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Anaplasmosis in Buffaloes - Clinico- Pathology and Therapeutic Management

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ABSTRACT

Anaplasma marginale infection was diagnosed in three Murrah she buffaloes by microscopic examination of blood smears. All three animals showed the clinical symptoms of high temperature, inappetence, weakness, reduced milk yield, pale mucous membranes, and labored breathing. Microscopic examination of dung samples did not reveal the presence of ova/cysts/oocysts of any parasite. Haematological studies revealed decreased haemoglobin levels, total erythrocyte count, packed cell volume and mean corpuscular haemoglobin concentration and an increase in mean corpuscular volume. The animals were treated with a combination of Imidocarb dipropionate and Oxytetracycline along with antipyretics and anti-inflammatory agents, haematinics, B - complex and liver extracts. Clinical symptoms reduced from 2nd day onwards and complete recovery was observed around 15 days post-treatment.

Key Words: *Anaplasma marginale*, Buffaloes, Imidocarb dipropionate and Oxytetracycline.

INTRODUCTION

Anaplasma marginale is an obligate intra-erythrocytic gram-negative rickettsial organism belonging to family Anaplasmataceae of the order Rickettsiales and is responsible for severe disease in cattle but the infection also occurs in zebu buffalo, bison and African antelopes (Kocan *et al*, 2010). Anaplasmosis is endemic in the tropics and subtropics and causes significant economic losses. The disease is also known as gall sickness or yellow bag disease. Even though about 20 species of ticks were identified as vectors, *Rhipicephalus microplus* is considered as the major biological vector (Aubry and Geale, 2011). Mechanical transmission occurs by injecting infested RBCs by biting flies or by contaminated fomites. Cattle husbandry practices such as dehorning, castration, vaccination and blood sampling, etc. also responsible for mechanical transmission (Vatsya *et al*, 2013).

Infection is characterized by progressive hemolytic anemia associated with reduced milk production, abortion, hyperexcitability, dullness or depression, rapid deterioration of the physical condition, brownish urine, loss of appetite, muscle tremors, constipation, pale mucous membranes and laboured breathing (Brahma *et al*, 2018). Recovered

animals may act as carriers for life and are responsible for the transmission to other susceptible animals (Gurjar *et al*, 2019). Though cattle are the principle host, clinical cases of anaplasmosis in buffaloes have also been reported in different states of India like Punjab (Ashuma *et al*, 2013), Uttarakhand (Vatsya *et al*, 2013) and Telangana (Namratha and Ramesh, 2020). The present paper reports the clinical pathology of anaplasmosis in buffaloes in Andhra Pradesh and its therapeutic management.

MATERIALS AND METHODS

Blood and fecal samples of three buffaloes with around 2 to 3 lactations were brought to the Animal Disease Diagnostic Laboratory, Eluru, West Godavari District, Andhra Pradesh with a history of pyrexia 104^o F, 103.8^oF and 105^oF respectively. Other clinical symptoms were inappetence, weakness, diarrhoea, reduced milk yield and pale mucous membranes. Dung samples received were examined by both direct smear and sedimentation methods for parasitological infection (Soulsby, 1982). Blood samples were received in EDTA containing vacutainers. Microscopic examinations of wet blood films are done under 10X and 40 X magnifications. Thin blood smears

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are made, air-dried and stained with Geimsa satin after methanol fixation. The stained smears were examined microscopically under 100X magnification. Hematological parameters (Hemoglobin, Packed cell volume (PCV), Total Red blood cell count (RBC), White blood cell count (WBC), Mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH), Mean corpuscular hemoglobin concentration (MCHC) & Platelet count) were taken on 0 days, 7th days and on 15th day using fully automatic hematology analyzer PE6800Vet.

TREATMENT

The animals were treated with Imidocarb dipropionate (Babimido, Zydus AHL) @ 3 mg/Kg BW as a single dose intramuscularly (IM), followed by Oxytetracyclin -10 mg/Kg BW for 3 days IM along with antipyretics Flunixin meglumine 2.2 mg/Kg (Megludyn, Virbac Pharma) BID for 3 days IM, haematinic preparations Iron sorbital -10 mg/Kg (Ferritas, Intas pharma) as single injection IM followed by oral haematinics (3D Red, Intas pharma) @ 50mL per day for 10 days orally, and B- complex and liver extracts (Rumrec, Virbac pharma) 10mL for 5 days IM.

RESULTS AND DISCUSSION

Fever, anemia, anorexia weakness and pale mucous membranes reported in the present study were in agreement with Vatsya *et al* (2013). Fecal samples examined were found to be devoid of any parasitic ova/ cysts/ larvae. No haemoparasites could be detected on wet blood film examination. Geimsa stained thin blood smear from all three animals revealed the presence of intra-erythrocytic dot forms of *Anaplasma marginale* organisms at the margin of stained RBCs (Fig. 1). Although nuclear-based molecular techniques are required for the diagnosis and confirmation of subclinical anaplasmosis, conventional microscopic examination like Giemsa stained thin blood smear examination is the gold standard test for the diagnosis of clinical cases of anaplasmosis (Sahukat *et al*, 2019). Hematological studies (Table 1) revealed anemia with a decrease in hemoglobin, RBC count, and PCV which is in accordance with the findings of Brahma *et al* (2018) and Vatsya *et al* (2013). Phagocytosis of the

infected RBCs by activated macrophages and removal of destroyed cells by the reticuloendothelial system causes reduced RBC count (Ashuman *et al*, 2013). Indiscriminate destruction of infected and non-infected erythrocytes occurs due to antibodies produced against infected RBCs leads to immune-mediated autolysis. An increase in MCV and decrease in MCHC indicates macrocytic hypochromic regenerative anemia which in turn indicates the release of immature RBCs by the bonemarrow to meet the demand for RBCs due to the rapid destruction of RBCs (Sahukat *et al*, 2019). Clinical signs started to subside from 2nd day onwards. Improvement in blood parameters was observed on the 7th day and complete recovery of the animals was observed after 15 days of treatment. Similar trends in hematological changes were observed in *Anaplasma* infected cow by Brahma *et al* (2018) and in buffalo by Vatsya *et al* (2013). In the present study, the infected animals were treated with the combination of Imidocarb dipropionate and oxytetracyclin. Higher doses of Oxytetracycline were found to be effective by Brahma *et al* (2018) and Sharma *et al* (2020). Akhtar *et al* (2010) successfully treated *Anaplasma* infected animals with single dose and carrier state animals with two doses of imidocarb dipropionate at the dose rate of 3 mg/kg b.wt. A combination of imidocarb dipropionate and Oxytetracycline was found to be more effective against anaplasmosis by Sahukat *et al* (2019) and Gurjar *et al* (2019).

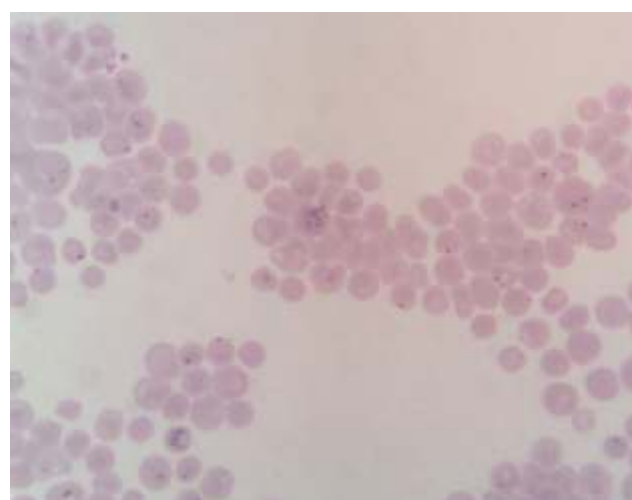


Fig.1. Blood smear showing the intraerythrocytic *Anaplasma marginale* organism at the margin of RBCs (100X)

Anaplasmosis in Buffaloes - Clinico- Pathology and Therapeutic Management

Table 1: Haematological changes due to anaplasmosis in buffaloes

Sr. No	Parameter	0 day	7 th day	15 th day	Reference values
1.	Hemoglobin g/dL	4.3 ± 0.65	7.4 ± 0.68	11.06 ± 0.9	8 – 15.0
2.	PCV %	15.1 ± 1.8	26.9 ± 5.4	36 ± 3.5	25 – 35
3.	RBC 10 ⁶ /μL	2.02 ± 0.59	4.2 ± 0.5	5.55 ± 0.34	5 – 10
4.	WBC 10 ³ / μL	4.8 ± 2.8	8 ± 1.65	10.7 ± 1.45	4 – 12
5.	MCV fL	77.4 ± 12.5	62.8 ± 5.9	60.7 ± 4.2	40 – 60
6.	MCH pg	22.2 ± 6.17	17.36 ± 1.01	20.5 ± 0.8	14 – 18
7.	MCHC g/dL	28.7 ± 4.7	28 ± 3.68	30.8 ± 2.4	30 – 36
8.	PLT 10 ³ μL	131.6 ± 46	323.6 ± 90.8	273 ± 45.6	100 – 800

CONCLUSION

Anaplasmosis in buffaloes can be successfully treated with the combination of Imidocarb dipropionate and Oxytetracyclin along with antipyretics, haematinics and liver extracts. Regular screening is required in buffaloes with suspected symptoms and anaemia for the presence of *Anaplasma marginale* infection as they may act as carriers and potent sources of infection to the more susceptible cattle host.

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Assessment of Varietal Response and its Impacts on Different Cane Attributes due to Sugarcane Wilt caused by *Fusarium Sacchari*

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ABSTRACT

Sugarcane (*Saccharum officinarum* L.) of Poaceae family is an important agro-industrial crop of tropical and subtropical regions of India. A vast industrial set-up, the value-chain, supply-chain, and several stakeholders are mutually impacted by the success and failure of the sugarcane crop. In Bihar, more than 20 diseases of sugarcane have been reported which are caused by pathogens of varying group, which get sufficient time to establish themselves in the long duration annual crop of sugarcane. The crop is affected by majority of diseases among which wilt disease caused by *Fusarium sacchari* is one of the most prevalent in the Bihar region. Out of thirty evaluated varieties against *Fusarium sacchari*, it was observed that 6 varieties (20.69%) were resistant, 15 varieties (51.72%) were moderately resistant, 5 varieties (17.24%) were moderately susceptible, and 3 varieties (10.34%) were susceptible in field condition. The pot experiments revealed 6 varieties (20.69%) as resistant, 11 varieties (37.93%) as moderately resistant, 4 varieties (13.79%) as moderately susceptible and 8 varieties (31.03%) as susceptible. A significant loss was noticed in different quantitative and qualitative attributes of sugarcane due to wilt disease. The reduction in germination% (6.14%-38.20%), settling mortality% (4.55%-41.24%), cane height (6.66%-27.83%), cane girth (2.67%-45.16%), cane weight (6.40%-47.27%), brix % (4.04%-25.58%), sucrose % (6.96%-49.16%) and in purity % (3.04%-31.69%) was observed.

Key Words: *Fusarium sacchari*, sugarcane, wilt, quantitative and qualitative attributes

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is grown in more than 110 countries, occupying about 26.5 million ha, and producing about 1949 Mt of cane. The largest sugarcane producer in the world is Brazil with India ranking second (FAO Stat Yearbook 2021). In India, it is cultivated in an area of 50.98 lakh ha of land with a production of 430.50 million tonnes and average cane productivity of 84.44 t/ha. In Bihar, it is cultivated in an area of 2.11 lakh ha of land with a production of 13.97 Mt and cane productivity of 60.25 t/ha (Directorate of Economics and Statistics, 2021-22). There are around 700 installed sugar factories in the nation, and they produce over Rs 80,000 crores annually and have a crushing capacity of about 340 lakh million tonnes of sugar. More than 125 sugarcane diseases caused by fungi, bacteria, viruses, phytoplasma, and nematodes have been documented worldwide (Rott *et al*, 2000). In India, there have been 180 sugarcane diseases reported due to which 10-15% of the sugar is lost (Viswanathan

and Rao, 2011). In Bihar, more than 20 diseases of sugarcane have been reported which are caused by pathogens of varying groups. The observations made during 2019-2022 revealed that among the important diseases like red rot, wilt, pokkah boeng, smut, leaf spot and ratoon stunting the diseases red rot and wilt are of serious concern in Bihar (Minnatullah *et al*, 2022).

MATERIALS AND METHODS

During the cropping season of 2021-2022 field experiments were carried out at Research Farm, SRI, RPCAU, Pusa, geolocated at 25.98' N latitude and 85.67'E longitude and 52.0 meters high from mean sea level.

The inoculum was prepared for application in soil and the process is explained as follows:

The grinded maize grains 250 g and 750 g sand in 1:3 ratio and 100 ml of distilled water were thoroughly mixed in a container. In 250 ml conical flasks 100 g of the maize-sand mixture were put and then these flasks were sterilized at 15 lb psi for 2 hr. After 2 days each

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flask was inoculated with 4-5 mycelia discs from inoculated petriplates of *Fusarium sacchari* grown on oat meal agar media. These inoculated conical flasks were incubated at 22 ± 1 °C for 15 days. On the 16th day the whole inoculum was collected in one tray and mixed thoroughly. This inoculum mixture was applied (@100g/ meter row) over the setts uniformly in the furrows and the pots at the time of planting.

The thirty sugarcane varieties (Table 3) including the Control (CoSe 95422), with three budded setts were planted in the wilt sick plot at a row-row distance of 90 cm in three replications, while in the case of pots two budded setts were planted with same setts of thirty varieties including one control in wilt sick soil and normal agronomic practices were adopted.

Observations for disease development on the individual varieties were taken to know their response to the pathogen. The varieties were evaluated according to the disease rating scale of (0-4).

Observations:

- i. Germination count at 45 days after planting
- ii. Appearances of wilt symptoms on the standing canes (on clumps)
- iii. After 10 months, ten clumps were uprooted with roots. All the canes from clumps were split open longitudinally and the wilt severity index was scored on a 0-4 scale.

The evaluation was made on the following 0-4 scale:

0. Healthy canes and roots with no external or internal symptoms of wilt.
1. No wilting or drying of leaves, no stunting or shrinking of the stalk or rind, slight pith formation with yellow discolouration of the internal tissues in one or two lower internodes only. No cavity formation or fungal growth seen. Apparently normal and healthy roots.
2. Mild yellowing of top leaves and drying of lower leaves, mild stunting and shrinking of the stalk and rind. Yellowish discolouration of the internal tissues extending to three or four bottom internodes. Slight cavity formation of the pith, no fungal growth seen, slightly discoloured roots.
3. Mild yellowing of top leaves and drying of lower leaves, mild stunting and shrinking of the stalk and rind. Light brown discolouration of internal tissues throughout the entire length of the cane except the top. Severe pith and cavity formation. Sparse

fungal growth observed in the pith cavities.

4. Complete yellowing and death of the leaves, marked stunting, shrinking and drying of the stalk and rind, dark brown discolouration of internal tissues extending throughout the entire length of the cane. Large pith cavities with profuse overgrowth of the associated fungi. Most of the roots necrotic with dark discolouration dislodge easily from the stalks. Roots mildly discoloured and slightly necrotic.

The mean wilt severity index is worked out based on the number of cane samples.

$$\text{Mean wilt severity index} = \frac{\text{Sum of wilt indices of individual stalks}}{\text{Number of stalk samples}}$$

The varieties were graded as follows:

Rating score	Disease Reaction
0-1.0	R (Resistant)
1.1-2.0	MR (Moderately Resistant)
2.1-3.0	MS (Moderately Susceptible)
3.1 and above	S (Susceptible)

The extent of losses on various cane parameters due to wilt disease were assessed. For this study the observations were taken as: germination count at 45 days after planting, disease incidence at 75 days after planting and settling mortality at 90 days after planting. At the time of harvesting the observations were taken on three quantitative parameters which are cane height (cm), cane girth (cm), cane weight (kg) and three qualitative parameters viz. brix %, sucrose % and purity %. Juice samples were obtained from inoculated (diseased) and uninoculated (healthy) canes to determine the juice qualities. Brix percent was measured using brix hydrometer, Sucrose percent by polariscope and Purity was recorded as the coefficient of purity following the method of Browne and Zerbán (1941) and Spancer and Meade (1955).

The reduction and purity coefficient were calculated as follows respectively:

$$\text{Reduction \%} = \frac{H-D}{H} \times 100 \quad \text{Here, H-Healthy, D-Diseased}$$

$$\text{Purity Coefficient} = \frac{\text{Sucrose (\%)}}{\text{Brix (\%)}} \times 100$$

RESULTS AND DISCUSSION

Evaluation of sugarcane varieties in field condition

It was observed that in the field conditions six (20.69%) varieties showed resistant reaction, fifteen varieties (51.72%) showed moderately resistant reaction, five (17.24%) varieties showed moderately susceptible reaction whereas, three (10.34%) varieties showed susceptible reaction against wilt disease (Table 1, Table 3, Figure 1).

Evaluation of sugarcane varieties in pot condition

It was observed that in pot conditions six (20.69%) varieties showed resistant reaction, eleven (37.93%) varieties showed moderately resistant reaction, four (13.79%) varieties showed moderately susceptible reaction whereas, eight (31.03%) varieties showed susceptible reaction against wilt disease (Table 2, Table 3, Figure 1).

Assessment of Quantitative and Qualitative attributes of sugarcane varieties affected by wilt disease

The extent of losses on quantitative and qualitative cane parameters was observed for the thirty sugarcane varieties including one control against the wilt disease caused by *Fusarium sacchari*. Germination count of healthy plots varied from 31.91% to 17.21% in comparison to control i.e., 16.36%. The germination count of diseased plots varied from 29.95% to 11.84% in comparison to control i.e., 10.11%. The calculated reduction % in germination count of the varieties graded as resistant varied from 6.14% to 9.89%, moderately resistant varied from 10.17% to 16.24%, moderately susceptible varied from 21.55% to 26.87% whereas, in susceptible varieties the reduction % in germination count varied from 28.96% to 31.20% while, in control the reduction % in germination count was observed as 38.20% (Table 4).

Settling mortality % of healthy plots varied from 4.83% to 13.98% in comparison to control i.e., 18.69%. The settling mortality % of diseased plots varied from 5.06% to 19.71% in comparison to control i.e., 31.81%. The calculated reduction % in settling mortality % of the varieties graded as: resistant varied from 4.55% to 7.08%, moderately resistant varied from 7.84% to 20.08%, moderately susceptible varied from 21.25% to 27.54% whereas, in susceptible varieties the reduction % in settling mortality % varied from 28.82% to 29.07% while, in control the reduction % in settling

mortality was observed as 41.24% (Table 4).

Cane height of healthy plots of the varieties varied from 234.71 to 154.65 cm in comparison to control i.e., 139.84 cm. The cane height of diseased plots varied from 219.08 cm to 123.12 cm in comparison to control i.e., 100.92 cm. The calculated reduction% in cane height of the varieties graded as: resistant varied from 6.66% to 6.90%, moderately resistant varied from 7.08% to 9.89%, moderately susceptible varied from 12.94% to 14.32% whereas, in susceptible varieties cane height varied from 20.02% to 20.39% while, in control the reduction % in cane height was observed as 27.83% (Table 5).

Cane girth of healthy plots varied from 7.07 cm to 2.48 cm in comparison to control i.e., 1.95 cm. The cane girth of diseased plots varied from 6.88 cm to 1.73 cm in comparison to control i.e., 1.07 cm. The calculated reduction% in cane girth of the varieties graded as: resistant varied from 2.67% to 5.34%, moderately resistant varied from 7.88% to 15.38%, moderately susceptible varied from 19.26% to 24.47% whereas, in susceptible varieties cane girth varied from 27.06% to 30.38% while, in control the reduction % in cane girth was observed as 45.16% (Table 5).

Cane weight of healthy plots varied from 1.25 kg to 0.54 kg in comparison to control i.e. 0.55 kg. The cane weight of diseased plots varied from 1.17 kg to 0.37 kg in comparison to control i.e. 0.29 kg. The calculated reduction % in cane weight of the varieties graded as: resistant varied from 6.40% to 8.49%, moderately resistant varied from 8.74% to 16.90%, moderately susceptible varied from 17.14% to 25.40% whereas, in susceptible varieties cane weight of diseased plots varied from 27.12% to 31.48% while, in control the reduction % in cane weight was observed as 47.27% (Table 5).

Brix % of healthy plots varied from 20.03% to 14.24% in comparison to control i.e., 13.41%. The brix % of diseased plots varied from 19.22% to 11.45% in comparison to control i.e., 9.98%. The calculated reduction % in brix % of the varieties graded as: resistant varied from 4.04% to 4.48%, moderately resistant varied from 4.80% to 8.21%, moderately susceptible varied from 11.24% to 16.33% whereas, in susceptible varieties brix % varied from 16.54% to 19.59% while, in control the reduction % in brix % was observed as 25.58% (Table 6).

Sucrose % of healthy plots varied from 17.53% to 10.06% in comparison to control i.e., 8.97%. The sucrose % of diseased plots varied from 16.31% to 6.08% in comparison to control i.e., 4.56%. The calculated reduction % in sucrose % of the varieties graded as: resistant varied from 6.96% to 8.74%, moderately resistant varied from 9.40% to 18.36%, moderately susceptible varied from 22.72% to 31.44% whereas, in susceptible varieties sucrose % varied from 33.33% to 39.56% while, in control the reduction % in sucrose % was observed as 49.16% (Table 6).

Purity % of healthy plots varied from 87.52% to 70.65% in comparison to control i.e., 66.89%. The purity % of diseased plots varied from 84.86% to 53.10% in comparison to control i.e., 45.69%. The calculated reduction % in purity % of the varieties graded as: resistant varied from 3.04% to 4.46%, moderately resistant varied from 4.83% to 11.06%, moderately susceptible varied from 12.93% to 18.06% whereas, in susceptible varieties purity % varied from 201.12% to 24.84% while, in control the reduction % in purity % was observed as 31.69% (Table 6).

The same varieties were evaluated in field and pot conditions and observed that the wilt severity was more in pot condition than in field condition as seen that the disease reaction of seven varieties inclined towards susceptibility in pot condition which is discussed here: Two varieties (CoLk 16466 and CoSe 17451) which were graded as moderately resistant in field condition showed susceptible reaction in pot condition, two varieties (CoP17446 and CoSe 16452) which were graded as moderately resistant in field condition showed moderately susceptible reaction in pot conditions, three varieties (CoBln 17501, CoBln 16502 and CoLk 94184) while, which were graded as moderately susceptible in field conditions showed susceptible reaction in pot condition. These findings were also supported by results obtained by Hossain *et al* (2017). Minnatullah *et al* (2016) evaluated 26 sugarcane varieties against wilt and found 5 resistant varieties, 15 moderately resistant varieties and 4 moderately susceptible varieties. Similar results were also recorded by Viswanathan (2019, 2020), Kishore Varma *et al* (2021).

The extent of losses on quantitative and qualitative cane parameters were observed for the thirty sugarcane varieties including one control (CoSe 95422) against the wilt disease caused by *Fusarium sacchari*. The reduction in germination varied from 6.14% to 38.20%, reduction in settling mortality ranged from 4.55% to 41.24%, reduction in cane height varied from 6.66% to 27.83%, 2.67% to 45.16% of reduction was observed in cane girth, 6.40% to 47.27% reduction was noted in cane weight, the reduction in brix % ranged from 4.04% to 25.58%, reduction in sucrose % varied from 6.96% to 49.16% and 3.04% to 31.69% reduction was noticed in purity %. The results were as comparable to the findings of Minatullah *et al* (2012), Viswanathan *et al* (2012). Minnatullah & Kamat (2018) had also observed reduction in brix (16.60-20.80%), sucrose (31.60-38.26%) and purity (18.00-22.10%) of cane. Sanjeev *et al* (2015) observed the reduction in sett germinability (40.2-50.1%) number of millable cane (39.9 to 50.9 %) cane yield (45.2-51.2 %) juice (10.0-14.9%), Brix (31.4-44.8%) and purity (12.9-25.7%).

CONCLUSION

The comparison of the varietal reaction in field and pot condition revealed that the wilt severity was more in the pot condition than in field condition. Thus, it was concluded that to evaluate the level of resistance in different varieties against wilt disease and for discarding susceptible varieties the pot experiments are more reliable. Due to wilt disease a significant reduction was noticed in germination, settling mortality, cane height, cane girth, cane weight, brix, sucrose and purity. On the basis of observations, there is need to frequently visit the sugarcane growing regions to know the disease status and varietal susceptibilities so that we can advocate the suitable varieties graded as resistant against wilt disease to minimize the losses on cane parameters.

Assessment of Varietal Response and its Impacts on Different Cane Attributes

Table 1. Percentage of varieties showing different disease reaction against *Fusarium sacchari* in field conditions.

Sr. No.	Rating score	Disease Reaction	Number of varieties	Percentage
1	0-1.0	R (Resistant)	6	20.69
2	1.1-2.0	MR (Moderately Resistant)	15	51.72
3	2.1-3.0	MS (Moderately Susceptible)	5	17.24
4	3.1 and above	S (Susceptible)	3	10.34

Table 2. Percentage of varieties showing different disease reaction against *Fusarium sacchari* in pot condition.

Sr. No.	Rating score	Disease Reaction	Number of varieties	Percentage
1	0-1.0	R (Resistant)	6	20.69
2	1.1-2.0	MR (Moderately Resistant)	11	37.93
3	2.1-3.0	MS (Moderately Susceptible)	4	13.79
4	3.1 and above	S (Susceptible)	8	31.03

Figure 1. Evaluation of sugarcane varieties under field and pot conditions against *Fusarium sacchari*

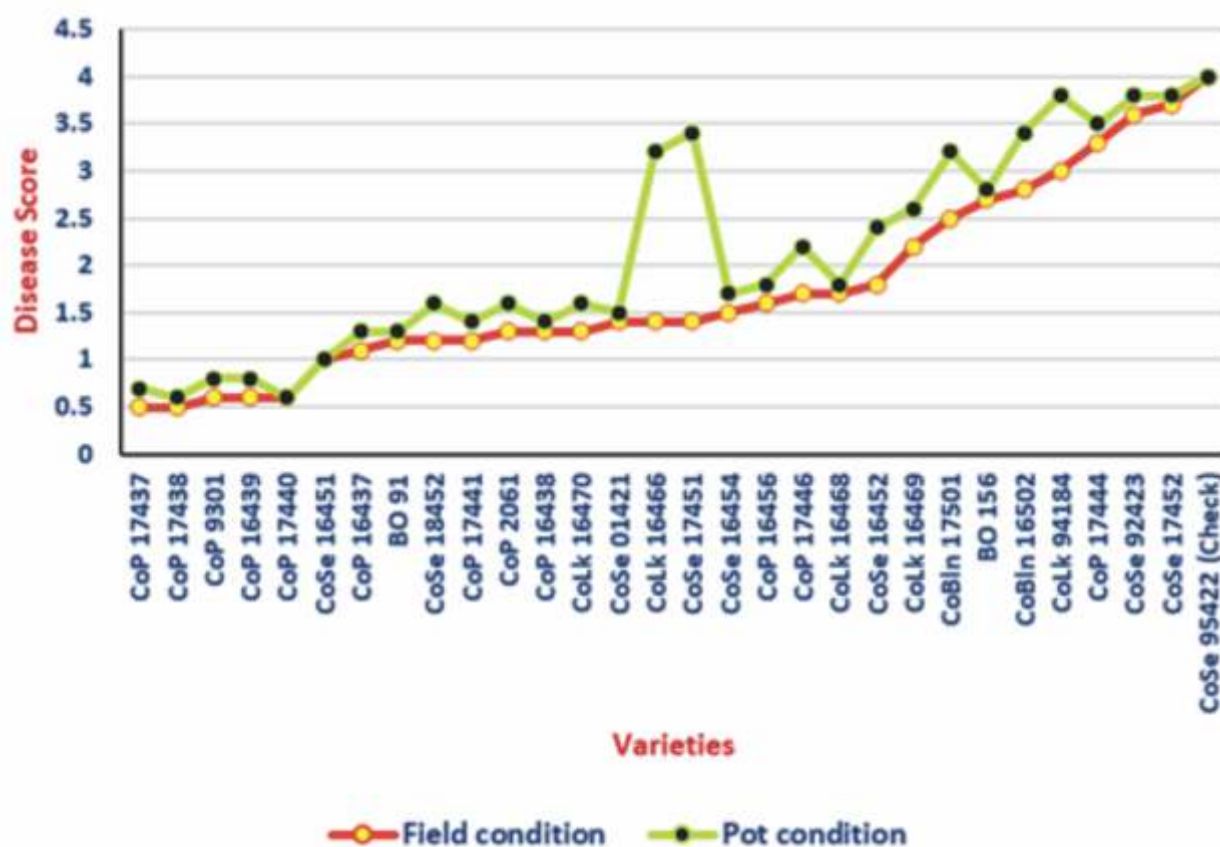


Table 3. Evaluation of sugarcane varieties under field and pot conditions against *Fusarium sacchari*

Sr. No.	Variety	Under field conditions		Under pot conditions	
		Disease Score	Disease Reaction	Disease Score	Disease Reaction
1	CoP 17437	0.5	R	0.7	R
2	CoP 17438	0.5	R	0.6	R
3	CoP 9301	0.6	R	0.8	R
4	CoP 16439	0.6	R	0.8	R
5	CoP 17440	0.6	R	0.6	R
6	CoSe 16451	1.0	R	1.0	R
7	CoP 16437	1.1	MR	1.3	MR
8	BO 91	1.2	MR	1.3	MR
9	CoSe 18452	1.2	MR	1.6	MR
10	CoP 17441	1.2	MR	1.4	MR
11	CoP 2061	1.3	MR	1.6	MR
12	CoP 16438	1.3	MR	1.4	MR
13	CoLk 16470	1.3	MR	1.6	MR
14	CoSe 01421	1.4	MR	1.5	MR
15	CoLk 16466	1.4	MR	3.2	S
16	CoSe 17451	1.4	MR	3.4	S
17	CoSe 16454	1.5	MR	1.7	MR
18	CoP 16456	1.6	MR	1.8	MR
19	CoP 17446	1.7	MR	2.2	MS
20	CoLk 16468	1.7	MR	1.8	MR
21	CoSe 16452	1.8	MR	2.4	MS
22	CoLk 16469	2.2	MS	2.6	MS
23	CoBln 17501	2.5	MS	3.2	S
24	BO 156	2.7	MS	2.8	MS
25	CoBln 16502	2.8	MS	3.4	S
26	CoLk 94184	3.0	MS	3.8	S
27	CoP 17444	3.3	S	3.5	S
28	CoSe 92423	3.6	S	3.8	S
29	CoSe 17452	3.7	S	3.8	S
30	CoSe 95422 (Control)	4.0	S	4.0	S

R-Resistant, MR-Moderately Resistant, MS- Moderately Susceptible, S- Susceptible

Assessment of Varietal Response and its Impacts on Different Cane Attributes

Table 4. Extent of losses on germination % and settling mortality of sugarcane varieties due to *Fusarium sacchari*.

Sr. No.	Variety	Disease score	Rating	Germination%			Settling mortality %		
				H	D	R	H	D	R
1	CoP 17437	0.5	R	31.91 (34.37)	29.95 (33.16)	06.14 (14.22)	04.83 (12.68)	05.06 (12.95)	04.55 (12.29)
2	CoP 17438	0.5	R	31.62 (34.18)	29.58 (32.92)	06.45 (14.69)	04.91 (12.78)	05.16 (13.09)	04.84 (12.69)
3	CoP 9301	0.6	R	30.85 (33.68)	28.62 (32.32)	07.23 (15.52)	05.18 (13.14)	05.46 (13.45)	05.13 (13.04)
4	CoP 16439	0.6	R	30.82 (33.70)	28.51 (32.24)	07.50 (15.78)	05.19 (13.04)	05.48 (13.45)	05.29 (13.25)
5	CoP 17440	0.6	R	30.76 (33.66)	28.41 (32.17)	07.64 (15.96)	05.22 (13.10)	05.56 (13.57)	06.12 (14.29)
6	CoSe 16451	1.0	R	30.14 (33.28)	27.16 (31.39)	09.89 (18.22)	06.04 (14.12)	06.50 (14.62)	07.08 (15.30)
7	CoP 16437	1.1	MR	30.09 (33.23)	27.03 (31.30)	10.17 (18.53)	06.11 (14.27)	06.63 (14.87)	07.84 (16.20)
8	BO 91	1.2	MR	29.81 (33.05)	26.64 (31.04)	10.63 (18.98)	06.62 (14.86)	07.25 (15.55)	08.69 (17.04)
9	CoSe 18452	1.2	MR	29.68 (32.98)	26.41 (30.89)	11.02 (19.34)	06.59 (14.76)	07.32 (15.64)	09.97 (18.33)
10	CoP 17441	1.2	MR	29.63 (32.95)	26.33 (30.83)	11.14 (19.44)	06.85 (15.15)	07.65 (16.02)	10.46 (18.78)
11	CoP 2061	1.3	MR	28.95 (32.52)	25.61 (30.36)	11.54 (19.83)	07.01 (15.31)	07.88 (16.26)	11.04 (19.31)
12	CoP 16438	1.3	MR	28.73 (32.36)	25.36 (30.20)	11.73 (20.00)	07.15 (15.46)	08.09 (16.46)	11.62 (19.90)
13	CoLk 16470	1.3	MR	28.58 (32.20)	25.14 (30.06)	12.04 (20.25)	07.20 (15.54)	08.21 (16.62)	12.30 (20.50)
14	CoSe 01421	1.4	MR	27.81 (31.75)	24.38 (29.55)	12.33 (20.53)	07.52 (15.9)	08.64 (17.02)	12.96 (21.08)
15	CoLk 16466	1.4	MR	27.75 (31.75)	24.14 (29.38)	13.01 (21.10)	07.59 (15.93)	08.75 (17.18)	13.26 (21.31)
16	CoSe 17451	1.4	MR	27.69 (31.73)	23.95 (29.24)	13.51 (21.53)	07.65 (16.01)	08.91 (17.36)	14.14 (22.04)
17	CoSe 16454	1.5	MR	27.32 (31.49)	23.46 (28.91)	14.13 (22.01)	07.81 (16.18)	09.17 (17.54)	14.83 (22.60)
18	CoP 16456	1.6	MR	26.87 (31.09)	22.91 (28.53)	14.74 (22.54)	07.88 (16.18)	09.39 (17.83)	16.08 (23.60)
19	CoP 17446	1.7	MR	26.41 (30.90)	22.41 (28.23)	15.15 (22.86)	08.03 (16.39)	09.69 (18.12)	17.13 (24.41)
20	CoLk 16468	1.7	MR	26.23 (30.67)	22.17 (28.03)	15.48 (23.12)	08.05 (16.46)	09.80 (18.19)	17.86 (24.88)
21	CoSe 16452	1.8	MR	25.74 (30.45)	21.56 (27.61)	16.24 (23.72)	08.12 (16.52)	10.16 (18.56)	20.08 (26.57)
22	CoLk 16469	2.2	MS	21.86 (27.84)	17.15 (24.41)	21.55 (27.63)	08.56 (16.98)	10.87 (19.21)	21.25 (27.39)
23	CoBln 17501	2.5	MS	21.21 (27.34)	16.36 (23.83)	22.87 (28.54)	09.04 (17.43)	11.70 (19.89)	22.74 (28.41)
24	BO 156	2.7	MS	19.65 (26.30)	14.84 (22.60)	24.48 (29.63)	09.53 (17.95)	12.45 (20.62)	23.45 (28.91)
25	CoBln 16502	2.8	MS	19.27 (26.02)	14.46 (22.42)	24.96 (29.96)	09.79 (18.19)	12.98 (21.06)	24.58 (29.67)
26	CoLk 94184	3.0	MS	18.94 (25.76)	13.85 (21.81)	26.87 (31.20)	10.05 (18.44)	13.87 (21.83)	27.54 (31.61)
27	CoP 17444	3.3	S	17.85 (24.97)	12.68 (20.79)	28.96 (32.52)	12.84 (20.96)	18.04 (25.10)	28.82 (32.42)
28	CoSe 92423	3.6	S	17.34 (24.59)	12.09 (20.28)	30.28 (33.35)	13.43 (21.46)	18.89 (25.73)	28.90 (32.44)
29	CoSe 17452	3.7	S	17.21 (24.50)	11.84 (20.08)	31.20 (33.93)	13.98 (21.92)	19.71 (26.28)	29.07 (32.56)
30	CoSe 95422 (Control)	4	S	16.36 (23.84)	10.11 (18.45)	38.20 (38.16)	18.69 (25.58)	31.81 (34.30)	41.24 (39.93)
	SEm(+)			1.32	1.15	1.01	0.86	0.95	1.18
	CD(5%)			3.75	3.27	2.88	2.44	2.7	3.37
	CV			7.52	7.18	7.61	9.05	9.02	9.07

H- Healthy, D- Diseased, R- Reduction, R-Resistant, MR-Moderately Resistant, MS- Moderately Susceptible, S- Susceptible

Table 5. Extent of losses on various quantitative cane parameters due to *Fusarium sacchari*

Sr. No.	Varieties	Disease score	Rating	Cane Height (cm)			Cane girth (cm)			Cane Weight (Kg)		
				H	D	R	H	D	R	H	D	R
1	CoP 17437	0.5	R	234.71	219.08	6.66	7.07	6.88	2.67	1.25	1.17	6.40
2	CoP 17438	0.5	R	231.89	216.43	6.67	6.98	6.79	2.70	1.23	1.15	6.50
3	CoP 9301	0.6	R	230.25	214.83	6.70	6.91	6.66	3.64	1.19	1.10	7.56
4	CoP 16439	0.6	R	229.78	214.25	6.76	6.85	6.57	4.13	1.16	1.07	7.76
5	CoP 17440	0.6	R	229.69	214.14	6.77	6.76	6.41	5.12	1.11	1.02	8.11
6	CoSe 16451	1.0	R	228.84	213.04	6.90	6.47	6.13	5.34	1.06	0.97	8.49
7	CoP 16437	1.1	MR	228.23	212.07	7.08	6.38	5.88	7.88	1.03	0.94	8.74
8	BO 91	1.2	MR	227.85	211.66	7.11	6.32	5.81	7.96	0.98	0.89	9.18
9	CoSe 18452	1.2	MR	227.37	211.13	7.14	6.22	5.72	8.08	0.96	0.87	9.38
10	CoP 17441	1.2	MR	227.04	210.78	7.16	6.13	5.63	8.21	0.95	0.86	9.47
11	CoP 2061	1.3	MR	226.35	210.06	7.20	5.91	5.41	8.51	0.93	0.83	10.75
12	CoP 16438	1.3	MR	226.49	209.98	7.29	5.85	5.31	9.14	0.91	0.81	10.99
13	CoLk 16470	1.3	MR	225.52	209.03	7.31	5.75	5.22	9.29	0.88	0.78	11.36
14	CoSe 01421	1.4	MR	225.16	207.68	7.76	5.63	5.03	10.61	0.86	0.76	11.63
15	CoLk 16466	1.4	MR	224.81	207.03	7.91	5.59	4.97	11.24	0.84	0.74	11.90
16	CoSe 17451	1.4	MR	224.24	206.43	7.94	5.53	4.87	11.93	0.83	0.73	12.05
17	CoSe 16454	1.5	MR	222.93	204.13	8.43	5.28	4.62	12.50	0.79	0.68	13.92
18	CoP 16456	1.6	MR	218.95	200.16	8.58	5.15	4.46	13.41	0.77	0.66	14.29
19	CoP 17446	1.7	MR	215.63	197.09	8.60	4.93	4.24	14.01	0.74	0.63	14.86
20	CoLk 16468	1.7	MR	214.04	194.71	9.03	4.81	4.09	15.03	0.73	0.62	15.07
21	CoSe 16452	1.8	MR	211.75	190.81	9.89	4.49	3.80	15.38	0.71	0.59	16.90
22	CoLk 16469	2.2	MS	193.58	168.54	12.94	4.24	3.43	19.26	0.70	0.58	17.14
23	CoBln 17501	2.5	MS	184.65	160.32	13.18	4.02	3.21	20.31	0.69	0.54	21.74
24	BO 156	2.7	MS	175.87	151.54	13.83	3.61	2.80	22.61	0.67	0.52	22.39
25	CoBln 16502	2.8	MS	174.00	149.56	14.05	3.05	2.39	21.65	0.66	0.51	22.73
26	CoLk 94184	3.0	MS	161.82	138.65	14.32	2.95	2.23	24.47	0.63	0.47	25.40
27	CoP 17444	3.3	S	159.93	127.92	20.02	2.67	1.95	27.06	0.59	0.43	27.12
28	CoSe 92423	3.6	S	157.91	125.87	20.29	2.58	1.82	29.27	0.57	0.41	28.07
29	CoSe 17452	3.7	S	154.65	123.12	20.39	2.48	1.73	30.38	0.54	0.37	31.48
30	CoSe 95422 (Control)	4.0	S	139.84	100.92	27.83	1.95	1.07	45.16	0.55	0.29	47.27
	SEm(+)			9.54	7.58	0.43	0.22	0.19	0.63	0.04	0.04	0.75
	CD(5%)			27.07	21.5	1.21	0.63	0.55	1.79	0.12	0.1	2.14
	CV			7.96	7.03	7.01	7.97	7.77	7.68	8.69	8.61	8.35

Table 6. Extent of losses on various qualitative cane parameters due to *Fusarium sacchari*

Sr. No.	Varieties	Disease score	Rating	Brix %			Sucrose %			Purity %		
				H	D	Red (%)	H	D	Red (%)	H	D	Red (%)
1	CoP 17437	0.5	R	20.03 (26.55)	19.22 (25.98)	04.04 (11.59)	17.53 (24.73)	16.31 (23.81)	06.96 (15.29)	87.52 (69.32)	84.86 (67.10)	03.04 (10.04)
2	CoP 17438	0.5	R	19.97 (26.53)	19.16 (25.95)	04.06 (11.59)	17.47 (24.67)	16.25 (23.76)	06.98 (15.31)	87.48 (69.27)	84.81 (67.04)	03.05 (10.05)
3	CoP 9301	0.6	R	19.86 (26.45)	19.04 (25.86)	04.13 (11.69)	17.31 (24.57)	15.98 (23.55)	07.68 (16.07)	87.16 (69.00)	83.93 (66.35)	03.71 (11.10)
4	CoP 16439	0.6	R	19.77 (26.37)	18.95 (25.79)	04.15 (11.73)	17.17 (24.46)	15.84 (23.44)	07.75 (16.16)	86.85 (68.75)	83.59 (66.09)	03.75 (11.14)
5	CoP 17440	0.6	R	19.74 (26.36)	18.91 (25.76)	04.20 (11.81)	17.11 (24.42)	15.68 (23.32)	08.36 (16.79)	86.68 (68.58)	82.92 (65.58)	04.34 (12.01)
6	CoSe 16451	1.0	R	19.41 (26.12)	18.54 (25.49)	04.48 (12.21)	16.59 (24.02)	15.14 (22.89)	08.74 (17.19)	85.47 (67.60)	81.66 (64.62)	04.46 (12.19)
7	CoP 16437	1.1	MR	19.36 (26.06)	18.43 (25.41)	04.80 (12.65)	16.27 (23.77)	14.74 (22.57)	09.4 (17.84)	84.04 (66.45)	79.98 (63.43)	04.83 (12.69)
8	BO 91	1.2	MR	19.33 (26.06)	18.39 (25.38)	04.86 (12.73)	16.21 (23.72)	14.66 (22.5)	09.56 (18.00)	83.86 (66.32)	79.72 (63.23)	04.94 (12.84)

Assessment of Varietal Response and its Impacts on Different Cane Attributes

Sr. No.	Varieties	Disease score	Rating	Brix %			Sucrose %			Purity %		
				H	D	Red (%)	H	D	Red (%)	H	D	Red (%)
9	CoSe 18452	1.2	MR	19.28 (26.01)	18.34 (25.34)	04.88 (12.75)	16.16 (23.69)	14.61 (22.46)	09.59 (18.03)	83.82 (66.31)	79.66 (63.19)	04.96 (12.85)
10	CoP 17441	1.2	MR	19.21 (25.98)	18.26 (25.28)	04.95 (12.83)	15.95 (23.52)	14.39 (22.28)	09.78 (18.21)	83.03 (65.67)	78.81 (62.6)	05.09 (13.03)
11	CoP 2061	1.3	MR	19.09 (25.88)	18.15 (25.20)	04.92 (12.81)	15.74 (23.36)	14.13 (22.07)	10.23 (18.64)	82.45 (65.24)	77.85 (61.94)	05.58 (13.65)
12	CoP 16438	1.3	MR	19.03 (25.84)	18.08 (25.15)	04.99 (12.88)	15.69 (23.32)	14.05 (22.00)	10.45 (18.85)	82.45 (65.27)	77.71 (61.88)	05.75 (13.87)
13	CoLk 16470	1.3	MR	18.96 (25.78)	18.01 (25.10)	05.01 (12.92)	15.59 (23.24)	13.86 (21.85)	11.10 (19.45)	82.23 (65.08)	76.96 (61.32)	06.41 (14.66)
14	CoSe 01421	1.4	MR	18.83 (25.68)	17.86 (24.98)	05.15 (13.10)	15.35 (23.05)	13.62 (21.65)	11.27 (19.60)	81.52 (64.54)	76.26 (60.83)	06.45 (14.70)
15	CoLk 16466	1.4	MR	18.77 (25.65)	17.81 (24.95)	05.11 (13.06)	15.29 (23.01)	13.56 (21.60)	11.31 (19.64)	81.46 (64.49)	76.14 (60.75)	06.53 (14.80)
16	CoSe 17451	1.4	MR	18.74 (25.64)	17.77 (24.89)	05.18 (13.14)	15.19 (22.92)	13.42 (21.48)	11.65 (19.94)	81.06 (64.20)	75.52 (60.34)	06.83 (15.14)
17	CoSe 16454	1.5	MR	18.62 (25.54)	17.57 (24.77)	05.64 (13.73)	15.01 (22.78)	13.18 (21.27)	12.19 (20.42)	80.61 (63.90)	75.01 (60.00)	06.94 (15.26)
18	CoP 16456	1.6	MR	18.43 (25.41)	17.38 (24.63)	05.70 (13.81)	14.89 (22.67)	13.07 (21.19)	12.22 (20.45)	80.79 (63.99)	75.20 (60.14)	06.92 (15.23)
19	CoP 17446	1.7	MR	18.31 (25.32)	16.95 (24.24)	07.43 (15.81)	14.76 (22.58)	12.49 (20.68)	15.38 (23.07)	80.61 (63.88)	73.69 (59.13)	08.59 (17.04)
20	CoLk 16468	1.7	MR	18.25 (25.28)	16.87 (24.22)	07.56 (15.95)	14.68 (22.52)	12.28 (20.50)	16.35 (23.83)	80.44 (63.80)	72.79 (58.55)	09.51 (17.95)
21	CoSe 16452	1.8	MR	18.14 (25.20)	16.65 (24.07)	08.21 (16.64)	14.43 (22.31)	11.78 (20.05)	18.36 (25.34)	79.55 (63.14)	70.75 (57.26)	11.06 (19.42)
22	CoLk 16469	2.2	MS	17.62 (24.81)	15.64 (23.28)	11.24 (19.58)	13.91 (21.89)	10.75 (19.13)	22.72 (28.45)	78.94 (62.68)	68.73 (56.00)	12.93 (21.07)
23	CoBln 17501	2.5	MS	17.25 (24.52)	15.01 (22.77)	12.99 (21.12)	13.25 (21.33)	10.03 (18.43)	24.30 (29.52)	76.81 (61.22)	66.82 (54.83)	13.01 (21.13)
24	BO 156	2.7	MS	16.93 (24.29)	14.72 (22.55)	13.05 (21.17)	12.73 (20.88)	09.38 (17.82)	26.32 (30.85)	75.19 (60.12)	63.72 (52.95)	15.25 (22.98)
25	CoBln 16502	2.8	MS	16.21 (23.73)	13.76 (21.76)	15.11 (22.87)	11.91 (20.16)	08.45 (16.88)	29.05 (32.60)	73.47 (58.99)	61.41 (51.59)	16.42 (23.90)
26	CoLk 94184	3.0	MS	15.98 (23.55)	13.37 (21.43)	16.33 (23.82)	11.64 (19.94)	07.98 (16.36)	31.44 (34.08)	72.84 (58.58)	59.69 (50.58)	18.06 (25.14)
27	CoP 17444	3.3	S	15.36 (23.06)	12.82 (20.96)	16.54 (23.99)	11.04 (19.39)	07.36 (15.71)	33.33 (35.24)	71.88 (57.96)	57.41 (49.25)	20.12 (26.64)
28	CoSe 92423	3.6	S	14.87 (22.67)	12.31 (20.50)	17.22 (24.51)	10.53 (18.92)	06.67 (14.95)	36.66 (37.24)	70.81 (57.29)	54.18 (47.38)	23.48 (28.97)
29	CoSe 17452	3.7	S	14.24 (22.16)	11.45 (19.73)	19.59 (26.26)	10.06 (18.48)	06.08 (14.27)	39.56 (38.96)	70.65 (57.18)	53.10 (46.76)	24.84 (29.87)
30	CoSe 95422 (Check)	4.0	S	13.41 (21.47)	09.98 (18.36)	25.58 (30.37)	08.97 (17.42)	04.56 (12.32)	49.16 (44.50)	66.89 (54.92)	45.69 (42.51)	31.69 (34.24)
	SEm(±)			0.46	0.43	0.32	0.46	0.39	0.46	1.11	1.50	0.31
	CD(5%)			1.31	1.22	0.91	1.31	1.10	1.31	3.14	2.98	0.88
	CV			3.19	3.12	3.40	3.58	3.31	3.39	3.00	3.10	3.08

H- Healthy, D- Diseased, R- Reduction, R-Resistant, MR-Moderately Resistant,
MS- Moderately Susceptible, S- Susceptible

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Assessment of Purdue Improved Crop Storage Bags for Hermetic Storage Technology on Groundnut Pods

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ABSTRACT

Groundnut seed has the highest quality deterioration due to indigenous techniques and damage due to Bruchid infestation and mold growth. Purdue Improved Crop Storage (PICS) bags (T1) were introduced for hermetic storage of groundnut pods against traditional methods using gunny bags (T2). PICS storage bags were consisting of 80 micron thick high density polyethylene in two inner layers and surrounded by a third layer of woven nylon bag for strength. For the assessment of PICS hermetic storage bags to reduce the pest incidence, Groundnut varieties (Dharani and Kadiri 6) were selected and stored for 6 months period. T1 consisted of Groundnut varieties with good germination percent during the storage study. T2 consisted of Groundnut varieties with a loss in germination per cent of 20 and 26 under the indigenous method of using gunny bags whereas in PICS(T1) negligible loss of 2 and 4% were recorded during 180 days. Grain weight of samples stored in PICS bags (T1) was restored from the beginning to end of the study of 6 months and maintained 'A' grade quality up to the 5th months where in T2, the loss of grain weight was higher and the quality of grain was reached to 'D' grade at the end of the study. Thus, the efficacy of triple-layer PICS bags over gunny bags was protecting seed viability, seed weight and quality content while safeguarding the groundnuts from bruchids and retarding toxic aggregation.

Key Words: Aflatoxin, PICS Bags, Germination, Groundnut, Post-harvest technology.

INTRODUCTION

Storage loss of many kinds of cereal, pulses and oilseeds in developing countries is a major problem at the small and marginal farmer level. Post-harvest losses are a significant concern, insects and pest incidence is the major cause of dry matter loss; the majority of farmers use indigenous methods and application of insecticides to handle and store the grains after harvesting. Storage of the grains in woven gunny bags is inexpensive and need not require any special techniques to use. Most of the farmers are cultivating DHARANI (TCGS-1043(2013)) is drought tolerant, water use efficient, tolerant to stem and dry root rots, and yield 16-26 q/ha during *kharif*-rainfed, 37-43q/ha during *rabi*. KADIRI-6 which is tolerant to leaf spots, duration of 105 -110 d and yields 18-24 q/ha. But the farmers are facing problems with the storage of pods after harvesting. Most of the farmers are selling the product immediately to the market without storing

the product for the next crop season of sowing, due to its contamination with aflatoxin which occurs more during post-harvest. At farmer practice for long-term storage, the containers are sealed with mud after the addition of ashes, ground pepper, dried neem leaves or other local herbs to control storage pests. The summer crop of groundnut is harvested from May to June. When this product is stored, the relative humidity increases up to 80 to 90% with the onset of monsoon in June to July. Consequently, the pod moisture also increases to 10 to 15%. Pod moisture percent over 10% will affect seed viability and quality. Reduction in post-harvest losses is one of the keys to improving the economy of the Nation. Moreover, post-harvest losses is vital for increasing food availability without the need for additional resources (Kimatu *et al*, 2012). The Introduction of PICS triple-layer hermetic storage bags is sustainable, cost-effective and user-friendly for the storage of cereals, pulses and oilseeds, to reduce pest

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incidence, restoration of grain weight, and quality during storage. The PICS bags usage in grain storage enhances an opportunity to improve food security through the lean season when supply is low; Increases the incomes of millions of small and marginal farmers by providing the flexibility to store grain until to get good supporting prices and improves health by alleviating the impact of aflatoxin while restricting the insecticide use. The present study on Assessment of PICS Hermetic storage bags to reduce pest incidence was aimed to reduce the drudgery of farm women for repeated cleaning of produce and changing bags, evaluation of the performance of seed storage bags through germination, grain weight, and quality. Almeida *et al* (2017) while working on chemical changes in bean grains during storage in controlled conditions concluded that the storage conditions and storage time influenced the quality and nutritive content of pinto group of beans.

MATERIALS AND METHODS

PICS bags were originally developed for cowpeas but were later shown to be effective against pests of several other stored crops including maize, beans, sorghum, pigeon pea, peanuts, and rice (Baributsa *et al*, 2015). PICS storage bags were consisting of 80 micron thick high density polyethylene in two inner layers and surrounded by a third layer of woven nylon bag for strength. These bags are produced in 10, 25, 50 and 100 kg capacity sizes (Sudini *et al*, 2014). 10 kg capacity of Triple-layer hermetic PICS airtight bags were obtained from an authorized dealer from Telangana state served as sample bags and the non-airtight jute bags were procured from the local market and loaded with 10 kg of groundnut seed in both bags. These jute bags served as controls for comparison with triple-layer bags. A total number of 15 locations (15 farm families) in Guttapalem, Yallampalli, and Balamvari Palli villages were selected for the study.

Groundnut varieties DHARANI (TCGS1043(2013) and KADIRI 6 (K6 2005) were

stored in PICS triple layer hermetic bags for assessing the germination percentage, grain weight and quality for 6 months of storage. Groundnut is the major crop in these villages which are adopted by KVK, Kalikiri. Analysis of Groundnut during storage period was done for germination percentage, 1000 seed count and weigh method, visual analysis and organoleptic analysis.

Organoleptic analysis

Sensory or Organoleptic evaluation is an important task to analyze groundnut due to its aflatoxin accumulation and its effect on palatability. Stored grains were arranged for sensory evaluation by using 9 points hedonic scale with the scores on a 9-point hedonic scale, which has 9- Like extremely, 8- Like very much, 7- Like moderately, 6- Like slightly, 5- Neither like nor dislike, 4- Dislikeslightly, 3- Dislike moderately, 2- Dislike very much, 1- Dislike. Using the scale Appearance, Taste, Texture, Colour and Overall acceptability were analyzed by attained panel.

RESULTS AND DISCUSSION

The germination percentage was same in T1 and T2 in two varieties of groundnut Dharani and K6. The data depict the post-test germination of mean values from the sample of T1 (PICS bags) which show 2% reduction in germination percentage in Dharani and 4% in K6 were recorded respectively. Whereas T2 (Gunny bags) showed a 20% of the loss in germination percentage from the 1st month to the 6th month of the storage period was recorded in Dharani and 26% in K6. The seed weight was observed that 1.1g loss in Dharani and 1.2g per 100 grams of seed in K6 in observed in T1, and 7.1g and 7.2g per 100 grams were recorded mean weight loss in T2. According to visual observation of seeds from T1 sample of Dharani and K6 reached B grade which shows that 20% and T2 sample reached the D grade i.e., about 85% seeds were damaged in gunny bags.

Assessment of Purdue Improved Crop Storage Bags for Hermetic Storage Technology

Table1. Initial readings of germination, seed weight, and visual damage of Groundnut.

Germination percentage of seed (Variety)	T1 (PICS Storage Bags) Mean	T2 (Gunny Bags) Mean
Pre-test for Initial sample (1st month)		
Dharani	95	95
K6	95	95
Seed weight		
Dharani	43.09g	42.08g
K6	41.51g	41.58g
Visual damage		
Dharani	A	A
K6	A	A

Table2: Post-test readings of germination, seed weight and visual damage of groundnut

Post-test	2 nd month		3 rd month		4 th month		5 th month		6 th month	
Germination %	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Dharani	95	89	94	86	94	87	94	82	93	75
K6	95	90	95	88	94	87	93	79	91	69
Seed weight per 100 g										
Dharani	42.5	41.3	42.4	39.8	42.1	37.1	41.4	35.4	41.4	34.2
K6	42.8	40.3	42.7	38.7	42.5	36.2	41.9	34.5	41.6	33.1
Visual damage										
Dharani	A	A	A	B	A	C	A	D	B	D
K6	A	A	A	B	A	C	A	D	B	D

Williams *et al* (2017) noticed that overall, germination rates for maize stored in triple bags were almost equal to rates observed in non-infested controls. Maize germination rates ranged between 70 and 95% across eight month study period. After 8 months, germination rates for maize stored in the infested woven bags were statistically lower than rates observed in non-infested woven bags (9% lower) and all triple bags (30% lower). He indicated that the technology may as well be good in nutrient preservation. This is because it was shown that relative humidity in PICS remains constant during the storage of cowpeas, while oxygen concentrations reduced with storage time compared to poly propylene bags, indicating that PICS could retain quality of grains under storage.

