern in TFP and lower in FLD might be due to maintaining proper health care like periodical deworming, vaccination, hygiene and sanitation under FLD (Islam *et al*, 2015). Kumaresan *et al* (2008) also reported that

Table 4. Productive and reproductive results of *Vanaraja* under TFP and FLD

Sr. No.	Parameter	TFP (n=60)	FLD (n=60)
1.	Age at sexual matu rity (Weeks)	24.97 ±0.59 [a]	23.21 ±0.69 [b]
2.	Age at marketing (Weeks)	14.00 ±3.2 [a]	13.00 ±2.2 [b]
3.	Adult cock weight (g)	2650 ±1.54 [a]	3400 ±2.62 [b]
4.	Age at first egg production (Weeks)	25.44 ±0.54 [a]	24.40 ±0.32 [b]
5.	Body weight at first egg production (g)	1616 ±128 [a]	1799.42 ±120 [b]
6.	Average first egg weight (g)	44.17 ±0.38	45.58 ±0.43
7.	Average monthly egg production (no.)/bird	9.41 ±0.32 [a]	11.67 ±0.13 [b]
8.	Annual egg production (no.)/bird	112.26 ±2.10 [a]	140.04 ±1.25 [b]
9.	Mortality (%)		
a.	0 to 8 weeks	14.93 ±0.19 [a]	6.02 ±0.25 [b]
b.	9 to 24 weeks	4.20 ±0.55	0.03 ±0.02
c.	25 to 52 weeks	0.34 ±0.13	0.13 ±0.12
d.	Overall	19.47 ±0.25 [a]	6.18 ±0.14 [b]
10.	Egg colour	Tinted	Tinted

Figure in parenthesis indicate number of birds
Mean under the same superscript in a row didn't differ significantly (P<0.05)

good brooding, vaccination and balance feed practices reduces the mortality rate of *Vanaraja* poultry.

The expenses of raising 20 *Vanaraja* chickens under FLD and TFP for the age of 18 months were displayed in Table 5.

In current study the total production cost of *Vanaraja* chickens under FLD was found to be greater (Rs. 9371/-) than that of the TFP (Rs. 7141/-) this might result from the higher percentage of feed cost (10.24%) and poultry shed construction cost (21.34%) in FLD. Similar type of cost involvement in backyard poultry rearing also reported by Uddin *et al* (2013). Current finding is in contrast with the finding of Nath *et al* (2013), where he has stated that feed cost alone constituted the majority of expenditure for *Vanaraja* under backyard farming condition.

The study revealed that maximum amount of net return in case of FLD was achieved through the sale of eggs (67.61%), followed by sale of cocks (22.73%) and spent hens (9.66%). In the case of TFP, the same return trend was noted, with the biggest income coming from the sale of eggs (62.33%), followed by the sale of cock (26.54%) and the sale of spent hens (11.13%).

The total gross income and net income in FLD was recorded as Rs. 26,920 and Rs. 17,549, respectively, which was 66.75% and 61.70% higher than that of gross income (Rs. 17,970) and net income (Rs. 10,828) of TFP. The Gross Margin (Rs.) and the Net Farm Income under FLD and TFP were recorded as Rs.11,177, Rs.8178.00, Rs.5186 and Rs.3686 respectively, which indicate that scientific interventions under FLD give much more profit than that of TFP. Under FLD and TFP, the anticipated benefit cost (B: C) ratio was 2.87 and 2.52, respectively. Higher B: C ratio in case of FLD than that of TFP might be due to better management of chickens under FLD which leads to increased egg production and achievement of better body weight within the allotted time (Uddin *et al*, 2013).

Perception of farmers towards the technologies demonstrated

The factors *viz.* knowledge improvement, spreading of knowledge, livelihood improvement, social and financial security, confidence of scientific poultry farming, risk taking ability for new venture, participation in group activities, information utilization abilities and overall satisfaction were achieved a highly significant

Table 5. Estimated rearing cost of 20 *Vanaraja* under TFP and FLD ,

Sr. No.	Particular	Rearing Cost (Rs.)	
		TFP	FLD
1	Variable Cost		
A	Cost of a day old chicks @Rs. 40/ - for Vanaraja	800.00 (11.20)	800.00 (8.54)
B	Cost of feed up to the age of 42 days		
i	1.2 kg of broiler starter/ bird i.e. 24 kg @ Rs. 40/ - per kg	-	960.00 (10.24)
ii	10 kg of broken rice @ Rs. 25/ - per kg	250.00 (3.50)	-
C	Cost of vaccine @ Rs. 1.60/ chick	32.00 (0.45)	32.00 (0.34)
D	For Vanaraja chick, cost of medicine and feed supplement @ Rs. 4.00/chick	-	80.00 (0.85)
E	For Local chicken, cost of medicine and feed supplement @ Rs. 3.00/chick	60.00 (0.84)	-
F	For both the flock (FLD & TFP) cost of labour @ 10 hrs. / month = 1.25 Man -days × 18 months = 22.50 man -days × Rs. 200/ - per Man -day	4500.00 (63.01)	4500.00 (48.02)
Total Variable cost (A)		5642.00	6372.00
2	Fixed cost		
A	Land	Available with the farmers	Available with the farmers
B	Low cost poultry shed constructed from locally availabl e material (L/S)	1000.00 (14.00)	2000.00 (21.34)
C	Depreciation cost on poultry shed @ 33.33 % per year	499.95 (7.00)	999.99 (10.67)
D	Drinker/ Feeder	Locally made	Locally made
Total fixed cost (B)		1499.95	2999.00
3	Total cost of production (D = A+B)	7141.95	9371.00
4	Cost of production per bird (D/20)	357.10	468.55

data (as œ =0.000<0.05) which indicates FLD had a greater influence on *Vanaraja* poultry farming in the study area.

CONCLUSION

Ensuring the adoption of efficient scientific production technologies such as low-cost scientific housing, feeding and health care techniques in backyard *Vanaraja* poultry farming has huge potential for the resource poor tribal farmers than that of traditional rearing techniques.

ACKNOWLEDGEMENT

For financial support, the authors are grateful to ICAR Research Complex for NEH Region, Umiam, Meghalaya, India.

Table 6. Estimated return from *Vanaraja* chickens under TFP and FLD.

Sr. No.	Particular	TFP (n=20)	Amount (Rs.)	FLD (n=20)	Amount (Rs.)
1	Income from sale of eggs (10 female under FP and 13 Females under FLD)	Avg. annual egg production 112 eggs/ hen *i.e.* 1120 nos. of eggs @ Rs. 10/- per egg	11,200 (62.33)	Avg. annual egg productio n 140 eggs/ hen *i.e.* 1820 nos. of eggs @ Rs. 10/- per egg	18,200 (67.61)
2	Sale of cocks (6 nos. both in FLD and FP)	Avg. body weight = 2.65 Kg. Total weight = 15.90 Kg @ Rs. 300/- per Kg	4,770 (26.54)	Avg. body weight = 3.40 Kg. Total weight = 20.40 Kg @ Rs. 300/- per Kg	6,120 (22.73)
3	Sale of spent hens (13 nos. under FLD and 10 nos. under FP)	Rs. 200/ hen	2000 (11.13)	Rs. 200/ hen	2,600 (9.66)
4	Total gross income	-	17,970	-	26,920
5	Net income	-	10,828	-	17,549
6	Net income / bird	-	541.40	-	877.45
7	Gross margin (Net income – Total variable cost)	-	5186	-	11,177
8	Net Farm Income (GM-Total fixed cost)	-	3686	-	8178
9	Benefit-Cost-Ratio (BCR)	-	2.52	-	2.87

REFERENCES

Awasthi P K, Tomar A and Raghuwanshi N K (2015). Poverty reduction through strengthening backyard poultry farming in central India: an economic analysis. *Int J Food Agri Vet Sci* **5**(1): 11-17.

Baruah M S, Raghav C S and Kalita H (2018). Effect of technological intervention on the economics of Vanaraja chicken rearing in West Siang district of Arunachal Pradesh. *J World Poult Res* **8**(2):37-42.

Baruah M S, Raghav C and Kalita H (2021). Impact of Front-Line Demonstration on Pig Farming and Farmers' Adoption Level in Three Districts of Arunachal Pradesh,

Table 7. Perception of technological intervention on socio-physiological factors of the poultry farmers under FLD.

Sr. No.	Particular	Perception Index (PI)	Rank	Wilcoxo n Z Statistic	Significance at P=0.05
1.	Knowledge improvement	100.00	I	-8.000	0.000
2.	Spreading of knowledge among the farmers	86.50	II	-8.300	0.000
3.	Livelihood improvement	84.00	III	-7.240	0.000
4.	Social and financial security	62.00	IV	-7.280	0.000
5.	Confidence of scientific poultry farming	56.50	V	-6.250	0.000
6.	Risk taking ability for new venture	45.20	VI	-6.055	0.000
7.	Participation in group activities	42.50	VII	-6.840	0.000
8.	Information utilization ability	41.50	VIII	-6.820	0.000
9.	Overall satisfaction	40.00	IX	-7.135	0.000

India. *Int J Livestock Res* **11**(6): 56-64.

Ghosh M K, Ahmed F A, Buragohain R, Pathak P K and Bhattacharya M (2005). Growth performance of Vanaraja birds in high altitude areas of Arunachal Pradesh under Backyard system of management. In XXIII Annual Conference and National Symposium, Indian Poultry Science Association, Project Directorate on Poultry, Hyderabad, from (pp. 2-4). https://dahd.nic.in/sites/default/filess/Key%20Results%2BAnnexure%2018.10.2019.pdf.

Groenendijk L (2002). SWOT analysis: strengths, weaknesses, opportunities, threats social science division/ITC/Enschede/ Netherlands. Retrieved from http://pgis-tk.cta.int/m05/docs/M05U04handout SWOT Analysis.

Islam R, Nath P, Bharali A and Borah R (2015). Analysis of benefit-cost (B: C) ratio of Vanaraja and local chicken of Assam under backyard system of rearing. *J Res Agri Anim Sc* **3**(7):7-10.

Kumaresan A, Bujarbaruah K M, Pathak K A, Chettri B, Ahmed S K and Haunshi S (2008). Analysis of a village chicken production system and performance of improved dual purpose chickens under a subtropical hill agro- ecosystem in India. *Trop Ani Health Prod* **40**:395-402.

Nath B G, Pathak P K and Mohanty A K (2013). Scientific backyard poultry rearing technology: an approach to awareness and adoption of technology for livelihood development of rural farmers in Sikkim, India. *Russ J Agric Soc-Econ Sci* **22** (3):38-43.

Niranjan M, Sharma R P, Rajkumar U, Reddy B L N, Chatterjee R N and Battacharya T K (2008). Comparative evaluation of production performance in improved chicken varieties for backyard farming. *Int J Poult Sci* **7**(11): 1128-1131.

Oladunni M E and Fatuase A I (2014). Economic analysis of backyard poultry farming in Akoko North West Local Government area of Ondo State, Nageria. *Glob J Health Sci* **3**(1):141-147.

Patel N, Sundi B, Prasad S, Kumar R and Mandal B (2018). Growth Performance of Vanaraja Birds under Different System of Management. *Int J Curr Microbiol Appl Sci* **7**: 691-695.

Patel S K, Machhar R G, Kacha H L, Rani R R, Patel G D and Patel U M (2014). Effect of backyard poultry farming on living standard of tribal farmers in Dahod district of Gujarat, India. *J Poult Sci Technol* **2**(4): 79-83.

Patra M K, Hajra D K, Das R K, Sarkar P and Deka B C (2018). Effect of season on growth and reproduction performance of improved backyard poultry in North Eastern Hill Region. *Indian J Ani Res* **52**(7): 1071-1076.

Rath P K, Manda K D and Panda P (2015). Backyard Poultry Farming in India: A Call for Skill Upliftment. *Res J Recent Sci* **4**:1-5.

Riedel S, Schiborra A, Huelsebusch C, Huanming M and Schlecht E (2012). Opportunities and challenges for smallholder pig production systems in a mountainous region of Xishuangbanna, Yunnan Province, China. *Trop Anim Health Prod* **44**: 1971-1980.

Singh M, Mollier R T G, Rajesha A, Nguillie A M, Rajkhowa D J, Rajkumar U, Paswan C and Chatterjee R N (2018). Backyard poultry farming with Vanaraja and Srinidhi: proven technology for doubling the tribal farmers' income in Nagaland. *Indian Farming* **68**(01): 80-82.

Snedecor G W and Cochran W G (1994). *Statistical Methods*, 6th Edition, (Oxford and IBH Publishing Co., Calcutta, India).

Uddin M T, Islam M M, Salam S and Yasmin S (2013). Economics of native poultry rearing in the coastal regions of Bangladesh. *Bangladesh J Ani Sci* **42**(1) 49-56.

Received on *Accepted on*

DOI : 10.5958/2349-4433.2024.00075.8

J Krishi Vigyan 2024, 12(2) : 424-428

Understanding the Applications of Artificial Intelligence and Drones in Agriculture

Gigi Annee Abraham* **and A K Singh**
Krishi Vigyan Kendra, JNKVV, Jabalpur (Madhya Pradesh)

ABSTRACT

Artificial Intelligence (AI) is rapidly transforming the agricultural sector. This paper explores the integration of AI solutions in agriculture to optimize resource management, enhance productivity and ensure sustainability. The systematic collection and analysis of data from diverse sources such as sensors, drones and satellites, AI algorithms provide valuable insights into soil conditions, crop health and weather patterns. These insights enable farmers to make informed decisions regarding seed selection, pest management, irrigation and market strategies. Machine Learning processes, including data input, model building and generalization, empower AI algorithms to tackle complex problems such as weather forecasting, disease diagnosis and pattern recognition. Additionally, computer vision technologies enable machines to interpret and extract meaningful information from visual data, revolutionizing tasks like crop monitoring and weed detection. Unmanned Aerial Vehicles (UAVs) or drones play a pivotal role in agriculture by gathering data, mapping fields and performing tasks such as surveillance and pesticide spraying with precision and efficiency. The integration of AI, drones contribute to sustainable farming practices and improved yield outcomes. Overall, the adoption of AI-driven solutions in agriculture promises to revolutionize traditional farming methods, mitigate environmental challenges and ensure food security in the face of growing global demand and climate variability.

Key Words: Application, Artificial intelligence, Drone, UAVs, Integration

INTRODUCTION

Artificial Intelligence (AI) is a field within computer science that utilizes machine learning and deep learning algorithms, among other techniques, to analyze data and replicate human-like intelligence. Through interconnected input and output variables, these networks generate predictions that contribute to the development of diverse solutions (Javaid *et al*, 2023). Machine Learning, a subset of AI, allows machines to learn from data without explicit programming, while deep learning, another subset, uses artificial neural networks with multiple layers to model complex patterns and relationships in data.