Antoine Waongo *et al* (2019) noticed that grain weight loss and damage caused by the insects in

the Poly Propylene bags were significantly higher compared to those stored in PICS bags. Germination rates of sorghum grains stored in Poly Propylene bags decreased significantly while no changes were observed in grains stored in PICS bags when compared to the initial germination. PICS bags preserved the quality and viability of stored sorghum grains and protected it from key insect pests. The PICS technology is effective for long-term sorghum storage but the potential resurgence of insects in low-oxygen environment calls for further research. PICS are superior to PPB bags in nutrient and quality retention of common beans during storage. Beans in PICS bags had optimal starch and protein digestibility and tannin content on day 225 of storage. Nutrient retention in beans was high at lower storage moisture and duration in PICS (Micah Rambeka Momanyi *et al*, 2022).

Vanitha *et al* (2021) observed that there was no decrease in seed moisture content at 2, 4 and 6 months respectively and germination percent in triple-layer PICS bag at 2, 4 and 6 months storage was highest among all bag types. Test weight (g), protein content (%) and carbohydrate content (%) at 2, 4 and 6 months storage respectively were higher in triple layer PICS bag. The mean fat content recorded was highest in jute bag (1.25%) and lowest in triple layer PICS bag

(0.63%). It was concluded that the triple layer PICS bags hermetic technology was efficient in managing maintaining same level of moisture content percent, germination percent and test weight compared to other bags over 3 different periods of storage. The triple layer PICS bags were also highly useful for retaining carbohydrate percent and protein percent at almost the same levels compared to initial values.

Table1. Initial readings of germination, seed weight, and visual damage of Groundnut.

Germination percentage of seed (Variety)	T1 (PICS Storage Bags) Mean	T2 (Gunny Bags) Mean
Pre-test for Initial sample (1st month)		
Dharani	95	95
K6	95	95
Seed weight		
Dharani	43.09g	42.08g
K6	41.51g	41.58g
Visual damage		
Dharani	A	A
K6	A	A

Table2: Post-test readings of germination, seed weight and visual damage of groundnut

Post-test	2 nd month		3 rd month		4 th month		5 th month		6 th month	
Germination %	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Dharani	95	89	94	86	94	87	94	82	93	75
K6	95	90	95	88	94	87	93	79	91	69
Seed weight per 100 g										
Dharani	42.5	41.3	42.4	39.8	42.1	37.1	41.4	35.4	41.4	34.2
K6	42.8	40.3	42.7	38.7	42.5	36.2	41.9	34.5	41.6	33.1
Visual damage										
Dharani	A	A	A	B	A	C	A	D	B	D
K6	A	A	A	B	A	C	A	D	B	D

Williams *et al* (2017) noticed that overall, germination rates for maize stored in triple bags were almost equal to rates observed in non-infested controls. Maize germination rates ranged between 70 and 95% across eight month study period. After 8 months, germination rates for maize stored in the infested woven bags were statistically lower than rates observed in non-infested woven bags (9% lower) and all triple

bags (30% lower). He indicated that the technology may as well be good in nutrient preservation. This is because it was shown that relative humidity in PICS remains constant during the storage of cowpeas, while oxygen concentrations reduced with storage time compared to poly propylene bags, indicating that PICS could retain quality of grains under storage.

Assessment of Purdue Improved Crop Storage Bags for Hermetic Storage Technology

Antoine Waongoa *et al* (2019) noticed that grain weight loss and damage caused by the insects in the Poly Propylene bags were significantly higher compared to those stored in PICS bags. Germination rates of sorghum grains stored in Poly Propylene bags decreased significantly while no changes were observed in grains stored in PICS bags when compared to the initial germination. . PICS bags preserved the quality and viability of stored sorghum grains and protected it from key insect pests. The PICS technology is effective for long-term sorghum storage but the potential resurgence of insects in low-oxygen environment calls for further research. PICS are superior to PPB bags in nutrient and quality retention of common beans during storage. Beans in PICS bags had optimal starch and protein digestibility and tannin content on day 225 of storage. Nutrient retention in beans was high at lower storage moisture and duration

in PICS (Micah Rambeka Momanyi *et al*, 2022). Vanitha *et al* (2021) observed that there was no decrease in seed moisture content at 2, 4 and 6 months respectively and germination percent in triple-layer PICS bag at 2, 4 and 6 months storage was highest among all bag types. Test weight (g), protein content (%) and carbohydrate content (%) at 2, 4 and 6 m storage respectively were higher in triple layer PICS bag. The mean fat content recorded was highest in jute bag (1.25%) and lowest in triple layer PICS bag (0.63%). It was concluded that the triple layer PICS bags hermetic technology was efficient in managing maintaining same level of moisture content percent, germination percent and test weight compared to other bags over 3 different periods of storage. The triple layer PICS bags were also highly useful for retaining carbohydrate percent and protein percent at almost the same levels compared to initial values.

Table3. Pre and Post-test sensory evaluation scores of groundnut varieties.

Sensory attribute	Ground Nuts (Pre-test)		Dharani (post -test)						K6 (Post -test)					
	Dharani	K6	60days		120days		180days		60days		120days		180days	
			T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Appearance	9.0	9.0	9.0	7.7	8.0	7.1	8.0	5.2	9.0	7.4	8.0	6.9	8.0	5.1
Taste	9.0	9.0	8.2	7.9	8.1	6.8	7.0	5.1	8.2	7.5	7.5	6.1	7.0	4.9
Texture	9.0	9.0	8.6	7.3	8.1	6.4	7.1	6.1	8.1	7.2	7.9	6.2	7.1	5.1
Colour	9.0	9.0	8.8	6.8	7.9	5.3	7.1	4.3	8.9	6.1	7.9	5.1	7.2	4.9
Flavor	9.0	9.0	8.4	7.9	7.9	6.2	7.1	5.2	8.3	7.2	7.5	6.1	6.9	4.8
Overall acceptance	9.0	9.0	8.2	7.1	7.5	6.2	7.2	6.1	8.7	7.0	7.5	6.1	7.1	5.8

Sensory evaluation was conducted in 3 villages by 60 farmers and staff of KVK at 60 days intervals. A storage period of 180 days showed significant results on the palatability of Groundnut. T1 and T2 both showed declined mean scores from the initial to the end of the study. In samples of T1, Dharani and K6 appearance scored like extremely at 60 days and neither like nor dislike at 180 days. Taste and texture are important factors in sensory evaluation. According scores of T1 in both varieties showed like very much at 60 days and like moderately at 180 days. Colour and flavor improve the appetite of individuals and it plays an important role in recipe preparation. Both color and

flavor of groundnut scored from like very much to like slightly due to its aflatoxin content. Overall acceptance of groundnut from PICS bags showed positive results during the storage period i.e., from like very much to like moderately. Whereas in T2 all parameters showed declined mean scores from like moderately at 60 days and dislike slightly at 180 days.

CONCLUSION

The present study revealed that PICS hermetic bags provide farmers with a safe and convenient method to preserve their agricultural commodities. Applications of hermetic storage systems expanded

throughout the Asian countries at the farmer's level. In India food is distributed through Public Distribution System to every village in collaboration with the Food Corporation of India, it needs proper storage conditions and transport. If the Food Corporation of India and Public Distribution System maintain these hermetic storage systems post-harvest losses, as well as storage loss can be reduced effectively.

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Awareness on Lumpy Skin Disease among Cattle Farmers in Tirunelveli District of Tamil Nadu

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ABSTRACT

The present study was conducted to assess the level of awareness among cattle farmers about Lumpy Skin Disease (LSD) with respect to general disease, its transmission and prevention and control measures in Tirunelveli district of Tamil Nadu. The study was carried out among 150 cattle farmers who visited the Veterinary College and Research Institute, Tirunelveli from different areas of the Tirunelveli district of Tamil Nadu through personal interview by using pre-tested and semi-structured interview schedule. The awareness level was measured based on the mean score obtained by cattle farmers. The study revealed that, the respondents were more aware about Lumpy Skin Disease affecting cattle and lack awareness about disease caused by virus that causes abortion in dairy animals. Whereas, respondents had more awareness about 'introduction of infected animals to the herd', 'contaminated feed and water' can transmit disease in animals and less awareness with respect to movement of cattle and ticks, mosquitoes and flies can transmit the disease in animals. Regarding, prevention and control measures, respondents had more awareness that vaccination is the effective way to control Lumpy Skin Disease in cattle and less aware in respect of 'there is no specific treatment for Lumpy Skin Disease' and 'quarantine of newly purchased animals'.

Key Words: Awareness level, Cattle farmers, Lumpy Skin Disease, Prevention and Control.

INTRODUCTION

Lumpy skin disease (LSD) is a vector-borne disastrous viral disease affecting cattle and buffalo characterized by eruption of skin nodules, high fever, lacrimation and nasal discharge. LSD caused substantial economic losses to cattle farmers due to reduction in milk production, chronic emaciation in the affected herd, poor growth, mastitis, infertility, abortion and death in some cases (Lothe *et al*, 2022). The presence of growing numbers of naive (i.e. not immune) animals, abundance of active blood-feeding vectors, and uncontrolled animal movements are usually drivers for extensive LSD outbreaks. The primary case is usually associated with the introduction of new animal(s) into, or in close proximity to, a herd. Morbidity varies between 2 and 45 percent and the mortality rate is usually less than 10 percent. Susceptibility of the host depends on immune status, age, and breed. Generally speaking, high milk-producing European cattle breeds (Jersey and Holstein Friesian) are highly susceptible compared to indigenous African and Asian animals. Cows with high

milk production are usually most severely affected. Lumpy skin disease is host-specific, although mixed herds of cattle, sheep and goats are common, no epidemiological evidence on the role of small ruminants as a reservoir for LSDV has been reported (Tuppurainen *et al*, 2017). Disease surveillance is an important activity that provides the basis for knowing the disease burden in a country for follow-up actions to control, prevent and eventually to eradicate the disease (Kumar *et al*, 2021). Also, the use of ICT tools has the ability to provide latest information about disease outbreaks and forecasts (Jat *et al*, 2021). Training and capacity building programmes are essential to increase knowledge and awareness level of farmers (Madhu, 2020). To this essence, the current research study was carried out to assess the awareness level of the cattle farmers about Lumpy Skin Disease (LSD) and enhances the knowledge of the cattle farmers and other stakeholders regarding various control and prevention measures against LSD that can play a significant role in the containment of the disease.

MATERIALS AND METHODS

The present study was conducted from the cattle farmers who visited the Veterinary College and Research Institute, Tirunelveli belonged to different areas of the Tirunelveli district of Tamil Nadu during August 2022 to July 2023. A semi-structured and pre-tested interview schedule was developed and a total of 150 respondents were interviewed. A set of 17 questions regarding Lumpy Skin Disease (LSD) that included the important recommendations given by the experts, various published documents and reports *viz.*, general disease awareness, transmission, and prevention and control measures against Lumpy Skin Disease (LSD) were presented to the respondents. The awareness level was measured based on the weightage of '1' and '0' applied to each correct and incorrect answer, respectively. The awareness score of general disease awareness, disease transmission and prevention and control measures of a respondent was added to explore the awareness level of cattle farmers about Lumpy Skin Disease.

The awareness mean score of respondents was calculated by the following formula

$$\text{Awareness mean score} = \frac{\text{Respondent's total obtained score}}{\text{Maximum possible score}}$$

RESULTS AND DISCUSSION

Awareness level of Lumpy skin disease related to general disease aspects

The awareness about Lumpy Skin Disease (LSD) affecting cattle had awareness mean score of 0.76 and ranked first followed by symptoms of Lumpy Skin Disease in cattle ranked second with awareness mean score of 0.70. A similar result was reported by Fedhessa *et al* (2015) that the awareness of LSD among cattle keepers was 71.64 %. Awareness about 'Lumpy skin disease is considered as economically important disease of cattle' (0.63), 'Lumpy skin disease is a disastrous disease of cattle caused by a virus' (0.58) and 'Lumpy skin disease causes abortion in dairy animals' (0.40) ranked as third, fourth and fifth, respectively. The results of the study unveiled that, cattle farmers

were more aware about Lumpy skin disease affecting cattle and less aware regarding Lumpy skin disease as a disastrous disease caused by virus and causes abortion in dairy animals.

Table 1. Distribution of respondents according to their general disease awareness.

Sr. No.	General disease awareness	Awareness mean score	Rank
1.	Awareness about Lumpy skin disease affecting cattle	0.76	I
2.	Symptoms of Lumpy skin disease in cattle	0.70	II
3.	Lumpy skin disease is considered as economically important disease of cattle	0.63	III
4.	Lumpy skin disease is a disastrous disease of cattle caused by a virus	0.58	IV
5.	Lumpy skin disease causes abortion in dairy animals	0.40	V

Awareness level of Lumpy skin disease related to disease transmission

Regarding disease transmission, respondents had awareness about introduction of infected animals to the herd can transmit the disease with score of 0.76 and ranked first. Awareness about other disease transmission aspects *viz.*, 'Contaminated feed and water can transmit disease in animals' (0.72), direct contact between animals can transmit the disease (0.64), movement of cattle (0.55) and ticks, mosquitoes and flies can transmit the disease in animals (0.44) ranked as second, third, fourth and fifth, respectively. Respondents of the study area were more aware that infected animals, contaminated feed and water can transmit disease among animals (Table 2). Further, the respondents were less aware that 'movement of cattle' and 'ticks, mosquitoes and flies' can transmit the disease in animals. Long-distance dispersal of LSDV seems to occur via the movement of infected animals, but distinct seasonal patterns indicate that arthropod-borne transmission is most likely responsible for the swift and aggressive short-distance spread of the disease (Sprygin *et al*, 2019). The results indicated that cattle farmers need to be educated about restriction of cattle movement during rainy season and control measures of ecto-parasites infestations.

Awareness on Lumpy Skin Disease among Cattle Farmers in Tirunelveli District of Tamil Nadu

Table 2. Distribution of respondents according to their awareness about disease transmission.

Sr. No.	Disease Transmission	Awareness mean score	Rank
1.	Introduction of infected animals to the herd can transmit the disease	0.76	I
2.	Contaminated feed and water can transmit disease to animals	0.72	II
3.	Direct contact between animals can transmit the disease	0.64	III
4.	Movement of cattle	0.55	IV
5.	Ticks, mosquitoes and flies can transmit the disease	0.44	V

Awareness level of Lumpy skin disease related to prevention and control measures

The study further reported that with respect to the prevention and control of Lumpy skin disease; vaccination is the effective way to control Lumpy Skin Disease in cattle had awareness mean score 0.86 and ranked first. Further, prevention and control measures including ticks, flies and mosquitoes control (0.78) ranked second, followed by isolation of the Lumpy skin disease virus-infected cattle (Third), cleaning and disinfection of animal shelters (Fourth), ethnoveterinary treatment for Lumpy Skin Disease (Fifth), there is no specific treatment for Lumpy Skin Disease (Sixth) and quarantine of newly purchased animals (Seventh) in that order. Table 3 vividly shows that, respondents of the study area were more aware that vaccination is the effective way to control Lumpy skin disease in cattle and less aware about quarantine measures for newly purchased animals. Vaccination along with strict quarantine measures and vector control could be effective in preventing the spread of the Lumpy skin disease (Tania *et al*, 2020).

Table 3. Distribution of respondents according to their awareness about LSD prevention and control measures

Sr. No.	Prevention and Control	Awareness mean score	Rank
1.	Vaccination is an effective way to control Lumpy skin disease in cattle	0.86	I
2.	Ticks, flies and mosquito control measures	0.78	II
3.	Isolation of the Lumpy skin disease virus infected cattle	0.70	III
4.	Cleaning and disinfection of animal shelter	0.65	IV
5.	Ethnoveterinary treatment for Lumpy skin disease	0.62	V
6.	There is no specific treatment for Lumpy skin disease	0.50	VI
7.	Quarantine of newly purchased animals	0.48	VII

CONCLUSION

The results of the present study concluded that the majority of the cattle farmers were small farmers and well aware of Lumpy skin disease affecting cattle, and vaccination is the most effective way to control the Lumpy skin disease in cattle. Despite this, the majority of the respondents lack awareness about disease caused by virus that causes abortion in dairy animals, the movement of cattle, 'ticks, mosquitoes, and flies that can transmit the disease to animals, and the quarantine of newly purchased animals. Hence the study recommends that, there is a prompt and calamitous need to create awareness among cattle farmers about several disease transmission routes and preventive and control measures against Lumpy skin disease through intensive awareness campaigns, social media, print media, Radio/TV talks and focused training programmes. Further, continuing veterinary education is to be inculcated to field veterinarians on the latest emerging and re-emerging diseases which promotes awareness about LSD to the farmers thereby augmenting their livelihood.

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Compatible Bioagents to Enhance Efficacy Against *Sclerotinia sclerotiorum*

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ABSTRACT

Sustainable crop production systems require phytopathogens to be managed effectively with the use of microorganisms. In recent years major thrust is given on other alternative methods including biological control with the inclusion of ecologically well-adopted, bio agents, which is environment-friendly and also curtail the hazards of intensive use of toxic materials and add as a major component of modern integrated disease management strategy. The concept of developing microbial consortia for bio-control relies on the fact that bioagents under natural habitats live in communities with some benefits for plants. Attempts were made to evaluate the relative compatibility of *Trichoderma harzianum* with a few other commonly used soil antagonists viz. *Trichoderma harzianum*, *Trichoderma koningii*, *Trichoderma viride*, *Aspergillus terreus*, *Aspergillus flavus* and *Gliocladium virens* by dual culture technique. The most compatible antagonist was found to be *G. virens* with *T. harzianum* followed by *T. koningii*, *T. viride* and *A. flavus*. The radial growth of *T. harzianum* was more as compared to other soil antagonists on dual culture assay except in case of *T. harzianum* and *A. terreus* where the *A. terreus* was seen to suppress the growth of *T. harzianum*. The best pair of compatible antagonists was found to be *T. harzianum* - *G. virens*. Under pot condition, dual application of bioagents- *T. harzianum* and *G. virens* showed significant reduction in percent disease incidence and greater efficacy in increasing plant height, dry weight of root, shoot and crop yield as compared to the control.

Key Words: Bioagents, *Trichoderma harzianum*, *Gliocladium virens*, white mold, French bean

INTRODUCTION

French bean is susceptible to a wide range of disease causing pathogens. White mold or Stem rot of French bean caused by *Sclerotinia sclerotiorum* (Lib) de Bary is the most important disease which has caused serious and unpredictable yield losses as high as 100 per cent (Tu, 1989). It affect plant in all stages i.e. seedling, matured, harvested stages of crops. The disease has been found to be one of the most destructive in French bean as reported by several workers (Bag, 2000). The fungus attacks practically all vegetable crops and has a host range of 64 plant families, 225 genera and 361 species and 22 other cultivars from a total of 385 species and considered to be the most non-specific phytopathogen. The pathogen is worldwide in distribution and is pathogenic to more than 500 species of higher plants (Willettts and Wong, 1980) and causes numerous soft rots of horticultural and agricultural crops. It was originally believed to occur only in cool, moist areas, but is now known to occur in hot, dry areas as well. The fungus can survive on infected tissues, in the soil, and on living plants. White mold can spread quickly in the field from plant to plant.

It can also spread in a storage facility throughout the harvested crop. It survived by production of sclerotia upto 4-5 years. White mold epidemics of beans are produced by sclerotia of *S. sclerotiorum* (Abawi and Grogan, 1979). Soil pH, nutrient status or inorganic supplement to the soil generally do not reduce the survivability, hence, there is every possibility of reappearance of the disease in the subsequent crop season resulting from either myceliogenic or apothecial germination of the sclerotia (Huang and Hoes, 1985). But it has been found that the biological component of soil affect the survival of sclerotia in soil most significantly (Adams and Ayers, 1979). The different conventional and non-conventional methods like crop rotation, field sanitation, clean cultivation, reduced irrigation, growing of resistant varieties etc. do not curb the activity of the organism completely. Frequent and indiscriminate use of fungicides often leads to atmospheric pollution and development of fungicide-resistance in pathogen for which use of chemicals needs to be restricted. Therefore, in recent years major thrust is given on other alternative methods including

biological control with the inclusion of ecologically well-adopted, biocontrol agents, which is environment-friendly and curtail the hazards of intensive use of toxic materials apart from having suitability for inclusion as a major component of modern integrated disease management strategy. Integration of one or more bioagents can therefore, constitutes a very promising way of controlling various soil-borne pathogens. Therefore, an integrated approach of using combination of two or more biocontrol agent may hold a promising way for an effective control of *Sclerotinia sclerotiorum* on French bean.

MATERIALS AND METHODS

The experiments were carried out in the Department of Plant Pathology, Assam Agricultural University, Jorhat situated at 26°47'N latitude, 94°12'E longitude and at an altitude of 86.60 meters above mean sea level. Infected French bean (*Phaseolus vulgaris*) plants showing typical symptoms of white mold caused by *Sclerotinia sclerotiorum* (Lib.) de Bary were collected from the Experimental Farm. The target pathogen was isolated on Potato Dextrose Agar (PDA) media and incubated at 25±2°C. Pure culture of the pathogen was obtained through hyphal tip culture. Five widely accepted saprophytic antagonists of the plant pathogens, viz., *Trichoderma harzianum* Rifai, *Trichoderma viride* Pers, *Trichoderma koningii* Oudem, *Gliocladium virens* Millers, *Aspergillus flavus* Link and *Aspergillus terreus* Thom were obtained from the culture collections of the Department of Plant Pathology, AAU, Jorhat. Pure culture of *Trichoderma koningii* was collected from Indian Type Culture Collection (ITCC No. 7112), Division of Plant Pathology, Indian Agricultural Research Institute (IARI), New Delhi.

Compatibility of *T. harzianum* with commonly used soil antagonists viz., *T. koningii*, *T. viride*, *A. terreus*, *A. flavus* and *G. virens* was tested by dual culture technique (Das, 1992). Mass multiplication of the highly virulent isolate of the pathogen (*S. sclerotiorum*) was done on maize-meal-sand medium. Mass multiplication and soil application of bioagents was done on wheat bran medium. Fifteen day-old culture of *S. sclerotiorum*, *T. harzianum* and *G. virens* multiplied on wheat bran medium were applied @ 5g

and @ 10 g/pot respectively for the pot experiment with French bean cultivar (cv. Contender) susceptible to white mold. Different treatment combinations with 6 replications as T₁ – Soil application of *T. harzianum* + fungicidal spray; T₂ – Soil application of compatible antagonist + fungicidal spray; T₃ – *T. harzianum* + compatible antagonist; T₄ – Fungicidal spray at recommended dose; T₅ – *T. harzianum* (alone); T₆ – Compatible antagonists (alone); T₇ – *S. sclerotiorum* (control); T₈ – Absolute control was carried out. Laboratory and pot experiment data were subjected to Statistical analysis. Completely Randomised Design (CRD) and Fischer's method of analysis of variance (ANOVA) was employed for statistical analysis of the collected data.

RESULTS AND DISCUSSION

The symptoms produced by *Sclerotinia sclerotiorum* in French bean were first seen just above the soil surface on germination of sclerotia to mycelia at 15 days after emergence of french bean plants. The biocontrol agents viz., *Trichoderma harzianum*, *Trichoderma koningii*, *Trichoderma viride*, *Aspergillus terreus*, *Aspergillus flavus* and *Gliocladium virens* isolates showed significant inhibition of *S. sclerotiorum*.

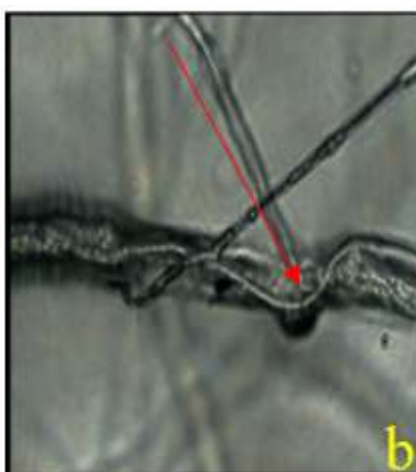
Relative compatibility of *T. harzianum* with soil antagonists

Microscopic observation showed that the hyphae of *S. sclerotiorum* were directly parasitized by the bioagents. It was observed that the radial growth of *T. harzianum* was more as compared to other soil antagonists on dual culture assay except in case of *T. harzianum* and *A. terreus* where the *A. terreus* was seen to suppress the growth of *T. harzianum* (Table 1; Fig.1). Based on percent inhibition of mycelial growth of *T. harzianum* and other soil antagonists, it was observed that *T. harzianum* was slightly antagonistic to *T. koningii*, *T. viride* and *A. flavus* whereas the *A. terreus* was moderately antagonistic to *T. harzianum*. Compatible pair of fungal isolates either showed very small degree of inhibition zone. The best pair of compatible antagonists was found to be *T. harzianum* - *G. virens* (Table 2). Lysis of *T. harzianum* hyphae was observed by *A. terreus* thus depicting moderately compatible reaction (Fig. 2; Fig. 3).

Compatible Bioagents to Enhance Efficacy Against *Sclerotinia sclerotiorum*

Table 1. Radial growth of *T. harzianum* with other soil antagonists in dual culture at 72 h of incubation *in vitro*

Treatment	Radial growth (cm) of antagonists over control after 72 hours of incubation					
	T.h	T.k	T.v	A.t	A.f	G.v
T ₁ = <i>Trichoderma harzianum</i> (T.h) + <i>Trichoderma koningii</i> (T.k)	5.34	5.19	-	-	-	-
T ₂ = <i>Trichoderma harzianum</i> (T.h)+ <i>Trichoderma viride</i> (T.v)	6.80	-	6.51	-	-	-
T ₃ = <i>Trichoderma harzianum</i> (T.h) + <i>Aspergillus terreus</i> (A.t)	3.12	-	-	5.01	-	-
T ₄ = <i>Trichoderma harzianum</i> (T.h) + <i>Aspergillus flavus</i> (A.f)	5.26	-	-	-	4.84	-
T ₅ = <i>Trichoderma harzianum</i> (T.h) + <i>Gliocladium virens</i> (G.v)	6.75	-	-	-	-	6.71
T ₆ = <i>Trichoderma harzianum</i> (T.h) (Control)	9	-	-	-	-	-
T ₇ = <i>Trichoderma koningii</i> (T.k) (Control)	-	9	-	-	-	-
T ₈ = <i>Trichoderma viride</i> (T.v) (Control)	-	-	9	-	-	-
T ₉ = <i>Aspergillus terreus</i> (A.t) (Control)	-	-	-	9	-	-
T ₁₀ = <i>Aspergillus flavus</i> (A.f) (Control)	-	-	-	-	9	-
T ₁₁ = <i>Gliocladium virens</i> (G.v) (Control)	-	-	-	-	-	9



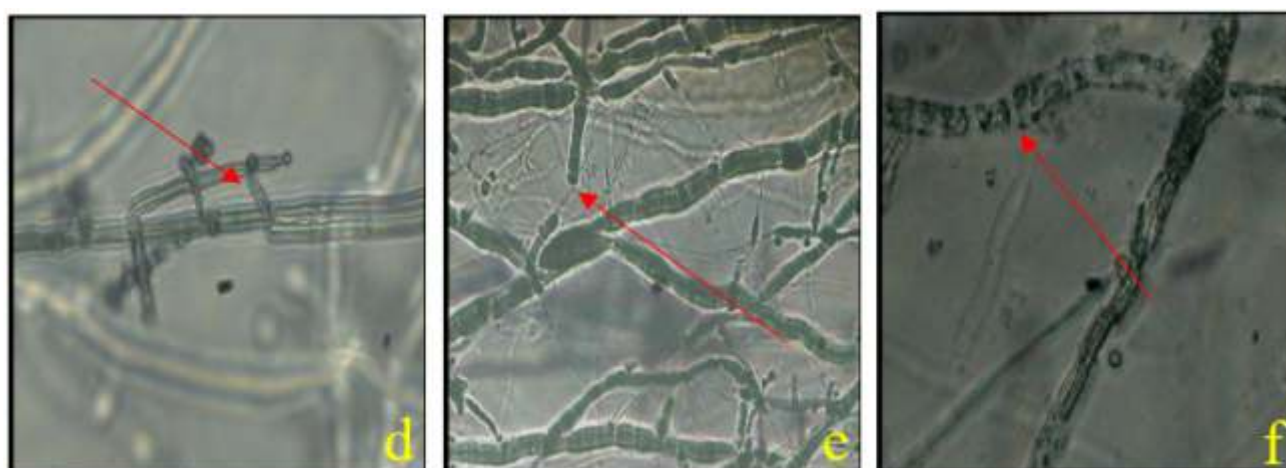


Fig.1 (a-f). Mycoparasitism and lysis of biocontrol agents against *S. sclerotiorum* a. Hyphal coiling of *S. sclerotiorum* by *T. harzianum* b. Hyphal coiling of *S. sclerotiorum* by *G. virens* c. Hyphal coiling of *S. sclerotiorum* by *T. koningii* d. Formation of hook like structure on *S. sclerotiorum* hypha by *T. viride* e. Lysis of *S. sclerotiorum* hypha by *A. terreus* f. Lysis of *S. sclerotiorum* hypha by *A. flavus*

Table 2. Percent inhibition of mycelial growth of *T. harzianum* and other soil antagonists at 72 h of incubation *in vitro*

Treatment	Per cent Inhibition over control						Per cent inhibition of counterpart antagonists	Class
	T.h	T.k	T.v	A.t	A.f	G.v		
T.h + T.k	40.66	42.33	-	-	-	-	1.67	2
T.h + T.v	24.44	-	27.66	-	-	-	3.22	2
T.h + A.t	64.33	-	-	44.33	-	-	20	3
T.h + A.f	41.55	-	-	-	46.22	-	4.67	2
T.h + G.v	25	-	-	-	-	25.44	0.44	1

Class 1 = Less than 1%-No antagonistic effect

Class 2 = 1-5%-Slightly antagonistic effect

Class 3 = 5.1-20%-Moderately antagonistic effect

Class 4 = 20.1-50%-Highly antagonistic effect

Class 5 = More than 50%-Extremely antagonistic effect

(Modified Bell's Scale- Bell *et al.*, 1982)

Compatible Bioagents to Enhance Efficacy Against *Sclerotinia sclerotiorum*

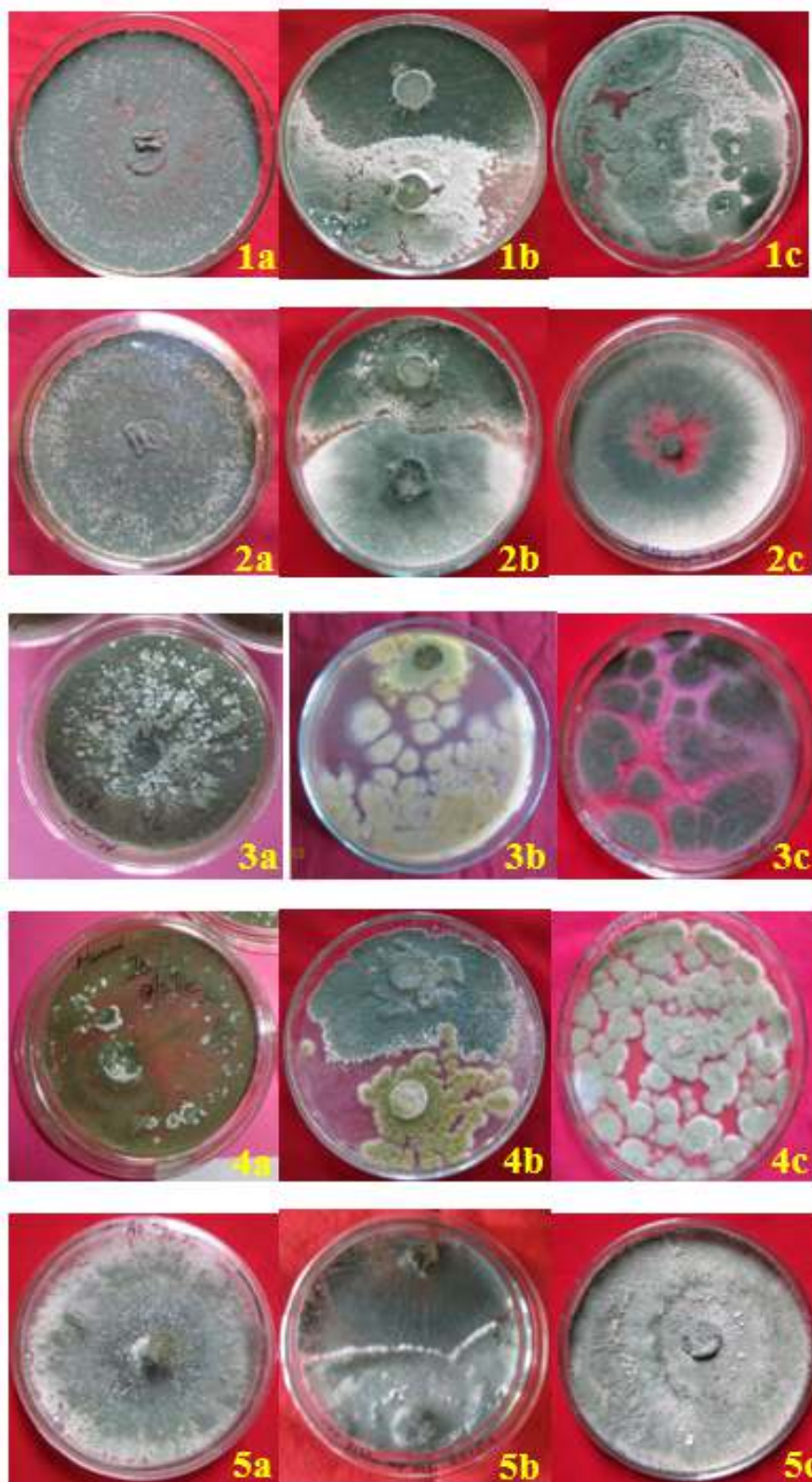


Fig. 2(1a-5c). Compatibility test of *T. harzianum* with soil antagonists (1a-5a) Normal growth of *T. harzianum* (1b-5b) Dual culture of *T. harzianum* with other antagonists 1b. *T. harzianum* + *T. koningii* 2 b. *T. harzianum* + *T. viride* 3b. *T. harzianum* + *A. terreus* 4b. *T. harzianum* + *A. Flavus* 5b. *T. harzianum* + *G. virens* (1c-5c). Normal growth of other antagonists 1c. *T. koningii* 2c. *T. viride* 3c. *A. terreus* 4c. *A. flavus* 5c. *G. virens*

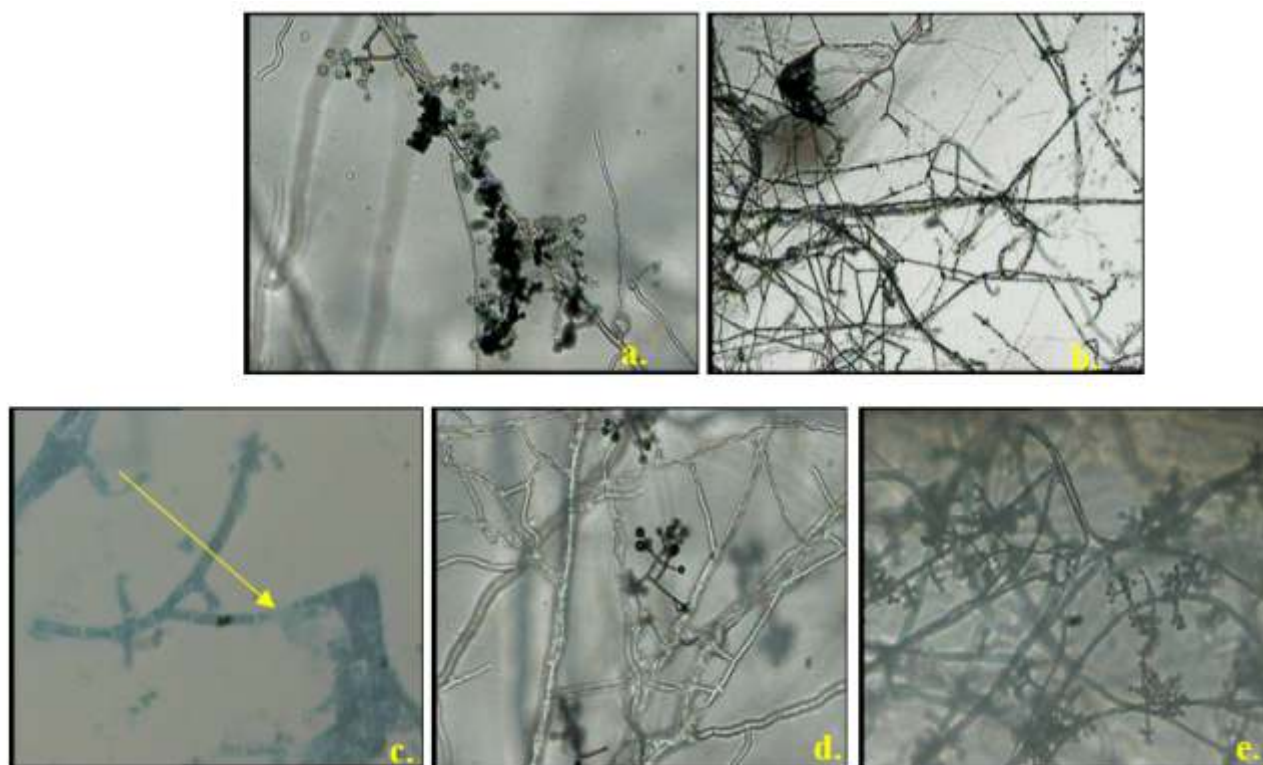


Fig. 3(a-e). Antagonism of *T. harzianum* and other soil antagonists a. *T. harzianum* + *T. koningii* b. *T. harzianum* + *T. viride* c. *T. harzianum* + *A. terreus* d. *T. harzianum* + *A. flavus* e. *T. harzianum* + *G. virens*

Management of white mold disease of French bean with integration of bioagents

Percent disease incidence of white mold in French bean infected by *S. sclerotiorum* was reduced significantly in all the treatments. However, the percent disease incidence was greater when *S. sclerotiorum* was added along with *T. harzianum* and fungicidal spray. Maximum control (13.5%) was achieved with the integration of *T. harzianum*, *G. virens* altogether followed by fungicidal treatment inoculated with *S. sclerotiorum* (Table 3). Effect of the treatments on yield attributing characters in Table 3 showed that maximum increase in height was achieved with integration of *T. harzianum*, and *G. virens* which was followed by only application of fungicide. Both the treatments were at par with each other. The maximum dry weight of root was observed with application of *T. harzianum* and *G. virens* which was at par with all the other treatments including the control. The maximum dry weight of shoot was observed with application of *T. harzianum* and *G. virens* which was at par with fungicidal treatment. The yield per pot increased significantly in all the treatment combinations (Table 3). The

maximum yield per pot was recorded with inoculation of *T. harzianum* + *G. virens* which was at par with *G. virens* + fungicidal spray

In the present study the antagonists *T. harzianum*, *T. koningii*, *T. viride*, *Aspergillus terreus*, *A. flavus* and *Gliocladium virens* could significantly inhibit the mycelial growth of *S. sclerotiorum* in dual culture. The mycelial growth of the pathogen was restricted as evidenced by formation of zone of inhibition. The similar results was observed by Das (2001). The mycoparasitic behaviour of *T. harzianum*, *T. koningii*, *T. viride*, *A. terreus*, *A. flavus* and *G. virens* against *S. sclerotiorum* on 1% water agar revealed that hyphae of *T. harzianum*, *T. koningii*, *T. viride* and *G. virens* ran parallel and adpressed to the hyphae of *S. sclerotiorum*. Then they started to coil and finally cause lysis. *A. flavus* and *A. terreus* showed gradual lysis of the hyphae of the pathogen without mycoparasitism.

T. harzianum showed different reaction to different soil antagonists in dual culture technique. It showed varying degrees of compatibility with *T. koningii*, *T. viride*, *A. flavus* and *G. virens* while

Compatible Bioagents to Enhance Efficacy Against *Sclerotinia sclerotiorum*

Table 3. Effect of integration of compatible bioagents on white mold disease and growth parameters of French bean

Treatment	Percent disease incidence			Growth parameters			
	30 DAS	60 DAS	90 DAS	Height of the plant (cm)	Root dry weight (g)	Shoot dry weight (g)	Yield (g/pot)
T ₁ = Soil application of <i>T. harzianum</i> + Fungicidal spray + <i>S. sclerotiorum</i>	7.58 (15.98) ^c	10.86 (19.21) ^c	23.50 (28.99) ^b	20.17 ^d	0.83 ^a	3.80 ^b	204.00 ^c
T ₂ = Soil application of <i>G. virens</i> + Fungicidal spray + <i>S. sclerotiorum</i>	8.48 (16.93) ^b	11.00 (19.34) ^c	22.6 (28.41) ^{bc}	23.17 ^c	0.74 ^a	2.65 ^b	229.99 ^a
T ₃ = <i>T. harzianum</i> + <i>G. virens</i> + <i>S. sclerotiorum</i>	6.16 (14.37) ^d	8.96 (17.34) ^d	13.5 (21.55) ^e	30.33 ^a	0.99 ^a	5.36 ^a	230.37 ^a
T ₄ = Seed and foliar spray of fungicide + <i>S. sclerotiorum</i>	7.35 (15.72) ^c	13.58 (21.61) ^{bc}	19.25 (26.02) ^d	29.17 ^a	0.36 ^a	5.09 ^a	212.31 ^b
T ₅ = <i>T. harzianum</i> + <i>S. sclerotiorum</i>	7.75 (16.16) ^c	12.19 (20.42) ^c	21 (27.26) ^d	26.00 ^b	0.55 ^{ab}	2.48 ^{bc}	196.08 ^c
T ₆ = <i>G. virens</i> + <i>S. sclerotiorum</i>	8.58 (17.03) ^b	14.38 (22.25) ^b	22.23 (28.13) ^d	25.60 ^b	0.42 ^a	2.65 ^b	195.01 ^c
T ₇ = <i>S. sclerotiorum</i> (control)	18.16 (25.21) ^a	22.83 (28.52) ^a	37.66 (37.85) ^a	18.00 ^e	0.31 ^a	1.03 ^d	181.00 ^f
T ₈ = Absolute control	2.45 (8.98) ^e	3.84 (11.28) ^e	5.48 (13.53) ^f	24.00 ^{bc}	0.48 ^a	1.25 ^c	200.16 ^d
S.Ed ±	0.25	0.65	0.38	0.78	0.15	0.57	1.27
CD _{0.05}	0.57	1.52	1.34	1.77	0.33	1.29	2.86

moderate antagonistic behavior by *A. terreus* against *T. harzianum*. The most compatible antagonists with *T. harzianum* was found to be *G. virens* followed by *T. koningii*, *T. viride* and *A. flavus*. There is not much information on the compatibility between different fungal biocontrol agents. Variation in compatibility of *T. harzianum* with *G. virens*, *T. koningii*, *T. viride* and *A. flavus* may be due to the competition for food and space. Although lysis of *T. harzianum* by *A. terreus* was observed in the interaction with the presence of inhibition zone which indicated that there might be either some secretion of non-volatile compounds or might be due to mycoparasitism. Rayner and Webber (1984) reported that fungi utilizing the same resource may interact in at least three broadly defined ways – mutualistically and neutralistically. Baiswar and Chandra (2007) reported that *T. harzianum* and *T. viride* were found compatible with each other for the

management of corm rot of *Gladiolus* which give support to the present findings. Biocontrol attributes also are more in consortia in comparison to using single isolates (Thakkar and Saraf *et al.*, 2015).

The results on integration of the bioagents in different treatment combinations revealed that maximum disease control was recorded in the plants treated with both *T. harzianum* and *G. virens* indicating that integration of more than one bioagents has high potential of success. Integration of *T. harzianum* and *G. virens* proved much effective against white mold of French bean under pot condition, which also improved in growth parameter and yield significantly over individual components. This might be due to either early establishment of antagonist in rhizosphere and release of antibiotic substance or direct competition between three organisms viz., *T. harzianum*, *G. virens*

and *S. sclerotiorum*, thereby reducing the disease incidence which is similar to the findings of Jhumishree *et al.* (2018) and Patole *et al.*, (2017). Application of *G. virens* with fungicidal spray did not exhibit much difference in yield and infact these were at par with each other.

CONCLUSION

Integration of more than one biocontrol agents constitutes a very promising way of managing plant pathogens due to its minimal interference with the biological equilibrium in nature. It may be concluded that integration of *T. harzianum* and *G. virens* for combating white mold of French bean caused by *S. sclerotiorum* with correspondence increased in yield and plant biomass. Although, foliar application of the fungicide (0.2%) was also effective in reducing the incidence of the disease, its application alone should preferably be avoided because chemical control measures are not only uneconomical, but these are also not eco-friendly for their potentially hazardous toxic effects.

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Constraints Encountered by the Flower Growers in Krishnagiri District

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ABSTRACT

The study entitled “Constraints encountered by the flower growers In Krishnagiri District” was aimed to identify the constraints encountered in flower cultivation and marketing and suggest suitable strategies to overcome the same. Krishnagiri district was purposively selected based on higher area under flower cultivation. The study was undertaken in ten villages in Kelamangalam and Thally blocks of Krishnagiri district in Tamil Nadu. One hundred and twenty flower growers were selected by using proportionate random sampling technique representing sixty farmers from each flower growers *viz.*, Chrysanthemum and Rose. Data were collected and analyzed using Garette ranking technique. Major constraints encountered by the flower growers in cultivation of flowers were imbalanced manuring, lack of rain fall, lack of information, high cost of input, unawareness about that diseases and pests, lack of knowledge on other market price.

Key Words : Constraints, Knowledge, Marketing, Strategies.

INTRODUCTION

India is second largest in the world in floriculture next to China. Production of flowers was estimated to be 2910 thousand MT of which loose flowers accounted to 2263 thousand MT and cut flowers to 647 thousand MT. Tamil Nadu is a foremost state in area under production of flowers in the country. Tamil Nadu takes the third place in regard to area, by cultivating the flowers in an area of 34,227 Ha and Dharmapuri, Salem, Dindigul, Krishnagiri, and Tiruvannamalai districts. A huge number of flowers jasmine, tuberose, rose, chrysanthemum, marigold, crossandra, barleria, lily, limonium, alstemeria, liatris, freesia, iris, lisianthus, calla, carnation, gerbera and anthurium are commercially cultivated in the state. Many hi-tech units with export tie-ups are there in the state. Dindigul, Krishnagiri, Dharmapuri, Salem, Vellore, Madurai, Tiruvannamalai, Tirunelveli and Erode are the major flowers growing districts in our state (TANHODA). The major flowers grown are jasmine, rose, crossandra, chrysanthemum, marigold, tuberose, China aster and nerium (Kumar et al, 2016). The soil and climatic conditions of South India are ideally suited for floriculture (Shivkumar, 2009). Krishnagiri district was purposively selected based on higher area (2852 ha) under flower cultivation. Flower

cultivation is the primary occupation in Krishnagiri district as more than 80 percent of the people are actively involved in flower cultivation, harvesting, distribution, garland making and marketing. Thus, the study was undertaken to delineate constraints being faced by the flower growers.

MATERIALS AND METHODS

The study was undertaken in ten villages in Kelamangalam and Thally blocks of Krishnagiri district in Tamil Nadu. One hundred and twenty flower growers were selected by using proportionate random sampling technique representing sixty farmers from each flower growers *viz.*, Chrysanthemum and Rose. Data were collected from each respondent through pre-tested interview schedule and the collected data were analyzed by using appropriate statistical tool, Garrett ranking method.

RESULTS AND DISCUSSION

Data were collected on Technological, Physical, Extension, Economics, Personal and marketing constraints in flower cultivation from each respondent through pre-tested interview schedule. The collected data were analyzed by using Garrett Ranking method and presented in Tables

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Technological and Physical constraints**Table 1. Technological and Physical Constraints encountered by the flower growers.**

Sr. No	Constraint	Flower growers (n=120)	
		Mean Score	Rank
I	Technological constraints		
1.	Imbalanced manuring	70.88	I
2.	Undesirable climatic factors	69.74	II
3.	High risk and uncertainty of returns	68.33	III
4.	Major incidence of pest and diseases	63.23	IV
II	Physical Constraints		
1.	Lack of rainfall	76.00	I
2.	Labour scarcity	75.13	II
3.	Lack of drainage facilities	73.63	III
4.	Lack of irrigation	73.50	IV
5.	Non availability of inputs	71.63	V

With regard to technological constraints on flower cultivation, imbalanced manuring was the major constraint and was assigned first rank (70.88 mean score) followed by undesirable climatic factors (II rank, mean score 69.74). High risk and uncertainty of returns was the third technological constraint (68.33 mean score) followed by major incidence of pest and diseases (IV rank, 63.23 mean score). Regarding the physical constraints on flower cultivation, lack of rainfall was the major constraint and was assigned rank first (76.00 mean score) followed by labours scarcity (II rank, 75.13 mean score), lack of drainage facilities (III rank, 73.63 mean score). Lack of irrigation was the fourth physical constraint (73.50 mean score) followed by non-availability of input (V rank, 71.63 mean score). This finding was in conformity with the findings of Phukan *et al* (2017) who revealed that non

availability of bio-fertilisers and bio control agents were the constraints of horticultural growers of East Sikkim. Due to drought or scarcity of rainfall in the past years, the respondents experienced minimum flower production. High wages and guarantee of employment almost throughout the year offered in the secondary and tertiary sectors tempted the labours to prefer non-agriculture oriented jobs. Migration of agricultural labourers caused labour scarcity especially during peak season. The same has been resulted in the study area.

Flower crop, plucking of flowers is a labour consuming work. Early morning is ideal time for flower plucking and it is seen as part time work among labours so, they are showing less preference towards flower plucking and there will be a heavy demand of labour and they in turn will demand higher wages.

Extension and Economic constraints

With regard to extension constraints on flower cultivation lack of information was the major constraint and assigned was rank first (71.02 mean score) followed by lack of training on export process (II rank, 66.77 mean score). Lack of technical guidance was the third extension constraint (66.20 mean score) followed by lack of training on flower crop protection

practices (IV rank, 66.06 mean score). Respondents in the study area showed lack of awareness about any technological information and trainings. The extension officers and agricultural officers should visit the respondents at regular intervals and should provide technical guidance, training on export process and training on flower crop protection for the betterment of the farmers.

Constraints Encountered by the Flower Growers in Krishnagiri District

Table 2. Extension and Economic Constraints encountered by the flower growers

Sr. No	Constraint	Flower growers (n=120)	
III	Extension constraints	Mean Score	Rank
1.	Lack of information	71.02	I
2.	Lack of training on export process	66.77	II
3.	Lack of technical guidance	66.20	III
4.	Lack of training on flower crop protection practices	66.06	IV
IV	Economic constraints		
1.	High cost of input	71.73	I
2.	High rate of interest	71.02	II
3.	Lack of credit	70.59	III
4.	High cost of labour	69.60	IV

* Multiple responses

With regard to economic constraints on flower cultivation high cost of input was the major constraint and was assigned first rank (71.73 mean score) followed by high rate of interest (II rank, 71.02 mean score). Lack of credit was the third economic constraint (70.59 mean score) followed by high cost of labour (IV

rank, 69.60 mean score). As the cost of input is high and the respondents required a huge amount which was not affordable by them. Banks who is providing finance to the respondents gives only a limited amount by which the respondents are not able to meet the cost of input and cost of labours.

Personal and marketing constraints

Unawareness about the pest and diseases on was the major personal constraint which was assigned first rank (70.59 mean score) followed by Lack of knowledge on post-harvest technologies (II rank, 67.90 mean score). Lack of scientific knowledge on cultivation practices was the third personal constraint (66.06 mean score) followed by lack of disease resistant variety (IV rank, 65.92 mean score).

Due to Unawareness of trainings, meeting by the extension officials, the flower growers were not aware about that diseases and pests on the flowers. This problem could be solved only when the flower growers attend meeting and training. The extension officials should also give proper and regular awareness and training to the flower growers. Lack of knowledge on other market price was the major marketing constraint

which was assigned first rank (76.08 mean score) followed by lack of transport facilities (II rank, 75.86 mean score), lack of adequate marketing facilities (III rank, 75.32 mean score), lack of regulated markets (IV rank, 74.99 mean score), exploitation by middleman (V rank, 73.48 mean score). Lack of knowledge on export process was the sixth marketing constraint (72.93 mean score) followed by lack of storage facilities (VII rank, 71.31 mean score).

Proper and timely transport facilities can be solved by provided good transport facilities by the government. The market prices prevailing in nearby markets should be known to the flower growers through display the rates in Uzhalavar Sandhai and trade centre notice boards and newspaper also so that there is less prices fluctuation. Direct procurement of flowers can reduce the exploitation of middlemen, so that there farmers get complete profit. Good ware house

Table 3. Personal and marketing Constraints encountered by the flower growers.

Sr. No	Constraints	Flower growers (n=120)	
V	Personal constraints	Mean Score	Rank
1.	Unawareness about the pest and diseases	70.59	I
2.	Lack of knowledge on post -harvest technologies	67.90	II
3.	Lack of scientific knowledge on cultivation practices	66.06	III
4.	Lack of disease resistant variety	65.92	IV
VI	Marketing constraints		
1.	Lack of knowledge on other market price	76.08	I
2.	Lack of transport facilities	75.86	II
3.	Lack of adequate marketing facilities	75.32	III
4.	Lack of regulated markets	74.99	IV
5.	Exploitation by middleman	73.48	V
6.	Lack of knowledge on export process	72.93	VI
7.	Lack of storage facilities	71.31	VII

and cold storage units should be set up by the government at every market and provided with minimum charges to farmers so, by that there is no loss during storage.

CONCLUSION

Direct procurement of flowers can reduce the exploitation of middlemen, so that there farmers get complete profit. Good ware house and cold storage units should be set up by the government at every market and provided with minimum charges to farmers so, by that there is no loss during storage. The growing demand of flowers in the domestic as well in as the export markets need concerted effort for its marketing on the part of the government as well as the private entrepreneurs. At present, due to lack of a proper market patch and cold storage in market, growers are often forced to sell their produce at whatever price prevailing in the market. This problem can be addressed by establishing cold storage facility in the market. Developing an integrated approach for floriculture including input needs, technology and guidance, resource management, infrastructure development, marketing facilities, financial assistance, export promotion, entrepreneur friendly policies etc., would lead to a balanced growth of the floriculture industry.

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Eco Friendly Management of Bacterial Wilt of Brinjal (*Solanum melongena* L) for Sustainability and Livelihood of Small and Marginal Farmers of Assam

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ABSTRACT

The Brinjal (*Solanum melongena* L) is a common and popular vegetable crop grown extensively in Assam and major source of income for the small and marginal farmers of the state. The major constraint in the production of brinjal is the bacterial wilt disease caused by *Ralstonia solanacearum*. It constitutes a serious obstacle to the cultivation of brinjal, causing total damage of plantations before (15-23% loss) as well as after bearing fruits (54.6- 62.5%). Biological control through the use of natural antagonistic microorganisms has emerged as one of best eco friendly management system, a promising alternatives to chemical pesticide. Local strain of biocontrol agents were tested for finding out the best bio-agent in suppressing the attack of *Ralstonia solanacearum* on Brinjal under field condition. Among all tested combination, the treatment containing combination of *Trichoderma viride* + *Pseudomonas fluorescens* applied in Seed+ Root + Soil methods of application was found most effective in reducing the incidence (19.80%) of bacterial wilt disease under field situation. Highest per plant yield, (3866.77 g/plant), plant height, fruit size (337.02 gram per fruit) and numbers were also recorded from the same combination and the same methods of application.

Key Words: Brinjal, Bacterial wilt, Bio control agents, Eco- friendly.

INTRODUCTION

Biological control through the use of natural antagonistic microorganisms has emerged as one of the promising alternatives to chemical control. Biological control appears to take place on the plant surface by the activity of epiphytic micro flora. This is an important consideration when applying chemicals to plants, since there is a risk of killing natural antagonists of pathogens other than the one being treated. The most common mechanisms for microbial antagonism of plant pathogens are parasitism, predation, competition, induced resistance and the production of antimicrobial substances. Often, several mechanisms act together. While it is unlikely that biological control will completely replace chemical pesticides in the foreseeable future, we can expect that there will be some decline in the use of chemicals. So far, most approaches have involved the single antagonist concept, although a biological systems approach, where disease is suppressed from several angles, might provide a better alternative. Similarly, the use of biological control agents could be used as one component of an integrated management program to achieve the best possible results.

The Brinjal (*Solanum melongena* L) is a common and popular vegetable crop grown extensively in Assam and is a major source of income for the small and marginal farmers of the state. The major constraint in the production of brinjal is the bacterial wilt disease caused by *Ralstonia solanacearum* (Yabuuchi *et al*, 1996). It is a soil borne and can survive in soil upto 1-10 years. It constitutes a serious obstacle to the cultivation of brinjal, causing total damage of plantations before as well as after bearing fruits. Bacterial wilt can account for 15 to 23% loss of brinjal crops before they bear any fruit and the average reduction in yield may be 54.6 to 62.5% due to further death of the bearing plants before full maturity (Das and Chattopadhyay, 1955). (Chao *et al*, 1997). Biological control could have an important role in the management of bacterial wilt (Akiew *et al*, 1993, Anuradha *et al.*, 1990). The specific objectives of the present study were to assess the nature and intensity of damage caused by the bacterial wilt disease, study efficacy of different antagonist against the wilt disease under field condition. To evolve suitable Biocontrol measure and disease management strategies for growers.

MATERIALS AND METHODS

Diseased leaf symptoms of Brinjal (*Solanum melongena* L) with suspected bacterial symptoms were collected for present study. The characteristics disease symptoms of the collected samples were observed and recorded. Leaf samples showing suspected bacterial were examined for bacterial ooze and bacterium were isolated from infected tissues in pure culture using streak plate method on Nutrient Agar Medium (NAM). Periodic transfer of the cultures were made to maintain the viability of the preserved bacteria. After isolation of the causal organisms the pathogenicity test was conducted through Koch's postulates (1882) by root inoculation technique (Winstead and Kleman, 1952). Another set of plants were inoculated with sterile distilled to serve as a control.

Bio agents used for management of bacterial wilt pathogen

Local strain of biocontrol agents like *Trichoderma viride*, *Trichoderma harzianum* and *Pseudomonas fluorescens* were collected and was tested in alone or combination with each other against *Ralstonia solanacearum* in field condition

Antagonists enriched Farm yard manure (FYM) for soil application:

One kg of talcum powder packets inoculated with bioagent like *Trichoderma viride*, *T. harzianum* and *Fluorescent Pseudomonas* each were mixed separately in 100 kg of FYM and sprinkled some amount of water over it to maintain the required humidity. After that the mixture was covered with gunny bags for 0 days. After 10 days of incubation the antagonist were rapidly multiplied in the farm yard manure and ultimately antagonist enriched FYM were produced which were ready for soil application.

Evaluation of potential biocontrol agents under field condition:

Local strain of biocontrol agents like *Trichoderma viride*, *Trichoderma harzianum* and *Fluorescens Pseudomonas* were tested either alone or in various combinations for finding out their efficacy in suppressing the *Ralstonia solanacearum* the causal agent of bacterial wilt diseases on Brinjal (*Solanum melongena* L) under field conditions.

Preparation of talc-based formulation of fungal and bacterial bio-agents

Culture of fungal cells were maintained on the potato Dextrose medium (PDA) and bacterial cell were maintained in nutrient agar (NA) medium. Both *Trichoderma spp.* and fluorescent *Pseudomonas* were multiplied separately in talcum powder at 1:3 ratios (v/w). Polypropylene bags with 1 kg finely sieved talcum powder were taken for multiplication of both fungi and bacteria, there added 10 ml filter water and exposed to steam in autoclave at 100 °C. 1% of Carboxy methyl cellulose (CMC) solution, 1% of Manitol solution and 0.1% of Humic acid solution were added to the Polypropylene bags containing 1 kg of talcum powder at the time of inoculation of antagonistic fungi or bacteria to hold it together. The mixture were incubated at $26 \pm 2^\circ$ for 24 hr for multiplication of *Pseudomonas fluorescent* and *Trichoderma spp* respectively. After 24 hr of incubation the packets were shaken manually for uniform spread of antagonist in the talcum powder. This operation was repeated after 48hr, 72 hr, 96hr, 120hr, 144hr of incubation, respectively. After 168 hr (7 days) of incubation and continuous shaking the inoculated packets were brought out from the incubator and evaluated for presence of required population of the antagonists (Vidhyasekaran and Muthamilan, 1995).

Mass multiplication of antagonistic agents on Farm Yard Manure (FYM)

In order to get antagonist enriched FYM, 1kg of biopesticide was mixed with 100 kg of dry cow dung. The mixture was sprinkled with water and covered with gunny bags for its multiplication. After 10 – 12 days, the applied bioagent multiplied rapidly over the used dry cowdung and finally the 100kg of farm yard manure were converted into antagonist enriched FYM and ready for soil application. (Jeyarajan *et al*, 1998; Jacob *et al*, 1994). A field study was conducted at the with three replication during Oct-Feb for 3 consecutive years. Analysis of yield and disease incidence of bio agent treated crops: Data were recorded on Disease incidence (%), Yield/plant (g), Plant height, Number of fruits per plant, average fruit weight of the bio agent treated plants. Appropriate statistical tools were used to analyze the data following the procedure described (Gomez and Gomez, 1984).

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Preparation of planting material/Collection of healthy seed and sowing in seed bed:

Healthy seeds of Brinjal were collected from the diseased free plot. In order to conduct field experiment of bio-agent efficacy against the wilt pathogen of Brinjal, seeds were sown in standard size of seed bed just after treated with antagonistic bacteria and fungi in alone or combination with each other @ of 1 gm antagonist / 10 gm of seeds. In order to protect the seedling of both the crops from insect infestation, caging of nursery bed was done.

Treatment:

A1	<i>Trichoderma viride</i>
A2	<i>T. harzianum</i>
A3	<i>Pseudomonas fluorescens</i>
A4	<i>T. viride</i> + <i>P. fluorescens</i>
A5	<i>T. harzianum</i> + <i>P. fluorescens</i>
A6	Chemical control
A7	Control

Seed treatment with antagonist (1 gm/ 10 gm of seed)

Root treatment with antagonist (1 kg in 2 litres of water for 1000 seedlings) &

Soil application with antagonist (100g antagonist enriched dried cow dung/plant)

Efficacy of antagonists on wilt disease incidence under field condition

In order to study the efficacy of bio control agents against the Bacterial wilt pathogen, field trials were conducted at the farmers sick plot during Rabi season for 3 consecutive years in 2018–19, 2019-20 & 2020-21. Brinjal cultivar Thur Bengena were grown in the nursery and transplanted into the field 3-4 weeks after sowing. Each plot consisted of 9 plants spaced 50 cm apart for brinjal. Treatments were arranged in Complete Block Design using Strip Plots with three replications. Chemical fungicide Copper oxychloride (0.1%) was used as the standard check. Treatments were assigned as described in the Materials and Methods.

Methods of application

M1	Seed treatment
M2	Seed + Root treatment
M3	Seed + Soil treatment
M4	Seed + Root + Soil treatment

Number of Treatments						
A1M1	A2M1	A3M1	A4M1	A5M1	A6M1	
A1M2	A2M2	A3M2	A4M2	A5M2	A6M2	
A1M3	A2M3	A3M3	A4M3	A5M3	A6M3	
A1M4	A2M4	A3M4	A4M4	A5M4	A6M4	
Control						

Number of Replications: 3

Experiment Design: Complete Block Design using Strip Plots

RESULTS AND DISCUSSION

Ooze test for preliminary diagnosis of bacterial diseases:

White coloured slimy bacterial cells oozed out from all the suspected diseased samples. Infected leaf sections also showed the oozing of bacterial cells, indicating that the disease is caused by bacteria. Samples without characteristic disease symptoms did not produce any ooze indicating healthy samples.

Isolation of the bacteria from the diseased plant parts:

The colonies were observed as Light pink in colour, opaque, circular, medium surface, entire margin with low convex elevation.

Pathogenicity Test:

Koch postulation of the isolate was performed to prove the pathogenicity by root inoculation technique. Inoculated seedlings of the plants

reproduced the typical symptoms observed on the naturally infected plant within 10 days. In control plants inoculated with sterile distilled water without bacterial inoculums, no such symptoms were reproduced.

The data (Table 1) represent the effect of tested treatments on yield and disease incidence in Brinjal under the field experiment. In field experiment, all the treatments were found significantly superior to the absolute control in reducing the incidence of the Bacterial wilt in Brinjal. The minimum disease incidence (24.43 %) was recorded from the combination of *T. viride* and *P. fluorescens* application among all antagonist treatments. However, this was the second best treatment when compared to Copper oxychloride (0.1%) application which reduced the disease incidence to 18.90 per cent. In case of absolute

control the disease incidence was as high as 51.07 per cent. Among the individual antagonist *T. viride* was found the best recording 30.44 per cent disease incidence while *T. harzianum* was observed least effective showing the disease incidence of 41.62 per cent.

The highest average fruit yield (3896.93 g/plant) was recovered from chemically treated plants followed by combination of *T. viride* + *Pseudomonas fluorescens* with an average fruit yield of 3154.29 gram per plant. Among individual antagonist, *T. viride* performed the best to produced an average fruit yield of 2638.66 gram perplant. Plants treated with *Trichoderma harzianum* showed the lowest yield (1964.60 g/plant) among all the treatments. However, all the treatments gave statistically superior yield than the control.(Fig1)

Table 1. Effect of antagonist applied in different methods on yield and disease intensity of Brinjal under field condition

Antagonist	Yield(g/Plant)				Disease intensity (%)			
	Method of Application				Method of Application			
	M1	M2	M3	M4	M1	M2	M3	M4
<i>T.viride</i> (A1)	2054.987	2304.96	2681.76	3512.93	37.62	33.21	28.76	22.17
<i>T. harzianum</i> (A2)	1260.81	1513.13	1608.65	1862.33	45.16	41.66	40.35	39.32
<i>Fluorescen Pseudomonas</i> (A3)	1447.06	1682.32	1948.02	2241.36	41.77	40.44	36.94	34.47
<i>T.viride</i> + <i>P.fluorescens</i> (A4)	2605.58	2911.98	3232.83	3866.77	28.65	26.00	23.28	19.80
<i>T.harzianum</i> + <i>P.fluorescens</i> (A5)	1624.91	2203.733	1429.12	2600.64	40.82	36.38	33.54	27.33
Chemical (A6)	3449.06	3504.97	4038.40	4595.29	20.33	20.78	18.15	16.32
Control(A7)	854.76	854.76	854.76	854.76	51.07	51.07	51.07	51.07

	CD (5%)	CV (%)	CD (5%)	CV (%)
Antagonists	205.55	7.08%	1.39	2.98%
Methods of application	173.42		1.18	
Antagonists x Methodof application	261.67		1.69	

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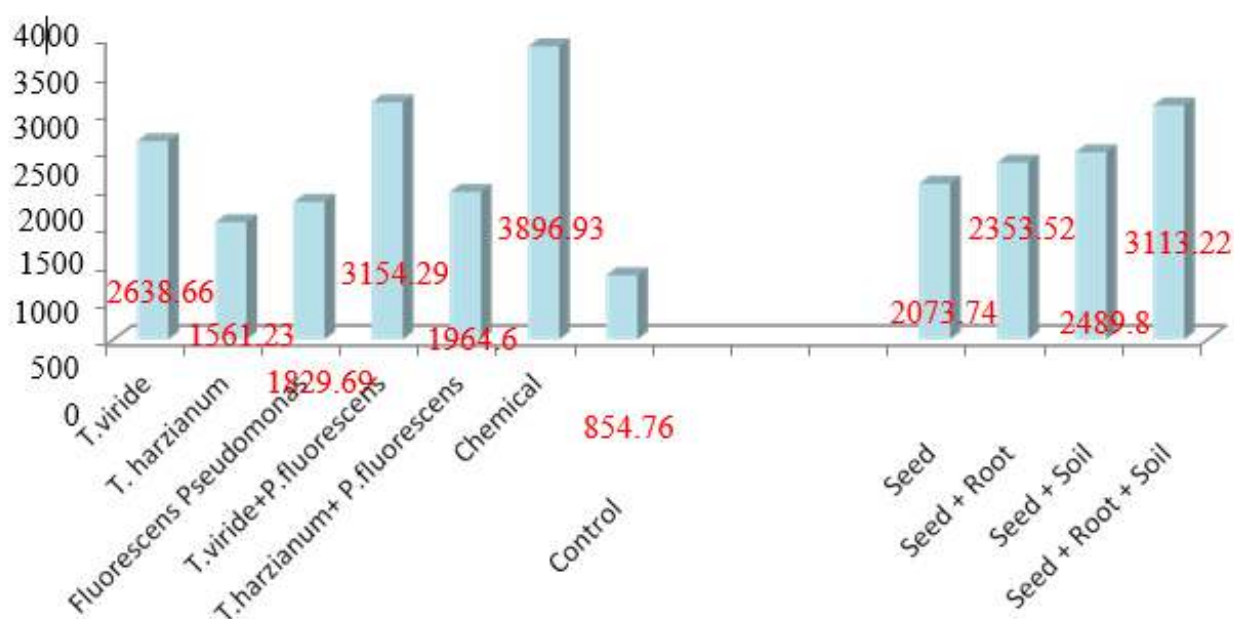


Fig.1. Average yield of Brinjal (g/plant) under different Antagonist treatments and methods of application in field condition

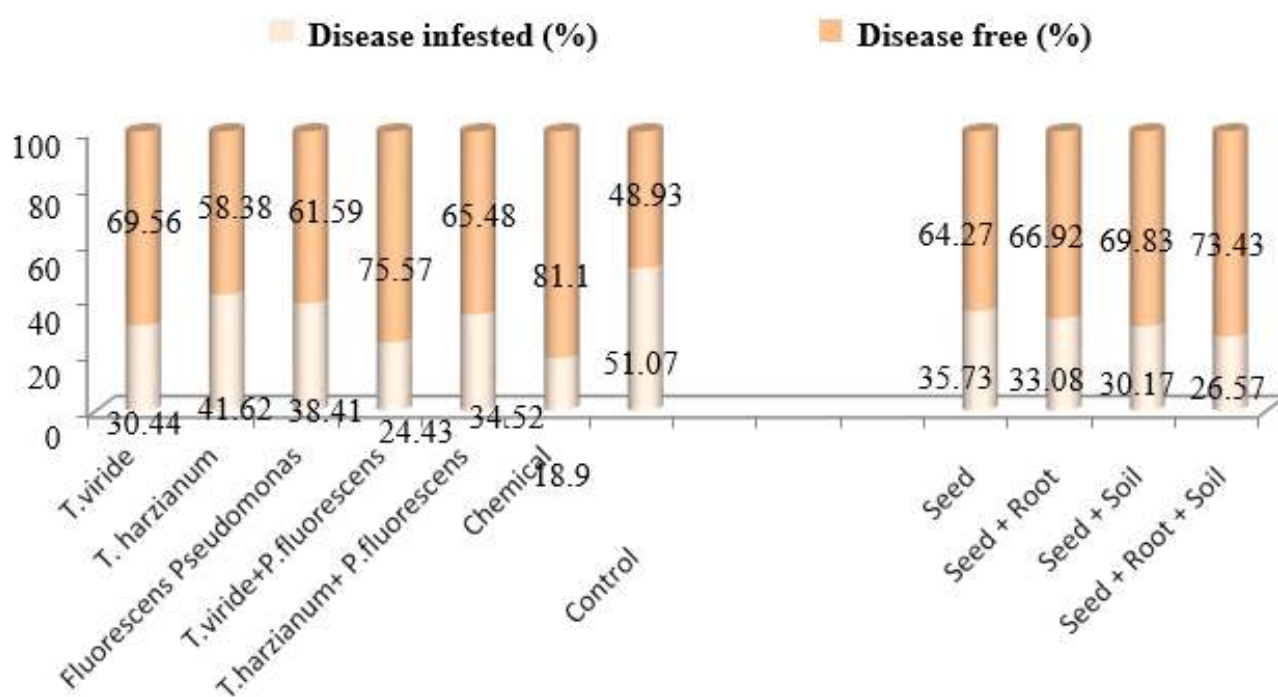


Fig.2 Average wilt incidence (%) of Brinjal under different Antagonist treatments and methods of application in field condition

Comparison of different methods of application showed that the seed + root + soil method of application performed the best to minimise the disease incidence and to generate the maximum yield for all the antagonist and chemical treatments followed by seed + soil method of application.

Regarding interaction effect of antagonists/chemicals and their methods of application, the data (Table 1) show that treatment *T. viride* + *Pseudomonas fluorescens* applied through seed + root + soil method of application recorded the maximum yield (3866.77 g/plant) among all the tested treatments using antagonist and their combinations. However, the highest yield (4595.29 g/plant) among all the treatments was recorded from copper oxychloride treatment applied through seed + root + soil method of application. (Table 1)

The data (Table 2) reveal that average plant height, average number of fruits and average fruit weight of Brinjal increased significantly under all the treatments comprising different antagonists and chemicals over the control. The highest average plant height (132.03 cm) was observed in copper oxychloride treated plants followed by *T. viride* + *Pseudomonas fluorescens* treatment (108.24) while highest average fruit weight of 337.02 gram per fruit was found in *T. viride* + *Pseudomonas fluorescens* treatment followed by copper oxychloride treated plants (334.88g/fruit). In respect of average number of fruits, *T. viride* + *Pseudomonas fluorescens* treatment was found at par with copper oxychloride treatment. Among the different methods of application, seed + root + soil method of application found the best to increase average plant height, average number of fruits and average fruit weight over all the treatments.

Table 2. Effect of antagonist in different methods on Plant height, fruit numbers and average fruit weight of Brinjal under field condition

Antagonist	Plant height(Cm)				Fruit numbers				Average fruit weight(g)			
	Method of Application				Method of Application				Method of Application			
	M1	M2	M3	M4	M1	M2	M3	M4	M1	M2	M3	M4
<i>T. viride</i>	90.57	102.92	105.79	112.70	8.00	8.33	9.33	10.00	256.87	276.31	297.97	351.29
<i>T. harzianum</i>	77.74	80.47	82.46	83.32	6.66	7.33	7.00	8.66	189.31	226.03	229.81	242.57
<i>Fluorescens Pseudomonas</i>	81.40	82.93	88.17	91.00	7.30	8.32	9.00	9.60	198.23	229.38	265.14	280.17
<i>T. viride</i> + <i>P. fluorescens</i>	100.06	103.69	110.17	119.02	9.33	10.66	11.00	13.60	279.27	323.55	358.57	386.68
<i>T. harzianum</i> + <i>P. fluorescens</i>	85.04	85.35	82.05	91.94	8.30	8.60	9.30	10.00	195.77	277.55	204.16	288.96
Chemical	130.35	129.67	132.61	135.48	10.3	11.00	11.60	13.6	334.86	318.63	348.14	337.89
Control	73.85	73.85	73.85	73.85	5.33	5.33	5.33	5.33	159.92	159.92	159.92	159.92

	CD (5%)	CV (%)	CD (5%)	CV (%)	CD (5%)	CV
(%)						
Antagonists	2.58	2.04%	0.36	7.54	11.94	3.41%
Methods of application	1.07		0.782		7.91	
Antagonists x Methods of applications	3.08		1.22		14.87	

Eco Friendly Management of Bacterial Wilt of Brinjal

Lower incidence of Bacterial Wilt disease and higher fruit yield for the crops under study were recorded from *T. viride* + *P. fluorescens* treatment among all the antagonists and their combinations. This combination of *T. viride* + *P. fluorescens* performed the best showing the lowest disease incidence and the highest fruit yield in seed+ root + soil method of application under field condition. Maximum plant height, maximum number of fruits per plant and maximum fruit weight were also reported in same treatment and same method of application. Hence, it was evident from the present experimental results that the combination of *T. viride* + *P. fluorescens* is more effective against *Ralstonia solanacearum* causing Bacterial wilt disease in Brinjal compared to individual antagonist and the other combinations of antagonists considered under study. Rani *et al.*, (2006) also reported that combination of *T. harzianum* (TR20) + *P. fluorescens* (P28) was found most effective in reducing *Rhizoctonia . solani* in chilli. Manoranjitham *et al.*, (2001) reported similar results for tomato. The result indicated the possibility of using of environment friendly native isolates of *Trichoderma viride* and *Pseudomonas fluorescens* based biopesticide for the management of bacterial wilt disease on Brinjal.

CONCLUSION

The results suggested that *Trichoderma viride* and *Pseudomonas fluorescens* based powder formulation of Biopesticide applied as seed treatment, root dip treatment and soil application is an excellent biological option to chemical methods for management of bacterial wilt of Brinjal , encouraging organic production. In addition to the positive impact of organic products on human health, this would provide the farmers a better market for their products as the demand for organic products have been increasing over time and space. Moreover, application of these antagonists further increase the yield , fruit numbers and fruit size of Brinjal ,which would enabling the farmers to earn more and thereby improving their economy and standard of living.

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Economics of Baled Fermented Rice Straw over Conventional Method of Baling System

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ABSTRACT

The farmers of Indo Gangetic Plains of India follows rice-wheat cropping system on large area. In Punjab, Paddy cultivation is practiced on around 3.06 mha in Punjab, generating more than 20 MT of paddy straw. Some farmers burn the paddy residue in the fields for clearing the fields for sowing of wheat due to short window period between harvesting of paddy and sowing of wheat. The loose paddy residue can be managed if the loose paddy residue coming out from conventional combine harvester is managed successfully. The fermentation of paddy residue is one of the alternatives for managing paddy residue. The fermented paddy straw has more nutritive value than untreated paddy straw for feeding the milch animals. The comparative cost analysis of natural fermentation of rice straw in bales over conventional method of baling system was worked out. The total profit under conventional and fermentation baling system was Rs. 5865/ha and Rs. 6519/ha respectively.

Key Words: Paddy residue, Fermented paddy straw, Baling System

INTRODUCTION

Rice-wheat cropping system is being followed in the Indo-Gangetic Plains of India covering about 10.5 mha area, out of which 39.05 % (4.1 mha) area is in Northwestern (NW) states including Punjab, Haryana, Uttarakhand and Western Uttar Pradesh. Presently, in the Northern states of India such as Punjab, Haryana and Uttar Pradesh, there is a huge surplus of paddy straw (about 140 MT), out of which 65.7 % (92 MT) straw is burnt annually (Bhuvaneshwari *et al*, 2019). In Punjab, the area under paddy cultivation was about 3.06 mha with the production of paddy about 20.07 mt generating 20.17 mt of paddy straw (Anonymous, 2019; Anonymous 2020). About 50 % paddy straw was reported to be burnt in fields in Punjab itself whereas 16.9 % in Haryana (7.93 mt) during the year 2018-19 (Anonymous, 2019). Farmers choose to burn the paddy straw in the field due to a lesser window period (only 15 days) between harvesting of paddy and sowing of wheat (Modi *et al*, 2020). Timely management of paddy residues prior to sowing of wheat is a cumbersome job for the farmers. Due to short window period between paddy harvesting and wheat sowing,

the farmers find burning of paddy residue as an easiest way because the loose paddy residue left after the harvesting of paddy with conventional combine harvester hinders the tillage and wheat sowing operations. The burning of paddy straw results in extensive impacts both on and off farm, *e.g.*, losses in soil organic matter, soil nutrients, production and productivity, air quality, biodiversity, water and energy efficiency and on human and animal health (Bindu *et al*, 2018). The technology evolved for using second generation machinery such as happy or smart seeder, which can sow crop in the standing stubble and crop residue without cultivating the soil completely provides the solution of crop residue burning (Gill *et al*, 2023).

In Northern India paddy straw is not being used as animal fodder due to high silica content (Kumar *et al*, 2014). The natural fermented paddy straw can also be used as feed for animals. It improves the live weight gain of animals above 6 months age. The fermented straw supplemented with low protein concentrate mixture would not have any undesirable effect on the conception rate in buffaloes and quality/quantity of milk produced (Anonymous, 2011). Straw treatment with aqueous and anhydrous ammonia, urea or other ammonia-releasing compounds has been widely

investigated to improve degradability of straw. It was found that ammonia treatment also adds nitrogen to the straw in addition to improve its degradability. The ammonia treatment also preserves the straw by inhibiting the growth of mould (Enin *et al*, 1999). Bamaga *et al*, (2000) evaluated a method utilizing drip irrigation emitters for application of urea solution into rectangular bales of paddy and wheat straw. The treated bales were stored in an airtight polythene covered stack for 28 days. The crude protein content increased from 3.73 % (untreated) to 13.42 %. Selim *et al* (2004) treated rice straw packed in polyethylene bags for 4 weeks with gaseous ammonia (3 g NH₃ per 100 g dry matter). The excess ammonia was removed before offering the straw to animals. The ammonia treatment increased the nitrogen content in the rice straw from 8.16 to 18.4 g/kg (crude protein content increased from 51 to 115 g/kg). Kaur *et al* (2007) evaluated the fermentation changes that took place in baled rice straw moistened with urea solution in comparison to conventional stacking method. The un-chaffed rice straw treated with 3.5 % urea at 20, 30 and 40% moisture was baled (91.4 cm × 45.7 cm × 38.1 cm) by using fully automatic stationary baler and kept in a shed for 9 days. Simultaneously, chaffed rice straw was treated with 3.5 % urea at 40 % moisture and stacked for 9 days. The average crude protein for fermented un-chaffed baled rice straw, fermented chaffed rice straw and unfermented rice straw were 7.7%, 7.9% and 4.5%

respectively. The literature suggested that the fermented paddy straw have more nutritive value than untreated paddy straw and can be fed to the milch animals. A study was conducted to study the economic analysis of fermented paddy bales and conventional method of untreated paddy bales.

MATERIALS AND METHODS

The comparative cost analysis of natural fermentation of rice straw in bales over conventional method of baling system was worked out. The conventional method of baling includes the operation of stubble shaver after the combine harvesting for cutting of standing paddy stubbles, windrowing of paddy residue by rake and baler used for making bales of paddy residue. Before baling, firstly the stubble shaver was operated to harvest the stubbles from base level and spreaded in the field (Fig. 1). A rotary rake was operated to collect the cut and loose paddy residue and made a windrow of narrower section thereby provided dense straw input for baler machine (Fig 2). The specifications of the rotary rake used in the field have been given in Table 1. A rectangular baler (Fig 3) was operated to compress the cut and raked paddy residue into compact rectangular bales. The specifications of the rectangular baler used in the field have been given in Table 2. The fixed cost and variable cost were calculated as per the procedure described in the Indian Standard Code IS 9164-1979.



Fig. 1. A view of operation of tractor operated stubble shaver in combine harvested paddy fields



Fig. 2. A view of operation of tractor operated rake



Fig. 3. A view of tractor operated baler

Economics of Baled Fermented Rice Straw over Conventional Method of Baling System

Table 1. Specifications of rotary rake

Sr. No.	Description of component	Specification
1	Type of machine	Mounted
2	Power source, hp	PTO, 40
3	Rotor, rpm	75
4	Rotor diameter, mm	2900
5	No. of arms	9
6	No. of double tines per arm	3
7	Working width, mm	3500
8	Working height, mm	1700
9	No. of tyres	4
10	Weight, kg	450

For baling of fermented paddy straw, the paddy straw was treated with urea. The ratio of urea to paddy straw was kept at 3.5:96.5 and moisture of the paddy straw was kept 40 % (Bakshi and Wadhwa, 2001). The urea mixed with water was sprayed on the paddy straw after the operation of combine harvesting followed by stubble shaver and this urea treated paddy straw was baled with baler after the operation of rake. The fermented baled paddy straw was easy transportation to other places. For feeding these fermented bales to the milch animals, these bales were untied and spreaded over the floor for the removal of ammonia gas from the

Table 2. Specifications of rectangular baler

Sr. No.	Parameter	Description
1	Hitching system	Drawbar hitch
2	Overall dimensions (L×W×H), m	6155× 2910×1843
3	Power source	Tractor (45 and above HP)
4	Pick up unit	
	Working width, mm	1650
	Pickup height adjustment	Hydraulic
5	Feeder unit	
	No. of inner tynes	3
	No. of outer tynes	2
6	Plunger speed	93 plunger strokes min ⁻¹
7	Flywheel diameter, mm	560
8	Bale chamber (W × H), mm	460×360
9	Bale length, mm	400 to 1100
10	No. of knotters	2
11	Bale length control	Mechanical
12	Bale density control	Manual
13	Type of bale	Rectangular

fermented bales after 9 days of stacking. Table 3 represents the particulars of the bales formed. In conventional method of baling, the transportation of bales was done by tractor trailers and the cost of transportation was Rs. 9.0/q in the radius of 10 km from the biomass plant. The price of twine used to tie the bales was Rs. 170/kg. Various parameters of bales were tabulated in Table 4.

Table 3. Particulars of the bales

System used	Particulars	Length, m	Width, m	Height, m	Dry weight (kg)	Volume (m ³)	Density (kg m ⁻³)
Conventional baling system	Range	0.85 -0.95	0.45 -0.50	0.34 -0.38	25.5 - 32.3	0.132 - 0.175	168.76 - 217.35
	Mean	0.89	0.47	0.36	30.1	0.151	199.17

Table 4. Details of various parameters of the bales formed by different baling system

Particular	Conventional baling system
Mean dry weight of one bale, kg	30.1
No. of bales per ha	260
Total weight of bales, kg/ha	7826.0
Twine length per bale, m	4.37
Total weight of the twine per bale, g	10.28
Total weight of the twine required, kg/ha	2.67
Cost of twine, Rs/kg	170
Total cost of the twine, Rs/ha	453.90

Table 5. Total cost of conventional and fermented baling system.

Title	Conventional baling system				Fermented baling system			
	Tractor (50HP)	Stubble shaver	Rake	Baler	Tractor (50HP)	Stubble shaver	Rake	Baler
New cost (Rs), P	650000	35000	300000	1000000	650000	35000	300000	1000000
Salvage value (Rs.), S = 10 % of P	65000	3500	30000	100000	65000	3500	30000	100000
Life (years), L	15	10	10	10	15	10	10	10
Average use/year (h)	1000	200	200	200	1000	200	200	200
Annual Fixed Charges								
Depreciation, Rs/year	39000	3150	27000	90000	39000	3150	27000	90000
Rate of interest (%), i	12	12	12	12	12	12	12	12
Interest cost, Rs/year	42900	2310	19800	66000	42900	2310	19800	66000
Taxes, insurance and shelter (Rs/year) = 2 % of P	13000	700	6000	20000	13000	700	6000	20000
Total fixed costs (Rs/year)	94900	6160	52800	176000	94900	6160	52800	176000
Total fixed costs (Rs/h)	94.9	30.8	264.0	880.0	94.9	30.8	264.0	880.0
Variable Costs								
Repair and maintenance, Rs/h = ((5 % × P)/(Avg. use/year))	32.5	8.8	75.0	250.0	32.5	8.8	75.0	250.0
Mean fuel required (l h ⁻¹)		4.2	3.2	5.3		4.2	3.2	5.3
Fuel cost, Rs/h = Fuel required, l/h × Price of fuel, Rs/l @ Rs.82.63/l		342.9	266.9	439.6		342.9	266.9	439.6
Cost of lubricants (Rs/h) = 20% of fuel cost		68.6	53.4	87.9		68.6	53.4	87.9
Labour cost, Rs/h	55.4			55.4	55.4			55.4
Total variable cost, Rs/h	87.9	420.2	395.3	832.9	87.9	420.2	395.3	832.9
Total cost, Rs/h = Total fixed cost, Rs/h + Total variable cost, Rs/h	182.8	451.0	659.3	1712.9	182.8	451.0	659.3	1712.9
Total cost of using the implement with tractor, Rs/h	-	633.8	842.0	1895.6	-	633.8	842.0	1895.6
Field capacity of machine, ha/h	-	0.60	0.65	0.35	-	0.60	0.65	0.35
Cost of using the system, Rs/ha	-	1056.3	1295.4	5416.0	-	1056.3	1295.4	5416.0
Cost of twine, Rs/ha	-			453.9	-			453.9
Total cost of using the system, Rs/ha		1056.3	1295.4	5869.9		1056.3	1295.4	5869.9
Chopping of paddy straw								910.7
Total cost of the whole system, Rs/ha	8221				9132			

Economics of Baled Fermented Rice Straw over Conventional Method of Baling System

Table 6. Total income of conventional and fermented baling system

Title	Conventional baling system	Fermented baling system
Total yield of paddy straw, t /ha	7.8	7.8
Cost of straw/fermented, Rs /t	1800	2000
Total income from the system, Rs /ha	1408 7	15652
Profit, Rs/ha	5865	6519

The cost of twine used in tying of the bale was Rs. 454/ha. The total cost of baling the paddy straw in conventional baling system and fermented baling system was Rs. 8221/ ha and Rs. 9132/ha, respectively. The total profit under conventional and fermentation baling system was Rs. 5865/ha and Rs. 6519/ha respectively as depicted from Table 6.

CONCLUSION

The total profit in fermented baling system was 11.15 % more as compared to conventional baling system. There should be some system attached behind the combine harvester for baling of loose residue coming out from the combine harvester. As the loose straw coming out from the combine harvester was having high moisture content, therefore the fermentation had to be done simultaneously while baling the loose straw to make that fermented baled material as animal fodder.

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Effect of Blanching and KMS Treatments on Drying Parameter of Solar and Tray Dried Organically vs Conventionally Grown Broccoli

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ABSTRACT

This study was carried out to dry organically vs conventionally grown broccoli using sulfuring, blanching and no treatment (control). The treated samples were dried in the mechanical tray drier (at 60°C) and in solar drier until constant weight was achieved. The drying of broccoli revealed that the samples treated with KMS and dried in mechanical drier took minimum time for drying and were low in moisture content. Blanched samples took more drying time and were high in moisture content. Mechanically dried vegetables took less time for drying and had lower moisture content as compared to solar dried samples. The average ascorbic content of KMS treated samples of organic broccoli was maximum i.e. 35.60 mg/100g and that of control and blanched organic broccoli samples was 31.20 and 30.40 mg/100g, respectively. The dehydrated organic and conventionally grown broccoli varied significantly ($P \leq 0.05$) with each other in terms of rehydration ratio, coefficient of rehydration and bulk density. The finding of the study concluded that dehydration of broccoli can help to minimize their post-harvest losses as broccoli is highly perishable due to high moisture content.

Key Words: Blanching, Broccoli, Dehydrated, Organic, Solar Dried, Tray Dried.

INTRODUCTION

Broccoli (*Brassica oleracea var italica*) belong to the family *Cruciferae* is a native of Italy, but can be successfully grown in our country. Broccoli is a “cool weather crop” and grows best in temperature ranging between 18°C and 23°C. The cluster of the flower, also referred to as a “head”, appears in the center of the plant, and is green (Mukherjee and Mishra, 2012). Broccoli is very low in calories. However, it is rich in dietary fibers, minerals, vitamins and anti-oxidants that have proven health benefits. Presence of appreciable amount of beta-carotene makes broccoli a valuable vegetable. Further, low fat and high protein content of broccoli is highly suitable for cardiovascular diseases. Also, broccoli is rich in health promoting phytochemicals, such as glucosinolates, which are a large group of sulphur and nitrogen containing secondary metabolites (Le *et al*, 2020).

Broccoli has a shorter shelf-life (highly perishable) due to high moisture content. If proper post-harvest management not done, can lead to rapid senescence and undesirable quality loss, expressed as surface dehydration, loss of green color and stem

firmness, opening of florets, development of undesirable odors, and soft rots (Wang *et al*, 2021). Therefore, new approaches were developed to extend the shelf-life of broccoli in order to control the senescence and quality decay by various means, like modified atmosphere packaging, UV-C treatments heat treatments like hot water and appropriate refrigerated storage. These treatments have been observed to effectively reduce yellowing of stored fresh broccoli while some other scientists used dehydration technique for preservation of broccoli.

Food dehydration refers to the complete removal of water from foods under controlled conditions. During dehydration some important changes take place, as structural and physicochemical modifications that affect the final product quality and also result in lower shipping and container cost. Dehydrated foods have increased shelf life, inexpensive than the fresh ones or canned ones, and also leads to the production of convenience items. Thus, dehydration techniques were used to maintain quality criteria like color, nutritional composition, shape or texture. Therefore, there was need to standardize the techniques for drying of broccoli and to

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Table 1. Effect of treatments, drying sources and time on per cent water loss and dried weight (g) of broccoli.

Attributes/Treatment				Time (hours)							
				0	2	4	6	8	10	12	14
Organic Broccoli	DW	MD	C	1000	620	470	270	126	136	-	-
			K	1000	690	450	240	148	132	-	-
			B	1000	698	454	252	150	138	-	-
	WL	MD	C	0.00	38.00	53.00	73.00	87.40	86.40	-	-
			K	0.00	31.00	55.00	76.00	85.60	86.80	-	-
			B	0.00	30.20	54.60	74.80	85.00	86.20	-	-
Inorganic Broccoli	DW	MD	C	1000	630	472	276	140	124	-	-
			K	1000	710	510	310	148	120	-	-
			B	1000	712	504	310	150	130	-	-
	WL	MD	C	0.00	37.00	52.80	72.40	86.00	87.60	-	-
			K	0.00	29.00	49.00	69.00	85.20	88.00	-	-
			B	0.00	28.00	49.60	69.00	85.00	87.00	-	-
Organic Broccoli	DW	SD	C	1000	840	680	610	476	160	120	116
			K	1000	880	760	640	470	170	176	114
			B	1000	904	808	648	418	220	138	120
	WL	SD	C	0.00	16.00	32.00	39.00	52.40	84.00	88.00	88.40
			K	0.00	12.00	24.00	35.20	53.00	78.00	86.20	88.60
			B	0.00	9.60	19.20	35.20	58.20	78.00	86.20	88.00
Inorganic Broccoli	DW	SD	C	1000	822	700	500	230	190	136	114
			K	1000	856	648	472	252	140	132	110
			B	1000	856	712	568	318	180	138	116
	WL	SD	C	0.00	17.80	30.00	50.00	67.00	82.00	86.40	88.60
			K	0.00	14.40	35.20	52.00	74.80	86.00	86.80	88.60
			B	0.00	14.40	28.80	43.20	68.20	84.00	86.20	88.40
WL=Water Loss (%) ; DW=Dried Weight (g); MD= Mechanical Drier; SD= Solar Drier C= Control: K= KMS treated: B=Blanched											

study the effect of drying techniques on rehydration and chemical characteristics of broccoli.

MATERIALS AND METHODS

Dehydration of Broccoli

For dehydration, broccoli samples grown organically and conventionally were taken and divided into three lots. One lot was subjected to no treatment (Control). The second lot was subjected to sulphuring by dipping in 2 per cent solution of potassium metabisulphite for 5 minutes. The third lot was subjected to water blanching for 1-2 minutes. The treated samples

were dried in the mechanical tray drier (at 60°C) and kept in solar drier until constant weight was achieved. The dried/dehydrated samples were packed in polythene bags for physico-chemical. The physical parameters drying time, drying rate , rehydration characteristics, rehydration ratio, coefficient of rehydration, rehydration percentage, percent yield and bulk density were analysed as per method given in Rangana (2017). The chemical parameters moisture, total soluble solids acidity, ascorbic acid and Sugars were determined by method reported in Ranganna, (2017).

Effect of Blanching and KMS Treatments on Drying Parameter of Solar

RESULTS AND DISCUSSION

Effect of drying on physical parameter of broccoli

Dried weight and water loss

It was found that irrespective of organic or inorganic broccoli, the sample dried in solar drier took more time i.e. up to 14 hours to attain equilibrium when compared with sample dried in mechanical drier where the time required for attaining equilibrium was only 10 hours (Table 1). The dried weight of mechanically dried control, sulphured and blanched organic broccoli after 10 hours of drying was 136, 132 and 138 g/ kg and the corresponding values for inorganic broccoli samples were 124, 120 and 130 g/kg, respectively.

The dried weights of solar dried control, sulphured and blanched organic and inorganic broccoli samples after 14 hours of drying were 116, 114, 120 and 114, 110 and 116 g /kg, respectively with per cent weight loss of 88.40, 88.60, 88.00 and 88.60, 88.60, 88.40, respectively.

Among the various treatments i.e. control, sulphured and blanched, maximum dried weight was observed in blanched organic and inorganic broccoli samples followed by control and KMS treated samples. As far as the physical appearance of dehydrated samples was concerned, the sample dried in mechanical drier had better appearance than that of samples dried in solar drier (Plate-1). Similar results have been also reported by Kar and Gupta (2003).

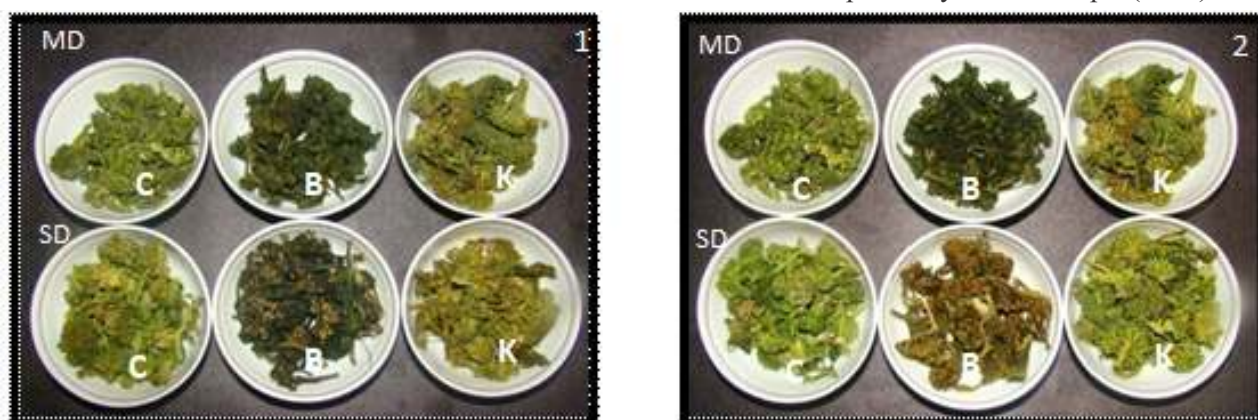


Plate 1 Physical appearance of dehydrated broccoli (1) Organic (2) Inorganic

C-Control, B- Blanched, K- KMS treated

Product yield of Broccoli

Data in (Table 2) represented the per cent product yield of broccoli both organic and inorganic and dried in mechanical and solar driers. To achieve satisfactory drying, blanched organic and inorganic broccoli sample dried in mechanical drier required 10

and 10.10 hours, respectively with equilibrium yield of 13.80 and 12.80 per cent, respectively. The corresponding values for KMS treated and control organic and inorganic broccoli samples were 9.30, 9.10 and 9.35, 9.12 hours, respectively with equilibrium yields of 13.20, 13.60 and 11.40, 11.60 per cent, respectively.

Table 2. Effect of treatments and drying source on product yield (%) of dried broccoli.

Treatment		Organic		Inorganic	
		Product Yield (%)	Time of Drying (h)	Product Yield (%)	Time of Drying (h)
MD	C	13.60	9.10	11.60	9.12
	K	13.20	9.30	11.40	9.35
	B	13.80	10.00	12.00	10.10
SD	C	12.60	13.15	11.40	13.20
	K	12.40	13.45	11.00	13.50
	B	13.60	13.55	11.60	14.00

MD= Mechanical Drier; SD= Solar Drier; C= Control; K= KMS treated; B=Blanched

Further, scrutiny of the data revealed that irrespective of the treatments, the per cent product yield of organic broccoli was more when compared with inorganic broccoli. Similar studies on dehydration of *kachnar* and *lesora* were conducted by Awasthi and Verma (2019) with almost similar results where the per cent yield decreased with decrease in drying time.

Rehydration characteristics of broccoli

The effect of various treatments and drying source on the water absorption characteristics of organic and inorganic broccoli are presented in Figure (1 & 2). Among the various treatments samples treated with KMS showed maximum water absorption. Irrespective of various treatments, the sample dried in mechanical drier exhibited more water absorption in comparison to those dried in solar drier. Among the various sources of broccoli i.e. organic and inorganic, the dehydrated samples of broccoli grown with organic inputs showed slightly better water absorption. The organic broccoli samples dehydrated after giving KMS treatment and dried in mechanical and solar driers exhibited 4.03 and 3.63 ml/g water absorption. The corresponding values for blanched dehydrated samples were 3.53 and 3.45 ml/g on dry weight basis. In case of inorganic broccoli, almost similar trends were observed where KMS treated samples dried in both the drying sources had maximum water absorption and the values were 3.88 and 3.65 ml/g respectively on dry weight basis. Further it was observed that as the time given for water absorption increased, the water absorption also increased. But it decreased in solar dried samples when compared with mechanically dried samples. Similar results have been observed by Kar and Gupta (2003), Awasthi and Verma (2019) and Lal (2004).

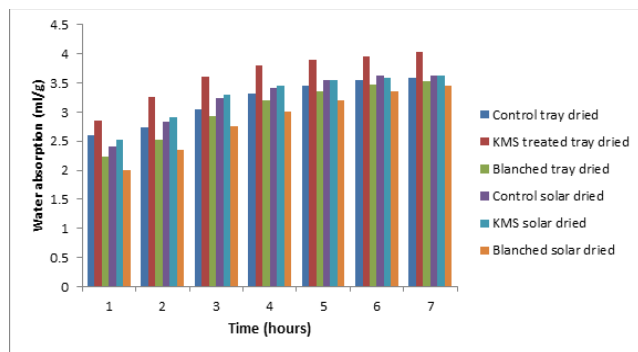


Fig. 1 Effects of treatments and drying source on the water absorption (ml/g) behaviour of dehydrated organic broccoli

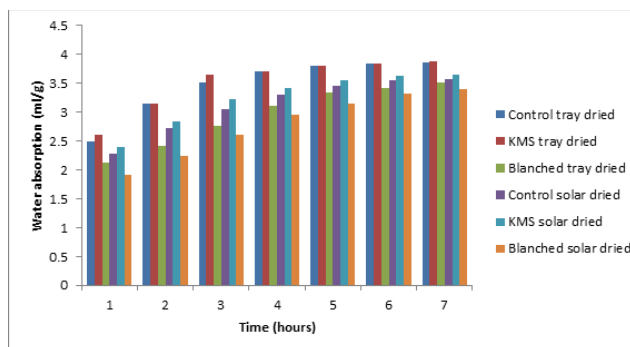


Fig. 2 Effects of treatments and drying source on the water absorption (ml/g) behaviour of dehydrated inorganic broccoli

The data (Table 3) depicted the rehydration characteristics of dehydrated broccoli as affected by treatments and source of drying i.e. mechanical and solar drier. A perusal of data revealed that among the various treatments, KMS treated dehydrated organic broccoli samples exhibited maximum rehydration ratio i.e. 5.20 and 5.10 for mechanically and solar dried samples, respectively. The corresponding values for inorganic broccoli samples were 5.62 and 5.20 for mechanically and solar dried samples, respectively. Irrespective of the treatments and source of drying i.e. solar or mechanical, the average rehydration ratio of organic broccoli was 4.53 and that of inorganic broccoli was 4.71. Further in terms of rehydration ratio, the source of broccoli i.e. organic and inorganic varied significantly ($P \leq 0.05$) with each other. Similarly, among the drying sources and various treatments there was a significant difference among the samples in rehydration ratio.

The coefficient of rehydration was also maximum in KMS treated organic and inorganic broccoli samples. Among the various sources of drying i.e. mechanically or solar dried, KMS treated organic broccoli samples had maximum coefficient of rehydration i.e. 0.76 in samples dried in both solar as well as mechanical drier whereas, the corresponding values for inorganic broccoli were 0.67 and 0.66 in mechanical and solar dried samples, respectively. Among the various treatments, KMS treated samples had maximum coefficient of rehydration followed by blanched and untreated i.e. control samples. Irrespective of the treatments and drying sources, the mean coefficient of rehydration of organically grown samples was higher i.e. 0.65 when compared with conventionally grown samples where the mean

Effect of Blanching and KMS Treatments on Drying Parameter of Solar

coefficient of rehydration was 0.58. A perusal of the data revealed that the organic and inorganic broccoli samples varied significantly ($P \leq 0.05$). Also, there was a significant difference among sources of drying in terms of coefficient of rehydration. Among the various

treatment, KMS treated samples varied significantly with blanched and control sample but there was a non significant difference among control and blanched samples.

Table 3.Effect of treatments and drying source on rehydration characteristics of dehydrated broccoli.

Treatment/ drier	Organic			Inorganic			
	Mechanical	Solar	Mean	Mechanical	Solar	Mean	Overall mean
Rehydration ratio							
Control	4.00	4.22	4.11	4.43	4.00	4.22	4.16
KMS	5.20	5.10	5.15	5.62	5.20	5.40	5.28
Blanched	4.23	4.41	4.32	4.63	4.38	4.50	4.41
Mean	4.47	4.58	4.53	4.89	4.52	4.71	4.68
Coefficient of rehydration							
Control	0.57	0.62	0.59	0.53	0.56	0.54	0.57
KMS	0.76	0.76	0.75	0.67	0.66	0.67	0.71
Blanched	0.60	0.63	0.61	0.55	0.57	0.56	0.59
Mean	0.64	0.66	0.65	0.58	0.59	0.58	0.62
Rehydration percentage (%)							
Control	77.63	74.60	76.11	79.62	77.53	78.52	77.31
KMS	82.05	81.34	81.70	80.33	78.52	79.52	80.61
Blanched	78.47	78.77	78.62	80.28	79.27	79.77	79.20
Mean	79.38	78.23	78.81	80.04	78.50	79.28	79.04
Bulk density (kg/m³)							
Control	0.75	0.81	0.78	0.71	0.80	0.76	0.77
KMS	0.77	0.80	0.78	0.82	0.80	0.81	0.79
Blanched	0.73	0.77	0.75	0.84	0.78	0.80	0.77
Mean	0.75	0.79	0.77	0.78	0.79	0.79	0.78
LSD (P≤0.05)							
	Rehydration ratio		Coefficient of rehydration		Rehydration percentage		Bulk densit
Source (S)	0.08		0.02		0.60		0.01
Drying Source (DS)	0.08		0.02		0.60		0.01
Treatments (T)	0.10		0.02		0.73		0.01

Similar trends were observed in case of rehydration percentage. The KMS treated organic broccoli samples dried in mechanical drier had maximum rehydration of 82.05 per cent followed by in sample blanched (78.47%) and control (77.63%) whereas, the corresponding values for inorganic broccoli samples were 80.33, 80.28 and 79.62 per cent, respectively. The organic broccoli treated with KMS, blanched and untreated i.e. control dried in solar drier also depicted similar trends where the KMS treated samples exhibited maximum rate of rehydration i.e. 81.34 followed by blanched samples i.e. 78.77 and control samples i.e. 74.60 per cent. The rehydration percentage of organically grown broccoli was significantly higher. Irrespective of the sources of broccoli, various treatments also varied significantly where the KMS treated samples had significantly higher rehydration percentage followed by in blanched samples. The source of drying i.e. mechanical and solar also had a significant ($P \leq 0.05$) effect on rehydration percentage of broccoli samples.

Regarding the bulk density, KMS treated organic and inorganic samples dried in mechanical drier had maximum bulk density i.e. 0.77 and 0.82 kg/m^3 . The corresponding values for solar dried samples were 0.80 and 0.80 kg/m^3 , respectively. Among the various treatments, KMS treated samples varied significantly in terms of bulk density with other treatment i.e. control and blanched but there was a non significant difference among control and blanched treatments in both organic and inorganic broccoli samples. The solar dried samples of broccoli both organic and inorganic had significantly ($P \leq 0.05$) higher bulk density when compared with mechanically dried samples.

Chemical characteristics of dehydrated broccoli

Data pertaining to chemical characteristics of dehydrated broccoli as affected by various treatments and drying source is presented in Table 4. The moisture content of organic broccoli dehydrated after giving blanching treatment was significantly higher ($P \leq 0.05$) in both type broccoli samples whereas, the KMS treated dehydrated samples had significantly lower values for moisture content in same type of broccoli. Among the various broccoli samples the average moisture content of samples of inorganic broccoli was significantly higher i.e. 7.15 per cent when compared

with dehydrated organic samples where the moisture was 6.84 per cent. Irrespective of source of broccoli and various treatments, the moisture content of sample dried in solar drier was significantly higher with an average moisture content of 7.25 per cent when compared with samples dried in mechanical drier where the average moisture content recorded was 6.75 per cent. This could be attributed to the reason that the sample dried in tray drier had resulted in complete drying due to continuous and similar temperature to which the samples were exposed. Similar result have been reported by Awasthi and Verma (2019) and Kar and Gupta (2003).

The average TSS content of dehydrated organic broccoli was significantly higher and was 16.17°B than the conventionally grown broccoli where the TSS was 16.07°B . The average TSS content of KMS treated samples of organically and inorganically grown broccoli were significantly higher i.e. 16.29 and 16.13°B , followed by blanched and control samples where the average values for same broccoli samples were 16.17 , 16.05 and 16.06 , 16.06°B , respectively. Irrespective of sources of broccoli and treatments given to broccoli, the sample dried in mechanical drier had slightly more total soluble solids with an average value of 16.14°B when compared with those dried in solar drier with 16.11°B . It was observed that the difference in TSS due to source of drying was non- significant. The similar results reported by Devi *et al* (2023).

Similarly, the acidity content of KMS treated samples was significantly higher than control and blanched both type broccoli samples. The average values of acidity for KMS treated samples irrespective of source of broccoli and drying source were 0.53 and 0.35 per cent whereas, the values for control and blanched samples were 0.52, 0.29 and 0.44, 0.26 per cent, respectively. Among the samples of broccoli whether grown with organic or inorganic inputs, the acidity content of dehydrated organic broccoli was significantly higher i.e. 0.49 per cent in comparison to inorganic broccoli i.e. 0.30 per cent. Scrutiny of the data revealed that the sample dried in solar drier had less acidity content when compared with samples dried in mechanical drier. It may be due to loss of acidity during prolonged drying of samples in solar drier. The results are in accordance with those reported by Awasthi and Verma (2019).

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Table: 4 Effect of treatments and drying source on chemical characteristics of dehydrated broccoli

Treatment	Organic Broccoli			Inorganic Broccoli			Overall mean
	Mechanical	Solar	Mean	Mechanical	Solar	Mean	
Moisture (%)							
Control	6.22	7.35	6.79	7.07	7.14	7.11	6.79
KMS	6.13	7.12	6.63	6.85	7.06	6.95	6.79
Blanched	6.74	7.46	7.11	7.38	7.37	7.38	7.84
Mean	6.36	7.31	6.84	7.10	7.19	7.15	6.99
TSS (°B)							
Control	16.05	16.07	16.06	16.03	16.07	16.06	16.05
KMS	16.35	16.23	16.29	16.16	16.11	16.13	16.21
Blanched	16.18	16.18	16.17	16.11	16.00	16.05	16.21
Mean	16.19	16.16	16.17	16.09	16.06	16.07	16.13
Acidity (%)							
Control	0.50	0.54	0.52	0.29	0.29	0.29	0.40
KMS	0.54	0.51	0.53	0.35	0.35	0.35	0.44
Blanched	0.48	0.41	0.44	0.26	0.25	0.26	0.35
Mean	0.51	0.49	0.49	0.29	0.30	0.30	0.40
LSD (P≤0.05)		Moisture	TSS	Acidity			
Source (S)		0.09	0.04	0.05			
Drying Source (DS)		0.09	0.04	0.05			
Treatments (T)		0.09	0.04	0.06			

Data of Table 5 depicts ascorbic acid, total and reducing sugar content of dehydrated broccoli as affected by source of drying and different treatments given to samples prior to drying. There was a significantly higher retention of ascorbic acid content in KMS treated samples followed by control and blanched samples. The average ascorbic content of KMS treated samples of organic broccoli was 35.60 mg/100g and that of control and blanched organic broccoli samples was 31.20 and 30.40 mg/100g, respectively. Almost similar trends were observed in case inorganic broccoli, where the KMS treated sample had an average ascorbic acid content of 30.40 mg/100g

in comparison to control and blanched sample with 21.60 and 21.30 mg/100g ascorbic acid. As is evident from the data there was maximum retention of ascorbic acid in samples dried in mechanical drier with average ascorbic acid content of 34.66 and 26.87 mg/100g in dehydrated organic and inorganic broccoli. The ascorbic acid content of samples dried in solar drier was significantly ($P \leq 0.05$) lower with values of 30.13 and 22.00 mg/100g in organic and inorganic broccoli, respectively. The ascorbic acid content of sulphured sample was more than blanched and even control samples and this may be attributed to the retardation of non enzymatic browning by sulphur which destroys

ascorbic acid. Another reason for this could be ascorbic acid loss in blanching due to its heat sensitive nature. There was a significantly higher ascorbic acid content in dehydrated organic broccoli in comparison to inorganic broccoli and the average corresponding values were 32.40 and 24.43 mg/100g, respectively.

This could be due the reason that organic broccoli samples initially had higher ascorbic acid content. The results are in conformity with those reported by Awasthi 2007 who also concluded that KMS treatment with mechanical drying is better option for dehydration.

Table 5.Effect of treatments and drying source on ascorbic acid and sugar contents of dehydrated broccoli.

Treatments/Drier	Organic			Inorganic			Overall Mean
	Mechanical	Solar	Mean	Mechanical	Solar	Mean	
Ascorbic acid (mg/100g)							
Control	33.60	28.80	31.20	32.00	20.00	21.60	26.40
KMS	39.20	32.20	35.60	23.20	28.00	30.40	33.00
Blanched	31.20	29.60	30.40	25.40	17.20	21.30	25.90
Mean	34.66	30.13	32.40	26.87	22.00	24.43	28.42
Total sugars (%)							
Control	2.01	1.99	2.00	1.98	1.94	1.96	1.98
KMS	2.05	2.01	2.03	1.95	1.95	1.95	1.99
Blanched	2.00	1.99	1.99	1.96	1.94	1.95	1.97
Mean	2.02	1.99	2.01	1.96	1.94	1.95	1.98
Reducing sugars (%)							
Control	1.91	1.77	1.84	1.83	1.81	1.82	1.83
KMS	1.84	1.75	1.80	1.78	1.67	1.72	1.76
Blanched	1.82	1.81	1.81	1.71	1.54	1.63	1.72
Mean	1.86	1.77	1.82	1.78	1.68	1.72	1.77
LSD (P≤0.05)		Ascorbic acid		Total sugars		Reducing sugars	
Source (S)		1.25		0.01		0.02	
Drying Source (DS)		1.25		0.01		0.02	
Treatments (T)		1.54		0.01		0.02	

The total sugar content of blanched samples was significantly minimum in both i.e. organic and inorganic broccoli dried with mechanical and solar driers. The average total sugar content of blanched organic and inorganic broccoli was 1.99 and 1.95 per cent, respectively. The corresponding values for

control samples were 2.00 and 1.96 whereas, for KMS treated samples were 2.03 and 1.95 per cent which were significantly higher than any other treatment. Among the two resource of broccoli, the organic broccoli had significantly higher total sugars 2.01 per cent when compared with inorganic broccoli where the

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corresponding value was 1.95 per cent. The source of drying also had a significant difference in terms of total sugars. The sample dried in mechanical drier had maximum amount of total sugar with average values of 2.02 and 1.96 per cent in organic and inorganic broccoli in comparison to solar dried sample where the corresponding values were 1.99 and 1.94 per cent, respectively. The data revealed that blanching had minimum amount of total sugar than sulphured samples which may be due leaching of sugar in blanching water thereby causing loss of sugar.

The difference in total sugar of dehydrated sample of organic and inorganic broccoli could be attributed to the initial higher values of total sugar in organic broccoli. Result are in consonance with those reported by Awasthi and Verma (2019) who also found that KMS treated samples had better total sugar retention than blanched ones.

The reducing sugars also exhibited similar trends as total sugars. The organically grown broccoli had significantly higher reducing sugar (1.82%) in comparison to inorganic broccoli (1.72%). Irrespective of drying sources, organic and inorganic dehydrated broccoli samples treated with KMS had better reducing sugar values than blanched. On the contrary, the untreated i.e. control samples had significantly higher reducing sugars. The blanched samples had minimum retention of reducing sugars which may be attributed to the loss of reducing sugar during blanching. Similar results have been reported by Awasthi and Verma (2019).