The agriculture sector faces a myriad of challenges that necessitate the integration of AI solutions. These challenges include increasing global food demand due to population growth, limited arable land availability and environmental degradation aggravated by climate change. Additionally, farmers contend with insufficient forecasting of demand, excessive or improper application of pesticides and fertilizers (Sunil *et al*, 2019), unpredictable weather patterns, water scarcity, labour shortages and rising input costs (Niti Aayog, 2019). Traditional farming methods often lack precision and efficiency, leading to resource wastage, yield variability and decreased profitability. Moreover, pest and disease outbreaks threaten crop health and productivity, while market volatility and supply chain disruptions further complicate agricultural operations. AI has been extensively applied in agriculture recently. To select the proper seed for planting, cultivate healthier crops, manage pests and diseases and weeds, monitor soil, water and other growing conditions, analyze data for farmers and enhance other management activities of the food supply chain, agriculture is turning to AI technology (Javaid *et al*, 2023).

The integration of Artificial Intelligence (AI) in agriculture involves a systematic process

Corresponding Author's Email - gigiannee@gmail.com

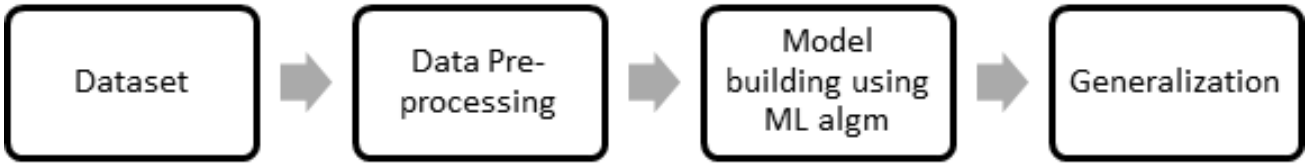


Fig 1. A Machine Learning process

Fig 2. Steps in the Computer vision process

starting with data collection through various sensors and devices including drones and satellites to gather information on soil conditions, weather patterns and crop health. This data is then preprocessed, integrated and analyzed using machine learning algorithms and predictive models to identify patterns and trends, ultimately leading to the development of decision support systems. These systems provide actionable insights and recommendations to farmers regarding resource allocation, crop management and risk assessment. Implementation involves the adoption of precision agriculture techniques and real-time monitoring systems, allowing for adaptive management practices based on AI-driven insights. Continuous evaluation and iteration ensure the refinement and improvement of AI models and workflows, contributing to optimized resource management, improved productivity and enhanced sustainability in agriculture (Jha *et al*, 2019).

MACHINE LEARNING

The Machine Learning (ML) process comprises three pivotal stages: data input, model building and generalization, as depicted in Fig 1. Generalization involves predicting outputs for inputs that haven't been part of the algorithm's training data. ML algorithms excel in solving intricate problems where human expertise may fall short, including weather forecasting, spam detection, plant disease diagnosis and pattern recognition (Sharma *et al*, 2021).

COMPUTER VISION

Computer vision is a field of computer science that enables computers to interpret and understand the visual world through digital images or videos. It involves developing algorithms and techniques that allow machines to process, analyze and extract meaningful information from visual data. The primary goal of computer vision is to replicate human vision capabilities using computational methods (Tian *et al*, 2020). The different steps in the computer vision process include (Fig 2);

Image acquisition initiates the process by capturing images or videos using cameras or similar devices, followed by pre-processing to refine and augment image quality for analysis. Subsequently, computer vision algorithms extract pertinent features such as edges, shapes, colours and textures, alongside recognizing objects through predefined models or machine learning methods. The final stage encompasses analyzing and interpreting the outcomes to derive insights or undertake relevant actions based on the visual data.

APPLICATIONS OF AI IN AGRICULTURE

Precision agriculture

Precision agriculture is an approach to farming that utilizes advanced technologies and data analysis to optimize the management of

Fig 3. Drone in agriculture application

resources. AI allows for precise control of resources like water, fertilizers and pesticides through real-time data analysis (Sharma *et al* 2023, Sharma *et al* 2021). AI-driven sensors and data analytics empower farmers to accurately track soil moisture levels, weather conditions and crop water needs in real time, leading to optimized water management. By analyzing this data, AI algorithms can recommend optimal irrigation schedules and precise water application rates tailored to specific areas of the field. This focused strategy reduces water wastage, guarantees sufficient hydration for crops and avoids excessive irrigation, which can result in water logging and nutrient loss.

For efficient pesticide application, AI can assist farmers in monitoring pest populations, identifying pest outbreaks and predicting pest pressure based on factors such as weather conditions and crop growth stages. By integrating this data with Geographic Information Systems (GIS), AI algorithms can generate maps highlighting areas of the field requiring pesticide treatment. This specific method decreases the total amount of pesticides utilized, diminishes environmental consequences and reduces expenses for farmers. For optimal fertilizer usage, AI algorithms analyze soil samples, historical data and crop nutrient requirements to recommend customized fertilizer blends and application rates. By precisely matching fertilizer inputs to crop needs, soil characteristics and environmental conditions, farmers can maximize nutrient uptake by plants while minimizing excess fertilizer runoff into water bodies. This not only improves crop yields and quality but also enhances soil health and reduces the risk of nutrient pollution in the surrounding ecosystem.

Crop monitoring

Crop monitoring refers to the systematic observation of farmland and crops aimed at improving productivity and minimizing expenses. Utilizing data from a wireless sensor network that gathers environmental and soil information, along with the implementation of artificial intelligence and prediction algorithms, an expert system has been created. This system can mimic the decision-making process of a human expert regarding diseases, issuing warning messages to users prior to the onset of outbreaks (Ahmed *et al*, 2019).

AI-powered systems use sensors, drones and satellites to monitor crop health, identify diseases and assess yield potential. By using data from sensors and drones, a crop monitoring system has been developed from seed germination to the harvesting stage (Mohammad *et al*, 2019). AI algorithms undergo training using extensive datasets containing crop images, disease symptoms and environmental factors. Through the application of machine learning methods, these algorithms can identify patterns and irregularities that signal particular diseases, pests, or nutrient deficiencies, facilitating early detection and

intervention. Machine learning and deep learning algorithms can be utilized for crop yield prediction, which helps farmers calculate crop yield before sowing seeds in their fields, using optimal agriculture inputs, reducing losses and getting the best price for their crop (Thomas *et al*, 2020).

Predictive analytics

AI algorithms analyze various data sources, including historical weather data, pest populations and market trends, to predict future weather patterns, anticipate potential pest outbreaks and forecast market trends in agriculture. By processing and interpreting this information, AI helps farmers make informed decisions regarding crop management practices, resource allocation and marketing strategies. This predictive capability enables farmers to proactively mitigate risks, optimize yields and maximize profitability in their agricultural operations.

Automation

Agricultural machinery equipped with AI technology and Agricultural robots powered by AI can perform a range of tasks, including planting seeds, transplanting seedlings, removing weeds and harvesting crops. These robots use computer vision and machine learning algorithms to identify plants, assess their health and perform targeted actions with precision. Autonomous farm equipment, drones and agricultural robots help mitigate the challenge posed by labour shortages in agriculture (Subeesh and Mehta, 2021).

AI analyses soil data to determine nutrient levels, pH balance and fertility, guiding optimal fertilization and crop rotation practices. AI-based systems monitor animal health, behaviour and productivity, enabling proactive intervention and improved breeding strategies. It streamlines logistics, inventory management and distribution processes to minimize waste and ensure timely delivery of agricultural products.

DRONES / UAVS (UNMANNED AERIAL VEHICLES)

DRONE (Dynamic Remotely Operated Navigation Equipment) or an Unmanned Aerial Vehicle (UAV), is an aircraft capable of flying and sustaining flight without the presence of a human pilot. It conducts essential agricultural tasks without risking human safety and operates with greater cost efficiency compared to manned aircraft performing similar functions (Fig 3).

Drones/ UAVs are transforming agriculture by providing farmers with valuable data, automating tasks and improving overall efficiency. These technologies contribute to sustainable and precision farming practices, ultimately enhancing productivity and reducing the environmental impact of agriculture. Through remote sensing, precision agriculture, deep learning, machine learning and IoT integration, drones have transformed the way farmers manage their crops, leading to more sustainable and profitable agricultural practices (Rejeb *et al*, 2022).

APPLICATIONS OF DRONES IN AGRICULTURE

- Drones with sensors and cameras gather data on crop health, soil moisture and pest infestations, aiding informed decision-making.
- Drones employ advanced imaging and GPS systems to map fields and manage resources like water, fertilizers and pesticides, optimizing productivity and minimizing waste (Precision Agriculture)
- Deep Learning and Machine Learning are applied to drone data, these technologies extract insights and correlations, aiding in strategy optimization and yield improvement.
- Drones communicate with IoT sensors in fields, providing real-time updates on environmental conditions and crop status, enhancing decision-making.
- Drones handle various tasks such as surveillance, pesticide spraying and drip irrigation, while deep learning algorithms help identifies diseases and weeds for targeted intervention.
- AI-driven solutions like drip irrigation based on weather patterns address water scarcity issues.

CONCLUSION

Artificial Intelligence (AI) has evolved as a potential technology in digital agriculture. Digital agriculture relates to using digital technologies for collecting, storing and further analyzing electronic agricultural data for better reasoning and decision-making using AI techniques. Precision agriculture is a method that oversees factors like soil moisture, temperature and humidity. It then calculates the ideal fertilizer and water needs for particular crops and various sections of a farm. Then there are computer vision and machine learning techniques to detect diseases and deficiencies in plants, recognizing weeds that help in spraying only those parts of land where the plants are disease-infected or where weeds are present instead of the whole field. The utilization of AI in agriculture is helping in developing agricultural methods capable of increasing crop yield and reducing the previously stated challenges. AI-powered robots have emerged as a faster and more efficient alternative for crop harvesting on a large scale, significantly reducing the need for manual labour. These robots can be integrated with drones for comprehensive field monitoring.

REFERENCES

Ahmed K, Serag ED Habib, Haythem I, Sahar Z, Fahmy Y and Mohamed MK (2019). An IoT-based cognitive monitoring system for early plant disease forecast. *Computers and Elects in Agri* **166**: 105028.

Javaid M, Haleem A, Khan H, Ibrahim and Suman R (2023). Understanding the potential applications of Artificial Intelligence in Agriculture Sector. *Adv Agrochem* 2 (1): 15-30.

Jha K, Doshi A, Patel P and Shah M (2019). A comprehensive review on automation in agriculture using artificial intelligence. *Artificial Intelligence in Agri* **2**: 1-12.

Mohammad AU, Muhammad A, El-Hadi MA, Mansour A and D. Le Jeune (2019). Affordable Broad Agile Farming System for Rural and Remote Area. *IEEE Access* **7**: 127098–127116.

Niti Aayog (2019). National Strategy for Artificial Intelligence. https://indiaai.gov.in/research-reports/national-strategy-for-artificial-intelligence.

Rejeb A, Abdollahi A, Rejeb K and Treiblmaier H (2022). Drones in agriculture: A review and bibliometric analysis. *Computers and Elects in Agri* **198**: 107017

Sharma A, Jain A, Gupta P and Chowdary V (2021). Machine Learning Applications for Precision Agriculture: A Comprehensive Review. In: *IEEE Access* 9: 4843-4873.

Sharma A, Sharma A, Tselykh A, Bozhenyuk A, Choudhury T, Alomar MA, Sánchez-Chero M. (2023). Artificial intelligence and internet of things oriented sustainable precision farming: Towards modern agriculture. *Open Life Sci* **18**(1):20220713.

Subeesh A and. Mehta CR (2021). Automation and digitization of agriculture using artificial intelligence and internet of things. *Artificial Intelligence in Agric* **5**: 278-291.

Sunil V G, Berin Pathrose and Prasanth Krishanan (2019). Design and Development of an expert support system for fertilizer calculation. *J Krishi Vigyan* **8** (1): 38-42

Thomas VK, Ayalew K and Catal C (2020). Crop yield prediction using machine learning: A systematic literature review. *Computers and Elects in Agri* **177**:105709.

Tian H, Wang T, Liu Y, Qiao X and Li Y (2020). Computer vision technology in agricultural automation-A review. *Inform Process in Agri* **7**(1): 1-19.

Sunil V G, Berin Pathrose and Prasanth Krishanan (2019). Design and Development of an expert support system for fertilizer calculation. *J Krishi Vigyan* **8** (1): 38-42

Received on 22/4/2024 Accepted on 28/5/2024

DOI : 10.5958/2349-4433.2024.00083.3

J Krishi Vigyan 2024, 12(2) : 429-434

Use of Lignocellulolytic Microbes for In-situ and Ex-situ Wheat Residue Decomposition

A K Singh*, Nitin Singhai, Yatiraj Khare[1] and Siddharth Nayak
Krishi Vigyan Kendra, JNKVV, Jabalpur, MP,

ABSTRACT

Crop residue is one of the various kinds of agricultural waste produced annually. In order to handle the massive amount of crop leftover and have the field ready for the succeeding crop ahead of schedule, farmers choose to burn the residue. In addition to contributing to global warming, crop residue burning has grown to be a serious environmental vis-à-vis soil health concern. Taking into account the abovementioned circumstances, a participatory field trial was carried out during 2021-22 and 2022-23 in Pipariya Kalan and Khairi villages of Shahpura and Patan blocks of Jabalpur district in Madhya Pradesh. Rice-wheat farming, the primary cause of crop residue fires, was the pattern utilized in the trial. The current study aimed to compare three treatments: crop residue removal for ex situ decomposition (ED), in situ decomposition (ID), and residue burning (RB) in field. The pooled data of two years indicated that the ED residue completely decomposed in 52 d after use of lignocellulolytic bacterial and fungal based microbial consortia over traditional decomposition (TD) practices where it took 95 d. Organic carbon (14.88%), nitrogen (0.97%), phosphorus (0.55%), and potassium (0.79%) contents were greater in ED than that of residues decomposed conventionally. Soil samples from in situ decomposition (ID) and the RB fields were taken before onset of monsoon and analyzed for SOC, available N, P and K contents. The results of the in situ decomposition of wheat residue using bacterial and fungal base microbial inoculants and residue burnt (RB) fields showed that the soil organic carbon (SOC), available N, P, and K status decreased by 11.48, 27, 13.62, and 16.55 per cent in the burnt fields, respectively. These values were recorded as 0.61%, 175.66, 18.32, and 231.77 kg/ha in the RB fields, and 0.68%, 223.08, 20.81, and 270.13 kg/ ha in the ID fields respectively.

Key Words: Decomposition, *Ex situ*, *In situ* decomposition, Microbial inoculants, Residue burning.

INTRODUCTION

India produces a large amount of crop residues every year, thirty percent of which contributed by rice and wheat. According to Singh *et al* (2019) rice and wheat contribute to 62% of the crop residue that is burnt, which accounts for 16% of the total quantity. Bhattacharjya *et al* (2019) estimated that 683 million tonnes of crop residue are produced on and off farms by ten key crops grown in India: rice, wheat, sorghum, pearl millet, barley, finger millet, sugarcane, potato tubers, pulses, and oilseeds. When harvesting the crop, combined harvesters leave a lot of standing stubble in the field because they don't remove entire plants. In India, 92 Mt of crop waste are burnt annually as a result of improper disposal practices (Bhuvaneshwari *et al*, 2019). Since burning crop residue is the most economical method of preparing the field for the next crop, farmers choose it as a simple and quick approach to manage the substantial volume of crop residue. One of the main causes of the country's rising agricultural residue burning rates is the replacement of human harvesting methods with mechanical ones through combination harvester harvesting, which is a consequence of a labour shortage. Crop residue burning in the field has been widely used in the states of Punjab, Haryana, Uttar Pradesh, and Uttarakhand after the harvesting of rice and wheat crops using combined harvester (Sarkar *et al*, 2018).