CONCLUSION

The KMS treated broccoli dried in mechanical drier took minimum time for drying and were low in moisture content. Blanched samples took more drying time and were high in moisture content. The KMS treated broccoli had higher retention of ascorbic acid content followed by control and blanched samples. The average ascorbic content of KMS treated samples of organic broccoli was maximum i.e. 35.60 mg/100g and that of control and blanched organic broccoli samples was 31.20 and 30.40 mg/100g, respectively. The dehydrated organic and conventionally grown broccoli varied significantly ($P \leq 0.05$) with each other in terms of rehydration ratio, coefficient of rehydration and bulk density. Dehydration of broccoli can help to minimize

their post-harvest losses as this vegetable is highly perishable due to high moisture content.

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Effect of Post-Milking Teat Dip on Subclinical Mastitis in Crossbred Cows

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ABSTRACT

The prevalence of subclinical mastitis is currently increasing in our country and adversely affecting dairy farmers' economies. To note down the effect of post-milking teat dip on subclinical mastitis, 30 crossbred cows were randomly divided into two groups based on parity and age viz., T₀ (n=15, farmer's practices - washing of milker hand and udder with water) and T₁ (n=15, with farmer's practices along with the use of post-milk teat dip of 3.5% Lactic acid) during the experimental trial of 30 days. By use of post-milk teat dip, the CMT and SCC positive cases were decreased by 71.4 % and 72.2 % respectively in T₁. The SCC and pH of milk were significantly ($p < 0.05$) reduced however, milk yield was significantly ($p < 0.05$) increased by 6.7 % in T₁ compared to T₀ on 28th day. The use of post-milk teat dip is cost-effective in terms of economics and recommended for dairy farmers to prevent subclinical mastitis.

Key Words:, California mastitis test, Crossbred Cows, post milk teat dip, Subclinical Mastitis, Somatic Cell Count.

INTRODUCTION

India is the number one milk-producing country in the world having 221 million tons of milk production as per BAHHS-2022. However, Krishnamoorthy *et al* (2021) revealed that subclinical and clinical mastitis prevalence in India was 45 % and 18 % respectively. Even subclinical mastitis prevalence was higher in cattle (49 % vs. 32%) than in buffalo. Mastitis is an economically hampering disease in the country (Wani *et al*, 2022; Ali *et al*, 2022).

Mastitis is an inflammation of the udder and associated structure that is caused by mainly bacteria, less common by other microorganisms namely fungi, mycoplasma, and algae (Chakrabarti, 2007). When the teats are injured, irritated, or damaged or the sphincter muscle is loose, these organisms get the opportunity to enter the teat canal damaging epithelial cells and a series of consequences lead to fibrosis causing hardening of the udder. The prevalence of mastitis is higher in the humid rainy season than in summer and winter. Mastitis may occur in clinical and subclinical forms where the presence of blood clots, change in consistency, pus may not be visible in subclinical mastitis like clinical form of mastitis. Mastitis milk is

causing problems in dairy animals and deteriorating human health.

Management practices to reduce mastitis are complete drying off, intramammary infusions, feeding of the cow after milking, culling of the cow, and pre & post-milking teat dip. However, post-milk teat dip was found to be an effective practice because it reduces the microbial load from the teat surface and orifice. So, there should be awareness among dairy farmers regarding post-milk teat dip and the cleanliness of the shed. Subclinical mastitis can be precisely detected by somatic cell count (SCC) and it can be detected by various methods. One of the methods to detect subclinical mastitis is by counting the SCC which has been reported to be an index for udder health (Singh and Ludri, 2000). The present study was conducted to see the effect of post-milking teat dip on subclinical mastitis of the crossbreed cows.

MATERIALS AND METHODS

A total of 30 farmers were selected from the district of Vaishali, India. The experiment was conducted as per the guidelines of the Institute's ethical committee. Each farmer had a crossbred cow (Jersey, HF with local) in

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mid-lactation (90-100 days). So, thirty Mastrip (Ayurvet Ltd India)-positive cases of cows were randomly divided into 2 groups based on parity and ages; control (T_0), where normal farmer practices (washing of udder and milker hand with water) occur, another treatment (T_1) group where normal farmer practice along with the use of post milking teat dip of 3.5% Lactic acid. The experiment was conducted from June to July 2022. All experimental cows were tied with neck chains at farmers' fields. Cows were offered a balance ration as per the requirement ICAR (2013). The balanced ration was made up of concentrate (composition given in Table 1), green fodders maize, and wheat straw. The cost of maize fodder was 2 Rs/ kg, wheat straw 5 Rs/ kg and concentrate 20 Rs/ kg was used for economics calculation.

Table 1. The physical composition of the concentrate mixture.

Sr. No.	Ingredient	Parts (%)
1.	Maize grain	33
2.	Barely	18
3.	Linseed Cake	20
4.	Wheat Bran	15
5.	Deoiled Rice Bran (DORB)	11
6.	Mineral Mixture	2
7.	Common Salt	1
	Total	100

Each quarter milk sample was tested by the California Mastitis Test (CMT). Striped 2 ml of milk in each cup of CMT Paddle, pour 3 ml of CMT reagent in each cup, and stir anti-clockwise. Somatic cell count in milk was estimated by the method of Singh and Ludri (2001). A threshold value of subclinical mastitis was considered when SCC was ≥ 2 lakh/ml of milk sample (NMC, 2001). The post-milking teat dip was performed for the T_1 group. Milk yield was recorded daily however, other parameters (CMT, SCC, and pH) were evaluated fortnightly. CMT kit obtained from Delaval Private Limited. A single-electrode digital pH meter was used for measuring milk pH.

STATISTICAL ANALYSIS

The diagnosed number of quarter and crossbred cows that tested positive for CMT and SCC were calculated by the percent of cases obtained from the total quarter and crossbred cows respectively

shown in Table 2. The milk parameters were evaluated with the use of a T-test using SPSS 22.0 (SPSS Inc., 2013, USA). The data generated from the study were presented as mean $\pm$ standard error (S.E.). The percent of subclinical mastitis cases reduced was calculated by $[(\text{number of positive cases before teat dip}) - (\text{number of positive cases after teat dip})] / \text{number of positive cases before teat dip} \times 100$ as per (Munoz *et al.*, 2008).

RESULTS AND DISCUSSION

It is clear in Table 2 that CMT-positive cases increased by 133 % in the T_0 group from the 0th day compared to the 28th day however, CMT-positive cases decreased by 71.4 % in the T_1 group. Similarly, Table 2 revealed that SCC increased by 133 % in the control group from the 0th day compared to the 28th day however, SCC decreased by 72.2 % in the T_1 group. From the beginning (0th day) to the end of the experiment (28th day), there was a decrease in cases of subclinical mastitis in T_1 compared to T_0 . Results of the CMT cases were in agreement with Yasothai (2017), Singh *et al* (2018), and Ali *et al* (2022) who found a significant decrease in CMT cases in the antimicrobial-treated group compared to the control group. The number of CMT-positive cases was less compared to the control because of the reduction of microbes from the teat surface and teat pore area.

Somatic cell count was non-significant ($p > 0.05$) on the 0th day of the experiment however, on the 14th and 28th day of the experiment it significantly ($p = 0.000$) decreased to 1.92×10^5 and 1.62×10^5 respectively in T_1 mentioned in table 3. This was in agreement with Kucevic *et al* (2013) found that SCC in milk were 133,000 and 257,000 cells/ml in the treatment and control groups respectively. Ali *et al* (2022) also found a reduction in the number of SCC in treatment compared (77,000 vs 323,000 cells/ml) to the control group which shows that lactic acid sanitizer reduces the microorganism load on teat surface and pores.

From Table 3, the pH of milk on the day 28th was significantly ($p = 0.001$) less in post-milk teat dip treatment (6.54 vs 6.74) compared to the control group. Our findings were in agreement with Waghmare *et al* (2013), Patil *et al* (2014), and Ali *et al* (2022) who revealed in their finding that post-milk teat dip reduces and restores the milk pH compared to the control group.

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When microorganisms enter the teat canal they convert lactose into lactic acid which increases the pH in the control group. Further, there is an increase in the permeability of mammary epithelial cells to blood constituents like chloride and other ions which also increases the pH of milk. However, when the concentration of microorganisms keeps on reducing from the surface then the body's immune system gets sufficient time to kill those entered microorganisms and create homeostasis inside udder tissue, and restore the pH.

There was also an increase (6.7%) and decrease (5.3%) in milk yield from the beginning to the end of the experiment in the treatment and control group respectively. On the 0th day and 14th day, there were no significant ($P>0.05$) differences in milk yield however, on the 28th of the experiment there was a significant ($P=0.03$) difference in milk yield of the treatment and control group. Our findings were in support with Waghmare *et al* (2013), Patil *et al* (2014), and Singh *et al* (2018), who also found a significant ($p<0.05$) increase in the milk yield of post-milking teat dip group compared to the control group. Patil *et al*

(2014) recorded a 17.3 % increase in milk yield, whereas Waghmare *et al* (2013) found a 19.25 % hike in the post-milk teat dip group compared to the control group. The reason behind the decrease in milk yield in the control group was damage to the secretory mammary epithelial cells which might contributed to the total milk output decrease. When teat dip with lactic acid sanitizer is applied it reduces the different harmful microorganisms that enter through teat pores and any damage to the teat surface.

The economics of milk production and the cost of treatment are shown in Table 4. Total feed cost (115 Rs/animal/day) was similar in both groups. However, the cost of lactic acid (3.5%) with teat dip was 5.2 Rs/day/animal in the treatment group. The gross income on milk selling @ 50 Rs/liter is higher (180.80 vs 168.50 Rs /animal/day) in the treatment group compared to the control group. The benefit-cost ratio (BCR) was also higher (1.5 vs. 1.46) in the treatment over the control group. Our findings also support the finding of Wani *et al* (2022) whose losses were 105-123 Rs/ day high since those were high-producing cows.

Table 2. Number of the quarter and crossbred cows that test positive for CMT and SCC .

Parameter	Group	Quarter				Animal			
		No. of teats	0th day	14 th day	28 th day	No. of animal	0th day	14 th day	28 th day
CMT	To	60	18 (30%)	24 (40%)	42 (70%)	15	12 (80%)	13 (86.6%)	15 (100%)
	T1	60	21 (35%)	16 (26.6%)	6 (10%)	15	13 (86.6%)	7 (46.6%)	3 (20%)
SCC	To	60	18 (30%)	24 (40%)	42 (70%)	15	12 (80%)	13 (86.6%)	15 (100%)
	T1	60	22 (36.6%)	16 (26.6%)	6 (10%)	15	14 (93.3%)	7 (46.6%)	3 (20%)

Table 3. Milk parameters and SSC ($\times 10^5$ /ml) of crossbred cows.

Parameter	0th day		14 th day		28 th day	
	To	T1	To	T1	To	T1
SSC ($\times 10^5$ /ml)	2.0 $\pm$ 0.05	2.05 $\pm$ 0.03	2.39 $\pm$ 0.04	1.92 $\pm$ 0.03	2.59 $\pm$ 0.03	1.62 $\pm$ 0.04
p-value	0.49		0.000		0.000	
pH	6.52 $\pm$ 0.05	6.58 $\pm$ 0.03	6.71 $\pm$ 0.03	6.62 $\pm$ 0.04	6.74 $\pm$ 0.03	6.54 $\pm$ 0.04
p-value	0.32		0.10		0.001	
Yield (kg)	5.79 $\pm$ 0.21	5.80 $\pm$ 0.25	5.73 $\pm$ 0.20	6.07 $\pm$ 0.25	5.48 $\pm$ 0.21	6.19 $\pm$ 0.24
p-value	0.97		0.29		0.03	

Table 4. Economic of milk production and cost of treatment

Economic of trial	To	T1
Total feed cost (Rs/animal/day)	115	115
Cost of lactic acid with teat dip	0	5.2
Total expense (Rs/animal/day)	115	120.2
Average daily milk yield (Liter/ animal/day)	5.67	6.02
Cost of milk production (Rs/L)	20.282	19.96
Gross income on milk sold (Rs /animal/day) @50 Rs/liter	283.5	301
Profit (Rs/day)	168.50	180.80
BCR	1.46	1.50

CONCLUSION

The present study revealed that the use of post-milk teat dip was one of the effective preventives as well as curative measures for the control of subclinical mastitis in crossbred cows with cost-effectiveness. This technology was recommended for dairy farmers so that economic as well as human health loss can be minimized.

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Emerging Threat of *Colletotrichum siamense* Causing Leaf Blight in *Plectranthus vettiveroides*

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ABSTRACT

Leaf blight disease emerges as the most prevalent disease affecting *Plectranthus vettiveroides*. The onset of leaf blight symptoms manifested initially as water-soaked lesions appearing at the edges of the leaves. Over time, these lesions transformed into ash-brown color with irregular margins. As the disease advanced, the lesions expanded to encompass the entire leaf lamina. On PDA media, the pathogen exhibits robust growth, producing white, aerial, floccoid mycelia. The hyaline, branched and septate hyphae bear bullet shaped conidia with an average size of $7.73 \times 2.9 \mu\text{m}$. Molecular characterization using ITS primers (ITS-1F/ITS-4R), followed by sequence analysis in the NCBI database, conclusively identifies the pathogen as *Colletotrichum siamense*. Hence, this study is the first report of *Colletotrichum siamense* causing leaf blight in *Plectranthus vettiveroides*.

Key Words: Leaf blight, *Plectranthus vettiveroides*, *Colletotrichum siamense*, first report.

INTRODUCTION

Plectranthus vettiveroides formerly known as *Coleus zeylanicus* is a sturdy, densely branched annual herb that reaches a height of 1.5 metres belonging to the family Lamiaceae (Nisheeda *et al*, 2016). Cherian Jacob first classified it as *Coleus vettiveroides* in 1942; subsequently, it was transferred to the genus *Plectranthus* (Murugan *et al*, 2015). The plant has long been utilised in indigenous and ayurvedic medicine as an active ingredient in various herbal formulations or as a single agent. Ethnomedical evidence supports the use of *P. vettiveroides* leaves for ulcers, dyspepsia, and dysentery (Athikkavil *et al*, 2023). Only a few diseases have been documented, despite the fact that several diseases pose challenges to its production (Nisheeda *et al*, 2016). However, Varma (1991) reported leaf blight disease of *Plectranthus vettiveroides* in Kerala.

MATERIALS AND METHODS

The experiment was carried out at the Department of Plant Pathology, College of Agriculture, Kerala Agricultural University, Vellanikkara during the period 2022-23.

Survey and collection of diseased samples

Sampling surveys were carried out in Thrissur, Ernakulam and Palakkad districts of Kerala. Per cent disease incidence (PDI) and Per cent disease severity (PDS) of the symptoms collected were note.

Isolation of pathogens and pathogenicity studies

Tissue segmentation methodology was employed to isolate fungal pathogens from diseased plant samples (Rangaswamy, 1958). The mycelial bit inoculation method (Rocha *et al*, 1998) was utilized to establish the confirmation of Koch's postulates for the fungal isolate. A mycelial disc of approximately 7 or 8 mm, obtained from a culture aged seven to eight days, was placed on a healthy plant section after making two to three punctures using a sterile needle. As a control, a plant part was inoculated with sterile water. Moistening the bits with sterilized cotton, they were then incubated in a humid chamber. Once the symptoms appeared, re-isolation was carried out to confirm the validity of Koch's postulates.

Characterisation of pathogens

The cultural characters of the pathogen in terms of growth, including texture, colour, growth rate,

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sporulation, pigmentation, reverse side colour on Petri plates, and the presence of a fruiting body, were observed. Morphological features such as hyphal colour, branching, hyphal septation, conidia presence, conidial septation, spore type, size, and form, as well as sexual structure prevalence, were examined. Tentative genus-level identification relied on comparing physical and cultural traits to descriptions from the Commonwealth Mycological Institute. Molecular characterization involved sequencing and amplifying the ITS region using ITS-1F/ITS-4R primers, and the obtained sequence was analysed in the NCBI database.

RESULTS AND DISCUSSION

Survey and occurrence of the disease

Maximum incidence of the disease was noticed in Thrissur district of Kerala with 55.0 per cent PDI and 37.5 per cent PDS. Leaf blight sample from Ernakulam district showed 33.33 per cent PDI and 25.0 per cent PDS. Likewise, the intensity and severity of the disease in Palakkad district were 33.33 per cent and 20 per cent disease respectively. The incidence of leaf blight of the plant was reported by Varma (1991).

Symptomatology

Leaf blight symptoms were initially seen as water soaked lesions from the periphery of the leaves. The lesions turned to ash brown in colour with irregular margins. The lesions covered the entire leaf lamina as the disease progressed.

Symptoms under artificial inoculation were similar to the naturally inoculated symptoms. Russet brown colour lesions surrounded by yellow halo was noticed at the infected area which covered the entire leaf lamina upon later stages of infection. Symptom expression from 3 DAI.

Characterisation of pathogens

The pathogen produced white, floccose, aerial mycelia on PDA medium. The reverse side of Petri

plates showed concentric zonations of grey and cream coloured mycelia. The fungus attained full growth 7 days after incubation. The hyphae was hyaline, septate and branched. Conidia produced were ovoid, hyaline, single celled having an oil globule at the center. The average length and breadth of the conidia were $7.73 \times 2.9 \mu\text{m}$. Based on the cultural and morphological characters the pathogen was tentatively identified as *Colletotrichum* sp. The cultural and morphological characters were similar with *Colletotrichum siamense* from *Kadsura coccinea* (Jiang *et al*, 2022).

Molecular characterisation of pathogens were carried out for species level identification of the pathogen. The leaf blight pathogen was identified by sequencing and amplification of ITS region using ITS primers ITS-1F/ITS-4R. The isolate showed sequence similarities with the existing sequence in NCBI database with *Colletotrichum siamense* (accession number KT582185.1) having 99.81 per cent identity and 96 per cent query cover. Hence the pathogen was identified as *Colletotrichum siamense*. No records of *Colletotrichum siamense* causing leaf blight in *Plectranthus vettiveroides* have been recorded till date. Hence this can be considered the first report of *Colletotrichum siamense* causing leaf blight in *Plectranthus vettiveroides*.

CONCLUSION

Leaf blight can be considered the most frequent disease of *Plectranthus vettiveroides* according to the disease incidence and severity data. The cultural, morphological and molecular characteristics of the pathogen associated with the disease was identical to *Colletotrichum siamense*. Until now, there have been no recorded instances of *Colletotrichum siamense* causing leaf blight in *Plectranthus vettiveroides*. Thus, this serves as the first report of *Colletotrichum siamense* causing leaf blight in *Plectranthus vettiveroides*.



Fig 1. Symptom under natural conditions



Fig 2. Symptom under artificial condition

Emerging Threat of *Colletotrichum siamense* Causing Leaf Blight



Fig 3. Growth of *Colletotrichum siamense* on PDA medium

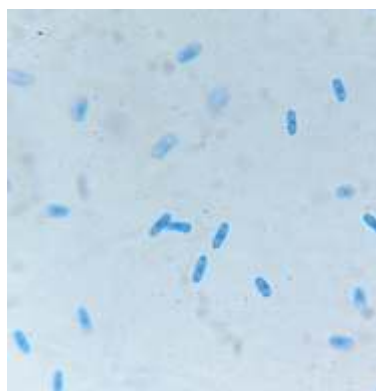


Fig 4. Conidia of *Colletotrichum siamense*

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Empowering Rural Youth in Puri District through Mushroom Cultivation for Sustainable Livelihoods

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ABSTRACT

Mushroom cultivation presents itself as a lucrative and sustainable opportunity that warrants encouragement among young individuals, fostering their engagement in agriculture. Notably, within the Puri district, there is a discernible upswing in the adoption of mushroom cultivation. However, for this trend to evolve into a genuinely profitable venture, it is crucial to equip farmers with the requisite training and knowledge. Recognizing that young people are the primary contributors to income, their active involvement is pivotal. In an attempt to enhance the earnings of rural unemployed youth, a comprehensive training program was implemented, benefitting 50 participants aged between 20 and 40 yrs. This initiative encompassed a diverse range of activities, such as practical demonstrations, structured training sessions, exposure visits, extension initiatives, provision of essential startup resources, and facilitation of access to government schemes and programs. As a direct outcome of their involvement in the ARYA Project, these previously unemployed youths have undergone a significant transformation, notably enhancing their capacity to contribute to their families' income.

Key Words: Development, Income, Mushroom, Production, Rural, Youth.

INTRODUCTION

Agriculture and allied sectors are the heart of the social growth of our country (Sharma and Rathore, 2022). The ARYA project is more important for rural youth in agricultural development with respect to the security of India. In the ARYA project, the younger generation will be interested in taking to farming as a profession only if farming becomes both economically and intellectually attractive (Choudhary *et al*, 2022). ARYA programme has proved to be a constructive idea of the ICAR which diligently attracts rural youths towards the agri-preneurship and retaining them in agriculture for a profitable surplus. After the intervention of KVK in terms of promotion of different agri-enterprises, rural youth got the exposure of certain scientific methods of mushroom cultivation, bee keeping, poultry and fish farming that resulted in adoption and establishment of these enterprises for their income diversification and livelihood security (Sahoo *et al*, 2023).

The global mushroom industry has expanded very rapidly in the last two decades by the addition of newer types of mushrooms for commercial cultivation

(Sharma *et al*, 2017). Mushroom supplementation is an agronomic process which consists of the application of nutritional amendments to the substrates employed for mushroom cultivation (Carrasco, 2018). Mushroom cultivation is a good enterprise for small, marginal and landless farmers as it is grown on agricultural waste, requires less land, and require short span of time to grow. Mushroom is now getting significant importance due to their nutritional and medicinal value and today their commercial cultivation is being done at large scale (Singh and Singh, 2017). It has proved as potential source for employment generation, food, nutrition and medicine security in tribal dominating rural India (Thakur, 2020).

Mushroom cultivation stands out as a promising and sustainable opportunity, particularly in the agricultural landscape. The Puri district has witnessed a notable surge in the practice of mushroom cultivation, signalling a potential for economic growth. However, to truly capitalize on this trend, it is essential to provide farmers with the necessary training and knowledge. Recognizing the pivotal role of young

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individuals as primary income generators, the ARYA Project initiated a comprehensive training program aimed at elevating the economic prospects of rural unemployed youth. Mushroom cultivation has emerged as a distinctive and sustainable livelihood option in Puri, benefiting from the favorable climate and the availability of space in the partial shade conditions of coconut orchards. The district's significant contribution of mushrooms to nearby cities has attracted a growing number of small and marginal farmers to engage in mushroom cultivation for economic sustenance. Beyond livelihoods, this practice also serves as a substantial source of employment opportunities (Markam *et al*, 2018).

MATERIALS AND METHODS

A total of 50 youths were selected and underwent training, covering technological support, exposure visits, linkages, input supply, and marketing aspects as part of the ARYA Project. Primary data were gathered through structured questionnaires, interviews, and direct observations, while secondary data were obtained from various published and unpublished documents, including insights from individuals, experts, and organizations involved in the mushroom farming sector. The training program targeted 50 participants, aged 20 to 40yrs, and employed a multifaceted approach. Suitable statistical methods, such as frequency, percentage, mean score, standard deviation, rank order, and correlation, were used in the collection, treatment, and analysis of the data to obtain descriptive and inferential statistics.

Description of youth		Mushroom (Youth-50)
Age (yrs.)	20-25	9
	25-30	11
	30-35	13
	35-40	17
Education (nos.)	Primary (up to 5 th)	4
	High school (up to 10 th)	29
	Intermediate (up to 12 th)	8
	Graduation	9
Sex	Male	44
	Female	6
Caste	SC	14
	ST	-
	Others	36

Empowering Rural Youth in Puri District through Mushroom Cultivation

Table 1. Mushroom cultivation in the notable blocks.

Sr. No.	Block	*Small Grower	*Medium Grower	*Large Grower	Production (t/yr)
1	Pipili	390	156	21	3017.76
2	Satyabadi	269	74	8	1494.48
3	Nimapada	707	35	1	1839.12
4	Delanga	215	30	3	966
5	Puri Sadar	82	35	6	763.68

*Small growers: 0-20kg/day, medium growers: 21-50kg/day, large growers: >50kg/day.

Table 2. Constraints in Mushroom Production.

Sr. No.	Constraint	Mean	S. D	Rank
1.	Inadequate infrastructure, such as availability of proper storage facilities, cooling units, and transportation, can hinder the timely and efficient distribution of mushroom	1.02	0.14	1
2.	Establishing robust market linkages can be challenging for small scale growers	1.02	0.14	1
3.	Lack of sufficient technical knowledge about advanced cultivation techniques, leading to suboptimal yields and quality	1.04	0.19	2
4.	Availability of training programs and educational resources for mushroom cultivation might be limited	1.04	0.19	2
	Small and marginal farmers may face financial constraints	1.08	0.27	3
5.	The extent of government support and awareness programs for mushroom cultivation	1.08	0.27	3
6.	Mushroom crops are susceptible to pests and diseases	1.10	0.30	4
7.	Availability and accessibility of high -quality mushroom spawn	1.16	0.37	5
8.	Mushroom cultivation is sensitive to climatic conditions	1.22	0.41	6
9.	Availability of suitable land for mushroom cultivation	1.34	0.47	7

RESULTS AND DISCUSSION

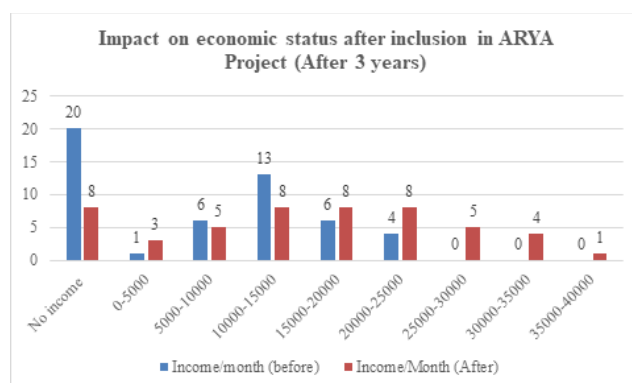
A temperate tropical climate prevails in the Puri district of Orissa. All year round, there is a lot of humidity, which is ideal for growing mushrooms. Scientists have vigorously promoted oyster mushrooms and paddy straw mushrooms (PSM) due to their nutritional value as well as their potential to generate revenue and jobs.

The study focused on five mushroom-dominated blocks: Satyabadi, Pipili, Puri Sadar, Delanga, and Nimapada, presenting detailed information on production levels and the involvement of farmers in mushroom cultivation in Table 1. A thorough evaluation of a mushroom cultivation enterprise was conducted, with a specific focus on the production of Paddy Straw

Mushrooms (450 Beds) and Oyster Mushrooms (200 Bags). Each unit, covering an average area of 1000 sq. ft, operates on a 21-day cycle for Paddy Straw Mushroom over 10 months and a 2-month cycle for Oyster Mushroom throughout the year. The estimated cost of production per unit is Rs. 2,22,000/-. Sales values for the produce are Rs. 120/kg for Paddy Straw Mushroom and Rs. 30/kg for Oyster Mushroom. The net economic gains per unit per year stand at Rs. 2,80,000/-. Beyond economic success, this enterprise has significantly contributed to employment generation, offering self-employment opportunities to 30 youths, with 2 manpower consistently engaged year-round. Additionally, 25 mushroom beneficiaries have availed the CM special package of Rs. 40,000/-,

further reinforcing support within the local community. The initiative garnered additional assistance through 1 Mushroom Spawn Unit and 1 Processing Unit under the MKUY Programme, demonstrating the potential for sustainable and profitable mushroom cultivation ventures in the region. Consequently, the observed correlation between knowledge and the adoption of mushroom production technology by the trainees is a noteworthy aspect of this initiative (Acharya *et al*, 2018).

The constraints faced by mushroom growers in the Puri district may vary, but some common challenges. Efforts to address these constraints could involve targeted training programs, improved infrastructure, enhanced market linkages, and increased access to financial resources and government support for mushroom growers in the Puri district. It is evident from the Table 2 that Inadequate infrastructure, such as availability of proper storage facilities, cooling units, and transportation, can hinder the timely and efficient distribution of mushroom and establishing robust market linkages can be challenging for small scale growers ranked first as they are the prior constraints faced by the youths of ARYA. Followed by Availability of training programs and educational resources for mushroom cultivation might be limited and Lack of sufficient technical knowledge about advanced cultivation techniques, leading to suboptimal yields and quality stood second in the table. financial constraints and government support and awareness programs for mushroom cultivation ranked third. pests and diseases problem, Availability and accessibility of high-quality mushroom spawn and climatic conditions problem ranked fourth, fifth and sixth respectively. Youths faced least problem in Availability of suitable land for mushroom cultivation because they have sufficient land for mushroom cultivation.



The impact of the training on participants' income levels was evidently significant. Prior to the training, 30 out of 50 youths were earning income, ranging from Rs. 0 to Rs. 25,000, with an average income of Rs. 13,730/-. Following the training, income generation saw a notable improvement. Among the 50 participants, 12 individuals reported an increase in their income, resulting in a total of 42 youth engaged in income-generating activities. Moreover, the average income post-training rose to Rs. 18,542/-. This data reflects a substantial enhancement in income generation among the youths, with 84% of the participants now generating income compared to the initial 60%. The importance of proper training and guidance for trainees is underscored, emphasizing the role of mushroom production in providing additional income opportunities (Koodagi *et al*, 2021).

Table 3. Correlation between personal profile and constraints.

Personal profile	Constraint
Age	0.314*
Gender	0.027
Education	-0.279*
Caste	-0.377**
Family size	0.352*
Family type	0.352*
Annual income	0.282*

The coefficient of correlation between constraints and personal profile variables was presented in Table 3. Age, family size, family type, and annual income were positively correlated with the constraints. The constraints can be well managed by the youths which can not hinder their annual income. Education was negatively correlated with the constraints. Low-educated youths face more constraints as they were not aware of the technical knowledge, and educational resources and not actively involved in the training programs. Additionally, caste and constraints have a negative correlation. People from lower castes gain greatly from the government program for mushroom growing, and they do not encounter many difficulties with it. It demonstrates how researchers, policymakers, state departments, and line department of agriculture officials are getting to the ground level to assist farmers in enhancing their standard of living and becoming more self-reliant, which will reduce the problem of migration and help them become well-established agripreneurs.

Empowering Rural Youth in Puri District through Mushroom Cultivation

CONCLUSION

The institutional backing received from ARYA and NHM has proven to be a valuable asset in sustaining and expanding mushroom farming endeavours. Furthermore, there is an aspiration to establish a Mushroom Processing Unit with the support of the ARYA project. Thus, it is necessary to encourage successful agribusinesses by involving prospective rural youth, since this will stop migration and offer a low-investment, sustainable source of income and subsistence.

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Evaluation of Different Litter Materials on Performance of Commercial Broilers

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ABSTRACT

A 6 week study was conducted on 240 Commercial day old broiler chicks. The birds were randomly assigned to four treatments (4 replicates of 20 birds each) consisting different litter material like paddy husk, ragi husk, shredded areca nut sheath waste and smashed maize cobs. The birds were reared on deep litter system of housing. All the groups were provided with similar environmental and managerial conditions throughout the experimental period. T1; paddy husk, T2; ragi husk, T3; shredded areca nut sheath waste and T4; smashed maize cobs on the performance and cost of production of commercial broilers reared in deep litter system of rearing. Among different litter materials like paddy husk, maize cob, ragi husk and shredded areca nut sheath waste, there was an improvement in body weight gain, feed consumption, FCR and mortality rate in paddy husk group when compared to other litter materials. BCR ratio was comparable among different treatment groups. Therefore, In addition to paddy husk, other litter materials can be used as an alternative in broilers if available at cheaper cost.

Key Words: Broilers, Performance, Litter materials, paddy husk.

INTRODUCTION

Poultry is the most organised sector in animal production system. It has witnessed fastest growth amongst agriculture and allied sectors in India. While the production of agricultural crops has been rising at a rate of 1.5 to 2 %t per annum that of eggs and broilers has been rising at a rate of 8 to 10 % per annum. Poultry meat is the fastest growing component of global meat demand, and India, the world's second largest developing country, is experiencing rapid growth in its poultry sector. To obtain maximum meat production, management in the poultry house is the key point in success. One of the management practices is the proper maintenance of poultry litter commonly named as deep litter system of management. The litter material is used in a poultry farm to give more comfort to the birds. The aim of this study was to determine the selection of litter/bedding material used in broiler farm during the rearing period. The quality of litter material mainly influences the overall performances of the broiler birds as well as the chickens. It receives droppings and absorbs moisture from faeces and respiratory

processes. It also provides a warm, soft and spongy surface for optimum comfort of the birds.

A variety of litter material including paper products, gypsum (Grimes *et al*, 2007), hardwood bark, sand (Shields *et al*, 2005), rice and wheat straw (Sreehari and Sharma 2010), ground corn cob and soybean straw (De Avila *et al*, 2008), paddy straw and pine leaves (Navneet *et al* 2012, Sharma *et al* (2015). Comparative studies on various crop residues namely ground nut shell, sorghum husk, red gram husk and bajra (pearl millet) husk as litter materials have been used as substitute bedding materials with various level of success (Thirumalesh *et al*, 2013). Particle size, absence of dust, bulk density, thermal conductivity, drying rate and compressibility make pine shavings an ideal bedding material for broilers and layer birds. Therefore, the first objective of the present research was to evaluate the effect of different types of litter materials on feed intake, FCR, body weight gain and mortality rate in commercial broilers reared on different types of materials widely used as litter in the poultry industry (paddy husk, ragi husk, shredded areca

nut sheath waste and smashed maize cobs) The other objective was to study the Benefit cost ratio (BCR) on broiler production Moreover, the characteristics of the materials used as broiler substrate must be taken into account, because some substrates may enrich the environment and support important behaviors of the birds (Gunnarson *et al*, 2000), as well as determine chickens.

MATERIALS AND METHODS

A 6 week study was conducted on 240 Commercial broiler chicks (day old). The birds were randomly assigned to four treatments (4 replicates of 20 birds each) consisting different litter material like paddy husk (PH), shredded areca nut sheath waste (AS), ragi husk (RH), and smashed maize cobs (MC). The birds were reared on deep litter system of housing. All the groups were provided with similar environmental and managemental conditions throughout the experimental period. The commercial starter and finisher feed was formulated as per BIS 2007 specification. An identical and adequate feeding and watering space was provided to all the birds throughout the experimental period. Brooding was carried out for two weeks by using electric bulbs. In the study weekly feed intake, FCR, Body weight and mortality percent Litter moisture content at every week was recorded among different treatments during 0-6 weeks of rearing period. The data collected on various parameters were subjected to statistical analysis as per the methods suggested by Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

The statistical analysis of data on effect of different litter material on feed intake live body weight, body weight gain and feed conversion ratio is depicted in table 1, 2, 3 and 4 respectively. The results on cumulative live body weights of broilers from group PH differed significantly ($P<0.05$) from 0-3 weeks of age. However, the overall live body weights of broilers in group PH for 0-6 weeks period found to be

significantly ($P<0.01$) higher than live body weights of broilers from other groups. This indicated that, rearing of broiler birds on paddy husk litter material found to be beneficial for significant improvement in live body weight. Similar results were found with body weight gain of broilers. When the data on body weight gain from 0-6 weeks was analyzed, significant ($P<0.05$) increase in gain in weights of broiler birds were observed from PH than groups. The results of the present findings indicated that paddy husk improved the weight gain in broiler birds. The efficiency of utilization of feed was significantly better in the paddy husk material than the other material. This was in agreement with the findings of Davasgaum and Boodoo (2000) and Dhaliwal *et al* (2018).

The feed conversion ratio of broilers was statistically analyzed for 0-3 weeks and 0-6 week period. The feed conversion ratio of broiler birds from 0-3 weeks of age was significantly improved in group PH than groups. The feed conversion ratio of broiler birds from 0-6 weeks of age was found to be significantly ($P<0.05$) improved in group PH than other groups.

Economics of the four different litter materials was calculated on the basis of market prices at the time of trial. Keeping the standard floor space of one square foot per broiler, prices of different litter materials were calculated. The cost of paddy husk (PH), shredded areca nut sheath waste (AS), ragi husk (RH), and smashed maize cobs (MC) was Rs. 3.67, 3.17, 3.15 and 3.12, respectively for kilogram (Table 5). The rice husk had an edge on shredded areca nut sheath waste (AS), ragi husk (RH), and smashed maize cobs (MC) due to its very high moisture absorbing ability, paddy husk is also better than other litter materials in respect of availability and economics

The overall results of the study indicated that the body weight, weight gain, feed intake and feed conversion ratio of broiler birds reared on paddy husk litter material were significantly improved than the birds reared on other materials.

Evaluation of Different Litter Materials on Performance of Commercial Broilers

Table 1. Weekly mean feed intake (g/bird) of commercial broilers reared on different litter materials.

Treatment		Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Cumulative		
								Wk 0-3	Wk 4 to 6	wk 0-6
T1	PH	94.41 ^a	291.13 ^a	503.83 ^a	619.20 ^a	777.03 ^a	752.54 ^a	889.42	2148.37 ^a	3037.68 ^a
T2	AS	90.15 ^b	272.39 ^c	486.64 ^c	604.83 ^b	771.15 ^b	730.18 ^c	850.46 ^c	2105.54 ^c	2955.73 ^d
T3	RH	91.65 ^{ab}	271.52 ^c	496.49 ^b	602.86 ^b	765.33 ^c	739.55 ^b	861.81 ^b	2105.49 ^c	2965.84 ^c
T4	MC	91.18 ^b	283.07 ^b	496.72 ^b	604.44 ^b	776.35 ^a	730.05 ^c	870.81 ^c	2109.32 ^b	2979.79 ^b
Mean		0.57	2.14	1.73	1.74	1.25	2.41	3.70	4.70	8.29
P value		0.03	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Table 2. Weekly mean body weight (g) of commercial broilers reared on different litter materials.

Treatment		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
T1	PH	141.25	345.23a	701.75a	1,051.00a	1,427.50a	1,830.75a
T2	AS	138.75	339.83b	646.50c	992.00b	1,355.00c	1,720.25b
T3	RH	140.34	336.53c	668.25b	1,014.00ab	1,374.50b	1,741.75b
T4	MC	139.75	343.47a	674.75b	1,016.00ab	1,382.25b	1,754.00b
SEM		0.93	0.92	5.73	7.72	7.09	11.93
P value		0.844	0.001	0.001	0.035	0.001	0.001

Table 3. Weekly mean body weight gain (g) of commercial broilers reared on different litter materials.

Treatment		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
T1	PH	89.12b	203.66a	356.27a	361.47a	366.44	403.35a
T2	AS	88.50b	198.76b	305.08c	352.05ab	359.10	365.70c
T3	RH	92.32a	192.35c	330.01b	347.28b	362.10	367.55c
T4	MC	89.51b	203.67a	332.86b	343.08b	363.60	371.69b
SEM		0.55	1.32	4.79	2.24	1.28	3.99
P value		0.04	0.001	0.001	0.001	0.244	0.001

Table 4. Weekly mean FCR of commercial broilers reared on different litter materials

Treatment		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
T1	PH	1.07a	1.43	1.42c	1.71	2.13	1.86c
T2	AS	1.03b	1.38	1.60a	1.71	2.15	2.00a
T3	RH	0.99c	1.41	1.51b	1.74	2.11	2.01a
T4	MC	1.03b	1.40	1.50b	1.75	2.16	1.97b
SEM		0.01	0.01	0.02	0.01	0.02	0.02
P value		0.001	0.610	0.001	0.09	0.799	0.001

Table 5. Economics of production for the birds from different groups

Treatment	PH	AS	RH	MC
Chick cost	35	35	35	35
Feed Intake	3,037.68	2,955.73	2,965.84	2,979.79
Cost of feed (Rs. 28 /Kg)	85.06	82.76	83.04	83.43
Miscellaneous cost (Rs.4/ Bird)*	4	4	4	4
Cost of litter	3.67	3.17	3.15	3.12
Total cost per bird	128	125	125	126
Body Weight	1,830.75	1,720.25	1,741.75	1,754.00
Return on sale @ Rs. 80/ kg	146.46	137.62	139.34	140.32
Net profit/bird	18.73	12.69	14.15	14.47
Net profit /kg	10.23	7.38	8.12	8.25
Benefit cost ratio (BCR)	1.15	1.10	1.11	1.12

*Includes labour, electricity, etc

CONCLUSION

Among different litter materials like paddy husk, maize cob, ragi husk and shredded areca nut sheath waste, there was an improvement in body weight gain, feed consumption, FCR and mortality rate in paddy husk group when compared to other litter materials. BCR ratio is comparable among different treatment groups. Therefore, In addition to paddy husk, other litter materials can be used as an alternative in broilers if available at cheaper cost.

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Extent of Damage by Avian Fauna in Maize and the Measures for Management

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ABSTRACT

The study on extent of damage by avian fauna in maize and measures for management was conducted at ICAR-Krishi Vigyan Kendra, Virudhunagar District, Tamil Nadu. The per cent cob damage was assessed at the time of harvest. In addition, the bird species and its nature of damage also recorded. The results showed that, three rows of pearl millet in the border area combined with placement of reflective ribbons and scare crows (12/ha) had recorded least cob damage (32.29%) followed by treatment with placement of reflective ribbons and scare crows (12/ha) (35.43%) as against 68.29 per cent in the control plots. The yield also comparatively higher in treatment imposed plots (6242 and 5400 kg/ha), while the control plots registered 4562 kg/ha. Mostly the bird species viz., *Columbia livia*, *Psittacula krameri* and *Corvus splendens* were primarily causing damage to the maize crop.

Key words: Avian Fauna, Cob Damage, Reflective Ribbons, Scare Crow.

INTRODUCTION

Birds are considered to be an important component of agro-ecosystems. They cause potential threat to crop production due to their habit of damaging in both agricultural and horticultural crops (Brooks and Ahmed, 1990; Khan and Ahmad, 1990). The pigeons and crows inflict the damage at the germination and seedling stages. Maize kernels were severely attacked by the birds during milking stage. The parakeet was very destructive to maize, sorghum, wheat, sunflower and other grain crops. It is also damage the fruits such as mango, loquat, guava and orange despairingly. The bird damage occurs at various stages of the crops *i.e.* seeds may be picked or destroyed after sowing, seedlings may be pulled out or uprooted, and grains in milky stage or at the ripening stage may be fed by the birds. However, birds are difficult to control because of their behavior and feeding habits. Usually, many traps such as parotrap, mist trap, clip net and house loop traps were used to manage or capturing the bird pests (Khan *et al.*, 2002). Stevens *et al.* (1998) reported that use of mechanical devices was far better for controlling pest birds. But very few attempts were made by to test the reflector ribbon and scare crow. Hence, the present study was undertaken by the ICAR-Krishi Vigyan

Kendra, Virudhunagar District, Tamil Nadu to manage the avian fauna in millets.

MATERIALS AND METHODS

The study was carried out at ICAR-Krishi Vigyan Kendra, Virudhunagar research farm during 2021-22. The areas in and around the research farm is the hub for the rainfed crops such as sorghum, pearl millet, maize and other minor millets. Soil was mostly black cotton soil, which is rich in nutrients. The maize hybrid Co8 was cultivated in macro plots. Before sowing, seed treatment was done with Chlorpyrifos 20EC @ 4 ml/kg of seed along with 0.5 gram gum in 20 ml of water. The treated seeds were dibbled at a depth of 4 cm along the furrow in which fertilizers are placed and cover with soil. Thinning was done on the 12-15 days after sowing by leaving only one healthy and vigorous seedling per hole. Other intercultural operations viz., irrigation, weeding and fertilizer application was followed as per the TNAU crop production guide for the agriculture crops. To assess the damage potential and minimizing the bird damage, the experiment was conducted in macro plot design with following treatments.

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Treatment	Maize
T1	Pearl millet - 3 rows (border crop) + reflective ribbons + scare crows (12/ha)
T2	Reflective ribbons + scare crows (12/ha)
T3	Control

All the treatments were imposed at early cob formation stage. The reflective ribbons were tied up around the crop and were supported by the bamboo sticks used to fence around the field. The height of the reflective ribbons was given special consideration because too high and too low reflectors had significant effect on visiting bird pests. Hence, the reflective ribbons were erected three to four feet above the soil surface was found to give better results for maize crop. Similarly, five numbers of scare crows are placed 2 feet above the crop canopy in and around experimental plots.

The mean cob damage was assessed by recording the number of cobs damaged out of 50 cobs at five different points in the experimental plot. The weighted damage percentage was worked out as per the following formula.

$$\text{Weighted cob damage (\%)} = \frac{0.0 \times S1 + 0.25 \times S2 + 0.50 \times S3 + 0.75 \times S4 + 1.0 \times S5}{N} \times 100$$

Where, S1 = No. of cobs with no damage; S2 = No. of cobs with < 25 % damage; S3 = No. of cobs with 25 - 50 % damage; S4 = No. of cobs with 51 - 75 % damage and S5 = No. of cobs with > 75 % damage.

The data on per cent earhead damage, weighted earhead damage, yield per ha and BCR also worked out and statistical analysis was done. In addition, the bird species visiting or damaging the maize crop also recorded along with nature of damage caused from sowing to till harvest.

RESULTS AND DISCUSSION

The predominant bird species damaging maize crop was Blue Rock Pigeon *Columbia livia*, Rose Ringed Parakeet *Psittacula krameri* and common house crow *Corvus splendens*. The pigeon and common house crow caused damage to the sown maize seeds and eat away the young seedlings. The rose ringed parakeet incidence was noticed from cob formation to maturity stage. The tender cobs along with silky style was heavily damage by the rose ringed parakeet. They cut the green spathe covering the cob into pieces and feed on exposed grains resulting in higher per cent of yield loss.

Similarly, the per cent cob damage was assessed at the time of harvest. The results showed that, three rows of pearl millet in the border area combined with placement of reflective ribbons and scare crows (12/ha) (T1) was superior in registering the least cob damage (32.29%) followed by treatment with placement of reflective ribbons and scare crows (12/ha) (T2) (35.43%) as against 68.29 per cent in the control plots. Similarly, the yield was also comparatively

Table 1. Effect of different pest control methods on the avian pest damage in maize.

Treatments	Earhead damage (%) [*]	Weighted earhead damage (%)	Reduction over control (%)	Yield (kg/ha)	Yield Increase over control (%)	BC ratio
T1 – Pearl millet (3 border rows) + Reflective ribbons + scare crows (12/ha)	32.29 (34.62)	25.77 (30.50)	52.71	6242	36.82	2.10
T2 - Reflective ribbons + scare crows (12/ha)	35.43 (36.52)	24.69 (29.79)	48.11	5400	18.35	1.83
T3 - Control	68.29 (55.72)	39.19 (38.75)	-	4562	-	1.69
SEd	1.8	0.80	-	-	-	-
CD (0.05 %)	3.9	1.72	-	-	-	-
* Values in paranthesis are arcsine transformed values Means followed by a common letter are not significantly different by LSD (p<0.05)						

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higher in T1 (6242 kg/ha) followed by T2 (5400 kg/ha) while the control plots registered 4562 kg/ha. The mirror reflections from the reflective ribbons disturbed the birds and forced them to leave the experimental plots. The inclusion of pearl millet as border rows, though effective to certain extent, was not significantly contributing to reduction in bird damage. Hence, tying reflective ribbons and placement of scare crows (12/ha) can be recommended to farmers for minimizing the bird damage in maize. Hafeez *et al.* 2008 reported that, the continuous use of reflector ribbon in wheat and maize fields is helpful to minimize the visit of bird pests to “Zero” level. They also revealed that, maximum number (26) of parakeets attacked maize crop during early stage but this number was decreased drastically to 5 during later stage, where as the number of mynah attacking maize crop also decreased from 9 to “zero” by using reflective ribbon. The present finding was in accordance with the finding of Hafeez *et al.*

CONCLUSION

Using of reflective ribbons around the maize crop and scare crows @ 5 numbers per acre would be very effective in scare away the avian fauna. For maximum benefit this method should be adopted over an large area.

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Growth and Yield of Fodder Cowpea as Influenced by Nutrient Management in Sandy Loams of Onattukara in Kerala

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ABSTRACT

An experiment was conducted to examine the effect of nutrient management on growth and yield of fodder cowpea in sandy loams of Onattukara. The experiment was laid out in RBD with eight treatments and three replications. The treatments were T₁ (100% RDF), T₂ (75% RDF), T₃ (T₁ + zinc @ 0.25% as foliar spray at 20 DAS), T₄ (T₁ + boron @ 0.25% as foliar spray at 20 DAS), T₅ (T₁ + boron @ 0.125% + zinc @ 0.125% as foliar spray at 20 DAS), T₆ (T₂ + zinc @ 0.25% as foliar spray @ 20 DAS), T₇ (T₂ + boron @ 0.25% as foliar spray @ 20 DAS) and T₈ (T₂ + boron @ 0.125% + zinc @ 0.125% as foliar spray at 20 DAS). The results revealed that T₃ produced significantly higher plant height, number of leaves per plant and LAI at 30 DAS and at harvest. The green fodder yield per plant (106.72 g), green fodder yield per hectare (23.74 t), dry fodder yield per plant (10.12 g) and dry fodder yield per hectare (2.25 t) were significantly influenced by the treatment T₃. For enhanced growth and yield of fodder cowpea in Onattukara sandy loam soils of Kerala, the crop has to be supplied with 100 % recommended dose of fertilizers (FYM @ 10 t/ha, N, P₂O₅ and K₂O @ 25:60:30 kg/ha) along with foliar application of zinc sulphate heptahydrate @ 0.25 percent at 20 days after sowing.

Key Words: Foliar, Fodder yield, Onattukara, Sandy loam

INTRODUCTION

Good quality fodder is essential for the growth and development of livestock sector. In summer, both the quantity and quality of available herbage are notably low. Introducing a fodder legume in low-lying areas during the summer season can significantly improve fodder production and enhance the overall productivity of rice-based cropping systems. Fodder cowpea, particularly well-suited for sandy and relatively infertile soils, is widely cultivated in such regions (Singh and Tarawali, 2011). Addressing nutrient availability is crucial for optimizing crop production. Leguminous crops like fodder cowpea play a dual role by fixing nitrogen from the atmosphere in their root nodules, enriching the soil, and serving as green fodder, dry fodder, and silage during the lean summer months. Boron and Zinc are essential plant micronutrients and their importance to crop productivity is similar to that of major nutrients (Rattan *et al.*, 2009; Padbhushan and Kumar, 2014). The

Onattukara region of Alappuzha district, Kerala is characterized by a cropping system of two crops of rice followed by sesame/pulses/vegetables in the summer. The sandy loam soils of Onattukara is inherently low in nutrient contents (Mini and Mathew, 2015). To overcome this, strict adherence to fertilizer recommendations for each crop is necessary to achieve satisfactory yields. Hence, the present study was undertaken with the objective of yield enhancement in fodder cowpea through foliar nutrition of boron and zinc in the sandy loam soils of Onattukara.

MATERIALS AND METHODS

A study for enhancement in yield of fodder cowpea was done during December 2022 to February 2023 at Onattukara Regional Agricultural Research Station, Kayamkulam. The experiment was laid out in randomized block design (RBD) with eight treatments and three replications. The treatments were T₁ (100% RDF), T₂ (75% RDF), T₃ (T₁ + zinc @ 0.25% as foliar

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spray at 20 DAS), T₄ (T₁ + boron @ 0.25% as foliar spray at 20 DAS), T₅ (T₁ + boron @ 0.125% + zinc @ 0.125% as foliar spray at 20 DAS), T₆ (T₂ + zinc @ 0.25% as foliar spray @ 20 DAS), T₇ (T₂ + boron @ 0.25% as foliar spray @ 20 DAS) and T₈ (T₂ + boron @ 0.125% + zinc @ 0.125% as foliar spray at 20 DAS).

The experimental area was cleared, stubbles were removed and clods were broken. Dolomite @ 1 t/ha was applied uniformly in the experimental area and incorporated into soil along with tillage. Well decomposed farm yard manure was applied to all the plots as per treatments at the time of land preparation. The recommended dose of fertilizers given were 25:60:30 kg N: P₂O₅:K₂O ha⁻¹. The fertilizers were given in splits as half N, full P, half K as basal and the remaining half N and half K were given as top dressing at 15 days after sowing (KAU, 2016). Foliar nutrition of zinc was supplied as zinc sulphate heptahydrate @ 0.25 % and boron was applied as solubor @ 0.25%. Fodder cowpea var. Aiswarya released from ICAR-AICRP on Fodder Crops, College of Agriculture, Vellayani, Kerala was used for the study. It has a potential yield of 30 t/ha. The seeds of fodder cowpea were sown directly in lines in raised beds at a spacing of 30 cm x 15 cm. Interculture, weeding and earthing up for fodder cowpea were done at 10 days after sowing and at one month after sowing. Growth characters of fodder cowpea *viz.*, plant height, number of leaves per plant, leaf area index and number of branches per plant were recorded from five observational plants in each plot at 15 DAS, 30 DAS and at 45 DAS and the average was worked out. The plant height was measured in centimetres using a meter scale from the base of the plant to the growing tip of the stem. The total number of fully opened green leaves per plant was counted and the average was worked out and recorded. For calculating the Leaf are index (LAI), the method suggested by Gomez (1972) was followed. At 15 DAS, there was two fully opened unifoliate leaves and one trifoliate leaf from each observational plant. At 30 DAS and 45 DAS, only trifoliate leaves were present which were selected from each observational plant. The length and width of the fully opened individual lobes of trifoliate leaves in the observational plants per plot were recorded. The

total leaf area per plant was worked out by multiplying average leaf area by number of leaves.

Leaf area was calculated by using the formula:

LA=L x W x K Where,

LA : Leaf area per plant (cm²)

L : Length of leaf (cm)

W : Width of leaf (cm)

K : Factor (0.75)

Leaf area index was calculated using the following formula.

$$LAI = \frac{\text{Total functional leaf area per plant (cm}^2\text{)}}{\text{Land area occupied per plant (cm}^2\text{)}}$$

The number of primary branches per plants from each observation plant was counted and the mean was recorded. The yield characters like green fodder yield per plant, green fodder yield per hectare, dry fodder yield per plant and dry fodder yield per hectare was recorded at harvest. The fresh weight of observational plants from the respective treatments were recorded and the average was worked out for green fodder yield per plant. The plants in the net plot were cut at the base and made into bundles, in each plot and were weighed and expressed as kg/ha for green fodder yield per hectare. The observational plants harvested separately were first shade dried and then oven dried at 60° ± 5° C till constant weight was achieved. The dry weights of these samples were taken and total dry fodder yield per plant was calculated and expressed as g/plant. For dry fodder yield per hectare, the observational plants dried to constant weight were taken and calculated for dry fodder yield per hectare.

RESULTS AND DISCUSSION

Effect of Treatments on Growth and Growth Attributes

The plant height was found to increase throughout the crop period. The results (Table 1) indicated that different treatments did not significantly influence the plant height at the initial stage of growth (15 DAS). At 30 DAS and at harvest there was significant effect due to treatments. The treatment T₃ (T₁ + zinc @ 0.25% as foliar spray @ 20 DAS) recorded the tallest plants at 30 DAS and at harvest. The increase in plant height might be due to higher shoot growth by

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cell elongation, cell differentiation and apical dominance promoted by zinc. In general, the treatments that received 100 % RDF recorded taller plants compared to 75 % RDF. This might be due to the increased nutrients received from higher dose of fertilizers supplied. When zinc was applied as foliar (0.25%) spray there was an increase in plant height for fodder cowpea. This might be due to the favourable effects of zinc on cell division and enlargement which might have resulted in an increased plant height. Similar reports on improved plant height due to foliar application of zinc were also reported in tomato (Haleema *et al*, 2018), cowpea (Salehin and Rahman, 2012) and mung bean (Samreen *et al*, 2017). When boron, at a higher dose, was applied as foliar spray (T_4 and T_7), the older leaves of fodder cowpea developed spots which later turned necrotic. The younger leaves which developed latter were found to be unaffected. This might be the reason for the shorter plants in the treatments which received boron spray. Hosseini *et al* (2007) also reported reduced plant height in corn due to higher level of boron. When zinc was applied in combination with boron (T_5 and T_8), plants were taller compared to foliar application of boron alone (T_4 and T_7). This might be due to the lower dose of applied boron (0.125%) and the combination of zinc might have aided in increasing the photosynthetic activity, cell division and cell elongation. Hatwar *et al* (2003) also reported similar results in chilli.

This increase in number of leaves per plant with foliar nutrition of zinc might be due to the role of zinc in formation of tryptophan required for the synthesis of auxin. Zinc is also reported to promote chlorophyll formation and nutrient uptake thereby improving the vegetative growth and leaf number (Cakmak, 1999). Similar results of effect of foliar applied zinc in increasing the number of leaves were also reported in tomato (Haleema *et al*, 2018 and Ejaz *et al*. 2012). In general, the treatment that received a higher nutrient dose was found to improve the number of leaves compared to those which received a lower dose. The combined application of zinc and boron was found to increase the number of leaves per plant. This

might be due to the increased photosynthetic activity, cell division and cell elongation as reported by Hatwar *et al*. (2003). This was in agreement with the findings of Singh and Tiwari (2013) and (Ali *et al*, 2015) in tomato. Similarly, the highest number of leaves per plant was observed for the treatment T_3 (9.73) at harvest.

The results revealed that the number of branches per plant increased with age of the crop. No branches per plant were observed at 15 DAS. There was no significant influence by the treatments in the number of branches throughout the crop period.

The findings showed that the various treatments had no discernible effect on leaf area index at 15 DAS. At 30 DAS, significantly higher leaf area index was observed for the treatment T_3 which was given the recommended dose of nutrients along with a foliar spray of zinc (0.25%) (Table 2). The rapid division and elongation of cells due to application of zinc and balanced dose of fertilizers might be the reason for a higher LAI. Mondal *et al*. (2011) also recorded a higher LAI due to foliar application of one % zinc in mung bean. Similar results of increased LAI was obtained with the application of zinc in baby corn (Kumar and Bohra, 2014), cluster bean (Meena and Jat, 2016) and pigeon pea (Thamake, 2019). The plants that received foliar application of 0.25% boron (T_4 and T_7) could not produce a higher LAI compared to those that received foliar application of zinc (T_3 and T_6). This might be due to the toxic effect of higher dose of boron. The older necrotic leaves had started to dry up at the time of observation and this might be the reason for the lower LAI. Similar reports of visible toxicity symptoms *viz.*, yellowing, spotting and drying of older leaves are reported by Nable *et al*. (1997). When zinc was applied along with boron as foliar spray (T_5 and T_8), higher LAI compared to boron spray alone (T_4 and T_7) was obtained. This might be due to the positive effects of zinc in cell enlargement and lower dose of boron in the combination. This was in confirmation with the findings of Tripathy *et al*. (1999) who reported a higher LAI in soya bean due to the combined application of zinc and boron. The same trend continued till harvest.