Gupta *et al* (2004) reported that burning crop stubble raises soil temperatures to 33.8–42.2 °C. Along with reducing the bacterial and fungal populations in the top 2.5 cm of the soil, burning

Corresponding Author's Email - aksjnkvv@jnkvv.org
1Krishi Vigyan Kendra, Katni (Madhya Pradesh)

also causes the soil's nitrogen content to be lost by 27–73%. Additionally, the bacterial population can be reduced by more than 50% by repeated burning. Long-term burning may reduce the amount of total N, C, and possibly mineralized N in the soil's top layer. The intact loss of paddy straw burning has been reported to be around 79.38, 183.71, and 108.86 kg/ha N, P, and K, respectively (Sahu *et al*, 2015). Therefore, continuing to remove and burn it could result in net nutrient losses, which would ultimately raise the cost of nutrient inputs in the short term and, in the long term, lower soil health and productivity. Moreover, burning residue is a primary source of trace gases and finer black carbon particles, which play a major role in the formation of ozone through photochemical reactions between its precursor VOCs and NOx, ultimately increasing radiative forcing into the atmosphere (Romasanta *et al*, 2017). According to a study, burning biomass is a major cause of air pollution in Asian nations, especially in China, India, and Indonesia, where air quality is rapidly declining (Andini *et al*, 2018). According to Gadde *et al* (2009) and IPCC (2013), open burning of residues also increases emissions of greenhouse gases (GHGs), including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

Ex situ decomposition, or composting, is a crop waste management practice that has been around for a few decades, but it is still important for sustainable crop residue recycling. However, there is not much research on the in situ or in-field the decomposition of crop residue utilizing microbial inoculums. It is a big challenge to not only achieve complete decomposition but also to increase the rate of in situ decomposition so that farmers can use the land for forthcoming crops. The residue's lignin and cellulose contents are thought to be the main factors controlling how quickly the material degrades. Prior studies (Hosseini and Aziz, 2013; Zhang *et al*, 2011) have employed acid or alkali pre-treatments to quicken the rate of decomposition in ex situ crop residue recycling; however, they are not practicable or cost-effective in in-situ conditions. Therefore, using lignocellulolytic microorganisms to speed up the breakdown of crop residues appears to be the most practical, affordable, and environmentally benign approach. Moreover, the in situ decomposition of crop residue may also increase soil health and productivity and enrich soil carbon (Sahu *et al*, 2015; Zhao *et al*, 2016; Goswami *et al*, 2019). Keeping in view the above, the present study was carried out to access the impact of impact of lignocellulolytic microbes on in-situ and ex-situ wheat residue decomposition.

MATERIALS AND METHODS

In the villages of Pipariya Kalan and Khairi, which are situated in the Shahpura and Patan blocks of the Jabalpur district in Madhya Pradesh, after the wheat harvest, a participatory field trial was conducted in 2021–22 and 2022–23. The region is known for its primarily hot and humid weather. *Typic Haplusterts* are representative soil types of the testing sites; the soils are high in CEC and rich in base. The most common crops cultivated in the Shahpura and Patan blocks of the district are rice, wheat, blackgram, and greengram, as indicated by the cropping pattern (Table 1). Taking into consideration ,five farmer's fields were chosen in each village according to the current cropping pattern, with the local check placed next to trial plots. The objective of the current study was to compare three treatments: the removal of crop residue for ex situ decomposition (ED), in situ decomposition (ID), and residue burning (RB) in the field. For the ex-situ decomposition of wheat residues, 500 ml of bacterial consortia (a multi-blend strain of *Bacillus species*) and fungal consortia (fungi producing lignocellulolytic enzymes) per metric tonne of raw material were used twice at a 10-day interval. For the in-situ decomposition of wheat residues, 2.5 l/ha in the same ratio were used twice in the fields of chosen beneficiaries in both villages. After the wheat was harvested, the bacterial and fungal consortia were sprayed and field ploughed, then again after ten days after ploughing. Just before the monsoon arrived, soil samples were collected from the ID and RB fields. Standard methods given by Jackson (1958), Subbaiah and Asija (1956), Olsen *et al* (1954) and Jackson (1973) were used to analyse the soil samples for soil organic carbon, available nitrogen, phosphorus, and potassium.

Table 1. Pattern of cropping in the study area (2021-22).

Block	Season wise area under crops								
	Kharif			*Rabi*			Summer		
	Crop	Area (ha)	% Area	Crop	Area (ha)	% Area	Crop	Area (ha)	% Area
Shahpura	Rice	13980	35.2	Wheat	28200	47	Blackgram	9935	55.3
	Blackgram	9775	24.6	Garden Pea	18120	30	Greengram	8025	44.7
	Others	15955	40.2	Others	13656	23	Others	--	--
Patan	Rice	32265	74	Wheat	35500	67	Blackgram	6500	50.8
	Blackgram	6030	14	Garden Pea	10000	20	Greengram	6300	49.2
	Others	5315	12	Others	7133	13	Others	--	--

Table 2. Promising indicators of technology under ex situ decomposition of wheat residues (pooled data of two years).

Parameter	Unit	Observation (Pooled data of two years)		
		TD	ED	% increase
Dry matter	Mt /ha	4.42	4.42	--
Decomposition	Days	95	52	(-) 82.7
Compost	Kg/ha	1865	2148	15.17
Organic carbon	%	12.95	14.88	14.9
N content	%	0.89	0.97	8.98
P content	%	0.53	0.55	3.77
K content	%	0.65	0.79	21.54
Net nutrient cost of compost	Rs/ha	3570	4111	15.15

RESULTS AND DISCUSSION

Compared to traditional decomposition (TD) methods, which took 95 d for wheat residue to completely decompose, the pooled data of two years showed that under ED, wheat residue entirely decomposed in 52 d when bacterial and fungal consortiums were used (Table 2). In ED, the decomposition duration was 82.7 per cent shorter than with traditional methods, which improved the decomposition cycle. Eventually, 2148 kg/ha of compost were recorded, 15.17 per cent higher than with traditional decomposition (1865 kg/ha). The residues decomposed utilizing microbial consortia had estimated contents of 14.88, 0.97, 0.55, and 0.79 per cent of organic carbon (OC), N, P, and K. These values were 14.9, 8.98, 3.77, and 21.54 percent higher than those of wheat residues that were decomposed traditionally. The compost produced under ED had a net nutrient cost of Rs.4111/-, which was 15.15% greater than the

Table 3. Nutrient status of soil under in-situ decomposition and residue burnt fields (Pooled data of two years).

Block	Soil organic carbon (%)			Available N (kg/ha)			Available P (kg/ha)			Available K (kg/ha)		
	ID	RB	% decline in RB	ID	RB	% decline in RB	ID	RB	% decline in RB	ID	RB	% decline in RB
Shahpura	0.64	0.57	12.28	214.62	170.58	25.82	19.27	16.76	14.98	256.81	218.68	17.44
Patan	0.72	0.65	10.77	231.54	180.73	28.11	22.35	19.87	12.48	283.44	244.85	15.76
Average	0.68	0.61	11.48	223.08	175.66	27.00	20.81	18.32	13.62	270.13	231.77	16.55

compost prepared traditionally, which had a net nutrient cost of Rs.3570/. Sahu *et al* (2019) and Sahu *et al* (2020) have investigated the capacity of consortia of thermophilic and mesophilic microorganisms to degrade residue rapidly. These studies have demonstrated the potential of composting, or the rapid ex situ degradation of wastes, which may hasten the in situ decomposition of crop residue.

According to Table 3, which describes the nutrient status in soils of residue burnt (RB) and in situ wheat residue decomposition (ID) fields, the average SOC was 0.61 per cent in RB fields and 0.68 per cent in ID fields. The mean reduction in SOC as a result of burning residue was 11.48 per cent; however, Shahpura block fields had a higher rate of reduction (12.28%) than Patan sites (10.77%). In the RB fields of Shahpura and Patan blocks, available nitrogen was measured at 170.58 and 180.73 kg/ ha. This was 25.82 and 28.11 per cent less than in the ID fields, where it was determined at 214.62 and 231.54 kg/ha, respectively. Regardless of block, RB fields showed an average reduction in available N of 28%. The mean reduction in available P under RB fields was found to be 13.62 per cent; however, compared to ID fields in Shahpura and Patan blocks, it was 14.98 and 12.48 per cent less, respectively. In ID and RB fields, available K was measured to be 270.13 and 231.77 kg/ha, respectively, regardless of block, with an average decrease of 16.55 per cent in RB fields. Compared to Patan block, where it was estimated to be 15.76 percent, Shahpura block had a greater reduction in available K (17.44 %). Because of residue burning, the rate of reduction was lowest in SOC and greatest in available N. Karwariya *et al* (2014) reported that after residue burning in wheat fields, there was an average reduction of 17.32% in carbon, 12.69% in nitrogen, and 16.23% in potassium; in soybean residue burnt fields, there was a reduction of 9.95, 29.17, and 15.65% in carbon, nitrogen, and potassium. Bhattacharjya *et al* (2021) also reported that a significant amount of nutrients that were also lost as a result of burning residue could be returned to the soil through in situ residue decomposition using lignocellulolytic microbes, replenishing the soil nutrient reserve and lowering the need for fertilizer for the next crop. Additionally, in situ residue the decomposition might enhance soil health by enriching soil organic carbon (SOC), which frequently declines as a result of intensive cropping systems.

CONCLUSION

The current study has shown that instead of burning crop residue, lignocellulolytic bacterial and fungal consortia can be used to decompose the residue both ex situ and in situ. Additionally, it

increased the organic carbon (OC), accessible N, P, and K contents in ex situ and in situ decomposition, which in turn decreased the amount of nutrients from inorganic sources and the cultivation cost of the next crop. The compost preparation cycle increased as a result of the residues' quick disintegration by microbial consortia, enabling farmers access to more compost with higher levels of essential and beneficial nutrients.

REFERENCES

Andini A, Bonnet S, Rousset P and Hasanudin U (2018). Impact of open burning of crop residues on air pollution and climate change in Indonesia. *Current Sci* **115**: 2259–2266.

Bhattacharjya S, Sahu A, Manna M C and Patra A K (2019). Potential of surplus crop residues, horticultural waste and animal excreta as a nutrient source in the central and western regions of India. *Current Sci* **116**: 1314–1323.

Bhattacharjya S, Sahu A, Phalke D H Madhab C M, Thakur J K, Mandal A, Tripathi A K, Sheoran P, Choudhary M, Mohammad M R, Bhowmick A, Naidu R and Patra A K (2021). *In situ* decomposition of crop residues using lignocellulolytic microbial consortia: a viable alternative to residue burning. *Environ Sci and Pollution Res* https://doi.org/10.1007/s11356-021-12611-8.

Bhuvaneshwari S, Hettiarachchi H and Meegoda J N (2019). Crop residue burning in India: Policy challenges and potential solutions. *Int J Environ Res and Public Health* **16**: 832; doi:10.3390/ijerph16050832.

Gadde B, Bonnet S, Menke C and Garivait S (2009). Air pollutant emissions from rice straw open field burning in India, Thailand and the Philippines. *Environ Pollution* **157**:1554–1558.

Goswami S B, Mondal R and Mandi S K (2019). Crop residue management options in rice-rice system: a review. *Arch Agron Soil Sci* https://doi.org/10.1080/03650340.2019.1661994.

Gupta P K, Sahai S, Singh N, Dixit C K, Singh D P and Sharma C (2004). Residue burning in rice-wheat cropping system: causes and implications. *Current Sci* **87**:1713–1715.

Hosseini S M and Aziz H A (2013). Evaluation of thermochemical pretreatment and continuous thermophilic condition in rice straw composting process enhancement. *Bioresour Technol* **133**:240–247.

IPCC (2013). In: Stocker T F, Qin D, Plattner G K, Alexander L V, Allen S K, Bindoff N L, Bréon F M, Church J A, Cubasch U, Emori S, Forster P (2013). *Technical summary.* In Climate change 2013: the physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Jackson M L (1958). In: *Soil Chemical Analysis*. Prentice-Hall Inc., Englewood Cliffs, New Jersey, 498.

Jackson M L (1973). *Soil Chemical Analysis.* Prentice Hall of India. New Delhi. pp. 498.

Karwariya S, Rajpoot P S, Ahirwar R P and Dubey A K (2014). Extraction of crop residue burnt field and its impact on soil fertility (Case study of Central Madhya Pradesh, India). *Int J Scientific Res in Agri Sci* **1**(8):156-164.

Olsen S R, Cole C V, Watanabe F S and Dean L A (1954). Estimation of available phosphorus in soils by extraction with NaHCO3, USDA Cir.939. U.S. Washington.

Romasanta R R, Sander B O, Gaihre Y K, Alberto M C, Gummert M, Quilty J, Nguyen V H, Castalone A G, Balingbing C, Sandro J, Correa T Jr, Wassmann R (2017). How does burning of rice straw affect CH4 and N2O emissions? A comparative experiment of different on-field straw management practices. *Agric Ecosyst Environ* **239**:143–153.

Sahu A, Bhattacharjya S, Manna M C, Patra A K (2015) Crop residue management: a potential source for plant nutrients. *JNKVV Res J* **49**:301–311.

Sahu A, Manna M C, Bhattacharjya S, Thakur J K, Mandal A, Rahman M M, Singh U B, Bhargav V K, Srivastava S, Patra A K, Chaudhari S K and Khanna S S (2019). Thermophilic ligno-cellulolytic fungi: the future of efficient and rapid bio-waste management. *J Environ Manag* **244**:144–153.

Sahu A, Manna M C, Bhattacharjya S, Rahman M M, Mandal A, Thakur J K, Sahu K, Bhargav V K, Singh U B, Sahu K P and Patra A K (2020). Dynamics of maturity and stability indices during decomposition of biodegradable city waste using rapo-compost technology. *Appl Soil Ecol* **155**:103670

Sarkar S, Singh RP, Chauhan A (2018) Crop residue burning in northern India: increasing threat to Greater India. *J Geophys Res Atmos*. https://doi.org/10.1029/2018JD028428.

Singh R, Yadav D B, Ravisankar N, Yadav A and Singh H (2019). Crop residue management in rice– wheat cropping system for resource conservation and environmental protection in north-western India. *Environ, Dev and Sustain* 1-26.

Subbiah B V and Asija G L (1956). A rapid procedure for the estimation of available nitrogen in soils. *Current Sci* **25**:259-260.

Zhang J, Zeng G, Chen Y, Yu M, Yu Z, Li H, Yu Y and Huang H (2011). Effects of physico-chemical parameters on the bacterial and fungal communities during agricultural waste composting. *Bioresour Technol* **102**:2950–2956.

Zhao B, Zhang J, Yu Y, Karlen D L and Hao X (2016). Crop residue management and fertilization effects on soil organic matter and associated biological properties. *Environ Sci Pollut Res* **23**:17581–17591.

Received on 28/2/2024 Accepted on 15/4/2024

DOI : 10.5958/2349-4433.2024.00076.4

J Krishi Vigyan 2024, 12(2) : 435-440

Value Chain and Constraints Analysis of Ginger in West Garo Hills district of Meghalaya

Tarun Kumar Das, Monica Singh and Sagarika Borah
ICAR-Krishi Vigyan Kendra,West Garo Hills,Meghalaya-794005

ABSTRACT

Ginger is usually cultivated on hilly slopes or upland in jhum cultivation by the Garo tribe. The ginger growers follow the traditional dibbling method of cultivation. The planting materials are sown in the months of March and April. The crop takes around 8-9 months to reach its maturity stage. The study was conducted in six different villages with the objective of identifying the value chain in ginger, involving 60 respondents from the district. The study revealed that ginger soft rot or rhizome rot was a major problem for the farmers in the district. During the value chain analysis, it was observed that every year, the price of ginger fluctuated and middlemen earned a profit of Rs. 15-20/kg, wholesalers earned Rs. 5-10/kg, and small processing units, after adding value (ginger powder), earned a profit of Rs. 80-100/kg. However, due to a lack of well-established marketing facilities and value-added industries or facilities in the district, most of the product was exported to neighbouring states.

Key Words : Constraint, Ginger, Garo REGION, Growers, Marketing, Value chain.

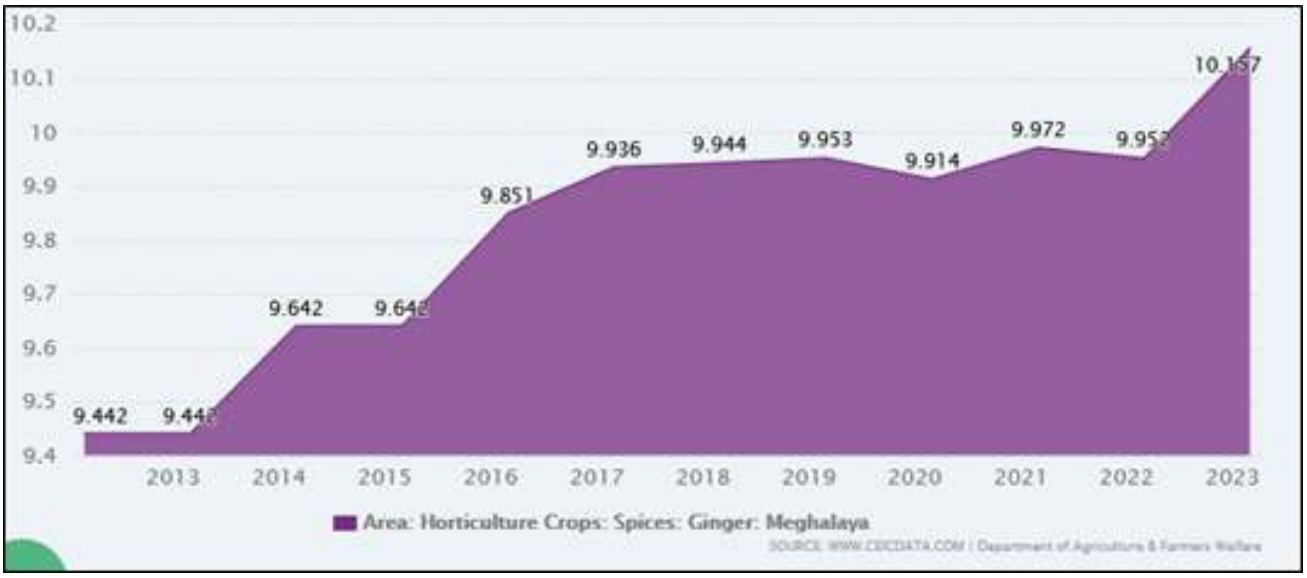
INTRODUCTION

India's agricultural system has experienced significant changes in recent decades. The traditional way of food production is being replaced by practices more similar to manufacturing processes, with greater co-ordination across farmers, processors, retailers, exporters and other stakeholders in the agriculture value chain (Kumar *et al,* 2011). The agricultural value chain framework encompasses a series of activities aimed at enhancing value, spanning from production to consumption, encompassing processing and marketing stages. Every segment of this chain is interconnected through backward and forward linkages. Different stakeholder of value chain are Government Agencies/Input Companies which provide support, infrastructure, financial assistance, and regulation for agricultural activities, Farmers who cultivate crops and livestock and performing primary processing and selling mainly to traders, Traders who purchase agricultural commodities directly from farmers, stockpile, and resell to larger traders or processors, Wholesalers who handle large quantities, own storage and transportation, and source from smaller traders or processors, Retailers who sell products directly to consumers, ranging from supermarkets to small shops and Consumers who are end-users who purchase and consume products or use them for manufacturing other goods or services (Arulmanikandan *et al,* 2023).

Ginger is commercially grown in almost all the states of the north eastern region, with Meghalaya, Arunachal Pradesh, and Mizoram as leading ginger-producing states. Prakash (2018) highlighted the value of growing ginger, stating that it is a significant cash crop in the Northeast. Meghalaya is the second-largest producer of ginger in the country after Kerala. Bag (2018) reported that, considering the rising demand for ginger as a health-beneficial item worldwide, emphasis has been placed on various government programs and the export potential of the country. The district is mainly dominated by Garo tribes, who cultivate ginger in jhum areas. For cultivation, they first cut and clear the vegetation in the selected area in the month of January. Cutting vegetation to clear the land is necessary for beginning agricultural operations in shifting cultivation (Singh and Devi, 2020). After cutting the trees and clearing the jungle, they leave the area to dry up.

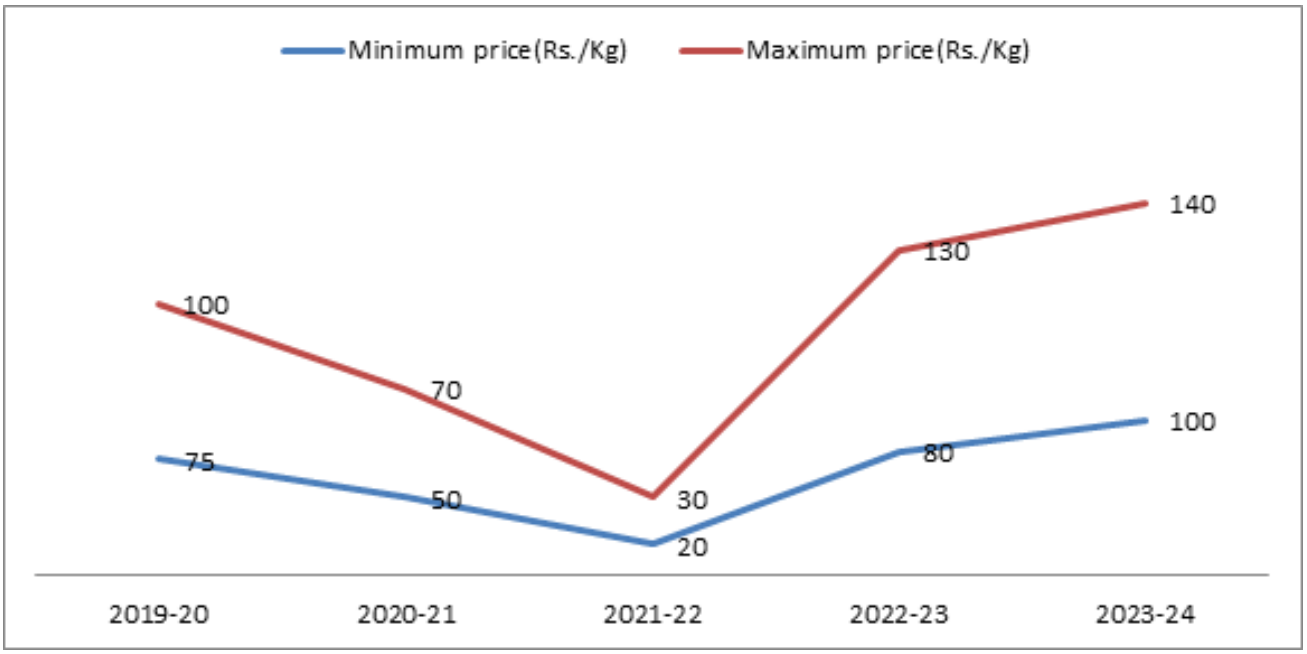
Corresponding Author's Email - tarunkd2011@gmail.com

Table 1. Increasing trend of area in ginger cultivation in Meghalaya.



Source: https://www.ceicdata.com

Fig 1. Average Market Price Variance (2019-2024)



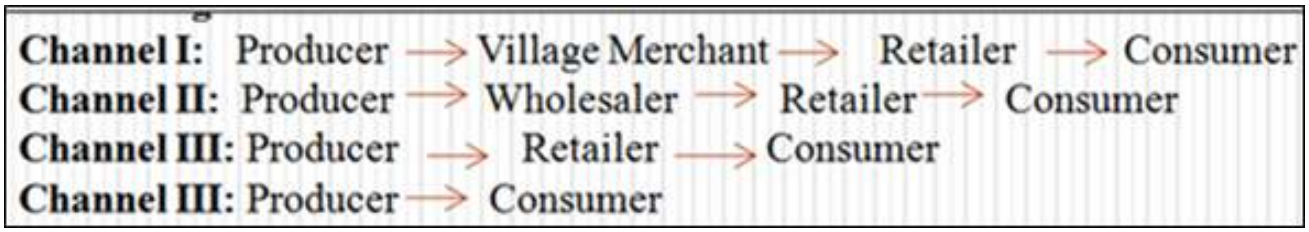
Source: www.miemeghalaya.org/the-meghalaya-institute-of-entrepreneurship and modified

Ginger is grown using the dibbling method with a locally made dibbler during the months of March or April. Ginger is a heavy feeder and demands nutrients continuously in large amounts. However, the use of large quantities of chemically formulated fertilizers is not feasible as it results in a progressive rise in multi-nutrient deficiencies, nutrient imbalance, and deteriorating soil health and productivity over time (Bindu and Podikunju, 2019). In the months of November and December, after harvesting the crop, it is sold in nearby weekly markets to retailers, middlemen, wholesalers, and small and medium processing units. The sale of the produce depends on the quantity harvested by the farmers. Some farmers sell their produce immediately, while others wait for better market prices. Adamade *et al* (2017) claimed that ginger is an essential crop with

Table 1. Marketing Practices adopted by ginger farmers

Sl. Nos.	Channel used by growers	Frequency	Percentage
1.	Selling in the nearest weekly market	49	81.67
2.	Intermediaries/agent procuring form firm/home	11	18.33

Fig 2. Marketing channel of ginger in the district.



Source: Singh and Feroze(2018)

medicinal, therapeutic, and herbal benefits that are beneficial in several facets of human life. However, the markets for ginger in the district always fluctuate. There is scope for improvement through value addition at the growers' level. Farmers can add significant value by processing and diversifying their raw ginger supply (Sangma and Kalita, 2022). The study explored the flow of ginger and its marketing patterns involving different agents or enterprises in the district.

MATERIALS AND METHODS

The study was conducted in six different villages, namely Kamagre, Botegre, and Chandigre under Rongram block, and Amakgre, Nengja Bolchugre, and Aminda Simsang under Gambigre block, purposively. The data were collected through semi-structured interview schedules. Data were collected by randomly surveying 60 farmers, 20 middlemen, 20 retailers, 10 wholesalers, and 3 medium and 10 small processing unit holders. Secondary information was collected from the District Horticulture Office, articles, newspaper reviews, etc. The data were analyzed using simple statistical tools.

RESULTS AND DISCUSSION

Marketing is problem for the growers because there is no established market for it. Producers sell the product to middleman, retailers, wholesalers and small or medium processing units. The price of the ginger depends on place to place and district to district. Transportation is another barrier for lowest price in the villages.
The maximum prize was in the year 2019, 2020,2022 and 2023 but in the year of 2022, farmers were in lost because of fall in prices of ginger. The reason reported for the same were less demand and rhizome rot in ginger. In 2021, some of the farmers did not harvest the crop because the cost of harvesting or production was higher than the selling price in the market. The produce was wasted in the field itself, and the farmers became demotivated.

Marketing pattern

Due to transportation problem, most of the producer sells their produce to nearby market sometime at lowest price also. Only few farmers sell their product in good price because the good extension contact or available transportation facility. This was equally important in the trade and marketing of ginger where it always witnessed that the producers have no genuine fixture of price (Mawlong, 2017).

The above table showed that 81.67 per of the ginger grower sell the produce in weekly market and only 18.33 percent sold to intermediaries/agent who is directly procuring form his/her firm/home. Generally, the growers who sell their produce from his/her firm because of immediate financial needs and afraid to destroy of the crop by wild animal like pigs.

Fig 3. Value chain analysis of ginger with their margin.

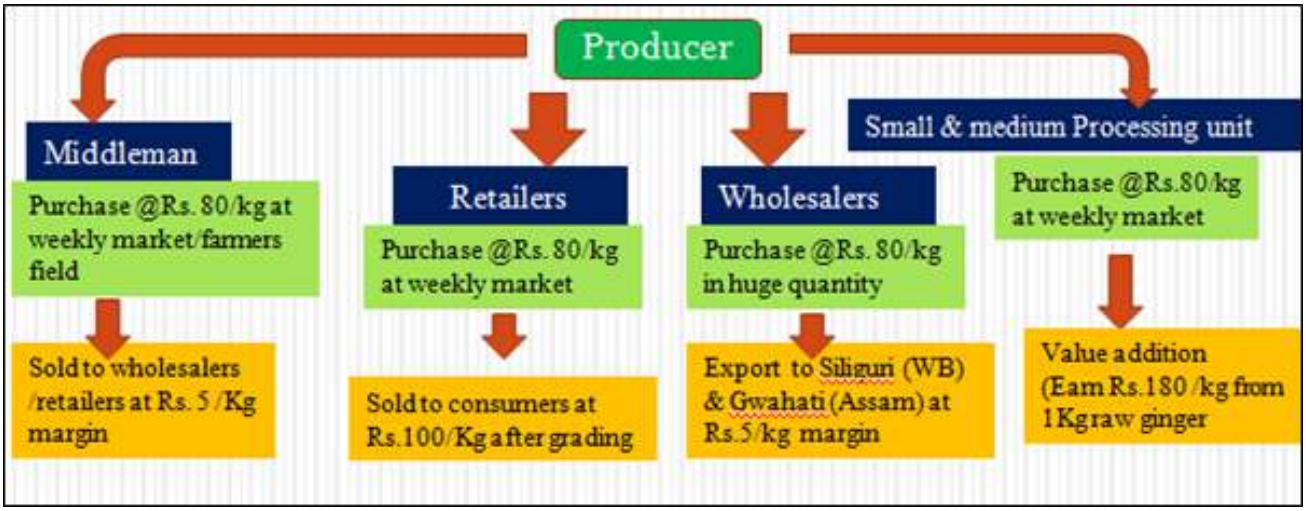


Table 2. Constraints faced by the ginger grower.