Effect of Treatments on Yield and Yield Attributes

In general, the reduction in nutrient dosage brought down the green fodder yield per plant. The growth parameters had significant influence on the green fodder yield per plant in fodder cowpea.

At harvest, the green fodder yield per plant was significantly influenced by the treatment T₃ (106.72 g per plant) followed by T₅, yielding 101.69 g per plant. There was a yield increase of 10.03 % compared to the treatment T₁ (control) (Table 3). The increase in green fodder yield might be due to the increase in growth parameters *viz.* plant height, number of leaves, number of branches and LAI. This is in agreement with the findings of Weldua *et al.* (2012) who reported an increased yield and above ground biomass for fafa beans due to zinc application. The treatment T₇ registered the lowest green fodder yield per plant (78.45 g per plant). The combined spray of boron and zinc along with the recommended dose of nutrients (T₅) produced a green fodder yield of 101.69 g per plant. This is in agreement with the findings of Debnath *et al.* (2018) who reported an increased yield of cowpea with the application of boron and zinc.

Green fodder yield per hectare mainly depends on the growth parameters like plant height, number of leaves and number of branches. The individual improvement in these parameters had a cumulative effect on the total green fodder yield per hectare of fodder cowpea. Among the different treatments, the green fodder yield per hectare was significantly influenced by the treatment T₃ (23.74 t/ha). This was 11.77 % higher than the control treatment (T₁). Since zinc is a co-factor of over 300 enzymes and also an important element in nucleic acid metabolism, the application of zinc might have favoured a higher yield. Taliee and Sayadian (2000) and Mousavi (2011) had earlier reported that zinc is required for the biosynthesis of IAA and gibberellins which might be responsible for the vigorous growth and yield. Pandya and Bhat (2007) observed that the application of sulphur and zinc along with the recommended dose of NPK could improve the green fodder yield of cowpea. The application of ZnSO₄ @ 1 % as foliar spray at 25 DAS to cowpea was found to produce higher yield

(Narayan *et al.* 2008). Similar results of increased yield in fodder maize due to application of adequate amount of zinc along with nutrition was also reported by Potarzycki and Grzebisz (2009). Dhaliwal *et al.* (2023) also opined that the productivity in fodder crops can be improved through the application of zinc. The treatment T₇ recorded the lowest green fodder yield per hectare. Close examination of data indicated that the plants that received zinc and boron exhibited a synergic effect on yield compared to boron alone. The highest biological yield was recorded with the treatment combination of RDF, boron @ 1.5 kg/ha and zinc @ 5 kg/ha in cowpea (Debnath *et al.* 2018).

Among the treatments, the dry fodder yield per plant was significantly higher for the treatment T₃ (100% RDF + zinc @ 0.25% @ 20 DAS) and was found to be on par with the treatment T₅. Overall, there was an increase of 18.78 % compared to the control. The increase in dry fodder yield per plant might be due to the increase in growth parameters *viz.* plant height, number of leaves, number of branches and LAI. The lowest dry fodder yield per plant was observed for the treatment T₇.

The trend in dry fodder yield per ha was found similar to green fodder yield per ha. The dry fodder yield per hectare was also significantly higher for the treatment T₃ (2.25 t/ha) and remained at par with the treatment T₅ (2.17 t/ha). The lowest dry fodder yield per hectare was observed for T₇.

CONCLUSION

It could be concluded from the results that for enhancing growth and yield of fodder cowpea in Onattukara sandy loam soils of Kerala, the crop has to be supplied with FYM @ 10 t/ha, N, P₂O₅ and K₂O @ 25:60:30 kg/ha (KAU POP) along with foliar application of zinc sulphate heptahydrate @ 0.25 percent at 20 days after sowing

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Table 1. Effect of treatments on plant height and number of leaves of fodder cowpea

Treatment	Plant height (cm)			Number of leaves		
	15 DAS	30 DAS	at harvest	15 DAS	30 DAS	at harvest
T ₁ – 100% RDF	3	7.67	8.60	15.41	30.48	42.77
T ₂ – 75% RDF	3	7.53	7.73	15.02	29.27	35.24
T ₃ – T ₁ + zinc @ 0.25%	3	8.20	9.73	15.22	35.57	50.82
T ₄ – T ₁ + boron @ 0.25%	3	7.40	7.67	15.35	29.07	34.00
T ₅ – T ₁ + boron @ 0.125% + zinc @ 0.125%	3	7.93	9.20	15.33	32.97	46.94
T ₆ – T ₂ + zinc @ 0.25%	3	7.53	8.53	15.01	30.44	39.07
T ₇ – T ₂ + boron @ 0.25%	3	6.53	6.80	15.29	25.43	31.36
T ₈ – T ₂ + boron @ 0.125% + zinc @ 0.125%	3	6.73	7.40	14.85	27.96	34.12
SEm (±)	-	0.15	0.16	0.21	0.78	1.24
CD (0.05)	NS	0.453	0.496	NS	2.350	2.145

RDF - Recommended dose of fertilizers

NS - Not significant

Table 2. Effect of treatments on number of branches and leaf area index of fodder cowpea

Treatment	Number of branches (Number)			Leaf area Index (Units)		
	15 DAS	30 DAS	at harvest	15 DAS	30 DAS	at harvest
T ₁ – 100% RDF	0	2.33	4.53	0.22	2.08	3.03
T ₂ – 75% RDF	0	2.20	4.33	0.20	1.62	2.30
T ₃ – T ₁ + zinc @ 0.25%	0	2.67	5.40	0.23	2.25	3.34
T ₄ – T ₁ + boron @ 0.25%	0	2.13	4.27	0.24	1.46	2.25
T ₅ – T ₁ + boron @ 0.125% + zinc @ 0.125%	0	2.67	4.93	0.23	1.98	2.83
T ₆ – T ₂ + zinc @ 0.25%	0	2.27	4.40	0.20	1.76	2.49
T ₇ – T ₂ + boron @ 0.25%	0	1.47	3.67	0.22	1.26	1.99
T ₈ – T ₂ + boron @ 0.125% + zinc @ 0.125%	0	2.00	3.93	0.22	1.37	2.10
SEm (±)	-	0.35	0.51	0.01	0.03	0.04
CD (0.05)	-	NS	NS	NS	0.097	0.128

RDF - Recommended dose of fertilizers

NS - Not significant

Table 3. Effect of treatments on yield of fodder cowpea

Treatment	Green fodder yield (g/plant)	Green fodder yield (t/ha)	Dry fodder yield (g/plant)	Dry fodder yield (t/ha)
T ₁ – 100% RDF	96.53	21.24	8.52	1.90
T ₂ – 75% RDF	86.89	19.95	8.38	1.86
T ₃ – T ₁ + zinc @ 0.25%	106.72	23.74	10.12	2.25
T ₄ – T ₁ + boron @ 0.25%	85.77	19.16	7.83	1.74
T ₅ – T ₁ + boron @ 0.125% + zinc @ 0.125%	101.69	22.45	9.74	2.17
T ₆ – T ₂ + zinc @ 0.25%	96.21	20.94	8.47	1.88
T ₇ – T ₂ + boron @ 0.25%	78.45	17.50	7.24	1.61
T ₈ – T ₂ + boron @ 0.125% + zinc @ 0.125%	79.33	17.95	7.43	1.65
SEm (±)	1.59	0.32	0.37	0.08
CD (0.05)	4.823	0.966	1.115	0.246

RDF - Recommended dose of fertilizers

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Growth Performance and Carcass Characteristics of Ram Lambs Fed with Concentrate Mixture Containing Varying Levels of Rice Dried Distillers Grains with Soluble

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ABSTRACT

This experiment was aimed to assess the impact of substituting soybean meal in the concentrate mixture by incorporating rice distillers dried grains with solubles (RDDGS) on the growth and carcass characteristics of Vizianagaram ram lambs. In a completely randomized design 24 ram lambs (3-4 m old, 9-11 kg body weight) were randomly divided into four dietary treatments. All animals received a diet of super napier and concentrate mixture. The soybean meal in the concentrate mixture was replaced with RDDGS at 0% (T₁), 50% (T₂), 75% (T₃), and 100% (T₄) levels. The feeding trial lasted for 90 days. The findings of the study suggest that partial or complete replacement of soybean meal with RDDGS did not have any negative impact on body weight gain, average daily gain, and feed conversion ratio in ram lambs. The carcass studies revealed different traits *viz.*, empty body weight, carcass weight and dressing percentage were statistically similar among all treatment groups. The proportion of wholesale cuts (% carcass weight) *viz.*, foreshank & brisket, shoulder & neck, rack, loin and leg were numerically higher in T₄ compared to other treatments, but the differences between treatments were statistically non-significant. The yield of visceral organs expressed as percentage of pre slaughter weight and longissimus dorsi muscle chemical composition were also unaffected with dietary any of the treatments. It was concluded that, RDDGS is a nutritionally similar to soybean meal for replacing in the concentrate mixtures fed to growing ram lambs.

Key Words: Carcass, Characteristics, Growth, Lambs, Performance, Ram.

INTRODUCTION

Sheep rearing is an option of sustainable livelihood particularly in semi-arid and arid region and play a very important role in Indian economy. There are 74.26 million sheep in India (20th Livestock Census, GOI, 2019) in India. Productive returns in livestock depend on economically balanced feeding practices. The conventional feed ingredients, especially protein sources are becoming unaffordable for the ruminant feeding. A cost-effective alternative with rich nutrients is needed, ensuring safety and compatibility with regular metabolic processes. Rice distillers dried grain with solubles (RDDGS) is one such agro-industrial byproduct from rice based ethanol producing industry. RDDGS is similar to soybean meal in terms of protein and energy content. In the foreseeable future, there will be more such grain-based products would be available to the feed industry, because the government is

encouraging ethanol blending with petrol. RDDGS does not contain any anti-nutritional factor and can be included in the diet either as a protein source or an energy source, depending on the animal nutrient requirements, type of diet being fed, and economic considerations. Thus, the main objective of present experiment was to study the effect of RDDGS as a replacement of soybean meal on growth performance, Carcass characteristics in ram lamb.

MATERIALS AND METHODS

The investigation was carried out at small animal experimental shed of Livestock Research station, Garividi, Vizianagaram district, Andhra Pradesh. Twenty four ram lambs with average body weight and age of 9 - 11 kg and 4 - 6 months were used in the study. Prior consent was obtained from CCSEA via the Institutional Animal Ethics Committee (IAEC)

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of Sri Venkateswara Veterinary University (SVVU) in order to carry out the study.

Experimental treatments and feeding

In completely randomized design ram lambs were divided based on body weights in four treatment groups with six animals each. Four different concentrate mixtures were prepared by replacing soybean meal with RDDGS at 0 in T1, 50 in T2, 75 in T3 and 100% in T4. Animals were kept in individual pen with *ad libitum* provision of Super Napier and clean water. The concentrate mixture was offered twice between 9:00 to 9:30 A.M and then between 3:00 to 3:30 P.M to meet the growth requirements of ram lambs according to ICAR 2013. The ingredient composition of concentrate mixtures was presented in Table 1.

Growth Trial

In a controlled growth trial, twenty-four ram lambs (age: 4-6 months; weight: 9-11 kg) were thoughtfully randomized into four groups of six. The study focused on individualized housing, precise feeding, and constant access to fresh water. As a part of deworming protocol all lambs received strategic deworming with Ivermectin (1 mL/50 kg body weight) before the trial's commencement and midway through, prioritizing their health and well-being. Weighing sessions were conducted as a crucial step in assessing the lambs' growth. Prior to the initiation of the experiment, these sessions occurred early in the morning over three consecutive days. The average weight obtained from these measurements was considered as the initial body weight for each lamb. Subsequently, the animals were weighed at weekly intervals, again in the early morning before being offered feed and water, throughout the duration of the experiment. Feed samples were analyzed for proximate composition as per AOAC, (2007), fiber fractions (Van Soest *et al*, 1991) and calcium and phosphorus Talapatra *et al* (1940).

Carcass studies

At the end of growth trial, a meticulous selection process identified two animals from each group whose body weights closely mirrored the respective group averages. These selected lambs were subjected to a comprehensive slaughter analysis aimed at understanding both slaughter performance and carcass traits. Prior to slaughter, the lambs underwent a 12-hour fasting period and were processed using the

halal method. The procedure involved measuring and documenting blood loss during exsanguination. Subsequently, the skin was methodically removed, and the weights of the skin, skull, and feet were meticulously recorded. The slaughtering process followed a systematic approach based on the methodology outlined by Gerrand (1964), encompassing procedures such as stripping, legging, dressing, and evisceration. Organ weights, along with that of the hot carcass, were carefully measured. Adhering to the guidelines established by the National Livestock and Meat Board of the USA (Brandly *et al*, 1968), the carcass was segmented into five distinct cuts: fore shank and brisket, neck and shoulder, rack, loin, and leg. For the determination of empty body weight (EBW), the stomach fill weight was subtracted from the pre-slaughter weight. An extensive list of weights, including those of the gastrointestinal system (GIT, both full and empty), skin, dressed head, feet, lungs with trachea, kidney, spleen, heart, and testes, were meticulously recorded. Further analysis included the weighing and separation of meat, bone, and fat from each cut, the cumulative sum of which was expressed as a percentage of the entire carcass. Additionally, samples of the longissimus dorsi muscle were carefully collected for subsequent analysis of proximate composition.

Statistical Analysis

The data were subjected to one-way analysis of variance procedure using SPSS (2012), using the linear model. The post-hoc comparison of means was done for the significant difference by Tukey and Duncan multiple range tests. Significant differences of treatments were considered at ($P < 0.05$).

RESULTS AND DISCUSSION

The daily weight gain (g/d) of ram lambs (Fig 1) slightly increased numerically at 100% level of inclusion but the difference was not statistically significant ($P > 0.05$). In line with present findings, Waffa and Mahmoud (2016) reported that inclusion of DDGS up to 50% levels had no effect ($P > 0.05$) on total body weight gain in lambs but insignificant improvement in ADG observed at 40 and 50% levels due to improvement in nutrients digestibility of the rations. Schauer *et al* (2008) also reported no effects ($P \geq 0.15$) on the final BW and performance related

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attributes of Ram bouillet lambs fed on DDGS up to 60 %. Abudabos *et al* (2021) reported that the insignificantly lower feed intake with the 50% DDGS diet had no effect ($P>0.05$) on body weight gain. McKeown *et al* (2010) reported that including corn DDGS, wheat DDGS or triticale DDGS at 20% in the diets did not affect ($P>0.05$) ADG. Feed conversion ratio (kg DMI/kg gain) was not affected at 100% replacement of soybean meal with DDGS in concentrate mixture of growing ram lambs but better FCR was reported at 100% replacement of RDDGS. In line with this, Schauer *et al* (2008) reported that inclusion of DDGS up to 60% level for part of the maize and soybean meal had no difference ($P>0.05$) in feed to gain ratio, it appears that feed to gain ratio is trending downward as the level of DDGS inclusion increases. This trend is supported by the increase in DM intake with no change in ADG as DDGS inclusion increased. Similarly, Huls *et al* (2006) observed that replacing soybean meal (SBM) and a portion of the corn with dried distiller's grains with solubles (DDGS) had no effect ($P>0.05$) on feed to gain ratio in lambs.

Carcass characteristics

The carcass characteristics of ram lambs fed diets containing RDDGS was presented in Table 2 and 3. No significant ($P>0.05$) difference was observed in carcass characteristics across all treatments. No difference across the all treatments may due the equal body weight gain. These findings support the results of earlier literature on replacing PNC with DDGS up to 100% (Reddy *et al*, 2021), DDGS replacing SBM completely (Kawecka *et al*, 2017), SBM at 0, 20, 40, or 60% DM (Schauer *et al*, 2008), barley grain and Canola meal at 20% DM (McKeown *et al*, 2010), and soybean meal at isonitrogenous levels (Abudabos *et al*, 2021; Huls *et al*, 2006). Present findings aligns with the findings of Abdelrahim *et al* (2014) who reported that the inclusion of DDGS either 12.7 or 25.4% did not result in any significant ($P>0.05$) alterations in carcass characteristics such as pre-slaughter weight, carcass weight, and dressing percentage in lambs. Van Emon *et al* (2012) reported that inclusion of DDGS had no effect on ($P>0.05$) on carcass weight and dressing percentage in lambs. Zelinsky *et al* (2006) also found no effect ($P>0.05$) on hot carcass weight in lambs when fed with corn or soya hulls supplemented with DDGS at 17.3%. Eun *et al* (2009) reported that inclusion of DDGS in

the diets of steers had no effect ($P>0.05$) on carcass characteristics. Beliveau *et al* (2008) reported that inclusion of wheat based DDGS had no effect ($P>0.05$) on carcass weight or dressing percentage in steers. In contrast, Felix *et al* (2012) found that the inclusion of DDGS at a 20% level resulted in increased carcass weight ($P=0.03$) compared to the 40 and 60% levels.

The wholesale cuts as a percentage of carcass weight in ram lambs fed a concentrate mixture containing RDDGS up to 100% showed no significant ($P>0.05$) difference. However, there were numerical increases in the weights of primal cuts in T₄ compared to the control due to slightly increase in body weight and best utilization of diet to muscle build up. In line with the present findings Hatamleh and Obeidat (2019) reported that no significant ($P>0.05$) differences, were observed in carcass cuts weight across the treatment when DDGS was fed to the lambs. Similarly, McKeown *et al* (2010) also found that DDGS derived from corn, wheat, or triticale replacing barley grain and Canola meal at 20% DM in lambs had no effect ($P>0.05$) on wholesale meat cuts. Schauer *et al* (2008) also reported that increasing levels of DDGS up to 60% in lamb finishing diets had no impact ($P>0.05$) on carcass cuts. Abdelrahim *et al* (2014) revealed that the inclusion of DDGS either 12.7 or 25.4% did not significantly ($P>0.05$) affect carcass characteristics.

The increase in the level of inclusion of RDDGS from 0 to 100% in the concentrate mixtures had no significant effect ($P>0.05$) on the lean, bone, and fat proportions in ram lambs. a similar was obtained by Kawecka *et al* (2018) who reported that inclusion of DDGS at 45% had no effect ($P>0.05$) on the chemical composition of the meat. Castro-Pérez *et al* (2014) reported that inclusion of DDGS in the diet of lambs had no effect ($P>0.05$) on composition of carcass. Whitney *et al* (2010) reported that inclusion of DDGS had no effect ($P>0.05$) on meat, bone and fat composition. Zelinsky *et al* (2006) also reported similar findings.

Increasing the level of incorporation of RDDGS from 0 to 100% in the concentrate mixtures had no effect ($P>0.05$) on the yield of visceral organs in ram lambs. Castro-Pérez *et al* (2014) reported that inclusion of DDGS in the diet of lambs had no effect ($P>0.05$) on visceral organ yield. O'Hara *et al* (2011) similarly conveyed that substituting a combination of

canola meal and barley grain with either low or high oil content corn dried distillers' grains with solubles (DDGS) or wheat DDGS in the diet had no impact ($P \geq 0.19$) on the yield of visceral organs in lambs.

CONCLUSION

It could be concluded that up to 100% of soybean meal could be replaced by RDDGS in the

concentrate mixture without affecting palatability of ration, growth performance, FCR and carcass characteristics in ram lambs.

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Table 1. Ingredient and chemical composition (% DM basis) of experimental diets fed to ram lambs.

Nutrient	Super Napier	RDDGS	CM-1	CM-2	CM-3	CM-4
Ingredient composition (%DM basis)						
Maize	-	-	31	34	35	31
DORB	-	-	36	33	32	36
Soybean meal	-	-	30	15	7.5	0
Rice DDGS	-	-	0	15	22.5	30
Mineral mixture	-	-	2	2	2	2
Salt	-	-	1	1	1	1
Chemical composition (%DM basis)						
Dry matter	24.32	91.02	91.34	91.30	91.32	91.33
Organic matter	88.05	94.18	90.67	91.15	90.57	91.28
Crude protein	11.68	47.32	20.05	20.07	20.07	20.08
Ether extract	3.47	6.25	2.96	2.78	3.43	3.84
Crude fibre	37.95	5.70	14.76	15.17	12.84	12.23
Nitrogen free extract	34.95	34.91	52.90	53.13	54.23	55.13
Total ash	11.95	5.82	9.33	8.85	9.43	8.72
Neutral detergent fibre	77.75	41.12	33.92	33.23	32.16	33.09
Acid detergent fibre	42.27	22.78	15.87	14.63	16.08	15.56
Hemicellulose	35.48	18.33	18.05	18.6	16.08	17.53
Cellulose	36.54	9.58	13.14	11.55	10.69	15.14
Acid detergent lignin	7.14	9.70	8.63	5.86	6.33	6.78
Silica	3.66	1.34	1.71	1.49	1.57	1.65
Calcium(%)	0.50	0.83	0.61	0.65	0.81	0.70
Phosphorous (%)	0.41	0.89	0.69	0.83	0.79	0.66

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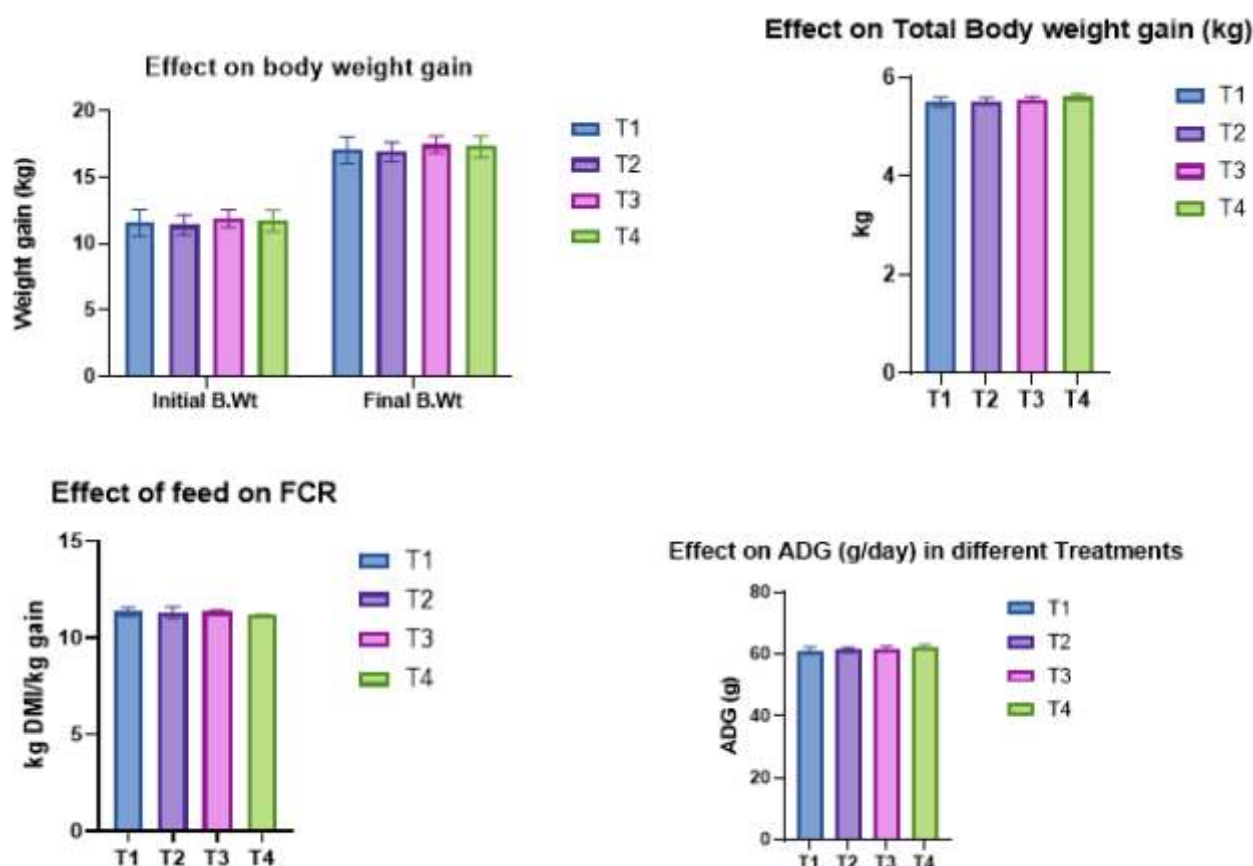
Table 2. Effect on carcass characteristics and wholesale cuts (% carcass weight) of ram lambs fed diets containing different levels of RDDGS

Parameter ^{NS}	T ₁ (Control)	T ₂	T ₃	T ₄
Pre slaughter weight (Kg)	17.75 ± 1.48	17.75 ± 1.12	17.84 ± 0.62	17.93 ± 1.36
Empty Body weight (Kg)	15.74 ± 1.32	15.76 ± 1.02	15.83 ± 0.63	15.86 ± 1.01
Carcass weight (Kg)	8.84 ± 0.79	8.85 ± 0.52	8.90 ± 0.25	8.95 ± 0.61
Dressing Percentage (%)				
(On pre slaughter weight)	49.78 ± 0.30	49.91 ± 0.37	49.91 ± 0.38	49.97 ± 0.37
(On emptybody weight)	56.12 ± 0.33	56.21 ± 0.41	56.26 ± 0.76	56.37 ± 0.30
Wholesale Cuts (% carcass wt.)				
Foreshank &Brisket	16.67 ± 0.10	16.68 ± 0.02	16.70 ± 0.07	16.71 ± 0.11
Neck & Shoulder	25.40 ± 0.24	25.50 ± 0.24	25.58 ± 0.15	25.85 ± 0.25
Rack	11.18 ± 0.16	11.28 ± 0.06	11.30 ± 0.09	11.35 ± 0.06
Loin	10.27 ± 0.80	10.89 ± 0.95	11.18 ± 1.11	11.46 ± 0.58
Leg	35.35 ± 0.27	35.69 ± 0.14	35.63 ± 0.12	35.66 ± 0.13

Table 3. Yield of visceral organs (% of pre slaughter weight) of ram lambs fed concentrate mixtures containing different levels of RDDGS

Parameter ^{NS}	T ₁ (Control)	T ₂	T ₃	T ₄
Pluck	3.11 ± 0.14	3.15 ± 0.15	3.15 ± 0.16	3.20 ± 0.15
Liver	1.20 ± 0.13	1.23 ± 0.14	1.26 ± 0.13	1.27 ± 0.13
Kidney	0.28 ± 0.04	0.29 ± 0.04	0.30 ± 0.05	0.31 ± 0.05
Heart	0.58 ± 0.08	0.59 ± 0.09	0.58 ± 0.09	0.61 ± 0.09
Testes	0.94 ± 0.07	0.97 ± 0.09	0.99 ± 0.10	0.99 ± 0.10
GIT (Full)	21.04 ± 0.52	21.43 ± 0.17	21.30 ± 0.14	21.44 ± 0.50
GIT(Empty)	6.39 ± 0.20	6.39 ± 0.09	6.38 ± 0.13	6.40 ± 0.10
Spleen	0.25 ± 0.04	0.23 ± 0.05	0.25 ± 0.06	0.27 ± 0.05
Pluck	1.15 ± 0.09	1.23 ± 0.09	1.21 ± 0.12	1.27 ± 0.12
Skin	8.23 ± 0.17	8.22 ± 0.18	8.23 ± 0.16	8.19 ± 0.15
Head	6.79 ± 0.11	6.52 ± 0.15	6.67 ± 0.23	6.88 ± 0.09
Blood	3.06 ± 0.10	3.05 ± 0.11	3.06 ± 0.12	3.45 ± 0.22
Intestines	2.33 ± 0.10	2.37 ± 0.10	2.32 ± 0.12	2.31 ± 0.14
Limbs	2.34 ± 0.12	2.32 ± 0.13	2.16 ± 0.10	2.30 ± 0.13

Fig1: Effect on growth performance and FCR of ram lambs fed different levels of RDDGS containing diets



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Health Care Textile Products using Antibacterial Herbal Finish

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ABSTRACT

An important and growing part of the textile Industry is the medical and related healthcare and hygiene sectors. The number of applications range from the simple cleaning wipe to the advanced barrier fabrics used for operating rooms. This paper reviews the healthcare and hygiene products used and required by consumers extensively today. The preferences of experts was sought to select healthcare and hygiene textile products to be developed using antimicrobial finish. The products selected from hygiene/utility textile articles category were multipurpose wipes and apron, from textile articles used for cleaning purposes were kitchen napkin and hand towel and from medical textiles category were mask and head cover. A total of thirty designs *i.e.* five designs for each selected article were created and the top ranked design of each article was selected for product development using herbal finished fabric. Cotton woven fabric was selected for development of multipurpose wipes, apron, kitchen napkin and head cover whereas cotton knitted fabric was selected for hand towel and face mask.

Key Words: Cotton, healthcare, hygiene, medical, textile products.

INTRODUCTION

An important and growing part of the textile Industry is the medical and related healthcare and hygiene sectors. Textile has always been a part of healthcare. The range of products available is vast but typically they are used in the operating room theatre or on the hospital ward for the hygiene, care and safety of staff and patients (Meena *et al*, 2021). The number of applications range from the simple cleaning wipe to the advanced barrier fabrics used for operating rooms (Desai, 2020). The healthcare and hygiene textile products can be organized into different categories *i.e.* patient specific, general management and occasion specific (Spagnolo *et al*, 2013). The textile products includes wide varieties of items like towel, napkin, apron, sponges, sheets, under-pads, diapers, wipes sterilization wrap, surgical gowns, drapes, table covers, face masks, head and shoe covers. etc.

Natural textiles are sources of unwanted microbes. Sweat, dirt and dust present in natural textile fibres (cellulosic and protein) create conducive environment for microbes to grow in millions (Tang *et al*, 2017). Textile fibres having microbes can

contaminate users and give rise to many diseases (Ravindra *et al*, 2010). Many bacteria populations double every 20–30 minutes at 36–40 deg.C and pH 5–9. A single bacteria cell can increase to 1 million cells in 7 hr. Hence, to avoid contamination of users and to avoid bad odour, one should apply an antimicrobial finish for textiles (Czajkowski and Paluszkiwicz, 2008).

There are lots of benefits of using antimicrobial finish in textiles that includes improve fabric strength, protects against generation of unpleasant odour, protects the fabric from discolouration, protects the fabric from stain, reduce chances of user contamination (Anonymous, 2021).

MATERIALS AND METHODS

Selection of products

For selection of products an exhaustive list of hygiene/utility textile articles, textile articles used for cleaning purposes and medical textile articles was prepared. Preferential choice index was developed and preferences of thirty experts were obtained on three point rating scale *i.e.* highly preferred, preferred and least preferred scoring 3, 2 and 1, respectively. Weighted mean scores were calculated and on the basis

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of scores obtained, rank was assigned to each article. Total six articles i.e. top ranked two articles from each category were selected for development of products using herbal finished fabric.

Creation of designs for selected products

For creation of designs, scaled outline of desired shapes with constructional feature for each article were drawn with the help of CorelDRAW-12 software. Various software tools for enlargement/reduction of size, transformation, modification, rotation, editing were used until required shapes/designs were obtained. A total of thirty designs i.e. five designs for each selected article were prepared.

Selection of designs for article development

To select the designs for development of selected articles, preferences of thirty experts were sought on three point rating scale using developed preferential choice index. On the basis of scores obtained, rank was assigned to each design. The top ranked design of each article was selected for product development using herbal finished fabric.

Selection of fabric

Suitable fabrics for development of selected articles were selected as per experts' preferences. Percentage was calculated on the basis of frequency.

RESULTS AND DISCUSSION

Selection of products

An exhaustive list of hygiene/utility textile articles, textile articles used for cleaning purposes and medical textile articles was prepared for selection of products. Total six articles i.e. top ranked two articles from each category were selected on the basis of preferences of thirty experts for development of products with antimicrobial finish.

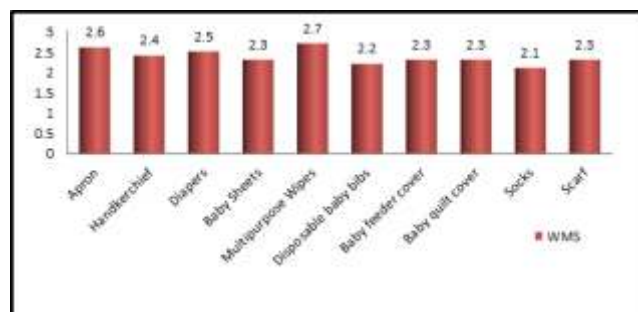


Fig. 1 Preferential choices for hygiene/utility textile articles (n=30)

The data pertaining to preferences of experts for hygiene/utility textile articles in Figure1 highlight that multipurpose wipes got I rank by scoring highest (WMS 2.7) and apron (WMS 2.6) ranked II. The preferences of experts for rest of the articles in descending order were diapers (WMS 2.5), handkerchief (WMS 2.4), baby sheets (WMS 2.3), baby feeder cover (WMS 2.3), baby quilt cover (WMS 2.3), scarf (WMS 2.3) and bibs (WMS 2.2). Socks was the least preferred hygiene/ utility article that scored 2.1 weighted mean score and ranked X.

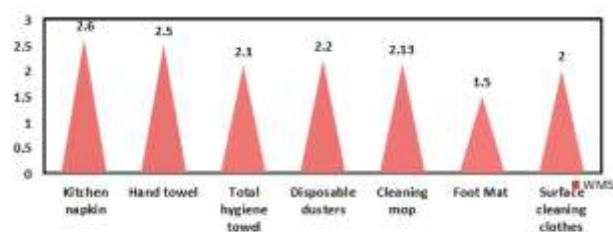


Fig2: Preferential choices for textile articles used for cleaning purposes (n=30)

The data presented in Figure 2 elucidate that for textiles articles used for cleaning purposes, kitchen napkin was preferred most by scoring WMS 2.6 and ranked I followed by hand towel (WMS 2.5) ranked II and disposable dusters which obtained WMS 2.2 ranked III. The other products preferred by experts in declining trend were cleaning mops (WMS 2.13), total hygiene towel (WMS 2.1) and surface cleaning clothes (WMS 2.0) The least preferred product in cleaning category was foot mat which with WMS 1.5 ranked VII.

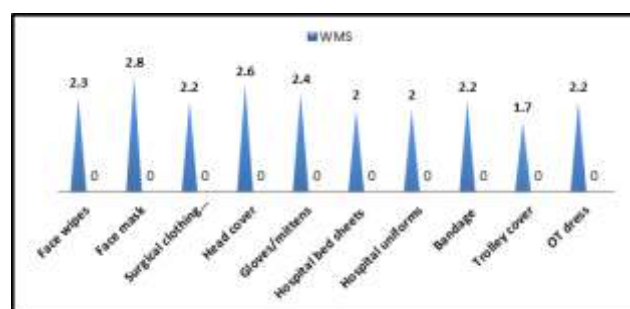


Fig3: Preferential choices for medical textile articles (n=30)

The data depicted in Figure3 reveal that from medical textiles articles category, mask scored highest with weighted mean score 2.8 and ranked I followed by head cover (WMS 2.6) ranked II and gloves/ mittens

Health Care Textile Products using Antibacterial Herbal Finish

ranked III by scoring WMS 2.4. The other articles obtained descending order of preferences as face wipes (WMS 2.3), surgical clothing gowns (WMS 2.2), bandage (WMS 2.2), OT dress (WMS 2.2), hospital bed sheets and pillows (WMS 2.0) and hospital uniform (WMS 2.0). Trolley cover was the least preferred medical textile article that scored 1.7 weighted mean score and ranked IX.

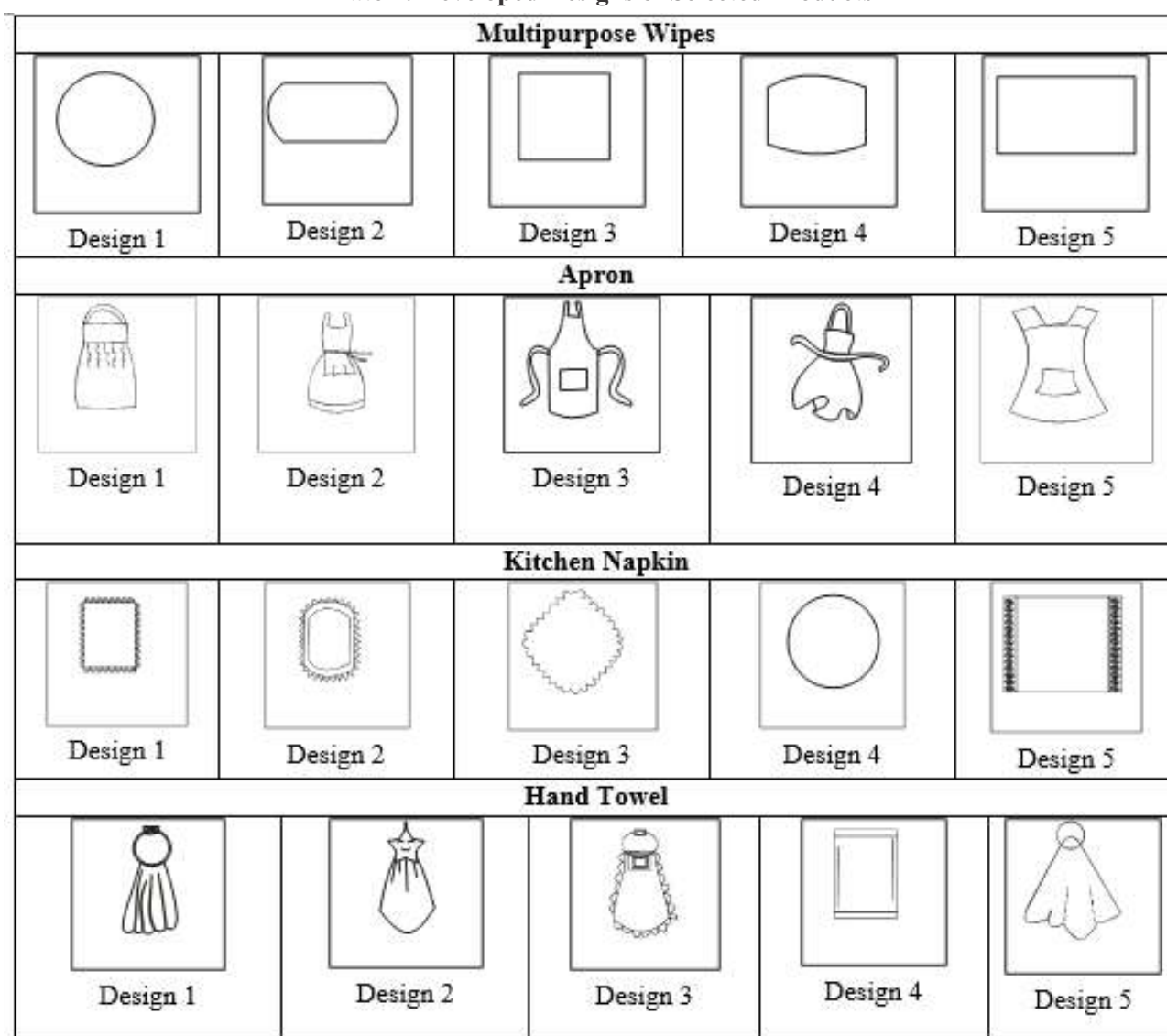
Thus, a total of six products i.e. two from each category were selected as per the preferences of experts from the listed products of hygiene/utility textile

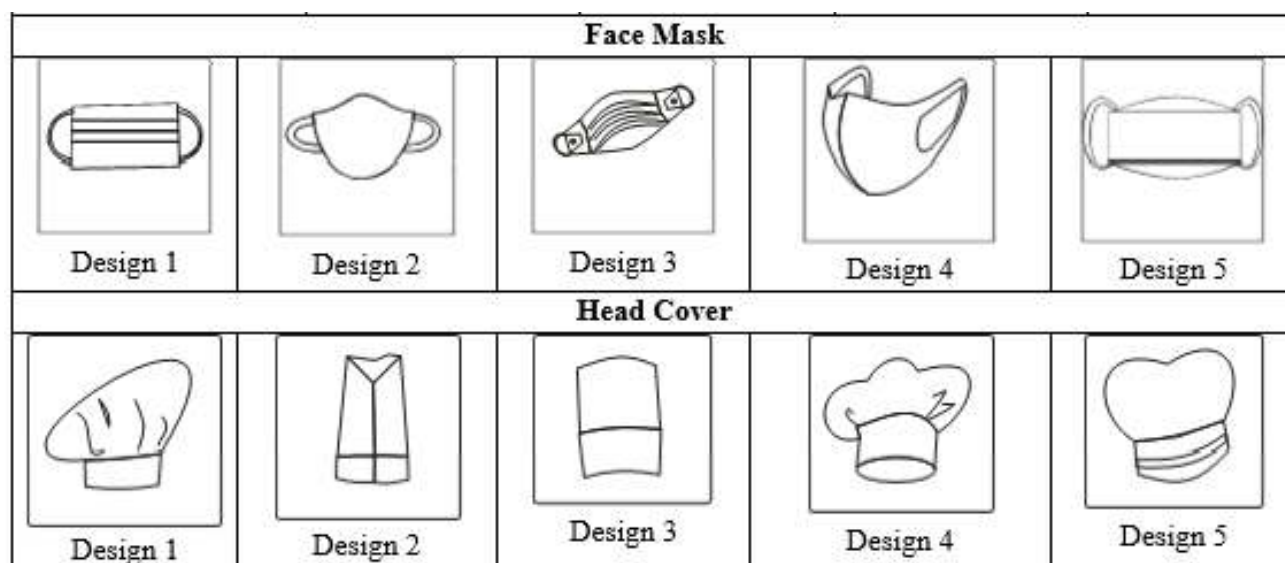
articles, textile articles used for cleaning purposes and medical textiles for product development using herbal finished fabric. The products selected from hygiene textile articles category were multipurpose wipes and apron, from textile articles used for cleaning purposes were kitchen napkin and hand towel and from medical textiles category were mask and head cover.

Creation of designs for selected products

The designs were created using CorelDRAW-12 software. A total of thirty designs i.e. five designs for each selected article were created.

Plate 1: Developed Designs of Selected Products





Selection of designs for article development:

Five designs for each selected article were developed using Corel DRAW 12 software and illustrated in Plate 1. From developed thirty designs,

top preferred one design of each article was selected on the basis of experts' preferences for the development of products and the data are presented in Tables 8 to 10.

Table 1: Preferential choices of developed designs for hygiene/ utility textile articles

Design	Articles			
	Multipurpose wipes		Apron	
	WMS	Rank	WMS	Rank
1	2.56	II	2.36	III
2	2.26	III	2.46	II
3	2.20	IV	2.50	I
4	2.10	V	2.13	V
5	2.63	I	2.16	IV

The data presented in Table 1 regarding preferential choices of developed designs for hygiene/utility textile articles reveal that amongst all the developed designs the most preferred design for multipurpose wipes was design number 5 scoring highest weighted mean score 2.63 and ranked I followed by design number 1 ranked II scoring 2.56. The design number 2 (WMS 2.26), 3 (WMS 2.20) and 4 (WMS 2.10) got III, IV and V rank, respectively.

For apron, the most preferred design was design number 3 scoring highest weighted mean score

2.50 and ranked I followed by design number 2 ranked II scoring 2.46. The other developed designs preferred in descending order were design number 1 (WMS 2.36) rank III, design number 5 (WMS 2.16) rank IV and design number 4 with lowest weighted mean score (2.13) was ranked V.

Thus, it is inferred that design number 5 for multipurpose wipes and design number 3 for apron were top preferred designs which were selected for development of textile articles.

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Table 2: Preferential choices of developed designs for textile products used for cleaning purposes (n=30)

Design	Products			
	Kitchen napkin		Hand towel	
	WMS	Rank	WMS	Rank
1	2.63	II	2.63	I
2	1.46	V	2.20	V
3	2.13	III	2.53	II
4	2.06	IV	2.33	IV
5	2.73	I	2.43	III

The data pertaining to preferences of experts for designs of textile products used for cleaning purposes presented in Table 2 highlight that amongst all the developed designs for kitchen napkin, design number 5 scored the highest weighted mean score 2.73 and rank I followed by design number 1 at rank II with weighted mean score 2.63. The design number 3 (WMS 2.13), 4 (WMS 2.06) and 2 (WMS 1.46) got III, IV and V rank, respectively.

For hand towel, design number 1 was most preferred (WMS 2.63) by the experts which obtained

rank I followed by design number 3 which obtained ranked II with weighted mean score 2.53. The other developed designs preferred in descending order were design number 5 (WMS 2.43) rank III, design number 4 (WMS 2.33) rank IV and design number 2 with the lowest weighted mean score (2.20) was ranked V.

Thus, it is inferred that design number 5 for kitchen napkin and design number 1 for hand towel were top preferred designs which were selected for development of selected articles.

Table3: Preferential choices of developed designs for medical textile articles (n=30)

Design	Products			
	Face m ask		Head cover	
	WMS	Rank	WMS	Rank
1	2.26	IV	2.53	II
2	2.53	II	1.86	V
3	2.43	III	2.20	IV
4	2.70	I	2.63	I
5	2.13	V	2.30	III

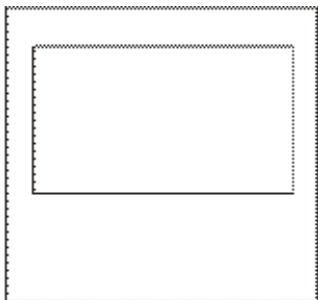
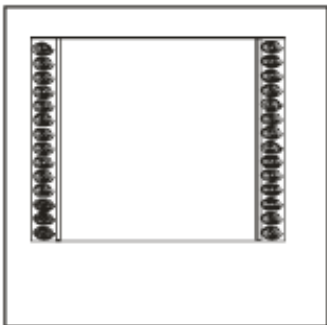
The data presented in Table 3 elucidate that for designs created for medical textile articles, design number 4 was most favored for mask by scoring highest weighted mean score 2.70 and rank I followed by design number 2 at rank II with weighted mean score 2.53. The design number 3, 2 and 5 got III (WMS 2.43), IV (WMS 2.26) and V (WMS 2.13) rank, respectively.

For head cover, design number 4 was most preferred (WMS 2.63) by the experts which obtained rank I followed by design number 1 which obtained

ranked II with weighted mean score 2.53. The other developed designs preferred in descending order were design number 5 (WMS 2.30) rank III, design number 3 (WMS 2.20) rank IV and design number 2 with the lowest weighted mean score (1.86) was ranked V.

Thus, it is inferred that design number 4 for face mask and head cover were top preferred designs which were selected for development of selected articles.

Plate 4: Selected Designs for Development of Products with Antimicrobial Finish

Hygiene/ Utility Textile Articles	
 Multipurpose Wipes Design 5	 Apron Design 3
Textile Products used for Cleaning Purposes	
 Kitchen Napkin Design 5	 Hand Towel Design 1
Medical Textiles	
 Face Mask Design 4	 Head Cover Design 4

Fabric Selection for Selected Products: Suitable fabrics for development of selected articles were selected as per experts' preferences.

Table 4: Preferential choices for selection of suitable fabric for product development

n=30

S. No.	Articles	Cotton woven F (%)	Cotton knitted F (%)	Cotton blend F (%)	Non woven F (%)
Hygiene/ utility textile articles					
1.	Multipurpose wipes	12 (40)	9 (30)	3 (10)	6(20)
2	Apron	21 (70)	3 (10)	6 (20)	-
Textile articles used for cleaning purposes					
1.	Kitchen napkin	24 (80)	3 (10)	3 (10)	-
2.	Hand towel	9 (30)	18 (60)	3 (10)	-
Medical textile articles					
1.	Mask	9 (30)	18 (60)	3 (10)	-
2.	Head cover	21 (70)	3 (10)	3 (10)	3 (10)

The data in Table 4 pertaining to preferences of experts for selection of fabric for development of hygiene/ utility textile articles show that 40 percent of the experts preferred cotton woven fabric followed by cotton knitted (30 %), nonwoven (20 %) and cotton blend (10 %) for wipes. Majority of experts preferred cotton woven fabric (70 %) followed by cotton blend (20 %) and cotton knitted (10 %) for apron.

The preferences of experts for selection of fabric for development of cleaning textile articles show that majority of experts preferred cotton woven fabric (80 %) followed by cotton knitted (10 %) and cotton blend (10 %) for kitchen napkin. Most of the experts preferred cotton knitted fabric (60 %) followed by cotton woven (30 %) and cotton blend (10 %) for hand towel.

It can be inferred from the data that for development of medical textile articles, majority of experts preferred cotton knitted fabric (60 %) followed by cotton woven (30 %) and cotton blend (10 %) for face mask. Majority of experts' preferred cotton woven fabric (70%) followed by cotton knitted (10 %), cotton blend (10%) and non woven (10 %) for head cover.

CONCLUSION

Health care and hygiene textile products are not directly used in medical treatment but are used for healthcare and good hygiene applications. These textile products help to improve people's lives and in some cases transform them. Hence, the products selected for product development using herbal finished fabric were multipurpose wipes, apron, kitchen napkin, hand towel, mask and head cover. A total of thirty designs *i.e.* five designs for each selected article were created and the top ranked design of each article was selected for product development using herbal finished fabric. Cotton woven fabric was selected for development of multipurpose wipes, apron, kitchen napkin and head cover whereas cotton knitted fabric was selected for hand towel and face mask.

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Impact Of Microfinance on Women Empowerment in Rewa District

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ABSTRACT

Microfinance and self-help groups are inseparable. Rewa block of Rewa district have 1,372 self- help groups involving 3,783 women in economic and social activities. The success of self-help groups in India and all over the developing and underdeveloped countries have proved that there is an exponential change in the mindset of the conservative and tradition bound, ignorant women in rural areas. Ex post facto research design was followed for the study. This study shows that out of total 120 respondents' majority belonged to medium aspiration (43.33%), half of the respondents exhibited medium level of socio-economic impact of microfinance on them (50.00 %).

Key Words: Empowerment, Microfinance, Socio-economic impact, Self-help group,

INTRODUCTION

Rural community faces lack of cash flow hence considered economically poor or marginalized. The self-help group is an alternative approach to achieve the objectives of rural development. Self-help group is a viable organized setup to disburse microcredit to the rural women and encouraging them enter into entrepreneurial activities. Credit needs of the rural women can be fulfilled totally through self-help groups. This has reduced the dependence on moneylenders and also resulted in empowerment benefits of women. (Singh *et al*, 2009). Self-help group enhances understanding of women regarding their local political institutions and other development agencies, which helps them to grow personally as well as socially.

Self- help group has got potential in creating awareness on day to day affairs, promoting saving habit, developing self and community-assets, increasing income level, improving social power etc. Self-help group concepts generate self-confidence, self-security and self-reliance. Presently self- help groups are functioning as an alternative approach to money lenders and bank to the beneficiaries Self-help groups enable women to grow their savings and to access the credit which banks are increasingly willing to lend. SHGs can also be community platform from

which women become active in village affairs, stand for local election of take action to address to social.

Total numbers of self-help groups in Madhya Pradesh are 3,15,607. Out of this total numbers of self-help groups in Rewa district are 11,573. Out of nine block Rewa block of Rewa district have 1,372 self-help groups involving 3,783 women in economic and social activities. (NRLM office Rewa, 2019). Keeping this in view the present study was undertaken with the objective to study the socio economic profile of the members of Self-help groups and determine the socio-economic impact of microfinance.

MATERIALS AND METHODS

This study was conducted in Rewa district M.P. The National Rural Livelihood Mission (NRLM) Project has been running in the district since 2015 for improving the livelihood of women beneficiaries through self-help groups. Out of 9 blocks; Rewa block was selected on the basis of higher number of rural women beneficiaries under NRLM project. A cluster consisting five villages viz, Kitvariya, Karahiya, Bansi, Dihiya and Jori of Rewa block was selected due to higher concentration of self-help groups members. A list of self-help group members was prepared from this cluster and a total of 120 respondents were selected through proportionate random sampling method.

The data were collected personally with the help of pre tested interview schedule. The appropriate statistical tools like percentage, average and Chi-square test and Co-efficient of association statistic were applied for drawing the inferences based on statistical results obtained from statistics analysis done. Chi-square test statistics is given as

$$\chi^2 = \frac{\sum \frac{(o - e)^2}{e}}{\quad} \quad \text{With d.f. (r - 1) (c - 1)}$$

RESULTS AND DISCUSSION

The data (table 1) show the percentage distribution of respondents according to psychological variable. Out of total respondents, majority belonged to

high achievement motivation level (51.67 %) followed by low achievement motivation (25.83 %) and medium achievement motivation (22.50 %). Similar results were also observed by Sangeeta *et al*(2013) Regarding Risk Orientation of respondents, majority belonged to high risk orientation (45.83 %) followed by low risk orientation (30.00 %) and medium risk orientation (24.17 %) which is quite dissimilar to findings of Bhosale (2003) . Similarly out of total respondents, majority belonged to high change proneness (52.50 %) followed by low change proneness (29.17 %) and medium change proneness (18.33 %). However, in case of Aspiration, majority belonged to medium aspiration (43.33 %) followed by low aspiration (33.33 %) and high aspiration (23.33 %).

Table 1. Distribution of respondents according to their psychological variable. N=120

Sr. No.	Independent variable	Category	No. of rural youth	Per cent
1	Achievement Motivation	Low	31	25.83
		Medium	27	22.50
		High	62	51.67
2	Risk Orientation	Low	36	30.00
		Medium	29	24.17
		High	55	45.83
3	Change proneness	Low	35	29.17
		Medium	22	18.33
		High	63	52.50
4	Aspiration	Low	40	33.33
		Medium	52	43.33
		High	28	23.33

The study shows that self-confidence ranks first with mean score 2.08. Maximum women members showed medium self-confidence level (50.00 %) followed by high self-confidence level (33.33 %) and low self-confidence level (16.66 %). The change in income ranked second with mean score 2.00. Maximum women members showed high change in income (69.17 %) followed by medium change in income (20.83 %) and low change in income (8.33 %).

The decision making ability ranked third with mean score 1.83. Maximum women members showed high decision making ability (70.83 %) followed by medium decision making ability (18.33 %) and low decision making ability (10.33 %) whereas communication level of women members ranked

fourth with mean score 1.56. Maximum women members showed high communication level of women members (58.33 %) followed by medium communication level of women members (33.33 %) and low communication level of women members (8.33 %).

It was revealed that community participation ranked fifth with mean score 1.5. Maximum women members showed high community participation (50.00 %) followed by medium community participation (41.66 %) and low community participation (8.33 %). Further, saving and financial decision making ranked sixth with mean score 1.47. Maximum women members showed medium saving and financial decision making (66.66 %) followed by high saving

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Table 2. Impact of micro-finance.

N=120

Sr. No.	Component	Socio-economic impact					Total score		Mean score	Rank
		High	%	Medium	%	Low	%			
1.	Self-confidence	40	33.33	60	50.00	20	16.66	250	2.08	I
2.	Change in income	83	69.17	25	20.83	12	10.00	240	2.00	II
3.	Decision –making ability	85	70.83	22	18.33	13	10.83	220	1.83	III
4.	Communication level of women members	70	58.33	40	33.33	10	8.33	188	1.56	IV
5.	Community participation	60	50.00	50	41.66	10	8.33	181	1.5	V
6.	Saving and financial decision making	20	16.67	80	66.66	10	8.33	177	1.47	VI
7.	Change in employment	60	50.00	35	29.16	15	12.5	170	1.4	VII
8.	Change in annual spending pattern	30	25.00	80	66.66	10	8.33	155	1.29	VIII
9.	Change in family violence	65	54.16	45	37.50	10	8.33	148	1.23	IX
10	Frequency of interaction with outsiders	20	16.66	83	69.16	17	14.16	120	1.00	X
11	Interaction with officials	13	10.83	30	25.00	77	64.16	110	0.91	XI
Average Mean :1.47										

and financial decision making (16.67 %) and low saving and financial decision making (8.33 %).

The study showed that change in employment ranked seventh with mean score 1.4. Maximum women members showed high change in employment level (50.00 %) followed by medium change in employment level (29.16 %) and low change in employment level (12.50 %). The annual spending pattern ranked eighth with mean score 1.29. Maximum women members showed medium change in annual spending pattern level (66.66 %) followed by high change in annual spending pattern level (25.00 %) and low change in annual spending pattern level (10.83 %).

The study shows that change in family violence ranks ninth means score 1.23. Maximum

women members showed high change in family violence (54.16 %) followed by medium family violence (37.50 %) and low change in family violence (8.33 %).

The data (Table 1) show that frequency of interaction with outsiders ranked tenth mean score 1.00. Maximum women members showed medium frequency of interaction with outsiders (69.16 %) followed by high frequency of interaction with outsiders (16.66 %) and low frequency of interaction with outsiders (14.16 %). Majority of women members had low interaction with officials (64.16 %) followed by medium interaction with officials (25.00 %) and high interaction with officials (10.33 %).

Table 3. Association between profile of the respondents and impact of the microfinance on them.

Sr. No.	Characteristic	c ²	D.f	C	Degree of association
1.	Achievement motivation	16.55	6d.f.	0.13	Fair
2	Risk orientation	11.66	6d.f.	0.28	Fair
3	change proneness	13.31	6d.f.	0.31	Fair
4	Aspiration	19.21	6d.f.	0.36	Fair

The characteristics namely risk orientation, achievement motivation, change proneness and aspiration of respondents had significant relationship with socio economic impact of microfinance on them at 5 per cent level of probability of significance. The results were in agreement with findings of *Rauch and Frese* (2000).

CONCLUSION

Lack of cash flow in rural area push the marginalized women and their families in borrowing and loans with heavy rate of interest. Microfinance have served to fulfill many needs in general and helped in empowerment of women in particular. The results on self confidence, income and decision making ability were found quite encouraging. However there are many challenges as well as constraints which should be addressed by policies and trainings.

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Impact of Zero Tillage Technology in Wheat and Summer Greengram Cultivation in Kymore Plateau and Satpura Hill Regions of Madhya Pradesh

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ABSTRACT

The Kymore Plateau and Satpura Hills region, which spans the districts of Sidhi, Rewa, Satna, Panna, Jabalpur, and Seoni, is a vertical strip that runs through the center of Madhya Pradesh. Medium to heavy cotton soils predominate in the area, while in the irrigated tracts, rice-wheat-green gram is the main cropping system. Conventional tillage techniques, such as preparing the seed bed for wheat by tillage with a cultivator and then breaking lumps with a rotavator, and preparing the seed bed for greengram by a similar procedure, further postpone the sowing by a further 12 to 15d. In 2019–20 and 2020–21, technology demonstrations on wheat and summer greengram were carried out with conventional and zero tillage while taking the aforementioned into account. ZT+R and CT-R plots showed grain yields of 51.99 and 48.77 q/ha, respectively, which were 41.55 and 32.78 per cent more than FP (36.73 q/ha). The cost of cultivation in ZT+R plots was found to be 0.63 per cent lower than in farmer's practices, but 9.57 per cent higher in CT-R. Wheat could have been sown 15–18 d earlier than with the CT–R method. With 10–12 d early sowing in ZT+R plots, greengram seed yield under ZT+R and CT-R fields was recorded to be 12.65 and 12.28 q/ha, with yield increases of 29.74 and 25.95 per cent over FP (9.75 q/ha). The cost for cultivating greengram was 0.38 per cent higher in CT-R technology but 4.87 per cent lower in ZT+R technology than in FP. In the disseminated area of 6385 ha, zero tillage technique minimized 675.92 MT CO₂ emissions, which was predicted to be 76% less than that of CT-R. This resulted in fuel savings of 252207 liters and decreased environmental pollution. In addition to the previously mentioned, it saved the need for one irrigation in greengram and wheat, saving a total of 5.795 million cubic feet of water in the disseminated area, valued at 63.85 lakh.

Key Words: Carbon dioxide, Conventional tillage, Emission, Zero tillage, Residue, Resource Retention.

INTRODUCTION

Madhya Pradesh is a significant producer of oilseeds, pulses, and cereal grains. It is the second-biggest producer of food grains in the nation. It is projected that in 2022–2023 the state will produce 352.7 lakh tonne of wheat (Anonymous, 2023). Additionally, Madhya Pradesh is the nation's second-biggest producer of greengram. In the Kymore Plateau and Satpura Hills region, a vertical band extending throughout central Madhya Pradesh that encompasses the districts of Sidhi, Rewa, Satna, Panna, Jabalpur, and Seoni, the major crops grown in rice-based farming systems are wheat and summer greengram. In the

Jabalpur district, where it is grown on 45385 ha., greengram is usually sown in the summer season (Singh *et al*, 2020). Medium to heavy black soils make up around 70% of the district's arable area, and in the irrigated tracts, the most common cropping pattern is rice-wheat-green gram. Although there are 22 to 25 d between the harvest of rice and the following planting of wheat in these soils, it is preferable to seed greengram early in order to reach crop maturity prior to the start of the monsoon season. These crops are traditionally produced on well-tilled soil that has had the remnants of previous crops burned or removed. Intensive tillage processes increase production costs

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and energy requirements. Annual crop waste removal reduces biological activity and soil organic content. Burning crop residue, on the other hand, pollutes the environment. Traditional tillage methods, which include preparing the seed bed for wheat by tillage with a cultivator and then breaking up lumps with a rotavator, as well as preparing the seed bed for greengram, further postpone the sowing by 12 to 15 d.

In order to ensure the long-term sustainability of intensive cropping systems, resource conservation technologies (RCTs) including residue retention and zero tillage have emerged in recent decades (Sharma *et al*, 2012). RCTs increase soil fertility by increasing carbon accumulation and biological activity and lowering energy inputs, in addition to lowering cultivation expenses and enhancing table yields (Meena *et al*, 2015). The application of zero tillage (ZT) approach, involving the planting of crops in loose and anchored wastes using a "Happy Seeder" zero till equipment, has the potential to reduce the adverse effects of conventional tillage (CT) and increase crop yield at a lower cost of cultivation. Taking the afore mentioned into account, technology demonstrations were conducted on wheat and summer greengram using conventional and zero tillage in order to evaluate crop performance as well as time, energy, and resource savings.

MATERIALS AND METHODS

In the *rabi* and summer seasons of 2019–20 and 2020–21, respectively, farmer's fields under conventional and zero tillage in Dehri Khurd and Pipariya Kalan villages of Kundam and Shahpura blocks of Jabalpur district hosted integrated crop management (ICM) demonstrations on bi-fortified bread wheat variety WB 2 and greengram variety IPM 02–03. (Fig. 1 & 2). In fields that were labeled as CT-R (conventional tillage after residue removal) and ZT+R (zero tillage with residue retention), biofertilizers containing azotobacter and phosphate solubilizing

bacteria (PSB) were applied at a rate of 5 kg/ha each during seed-bed preparation and prior to sowing. The recommended fertilizer dosage was 75% NPK of 100:60:40 kg/ha, along with 5 kg/ha of zinc. Urea, single super phosphate, and potash muriate were used to apply potassium, phosphorus, and nitrogen. Phosphatic fertilizer was placed two to three cm below the seed placement, and the seed rate used was 100 kg/ha. Prior to sowing, the seed was treated with a pre-mix fungicide (12% carbendazim and 63% mancozeb) at a rate of 2g/kg of seed followed by Azotobacter and PSB at a rate of 10 g/kg seed. In the CT-R and ZT+R plots, respectively, seed cum fertilizer drill and zero tillage machine 'happy seeder' were used for the sowing process. As a basal, full dose of phosphorus, potassium and zinc was applied; however, three equal splits of nitrogen were applied during the seeding, CRI and pre-flowering stages, respectively.

In the summer of 2020 and 2021, greengram was seeded at a rate of 25 kg/ha following seed treatment with a pre-mix fungicide (carbendazim 12% + mancozeb 63% WP) at a rate of 2 g/kg of seed followed by Rhizobium and PSB at a rate of 10 g/kg seed. PSB and *Trichoderma viridae* were inoculated into the soil at a rate of 5 and 2.5 kg/ha, respectively. During the sowing of the CT-R and ZT+R plots, 75% NPK of 20:50:20 kg/ha was applied using di-ammonium phosphate and muriate of potash. For the control of grassy and broadleaved weeds, pre-mix weedicide (sulphosulfuron 75% WP @ 25 g a.i./ha + metsulfuron methyl 5% WP @ 6 g a.i./ha) was used at 25–28 DAS in wheat and Imazethapyr 35% + Imazamox 35% WG @ 75 g/ha at 18–20 DAS in greengram. In order to control white fly and other sucking pests in greengram, pre-mix insecticide Betacyfluthrin + imidacloprid 300 OD @ 500 ml/ha was applied as foliar application at 32–35 DAS. *Pseudomonas fluorescence* was applied as spray in standing crop at the pre-flowering stage @ 2.5 l/ha to promote profuse flowering and pod development.

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Fig. 1: Sowing of wheat with happy seeder and zero tilled wheat crop (WB 2)



Fig. 2: Sowing of summer greengram with happy seeder and zero tilled crop (IPM 02-03)

RESULTS AND DISCUSSION

Promising Parameters and economics

In wheat, ICM frontline demonstrations using ZT+R and CT-R methods revealed 359 and 336 tillers/m², respectively, which were 60.98 and 50.67 per cent more than farmers' practices (Table 1). The grain yield of ZT+R and CT-R plots, which were determined as 51.99 and 48.77 q/ha, was 32.78% and 41.55% greater than that of FP (36.73 q/ha). ZT+R plots showed a 0.63 per cent low cultivation cost, but with 9.57 per cent high CT-R compared to farmer's practices. The net return seen under ZT+R plots was 56.53 per cent higher than FP, and CT-R came in second at 43.64 per cent. In ZT+R, CT-R, and FP plots, the B:C

ratio was 4.05, 3.8, and 3.14, respectively. With the least amount of soil disturbance attainable, the crop was directly seeded in the field shortly after the previous crop was harvested, by the use of zero-tillage technique with residue retention. Notwithstanding the afore mentioned, it shortened the duration and energy-intensive conventional tillage operations while lowering cultivation expenses and enabling wheat crop to be sown 15 to 18 d earlier than with the CT-R method. Gupta *et al* (2019) reported identical results from their study carried out in the Bhagalpur district of Bihar.

Table 1. Effect of ICM demonstrations on promising parameters of wheat under CT and ZT technology.

Particular	Tillers/m ²	Per cent change over FP	Grain yield (q/ha)	Per cent change over FP	Cost of cultivation (Rs/ha)	Per cent change over FP	Gross return (Rs/ha)	Net return (Rs/ha)	Per cent change over FP	B:C ratio
FP	223	-	36.73	-	22530	-	70696	48166	-	3.14
CT-R	336	50.67	48.77	32.78	24688	9.57	93873	69185	43.64	3.80
ZT+R	359	60.98	51.99	41.55	22388	-0.63	100081	75393	56.53	4.05

It was found that ZT+R and CT-R summer greengram demonstrations exhibited 32.65 and 31.92 pods/plant, respectively, which were 23.39% and 20.63% more than farmers' practices. ZT+R and CT-R fields recorded seed yields of 12.65 and 12.28 q/ha, respectively, with yield increases of 29.74 and 25.95 per cent relative to FP (9.75q/ha). ZT+R technology recorded a cultivation cost of Rs17430/ha, 4.87 per cent less than FP; in contrast, CT-R technology recorded a 0.38 per cent higher cultivation cost (Rs18350/ha) than FP (Rs18280/ha). The ZT+R and CT-R demonstrations generated a net return that was 56.53% and 43.64% greater, respectively, than farmers'

practices with B:C ratios of 5.22 and 4.82. Compared to the CT-R approach, the ZT+R approach allowed greengrams to be sown 10 to 12 d earlier, resulting in lower cultivation costs and increased yield. It was evident that the retention of residue as mulch on the soil contributed to the benefits of zero tillage. Higher N uptake was the outcome of residue additions that also increased the overall N, C, and other nutrient levels in the soil. In a study conducted in 2002, Halvorson *et al* (2002) found that in a cereal-legume cycle such as maize-chickpea-greengram, the biological N-fixation likely increased the N availability.

Table 2. Effect of ICM demonstrations on promising parameters of greengram under CT and ZT technology.

Particulars	Pods/plant	Per cent change over FP	Seed yield (q/ha)	Per cent change over FP	Cost of cultivation (Rs/ha)	Per cent change over FP	Gross return (Rs/ha)	Net return (Rs/ha)	Per cent change over FP	B:C ratio
FP	26.46	-	9.75	-	18280	-	70161	48166	-	3.84
CT-R	31.92	20.63	12.28	25.95	18350	0.38	88367	69185	43.64	4.82
ZT+R	32.65	23.39	12.65	29.74	17430	-4.87	91029	75393	56.53	5.22

Horizontal spread of the technology

Technology was made more widely recognized through popular articles, press releases, scientific advisories, folders/pamphlets, and Kisan Goshthies after ICM-ZT demonstrations in wheat and summer greengram. All seven blocks of the district—Jabalpur, Panagar, Majholi, Patan, Shahpura, Sihora, and Kundam—have ZT techniques for wheat and greengram disseminated throughout 86 and 105 villages, respectively, covering 3550 and 2835 ha. of area (Table 3). Since farmers adopted technological advances, the average yield of 44.5 and 11.7 q/ha of

wheat and summer greengram was recorded. Under the disseminated technology, wheat and summer greengram generated an average net return of Rs.63802/- and 67143/ha, respectively, with BC ratio of 3.92 and 4.94. According to a number of investigations (Erenstein *et al*, 2007; Farooq *et al*, 2006; Laxmi *et al*, 2007), the ZT method of growing wheat has also been shown to have a number of advantages, including less need for labor, irrigation, and timely crop establishment. These benefits all contribute to increased crop yield and net income.

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Table 3. Horizontal spread and net return in adoption of ZT technology in Jabalpur district.

Crop	Horizontal spread (No. of villages)	Area (ha)	Average yield (q/ha)	Average cultivation cost (Rs/ha)	Net return (Rs/ha)	B:C Ratio
Wheat	86	3550	44.5	21860	63802	3.92
Summer Greengram	105	2835	11.7	17050	67143	4.94

Table 4. Fuel consumption in conventional and zero tillage and saving under ZT technology.

Crop	Area (ha)	CT-R			ZT+R			Fuel saving & environmental impact in ZT+R	
		Requirement (l/ha)	Consumption (l)	CO ₂ emission in MT	Requirement (l/ha)	Consumption (l)	CO ₂ emission in MT	Diesel saving (l)	CO ₂ emission reduction (MT)
Wheat	3550	52	184600	494.73	12.5	44375	118.93	140225	375.80
Summer Green gram	2835	52	147420	395.09	12.5	35437.5	94.97	111982.5	300.11
Total	6385	--	332020	889.81	--	79812.5	213.90	252207.5	675.92

Fuel saving vis-a-vis environmental impact

The data (Table 4) reflected that zero-tillage technology saved 39.5 l of fuel per hectare. Diesel consumption under CT-R technology in 6385 ha recorded to be 332020 litres, however in ZT+R, it was 79812.5 litre thus 252207 litre fuel saved in the disseminated area under ZT, was 316 percent less to that of CT-R method. Zero tillage technology also reduced environmental pollution by minimizing 675.92 MT CO₂ emission which was estimated to be 76 percent less to that of CT-R. Above findings suggest that use of zero tillage with residue retention should be advocated for saving of fuel vis-à-vis CO₂ emission.

Irrigation and revenue saving

Zero tillage together with residue retention saved one irrigation for wheat and greengram. In addition, the method assisted in lowering soil disturbance and increasing soil structure, better soil aggregation, carbon accumulation, fertility, and

biological qualities. Weed occurrence was also decreased, mostly as a result of wheat and greengram emerging more rapidly.

CONCLUSION

The study revealed that cost and resource savings considerably increased the net return of wheat and summer greengram in zero tillage technology. It helps to reduce machine labour, fossil fuels, and irrigation water under zero tillage compared to conventional and farmers' traditional practices. Furthermore, the method significantly reduced CO₂ emissions, which are a major cause of environmental pollution. As a result, it could be a valuable choice for conserving scarce resources and increasing net farm income. The wider availability of happy seeder can encourage the adoption of zero tillage technology in rice-wheat-summer greengram cropping system.

Table 5. Irrigation water consumption and saving in ZT technology.

Crop	Area (ha)	Irrigation Requirement (cubic feet/irrigation/ha)	Total water consumption (million cubic feet)	Irrigation saving in ZT-R	Cost per irrigation (Rs/ha)	Total revenue saving per irrigation (in lakh)
Wheat	3550	9075	3.222	1	1000	35.5
Summer Greengram	2835	9075	2.573	1	1000	28.35
Total	6385	--	5.795	2	--	63.85

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Level of Farmers' Satisfaction in *Kisan Mela*

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ABSTRACT

Educating Kisan Mela attendees about new technology created by researchers mostly from government agricultural and allied research centers, state agricultural colleges, and some private sector institutions is the main goal of organizing such events. Purposefully carried out during the Kisan Mela, the current study aimed to find out how satisfied respondents were with the venue's location, stall orientation, arrangements for livestock, availability of high-quality seeds, information about new crop varieties, pesticide and insecticide information, and the overall experience of Kisan Mela for attendees. Based on a three-point continuum, the level of satisfaction was determined. The scores for most satisfied, satisfied, and not satisfied were 3, 2, and 1, respectively. The weighted mean score overall was determined, and a rating was completed. Most of the respondents indicated most content with the research area, namely, venue location, orientation of distinct stall, a system for drinking water, accommodations for animals to dwell in, the planning of an animal display, the accessibility of high-quality seeds, and details about novel crop strains, details on insecticides and pesticides, and the overall impact of farmer's fair. The vast majority of respondents claimed they couldn't afford acquiring knowledge about agriculture. There is a large gap between the amount of knowledge that is produced about agriculture and the amount of knowledge that farmers actually use. Kisan Melas are held to educate farmers about new technologies and products, such as hybrid seeds, fertilizers, tractors, banking services, mineral mixtures, medicines, and dairy utensils. A lot of effort goes into organizing Kisan Melas, and it is important to ensure that the farmers who attend are satisfied with the event so that they can benefit from the information that is being shared. This study was conducted to assess the level of satisfaction of farmers who attended a Kisan Mela.

Key Words: Bank loan, Kisan Mela, New-technology, Satisfaction level.

INTRODUCTION

The importance of *Kisan Mela* as a tool for extension education and raising farmer awareness has long been established. It aids them in expanding their knowledge of various cultural customs, cutting-edge concepts, newly created technologies, and government policy initiatives. The government and research organizations are working to develop better technology and other ways that will help farmers earn more money in order to enhance the production of agriculture and related sectors. A vast amount of agricultural literature has been produced by scientists, policymakers, extension agents, and other private sector professionals; these publications must be distributed to farmers. The only way the agriculture industry can expand so quickly is by bringing fresh knowledge from the lab to the field.

A major factor in agricultural development might be the dissemination of improved technology and agricultural knowledge via the use of modern communication tools. One way to quickly raise awareness and spread knowledge among a large number of farmers is through Kisan Melas. In order to educate farmers about new technology and to address their difficulties, agriculture research institutes have relied heavily on Kisan Mela and Kisan goshtis. The farming community uses Kisan Mela as a venue to raise awareness of and accept innovative agrotechniques. These gatherings assist the agriculture line departments and associated sectors in disseminating information regarding These gatherings support the line departments of agriculture and allied fields in providing farmers with information about new technologies. The scientific community demonstrates and offers farmers a multitude of options for novel

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procedures. These fairs draw a large number of farmers, scientists, students, extension workers from the KVK and the agricultural and related departments, and they assist farmers in expanding their understanding of new schemes or programs. Yadav and Kumar (2018) concluded that the main source of information about farmers' fair was friends and relatives (41.50%) followed by fellow farmers (37%). However in case knowledge level of farmers regarding farmers' fair activities was seeds sale (84.00%) followed by agro-industrial exhibition (83.50%).

The agricultural sector is not up to par despite government efforts to accelerate this key sector, and farmers still have the challenge of finding appropriate channels of communication or resources to keep them informed about contemporary technologies. This is despite the introduction of new technologies in the agricultural and related sectors. Farmers' information needs are always evolving, and the information need of the farmers is changing day by day and the farmers access the information from various sources as per their need. Now a day there is a lot of the information sources are present but within a period of time uses in agricultural practices.

MATERIALS AND METHODS

The study was carried out at Acharya Narendra Deva University of Agriculture and Technology during the Kisan Mela, in the Uttar Pradesh district of Ayodhya. A basic method of random sampling was utilized to choose the respondents. The majority of respondents were farmers who came in Kisan Mela. Respondents were personally interviewed using a pre-tested, semi-structured interview schedule to find out how satisfied Kisan Mela attendees were with various aspect of the event. Over the course of two days the Kisan Mela was held, 90 respondents were chosen and 45 of whom were questioned each day. Three point continuum's- Most Satisfied (MS), Satisfied (S), and Not Satisfied (NS) were used to gather data and 3, 2 and 1 were the scores that were assigned to each category. After determining the overall weighted mean score, a ranking was determined based on that score. Additionally, each aspect's total weighted mean scores were determined by adding together the frequencies, multiplying by the corresponding continuum scores, and divided by maximum possible score obtained by that aspect assigned by all respondents.

Total weighted mean score (TWMS) was calculated with the help of following formula:

$$TWMS = \text{freq of MS} \times 3 + \text{freq of S} \times 2 + \text{freq of NS} \times 1 / \text{Maximum possible score given by all respondents to a particular indicator}$$

Freq = Frequency, MS= Most satisfied, S= Satisfied, NS= Not satisfied

RESULTS AND DISCUSSION

Profile of the respondents

The data (Table 1) showed that 34.45 % of respondents had completed their education through graduation and (03.33%) beyond, followed by intermediate respondents (28.89%), high school education (18.89 %), primary education (7.78 %) and 06.66 % of those surveyed were able to just read and write. Respondents educational backgrounds revealed that those with higher education were also engaged in agriculture and related industries. Learning is a key instrument for enhancing the agriculture system that also helps educated farmers adopt new technologies more quickly. According to this study, formal education has already become more widespread in pastoral societies. The primary source of income was agriculture (60.0%) and over 21.11 % of respondents made their living from agriculture and some kind of business and 14.45 % of respondents were involved in animal husbandry as well as in business. Merely 04.44 % of the participants engaged in government job and agriculture. According to the survey, people living in rural communities today engage in a variety of jobs linked to agriculture and related fields. This kind of employment pattern suggested that the public sector's extension and advisory services ought to be comprehensive and intense.

Further the majority of respondents (70.03%) travel to Kisan Mela on their own dime. This is a significant indication of the respondents' information-seeking habits. 06.66 % and 07.77 % of the participants went to Kisan Mela with the assistance of KVK and with the help of other farmers. It is a proven fact that KVK significantly improved the socioeconomic standing of various farmer categories through exposure to this kind of visit whereas 09.99 % of respondents went mela with the help of advertisement they listened on radio, just 05.55 % of respondents said they went Mela with the assistance of various NGOs.

Level of Farmers' Satisfaction in Kisan Mela

Table 1. Profile of the respondents. (n=90)

A.	Education of respondents		
Sr. No.	Level of Education	Frequency	Percent
1.	Read and Write	06	06.66
2.	Primary education	07	07.78
3.	High School	17	18.89
4.	Intermediate	26	28.89
5.	Graduate	31	34.45
6.	Above graduation	03	03.33
B.	Occupation of the respondents		
1.	Agriculture	54	60.00
2.	Agriculture and Business	19	21.11
3.	Animal Husbandry and Business	13	14.45
4.	Government job and Agriculture	04	04.44
C.	Help of agencies for visiting Kisan Mela		
1.	Self	63	70.03
2.	With the help of Kvk	06	06.66
3.	Several NGOs	05	05.55
4.	Other farmers	07	07.77
5.	From advertisement on radio	09	09.99
D.	Number of Kisan Mela attended		
1.	One	68	75.57
2.	Two	10	11.11
3.	Three	06	06.66
4.	Four	04	04.44
5.	Five or above	02	02.22
E.	Purpose to visit kisan mela		
1.	To see new technology	24	26.68
2.	For entertainment purpose	20	22.22
3.	For purchase of good quality seed	33	36.66
4.	Information about types of farming	13	14.44
F.	Types of information obtained by respondent		
1.	Improved seed variety	35	38.90
2.	Improved agricultural technology	22	24.46
3.	Information about GI tagged	06	06.66
4.	Information about fertilizers	08	08.88
5.	Bank loan	17	18.88
6.	Labs	02	02.22
G.	Capability to pay for information		
1.	Yes	21	23.33
2.	No	69	76.67

The majority of visitors to the Kisan Mela (75.57%) were first-timers. The number of visits ranged from one to five and more. Visitors cited family obligations as a major constraint in attending such events. Only few of visitors had attended the Kisan Mela five times and more, which suggests that the event is a valuable source of information. The purpose of

visiting the Kisan Mela varied from person to person. The most common reasons were entertainment, purchasing high-quality seeds, learning about organic farming techniques. The Kisan Mela is also a good place for farmers to select crop seeds based on characteristics such as yield, irrigation needs, fertilizer needs, crop duration, and taste of produce. Despite the

Table 2. Satisfaction of respondents in Kisan Mela.

Sr. No.	Area of Satisfaction	Most Satisfied	Satisfied	Not satisfied	TS	TWMS	Rank
1.	Information regarding to pesticide and insecticide	71 (78.88)	19 (21.12)	00 (00.00)	251	02.78	I
2.	Behaviour of different Mela organizing persons towards you	70 (77.78)	19 (21.11)	01 (01.11)	249	02.76	II
3.	Drinking water arrangement	74 (82.23)	09 (10.00)	07 (07.77)	247	02.74	III
4.	Orientation of different stall	69 (76.66)	13 (14.46)	08 (08.88)	241	02.67	IV
5.	Location of venue	64 (71.11)	21 (23.34)	05 (05.55)	239	02.65	V
6.	Availability of quality seeds	56 (62.22)	33 (36.66)	01 (01.12)	235	02.61	VI
7.	Staying facilities for livestock	60 (66.66)	19 (21.12)	11 (12.22)	229	02.54	VII
8.	Overall effect of Kisan Mela	59 (65.55)	19 (21.12)	12 (13.333)	227	02.52	VIII
9.	Information regarding new technology development in agriculture	57 (63.33)	20 (22.23)	13 (14.44)	224	02.48	IX
10.	Information regarding new strains of crops	54 (60.00)	20 (22.22)	16 (17.78)	218	02.42	X
11.	Transportation Facility	44 (48.90)	30 (33.33)	16 (17.77)	208	02.31	XI
12.	Demonstartion of Technology	54 (60.00)	25 (27.77)	11 (12.23)	169	01.87	XII

Total Score, TWMS**= Total Weighted Mean Score

significant investment in terms of money, manpower, and time required to organize a Kisan Mela, it is a valuable event that meets the needs of farmers in the agriculture and allied sectors.

Farmers at the exhibition were interested in Rabi crop seeds, agricultural equipment, and new technologies. They also received information on a variety of topics, including improved seed varieties, agricultural technology and bank loans. The majority of respondents stated that they could not afford to pay for information on agricultural production systems. In summary, the Kisan Mela is a popular event that provides farmers and other visitors with information and entertainment on a variety of agricultural topics. It is a valuable resource for the agriculture and allied sectors.

Level of Satisfaction

Assessing farmers' satisfaction holds significant importance for several reasons. Farmers are the primary beneficiaries of agricultural fairs, making them the most suitable judges of these events' performance. Their firsthand experiences at the fair and their satisfaction levels provide valuable insights for shaping future plans and continuing similar activities (Elias *et al.* 2015). These findings were in agreement with Manjula and Sheikh (2010). Similarly, Kumari *et al.* (2023) and Sharma *et al.* (2023) found that majority of respondents were most satisfied with location of venue, timing of events, orientation of different stalls and behaviour of different Kisan Mela organizing persons. The majority of respondents (71.11%) expressed the highest satisfaction with the location of

Level of Farmers' Satisfaction in Kisan Mela

the Kisan Mela venue, while 23.34 % of respondents were satisfied, and 05.55 % were not content with the venue's location. In Table 2 by considering the overall satisfaction criteria, the venue's location ranked fifth based on the total weighted mean score. It's worth noting that participants at the Kisan Mela come from various parts of the nation, so they take into account various factors regarding the venue.

It was also observed that 76.66 % of respondents were highly satisfied with the arrangement and orientation of different stalls at the Kisan Mela grounds, while 08.88 % were not satisfied. The Kisan Mela efficiently utilizes the available space, contributing to its appealing appearance, and it ranked fourth based on the total weighted mean score.

Furthermore, the provision of drinking water at the Mela grounds received positive feedback, with 82.23 % of respondents expressing high satisfaction with this arrangement, and only a very small number of respondents were dissatisfied with the drinking water arrangements.

The majority of respondents, amounting to 66.66 % expressed satisfaction with the staying facilities provided for livestock at the Kisan Mela. Only few of the respondents were not satisfied with these facilities, possibly due to the high value, both monetarily and emotionally, that they attach to their animals. These dissatisfied respondents were primarily those who participated in the animal exhibition, and staying facilities for livestock ranked seventh based on the total weighted mean score.

Furthermore the data revealed that 62.22 % of the respondents were highly satisfied, 36.66 % were satisfied, and only were dissatisfied with the availability of quality seeds at the Kisan Mela. This aspect of the event ranked sixth in terms of overall satisfaction level.

The observed satisfaction trends can likely be attributed to the diverse needs of farmers concerning the quality and variety of seeds. About 60.00 % of the respondents expressed satisfaction with the information provided about new crop strains, Similar trends were noted at the Punjab Agriculture University farmers' fair, where participants likely attended the Kisan Mela to learn about newly developed crop varieties and the associated production and protection technologies, aiming to maximize productivity and

profitability.

A significant portion of the respondents (78.88%) exhibited the highest satisfaction in the area of information regarding pesticides and insecticides. In recent years, various insects and pests have posed threats to a variety of crops at different stages of cultivation.

Approximately 63 % of the respondents expressed the highest satisfaction with information regarding new technology development in agriculture. This high satisfaction is likely due to the rapid spread of information in Indian society. In terms of the behaviour of the organizing personnel at the Mela, most respondents (77.78%) were highly satisfied, followed by 22.22 % of respondents who were satisfied, and less than one per cent who were dissatisfied. Nearly all respondents (65.55%) were satisfied with the overall impact of the Kisan Mela, while a very small % (13.33%) expressed dissatisfaction. Evaluating client satisfaction levels can shed light on the reliability and responsiveness of services or the willingness of providers to meet clients' needs.

Overall, the satisfaction level of respondents regarding the location of the venue, orientation of different stalls, drinking water arrangements, staying facilities for livestock, arrangement of the animal exhibition, availability of quality seeds, information about new crop strains, information on pesticides and insecticides, and the overall impact of the Kisan Mela was notably high. These events cater to the diverse needs of attendees, including young and old, women and men, and youth. Interactive sessions between scientists and farmers facilitate a mutual understanding of on-field conditions and the applicability of knowledge. Such fairs also help farmers enhance their knowledge of new schemes or programs, attracting numerous participants, including farmers, scientists, students, and extension personnel from KVKs and agriculture-related departments (Tanusha and Chander, 2019).

CONCLUSION

Kisan Melas have demonstrably played a positive role in disseminating agricultural knowledge and resources to farmers, there is always a room for improvement. While the majority of farmers appreciate aspects like the venue, information provision, and stall

organization, further efforts are needed to ensure accessibility, infrastructure, and content effectively address the evolving needs of the agricultural community. By ensuring information and resources are readily available and affordable for all farmers, regardless of background or location, Kisan Melas can reach a wider audience. Additionally, providing adequate basic amenities and continuously updating the information and technologies showcased can significantly enhance the visitor experience and address contemporary agricultural challenges. Through these improvements, Kisan Melas can further empower farmers and become even more instrumental in fostering agricultural development and improving livelihoods.

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Mango Panicle Parameters: Comparative Study and Assessment of Weather Parameters Effect

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ABSTRACT

A field experiment was conducted at Navsari Agricultural University, Navsari, Gujarat, India during the year 2019-20 and 2020-21 to study the mango panicle characteristics and correlation between panicle growth parameters and climatic parameters. This study was conducted on seven mango varieties viz., Sonpari, Alphonso, Amrapali, Kesar, Dashehari, Totapuri and Rajapuri. Kesar recorded maximum length of panicle (37.55 cm) which was at par with Alphonso (35.66 cm) and Amrapali (32.80 cm). The maximum width of panicle (22.76 cm) was recorded in Kesar which was at par with Rajapuri (19.63 cm). Mango cv. Alphonso recorded maximum diameter of primary rachis (5.65 mm), which was at par with Kesar (5.60 mm) and Rajapuri (5.18 mm). Maximum numbers of spikelets panicle⁻¹ (above 10 cm) were recorded in cv. Kesar (14.00), which was at par with Alphonso (10.95). In correlation study it was noticed that, during the year 2020-21 panicle breadth was significantly positive correlated with minimum relative humidity ($r = 0.85^*$) and total rainfall ($r = 0.81^*$). During the year 2019-20, it was observed that, correlation between diameter of primary rachis and climatic parameters viz., maximum temperature ($r = -0.81^*$), minimum temperature ($r = -0.92^{**}$) and bright sunshine hours ($r = -0.91^{**}$) were significant and negatively correlated.

Key Words: Climatic parameters, Correlation coefficient, Mango, Panicle.

INTRODUCTION

Mango (*Mangifera indica* L) belongs to family Anacardiaceae is among the most widely spread fruit crops across the length and breadth of the country except temperate regions. Family Anacardiaceae made up of 73 genera and 830 species and originated in India Myanmar region (Yamanaka *et al*, 2006). This crop has huge diversity because of its allopolyploid nature, out breeding and phenotypic variations arising from varied agro climatic conditions (Ravishankar *et al*, 2000). Mango variability can be simply accessed by studying their inflorescences. Mango inflorescence is developed on reproductive shoot called as panicle. This crop produces panicles having hundreds of inconspicuous flowers, of which at most three or four flowers will develop fruits. The mango panicles among different varieties are predominantly terminal and varied in shape, length, breadth, flower colour and rachis diameter. Bhamini *et al* (2018) reported different shapes of mango inflorescences viz. pyramidal, conical and broadly pyramidal.

Among different internal and external factors, mango flowering is mostly affected due to particular varietal characters and its interaction with weather conditions. Evaluation of mango varieties for given ecological conditions is one of the pre-requisites for successful mango cultivation (Singh and Singh, 1996). The limited reports on the floral biology of popular cultivars of mango in South Gujarat promoted us to analyse the panicle behaviour of mango cultivars.

MATERIALS AND METHODS

The present investigation was carried out at Regional Horticultural Research Station, Navsari Agricultural University, Navsari during two consecutive seasons 2019-20 and 2020-21. Uniform fifteen year old trees of seven mango varieties viz., Sonpari, Alphonso, Amrapali, Kesar, Dashehari, Totapuri, Rajapuri were selected for this study. The objective was to study the variations in panicle growth parameters and degree of relationship between panicle growth characters and climatic parameters.

The experiment was laid out in Completely Randomized Block Design consisting of seven

treatments *i.e.* mango varieties which were repeated three times with two trees repetition⁻¹. Different panicle growth parameters were subjected to analysis of variance as suggested by Panse and Sukhatme (1985)

Correlation study between climatic parameters and panicle growth characters *viz.*, length and width of panicle, diameter of primary rachis and number of spikelets above 10 cm were studied. To study the correlation between panicle growth parameters and mean of environmental factors for effective time period (panicle emergence to complete flower opening) were considered.

Weather variables *viz.*, maximum temperature (°C), minimum temperature (°C), relative humidity (%), average wind velocity (km hr⁻¹), total bright sunshine hours day⁻¹ (BSSH) and total rainfall (mm) were considered for study. The degree of association was calculated by using Karl Pearson's coefficient of correlation.

$$r_{xy} = \frac{\text{Cov.}(X, Y)}{\sqrt{V(X) V(Y)}}$$

r_{xy} = Correlation coefficient between X and Y

Cov. (X, Y) = Covariance of X and Y

V(X) = Variance due to character X

V(Y) = Variance due to character Y

The significance of correlation coefficient (r) was tested by student's 't' test with (n-2) degree of freedom (Snedecor and Cochran, 1956) at 5 % level of significance.

$$t = \frac{r(n-2)}{\sqrt{1-r^2}}$$

RESULTS AND DISCUSSION

Panicle study

The data (Table 1), revealed that, mango cultivar Kesar recorded maximum length of panicle (37.55 cm) which was at par with Alphonso (35.66 cm) and Amrapali (32.80 cm). The length of panicle was minimum (19.73 cm) in Sonpari which was at par with Totapuri (20.91 cm). The variation in length of panicles in mango varieties might be due to genetic composition and more specifically the physiological condition of the shoot on which panicle arise. These results are also in harmony with findings obtained by Azam *et al* (2018), Kumar *et al* (2018), Kishor *et al* (2019), and Indian *et al* (2020).

The maximum width of panicle (22.76 cm)

was recorded in Kesar which was at par with Rajapuri (19.63 cm). Minimum width of panicle (14.27 cm) was recorded in Totapuri, which was at par with Amravati (16.46 cm), Alphonso (17.49 cm), Sonpari (16.76 cm) and Dashehari (16.91 cm). This variation in panicle width might be a result of interaction among the genetic composition of the varieties and climatic conditions. Similarly, Kishor *et al* (2019) and Indian *et al* (2020) reported that panicle width varied according to different mango cultivars.

Mango cv. Alphonso recorded maximum diameter of primary rachis (5.65 mm), which was at par with Kesar (5.60 mm), Rajapuri (5.18 mm), Sonpari (4.68 mm), Totapuri (4.64 mm) and Dashehari (4.62 mm). Significantly minimum diameter of primary rachis (3.91 mm) was recorded in Amrapali. Mango cv. Kesar recorded maximum number of spikelets panicle⁻¹ (above 10 cm) (14.00), which was at par with Alphonso (10.95). Minimum number of spikelets panicle⁻¹ (2.70) were recorded in Sonpari, which was at par with Totapuri (3.23), Dashehari (5.92) Amrapali (6.29) and (7.19). The variation in the diameter of primary rachis and number of spikelets panicle⁻¹ might be due to their varietal character. The results are in line with findings reported by and Singh (2014) and Rajatiya *et al* (2018).

Correlation study

Correlation between panicle growth parameters and weather parameters for the effective time had been studied individually for the year 2019-20 (Table 2) and 2020-21 (Table 3).

Panicle length and breadth

During both the years correlations between length of panicle and climatic parameters were found non-significant. It was revealed that the climatic parameters were not affected length of panicles. These results are in accordance with Yadav (2016), Rajatiya *et al* (2018) and Sinha *et al* (2020).

During the year 2019-20 correlations between panicle breadth and climatic parameters were found non-significant. However, during 2020-21 panicle breadth was significantly positive correlated with minimum relative humidity ($r = 0.85^*$) and total rainfall ($r = 0.81^*$). Correlations for rest of all parameters were found non-significant.

Humidity raised due to rainfall might be the cause for promoting growth of panicle by providing

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congenial conditions. These results are in accordance with Shu (1999), Yadav (2016), Rajatiya *et al* (2018) and Sinha *et al* (2020).

Diameter of primary rachis

During the year 2019-20, it was observed that, correlation between diameter of primary rachis and climatic parameters *viz.*, maximum temperature ($r = -0.81^*$), minimum temperature ($r = -0.92^{**}$) and bright sunshine hours ($r = -0.91^{**}$) were significant and negatively correlated. However, in case of minimum relative humidity ($r = 0.95^{**}$) it was significant and positively correlated. All other parameters recorded non-significant correlations. For the year 2020-21, correlation coefficient for minimum relative was significant and positively correlated ($r = 0.82^*$), whereas, it was significantly negative correlated for wind velocity ($r = -0.79^*$) and bright sunshine hours ($r = -0.80^*$). For all other parameters correlations were found non-significant.

Thicker rachis has been a varietal character of Alphonso (V_2), Kesar (V_4) and Rajapuri (V_7). Panicles of these were developed during cooler months (Jan.). While, thinner rachis is a varietal character of Amrapali (V_3), Dashehari (V_5) and Totapuri (V_6), who developed their panicles during warmer climate (Feb.). Because of these varietal characters maximum temperatures and bright sunshine hours fail to produce positive correlations. These results were in harmony with correlations reported by Yadav (2016), Rajatiya *et al* (2018) and Sinha *et al* (2020).

Spikelets/panicle (above 10 cm)

During the year 2019-20, number of spikelets/panicle (above 10 cm) were recorded significant and positive correlations with minimum relative humidity ($r = 0.78^*$) and negative correlation with bright

sunshine hours ($r = -0.79^*$). For the year 2020-21 climatic factors failed to produce significant correlations.

It is often said that humidity enhances vigorous growth this principle might be applicable to positive correlation between number of spikelets/panicle (above 10 cm) and humidity on one hand. While, on other hand, being a varietal character, branched rachis with more number of spikelets were produced in Kesar and Alphonso and whose panicles were developed during cooler months (Jan.). During this period comparatively humidity was more and sunshine hours were less than late flowering cultivars. Late flowering cultivars produced comparatively less number of spikelets *viz.*, Sonpari, Amrapali and Totapuri than earlier group. Due to these varietal characters all other climatic parameters might have failed to produce significant correlations. These results were in harmony with correlation study reported by Yadav (2016), Rajatiya *et al* (2018) and Sinha *et al* (2020).

CONCLUSION

Mango cv. Kesar recorded maximum panicle dimensions (length and breadth) and Number of spikelets/panicle (above 10 cm). Maximum primary rachis diameter was noticed in Alphonso. Panicle width and number of spikelets above 10 cm were significantly influenced by different climatic parameters. Climatic parameters failed to produce significant effect on panicle length, width and number of spikelets above 10 cm during both the years, first trial and second trial, respectively. However, correlations for rachis diameter were significant with different climatic parameters during both the years.

Table 1. Panicle parameters influenced by mango varieties (2019-20 & 2020-21)

Treatment	Inflorescence Density	Anthocyanin coloration of rachis and spikelets	Length of panicle (cm)	Width of panicle (cm)	Diameter of primary rachis (mm)	Number of spikelets/panicle (above 10 cm)
V ₁ - Sonpari	Sparse	Medium	19.73	16.76	4.68	2.70
V ₂ - Alphonso	Dense	Strong	35.66	17.49	5.65	10.95
V ₃ - Amrapali	Sparse	Weak	32.80	16.46	3.91	6.96
V ₄ - Kesar	Dense	Strong	37.55	22.76	5.60	14.00
V ₅ - Dashehari	Medium	Absent	27.36	16.91	4.62	5.92
V ₆ - Totapuri	Sparse	Medium	20.91	14.27	4.64	3.23
V ₇ - Rajapuri	Dense	Medium	30.63	19.63	5.18	7.19
S.E.m.±	-	-	2.31	1.21	0.31	1.52
C.D. at 5%	-	-	8.00	3.5	1.06	5.28

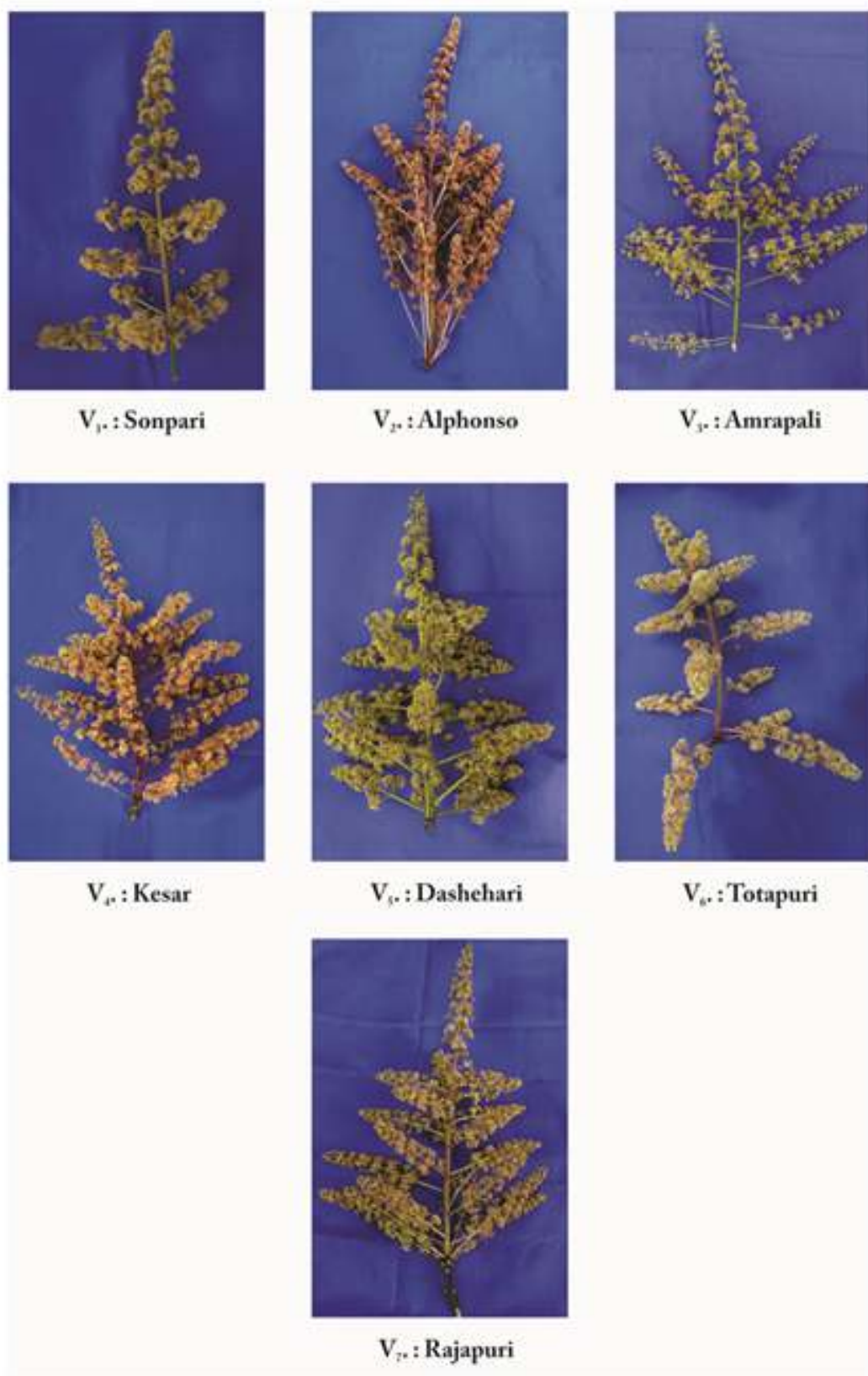


Plate: Comparison between mango varieties for panicle parameters

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V ₂ - Alphonso	Dense	Strong	35.66	17.49	5.65	10.95
V ₃ - Amrapali	Sparse	Weak	32.80	16.46	3.91	6.96
V ₄ - Kesar	Dense	Strong	37.55	22.76	5.60	14.00
V ₅ - Dashehari	Medium	Absent	27.36	16.91	4.62	5.92
V ₆ - Totapuri	Sparse	Medium	20.91	14.27	4.64	3.23
V ₇ - Rajapuri	Dense	Medium	30.63	19.63	5.18	7.19
S.E.m.±	-	-	2.31	1.21	0.31	1.52
C.D. at 5%	-	-	8.00	3.5	1.06	5.28

Table 2. Correlation between panicle parameters and climatic parameters in mango varieties (2019-20)

Treatment	Length of panicle (cm)	Width of panicle (cm)	Diameter of primary rachis (mm)	Number of spikelets/ panicle (above 10 cm)	T _{max} (°C)	T _{min} (°C)	RH _{max} (%)	RH _{min} (%)	Wind velocity (km/hr)	BSSH
V ₁ - Sonpari	18.63	14.27	4.34	2.40	30.03	14.05	86.28	43.42	1.66	8.33
V ₂ - Alphonso	38.26	17.44	5.75	11.98	29.09	11.89	85.35	55.11	1.65	7.23
V ₃ - Amrapali	33.11	16.71	3.94	6.48	33.69	15.93	83.59	40.70	0.66	8.66
V ₄ - Kesar	37.99	20.13	5.32	15.73	29.17	11.90	85.61	53.04	1.61	7.53
V ₅ - Dashehari	22.98	15.26	5.13	3.06	30.50	13.77	86.11	46.37	1.56	8.30
V ₆ - Totapuri	18.22	14.38	4.31	3.38	30.88	14.68	84.78	42.85	1.50	8.39
V ₇ - Rajapuri	31.06	16.93	5.16	8.39	29.35	12.02	85.33	52.52	1.59	7.64
Correlation coefficients		0.91**	0.56	0.91**	-0.16	-0.52	-0.28	0.68	-0.16	-0.67
			0.55	0.96**	-0.29	-0.59	-0.11	0.68	-0.01	-0.66
				0.64	-0.81*	-0.92**	0.49	0.95**	0.65	-0.91**
					-0.43	-0.69	-0.07	0.78*	0.13	-0.79*

Table 3. Correlation between panicle parameters and climatic parameters in mango varieties (2020-21)

Treatment	Length of panicle (cm)	Width of panicle (cm)	Diameter of primary rachis (mm)	Number of spikelets/ panicle (above 10 cm)	T _{max} (°C)	T _{min} (°C)	RH _{max} (%)	RH _{min} (%)	Wind velocity (km/ hr)	BSSH	Total rainfall (mm)
V ₁ - Sonpari	20.83	19.26	5.02	3.00	31.13	12.78	89.78	52.21	2.71	8.55	0.00
V ₂ - Alphonso	33.06	17.53	5.54	9.92	32.61	16.29	79.94	53.00	2.34	7.26	21.00
V ₃ - Amrapali	32.50	16.21	3.87	7.44	33.96	14.31	85.71	39.66	2.89	8.75	0.00
V ₄ - Kesar	37.11	25.39	5.88	12.28	31.04	15.05	86.85	59.46	2.27	6.95	39.00
V ₅ - Dashehari	31.73	18.56	4.11	8.78	31.57	12.32	83.89	43.19	2.97	8.78	0.00
V ₆ - Totapuri	23.61	14.15	4.97	3.08	32.09	12.74	83.36	41.83	3.05	8.66	0.00
V ₇ - Rajapuri	30.20	22.32	5.20	6.00	30.97	15.60	86.16	59.66	2.39	6.92	39.00
Correlation coefficients		0.49	0.14	0.95**	0.17	0.60	-0.34	0.26	-0.51	-0.53	0.57
			0.56	0.54	-0.66	0.40	0.44	0.85*	-0.76*	-0.73	0.81**
				0.27	-0.55	0.54	-0.04	0.82*	-0.79*	-0.80*	0.73
					0.05	0.54	-0.32	0.32	-0.57	-0.53	0.54

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Measurement Tool for Training Needs of Farmers for Solar Power Water Pump System

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ABSTRACT

An alternative to traditional grid-based or diesel-powered water pumps is the utilization of solar photovoltaic panels to generate electricity from captured sunlight, enabling solar-powered pumps. The availability of portable solar water pumps allows for easy relocation in accordance with seasonal or water demand fluctuations, all while maintaining lower operational costs. The technology employed for harnessing solar energy to power water pumps mirrors the methods previously used with electricity and diesel. In the years 2021-2022, a comprehensive scale was developed to assess the training needs of farmers who have adopted or not adopted solar-powered water pumping systems. This scale was constructed using the Likert method, incorporating a concise rating scale and standardized procedures. A total of 32 items were collected, and a thorough relevancy analysis was conducted by experts. Subsequently, a 23-item schedule was employed for preliminary interviews based on the results of the relevancy analysis. After subjecting the items to further scrutiny for their ability to differentiate, the final scale comprised 17 elements. Its validity and reliability were established using the split-half test reliability method and content validity, respectively. The scale's improved internal consistency was demonstrated by a commendable dependability coefficient of 0.890.

Key Words: Authenticity, Scale Construction, Solar Power, Renewable Energy and Trustworthiness.

INTRODUCTION

Solar water pumps are particularly efficient during peak solar array production, coinciding with high water demand on long, sun-drenched summer days. In India, the Ministry of New & Renewable Energy (MNRE) has been instrumental in promoting the growth of solar water pumping systems. Their initiative, launched in 1993, aimed to deploy 50,000 solar PV water pumping systems across the nation, as reported by Rathore *et al* (2018). Rajasthan, known for its abundant solar radiation with over 325 sunny days annually, boasts significant solar energy potential, up to 6-7 Kwh/M²/day. To demonstrate the system's effectiveness, the state government installed 14 PV pumps on its own farm in 2009–2010 and an additional 50 solar pumps in a farmer's field in 2010–11. Building on this success, a \$515 million program was initiated in 2011 to provide subsidized solar PV pumping systems to 10,000 farmers across the state. The expected result

is a significant annual savings of nine crore units of electricity when all 10,000 solar power systems are operational. Rajasthan set a precedent by offering an 86% subsidy in 2010–11 to horticultural farmers utilizing drip irrigation and farm ponds. This initiative provides an additional 1% subsidy on the initial capital cost of the pump, with financial support coming from two sources: the state government's Rashtriya Krishi Vikas Yojana (RKVY) and the Indian government's Ministry of New Renewable Energy, which oversees the Jawaharlal Nehru National Solar Mission (JNNSM), as noted by Kishore *et al* (2014). The present study aims to develop a scale for assessing the training requirements of farmers who have embraced solar-powered water pumping systems and those who have not. In the context of this study, perception, following Fisher's (2002) definition, refers to the process of selecting, organizing, and interpreting sensory data regarding a specific object or concept,

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with operational implications related to understanding farmers' training needs. The primary goal of this scale was to explore the relationship between farmer perception and its influence on their adoption behavior concerning the training requirements for solar-powered water pumping. Existing research by Mottaleb (2018), Chatterjee *et al* (2022), and Vecchio *et al* (2022) has demonstrated a positive association between farmers' perceptions and their adoption behavior. This scale aims to bridge the gap and contribute to the expanding body of knowledge in this field.

MATERIALS AND METHODS

The development of this scale followed Likert's (1932) summated rating approach, established as a standard practice. The scale's creation encompassed several key processes, including item collection, editing, relevancy analysis, item assessment, and scale standardization. A comprehensive array of items pertaining to various concerns associated with solar water pumping systems, as experienced by farmers, was compiled from a wide range of literature sources, including books, theses, journals, newspapers, and online resources. After consultation with academics, extension specialists, and farmers, an initial list of 40 items was generated. Subsequently, the 14 criteria proposed by Edward & Kilpatrick (1948) and Edwards (1969) for building attitude scales were employed to screen these items. From the initial pool of collected items, 32 items that conformed to informal scaling criteria were ultimately chosen.

For the purpose of relevancy analysis, these items were distributed via email to a panel of 80 judges who were instructed to critically evaluate each item's relevance using a three-point continuum: most relevant (HR), relevant (R), and non-relevant (NR), as per Kumar *et al* (2016), Kumar *et al* (2021), and Gupta *et al* (2022). Over a two-month period, 59 of the 80 judges responded, while the responses of four judges were excluded due to their lack of clarity and completeness. Based on the criteria of a relevancy percentage exceeding 70%, a mean relevancy weightage surpassing 0.70, and a mean relevancy score equal to or greater than the overall mean relevancy score of 2.83

(Raghuvanshi and Ansari, 2019), each item's relevance percentage, mean relevancy weightage, and mean relevancy score were computed individually. Consequently, 23 items were selected through this process and later revised and refined in response to feedback from the judges.

A set of 23 items was employed for in-person interviews with 30 farmers from a non-sampled area, utilizing a three-point scale for responses: most necessary (MN), necessary (N), and unnecessary (UN), corresponding to scores of 3, 2, and 1, respectively. The scoring formula was reversed for negative items. The perception score for each respondent was derived by summing the scores for all the items. Subsequently, respondents were grouped in ascending order according to their individual perception scores. To evaluate the ability of specific items to discriminate between respondents, two criteria groups were formed, each comprising 25% of respondents with the highest and lowest total scores, consisting of eight farmers in each group, following Edwards (1969). The distinction between the high and low groups was determined using the crucial ratio, or "t" value, with a higher 't' value indicating a more pronounced distinction. Items with a 't' value of 1.69 or higher were chosen for inclusion in the final scale.

To ensure reliability and content validity, the scale was standardized using the split-half approach. The scale was administered to 30 farmers, divided into two sets based on odd and even item numbers. This yielded two sets of scores. To assess the reliability of the half test, the Karl Pearson product-moment correlation coefficient was calculated between these two sets of scores. The reliability coefficient of the full set was computed using the Spearman-Brown method, further adjusting and confirming the scale's reliability and suitability for use across diverse contexts.

RESULTS AND DISCUSSION

Validity and reliability analysis

In accordance with Thorndike's (1971) perspective, a test's validity is contingent on its ability to effectively measure the variables it aims to assess. Content validity pertains to the extent to which a test comprehensively analyzes all aspects of the subject, behavior, or concept it is designed to gauge. The development of the present scale, incorporating

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Table 1. Standardized scale for the measurement of training needs of farmers for SPWP.

Sr. No.	Statement	PR	MRW	MRS	t-Value
1	Maintenance and repairing of solar pump.	90.90	0.90	2.72	1.79
2	Training on when solar panel is free in off season	94.54	0.93	2.8	1.73
3	Training on selection of inverters and batteries for better performance.	96.36	0.95	2.87	1.80
4	Government Scheme and policies on solar powered water pumps and its accessories	94.54	0.93	2.81	2.64
5	Training on using of solar power system	92.72	0.92	2.76	3.74
6	Ability to install and set up solar -powered water pumping systems.	90.90	0.87	2.63	2.64
7	Proficiency in operating and controlling the system, including understanding the control panel, sensors, and switches.	100	0.96	2.90	2.47
8	Basic understanding of solar energy and its conversion into mechanical energy.	90.90	0.90	2.70	1.89
9	Awareness of the components and functioning of solar -powered water pumping systems.	96.36	0.95	2.87	2.64
10	Familiarity with the benefits and potential applications of solar-powered water pumping systems.	96.36	0.95	2.85	1.87
11	Troubleshooting skills to identify and address common operational issues	94.54	0.93	2.8	2.64
12	Knowledge of water requirements for various crops and farming practices.	90.90	0.87	2.63	2.55
13	Understanding of irrigation scheduling and optimizing water usage with solar-powered pumping systems.	90.90	0.89	2.67	2.64
14	Awareness of routine maintenance tasks such as cleaning solar panels and checking connections.	96.36	0.91	2.74	2.21
15	Ability to diagnose and fix common system faults, including issues with pumps, valves, or electrical connections	100	0.98	2.94	2.04
16	Awareness of potential financial incentives, grants, or subsidies available for adopting renewable energy technologies.	92.72	0.92	2.76	2.93
17	Willingness to adopt new technologies and adapt farming practices accordingly.	92.72	0.92	2.76	2.64

Table 2. Reliability analysis of selected items.

Cronbach's Alpha Value		Set 1 (Odd items) Item No. 15	0.832
		Set 2 (Even items) Item No. 15	0.862
Correlation between forms		0.872	
Spearman-Brown Coefficient	Equal length	0.890	
	Unequal length	0.890	

insights from a literature review and professional opinions, adequately addresses the full spectrum of training requirements in the context of Solar Water Pumping Systems (SWPS). All items align with the procedural criteria of Likert's summated rating scaling technique and exhibit strong discriminative properties. Consequently, it was reasonable to endorse the scale as a reliable measurement tool. As per Anastasi's (1968) definition, reliability signifies the consistency of results when the same test is administered to a respondent on multiple occasions. The scale's dependability was assessed using the split-half method. Thirty farmers from outside the sampled area were administered the scale, which was divided into two sets based on odd and even item numbers, resulting in two sets of scores. To ascertain the reliability coefficient (r) for the complete set, the Spearman's Brown formula was applied to adjust the correlation coefficient between the set providing the half-test reliability, which measured 0.872. The scale's 'r' value was 0.890, significant at the 1% level of significance, affirming the scale's robust dependability. Consequently, it can be concluded that the test is both valid and dependable for evaluating farmers' training needs in the context of SWPS. Detailed results of the reliability analysis can be found in Table 1. The final scale comprises 17 items, with a three-point scale for respondents: Most Necessary (MN), Necessary (N), and Un-Necessary (UN), scored 3, 2, and 1, respectively, with 62 representing the highest and 52 the lowest scores.