Sr. No.	Constrain t	Agree		Disagree	
		No.	%	No	%
A.	**Seed/rhizomes related problems**				
1	Availability of seed/seedlings insufficient quantity	40	66.67	20	33.33
2	Availability good quality seed/rhizome	43	71.67	17	28.33
3	Reasonable price of seed/rhizome	48	80.00	12	20.00
4	No special subsidy on seed/rhizome	58	96.67	2	3.33
5	Problem of rhizome rot	59	98.33	1	1.67
B.	**Input related problems**				
6	Less know -how support from organization	45	75.00	15	25.00
7	Availability of inputs(organic fertilizers/FYM)	57	95.00	3	5.00
8	Availability of labour	35	58.33	25	41.67
C.	**Agronomic practices**				
9	Availability of organic package of practice	40	66.67	20	33.33
10	Availability of extension training facilities	25	41.67	35	58.33
11	Weeds problem	60	100.00	0	0.00
12	Insect/pest problem	52	86.67	8	13.33
13	Availability of Government scheme	4	6.67	56	93.33
D.	**Marketing related problems**				
14	Marketing through middleman/agents	45	75.00	15	25.00
15	Availability of regulated market	5	8.33	55	91.67
16	Un satisfactory market price during selling	40	66.67	20	33.33
17	High cost of production	51	85.00	9	15.00
18	Poor transportation/Own means of transport	58	96.67	2	3.33
E.	**Credit linkage facility**				
19	Acquired loan from bank	3	5.00	57	95.00
20	Availability of credit facility	5	8.33	55	91.67

Value chain analysis

Majority of the remote farmers bring their produced to the weekly market and sell their product before 12.0PM clock at market price set by the different agent/middleman. They are forced to do that because weekly market last upto 12.0PM usually and till this period maximum transaction of buying or selling is over. Ginger farmers have expressed concern over the fact that they were being forced to comply with weight deduction at the hands of traders. The farmers pointed out that out of every ton of ginger sold to traders; they lose around Rs 20,000 worth of ginger due to weight deduction (www.themeghalayan.com).

From the above figure, it was observed that farmers sell ginger to middlemen at Rs. 80 per kg. Middlemen then sell the same ginger to wholesalers or retailers at Rs. 85 per kg. Retailers sometimes purchase ginger directly from farmers at Rs. 80 per kg, and after minimal grading, sell it to consumers at Rs. 100 per kg. Farmers also sell their ginger to wholesalers at Rs. 80 per kg, who then transport it to Siliguri, West Bengal, and Guwahati, Assam for further processing. Wholesalers earn a profit of Rs. 5 per kg through this process. Although their profit per kilogram is small, they buy in large quantities, resulting in significant overall profit. Additionally, small processing units purchase ginger from the market at Rs. 80 per kg and, after some processing, sell it at Rs. 180 per kg, yielding a maximum profit of Rs. 100 per kg. This highlights the importance of value addition and processing in achieving higher income at the farmers' level. Value addition at the farmers' level could significantly increase their profits, considering that the retailers and wholesalers earn only Rs. 5 to Rs. 20 per kg.

Constraints related to Ginger production

In attempting to develop the ginger value chain, a number of constraints have been found which need to be addressed systematically and holistically. Some of the key issues are listed in Table 2

It was observed that 98.33% of respondents identified ginger rhizome rot as the major constraint related to seeds and rhizomes. This was followed by the lack of special subsidies for seeds/rhizomes (96.67%), the reasonable price of seeds/rhizomes (80.00%), and the availability of good quality seeds/rhizomes (71.67%). Regarding input-related constraints, 95.00% of respondents indicated that the availability of organic inputs was a major issue, while 75.00% cited a lack of know-how support from organizations. In terms of market-related constraints, poor transportation and high production costs were reported as major issues by 96.67% and 85.00% of respondents, respectively. It was also seen that all respondent (100%) said that weed problem is the major agronomical constrain followed by insect/pest problem (86.67 %) and availability of organic package of practice (66.67%).

CONCLUSION

The study highlights the various supply chain in respect to ginger in Garo hills. Also, significant constraints faced by ginger farmers in Meghalaya, particularly those in Garo-dominated districts were studied. Major issues include ginger rhizome rot, lack of subsidies, high costs, and poor transportation. The availability of good quality seeds and organic inputs also pose challenges, alongside limited organizational support and fluctuating market prices. Despite these challenges, ginger remains a crucial cash crop for the region. To improve the ginger value chain, targeted interventions are essential. These include providing subsidies for seeds/rhizomes.., improving access to organic inputs, offering better organizational support, and enhancing transportation infrastructure. Addressing these issues can lead to increased productivity, higher farmer incomes, and enhanced market stability. Furthermore, promoting value addition and processing at the farmer level can significantly improve profitability and reduce post-harvest losses, ensuring a more sustainable and resilient agricultural system in Meghalaya. The small entrepreneur having processing unit earn profit of Rs.100 and retailers earn Rs.20 from1 kg raw ginger. The middleman and wholesaler earn profit of Rs.5- 10/Kg. Hence it can be said that ginger-based agro-entrepreneurship should be promoted.

REFERENCES

Adamade C A, Boliran F M, Adebija J A and Opadotun O O (2017). Ginger oil processing, problems, challenges and Economic prospects. *Int J Scientific Engineer Res 8(5).*

Arulmanikandan, Vaishnavi P and Aparna Jayan R (2023). *The Role of Agricultural Value Chain Extension in Facilitating Agricultural Transformation.* A Book chapter. Emerging Trends in Agricultural Extension Education: pp 529-542

Bag B B(2018). Ginger Processing in India (Zingiber offiicinale): A Review. *Int J Curr Microbiol and Appl Sci* 7(4)

Bindu B and Bindu Podikunju (2019). Performance of Ginger (Zingiber officinale) varieties under organic nutrition. *J Krishi Vigyan* **7** (2):174-177.

CEICDATA(2023). Area: Horticulture Crops: Spices: Ginger: Meghalaya. Department of Agriculture & Farmers Welfare. https://www.ceicdata.com

Kithu C J (2003*). Marketing and Export Prospects of ginger in Indian Ginger-production and utilization*. H P Singh and M.Tamil Selvan (Edited), Directorate of Arecanut and Species Development, Ministry of Agriculture and Cooperation, Government of India, Calicut, Kerela.

Kumar Anjani, Singh Harbir, Kumar Sant and Mittal Surabhi (2011). Value chains of agricultural commodities and their role in food security and poverty alleviation: A synthesis, *Agri Econ Res Rev* **24**:169-181.

Laishram Kanta Singh and Devi S Roma (2020). Traditional tools and implements used in jhum agriculture in Nagaland. *J Krishi Vigyan* **8** (2): *293-297*.

Mawlong Monica (2017). Ginger Cultivation in Umroi, RiBhoi district, Meghalaya. *OSR J Human Social Sci (IOSR-JHSS)*. **22**(7) 36-45.

Prakash N (2018). Organic Ginger Cultivation in North Eastern Region. March. https://www.researchgate.net/publication/ Organic Ginger Cultivation in North Eastern Region.

Sangma Bilgark Ch and Kalita Bidyut Jyoti (2022). Present scenario of Ginger Farming in West- Garo Hills District Meghalaya: An Analysis. *SMS J Entrepreneurship and Innov* **8**(2):79-87.

Singh Ram and Feroze S M (2018). Marketing of ginger-A case study of Garo tribe of Meghalaya. *Indian J Agri Market* **32**(3):90-99.

The Meghlayan Bareau (2023). Ginger farmers weighed down by trader dictate. The Meghalaya. https://themeghalayan.com

Received on 25/4/2024 Accepted on 30/5/2024

DOI : 10.5958/2349-4433.2024.00077.0

J Krishi Vigyan 2024, 12(2) : 441-445

Wild Boar Management in Paddy Fields using Repelling Equipment

E B Gilsha Bai, K V Sumiya, A S Smijisha, K V Arun Kumar, K Sreelakshmi, J Resmi, R Reshmi, S Haritharaj, Anusree Aravind. C Nazila and Aboobacker Sidhiq and Thimmappa K.*
Krishi Vigyan Kendra, Palakkad, Kerala Agricultural University, 679306 (Kerala)

ABSTRACT

The present study focused on the effectiveness of mechanical methods to deter the wild animals from the paddy fields in the Palakkad district of Kerala state, India. An experiment for comparing the efficacy of three sound repellents (pot and stick, fan and plate, bio-acoustics equipment) and one light repellent against unprotected fields was conducted to determine the most effective method for deterring wild boar. All the mechanical methods were found effective in reducing crop damage incidences compared to unprotected fields. Sound repellents, bio-acoustics equipment (2.50), and fan and plate (4.25) reduced the crop damage incidences compared to the light repellent (7.25) and the fields without protection (18.50). It was found that bio-acoustics equipment protected a larger area, 4.4 ha, with a single unit. The best two equipment from the study, bio-acoustics and fan and plate, along with olfactory repellent, Bo Rep, and bio-fencing, were used to demonstrate wild boar management in a large area. It was found that the integrated use of mechanical and other repellents was very effective in preventing the wild boar from entering the paddy fields.

Key Words: Bio-acoustics equipment, Bio-fencing, Bo Rep, Fan and plate, Pot and stick, Flickering light, Wild boar.

INTRODUCTION

Conflicts between wild animals and humans over food crops are as old as agriculture. Elephants, wild boar, blue bulls, monkeys, etc., are wild animals that cause massive damage to cultivated crops (Rao, 2015; Tarvydas and Belova, 2022). Most farmers considered the wild boar a common pest and wished for its complete elimination from crop areas (Khattak *et al*, 2022). Wild boar has become a serious threat to major crops like paddy, banana, and tuber crops in Kerala. Several methods to protect crops from wild boar attacks other than culling (Schlageter and Haag-Wackernagel, 2012). Farmers usually adopt Indigenous Technical Knowledge ITKs to restrict their entrance into crop fields (Rao, 2015). Most of these methods are not properly tested for their efficacy. Scientific methods were also derived from long-term studies (Ananya *et al*, 2020; Balakrishna *et al*, 2021; Naik and Basavadarshan, 2020). Physical barriers, olfactory repellents, and sound repellents like bioacoustics are some of them (Sreeja and Chellappan, 2017). Electric fencing is reported as the most effective physical barrier (Schlageter and Haag-Wackernagel, 2011). Mohamad *et al* (2021) developed a blast explosion sound jig that produced sound between 88.77 dB and 100.14 dB over an area of 0.26 to 9.35 acres. The sound was in the hearing sensitivity range of wild boars and could be used as a repellent. Recently, IOT-based methods have also emerged to reduce crop damage due to wild boar attacks (Balakrishna *et al,* 2021).

Wild boar management is a big problem for the paddy farmers in Kerala, especially in Palakkad district. Hence, an experiment was conducted in farmers' fields to study the efficacy of some mechanical methods, including farmer innovations and scientifically proven equipment, to eliminate crop damage caused by wild boar in paddy fields.

Corresponding Author's Email - gilsha.bai@kau.in
*ICAR – Agricultural Technology Application and Research Institute, Zone XI, Bengaluru

MATERIALS AND METHODS

An experiment to compare the efficacy of various repelling equipment for wild boar in protecting paddy fields was conducted in the Muthalamada Panchayath of Kollengode block in the Palakkad district during the year 2020–21. Three sound repellents and one light repellent were compared with an unprotected field. The sound repellents were a fan and plate, a pot and stick, and bio-acoustic equipment (Kethi Rakshak). The fan and plate and pot and stick are farmer innovations, and Professor Jayashankar Telangana State Agricultural University developed the bio-acoustics equipment. The features of the different equipment tried were as follows:

Pot and Stick

This was a farmer's innovation to avoid wild boar in the crop field by making a sound with the help of the wind. A pot made of stainless steel was used. It was hung upside down, and two or three steel rods were also hung inside the pot. The position of the iron rods was such that they could strike the mouth of the pot when the wind blew. It makes a sound that deters the wild boars from entering the paddy field.

Fan and Plate

This was also a farmer innovation to prevent wild animals from damaging crops. The main component of the equipment is the leaves of a table fan, which are fitted in such a way that they rotate as the wind blows. One iron rod with two metal rings at both ends is fixed on the other end of the fan's axis. Hence, as the fan rotates, the rod also rotates. The fan and rod are mounted on a pipe shaft. A stainless-steel plate is fitted to the shaft. When the fan rotates, the metal rings attached to the iron rod strike the plate and make a sound. The sound repels the wild boar from entering the field. The pipe shaft makes fixing the equipment in the field at the desired height easy.

Bio-acoustics equipment (Kethi Rakshak): The equipment was developed from the All-India Network Project on Vertebrate Pest Management studies at Professor Jayashankar Telangana State Agricultural University (PJTSAU). This is an eco-friendly technology for deterring wild animals from farm areas. The equipment uses the natural sounds of predators, distress, and alarm calls of wild boars or related species. The wild boars start to avoid the area while hearing the sounds of their predators produced by the equipment. The equipment produces a fixed volume of 110 dB dissipating in an area of 3.2–4.0 hectares at an ambient noise level of around 42 dB. It can cover up to 7.6 hectares at 37 dB of ambient noise.

Flickering Light

Apart from the three sound repellents, one light repellent was also included in the trial to keep wild boar away from paddy fields during the night. The bulb used in the repellent produces a colorful and flickering light. Seeing this light, wild boars were reluctant to come near it. It is operated using electric current. In addition to material costs operational charges are also present in the case of this light repellent.

The experiment was conducted in paddy fields during the second crop season, from December to March. Uma was the variety cultivated during the season. A complete randomized design with five treatments and four replications was selected for the trial. Fields with the above four repellents and fields with no repellent (control) formed the five treatments. The number of crop damage incidences, area protected by a single piece of equipment, yield, loss due to crop damage, and net return were observed in the trial. The observations were analyzed statistically.

RESULTS AND DISCUSSION

Number of crop damage incidences

The results revealed that mechanical repellents effectively reduced the number of crop damage incidences in paddy fields. Wild boar avoided fields fitted with different equipment for up to three weeks. Then they started entering the fields occasionally. Sound repellents reduced the number of attacks by 77 per cent compared to the control fields, whereas light repellents reduced crop damage incidences only by 61 percent (Table 1). The results showed that sound repellents were more effective in reducing crop damage incidences than the mechanical repellents tried.

Table 1. Observations recorded during the experiment.

Equipment used	Number of crop damage incidences	Area protected by a single unit (ha)	Yield (kg/ha)	Yield loss due to damage (kg/ha)	Loss due to damage (Rs/ha)	Net return (Rs./ha)	B:C ratio
Pot and Stick	5	0.99	5843.75	1656.25	46375	88825	2.188
Fan and Plate	4.25	1.08	6137.50	1362.50	38150	96550	2.282
Bio-acoustics equipment (Kethi Rakshak)	2.50	4.45	6143.75	1356.25	37975	92825	2.172
Flickering Light	7.25	1.05	5125.00	2375.00	66500	69300	1.934
Field without any equipment	18.50	0	4787.50	2712.50	75950	60050	1.811
CD (P = 0.05)	3.051	0.291	NS	NS	NS	NS	NS
CV	26.998	12.768					

There was a significant difference between the treatments.