CONCLUSION

Amidst the pressing concerns of climate change and environmental preservation, the notion of addressing the training requirements for Solar-Powered Water Pumping (SPWP) is gaining substantial support. This surge of interest is primarily driven by the imperative need to curb exorbitant diesel costs,

exacerbated by the heavy reliance on this fuel within the population. Recognizing that farmers' training needs will play a pivotal role in the widespread adoption of SPWP, the development of this assessment tool is pivotal. The objective behind creating this scale is to furnish researchers, policymakers, and stakeholders with a practical instrument that can facilitate informed decision-making regarding SPWP training needs. Utilizing the SPWP approach, the scale is designed to enable these parties to conduct surveys aimed at devising policies and programs that can enhance productivity, profitability, and environmental sustainability. Notably, the reliability coefficient of the developed scale stands at 0.890, affirming its high degree of reliability and its utility across a range of settings.

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Overview of Dairy Milk Co-Operative Societies of Kalpetta Block, Wayanad, Kerala

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ABSTRACT

Dairy cooperative societies play a pivotal role in the agricultural and dairy sectors, providing a collaborative platform for local farmers in the Kalpetta block, Kerala. This study delves into the dynamics and functioning of 14 dairy cooperative societies, showcasing their impact on dairy sector in the study area. The societies were classified from Class 1 to Class 10 based on daily milk procurement capacity, each contributing uniquely to the cooperative's resilience and inclusivity. The study utilized structured interviews and data analysis to present a comprehensive overview of the cooperative landscape, emphasizing the societal, economic, and agricultural impact of these entities. The entire study examined data on milk procurement, member demographics, feed supply, animal possession, and workforce dynamics revealed the diverse and vital contributions of each class. The research contributes to the understanding of dairy cooperatives as drivers of community engagement, knowledge exchange, and socio-economic development.

Key Words: Animal possession, Dairy cooperative societies, Feed supply, Milk, Procurement,

INTRODUCTION

Dairy cooperative societies represent a unique and impactful model in the agricultural and dairy sectors. Dairy cooperatives were established to expand the dairy sector and satisfy local demand. In India, dairying is growing not just to produce more milk but also to give rural residents stable jobs (Sonkamble *et al*, 2021). These cooperative entities bring together local farmers, fostering collaboration, and collectively addressing challenges in producing and distributing dairy products. The fundamental principle behind dairy cooperatives is to empower farmers, enhance their bargaining power, and create a sustainable ecosystem that benefits both producers and consumers (Dhaliwal and Dhillon, 2017). Farmers themselves oversee the cooperatives in accordance with community needs and demands. The growth of the rural economy was significantly aided by dairy cooperatives (Wani *et al*, 2015). In a dairy cooperative, local farmers pool their resources, both in terms of milk production and expertise, to form a cohesive organisation. This joint

effort allows them to overcome individual challenges and collectively invest in facilities, technology, and marketing strategies. The cooperative model emphasises community-driven decision-making, ensuring that the interests of the farmers are at the forefront. The dairy cooperative has become a major driver of job creation, effective milk marketing, and the socioeconomic advancement of dairy producers. It is imperative to implement pertinent policies and practices that guarantee effective milk marketing, increased compensation, and the long-term socio-economic growth of dairy producers (Khan *et al*, 2014).

Key features of dairy cooperative societies include shared ownership, equitable distribution of profits, and a focus on improving the overall livelihoods of participating farmers, especially women (Asha *et al*, 2021). These cooperatives often play a crucial role in providing essential resources such as veterinary services, quality feed, and modern processing facilities, contributing to enhanced productivity and product quality (Nargunde, 2013). As

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we delve into dairy cooperative societies, it becomes evident that these entities go beyond economic transactions. They become hubs of community engagement, knowledge exchange, and socio-economic development. This article explores the impact of cooperative society on the dairy sector in the study area. The district Wayanad contains 55 Dairy cooperative societies (GOK, 2023). The present study has laid emphasize on investigating the dynamics and functioning of 14 dairy cooperative societies of Kalpetta block, Wayanad district of Kerala.

MATERIALS AND METHODS

The study was initiated in the Kalpetta block of Wayanad. Kalpetta, being a central location, provides a comprehensive representation of the dairy cooperative landscape in the region. Out of the total 15 dairy cooperative societies identified within the Kalpetta block, a strategic decision was made to include 14 societies in the study. This selection process aimed to capture a significant and representative sample, allowing for a more comprehensive understanding of the overall scenario.

A structured interview schedule was meticulously prepared which served as a tool for data collection to gather valuable insights through personal interviews with key stakeholders involved in the dairy cooperative societies. The structured nature of the interview schedule ensured that pertinent questions related to the functioning, challenges, and successes of the cooperative societies were systematically addressed. The personal interview method was chosen as it facilitates direct communication between the researchers and the respondents. This approach enhances the quality of data collected and allows for in-depth exploration and clarification of responses. The

data collected through these interviews are instrumental in providing a nuanced understanding of the operational aspects, organisational structure, and impact of the dairy cooperative societies in Kalpetta.

RESULTS AND DISCUSSION

The dairy cooperative landscape in Wayanad district exhibited a diverse range of societies, each classified based on their daily milk procurement capacity. This classification system, ranging from Class 1 to Class 10, provided a structured framework for understanding and assessing the different capacities and capabilities of these cooperative societies.

In this classification scheme, societies were further distinguished within certain classes. For instance, under Class 1, there are subdivisions like Super Grade and Special Grade, indicating exceptional performance or unique features. This nuanced classification allows for a more detailed analysis of the strengths and specializations of each society.

Specifically focusing on Kalpetta, one of the prominent locations in Wayanad district, the distribution of societies across different classes provided valuable insights into the varied capacities of these cooperatives. In this context, it is noteworthy that one society in Kalpetta falls under Class 2, showcasing a certain level of operational scale and efficiency. Moving down the classification, three societies fall under Class 3, while a substantial number—seven societies—belong to Class 4. This suggests a notable presence and contribution of societies with a mid-range daily milk procurement capacity.

Furthermore, the distribution revealed that two societies fall under Class 7, each potentially facing different operational dynamics. Lastly, one society is classified under Class 10, signifying a unique position and possibly distinct challenges or opportunities (Table 1).

Table 1. Categories of Dairy Cooperative Societies in the study area basis on milk procurement.

Class	Litres of Milk Procurement per Day (LMPD)	Number of societies in the study area
Class 2	Above 5000 and up to 7500 LMPD	1
Class 3	Above 3000 and up to 5000 LMPD	3
Class 4	Above 1500 and up to 3000 LMPD	7
Class 7	Above 400 and up to 700 LMPD	2
Class 10	Below 100 LMPD	1

Overview of Dairy Milk Co-Operative Societies of Kalpetta Block, Wayanad, Kerala

Milk procurement data of DCS in Kalpetta

As part of this analysis, it is important to consider the daily milk procurement figures of each DCS, as these numbers serve as a key indicator of their efficiency and impact. The data typically includes the amount of milk collected by each society on a daily basis, providing a comprehensive overview of their contributions to the overall milk production in the region. (FIG 1).

Average daily milk procurement (L)

The cooperative's milk procurement is thriving with diverse contributions from different classes of farmers. Class 2 leads with an impressive daily average of 6300 L, making an annual impact of 2,299,500 L. Following closely, Class 3 maintains a steady production of 3775 L daily, totalling 1,377,875 L annually. Class 4 showcases efficiency with a daily procurement of 2553.27 L, contributing 931,943 L yearly. Even smaller classes like Class 7 and Class 10, with daily averages of 571.5 L and 80 L respectively, play crucial roles, adding 208,597.5 L and 29,200 L annually. Together, these diverse classes create a resilient and inclusive cooperative system, ensuring a consistent and robust milk supply chain.

Average daily milk production (L)

Each class of farmers contributes uniquely to the cooperative's milk production. Class 2 maintains a consistent pace with 6300 L daily, ensuring reliability. Class 3 aligns closely with 3666 L daily, emphasizing equilibrium. Class 4, with seven societies, achieves efficiency at 228017.74 L daily. Class 7 highlights balance with 571.5 L daily. Even with a lower daily production of 80 L, Class 10 plays a crucial role in the cooperative's comprehensive approach.

Average quantity of milk sold locally/year

In Kerala's dairy market, each class plays a vital role. Class 2 dominates with annual sales of 271956.5 L, shaping the commercial landscape. Class 3 sustains momentum with 651184.55L in sales, while Class 4 strategically stabilizes the market with 240089 L. Class 7 proves moderate figures matter with 106154 L in sales. Even Class 10, selling 11300.4 L annually, meets specialized needs, showcasing the diversity and resilience of the dairy sector.

Average quantity of milk given by dairy to union/year

In the union's collective effort, Class 2 leads

with an annual supply of 1883789.2 L, addressing significant market demands. Class 3's consistent contribution of 943876.6 L adds stability to Kerala's dairy industry. Class 4 strategically supplies 587785 L, fortifying the cooperative structure. Even with a moderate supply of 126631.5 L, Class 7 plays a meaningful role. Class 10, despite its smaller scale at 4022.73 L annually, caters to specialized needs, showcasing the diverse and vital contributions of each class to the union's resilience.

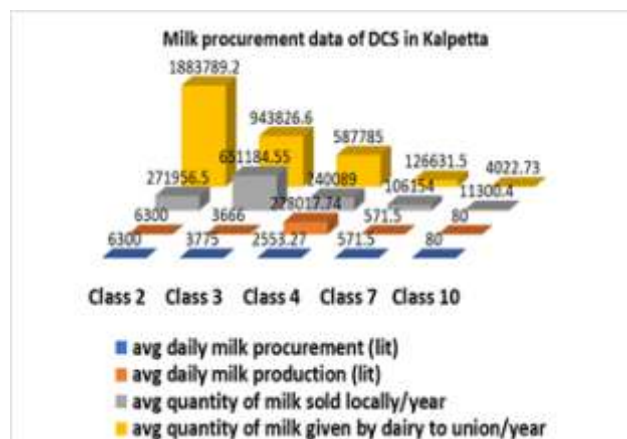


Fig 1

Details of registered members under DCS of Kalpetta

It involves an overview of the average membership, representation of SC/ST members, and the total count of male and female members. It shows the demographic composition of these cooperative societies & highlights the key aspects of their membership structure. (Fig 2).

Average number of membership

Class 2 leads with an impressive average of 2065 registered members, fostering a robust dairy enthusiast community. Class 3, with 991 members, embodies a deep commitment to the cooperative model. Class 4, with 849.16 registered members, contributes to diversity and cooperative values. Class 7, with 708 members, thrives as a cohesive collective. In a specialized niche, Class 10, with 16 registered members, showcases the dairy cooperative model's versatility, meeting unique community needs.

Average number of SC/ST members in society

Class 2 leads inclusively with an average of 160 SC/ST members, emphasizing equal opportunities. Class 3, with 115 SC/ST members on average, showcases dedication to social equality. Class 4, with

52.42 SC/ST members on average, represents ongoing efforts for balanced inclusion. Class 7, averaging 70 SC/ST members, fosters diversity, enriching cooperative perspectives. In the specialized realm of Class 10, with an average of 16 SC/ST members, the cooperative society demonstrates adaptability and commitment to niche inclusion within the dairy industry.

Average number of male and female members in society

Class 2 models' diversity with 1400 male and 635 female members, highlighting balanced participation. In Class 3, gender parity is actively pursued with 515.66 male and 272.33 female members on average. Class 4 fosters equality with 276.83 male and 110.17 female members on average. Class 7 thrives as a mosaic with 425.5 male and 177 female members on average, enriching the cooperative with diverse perspectives. In the specialized Class 10, an average of 10 male and 6 female members were involved.

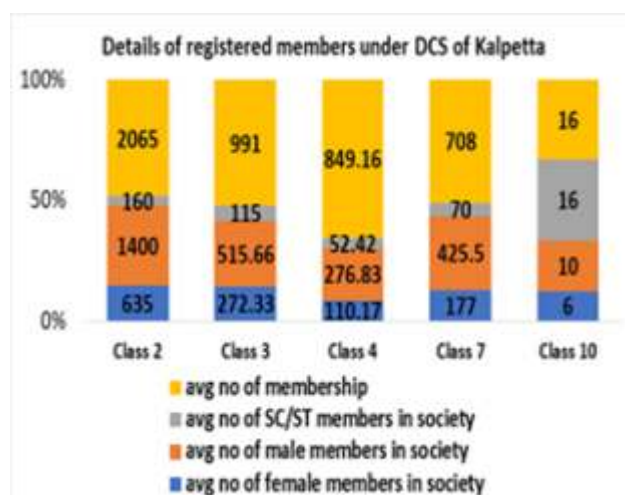


Fig 2

Data regarding feed supply to society

In the intricate web of Kerala's dairy cooperative society, the supply of cattle feed and food supplements plays a pivotal role in sustaining the health and productivity of the region's livestock. Examining the average quantities sold during the financial year across different classes within the society unveils a story of careful management, diverse needs, and the cooperative's commitment to ensuring the well-being of the dairy ecosystem. (Fig 3).

Average quantity of feed, feed supplement sold during 2022-23

Class 2 leads in feed supply, selling 480,000 kgs, serving as the cornerstone. In Class 3, 83,360.332 kgs are carefully supplied, focusing on balanced nutrition. Class 4 strategically manages feed with 51,270.83 kgs sold. Class 7 efficiently supplies 45,487.5 kgs, catering to moderate-scale livestock. Class 10, with a specialized supply of 25 kgs, meets specific and unique needs within the cooperative society.

Average quantity of cattle feed purchased during 2022-23

In Kalpetta's dairy landscape, Class 2 anchors feed supply with an annual purchase of 480,000 kgs, supporting neighbouring classes. Class 3 focuses on optimal nutrition with a substantial yearly purchase of 426,991.66 kgs. While Class 4 strategically manages feed, 51270.83 Class 7 efficiently procures 46,306.37 kgs, catering to diverse scales of dairy farming. In a specialized role, Class 10's precise annual purchase of 2,500 kgs meets unique cooperative society requirements.

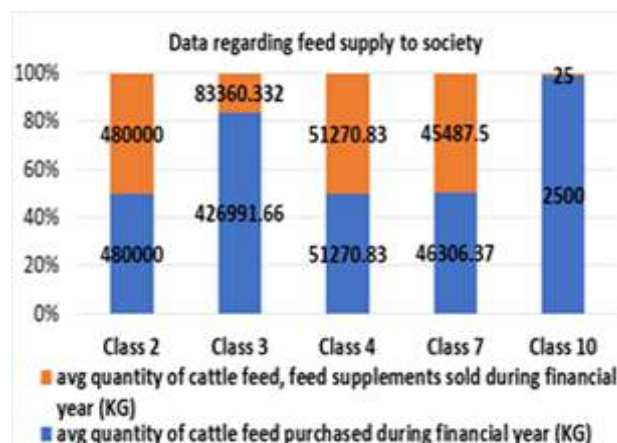


Fig 3

Details of animals possessed by members and non-members

In the serene landscapes of Kalpetta, Kerala, the possession of animals by both members and non-members plays a pivotal role in shaping the dynamics of the dairy cooperative society. Examining the average number of animals possessed by both groups across different classes unveils a narrative of diverse engagement, cooperative participation, and the collective effort to foster a thriving dairy ecosystem. (Fig 4).

Overview of Dairy Milk Co-Operative Societies of Kalpetta Block, Wayanad, Kerala

Average number of animals with non-members (poured milk to society)

In Class 2, an average of 230 animals showcase their significant engagement beyond formal membership. Class 3, with 178 animals, and Class 4, with 113.75 animals on average, emphasize the diverse and vibrant contributions of non-members. In Class 7, an average of 50 animals from non-members actively participate, reflecting the cooperative's commitment to accommodating various scales of animal possession. While Class 10 registers no animals from non-members, it highlights the cooperative society's adaptability to diverse needs within Kerala's dairy industry.

Average number of animals with members of society

In Class 2, members lead with an average possession of 1500 animals, defining the cooperative's livestock scale. Class 3 members contribute substantially to 380 animals, ensuring a reliable milk supply. Class 4 members strategically possess 263.75 animals, actively contributing. Class 7 members, with 120 animals on average, showcase commitment, ensuring a diverse milk supply. In Class 10, members possess 18 animals on average, contributing uniquely to the cooperative's diverse dairy landscape.

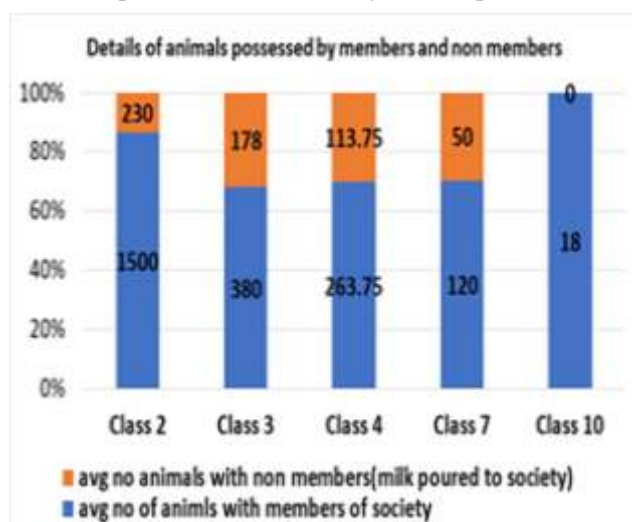


Fig 4

Employees engaged in DCS

Investigating 5 employee involvement within Dairy Cooperative Societies (DCS) of Kalpetta reveals key details such as the average number of employees, along with a breakdown of permanent and temporary

staff. This article sheds light on the workforce dynamics essential for the effective operation of these cooperative societies. (Fig 5)

Average no of employees in society

Class 2 leads with 20 employees, highlighting a commitment to meet diverse community needs. In Class 3, 11 employees streamline operations efficiently, emphasizing operational excellence. Class 4 maintains precision with 10.85 employees, ensuring stability and efficiency. Class 7 operates efficiently with four employees on average, showcasing adaptability. Class 10 represents niche expertise with an average of two employees, demonstrating a focused approach.

Permanent employees in society

Class 2 has 7 stable employees, bringing expertise to the cooperative. Class 3, with 3.6 employees, empowers the community in Kalpetta. Class 4, with 4.4 employees, is known for efficiency in the local dairy scene. Class 7 operates with 3 employees, showing efficiency in every role. Class 10 has no permanent employees, symbolizing a unique aspect of the cooperative society.

Temporary employees in society

Class 2 employs 3 temporary staff, contributing to operational efficiency. Class 3 adapts with an average of 7.3 temporary employees, responding to diverse demands. Class 4 manages well with 6.4 temporary employees. Class 7 operates efficiently with one temporary employee, strategically enhancing productivity. In Class 10, an average of two temporary employees provide specialized support within the Kalpetta Block dairy cooperative.

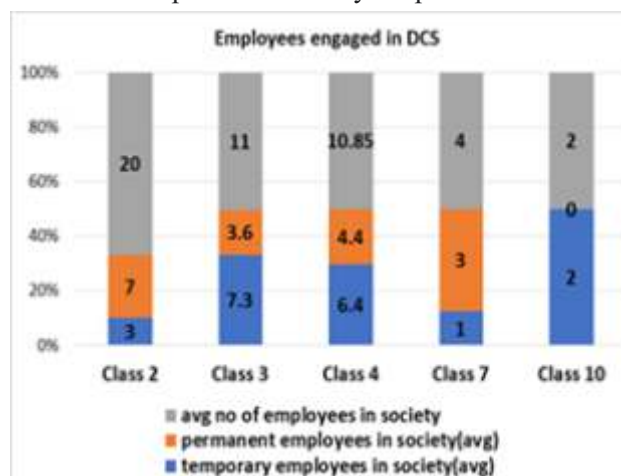


Fig 5

The research findings revealed that the majority of milk producers were male in different classes, as compared to the female members. This suggests a gender disparity in entrepreneurship within rural milk production, indicating a predominance of men in this sector. This finding is supported by earlier findings of Chander and Chand (2020). The members and non-member dairy farmers were significantly different concerning the animals they possessed. hence, the dairy cooperative has a positive impact on dairy farmers. This finding is in accordance with the observation of Khyalia *et al* (2016).

CONCLUSION

Noteworthy findings include Class 2's leading role in milk production, Class 3's commitment to social equality, and Class 7's efficiency with a small yet effective team. The study presents a comprehensive overview of the cooperative landscape, emphasizing the societal, economic, and agricultural impact of these entities. The study also reflects the need for further, deeper assessment of the functional dynamics of Dairy Milk Cooperative societies and also emphasise the need for studying the impact of these societies on the livelihood security of farmers in the study area.

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Physicochemical and Functional Properties of Tapioca (*Manihont esculenta*) Flour

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ABSTRACT

The study was carried out to assess the physicochemical and functional qualities of tapioca flour. The results of physical characteristics of tapioca tuber namely length, width and weight were recorded as 26.24cm, 2.74cm at the proximal end, 3.21cm at the middle, 3.29cm at the distal end, and 273.40 kg. The tubers were sliced, blanched, dried and then milled into flour. The proximate composition of tapioca flour including moisture, protein, fat, ash, crude fiber, carbohydrate and energy were estimated as $10.77 \pm 0.22\%$, $2.10 \pm 0.10\%$, $0.91 \pm 0.08\%$, $1.60 \pm 0.38\%$, $1.40 \pm 0.32\%$, $83.17 \pm 0.78\%$, 349 ± 4.00 Kcal, respectively. The functional properties of flour were found to be $20.25 \pm 1.05\%$ swelling power, $59.08 \pm 2.53\%$ flour dispersibility, 5.83 ± 0.12 cP viscosity, 0.836 ± 0.045 g/cm³ bulk density, $38.30 \pm 1.02\%$ percent solubility, $23.46 \pm 0.45\%$ emulsification capacity, $10.12 \pm 0.14\%$ gel capacity, $266.91 \pm 0.29\%$ water absorption capacity and $88.46 \pm 1.14\%$ oil absorption capacity. Tapioca is particularly high in carbohydrates, which makes it useful for persons with calorie deficiency and it also has a high functional value, so it may be used for home, commercial, and industrial purposes.

Key Words: Calorie, Deficiency, Flour, Proximate Composition, Properties, Tapioca, Value Addition.

INTRODUCTION

Tapioca is an underutilized root and tuber in Andhra Pradesh, which is available seasonally but not utilized to the extent that it should be. Manioc, yucca and cassava are the other common names for tapioca (*Manihot esculenta* Crantz) and karrapendalem is the local name used by the people of Andhra Pradesh, which belong to the family Euphorbiaceae. (Waisundara, 2018). It is regarded as Future Smart Food because to its tremendous potential for food, nutrition security, and adaptability. (Joshi *et al*, 2019). It is the most important food in the world and is also utilised as a feed plant. Tapioca ranks fourth in global production, after rice, maize, and wheat, with 16 crore tonnes produced per year. In the tropics, it has been a staple diet that supplies carbohydrates to billions of people. In contrast to other basic crops, tapioca grows more carbohydrates per hectare and may be farmed for a relatively low cost. (Ukwuru and Egbonu, 2013). The calorie source for around two-fifths of all Africans is cassava as it is a starchy tuber. For food security mostly people depend on cassava since its drought and climatic tolerance, high yield in poor soil and all-around-the-year availability.

Tapioca is a rich source of calcium, vitamin C, thiamine, riboflavin, dietary fibre, and carbohydrates. (Kanagasabapathi and Sakthivel, 2019). In addition to carbohydrates, tapioca is a good source of iron, zinc, B, C, and A vitamins. Moreover, because tapioca flour is gluten-free and acceptable for a variety of food products, it can entirely replace wheat in baking recipes for those with celiac disease (Marchini *et al*, 2022). In order to understand the functional properties and proximate composition of tapioca flour, the current investigation was carried out.

MATERIALS AND METHODS

The study was carried out in the Department of Food and Nutrition, College of Community Science, ANGRAU, Lam, Guntur, Andhra Pradesh in the year 2023. Tapioca roots used in the study was procured from Krishi Vigyan Kendra, Amadalavalasa, Srikakulam district, Andhra Pradesh, India. Physical parameters viz. length, width and weight of tapioca tubers were measured using Adetan *et al* (2003) method. Physical properties of twenty-five tubers were investigated at random. The length of the tubers was measured with a measuring tape, the breadth with

vernier callipers, and the weight was recorded with an electronic weighing balance.

A.O.A.C (2000) technique was used to determine moisture, protein, fat, ash, crude fibre, carbohydrate, and energy. The following methods were used to evaluate the functional qualities of tapioca flour, which included swelling power (Schoch 1964 method), flour dispersibility, viscosity, bulk density (Narayana and Narasinga Rao, 1984), percent solubility (Schoch, 1964), emulsification capacity (Beuchat 1975 method), gel capacity (Abbey and Ibeh, 1988), water absorption capacity and oil absorption capacity (Beuchat *et al*, 1975).

Flour dispersibility was determined by putting 10g of tapioca flour sample to a 100ml measuring cylinder. 100ml of distilled water was added, rapidly agitated, and left to sit for three hours. The per cent dispersibility was calculated by deducting the volume of settled particles from 100 and reporting the result. The viscosity of tapioca flour was measured using a Viscometer at 100 rpm with spindle number two at 5% and 10% slurry concentrations (100ml). Statistical method mean, standard deviation and coefficient of variance were used.



Figure 1. a) Tapioca b) Tapioca flour

RESULTS AND DISCUSSION

Physical parameters of roots

Physical parameters of tapioca root namely, length(cm), width(cm) and weight(kg) were presented in the table 1.

Length of root

The length of the tapioca roots ranged from 9 cm to 48 cm with a mean length of 26.24 cm. Our reported value closely agrees with the mean value of 26.58cm reported by Oriola and Raji (2014) and 12-40 cm reported by Adetan *et al* (2003) but higher than the value of 3.0 cm reported by Lomchangkum *et al* (2020). The width of tapioca roots were observed at three tuber sections (proximal, middle and distal). The width ranged from 1.3 to 4.6 cm, 1.9 to 4.8 cm and 1.8 to 4.4 cm. The mean width of tubers was 2.74, 3.21 and 3.03 cm at the proximal, middle and distal of the root. These values were consistent with the values 37.32mm, 35.34mm and 26.05mm reported by Oriola and Raji

(2014) and were lower than the values 37.32 mm and 35.34 mm for proximal and middle while higher than the value 26.05 mm at distal reported by Lomchangkum *et al* (2020). The weight of the tapioca roots ranged from 61 g to 739 g with a mean weight of 273.4 g which was in agreement with the values 0.3-1.0 kg and 59g to 722 g reported by Adetan *et al* (2003) and Oriola and Raji (2013) and but lower than the mean value 441.10g by Oriola and Raji (2014) and 0.6 kg mentioned by Lomchangkum *et al* (2020). This disparity in physical characteristics may be due to variations in tuber age and tapioca cultivars used.

Proximate Composition of tapioca flour

One important aspect affecting food and product shelf life is moisture content. On a dry weight basis, tapioca flour had a moisture content of 10.77 ± 0.22 percent. The important macronutrient and a functional ingredient in food formulations is protein. The protein value in this study was 2.10 ± 0.10 percent,

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Table 1. Physical parameters of Tapioca root

Sr.No	Length (cm)	Width (cm)			Weight (g)
		At Proximal	At Middle	At Distal	
1	44.0	1.7	3.5	3.8	208
2	32.5	3.5	4.5	2.5	378
3	33.0	3.0	4.8	3.8	739
4	28.5	3.8	3.5	3.6	228
5	29.0	1.5	4.0	3.5	439
6	19.0	2.0	3.0	5.0	69
7	11.0	2.2	2.3	2.0	77
8	18.0	2.5	3.6	3.0	464
9	15.0	1.3	3.4	4.1	564
10	12.0	3.5	3.2	3.2	96
11	26.5	2.4	3.3	3.6	231
12	16.5	2.4	2.6	2.3	102
13	9.0	1.6	2.1	2.5	99
14	42.0	2.8	2.5	2.3	144
15	37.0	2.6	2.4	1.85	197
16	22.0	2.2	1.9	1.8	210
17	19.5	1.5	2.1	1.9	61
18	16.0	2.1	2.3	2.4	74
19	19.5	4.0	4.8	4.4	236
20	24.0	3.6	3.2	3.0	354
21	48.0	3.2	3.6	3.7	450
22	38.0	3.9	3.5	2.3	435
23	36.0	4.6	3.7	2.9	410
24	28.5	3.7	4.2	2.9	250
25	31.5	3.1	4.3	3.4	320
Range	9.0-48.0	1.3-4.6	1.9-4.8	1.8-4.4	69-739
Mean	26.24	2.74	3.21	3.29	273.40
SD	14.21	0.91	0.80	0.86	177.21
CV	52.96	33.321	0.00249	0.00026	64.81

the value 23.51 percent reported by Obueh and Kolawole (2016) deviated from the findings of this study which explains that the fermentation process enhance the protein content, essential amino acids, and protein quality of cassava flour (Nilusha *et al*, 2021). Higher fat determines the stability of the flour. If the flour had a higher amount of fat will lead to rancidity and prone to oxidation and there will be the chance to the microbial growth (Verma *et al*, 2022). The fat content of tapioca flour was observed to be $0.91 \pm 0.08\%$. These values are similar to the finding of Verma *et al* (2022), Katunzi-Kilewela *et al* (2021), Okwunodulu *et al* (2022) and Banwo *et al* (2020). The difference in the values might be due to the variety, climatic conditions and processing technique (Nilusha *et al*, 2021).

Ash content shows the presence of mineral content which is used as a measurement of the quality of flours in the food industry (Verma *et al.*, 2022). The ash content of studied tapioca flour was 1.60 ± 0.38 percent. The fiber content was found to be 1.40 ± 0.32 percent, Verma *et al* (2022) described that fibre content increases with the increase in the age of the plant while protein and lipids decrease and the differences may be attributed to geographical location, maturity stage and environmental conditions (Chisenga *et al*, 2019). Carbohydrate is a chief source of energy that is required for human consumption. The present study revealed that the carbohydrate content of the tapioca flour was 83.17 ± 0.78 percent and the calorific value of tapioca flour was 349 ± 4.00 Kcal. Previous studies by Oyeyinka *et al* (2023), Oluwaniyi and Oladipo (2017), Olorode and Sobowale (2021) reported similar values as of this study.

Functional properties of tapioca flour

Swelling power

The swelling power in this study valued at 20.25 ± 1.05 percent. Swelling power differs among the flours due to the variation in amylose content, particle size distribution, size of the starch granules, number of interactions between amorphous and crystalline regions, and the molecular structure of amylose and amylopectin. (Agbemaflle 2019; Raya *et al*, 2022; Oyeyinka *et al*, 2023). The flour dispersity is an indication of particle suspensibility in water, move apart from water molecules and shows its hydrophobic interaction (Oyeyinka *et al*, 2023) and their ability to

produce smooth and consistent dough (Yves *et al.*, 2017). The flour dispersity of tapioca flour was 59.08 ± 2.53 percent. Viscosity of tapioca flour was 5.83 ± 0.12 cP. Nzuta *et al* (2022), reported the viscosity values ranged from 5.40 to 7.25 cP in three different varieties of tapioca. The weak intermolecular network that may allow the flour granules to disintegrate when gelatinized in hot water and create a paste with relatively low viscosity might be the source of the variation in viscosity.

Bulk density

The bulk density measures the compactness or heaviness of flour produced which helps to determine the porosity of a product (Agbemaflle, 2019; Geetha *et al*, 2021). It is a qualitative attribute that is dependent on the interaction of several components, including the number of contact sites, interparticle forces, and particle sizes. Tapioca flour had a bulk density of 0.83 ± 0.04 g/cm³. High bulk density flours may be desirable in some products as in infant formulas and used as a thickening agent in food products. The tapioca flour might be utilized as a thickener and binder in food product preparations like soups, gravies, meat sausages etc. High emulsion capacity is an indication that the flour samples could be an excellent emulsifier in various foods (Maruatona *et al*, 2010). In the study, tapioca flour had an emulsification capacity of 23.46 ± 0.45 percent. The gel capacity value of tapioca flour was observed to be 10.12 ± 0.14 percent. These values were in accordance with the values reported by Nwabueze and Anoruuoh (2011) and Praise *et al* (2022).

Water absorption capacity

This is an essential property that determines the quantity of water stored by the sample owing to hydrophilic sites in molecular chains and water contact via hydrogen bonding. It aids in measuring the sample's capacity to observe the water and increases the swelling of granule size to preserve the homogeneity of the sample. The water absorption capacity of tapioca flour was 266.91 ± 0.29 percent at room temperature which depicts a good tendency to bind with water. The amount of water that a flour sample may absorb depends on its molecular structure, protein concentration, interactions with water, hydrophilic groups, configuration features, grinding level, and amounts of protein, carbohydrates, and damaged starch. (Kaushal *et al*, 2012). The potential of the

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product to hold water when processing dough and paste is an indicator of water absorption capacity. Oil absorption capacity is attributed mainly to the physical entrapment of oils. It indicates the rate at which protein binds to fat in food formulations. In this study, the oil absorption capacity of flour was 88.46 ± 1.14 percent. Oil absorption capacity increased in processed flours which may be due to denaturing and separation of protein molecules when subjected to heat which unmasks the non-polar residues from the interior of the protein molecule. The values reported by Agbemaflle (2019) and Katunzi-Kilewela *et al* (2021) were in consistent with the value of the present study.

CONCLUSION

Tapioca is exceptionally high in carbohydrate, which makes it useful for persons with calorie deficiency. The functional properties of processed tapioca flour are enormous, making it useful for developing new food products or substituting in current food products to add value in the domestic, commercial, and industrial sectors.

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Profile and Information Source Utilization Behaviour of Shrimp Farmers in North Konkan Region, Maharashtra

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ABSTRACT

Shrimp farming is playing a pivotal role in the socio-economic development of our country. Shrimp aquaculture has developed very fast in Maharashtra since last decade. Shrimp farming activities have also generated employment along the coastline. As this sector is growing at a good pace and the state is earning valuable foreign exchange it is necessary to study the profile of shrimp farmers. The right information at the right time is crucial for being successful in any farming system. Sustainable shrimp aquaculture farming system is also dependent on correct information. In view of this, an investigation was undertaken to study the profile and information sources utilized by shrimp farmers in North Konkan region, Maharashtra. Information was collected randomly from 108 shrimp farmers, Maharashtra using an interview schedule. Descriptive statistics were used to determine the profile and information sources utilized by shrimp farmers. Results indicated that the majority of shrimp farmers in the North Konkan region were in the young age group (up to 35 years old), with 32.41% having secondary education. About 41.67% had experience up to 5 years. Majority of shrimp farmers had taken ponds on lease basis and were having farming areas up to 2 ha. Annual income of the majority of shrimp farmers (85.19%) is above 20 lakhs. Aqua company technicians/input dealers (100%) were the primary information source, followed by fisheries institutions (97.22%). Social media/internet was the third major source of information used by shrimp farmers (93.51%). The study suggested that it would be better if private and government sector extension mechanisms work together through convergence. It is also suggested that, internet/social media-based information exchange along with strengthening the digital extension system can be a viable strategy to provide right information and services to farmers.

Key Words: Profile, Source of information, Shrimp farmers, North Konkan, Maharashtra.

INTRODUCTION

Shrimp aquaculture has been practiced in India for centuries in a traditional manner in a certain coastal state, but made its presence felt by contributing to the socio-economic development of the country. Shrimp farming provides direct employment to about 0.3 million people and ancillary units provide employment for 0.6 to 0.7 million people in our country (Unnithan, 2006). Shrimps are called as the Pinkish Gold of the sea because of its universal appeal, unique taste, high unit value realisation and increasing demand in the world market (Gitte *et al*, 2021).

Information is a catalyst for solving any problem and a very important tool for country's economic development. The success of any farming system relies on having the right information at the right time. In the same way sustainable aquaculture farming system is also dependent on correct

information. In the Indian context, it is known that India occupies the second position in the world with respect to cultured shrimp production. However, in the context of governance it has been reported by many studies that the role of Government has been regulatory and input companies have played an important role as information providers.

Study of shrimp farmers profile is important because, on one hand, it influences the farming practices adopted by the farmers, and on the other hand, it reflects the outcomes of farming practices and performance. Lack of authentic information on the socio-economic condition of target group is one of the serious obstructions in the successful implementation of developmental policies (Sheikh and Goswami, 2013). The success behind the increased cultured Shrimp production has been attributed to the production, dissemination and adoption of a number of

improved technologies. The information sources utilized by shrimp farmers to build their knowledge base are crucial for the diffusion and adoption process, ultimately fostering the development of the shrimp industry.

Though shrimp industry is flourishing but it has several production risk factors starting from pond preparation to harvest and the farmers should have adequate knowledge and skill of shrimp farming technologies to prevent and manage risks. Therefore, information is a critical resource in operation and management of shrimp farming. The present study is an attempt to understand the profile and sources of information utilized by shrimp farmers in North Konkan region, Maharashtra.

MATERIALS AND METHODS

Maharashtra state has about 10,400 ha area which is reported to be suitable for brackishwater aquafarming. This suitable area is located in Konkan region, Maharashtra comprising South Konkan (Ratnagiri and Sindhudurg district) and North Konkan (Palghar-Thane and Raigad, district). Among these, North Konkan region (Palghar-Thane and Raigad, district) contribute significantly to the shrimp production. North Konkan region (Palghar and Raigad district) has 198 registered shrimp farms. Out of this, information was randomly collected from 108 shrimp farms comprising 58 shrimp farms from Palghar and 50 shrimp farms from Raigad district.

To achieve the objectives of the study, information regarding profile and information sources utilized by shrimp farmers was collected. Profile of shrimp farmers comprised personal information (age, religion, educational status, occupation status and years of experience in shrimp farming) and enterprise information (ownership of farm, water spread area of farm, financial assistance, Coastal Aquaculture Authority (CAA) registration status, number of crops per year, stocking density, types of harvesting, annual income). Information related to various source used by shrimp farmers was also collected. Descriptive statistics was used to interpret the findings appropriately.

RESULTS AND DISCUSSION

Profile of shrimp farmers

Information related to profile of shrimp farmers (personal profile and enterprise information) in North Konkan region, Maharashtra were collected and same is presented in Table 1.

The results revealed that, higher percentage of shrimp farmers were found dominant under, young age group (Up to 35 years). Majority of shrimp farmers (95.37%) belongs to Hindu religion and only few farmers along the North Konkan region were following Islam (4.63%). Similar type of result was reported by Naik (2020) in South Konkan region, Maharashtra and Sen and Roy (2015) in Tripura.

As far as educational level of shrimp farmers is concerned, higher percentages of shrimp farmers (32.41%) were educated up to secondary level, followed by higher secondary (25.93%). Similar results were reported by Salunkhe (2018) in his study in North Konkan region of Maharashtra. He recorded that higher percentage of shrimp farmers (41.51%) were educated up to secondary level.

Angela and Sharma (2023) in a study in Tamil Nadu reported that, all shrimp farmers had shrimp farming as their primary occupation, nearly half (48%) had agriculture as their secondary occupation and 30% had business as their secondary occupation. Result of the present study are in line with this study. Naik (2020), found that, majority of farmers (76.27%) in the North Konkan Region, Maharashtra were primarily engaged in aquaculture and other business activities.

The study revealed that, around 41.67% shrimp farmers had experience up to 5 years, followed by shrimp farmers (20.37%) with 6-10 years of experience in shrimp farming. Similar result reported by Patil and Sharma (2022), Kumaran *et al* (2003).

Majority of shrimp farmers (62.04%) in North Konkan region had taken pond on lease basis, while 37.96% shrimp farmers had their own ponds. Similar

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Table 1 Profile of shrimp farmers in North Konkan region, Maharashtra

Sr. No.	Profile characteristic	Categorys	Number	Percentage
Personal information				
1	Age (Years)	Young Age (Up to 35)	48	44.44
		Middle Age (36-50)	37	34.26
		Old Age (Above 51)	23	21.30
2	Religion	Hindu	103	95.37
		Islam	5	4.63
3	Education status	Illiterate	0	0
		Primary	20	18.52
		Secondary	35	32.41
		Higher Secondary	28	25.93
		Graduate	9	8.33
		Fisheries Graduate	5	4.63
		Post Graduate	9	8.33
		Diploma in fisheries	2	1.85
4	Occupation status	Aquaculture	93	86.11
		Aquaculture and agriculture	15	13.89
5	Experience in shrimp farming (years)	0 to 5 yrs.	45	41.67
		6 to 10 yrs.	22	20.37
		11 to 15 yrs.	16	14.81
		16 to 20 yrs.	9	8.33
		21 to 25 yrs.	9	8.33
		26 to 30 yrs.	6	5.56
		31 to 35 yrs.	1	0.93
Enterprise information				
1	Ownership of farm	Own	41	37.96
		Leased	67	62.04
2	Waterspread area of farm (ha)	0 to 2	37	34.26
		2 to 4	32	29.63
		4 to 6	13	12.04
		6 and above	26	24.07
3	Financial assistance	Own	92	85.19
		Bank	16	14.81
4	CAA registration	Registered	71	65.74
		Not-registered	37	34.26
5	Number of crops per year	One	3	2.78
		Two	104	96.30
		Three	1	0.93
6	Stocking density (nos./m²)	10-30	53	49.07
		31-50	45	41.67
		51-70	8	7.41
		71-90	1	0.93
		91-110	1	0.93
7	Types of harvesting	One time	8	7.41
		Multiple time	100	92.59
8	Annual Income	Up to 19 lakhs	16	14.81

type of observations was reported by Swathilekshmi *et al* (2005) in their study and recorded that 88.34% of shrimp farmers in Nellore district, Andhra Pradesh and 99.33% in Nagapattinam district, Tamil Nadu, operated their farms on lease basis. Naik (2020), in his study in South Konkan region, Maharashtra reported that, maximum number of the shrimp farmers (64.41%) operating their farm on lease basis whereas, 35.59 % shrimp farmers had own farms.

Majority of shrimp farmers (34.26%) in Palghar and Raigad district (North Konkan region) were having shrimp farming area up to 2 ha, 29.63% shrimp farmers were having shrimp farming area between 2-4 ha. The present study is in accordance with results reported by Salunkhe (2018), Srinivas and Vankatraylu (2016), Randive (2008) and Gawde (2006).

The study revealed that, maximum percentages of shrimp farmers (85.19%) use their own fund for establishing shrimp farming, while 14.81% shrimp farmers' dependent on bank for financial assistance. Similar type of observation was reported by Naik (2020) mentioned that, majority of shrimp farmers (76.27%) relied on their own funds for their farming operations.

Results revealed that, majority of shrimp farmers (65.74%) were registered with CAA whereas, 34.26% shrimp farms were not registered with CAA. Similar observations were reported by Naik (2020) in his study mentioned that, 52.54% shrimp farms in the South Konkan region were registered with the CAA, while the remaining 47.46% shrimp farms were not registered with CAA.

Higher percentages of shrimp farmers (96.30%) in North Konkan region were taking two crops per year and only 2.78% shrimp farmers taking

only one crop per year. However, only one farmer was practicing three crops per year. Similar findings were reported by Patil *et al* (2019), indicating that 94.55% of shrimp farmers were taking two crops annually. In line with the present study, Naik (2020) in his study recorded that, around 91.53% of shrimp farmers in the South Konkan region of Maharashtra were taking two crops per year.

Maximum number of shrimp farmers (49.07%) of the present study area were maintaining stocking density between 10-30 nos./m², while 41.67% shrimp farmers were practicing stocking density of 31-50 nos./m² and 7.41% shrimp farmers adopted stocking density between 51-70 nos./m². Rest of the shrimp farmers were adventurous to adopt stocking density above 71 nos. per square meter. Similarly, Naik (2020) reported that maximum shrimp farmers (44.07%) were maintaining stocking density ranging from 31 to 40 nos./m². Kumaran *et. al.* (2008) observed that 84.73% shrimp farmers from east coast adhered to the maximum stocking density allowed by CAA for *L. vannamei* shrimp farming, compared to 29.36% in the west coast.

Results revealed that, majority of the shrimp farmers (92.59%) doing partial harvesting (multiple time) of shrimps, while only 7.41 % shrimp farmers doing one-time harvesting. Similar results were reported by Naik (2020) in his study along South Konkan region mentioned that, majority of the shrimp farmers (89.93 %) doing partial harvesting while, only 10.17 % shrimp farmers doing one-time harvesting. However, Pravin and Ravindran (2005), reported that harvesting can be done partially and totally depending on the demand of market and availability of material.

Annual income of majority of shrimp farmers (85.19%) in North Konkan region, Maharashtra is above 20 lakhs, while 14.81% of shrimp farmers

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annual income is up to 19 lakhs. Similar type of results was reported by Naik (2020) mentioned that, annual income of 49.15 % shrimp farmers in the South Konkan region is above 20 lakh.

Source of information used by shrimp farmers

The information sources used by shrimp farmers of North Konkan region, Maharashtra is presented in Fig 1.

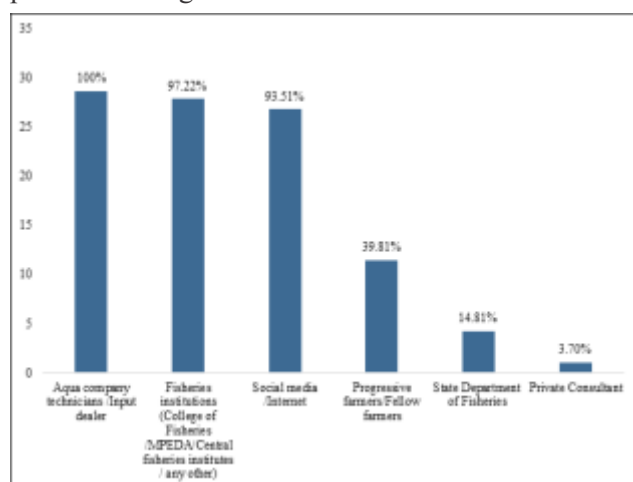


Fig. 1. Source of information used by shrimp farmers

In North Konkan region (Raigad and Palghar district), aqua company technicians/ input dealers (100%) were the main source of information for majority of shrimp farmers. Similar result reported by Patil and Sharma (2022) along the Maharashtra mentioned that, aqua company technicians/ input dealers were the main source of information for majority of shrimp farmers (78.15%). These findings were in conformity with the findings of Sathe (2008) who reported that feed technicians/Input dealers were most used source of information for shrimp farmers in Maharashtra.

Fisheries institutions (97.22%) was the second major source of information for majority of shrimp farmers. Patil and Sharma (2022) reported that, fisheries institutions/organizations like ICAR-CIFE, MPEDA and College of Fisheries was the third major source of information for 55.63% shrimp farmers. Kumaran *et al* (2012) have also reported that about 24% shrimp farmers of Tamil Nadu and Andhra Pradesh used public extension agencies such as DoF and MPEDA.

Social media/internet (93.51%) was ranked third major source of information for shrimp farmers. Patil and Sharma (2022) in his study in Maharashtra reported that, use of social media/internet was second

major source of information for majority of shrimp farmers (70.19%). Similar results were reported by Okumu (2013) mentioned that, internet, mobile phones and computer ranked the highest in the most preferred ICT tools used in the promotion of aquaculture. Ijatuyi (2016) also reported that mobile phone was the most useful source of information. Patil and Sharma (2023) reported that internet/social media was the main source of information for majority of fisheries officials (74.25%).

CONCLUSION

Developing effective policies for the shrimp farming sector requires a comprehensive understanding of farmers' profiles. This insight is crucial for the targeted design of programs, prioritizing development efforts based on the factors that motivate farmers.

Aqua company technicians/input dealers were the first and foremost major source of information followed by fisheries institutions/organizations like college of fisheries, Ratnagiri, MPEDA, ICAR-Fisheries institutions were second major source of information. The use of internet/social media were the third major source of information used by shrimp farmers.

It would be better if private sector and government sector work together through convergence, considering the higher influence of the private sector compared to public sector extension services.

In times of uncertainty, access to reliable information on new technologies, government schemes, market prices, etc., will facilitate better decision-making. Maximum shrimp farmers are already using mobile phones, social media and internet therefore, internet/social media-based information exchange along with strengthening of digital extension system can be a viable strategy to provide right information at right time to farmers.

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Response of Different Levels of Nitrogen and Phosphorus on Yield and Economics of Indian Mustard (*Brassica Juncea* L.) under climatic Conditions of Agra Region

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ABSTRACT

A field experiment was carried out to study the impact of different levels of nitrogen and phosphorus application on yield and economics of mustard. The experimental work was conducted in RBD (factorial) design with three replications. The experiment consisted of 3 levels of nitrogen (40, 80 and 120 kg N/ha) and four levels of phosphorus (0, 20, 40 and 60 kg P₂O₅/ha). The soil of experimental field was sandy loam in texture with a pH 8.20. The soil was low in available nitrogen (182.48 kg/ha), medium in available phosphorus (28.20 kg P₂O₅/ha) and rich in available potash (286.74 kg K₂O/ha). Various levels of nitrogen and phosphorus influenced seed yield significantly. Every increase in the level of nitrogen and phosphorus increased seed yield/ha. More values of seed yield and its contributory characters were observed with the application of N @ 120/kg and P₂O₅ @ 60/kg. Highest net profit of Rs. 48515/ha was recorded with 120 kg N/ha in combination with 60 kg P/ha while maximum B:C ratio (3.02) was noted with the application of 120 kg N/ha along with 20 and 40 kg P₂O₅/ha.

Key Words: Mustard, Nitrogen, Phosphorus, Yield, Economics.

INTRODUCTION

The production of mustard is not being fully exploited because of the lack of proper information of nutritional and water requirement. The important constraints to crop growth are those caused by shortage of plant nutrients. The nutrient requirement of oilseed crops, in general, is very high for almost all the essential mineral nutrients which are to be supplied in adequate quantities (Davari and Mirzakhani, 2009). Mustard is very sensitive to insufficient nitrogen and very responsive to nitrogen fertilization. Insufficient N availability to mustard plants results in low yields and significantly reduced profits compared to a properly fertilized crop (Singh *et al*, 2010). An adequate supply of available phosphorus in soil is associated with increased root growth, which means roots can explore more soil for nutrients and moisture. A deficiency of phosphorus will slow overall plant growth and delay crop maturity. Phosphorus is mobile in the plant, so it is absorbed during early growth and is later redirected for use in seed formation. Higher phosphorus levels increased the yield and N use efficiency (Yapping *et al*, 2015). Thus, A field experiment was conducted on sandy loam soil at RBS Collage Agricultural Research Farm, Bichpuri, Agra during *Rabi* season of 2018-19

with the objectives- 1) To determine the optimum level of nitrogen and phosphorus for obtaining optimum economic yield of mustard, and 2) To evaluate the economic viability of various treatments.

MATERIALS AND METHODS

The treatments included in the experiment were, 3 levels of nitrogen (40, 80 and 120 kg N/ha) and four levels of phosphorus (0,20,40 and 60 kg P₂O₅/ha). Thus, in all 12 treatment combinations were compared in a Randomized Block design(factorial) with three replications. Soil samples were collected from surface (0–15 cm) of the study area. The soil texture was sandy loam with 60.72% sand, 21.12% silt and 18.16% clay. The soil was low in available nitrogen (182.48 kg/ha), medium in available phosphorus (28.20 kg P₂O₅/ha) and rich in available potash (286.74 kg K₂O/ha). The pH of surface soil is 8.2. Full amount of nitrogen and P₂O₅ as per treatment through urea and SSP along with 30 kg K₂O/ha through MOP were applied at the time of sowing as basal dressing. The mustard variety (NRCD-2) which is well suited for Agra region was sown in furrows 5 cm deep at the distance of 45 cm. with seed rate of 5 kg/ha. The yield and yield attributes were recorded at harvest and analysed statistically. The

Table1. Yield contributing characters of mustard as influenced by various treatments.

Treatment	No. of siliquae / plant	Length of siliqua (cm)	No. of seeds / siliqua	1000 seed weight(g)
Nitrogen level (kg / ha)				
40 N ₁	175.73	4.85	11.41	4.44
80 N ₂	189.15	5.14	12.36	5.06
120 N ₃	208.50	5.36	13.04	5.62
SEm±	4.01	0.070	0.210	0.140
CD at 5%	11.75	0.21	0.62	0.41
Phosphorus level (kg / ha)				
0 P ₀	172.90	4.72	11.38	4.42
20 P ₁	185.13	5.00	11.98	4.82
40 P ₂	198.12	5.28	12.54	5.28
60 P ₃	208.38	5.48	13.17	5.65
SEm±	3.47	0.061	0.182	0.121
CD at 5%	10.18	0.18	0.53	0.36

mean of each parameter was compared statistically using analysis of variance. For various parameters the critical difference among the treatments was worked out.

RESULTS AND DISCUSSION

Nitrogen and phosphorus application induced significant increase in the yield of Indian mustard and its contributory characters. Nitrogen is the most important nutrient element responsible for increasing the yield and quality of crop plants. Mustard (*Brassica juncea* L.) responds favourably to nitrogen fertilization mainly due to its exhaustive nature and deep root system. For the data relating to rates of nitrogen, it was noted that with every increase in level of nitrogen both per plant and per hectare yields were improved. Nitrogen application up to 120 kg/ha recorded significant increase in number of siliquae plant⁻¹, seed siliquae⁻¹, length of siliqua and 1000 seed weight when compared with application of 40 and 80 kg N/ha (Table-1). These yields contributing characters influenced the seed yield plant⁻¹, which, in turn, was responsible for higher seed yield per hectare with increasing levels of nitrogen. The application of 80 and 120 kg N/ha produced significantly higher seed yield/ha by 26.85 and 40.05 per cent, respectively than 40 kg N/ha (Table-2). Similar results were obtained by

Singh *et al* (2012), Panotra *et al* (2016), Rajput R K (2017), Rajput *et al* (2018) and Bankoti (2021). As the seed yield plant⁻¹ is the combined effect of number of siliquae plant⁻¹, length of siliquae, number of seeds siliqua⁻¹ and 1000 seed weight. Almost all yield contributing characters improved appreciably with increasing levels of phosphorus upto 60 kg P₂O₅/ha. The application of phosphorus increased the symbiotic nitrogen fixation power and, in turn, increased number and weight of pods /plant and 1000 grain weight. Thus, these yield attributes might have resulted in significantly higher seed yield plant⁻¹ which, in turn, may be responsible for higher seed yield/ha. The seed yield with control, 20, 40 and 60 kg P₂O₅/ha was 11.28, 13.05, 14.48 and 15.63 q/ha, respectively. This indicate that seed yield appreciably increased with every increase in the rate of phosphorus application up to 60 kg P₂O₅/ha. These results are in the proximity with the findings obtained by Panotra *et al* (2016). Solanki *et al* (2018), Singh *et al* (2019) and Chauhan *et al* (2020).

The regional adaptability of any agronomic practice in the cultivation of any crop is completely based on maximum economic value of treatments. Based on the cost analysis (Table-3), highest net profit of Rs. 48515/ha was recorded with 120 Kg N/ha applied in combination with 60 kg P₂O₅/ha. The

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Table 2. Biological Yield, seed and stalk yield of mustard as influenced by various treatments.

Treatment		Biological yield (qha ⁻¹)	Seed yield (qha ⁻¹)	Stalk yield (qha ⁻¹)	Harvest index (%)
Nitrogen level (kg / ha)					
40	N ₁	40.24	11.21	29.03	27.86
80	N ₂	47.48	14.22	33.26	29.95
120	N ₃	50.54	15.70	34.84	31.06
SEm±		1.02	0.42	0.48	0.98
CD at 5%		2.99	1.23	1.41	NS
Phosphorus level (kg /ha)					
0	P ₀	40.06	11.28	28.78	28.16
20	P ₁	45.03	13.05	31.98	28.98
40	P ₂	48.30	14.48	33.82	29.98
60	P ₃	50.97	15.63	35.34	30.67
SEm±		0.88	0.364	0.416	0.849
CD at 5%		2.59	1.07	1.22	NS

Table 3. Economics of mustard crop (Rs ha⁻¹) as influenced by levels of nitrogen and phosphorus

Treatment	Gross income (Rs ha ⁻¹)	Common cost (Rs ha ⁻¹)	Cost of cultivation (Rs ha ⁻¹)	Net income (Rs ha ⁻¹)	B: C ratio
N ₁ P ₀	53010	19450	20015	32995	2.65
N ₁ P ₁	57047	19450	21065	35982	2.71
N ₁ P ₂	60234	19450	22115	38119	2.72
N ₁ P ₃	62801	19450	23165	39636	2.71
N ₂ P ₀	59754	19450	20580	39174	2.90
N ₂ P ₁	63791	19450	21630	42161	2.95
N ₂ P ₂	66978	19450	22680	44298	2.95
N ₂ P ₃	69545	19450	23730	45815	2.93
N ₃ P ₀	63020	19450	21146	41874	2.98
N ₃ P ₁	67057	19450	22196	44861	3.02
N ₃ P ₂	70244	19450	23246	46998	3.02
N ₃ P ₃	72811	19450	24296	48515	3.00

maximum B:C ratio (3.02) was noted with 120 Kg N/ha applied in combination with 20 kg P₂O₅/ha and 40 kg P₂O₅/ha. Additional benefit with each rupee invested in these cases is due to less investment.

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Role of Veterinary Extension Advisory and Tele health Services during COVID - 19 Pandemic Period

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ABSTRACT

Advent in developments of communication technologies has benefited wide variety of sectors endlessly. These impacts have generously found towards veterinary health and extension advisory services also. Tele health service in veterinary sector has been existed even since before, but its prominence has been recognised during pandemic. A study was conducted about tele health and extension advisory services. The data were collected through semi structured interview schedule among randomly selected Senior Veterinary Surgeons and Project Coordinators from Department of Animal Husbandry, Kerala and analysed using descriptive statistics and rank order technique. The mean age and working experience of respondents were 52.23 and 26.73 years, respectively. Majority (70%) of respondents were male and possessed maximum educational qualification of B.V.Sc. & AH. Medicine cases (including emergencies), gynaecology & obstetrics and deworming & immunization were found to be most delivered among tele health services, followed by farm consultancy / advisory, Extension activities and livestock & products marketing were found to be next in its ranking. Majority of respondents had a less favourable followed by highly favourable attitude towards the extension advisory services during COVID-19 pandemic. Major constraints perceived to provide tele health services were, assessing animal health condition without physical examination and insufficient technical / network support for consultation. Most respondents opined that ensuring timely veterinary aid to animals along with tele health services, strengthening technical and network support and organising capacity building programme to overcome difficulties in providing tele health Services. The present finding depicted the importance of preparedness for future pandemic crises and also helps to develop strategies to improve the access to veterinary health and extension advisories.