The area protected by a single unit.

The Effectiveness of various types of equipment in terms of the area protected by a single unit differed considerably. One of the sound repellents, bio-acoustics equipment, protected the most prominent area, 4.4 ha, with a single unit. Area coverage of all other equipment was almost the same at 1ha (Table 1). Hence, bio-acoustic equipment protected a significantly larger paddy area from the attack of wild boar.

Yield

The yield of paddy obtained from the trial is shown in Table 1. There was no significant difference in yield between the fields with wild boar-repelling devices and the control fields. The effect of the reduction in the number of crop damage incidences did not reflect in the yield. This is because paddy is different from root crops like Casava. The hills were not fully uprooted by the attack of wild boar. A portion of the panicles get back to growth some days after the attack. Hence, even though the number of crop damage incidences was highly reduced in the fields with various repelling equipment, the increase in yield from these fields was not as high as the reduction in attack. Damage only near the bunds rather than inside the field was observed in the field with sound repellent, especially bio-acoustic equipment while conducting cluster demonstrations during the successive years.

Loss due to damage

Loss due to wild boar attack was not significant between the mechanical repellents used. The results showed the same trend as that of yield obtained from the paddy fields (Table 1).

Net return and B:C ratio

Since there was no significant difference in paddy yield from the fields with and without repelling equipment, there was no significant difference in net return or B:C ratio either (Table 1). The results obtained from the trial showed that the paddy fields were not as vulnerable to wild boar attack as the root crops. The incidence of crop damage was high in control fields. Even then, the damaged hills were not fully uprooted by the wild boar. Hence, the reduction in yield observed in the control plots cannot be termed a significant reduction. The cost of the equipment (Table 2) used for experiment indicated that the bio-acoustics equipment had the highest cost, followed by the fan and plate, pot and stick, and flickering light. The life span was also the highest for the bioacoustics equipment. Hence, there was not much difference in net return and B:C ratio between the fields with this equipment.

Table 2. cost of the equipment.

Name of equipment	Description	Average a rea covered per unit (ha)	Cost (Rs per unit)
Pot and Stick	Sound repellent made up of stainless steel pot and stick. Making sound when wind blows.	0.99	800
Fan and Plate	Sound repellent using table fan leaves, steel plate and iron rod. Making sound when wind blows.	1.08	1500
Bio acoustics equipment	Sound repellent developed by the Professor Jayashankar Telangana State Agricultural University	4.45	27000
Flickering Light	Light repellent with colourful and flickering light	1.05	300
Field without any equipment	--	0	0

Table 3. Results of the Cluster Demonstrations.

Parameter with unit	2021 -22		2022 -23	
	Demo nstration	Control	Demonstration	Control
Yield (t/ ha)	6.3	4.8	7.40	6.02
Number of crop damage incidents	1	7	4	11
Extent of crop damage (% area affected)	3.5	20.0	2.0	16.8
Net return (Rs./ha)	104750	63438	135200	98560
B:C ratio	2.45	1.91	2.88	2.41

The effectiveness of the mechanical methods to reduce crop damage incidences due to wild boar in paddy fields was utilized for the protection of a larger paddy area through the integrated use of mechanical methods, olfactory repellent (Bo Rep), and fencing. Integrated use was demonstrated in an area of 50 ha during the years 2021–22 and 2022–23 in the Kollengode block and Kuzhalmannam block, respectively. It was found effective in managing wild boar. After 10–15 days, the position of the sound and light repellents changed in the field. This caused confusion among the wild boar and thus reduced crop damage. The results obtained from the two cluster demonstrations are given in Table 3. Cluster demonstrations showed that the integrated use of different methods is effective for the management of wild boar in paddy fields.

CONCLUSION

The damage to the crops is the central issue facing the farmers. Among the different methods available for deflecting wild boar from paddy fields, some mechanical methods were analyzed for their effectiveness in an on-farm trial. The two sound repellants, bio-acoustics equipment, and a fan and plate were found to be more effective in repelling the wild boar. The results obtained were demonstrated in a large area of 50 ha in two blocks of Palakkad district in integration with other wild boar repelling methods, including olfactory repellant (Bo Rep) and bio fencing. The demonstrations revealed that an integrated approach effectively confuses and prevents wild boar from entering the paddy fields.

REFERENCES

Ananya N, Chandrika D, Bhavani A and Reddy T V (2020). Protection of crops from wild

animals. *Int J Creative Res Thoughts* **8** (8):2714 – 2718.

Balakrishna K, Mohammed F, Ullas C R, Hema C M and Sonakshi S K (2021). Application of IOT and machine learning in crop protection against animal intrusion. *Glob Transitions Proc* **2**: 169–174. https://doi.org/10.1016/j.gltp.2021.08.061

Khattak R H, Teng L, Mehmood T, Ahmad S and Liu Z (2022). Impacts of the Wild Boar (*Sus scrofa*) on the Livelihood of Rural Communities in Pakistan and Understanding Public Attitudes towards Wild Boars. *Animals* **12**: 3381. https://doi.org/10.3390/ani12233381

Mohamad M A H, Yahya M S, Wagiman A, Rahman R A, Alimin N A F, Wahid K A and Sani W (2021). Development of Environmentally Friendly Wild Boar Repellent by Using Blast Explosion Sound Technique. *Int J Nanoelectr and Mater* **14** (SI): 69-74.

Naik M I and Basavadarshan A V (2020. Incidence and efficacy of crop protection measures against wild boar (*Sus scrofa* L.) in groundnut (*Arachis hypogaea* L.). *J Entomol and Zool Stud* **8**(3): 1616-1620. https://www.entomoljournal.com

Rao V V (2015). Management Strategies for Birds and Wild Animals in Organic Crop Production. *Int J Econ Pl* **2**(4):186-191

Schlageter A and Haag-Wackernagel D(2011). Effectiveness of solar blinkers as a means of crop protection from wild boar damage. *Crop Prot* **30**: 1216-1222. https://doi:10.1016/j.cropro.2011.05.008

Schlageter A and Haag-Wackernagel D (2012). A Gustatory Repellent for Protection of Agricultural Land from Wild Boar Damage: An Investigation on Effectiveness. *J Agric Sci* **5**: 61-68 https://www.ccsenet.org/jas

Sreeja P and Chellappan M (2017). Evaluation of crop protection measures against wild boar (*Sus scrofa*) damage on Chinese potato [*Solonostemonrotun difolius* (Poir) Morton] in Kerala. *Pest Manag Hortic Ecosyst* **23** (2): 133 -137.

Tarvydas A and Belova O (2022). Effect of Wild Boar (*Sus scrofa* L.) on Forests, Agricultural Lands and Population Management in Lithuania. *Diversity* **14**: 801. https://doi.org/10.3390/d14100801

Received on 2/5/2024 Accepted on 20/5/2024

DOI : 10.5958/2349-4433.2024.00078.7

J Krishi Vigyan 2024, 12(2) : 446-450

Yield and Economic Assessment of Different French bean Varieties under Organic Conditions

Kamal Kumar Pande[1] and Raj Kumar[2]
Krishi Vigyan Kendra (ICAR-VPKAS), Kafligair, Bageshwar
1- Subject Matter Specialist and 2- Senior Scientist and Head

ABSTRACT

An assessment of different french bean varieties under organic conditions of hills was carried out at KVK (ICAR-VPKAS), Kafligair, Bageshwar, Uttarakhand during spring- summer of 2022 and 2023, which is most suitable season for the growth, yield and marketing of french bean in hills. Six french bean varieties namely CITH- FB-1, PFB- 135, VL Bean- 2, Arka Suvidha, Komal Private and Pant Anupama with 3 replications were assessed in Randomized Block Design (RBD). The sowing was done in third week of March in both the years. PFB 135 was the first to flower 50 percent (36.5 days in 2022 and 39.4 days in 2023) and gave first harvest (55.3 days in 2022 and 61.0 days in 2023) in both the years, which was statistically *at par* to VL Bean 2. Significant differences were found in yield among different varieties of french bean and CITH FB 1 gave significantly highest yield. For quality attributes depending on consumer preference, Komal Private gained highest points and ranked as excellent. VL Bean 2 and Pant Amupama scored 4 and ranked as very good. Maximum gross return, net return and B:C was calculated for VL Bean 2.

Key Words: Consumer preference, Economic analysis, Organic conditions, Yield ,Quality.

INTRODUCTION

French bean (*Phaseolus vulgaris*) is an important off season vegetable crop of hills, generally used as cooked vegetable when the pods are tender and green. It is considered as food and nutritional security crop of hill farmers (Noopur *et al*, 2019) French bean is very particular about climate and its seeds do not germinate below 15 ^{0}C and pod setting and filling is hampered in hot or rainy weather. Moreover, it cannot tolerate frost. A mean air temperature of 20 ^{0}C to 25 ^{0}C is very congenial for its growth and high pod yield. Considering these climatic requirements, french bean is sown at different times in different parts of India. In northern plains and central India, it is sown during September to November. However, in hills, the best time of sowing is from March to mid-April. Thus, the crop from hills enjoys the high market price due to off season availability. Moreover, the production of french bean under organic conditions may have the potential of better price realization for the farmers and maintenance of soil health.

Organic farming is a method which primarily aims at cultivating the land and raising crops to keep the soil alive and in good health without adding any synthetically produced chemicals or fertilizers. Generally, for small and marginal farmers of India and particularly of hills, organic farming is most relevant as they are resource poor to provide costly inputs for enhancing yield. The inclusion of legume crops in the cropping sequence has added advantage of fixing atmospheric nitrogen into the soil and make it available for companion or succeeding crops and will also help to sustain organic matter levels and promote good soil tilth (Seaman, 2011). This also helps in protecting soil from soil erosion. Farmers should select the crops which are easy to grow, according to their needs, marketing opportunities and season for the organic farming. French bean is a good leguminous vegetable crop for the organic farming especially in hills, which helps in sustaining the soil fertility, fits well in cropping sequence for its short growth period and also gives good economic yield to fetch good price in the market due to off season availability.

Corresponding Author's Email - pande4kamal@gmail.com

Sr. No.	Quality preference	Marks	Expected Price (Above or Below percentage of average market rates)
1.	Excellent	5	Above 30 %
2.	Very good	4	Above 20 %
3.	Good	3	Average market price
4.	Fair	2	Below 20 %
5.	Poor	1	Below 30 %

Table 1. Duration of flowering and first harvest and yield of different varieties of french bean.

S. No.	Entry	Flowering (50%) duration (Days)			Duration of first harvesting (Days)			Yield (kg/ plot)			Yield (q / ha)		
		2022	2023	Mean	2022	2023	Mean	2022	2023	Mean	2022	2023	Mean
1	CITH FB1	41.3^{b*}	45.3^{b*}	43.3	59.8^{b*}	65.7^{b*}	62.7	5.662^{c*}	5.833^{c*}	5.748	89.87^{c*}	92.59^{c*}	91.23
2	PFB 135	36.5^{a}	39.7^{a}	38.1	55.3^{a}	61.0^{a}	58.2	4.525^{a}	4.733^{a}	4.629	71.83^{a}	75.13^{a}	73.48
3	VL Bean 2	38.0^{a}	40.3^{a}	39.2	56.3^{a}	62.3^{a}	59.3	5.212^{b}	5.323^{b}	5.268	82.73^{b}	84.49^{b}	83.61
4	Arka Suvidha	40.3^{b}	44.3^{b}	42.3	61.2 ^{bc}	66.0^{b}	63.6	5.434^{bc}	5.233^{b}	5.334	86.25^{b}	83.07^{b}	84.66
5	Komal Private	42.4^{bc}	46.3^{c}	44.3	61.4 ^{bc}	67.1^{bc}	64.3	4.681^{a}	4.900^{a}	4.791	74.30^{a}	77.78^{a}	76.04
6	Pant Anupama	43.3^{c}	47.2^{c}	45.3	62.3^{c}	68.5^{c}	65.4	4.532^{a}	4.833^{a}	4.683	71.94^{a}	76.71^{a}	74.33
CD		2.1	1.3	--	1.9	1.5	--	0.378	0.443	--	5.90	7.02	--

*Values within columns having common letter are statistically *at par*.

Table 2. Quality characteristics and expected price based on consumer preference for different varieties of french bean.

Variety	Pod shape, texture and Colour	Photo	Pod Length (cm)		No. of pods per kg		Consumer preference and Marks		Expected Price (Rs./ q)	
			2022	2023	2022	2023	2022	2023	2022	2023
CITH FB1	Flat, slightly curved, rough textured and light green		16.58^{c*}	16.53^{c*}	138^{a*}	143^{a*}	Poor - 1	Poor - 1	2,268.00	2,569.00
PFB 135	Flat, straight, semi-coarse textured and light green		14.75^{b}	14.60b	162^{b}	170^{b}	Good - 3	Good - 3	3,240.00	3,670.00
VL Bean 2	Round, slightly curved, smooth textured and green		14.18^{ab}	14.07^{ab}	198^{c}	196^{c}	Very Good- 4	Very Good- 4	3,888.00	4,404.00
Arka Suvidha	Flat, straight, rough textured and light green		14.58^{b}	14.50^{b}	164^{b}	171^{b}	Fair - 2	Fair - 2	2,592.00	2,936.00
Komal Private	Round, slightly curved, very smooth textured and dark green		13.43^{a}	13.20^{a}	232^{d}	237^{d}	Excellent- 5	Excellent- 5	4,212.00	4,771.00
Pant Anupama	Round, slightly curved, smooth textured and dark green		14.21^{ab}	14.17^{ab}	205^{c}	204^{c}	Very Good- 4	Very Good - 4	3,888.00	4,404.00
CD	--	--	1.10	1.01	14	11	--	--	--	--

*Values within columns having common letter are statistically *at par*.

Table 3. Economic analysis for different varieties of french bean.

Variety	Cost of cultivation (Rs./ ha)			Gross return (Yield x Expected price) (Rs./ ha)			Net return (Rs./ ha)			B: C		
	2022	2023	Average	2022	2023	Average	2022	2023	Average	2022	2023	Average
CITH FB1	98,546	1,04,255	1,01,400	2,03,825	2,37,864	2,20,844	1,05,279	1,33,609	1,19,444	2.07	2.28	2.18
PFB 135	97,638	1,03,642	1,00,640	2,32,729	2,75,727	2,54,228	1,35,091	1,72,085	1,53,588	2.38	2.66	2.53
VL Bean 2	1,12,765	1,20,354	1,16,559	3,21,654	3,72,094	3,46,874	2,08,889	2,51,740	2,30,315	2.85	3.09	2.98
Arka Suvidha	98,105	1,00,396	99,250	2,23,560	2,43,894	2,33,727	1,25,455	1,43,498	1,34,476	2.28	2.43	2.35
Komal Private	1,23,452	1,32,387	1,40,419	3,12,952	3,71,088	3,42,020	1,89,500	2,38,701	2,01,600	2.54	2.80	2.44
Pant Anupama	1,05,468	1,12,432	1,08,950	2,79,703	3,37,831	3,08,767	1,74,235	2,25,399	1,99,817	2.65	3.00	2.83

However, the studies on performance of different french bean varieties under organic conditions of hills including consumer preference and economic analysis was required.

MATERIAL AND METHODS

Krishi Vigyan Kendra (ICAR-VPKAS), Kafligair- Bageshwar is situated in the mid Himalayas between 29º45'07" N latitude and 79º44'03" E longitude at an altitude of 1245 meters above the mean sea level and represents humid sub- temperate climate with average annual rainfall of 1256 mm.

The experiment was conducted during spring- summer of 2022 and 2023, which is most suitable season for the growth, yield and marketing of french bean in hills. Six french bean varieties namely CITH- FB-1, PFB- 135, VL Bean- 2, Arka Suvidha, Komal Private and Pant Anupama with 3 replications were assessed in Randomized Block Design (RBD). The sowing was done during third week of March in both the years. The selected field had not received any chemical or synthesized fertilizer for last 5 years. The preceding crop was mustard and the succeeding crop was buckwheat. Well rotten compost was applied @ 25 t/ ha during ploughing.

Seed treatment of all the varieties was done with *Trichoderma harzianum*@ 10 g/ kg seed and regular prophylactic sprays of *Neem* oil (2 ml/L) at 15 days interval were also applied equally. The sowing geometry was 45 cm x 10 cm and the plot size was 3.15 m x 2.00 m (6.30 m^2). All the intercultural operations including weeding and hoeing were similar for all the plots.

Observations for flowering and harvesting duration, yield attributes and marketing related quality characteristics including pod shape, pod length and number of pods per kg were recorded and analysed statistically. Consumer preference along with expected price and economic analysis were also documented. For consumer preference and expected price a panel of ten-woman judges ranked the overall acceptability of pods on five-point scale and according the expected price was assigned depending on prevailing average market rates, which was as follows;

RESULTS AND DISCUSSION

Flowering duration and yield

The data (Table 1) clearly showed that PFB 135 was the first to flower 50 percent (36.5 days in 2022 and 39.4 days in 2023) and gave first harvest (55.3 days in 2022 and 61.0 days in 2023) in both the years, which was statistically *at par* to VL Bean 2. Pant Anupama came last at 50 percent flowering (43.3 days 2022 and 47.2 days in 2023) and fruiting (62.3 days in 2022 and 68.5 days in 2023) and was statistically *at par* to Komal Private. VL Bean 2 has also been documented as early maturity variety by Joshi *et al* (2019). Das *et al* (2014) has also observed significant differences in flowering and harvesting duration for various french bean varieties.

Significant differences were found in yield among different varieties of french bean. CITH FB 1 gave significantly highest yield of 89.87 q/ ha and 92.59 q/ha in 2022 and 2023, respectively. It was followed by Arka Suvidha that remained statistically at par to VL Bean 2, while the lowest yield was recorded for PFB 135 that was statistically non-significant to Komal Private and Pant Anupama. Rana and Kumar (2008), Muthuramu *et al* (2015), Pachiappan *et al* (2020), Noopur *et al* (2021) and Kumar A (2022) have also reported differences in yield attributes of various french bean varieties.

Quality characteristics

Quality is the most important parameter

that decides the value of vegetables, especially of french bean. Size, shape, texture and colour are the major factors that plays significant role in valuing the price of french bean. Wide range of price differentiation has been observed in market for french bean. The data (Table 2) showed that the assessed varieties had great quality differences. This eventually influenced the consumer preference and accordingly the expected price was assigned depending on average market price. CITH FB 1 scored least during both the years and ranked poor due to its flat shape, rough texture and light green colour. It was also having maximum pod length (16.58 cm and 16.53 cm in 2022 and 2023, respectively) and minimum number of pods per kg (138 in 2022 and 143 in 2023). Komal Private gained highest points and ranked as excellent. VL Bean 2 and Pant Amupama scored 4 and ranked as very good. Arka Suvidha was good and average market price was assigned to it and accordingly expected price for other varieties were calculated. Komal Private was awarded with highest price of Rs. 4,212.00/ q and Rs. 4,771.00/ q for the year 2022 and 2023, followed by VL Bean 2 and Pant Anupama (Rs. 3,888.00/ q in 2022 and Rs. 4404.00/ q in 2023). While, CITH FB 1 received the least expected price of Rs. 2,268.00/ q in 2022 and Rs. 2,569.00/ q in 2023.

Economic analysis

Economic analysis is the culminative stage to find out the suitability and applicability of tested treatments. It was found that cost of cultivation was highest for Komal Private (Rs. 123452/ ha in 2022 and Rs. 132387/ ha in 2023) followed by PFB 135, Arka Suvidha, Pant Anupama, VL Bean 2, whereas, it was lowest for CITH FB 1 (Rs. 98,546/ ha in 2022 and 1,04,255/ ha in 2023). This disparity was primarily due to differences of seed price. Seed of french bean was available at wide price range. Moreover, the seed rate of french bean was also high (75 kg/ ha), that create great difference in cost of cultivation. Second important factor was the care of harvesting and packaging. Smooth textured varieties are harvested more carefully that require more time and packaged delicately.

Not only yield but price depending on quality and consumer preference also played the major role for fetching the gross returns. Maximum gross return, net return and B:C was calculated for VL Bean 2. The average gross return was Rs. 3,72,094/ ha, net return was Rs. 2,30,315/ ha and B:C was 2.98 for VL Bean 2. Though, Komal Private gave higher average net return of Rs. 2,38,701.38 per ha than Pant Anupama, its average B:C (2.44) was less than Pant Anumapa (2.83). CITH FB 1 remained least profitable with average net return of Rs.1,19444/ ha and its B:C was 2.18. Muthuramu *et al* (2015) and Pachiappan *et al* (2020) also recorded differences among various french bean varieties.

CONCLUSION

The present study opened new vistas for assessing the french bean varieties and signified the quality over yield. The performance of food commodities in general and vegetables and fruits in particular, need to be analysed in a holistic way. This should encompass yield, quality and economic analysis. Though, CITH FB 1 significantly over passed all other varieties for yield, it could not perform up to the mark on quality parameters, hence the net return and B:C was lowest. However, Komal Private ranked excellent in terms of quality, its cost of cultivation and yield did not support it to become the top most choice among the assessed varieties. VL Bean 2 showed very good balance of yield, quality and cost of cultivation and gave highest profitability under organic production conditions of hills.

REFERENCES

Das R, Thapa U, Debnath S, Lyngdoh Y A and Mallick D (2014). Evaluation of French bean (*Phaseolus vulgaris* L.) genotypes for seed production. *J Appl Nat Sci* **6** (2): 594 – 598.

Joshi K, Pattanayak A, Jethi R and Stanley J (2019). Inventory of ICAR VPKAS Technologies: 95 Years of Science & Technology for Hill Regions of India. Pp xii+135

Kumar A (2022). Assessment of French bean (Phaseolus vulgaris L.) Genotypes for Yield Traits. *J Krishi Vigyan* **11** (1): 1-6

Muthuramu S, Paulpandi V K, Ramakrishna K and Karthnik R (2015). Assessing the performance of french bean (*Phaseolus vulgaris* L.) in district Virudhunagar of Tamil Nadu. *J Krishi Vigyan* **3** (2): 5-7

Noopur K, Babu S and Somasundram E (2021). On-farm assessment of french bean (*Phaseolus vulgaris* L.) cultivars for seed production in Nilgiri hills of *Tamil Nadu. Indian J Hill Farming* **34** (1): 158-161.

Noopur K, Samnotra R K, Jawaharlal M and Jha A (2019). French bean for food and nutritional security in Nilgiri Hills District of Tamil Nadu. In Souvenir of 3rd Global Meet on Science and Technology for ensuring food and nutritional security, held at NRC on Seed Spices Ajmer during 1-3 Dec, 2019. PP 107-08.

Pachiappan P, Alageson P, Saravankumar S, Srinivasan R D, and Vinothraj S (2020). Farmer participatory evaluation of french bean in Western Ghats of Erode district, Tamil Nadu. *Indian J Farm Sci* **10** (3&4): 65-67.

Rana D K and Kumar A (2008). Performance of various french bean (*Phaseolus vulgaris* L.) genotypes under mid- hill condition of Garwal Himalaya. *Prog Hort* **40** (2): 184-186

Seaman A (2011). Production Guide for Organic Snap Beans for Processing. NYSIPM Publication No.132, 2, pp 42.

Received on 9/4/20204 Accepted on 15/5/2024

DOI : 10.5958/2349-4433.2024.00079.3

J Krishi Vigyan 2024, 12(2) : 451-453

Short Communication

Successful treatment of Hydrallantois in a Crossbred Jersey Cow - A Case Report

B Srilatha[1], K Prabhakar Rao[2], M S S V Phaneendra[3] and G S Haritha[4]

Dept of Veterinary Gynaecology and Obstetrics, College of Veterinary Science, Garividi, Vizianagaram

ABSTRACT

Hydrallantois is a substantial agglomeration of fluid in the allantioc sac. It accounts for about 85-90% of the dropsical condition, which shows detrimental effect on bovine foetus and its membrane. Hydrallantois or hydropsy allantois is a sporadic pregnancy disorder reported in dairy animals. It is defined as severe and extensive edema of the fetal membrane, and incidence is noticed mainly in cattle, but sparsely spotted in sheep, pigs and carnivores. A case of such hydrallantois was presented with rounded abdominal distension for the past 5 days, for which the pregnancy termination was advocated using hormones, corticosteroids and fluid therapy. Furthermore, a complete recovery of the cow was noticed without any untoward consequences.

Key Words: Abdominal Distension, Allantoic Fluid, Corticosteroids Hydrallantois, , Placentomes.

INTRODUCTION

Hydrallantois is conventionally regarded as the maternal abnormality, where swift and unusual enlargement of abdomen occurs (Drivers and Peek, 2008) due to accumulation of watery, amber color fluid inside the allantoic cavity for 5 to 20 days in the late trimester, which invariably indicate twin/triplet pregnancy. In dairy cattle, hydrallantois to a greater extent is frequent in terminal phase of third trimester and not so much in buffaloes and heifers (Srinivas and Sreenu, 2006). It is over and over associated with either infectious disease or developmental imperfections of fetus (Kumar *et al,* 2019). It is customarily combined with a diseased uterus, where greater number of caruncles in one uterine horn were non-functional and further reduced in size. The remaining placentomes has become larger in size, inflamed and perhaps defective, which out-turn in the genesis of adventitious placenta (Drost, 2007). The steady and incessant removal of allantoic fluid might be a possible technique to keep away from shock to the animal (Noakes *et al,* 2009). Hydrallantois is one of the gestational disorderliness, that sequel because of production surge of a fluid that bear a resemblance to blood plasma within the allantoic sac (Kapadiya *et al,* 2018). The present case exhibited the successful gynaecological management of hydrallantois in a crossbred jersey cow.

CASE HISTORY AND OBSERVATIONS

A 7th month pregnant crossbred jersey cow, which was aged 5years and is in its 2nd parity was presented to the department of Veterinary Gynaecology and Obstetrics, College of Veterinary Science, Garividi one month ago with a complaint of bilateral abdominal distension (Fig. 1) coupled with decreased appetite for 5days. On clinical examination, the abdominal distension was rounded as well as the entire vital parameters were within the standard range. On per rectal palpation, enlarged and fluid filled uterus and unable to palpate the fetus and the placentomes. The fluid filled uterus inhabited the complete abdominal and pelvic cavity. Per Vaginal examination divulged the closed external os of cervix. Hematological and biochemical

Corresponding Author's Email - srilatha.vety@gmail.com

1.Assistant professor, Department of Veterinary Gynaecology & Obstetrics, College of Veterinary Science, Garividi, Vizianagaram

2.Assistant professor & Head, Department of Veterinary Gynaecology & Obstetrics, College of Veterinary Science, Garividi, Vizianagaram

3.Assistant professor (on deputation), Department of Veterinary Surgery & Radiology, College of Veterinary Science, Garividi, Vizianagaram

4.Assistant professor, Department of Veterinary Clinical Complex, College of Veterinary Science, Garividi, Vizianagaram

Fig 1: Bilateral abdominal distension

Fig 2: Dead male foetus

parameters were within the accustomed scale, except for the mild anemia. Taking the history, per rectal and per vaginal findings into consideration, it was pronounced as a case of hydrallantois and decided to terminate the pregnancy.

TREATMENT AND DISCUSSION

Pregnancy termination with the aid of hormonal drugs and corticosteroids was done. In the first instance, Inj. Cloprostenol sodium (Pragma® 500µg) and Inj. Dexamethasone sodium phosphate (Dexona ® 40mg) were administered intramuscularly along with intravenous fluid therapy (3 litres of Dextrose normal saline). There was gushing of watery, amber colored fluid succeeding 48 hours of initial treatment, followed by a slight traction to relieve the fetus, which was identified as a dead male fetus (Fig. 2). The animal was post-operatively kept on antibiotics, analgesics and fluid therapy for 5 days, which facilitated an uneventful recovery.

In the early stage of case admission, the cow was not gravely distressed with hydrallantois and was capable enough to walk. For this reason, it was decided for induction of parturition. Hydrallantois manoeuvring pivot on time span and gravity of the condition (Rangasamy *et al,* 2013). Superfluous allantoic fluid buildup in hydroallantois context conclude in acute abdominal distension and at time with deterioration of condition, which might upshot in fatal recumbency of the dam (Noakes *et al,* 2009). The practicable differentials of hydrallantois are hydramnios, intestinal obstruction, ascites, bladder rupture, tumor like abdominal growths, abscess or fat necrosis, bloat, substantial ventral dropsy, hydrometra and existence of more than one foetus. Traditional medical attention necessitates pregnancy termination utilizing prostaglandin $F_2\alpha$ and corticosteroids (Manokaran *et al,* 2011), which was employed in the current case. In general, subsidiary fluid therapy is highly imperative with gentle and uninterrupted evacuation of the immoderate allantoic fluid to abstain from hypovolemic shock, which might be attributed to instantaneous expulsion of allantoic fluid during the pregnancy termination procedure (Kumar *et al,* 2012). Miscellaneous protocols were put to use for inducing parturition in cattle diagnosed as hydrallantois involves the usage of natural or industrially manufactured synthetic prostaglandin $F_2\alpha$ (Manokaran *et al,* 2011) or sole administration of estrogen hormones (Peiro *et al,* 2007). The major sequelae of hydrallantois

condition is observed to be retention of placenta, which puts the dam at risk of metritis, with long-drawn-out recuperation and impeded conception rate (Noakes *et al,* 2019), but no such issues were noticed in the present case.

CONCLUSION

The contemporary case of a cow with hydropsy allantois was fruitfully dealt with therapeutic termination of pregnancy with the help of hormones like prostaglandins ($PGF_2\alpha$) and corticosteroids like dexamethasone. In this case, the cause for hydrallantois was highly attributed to defective placenta. Prompt intervention and medicaments facilitated uneventful recovery of the dam.

REFERENCES

Drivers T J and Peek S (2008). *Rebhun's diseases of dairy cattle*.2nd Edn., Saunders Elsevier, St. Louis, Missouri. p. 395.

Drost M (2007). Complications during gestation in the cow. *Theriogenology*, **68**: 487.

Kapadiya P S, Parikh S S, Chauhan P M, Sutaria T V and Nakhasi H C (2018). Management of hydroallantois in a Jaffrabadi buffalo: A case report. *J Pharmacog and Phytochem* **1**: 1534-1536.

Kumar A, Singh G, Arjun V, Hariom, Jain V K and Chandolia R K (2019). Dystocia Due to Hydroallantois and Congenital Foetal Ascites in a Murrah Buffalo - A Case Report. *Vet Res Int* **7** (4): 204-206.

Manokaran S, Ravikumar K, Ezakial Napolean R, Palanisamy M and Selvaraju M (2011).Hydrallantois in a non-descript buffalo: A case report. *The Indian J Field Veterinarians* **7**: 69.

Noakes D E, Parkinson T J and England G C W (2009). *Veterinary Reproduction and Obstetrics*. 9th Eds., *Saunders Elsevier*, China. pp: 141-142.

Noakes D E, Parkinson T J, England G C W (2019). *Veterinary Reproduction and Obstetrics*. 10th Eds., Saunders Elsevier, China, 191-192.

Peiro J R, Borges A S, Yanaka R, Koivisto M B, Mendes L C N, Feitosa F L F, Abujamra J O and Rodrigues C A (2007). Hydrallantois in an ewe (Case report). *Ars Veterinaria* **23**: 116 -119.

Rangasamy S, Rajasundaram R C, Sathiamoorthy T and Sarath T (2013). Management of hydroallantois in a non-descript cow. *Indian J Anim Repro* **34**(2), 52-53.

Srinivas M and Makkena S (2006). Hydroallantois with foetal ascites in a buffalo. *Indian Vet J* **83**(12):1342-1343.

DOI : 10.5958/2349-4433.2024.00080.4

J Krishi Vigyan 2024, 12(2) : 454-457

Short Communication

Yield performance of oyster mushroom in different substrate under cold arid conditions of Kargil Ladakh

Nassreen F. Kacho[1], Nazir Hussain[1], Mohd Hussain[2], Mansoor Hussain[1] and Rinchen Dolker[1]

Krishi Vigyan Kendra, Kargil-I, SKUAST-K 194103

ABSTRACT

In response to the reluctance to cultivate oyster mushrooms in Ladakh due to the high cost of wheat/barley straw, a study was undertaken to explore the feasibility of cultivating oyster mushrooms using a combination of straw and leaves. The objective was to evaluate the performance of mushroom yields and associated parameters, thereby underscoring the significance of mushrooms in the region. The study was carried out at three selected mushroom growers' sites as part of an On-farm trial. The substrate quality of two distinct materials, namely willow leaves and wheat straw, as well as a combination of both (wheat straw + willow leaves in a 1:1 ratio) were evaluated for cultivating oyster mushrooms. The cultivated mushrooms were harvested in three flushes, with the yield data revealing that the highest fresh weight yield was achieved from wheat straw (315g, 327g, 359 g from different locations). Contrary to this, a combination of wheat straw and willow leaves (1:1 ratio) produced slightly lower yields (299g, 300g, 302g) and the lowest yields were obtained from willow leaves alone (249 g, 273g, 281g). In this study it was found that on willow leaves the yield was low but it was economically feasible as it is the cheapest substrate to grow oyster mushroom.

Key Words: Cold arid, Leaves, Mushroom,Wheat straw,Willow.

INTRODUCTION

Mushrooms have been recognized for their role as a vital food source, both nutritionally and medicinally, making them a prominent component of modern diets. In comparison to other foods like beef, wheat, and potatoes, mushrooms stand out with protein content ranging from 4-44%, surpassing proteins found in beef (16%) and wheat (1%). Moreover, mushrooms serve as an excellent source of essential vitamins such as niacin, riboflavin, and vitamin C. They also contain folic acid, a crucial vitamin for blood-building, countering pernicious anemia (Oei, 2003; Effiong *et al,* 2024). Mushrooms flourish during the rainy season on manure heaps and dump sites with an abundance of humus. Cultivating mushrooms locally requires meeting specific growth conditions, including adequate food and humidity.

Utilizing agricultural and industrial wastes as substrates involves processes such as boiling, pasteurization, and fermentation. Various studies have explored substrates like straw, paper, sawdust, logs, rice straw, and wheat straw for mushroom cultivation, each showing varying yields and growth characteristics (Kurtzman, 1975; Park *et al,* 1975; Khan *et al,* 1981; Khan and Ali, 1981; Mathew *et al*, 1996; Jiskani, 1999; Agba *et al,* 2021; Argaw *et al* ,2023). Given the hesitation of oyster mushrooms cultivation in Ladakh due to high cost of wheat/barley straw, a study was conducted to cultivate oyster mushrooms on straw and leaves.

MATERIAL AND METHODS

Study area and experimental materials

The study was conducted at three interested mushroom growers. The substrate

Corresponding Author's Email - ftmkacho898@gmail.com

1, KVK, Kargil-I, SKUAST-K 194103

2, Department of Zoology, University of Ladakh, Leh Ladakh

quality of two different substrates namely, willow leaves, wheat straw, and wheat straw + willow leaves(1:1) were evaluated for growing oyster mushroom. Willow leaves was collected from the KVK, farm, wheat straw purchased from Department of Agriculture.

Pure culture preparation and production conditions

Mushroom culture was grown on Potato Dextrose Agar (PDA) medium for 7 d. 33 mg of PDA mixed with 1L of distilled water. Test tubes were corked, sterilized (at 121 °C, 1.5 p.s.i, for 30 min) and allowed to solidify in a slant position. To obtain pure culture, a piece (4 mm × 4 mm) of fleshy tissue (of the original *Pleurotus ostreatus* culture) was aseptically transferred to individual PDA slants under UV fitted inoculation chamber. The cultures were incubated at 25 °C until sufficient mycelial growth is observed and pure cultures were obtained by sub-culturing in PDA. The slant culture was transferred to petri-plates and incubated at 25 °C for 7 days. Once the mycelium fully invaded the agar medium, the culture was used for spawn preparation.

Grain spawn preparation

Wheat (*Triticum avestivum*) grain was used for spawn preparation. For this purpose, about 5 kg of grain was half-cooked,excess water drained off and allowed to cool down to room temperature. It was then spread uniformly over a surface sterilized (70 % ethanol) plastic sheet until optimum moisture (55–60%) is attained. The grain was then mixed with 0.5 % chalk (calcium carbonate), and 2 % gypsum (calcium sulfate) as nutrient supplement and the pH was adjusted to 9 (Romero, 2007). The mixture was then filled into 1kg autoclavable polythene bag, plugged and sterilized in an autoclave (at 121 °C, 15 p.s.i, for 1 h).Sterilized polythene were then allowed to cool and aseptically inoculated with a piece (5 mm × 5 mm) of mycelia culture (14 days old). The polythene bag were subsequently incubated at 24 ± 3 °C for 14 d until the mycelia fully invade the grains. After 15 d, the grain spawn was ready to use.

Substrate processing and spawning

The substrates underwent a ten-day sun-drying process, during which their air dry weight changes were meticulously monitored by daily weighing over a consecutive five-days period. Following this, one kilogram of air-dried substrate was placed into individual polypropylene bags (55 cm × 50 cm). Each bag was securely tied at the opening and immersed in distilled and sterilized tap water overnight. After soaking, excess water was drained, and the substrates were exposed to full sunlight, with periodic weighing continuing until the moisture content reached 65–70% (Islam *et al,* 2014). Once the desired moisture level was achieved, the substrates were sterilized in an autoclave and allowed to cool to room temperature over several hours. Subsequently, these sterilized substrates, enclosed in separate bags, were transferred to polythene bags (65 cm in length and 45 cm in width) that had undergone surface sterilization. Each bag, containing 1 kg of substrate, was then inoculated with 80 g of spawn. Aseptic conditions were maintained throughout the process, ensuring the uniform distribution of the inoculum thorough mixing of spawn and substrates. To facilitate cross-sectional ventilation, 6–8 holes were punctured on the sides of each plastic bag. In total, eight polythene bags for each substrate type were inoculated with spawn, and the entire experiment was conducted.

Cultivation conditions and cropping system

Once mycelia growth within the bags reached a substantial level, and pinheads began to emerge, sections of the bags were selectively cut to create perforations, facilitating the development of fruiting bodies. Subsequently, the fully colonized substrates were transferred to a growth room and positioned on racks constructed from wood and nylon rope, with a spacing of 15–20 cm between each bag. Adequate ventilation in the growth room was ensured by periodically opening the door every 2–3 days.

To maintain the required moisture levels for mycelia growth, the inoculated bags were watered 2–3 times daily. Monitoring and control of relative

Table1. Yield of *Pleorotus ostreatus (g)* on different substrate at different locations.

Sr. No.	Location	Wheat straw	Wheat straw +Willow leaves	Willow leaves
1.	Wakha	315	299	249
2.	Titichumik	327	300	273
3.	KVK, Kargil-I	359	302	281

Table 2. Effect of substrates on yield and biological efficiency per flush.

		Yield (g)			Biological efficiency (%)		
Sr. No.	Treatment	F_1	F_2	F_3	F_1	F_2	F_3
1.	Wheat straw (T_1)	123.67	119.33	115.67	12.36	11.93	11.56
2.	Wheat straw +Willow leaves(T_2)	103.03	100.20	99.11	10.30	10.02	9.91
3.	Willow leaves (T_3)	97.33	93.33	90.67	9.73	9.33	9.06

humidity (RH) and room temperature were conducted using a thermo-hygrometer. The RH was consistently maintained between 60 and 65% by occasionally spraying a fine mist of water. This meticulous environmental control aimed to create optimal conditions for the successful cultivation of fruiting bodies. The treatments were $T_{1=}$Wheat Straw, $T_{2=}$ Wheat Straw+ Willow Leaves (1:1) and $T_{3=}$Willow Leaves.

Harvesting and Cropping of Mushroom

Mature mushrooms were carefully harvested by hand to avoid any damage to the substrates. The total yield of mushrooms was determined by measuring the combined weight of all harvested fruiting bodies from each flush. Furthermore, the biological efficiency (B.E.) was calculated in accordance with the method (Familoni *et al*, 2018). The *Pleorotus ostreatus* were grown at different area of the district *viz.,* Wakha, Titichumik and KVK, Kargil-I, in triplicates and data were recorded periodically for three flush (1^{st}F, 2^{nd}F and 3^{rd}F).

RESULTS AND DISSCUSSION

The cultivated mushroom were harvested in 3 flushes and the yield data of fresh mushroom revealed that the maximum yield on fresh weight basis was obtained from wheat straw (315g, 327g, 359 g from different location), followed by wheat straw + willow leaves (1:1) (299g, 300g, 302g) and least was obtained willow leaves (249 g, 273g, 281g), almost same result was observed by Agraw *et al* (2023), Shah and Ashraf (2004) on waste leaves. Getachew and Chawaka (2019) found that wheat was the best straw to grow oyster mushroom but in Ladakh due to scarcity and high cost of straw it was not possible to grow on wheat /barley straw, so this study was conducted and found that on willow leaves the yield was low but was economically feasible as it is the cheapest substrate to grow oyster mushroom.

CONCLUSION

The study concluded that wheat straw was the effective substrate for cultivating oyster mushrooms, producing the highest fresh weight yields. A mixture of wheat straw and willow leaves (1:1) also performed well. Although wheat straw is the best substrate for oyster mushroom cultivation, its scarcity and high cost in Ladakh make it an impractical choice. Consequently, while willow leaves resulted in lower yields, they were identified as the most economically viable substrate for oyster mushroom cultivation in the region due to their availability and low cost.

REFERENCES

Agba M O, Markson A A and Oni J O (2021). Growth and yield impact of oyster mushroom *Pleurotus ostreatus* (Jacq P. Kumm) cultivated on diferent agricultural wastes. *J Biosci and Agri Res* **27** (1): 2225–2233.

Argaw B, Tesfay T, Godifey T and Asres N (2023). Growth and yield performance of oyster mushroom (P. ostreatus (Jacq.: Fr.) Kummer) using waste leaves and sawdust. *Hindawi Int J Agrony* **2023** , Article ID 8013491, 7 pages https://doi.org/10.1155/2023/8013491

Effiong M E, Umeokwochi C P, Afolabi I S and Chinedu S N (2024). Assessing, the nutritional quality of *Pleurotus ostreatus* (oyster mushroom). *Front in Nutri* **10**:2023. https://doi.org/10.3389/fnut.2023.1279208

Familoni T V, Ogidi C O, Akinyele B J and Onifade A K (2018). Evaluation of yield, biological efficiency and proximate composition of *Pleurotus* species cultivated on different wood dusts. *Czech Mycology* **70**(1): 33-45.

Getachew A, Keneni A and Chawaka M (2019). Production of oyster mushroom (*Pleurotus ostreatus*) on substrate composed from wheat straw, waste paper and cotton seed waste. *Int J Microbiol and Biotechnol* **4**(2): 38-44. https://doi.org/10.1155/2023/8013491

Jiskani M M, Pathan M A and Wagan K H (1999). Yield performance of oyster mushroom *Pleurotus florida* (strain PK, 401) on different substrates. *Pakistan J Agric Engg and Vety Sci* **15**: 26-9.

Khan S M and Ali M A (1981). Cultivation of oyster mushroom (*Pleurotus* spp.) on cotton boll locules. *In Proceedings of the Eleventh International Scientific Congress on the Cultivation of Edible Fungi, Australia, 1981/edited by NG Nair, AD Clift*.

Khan S M Kausar A G and Ali M A (1981). Yield performance of different strains of oyster mushrooms (*Pleurotus* spp.) on paddy straw in Pakistan. *In Proceedings of the Eleventh International Scientific Congress on the Cultivation of Edible Fungi, Australia, 1981/edited by NG Nair, AD Clift.*

Kurtzman Jr R H (1975). Summary of mushroom culture. *In Proceedings of seminar on mushroom research and production ARC, Printing Corporation of Pakistan Press, Karachi pp. 23-42*.

Mathew A V, Mathai G and Suharban M (1996). Performance evaluation of five species of *Pleurtotus* (Oyster Mushroom) in Kerala. *Mush Res* **5**: 9-12.

Oei P (2003). Mushroom cultivation, appropriate technology for mushroom growers. *Backhugs Publishers, Leiden. The Netherlands*

Park Y H, Go S J and Kim D S (1975). Studies on cultivation of oyster mushroom (*P. ostreatus*) using rice straw as substrate. *Research report of the office of Rural Development, Soil Science, Fertilizer, Plant Protection and Mycology* 17: 103-7.

Shah Z S and Ashraf M A (2004). Comparative study on cultivation and yield performance of oyster mushroom (*Pleurotus ostreatus*) on diferent substrates (wheat straw, leaves, sawdust). *Pakistan J Nutri* **3**(3):158–160.

Waqar Islam A R Zaynab M and Wu Z (2016). Efcacy ofdiferent weeds and agricultural substrates for cultivation of *Pleurotus ostreatus* (JACQ. FR.). *Asian J Agri Biol* **4**(4): 108–113.

Received on 25/4/2024 Accepted on 27/5/2024

J Krishi Vigyan 2024, 12(1) : 1-209

TABLE OF CONTENTS