Key Words: Animal, Extension, Health, Livestock, Tele health, Veterinary.

INTRODUCTION

Telehealth is an overarching term that encompasses all uses of technology to remotely gather and deliver health information, advice, education, and care. The AVMA classified the various functioning of telehealth into subcategories tele-advice, telemedicine, teleconsulting, telemonitoring, mHealth or mobile health, telecommunication, teletriage, telesupervision, e-VFD (e-Veterinary Feed Directive), and e-prescription (AVMA, 2021; Watson *et al*, 2019). Wearable biosensors are important application that benefits telehealth by providing the opportunity to improve animal healthcare services in a quality manner. Utilising these precise wearable sensor technologies along with tracking smartphone apps can monitor the health parameters efficiently; thereby it

provides faster and more accurate medical assistance in distant manner (Neethiraj, 2017; Watson *et al*, 2019).

The new risks that threaten livelihood of small farm holders has brought by COVID-19 pandemic (Alagukannan *et al*, 2020), by imposing restrictions which disrupted the supply chains and essential services (Neetha and Prema, 2020), it also created the most urgent platform for change that the veterinary profession has ever seen (Manketlow 2021). Telehealth had emerged as a crucial tool for protecting animals, their owners and veterinary professionals during the time of increased COVID 19 threat. These telehealth facilitates helped in halting the spread of COVID-19, by providing tele-consultation and also by providing physical consultation to selected animals which is essentially needed. The benefits of telehealth in human and veterinary practice are assumed to be similar. It includes; better service to their patients even in remote

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areas, improved access to specialists and their services, supporting isolated doctors, cost and time effective, overcoming shortages of veterinarians, delivering awareness, education and facilitating research (Mars and Auer 2006).

In comparison to the human health sector, veterinary and animal husbandry had the uniqueness of managing animal health, welfare and enterprise profitability goes hand in hand. Hence, telehealth and extension advisory services are functioning in an interlinked manner. The social responsibility of extension advisory services is preparing communities to deal with the shocks such as human, animal, or plant disease or pest outbreaks; and they are key partners in response as these shocks unfold; and in recovery, developing resilience in communities and food production systems after crises (Benjamin *et al*, 2020)

MATERIALS AND METHODS

The role of Veterinary Extension Advisory and Telehealth Services during the COVID-19 pandemic period was studied among 30 Senior Veterinary Surgeons and Project Coordinators from the Department of Animal Husbandry, Kerala. The semi-structured interview schedule was developed in consulting with subject matter specialists and available publications, which was pre-tested among the non-sampling study population. The data were collected by a researcher through direct interview from randomly selected 30 respondents. Constraints perceived and possible solutions to provide telehealth services were studied with a five-point continuum scale. Collected data were analysed using descriptive statistics and the rank order technique.

The attitude towards extension advisory services during COVID-19 was assessed among

respondents by adopting the unidimensional scale developed by Divya *et al* (2022) with suitable modifications. Individual attitude score was obtained by summing up the individual scores for each statement. Based on Dalenius-Hodges cumulative square root F (DH-CSR) method the respondents were classified into less favourable (36-44), favourable (45-50) and highly favourable (51-62) attitude that they possessed towards Veterinary Extension Advisory services.

RESULTS AND DISCUSSION

The socio-demographic characteristics of the participants were, among the total of 30 respondents, the majority of them were male (70.00%), average age of respondents were 52.23 years, while average working experience was 26.73 years. Majority (86.66%) of respondents have possessed education up to graduation level (B.VSc & AH) and 6.66 per cent each of respondent possessed M.VSc and PG Diploma.

Extension Advisory and Telehealth Services classification

Medicine cases (Including emergencies), gynaecology & obstetrics and deworming & immunization were found to be most delivered among telehealth services, followed by farm consultancy / advisory, extension activities (training/ demonstration/ field visits/ meetings) and livestock products marketing were the extension advisory services delivered by respondents. Similar findings were reported by Fazili *et al* (2022), mentioned that telehealth facility was significantly more availed by the animals with medical problems (67.66%) than those showing gynaecological ailments (18.25%).

Table 1. Classification of Veterinary Extension Advisory and Telehealth Services and its ranking

Sr. No	Service	Sum	Mean	SD	Ranking
1	Medicine Cases (Including emergencies)	118	3.93	1.142	1
2	Gynaecology and Obstetrics cases	117	3.90	1.184	2
3	Deworming and Immunization	105	3.50	0.973	3
4	Farm Consultancy / Advisory	92	3.07	1.201	4
5	Extension activities (Training/ Demonstration/ Field visits/Meetings)	91	3.03	1.159	5
6	Livestock Products Marketing	55	1.83	1.053	6

Role of Veterinary Extension Advisory and Tele health Services

An effort was made to study the attitude of field functionaries towards the specific aspects of extension advisory services. Attitude of the respondents was judged against 6 positive and 6 negative statements. The attitude scale and responses were mentioned in Table 2.

Table 2. Distribution of Respondents by their attitude towards the extension advisory services during COVID-19 (N=30).

Sr. No	Statement	SDA 6	DA 5	MDA 4	MA 3	A 2	SA 1	MWS
1	Restricted movement of Veterinary Officers to meet farmers during COVID-19	0 (0.00)	5 (16.66)	7 (23.33)	2 (6.66)	11 (36.66)	5 (16.66)	2.86
2	Increased difficulty in disseminating information to farmers during COVID-19	3 (10.00)	10 (33.33)	5 (16.66)	4 (13.33)	8 (26.66)	0 (0.00)	3.86
3	Conducting online training for farmers during COVID-19 was difficult	6 (20.00)	7 (23.33)	4 (13.33)	4 (13.33)	6 (20.00)	3 (10.00)	3.8
4	Continuous advisory services of extension officials/ veterinary surgeons were interrupted during COVID-19	2 (6.66)	10 (33.33)	7 (23.33)	3 (10.00)	5 (16.66)	3 (10.00)	3.73
5	Increased difficulty in enrolling farmers in new animal husbandry schemes / projects / programmes during COVID-19	4 (13.33)	9 (30.00)	8 (26.66)	5 (16.66)	4 (13.33)	0 (0.00)	4.13
6	COVID-19 reduces extension officials' role in livestock farmers' decision making	3 (10.00)	10 (33.33)	6 (20.00)	6 (20.00)	3 (10.00)	2 (6.66)	3.93
Sr. No	Statements	SDA 1	DA 2	MDA 3	MA 4	A 5	SA 6	MWS
7	Extension advisories act as emergency responses to adapt to the economic shocks of COVID-19	0 (0.00)	1 (3.33)	1 (3.33)	5 (16.66)	21 (70.00)	2 (6.66)	4.4
8	Social media is the most preferred means of	0 (0.00)	0 (0.00)	0 (0.00)	8 (26.66)	16 (53.33)	6 (20.00)	4.93

*The figures in the parenthesis indicate percentages.

SDA: Strongly Disagree; DA: Disagree; MDA: Mildly Disagree; MA: Mildly Agree; A: Agree; and SA: Strongly Agree

Overall attitude towards extension advisory services during COVID-19

It was noted that more than one third of the respondents (40.00%) had a less favourable attitude towards the extension advisory services during the COVID-19 pandemic. It was found that 33.33 per cent of respondents had a highly favourable attitude whereas, only 26.66 per cent of them had favourable attitude towards the services.

Constraints perceived to provide Telehealth Services

Study on constraints to deliver Telehealth Services revealed that assessing animal health conditions without physical examination, insufficient

technical / network support for consultation and difficulty in treating without the physical presence of animals through Telehealth were perceived to be major constraints in its rank order. Moharana and Gupta (2022) supported the above findings and mentioned that hectic schedules of providing online services created occupational job stress.

Lack of farmer's technical knowledge to explain animal clinical signs, unavailability of emergency medicines during the critical hour of treatment, Telehealth can encourage quack practice in the animal husbandry sector and lack of time to provide Telehealth consultancy were the other constraints perceived in that order.

Table 3. Major constraints perceived and it's ranking to provide Telehealth Services.

Sr. No	Statement	Sum	SD	Ranking
1	Assessing animal health condition requires a physical examination	86	0.434	1
2	Insufficient Technical/network support for consultation	83	0.568	2
3	Difficulty in treating without the physical presence of animal through Telehealth	83	0.568	2
4	Lack of farmer's technical knowledge to explain animal clinical signs	80	0.711	4
5	Unavailability of emergency medicines during the critical hour of treatment	78	0.723	5
6	Telehealth can encourage quack practice in animal husbandry sector	70	0.884	6
7	Lack of time to provide Telehealth consultancy	69	0.952	7

Suggestions to overcome the constraints of providing Telehealth Services

Considering the suggestions for the above studied constraints, timely veterinary aid to animals along with telehealth services, strengthening technical and network support, organising capacity building programme, with helpline services establishing a separate wing for telehealth consultancy and implementing strict vigilance on quackery were the suggestions in rank order, mentioned by respondents to overcome difficulties in providing telehealth Services. Bonnie *et al* (2021) reported that to answer the challenges of network and internet services in

extension services, there is a need to develop the infrastructure base; this will help speed up the digitalization of the agricultural sector of developing countries. In supporting the present finding of timely veterinary aid to animals along with Telehealth services, Kastelic and Ogilvie (2021) reported that "Telemedicine complements the delivery of in-clinic or on-site veterinary medicine in order to expand a veterinarian's ability to provide care to animals".

Present findings of establishing telehealth and regulation of services with the vigilance of quackery were supported by Briceno (2021), who reported that in most countries telemedicine has not been regulated,

however, laws will be created in the near future. Similarly, Smith *et al* (2022) proposed the critical need of curricula around veterinary telemedicine, financially resilient business models, understanding health disparities & vulnerable populations and future preparedness for health, economic or other crises response during the pandemic

CONCLUSION

The medicine cases were found to be most delivered among telehealth services. Hence, as suggested by respondents while establishing a separate wing for telehealth services, the prime importance can be provided for the emergency medicine services, with a provision for accessibility to attend the emergency cases present during a pandemic period. Considering the attitude towards extension advisory services during the pandemic it was found to be less favourable among the majority of respondents, this might be due to the additional duty of telehealth consultancy with other routines. Hence, it had been suggested by respondents, establishing a separate wing for helpline services along with telehealth consultancy. Assessing animal health conditions without physical examination and insufficient technical support for consultation were major constraints for providing telehealth services. These can be effectively addressed with the utilization of wearable biosensors. Hence, provision of such précised sensor technology to remote areas and during pandemic periods will enable the telehealth to render its service in a quality manner.

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Socio-Psychological and Health Problems of Left Behind Parents of Immigrants in Rural Punjab

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ABSTRACT

Punjab has become a hub of student migration as well as labour migration to the developed countries. When this migration took place, it tore families across the borders. Old-aged parents have to spend a significant portion of their life alone when their children migrate overseas and set up their families in their destination countries. The parents who stay at home may feel more emotionally stressed and burdened with household responsibilities due to the absence of their children. So, this study was undertaken with specific objective of knowing the socio-psycho and others problems faced by left behind parents in rural Punjab. A total sample of 120 households was selected with help of snowball sampling technique. The results revealed that about one fifth (22.53 %) of the total sample respondents belonged to the age group in 71-80 years and had high average income i.e., between Rs. 2-3 Lakh/annum. The respondents had various social problems among which social isolation was major social issue. People have lot of psychological problems such as, no one care at this stage, loneliness after migration of children coupled with over thinking and insecurities were there. Along with this, about 48 per cent of the total respondents faced tension and anxiety which was mainly related to their children and about their settlement and future. The respondents called their homes as “empty nests”. As far as suggestions to overcome the issue, a large number i.e., 71.66 per cent of respondents said that recreational activities must be there for parents such as social clubs, reading rooms with congenial atmosphere. Recreational activities as well as support and care must be there so that old aged parents can lead a comfortable life. Proper health care program should be paid by government for old aged person. Government should provide better health facilities, job opportunities, etc. to youth for curbing migration.

Key Words: Health problems, Migration, Old Aged, Remittances.

INTRODUCTION

Punjab has become a hub of student migration as well as labour migration to the developed countries. When this migration took place, it tore families across the borders. These migrants have to leave their homes and families that separate them from their parents and other family members. It becomes stressful and chaotic for the left behind family members who will look after the elders. Old-aged parents have to spend a significant portion of their life alone when their children migrate overseas and set up their families in their destination countries. In such cases, parents depend on extended family members and neighbours for their necessities. On the one hand, parents who stay at home may feel more emotionally stressed and burdened with household responsibilities due to the absence of their children. Conversely, migrant children send back

remittances to show their care and love for their parents (Tuccio and Wahba, 2020). Thus, the impact of migration on the parents who stayed behind has been both positive and detrimental. Adverse effects include increased chronic stress, greater social isolation, various health issues, reduced daily activity, and many more (Xiang *et al*, 2016). The positive side is that migrant children send remittances to their elder parents so that they can live comfortable life and afford nutritious food. If migrant member continuously sends remittances to their left behind family members, they have good mental and physical health, and if they discontinue sending remittances, they have a negative impact on their health because of the shortage of money as they discontinue taking their medicine etc. In case of old-aged parents, migrants continuously send remittances to their relatives so they can take care of

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their elderly parents. But sometimes, when migrant does not send remittances to their relatives, they stop caring for their parents. The caregiving of old-age parents in the absence of their family members becomes a big issue and creates a long-distance relationship. Sometimes these parents become dependent on others for their small needs and are also emotionally sick due to the non-availability of their children. They feel lonely and isolated after staying behind. In the case of the Punjabi migration, various studies were conducted on caste migration, country of migration, remittances flow and Punjabis migration in the colonial period (Kaur, 2022). Left behind parents had higher depressive symptoms, higher levels of loneliness, lower life satisfaction, lower cognitive ability and poorer psychological health. A number of risk factors were identified for mental health disorders among the left behind parents, which included living arrangements, gender, education, income, physical health status, physical activity, family and social support, age, rural residence and frequency of children's visit (Kaur *et al*, 2023). However, few research have looked into the link between adult children's migration and the health of parents who are left behind in rural areas to fend for themselves. The consequences of adult offspring migrating on the health of the elderly left behind have given conflicting outcomes in the literature. (Abas *et al* 2009, Arif 2009, Kuhn 2005, Xiang *et al*, 2016 and Taylor, 2013). The major objective of this study was to identify the psychological and health problems of the left behind old aged parents and suggest possible measures to overcome these problems.

MATERIALS AND METHODS

Punjab state has been divided into three regional zones: Majha, Malwa and Doaba. Two of three zones *i.e.*, Doaba and Malwa zone were selected to know difference between Malwa and Doaba area's migration. Multistage random sampling technique was used for collection of data. At the first stage, two districts *i.e.*, Sri Muktsar Sahib and Jalandhar were randomly selected to make the study representative of *Malwa* and *Doaba* region of Punjab. From each selected district one block was selected randomly. From Sri Muktsar Sahib the block namely Kot-Bhai was selected whereas, from Jalandhar district the block Jalandhar-West was taken into consideration for the study. From two blocks, six villages were selected randomly at final stage of sampling. From each village a total of twenty left behind old aged parents (males and females) were selected randomly for collection of data. In all the sample comprised of 120 respondents *i.e.* 60 respondents from each *Doaba* and *Malwa* of Punjab were taken up for the study. Descriptive statistics used for to achieves the requirement of study.

RESULTS AND DISCUSSION

The age of the respondents has been divided into four categories viz. 60-70 years, 71-80 years, 81-90 years, 91years and above. The data, indicated that most of the old aged people belonged to age group 60-70 years in *Doaba* and *Malwa* region. About one fifth (22.53 %) of the total sample respondents belonged to the age group in 71-80 years in both regions. On the other side only 3.33% of total respondents lies in age group 81- 90 years in Jalandhar district while questioning to female respondent. A very few 3.33 per cent of respondents belonged to 91 years and above and only in *Doaba* region (Table 1).

Table 1. Distribution of respondents according to their age

Age (years)	<i>Doaba</i> (n ₁ =60)	<i>Malwa</i> (n ₂ =60)	Total (N=120)
60-70	38 (63.33)	46 (76.66)	84 (70.00)
71-80	13 (21.67)	14 (23.34)	27 (22.53)
81-90	4 (6.66)	-	4 (3.33)
91 and above	5 (8.34)	-	5 (4.14)
Total	60 (100.00)	60 (100.00)	120 (100.00)

Note- Figures in parentheses indicate percentage

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Family income is one of the major indicators to access the economic conditions of family. The data indicated that 45.83 per cent of respondent had income level between Rs. 2 to 3 lakh per annum. Only 5.84 per cent earned less than Rs.1 lakh per year. It was seen that 20.00 per cent of the respondents had income above

three lakh. Further, nearly half of the respondents in *Doaba* region had income between Rs. 2-3 lakh. And in *Malwa* region 30.00 per cent had income above 3 lakh. So, in the total sample majority of elderly had high average income i.e., between Rs. 2-3 Lakh/annum.

Table 2. Distribution of respondents according to their annual income of family (Lakh/ annum)

Income of family (Lakh/ annum)	<i>Doaba</i> (n ₁ =60)	<i>Malwa</i> (n ₂ =60)	Total(N=120)
Up to 1	3(5.00)	4(6.66)	7(5.84)
1- 2	20(33.34)	14(23.34)	34(28.33)
2 -3	31(51.66)	24(40.00)	55(45.83)
3 and above	6(10.00)	18(30.00)	24(20.00)
Total	60(100.00)	60(100.00)	120(100.00)

Note- Figures in parentheses indicate percentage

Social problems

Social problems faced by the left behind respondents. Around 84.16 percent of respondents stated that due to age they are notable to independently manage and they find lost sense of purpose. Also 62.50 per cent revealed the dependency on neighbours and relatives as they do

not have their own children with them. In all, 80.00 per cent of respondents also found ageism as major issue. Overall, the respondents had various social problems among which social isolation children are abroad and busy in their own lives was major social issue.

Table 3. Distribution of respondents according to the social problems

Social problem	<i>Doaba</i> (n ₁ =60)	<i>Malwa</i> (n ₂ =60)	Total (N=120)
Increased dependency on neighbour's and relatives	33(55.00)	42(70.00)	75(62.50)
Mobility issues	44(62.85)	37(61.66)	81(67.5)
Ageism and loss of sense of purpose	45(64.28)	51(85.00)	96(80.00)
Social isolation as children are out and engaged in their own lives	60(100.00)	60(100.00)	120(100.00)
Inability to independently manage regular activities	52(86.67)	49(81.67)	101(84.16)

Note-Figures in parenthesis indicates percentage (Multiple responses)

It was found that people from both areas were under the pressure of debt. It was because people took (rank 1) debts from commission agents and banks for their children's migration. In *Doaba*, the major economic problem was that children took money from parents for settlement in abroad. In *Malwa* region,

parents were facing more monetary problems (rank 3) as compared to *Doaba* where the problem was less identified. The major reasons for the economic problems were taking away of money by children. Few parents even told their children want them to see property and give money to them

Economic problem	<i>Doaba</i> (n ₁ =60)	<i>Malwa</i> (n ₂ =60)	Total(N=120)
Debts	29(48.34)	24(40.00)	53(44.16)
Monetary issues	22(36.66)	13(21.66)	35(29.16)
Not proper investment	14(23.34)	20(33.34)	34(28.33)
Children took money	32(53.34)	20(33.34)	29(24.16)

Note- Figures in parentheses indicate percentage

There are a number of health problems in the old age such as cold and cough, joint and knee pain, tension or anxiety, heart disease, diabetes etc. Almost all the respondents faced one ailment or the other at this stage. Around 70.00 per cent of the respondents from both *Malwa* and *Doaba* respondent faced joint and knee pain problems. About 48 per cent of the total respondents faced tension and anxiety which was mainly related to their children and about their settlement and future. Least number of respondents (10.00%) suffered with heart. Surjit Kaur, 90 years old, from village Dhaliwal, Qadian, Jalandhar (*Doaba*) reported that her son Yoga Singh 60 years old, is currently living in England from last 40 years. She also told that it was just Rs. 232 only spent for the migration

and he migrated at the time when migration was rare. Being a widow, Surjit Kaur, regularly visit to see his son with his family in England. She she holds good relationship with her daughter in law and grandchildren. Being a heart patient, Surjit Kaur is currently living alone and her nephew take care of her at difficult times. She reported that she doesn't need any money from her son because she owns 35 acres of land but still his son sends her remittances on regular basis. She had already done property on the name of his son but still have fear in mind that her relatives might not create dispute for property. She also feared who will take care of her if she is become ill as her health is deteriorate nowadays.

Table 5. Distribution of respondents according to the health problems.

Health problem	<i>Doaba</i> (n ₁ =60)	<i>Malwa</i> (n ₂ =60)	Total(N=120)
Cough and cold	19(31.66)	25(41.67)	44(36.67)
Joint and knee pain	42(70.00)	42(70.00)	84(70.00)
Tension or anxiety	29(48.34)	29(48.34)	58(48.34)
Heart disease	7(11.66)	5(8.34)	12(10.00)
Diabetes	9(15.00)	26(43.34)	35(58.34)

Note- Figures in parentheses indicate percentage

In *Doaba* and *Malwa* region, joint and knee pain were recognized as the major health problem in old age parents rank 1 followed by tension and anxiety (rank 2) whereas heart disease is affecting the old aged parents the least. On the other hand, the least score was given to heart disease in both regions.

Parents also faced emotional breakdown after children's migration. In *Doaba*, 43.34 per cent and *Malwa* half of the parents were feel burdened after children's migration and a very little number of respondents had feared that they have no one at their home for care and love. They called their homes as

Psychological problems

Psychological problems are bound to sprout up among left behind old aged people such as ,no one care at this stage, loneliness after migration of children burdened ,over thinking and insecurities. In *Doaba*, 55.00 per cent of respondents were insecure as children moved away of respondents in *Malwa* had this feeling.

“empty nests” In the total sample, mostly left behind were missing their children. Almost 40.00 percent of the respondents were worried what they will do after death of spouse as they will be alone. One of the female respondents said that, “they felt if children are not there than spouse must be there to take care of them.”

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Table 6. Distribution of respondents according to the psychological problems.

Psychological problem	Doaba (n ₂ =60)	Malwa (n ₂ =60)	Total(N=120)
No one care at this stage	4(6.67)	5(8.33)	9(7.50)
Loneliness after the death of spouse	29(48.33)	17(28.33)	46(38.33)
Feel burdened after being left alone	26(43.34)	30(50.00)	56(46.66)
Overthinking and missing children	32(53.33)	27(45.00)	59(49.16)
Insecure	33(55.00)	32(53.33)	65(54.16)

Note: Figures in parenthesis indicates percentage (Multiple responses)

Table 7. Suggestions.

Suggestions regarding economic aspects	Doaba	Malwa	Total
Renumeration for left behind parents	49 (81.66)	57 (95.07)	110 (88.33)
Bank facilities in village	47 (78.33)	11 (18.33)	58 (48.33)
Monetary help from government	60 (100.00)	60 (100.00)	120 (100.00)
Suggestions regarding health aspects			
Regular checkups at homes	29 (48.33)	33 (55.00)	62 (51.66)
Better medical facilities in villages	48 (80.00)	54 (90.00)	102 (85.00)
Organize free medical camps	50 (83.34)	52 (86.66)	102 (85.00)
Free medicines and treatments for old aged	60 (100.00)	60 (100.00)	120 (100.00)
Suggestions regarding sociological and psychological aspects			
Providing security and freedom	9 (15.00)	17 (28.33)	26 (21.66)
Emotional support by family members	28 (46.66)	40 (66.66)	68 (56.66)
Developing age friendly services and settings	16 (26.66)	31 (51.66)	47 (39.16)
Training for health professional in proudly lane for old aged	5 (8.33)	8 (13.33)	13 (10.80)
Recreational activities for old aged	43 (71.66)	43 (71.66)	86 (71.66)
Counselling of elder person and encouragement of self-care	41 (68.33)	33 (55.00)	74 (61.66)
Social and health care programmes for elderly	9 (15.00)	9 (15.00)	18 (15.00)

Note-Figures in parenthesis indicates percentage (Multiple responses)

Suggestions regarding socio-psychological aspects

The suggestions regarding overcoming the socio-psychological problems were asked from the respondents. A large number *i.e.*, 71.66 per cent of respondents said that recreational activities must be there for parents such as social clubs, reading rooms with congenial atmosphere. Also 16.66 percent revealed that counseling of elder person and thus encouragement of self-care must be uncalculated in elderly persons. Further, emotional support by emigrant (56.66%) and other family members must

be there. Few (10.80%) of the respondents also quoted trainings for health professionals in promoting care for old persons should be there for old person. Also 15.00 per cent of old aged talked about social and healthcare programmes to be started for elderly. In *Doaba* region, mainly of elderly quoted about recreational activities of old aged followed by counselling of elder person *i.e.*, 71.66 per cent and 68.33 per cent especially. In *Malwa* region, about 29.00 per cent of respondents asked for providing security and freedom elderly and more than half also started need for developing.

Suggestions regarding economic aspects

It was observed that all of the respondents from *Doaba* and *Malwa*, suggested to have monetary help from government. Also respondents suggested that bank facilities like international bank should be in villages. The respondents demanded monetary help from government in face of “*karja-mafi, bjurag Bhatta*” etc. Respondents stated that government should help the left behind old aged parents of emigrants as they send their children as well as their finances went with them. So remuneration must be given to them.

Suggestions regarding health aspects

The suggestions regarding health aspect were asked. All the respondents were stated that free medicines and treatment for them. Large number of respondents suggested that there should be better medical facilities in villages like better government hospitals and proper educated staff. Government should organise free medical camps such as eye check-up camps, blood-sugar check-up camps, etc. Narinder Singh (79 years old) narrated that, he is the patient of heart. Many times he needs doctor near to him but he is unable to visit to doctor because doctors are very far from them and he is unable to go by himself. They said they are aware about health issues but unable to control because some of them living alone and are very old. Also parents from *Doaba* and *Malwa* suggested for having regular home check-up by good doctors and teams. Overall, all respondents were desired to free medicines and treatments for old aged parents by providing medical camps.

CONCLUSION

Migration is an age old and universal phenomenon. Historical accounts vividly indicate the migration of individuals, tribes and communities from one place to another to hunt for food, shelter, trade and economic activities. The study was an attempt to know light on knowing “economic and health problems of left behind parents and suggestions to overcome these problems In Punjabi diaspora” Most of the old aged respondents belonged to the age group of 60-70 years in the total sample. As regard to economic problems 44.16 per cent of respondents felt come under debt while sending children abroad and told they faced economic crunches. Also, in health problem 70.00 per cent had joint and knee problems. They suggested free medical camps and treatments must be there for all the old aged

persons. Recreational activities as well as support and care must be there so that old aged parents can lead a comfortable life. Proper health care program should be paid by government for old aged person. Government should provide better health facilities, job opportunities, etc. to youth for curbing migration. Punjab is one of the largest agriculture states. For those who are engaged in agriculture, rural youth should be trained for better adoption of technology and imparted skill development trainings so that they can earn well for their livelihoods.

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Studies on Growth and Quality of Coriander (*Coriandrum sativum* L.) Grown Under Shade Net and Open Field Conditions

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ABSTRACT

The coriander (*Coriandrum sativum* L.) is a cool season crop and can be successfully cultivated in *rabi* season on black cotton or other type of heavy soils. The study was conducted in the Department of Spices and Plantation Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore to study the effect of season of sowing on foliage yield and quality of coriander under two different growing condition *viz.*, open field and shade net (50%) with the variety CO (CR) 4. The experiment was laid out in a Randomized Block Design (RBD) with eighteen treatments replicated thrice. Under Shade net grown coriander yielded well compared to open field condition. In open field condition there was no germination observed during summer months (March, April and May) while in shade net condition slight reduction of yield was observed compared to other months. In case of quality, no significance was observed between open field and shade net condition. In case of effect on month of sowing, October month recorded higher yield and quality for both the condition.

Key Words: Coriander, Shade net, Yield, Quality, Year, Production.

INTRODUCTION

Coriander (*Coriandrum sativum* L.) is an important spice crop which belongs to the family Apiaceae originated from Mediterranean Region. Coriander is valued for its tender leaves and grains. The coriander is a cool season crop and can be successfully cultivated in *rabi* season on black cotton or other type of heavy soils which have better water retention capacity. Coriander plants are highly sensitive to the abrupt variations in climatic parameters as it is delicate in nature. The soil temperature especially in the afternoon (28.0° C to 32.5° C) is the most crucial factor in summer production of coriander leaf (Sarada *et al*, 2011). For leaf purpose, coriander is grown all-round the year. The plant has to be harvested for foliage before bolting as late harvest produces bitter leaves.

Temperature between 10° to 30° C provides optimum growing conditions for foliage production of coriander (Anonymous, 2000). Therefore, during off season (summer) high temperature negatively affects the quantity as well as quality of this valuable crop. Protected cultivation thus facilitate continuous production of leafy coriander throughout the year and off-season crop to fetch higher market rates due to high demand. Raising coriander under protection of shade

net is beneficial, as the shade nets provide partial shade to the crop with reduction of temperature inside resulting into better plant growth and development, which consequently increased the foliage yield during off- season. There is a continuous demand for fresh coriander leaves all-round the year. Hence, the experiment was conducted to assess the performance of coriander var.CO (CR) 4 under shade net and open field condition for yield contributing characters and quality characters.

MATERIALS AND METHODS

The study was undertaken in the Department of Spices and Plantation Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. The experimental location is situated at 11° N latitude, 77° E longitude and at an altitude of 426.26 m above MSL. The field experiment was conducted from September to May to study the effect of season of sowing on foliage yield and quality of coriander under two different growing condition *viz.*, open field and shade net (50%) with the variety CO (CR) 4. The experiment was laid out in a Randomized Block Design (RBD) with eighteen treatments replicated thrice. The treatment details were under

Treatment combinations

Treatment	Details
G1 S1	Open field condition + Time of sowing (September)
G2 S1	Shade net (50%) + Time of sowing (September)
G1 S2	Open field condition + Time of sowing (October)
G2 S2	Shade net (50%) + Time of sowing (October)
G1 S3	Open field condition + Time of sowing (November)
G2 S3	Shade net (50%) + Time of sowing (November)
G1 S4	Open field condition + Time of sowing (December)
G2 S4	Shade net (50%) + Time of sowing (December)
G1 S5	Open field condition + Time of sowing (January)
G2 S5	Shade net (50%) + Time of sowing (January)
G1 S6	Open field condition + Time of sowing (February)
G2 S6	Shade net (50%) + Time of sowing (February)
G1 S7	Open field condition + Time of sowing (March)
G2 S7	Shade net (50%) + Time of sowing (March)
G1 S8	Open field condition + Time of sowing (April)
G2 S8	Shade net (50%) + Time of sowing (April)
G1 S9	Open field condition + Time of sowing (May)
G2 S9	Shade net (50%) + Time of sowing (May)

The height of the plant from cotyledonary node to the tip was measured at final harvest stage and expressed in centimeter. The branches that arose from the main stem were considered as primary branches and was counted at final harvest stage and expressed in numbers. Plants were selected randomly in each treatment and the fresh weight of the herbage was calculated at the time of harvest and the mean value was expressed as gram per plant. The fresh weight of herbage per plot was recorded immediately after harvest by cleaning the adhering soil on the roots and expressed in kg per plot. The yield of herbage per hectare was estimated for the cropped area based on the yield per plot and expressed in kg per ha. The ascorbic acid content in coriander leaves was estimated at 35 days after sowing by using the procedure given in Association of Analytical Communities (Anonymous, 1975). The crude fiber content of leaves was analyzed as per the method described by (Chopra and Kanwar, 1976) and expressed in per cent. Leaf iron was

estimated at 35 days after sowing as per the method described by (Ranganna, 1986) and expressed in mg/100 g on fresh weight basis. Leaf calcium was analyzed at 35 days after sowing from the triple acid extract by Versenate method (Jackson, 1973) and expressed in mg/100g of leaf sample. Essential oil of the total fresh herb was estimated using Clevenger apparatus by hydro distillation. 100g of the herb was hydro distilled for six hours and the oil content V/W was expressed in per cent (%). The data were analyzed adopting the standard procedure (Panse and Sukhatme, 1985).

RESULTS AND DISCUSSION

The highest plant height (29.88 cm) and number of primary branches per plant (5.50) was observed in October month under shade net and open field condition. Date of sowing was an important management factor for almost all seed spices including coriander

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Table 1. Effect of time of sowing and growing condition on yield and quality characters

Sr. No	Time of sowing	Growing Condition (G)		Growing Condition (G)		Growing Condition (G)	
		Open (G1)	Shade (G2)	Open (G1)	Shade (G2)	Open (G1)	Shade (G2)
		Plant height (cm)		Yield (kg/plot)		Ascorbic acid (mg/100g)	
1	September	24.43	28.81	2.32	5.21	97.65	97.23
2	October	26.59	29.88	2.52	5.69	98.69	97.22
3	November	24.31	27.90	2.26	5.14	98.29	97.22
4	December	24.28	27.26	2.21	5.09	98.31	97.24
5	January	22.59	27.04	2.10	4.67	95.98	95.19
6	February	22.77	24.44	1.67	4.29	95.66	95.07
7	March	NA	24.07	NA	4.08	NA	97.42
8	April	NA	23.54	NA	3.89	NA	97.45
9	May	NA	27.39	NA	4.39	NA	96.17
Mean		24.16	27.94	2.18	4.71	97.43	96.69
SE(d)		0.563	0.68	0.028	0.069	1.27	1.59
CD (P=0.05)		1.254 **	1.45 *	0.062 **	0.147 **	NS	NS
NS – Non Significant and *Highly significant							

Table 2. Effect of different months of sowing and growing condition on quality parameters

Sr. No	Time of sowing	Condition (G)		Condition (G)		Condition (G)	
		Open (G1)	Shade (G2)	Open (G1)	Shade (G2)	Open (G1)	Shade (G2)
		Iron content(mg/100g)		Crude fiber content (%)		calcium (mg/100g)	
1	September	1.14	1.19	8.86	10.65	135.11	135.61
2	October	1.19	1.21	8.97	10.87	135.13	135.71
3	November	1.16	1.20	8.86	10.76	135.09	135.63
4	December	1.16	1.19	9.18	10.27	134.89	135.12
5	January	1.13	1.18	8.64	10.22	131.21	132.06
6	February	1.11	1.16	8.26	9.89	131.09	132.11
7	March	NA	1.17	NA	9.73	NA	133.42
8	April	NA	1.16	NA	9.29	NA	134.89
9	May	NA	1.19	NA	10.19	NA	135.09
Mean		1.15	1.18	8.80	10.21	133.7	134.40
SE(d)		0.027	0.021	0.106	0.182	3.2765	3.4970
CD (P=0.05)		0.060NS	0.044	0.237**	0.383**	7.3006 NS	7.4134 NS
NS – Non Significant and ** - Highly significant							

Table 3: Effect of different months of sowing and growing condition on quality characters

Sr. No	Time of sowing	Condition(G)		Condition(G)	
		Open (G1)	Shade (G2)	Open (G1)	Shade (G2)
		Aroma		Essential oil content	
1	September	5.00	4.00	0.088	0.084
2	October	5.00	4.00	0.088	0.085
3	November	5.00	4.00	0.087	0.085
4	December	4.0	3.00	0.087	0.084
5	January	4.0	3.00	0.087	0.086
6	February	3.68	3.00	0.085	0.087
7	March	NA	4.00	NA	0.087
8	April	NA	4.00	NA	0.083
9	May	NA	300	NA	0.081
Mean		4.45	3.56	0.087	0.085
SE(d)		-	-	0.0035	0.0036
CD (P=0.05)		-	-	0.0079 NS	0.0075 NS

Physical environment has profound influence on growth, biomass partitioning and ultimately the yield of coriander. Temperature, humidity, rainfall and other meteorological factors may individually or collectively limit the plant growth and production. Time of sowing controls the crop phenological development along with efficient conversion of biomass into economic yield (Khichar and Niwas, 2006). While comparing the growing conditions maximum mean plant height of 27.94 and 24.16 cm was recorded in shade net and open field condition respectively. October sown plants had optimum climate which delayed the reproductive stage and plants with prolonged vegetative phase gave higher fresh green leaf yield (Sagarika Guha *et al*, 2014). Better vegetative growth was observed in October sown crop due to more favourable temperature during its growth period (Guha *et al*, 2016). The maximum biological yield in October sown crop can be attributed to greater leaf area (Ayub *et al*, 2008).

The mean leaf yield/plot was higher under shade net condition (4.71 kg/plot) and was lower in the open field condition (2.18 kg/plot). During March, April and May there was no growth in open conditions. Even under shade net condition minimum growth and yield was observed.

Quality attributes

The Quality characters such as ascorbic acid content (mg/100g), iron content (mg/100 g), calcium content (mg/100 g), Aroma and essential oil content were found to be non-significant among different month of sowing and growing condition (Table 2). However, the highest ascorbic content (98.69 mg/100g), higher iron content (1.19 mg/100g), higher calcium content (135.13 mg/100g) and highest oil content (0.088%) during October under open condition. Crude fibre content showed a significant difference when grown at different months of sowing and growing condition (Table 2). Shade net condition recorded the higher crude fibre content of 10.87 % during October followed by November month (10.76 %). October month recorded more calcium content of 135.71 mg/100g under shade net and 135.13 mg/100g under open field condition. Similarly, the shade net condition had higher amount of calcium content (134.40 mg/100g) followed by open condition (133.70 mg/100g). Crude fibre content showed a significant difference when grown at different months of sowing and growing condition Calcium content during different months of sowing and growing condition found to be non significant.

The insignificant results in both the growing conditions and different months of sowing might be

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due to the fact that agronomic practices like dates of sowing and growing conditions might not be able to manipulate the levels of quality parameters in coriander leaves, as these characters may be genetically controlled (Guha *et al*, 2016b) However, the ascorbic acid content was higher in the open field grown coriander leaves than the shade net grown coriander leaves (Anitha *et al*, 2016).

In general, shading resulted in reduction in the ascorbic acid content of leaves. Low light intensity might be responsible for reducing the ascorbic acid content (Padmapriya, 2015) in tomato.

Ascorbic acid is synthesized from photosynthesis-produced sugars (Lee and Kader, 2000) Thus, a lower ascorbic acid content of the fruits produced in a protected environment is probably caused by the lower luminosity in the environment, which may have reduced the production of sugar, a substrate that is used in the synthesis of ascorbic acid. Leaf calcium and ascorbic acid composition of spinach (*Spinacea oleracea* L.) and lettuce (*Lactuca sativa* L.) increases with minor reduction in temperature and high light intensities due to climatic or weather changes. Ascorbic acid concentration also generally increases with increased exposure to light, particularly in leafy greens.

The assessment on aroma of coriander grown during different months and growing condition were evaluated on the basis of scoring. The aroma was scored to be poor under shade net conditions during March, April and May with the score of 3.00. But the crop raised during winter months under open condition exhibited a good aroma score of 5.00 during September, October and November respectively.

There are also reports stating that the effect of sowing dates was insignificant on essential oil content (Kaya *et al*, 2000). Sowing dates had no significant effect on essential oil content rather it was more related to planting density (Ghobadi and Ghobadi, 2010).

CONCLUSION

The findings of the study revealed that coriander cultivation under shade net condition is a profitable venture to get yield of fresh coriander leaves and income throughout the year which is not possible under open field.

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Tender Coconut Husk Biochar Augments the Growth and Yield of Okra in Onattukara Sandy Plains

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ABSTRACT

A field experiment was carried out to study the effect of biochar produced from tender coconut husk on growth and yield of okra [*Abelmoschus esculentus* (L.) Moench] in Onattukara sandy plain during 2023 at Onattukara Regional Agricultural Research Station, Kayamkulam, Kerala. The experiment was laid out in RBD with nine treatments which were replicated thrice. The treatments were T₁ (biochar @ 5 t/ha + 100% RDF), T₂ (biochar @ 10 t/ha + 100% RDF), T₃ (biochar @ 5 t/ha + 5 t/ha FYM + 100% RDF), T₄ (biochar @ 10 t/ha + 5 t/ha FYM + 100% RDF), T₅ (biochar @ 5 t/ha + 75% RDF), T₆ (biochar @ 10 t/ha + 75% RDF), T₇ (biochar @ 5 t/ha + 5 t/ha FYM + 75% RDF), T₈ (biochar @ 10 t/ha + 5 t/ha FYM + 75% RDF) and T₉ (20 t/ha FYM + 100% RDF). The results revealed that tender coconut husk biochar has good prospects for use as a soil conditioner for okra in the sandy loam soils of Onattukara. The soil application of biochar produced from tender coconut husk at the rate of 10 t/ha along with FYM @ 5 t/ha and 100 per cent recommended dose of fertilizer can be recommended for augmenting the growth and yield of okra in the sandy loam soils of Onattukara.

Key Words: Biochar, Growth, Okra, Tender coconut husk, Yield

INTRODUCTION

In India, the agricultural waste generated by crops is much greater compared to other countries. The lack of suitable technology to dispose the left-over crop residues, force the farmers to burn the residues as an easy way of clearing the field. According to Singh and Kaskaoutis (2014), about 43% of the total crop stubbles generated in India is burnt on the field. This leads to a lot of air pollution. Biochar, a carbonaceous product made by pyrolysis of biomass has low bulk density, high porosity, and high-water holding capacity (Punnoose and Anitha, 2015). When applied to soil, these properties make biochar, an ideal soil conditioner and improves the water and nutrient retention in soil, thereby improving the yield. Thus, the crop residues can be converted to biochar to serve as a potential technique to remediate the environmental problems caused by crop residue burning. In Kerala, tender coconut husk is an agricultural waste which require immediate measures for safe and quick disposal. A

fraction of the tender coconut husk waste generated is effectively utilized by composting or as a mulch in coconut gardens. This is not sufficient compared to the quantity of waste generated. Tender coconut husk has great potential to be converted to biochar after drying. This waste can be routed back to enhance agricultural productivity by converting it to biochar. Onattukara tract of Alappuzha district is a problematic soil since it is coarse textured with loamy sand nature and low in nutrient status. Due to this nature of soil, the nutrients in the applied manures and fertilizers tend to be washed out from the site of application along with rain. Since biochar is having high water holding capacity and low bulk density, on application to agricultural soils, can increase the soil moisture content, thereby restricting the leaching out of applied nutrients. Hence, a study was undertaken to assess the potential of tender coconut husk biochar as a soil conditioner for okra in the sandy loam soils of Onattukara.

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MATERIALS AND METHODS

An experiment was conducted in the wetlands of the Instructional farm attached to Onattukara Regional Agricultural Research Station (ORARS), Kayamkulam, Kerala during the Summer of 2023. The field experiment was laid out in RBD with nine treatments which were replicated thrice. The treatments were T₁ (biochar @ 5 t/ha + 100% RDF), T₂ (biochar @ 10 t/ha + 100% RDF), T₃ (biochar @ 5 t/ha + 5 t/ha FYM + 100% RDF), T₄ (biochar @ 10 t/ha + 5 t/ha FYM + 100% RDF), T₅ (biochar @ 5 t/ha + 75% RDF), T₆ (biochar @ 10 t/ha + 75% RDF), T₇ (biochar @ 5 t/ha + 5 t/ha FYM + 75% RDF), T₈ (biochar @ 10 t/ha + 5 t/ha FYM + 75% RDF) and T₉ (20 t/ha FYM + 100% RDF).

The experimental area was cleared, stubbles were removed and clods were broken. Dolomite @ 1 t/ha was applied uniformly in the experimental area and incorporated into soil along with tillage. After the layout of the field, tender coconut husk biochar and farm yard manure, along with half N, full P and full K of chemical fertilizers were applied in soil as per treatments just before sowing. The remaining N was given in soil at one month after sowing. The seeds of okra (var. Arka Anamika) were sown in lines in the main field at a spacing of 60 cm x 30 cm. The crop was sown during the last week of January 2023. After sowing, uniform population was maintained by thinning and gap filling. The crop was raised under rainfed condition. Intercultural, weeding and earthing up were done at 10 days after sowing and at one month after sowing along with topdressing with nitrogen. The outer row in each plot was left out as border row and five plants from each net plot were tagged as observational plants. The growth characters *viz.* height of the plant and number of leaves per plant were recorded from each plot at monthly intervals upto harvest and the average was worked out. Height of the plant was measured from the ground (base of the plant) to the terminal bud and the average was worked out and expressed in cm. The number of fully opened leaves of the observational plants were recorded and the average was calculated.

The observational plants, at harvest, were carefully dug out using spade without any breakage of roots and was carefully washed in water to remove the

soil. Root depth was measured by recording the length of the tap root of the observational plants and its mean was worked out and expressed in cm. For measuring the root volume, the roots were immersed in a measuring cylinder containing known volume of water. The increase in volume of water due to immersing roots is the root volume and is expressed in cm³ (Musick *et al*, 1965). The number of days taken from sowing to opening of the first flower of the observational plants in each plot was recorded and the average was worked out. The total number of fruits obtained from the observational plants of each plot was recorded and the average was worked out. The length of the fruits from the tip of the fruit to the stalk end of the fruits is measured from the observational plants and the average was worked out and expressed in cm. The weight of the fruits from each of the observational plants was recorded after each harvest. After the final harvest, the total weight of fruits obtained from the observational plants of each plot from different harvests were worked out and expressed in kilograms for fruit yield per plant. The weight of fruits from each plots excluding the border plants was summed up after each harvest and at the end of the cropping season the yield in terms of kg/plot was calculated and converted into t/ha. Harvest index was calculated using the following formula suggested by Donald and Hamblin (1976).

The statistical analysis of the data was done by applying the technique of analysis of variance (ANOVA) for Randomised Block Design and was done using GRAPES statistical software developed by the Department of Agricultural Statistics, College of Agriculture, Vellayani (Gopinath *et al*, 2020).

RESULTS AND DISCUSSION

The heights of the plants were recorded at 30 DAS, 60 DAS and at 90 DAS (Table 1). In general, there was an increase in plant height with the age of the crop. No significant difference was observed among the treatments in plant height at 30 DAS. At 60 DAS and at 90 DAS, the application of biochar had significantly produced taller plants. The application of 100 per cent RDF produced taller plants compared to the plants that were given 75 per cent RDF. At 60 DAS, the treatment T₄ (105.82 cm) recorded taller plants and was found to

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Table 2. Effect of different treatments on the yield attributes and yield of okra

Treatment	Fruit yield per plant (g)	Fruit yield (t ha ⁻¹)
T ₁ - biochar @ 5 t/ha + 100% RDF	480.30	10.44
T ₂ - biochar @ 10 t/ha + 100% RDF	487.23	12.25
T ₃ - biochar @ 5 t/ha + 5 t/ha FYM + 100% RDF	537.74	14.07
T ₄ - biochar @ 10 t/ha + 5 t/ha FYM + 100% RDF	544.93	15.71
T ₅ - biochar @ 5 t/ha + 75 % RDF	392.85	11.26
T ₆ - biochar @ 10 t/ha + 75 % RDF	415.59	11.89
T ₇ - biochar @ 5 t/ha + 5 t/ha FYM + 75% RDF	457.61	12.19
T ₈ - biochar @ 10 t/ha + 5 t/ha FYM 75% RDF	464.61	13.05
T ₉ - 20 t/ha FYM + 100% RDF (KAU POP)	380.24	7.65
SEm (±)	16.81	0.63
CD (0.05)	50.385	1.890

FYM- Farm yard Manure; NS- Not significant; RDF-Recommended dose of Fertilizer

Table. 1 Effect of different treatments on the growth attributes of okra.

Treatment	Height of the plant (cm)			Number of leaves per plant			Root depth (cm)	Root volume (cm ³)
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	at harvest	at harvest
T ₁ - biochar @ 5 t/ha + 100% RDF	23.45	99.10	118.70	6.00	19.89	6.56	20.23	16.68
T ₂ - biochar @ 10 t/ha + 100% RDF	24.28	101.32	121.37	6.00	20.66	6.89	20.60	16.67
T ₃ - biochar @ 5 t/ha + 5 t/ha FYM + 100% RDF	23.95	103.87	133.60	6.00	20.89	7.11	20.47	20.52
T ₄ - biochar @ 10 t/ha + 5 t/ha FYM + 100% RDF	21.77	105.82	141.00	6.00	20.44	7.89	15.80	25.64
T ₅ - biochar @ 5 t/ha + 75 % RDF	24.77	95.21	109.77	6.00	19.45	6.66	16.50	19.23
T ₆ - biochar @ 10 t/ha + 75 % RDF	24.98	95.48	109.77	6.00	20.00	6.67	18.03	15.39
T ₇ - biochar @ 5 t/ha + 5 t/ha FYM + 75% RDF	22.30	96.24	110.10	6.00	20.44	6.33	21.60	17.95
T ₈ - biochar @ 10 t/ha + 5 t/ha FYM + 75% RDF	20.57	97.94	111.27	5.89	20.33	6.34	23.60	16.67
T ₉ - 20 t/ha FYM + 100% RDF (KAU POP)	21.20	91.47	104.77	6.00	19.89	6.11	25.27	14.10
SEm (±)	1.09	2.00	2.79	0.04	0.38	0.21	0.35	1.97
CD (0.05)	NS	5.995	8.358	NS	NS	0.616	1.060	5.907

DAS- Days after sowing; FYM- Farm yard Manure; NS- Not significant; RDF-Recommended dose of Fertilizer

be on a par with the treatment T₃ (103.87 cm) and T₂ (101.32 cm). This might be due to the supply of nutrients in the applied biochar combined with the application of recommended dose of nutrients. As the dose of biochar was increased, the height of okra was found to increase. This might be due to the adsorption capacity of biochar in decreasing leaching loss of nutrients and improving the water and nutrient retention. Jabin and Rani (2023) had also reported an improvement in growth of ginger due to the application of different biochars at various levels. At 90 DAS, taller plants were recorded for the treatment T₄ (141 cm) and was found to be on a par with the treatment T₃ (133.60 cm). Similar reports of increased growth parameters were reported by Southavong *et al* (2012) in water spinach due to application of rice husk biochar. Dainy (2015) had also reported that the biometric characters of yard long bean was greatly influenced by the addition of tender coconut husk biochar along with NPK as per recommendation.

The number of leaves per plant were observed at 30 DAS, 60 DAS and at 90 DAS (Table 1). The number of leaves per plant increased with the age of the crop till 60 DAS and was then found to decline till harvest. At 30 DAS and 60 DAS, there was no significant influence in number leaves per plant by the treatments. The application of biochar had significantly influenced the number of leaves per plant at 90 DAS. Higher number of leaves per plant was recorded from the treatment T₄ (7.89). The activated plant growth was due to the application of biochar and organic fertilizer on soil nutrient availability (Blackwell *et al*, 2009 and Schulz *et al*, 2013) and this might have improved the number of leaves per plant in okra. Punnoose (2015) had also obtained higher number of leaves per plant with the application of biochar along with 100% NPK in amaranths. As the quantity of biochar increased, an increase in leaf number per plant was obtained. Similar results of significantly superior number of leaves per plant due to the progressive addition of biochar were observed by Dainy (2015) in yard long bean. There was an overall increase of 25.39 per cent in number of leaves per plant for the treatment T₄ compared to T₀ (KAU POP). Akpa *et al* (2019) had also recommended the combined application of cow dung (@ 12 t/ha) and biochar (@ 8 t/ha) for optimum growth and development of okra.

The effect of different treatments on root depth and root volume of okra was significantly influenced by the application of biochar (Table 1). The root depth and root volume was found to follow an inverse relationship with each other. As the root depth increased, the root volume decreased. Roots from a depth of 25.27 cm were obtained for the plants that received the treatment T₀ (KAU POP). The root volume for the treatment T₀ was 14.10 cm³ and was observed to be the lowest among the treatments. The roots might have gone deeper foraging for nutrients and water in T₀ plants which might be the reason for the lower root volume. Higher root volume was obtained from the treatment T₄ (25.64 cm³). The higher root volume due to an increased root weight in okra might be due to the nature of biochar applied as soil conditioner which might have retained the nutrients and water at the top soil. Similar reports of increased fresh root weight in chilli due to application of coconut shell biochar @ 10 t/ha was reported by Amaral *et al* (2019). Jabin and Rani (2022) had also reported the influence of increased rate of biochar on the higher rhizome spread of ginger.

The highest yield per plant was obtained from T₄ with 544.93 g and was found to be on a par with the treatment T₃ (537.74 g/plant) (Table 2). This was 35.60 per cent increase over T₀ (KAU POP). Higher fruit yield per plant was observed for the plants that received biochar and FYM along with 100 per cent RDF. The adsorbing property of biochar might have slowed down the release of nutrients from FYM and chemical fertilizers. As the amount of biochar was doubled, there was an increase in fruit weight. This is in accordance with the findings of Dainy (2015) who also reported a progressive increase in yield and yield attributing characters in yard long bean as the levels of biochar increased from 10 to 30 t/ha when applied with the recommended dose of fertilizers. Similar reports of increased plant yield with the application of biochar and recommended dose of fertilizers was reported by Punnoose (2015) in amaranthus and Hashmi *et al* (2019) in *Pisum sativum* L. In the case of fruit yield/ha, the application of tender coconut husk biochar had significantly improved the yield per hectare in okra. Higher fruit yield per hectare was observed for the treatment T₄ (15.71 t) and was on par with T₃ (14.07 t) (Table 2). The control plants (T₀) could only produce

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7.65 t/ha. Overall, there is a yield increase of 69 per cent in T₄ compared to T₀ (KAU POP). The lower yield per hectare in T₀ (KAU POP) might be due to the leaching loss of nutrients. There was 44 mm rainfall during the growth period of okra, which might have aggravated the leaching loss in the sandy loam soils of Onattukara. Nagula (2017) has also recommended the application of biochar @ 10 kg/ha along with the recommended dose of nutrients for higher yield in banana.

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CONCLUSION

Tender coconut husk biochar has good prospects for use as a soil conditioner for okra in the sandy loam soils of Onattukara. The soil application of biochar produced from tender coconut husk at the rate of 10 t/ha along with FYM @ 5 t/ha and 100 per cent recommended dose of fertilizer can be recommended for augmenting the growth and yield of okra in the sandy loam soils of Onattukara.

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Therapeutic Management of Russell's Viper Snake Bite in a Labrador Dog

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ABSTRACT

A Male Labrador dog of age two years was presented on emergency to Department of Veterinary Clinical Complex, Garividi with the history of Viper snake bite. Clinical examination revealed dull and depression, snake bite marks on right and left forelimbs with swelling and exaggerated respiration. The vitals were normal except for the increased heart rate. Blood clotting time revealed clotting time of more than 20 mins. There weren't any changes in the serum biochemistry and hematology except for the presence of few echinocytes as the dog was presented immediately 15 minutes after the snake bite. Treatment with Polyvalent snake venom antiserum diluted in normal saline, corticosteroid and antibiotic were administered intravenously. The dog recovered eventfully in three days. The hemato-biochemical values were normal post therapy (on day 7).

Key Words: Clotting time, Dog, Snake bite, Treatment, Viper.

INTRODUCTION

Snakebites pose a significant threat to both humans and animals, with vipers, belonging to the family Viperidae, being among the venomous snakes found worldwide. Russell's viper (*Daboia russelii*) is a prominent member of this family, recognized as one of the Big four venomous snakes in India and prevalent across Southeast Asia. Russell's viper venom is a potent cocktail of toxins, featuring biologically active procoagulant enzymes. These enzymes, including activating factors V and X, play a crucial role in the blood-clotting cascade. The venom also contains a metalloproteinase known as "haemorrhagin," which damages vascular endothelium, and toxins that impair platelet function. The combined impact of these elements results in venom-induced disturbances, leading to thrombosis, spontaneous hemorrhages, edema, and shock (Fleiseriu, 2017). The history accompanying cases of snake envenomation in dogs varies widely. Some owners witness the strike, while others may only notice their dog's reaction or remain unaware until severe clinical signs manifest. Dogs envenomated by snakes can present with diverse clinical signs, depending on the snake species and the severity of envenomation. Diagnosing snake envenomation in the absence of witnessed incidents

can be challenging due to the range of possible clinical presentations (Wagner, 2017). The effects of Russell's viper venom on dogs can be swift and severe. Recognizing these clinical signs is crucial for timely intervention. The primary approach to managing snake envenomation in dogs involves the timely administration of snake venom antiserum. Additionally, supportive treatments, including intravenous fluid therapy, analgesia, and addressing complications, play a vital role in ensuring a positive outcome (Armentano and Schaer, 2014). Delaying or inadequately treating snake envenomation in dogs can have severe consequences (Klaassen, 2008). Untreated cases may progress to life-threatening complications, emphasizing the importance of swift and appropriate intervention.

History and Observation

Two years old male Labrador dog was presented to Veterinary Clinical Complex, College of Veterinary Science, Garividi on emergency with the history of snake bite by Russell's Viper i.e., locally called as Ulli pamu (Telugu). The dog was presented immediately in a time period of 15 minutes' post snake bite. On presentation the dog was dull, depressed and on lateral recumbency (Fig 1). Clinical examination revealed presence of fang marks on right and left

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forelimbs with swelling of both the limbs (Fig 2, 3). All the vitals were within the range except for elevated heart rate and exaggerated breathing. The blood and serum samples were sent for analyses. No changes were noticed in hemato biochemistry. Blood smear revealed echinocytes (Fig 7). Blood clotting time was more than 20 minutes (Fig 4). During the treatment muscle tremors, shivering of hindlimbs and dilated pupils were noticed (Fig. 5).

Treatment and Discussion

Treatment was initiated with single vial (10ml) of Lyophilized polyvalent snake venom antiserum (®ViNS Bioproducts Limited, Telangana) diluted in 250 ml of normal saline intravenously followed by second dose of another 10 ml of antiserum in another 250 ml of normal saline. Inj. Dexamethasone at the dose of 2mg/kg was administered IV, Inj. Enrofloxacin at the dose of 5 mg/kg IM and Inj. Tetanus toxoid @2ml IM were given. After three hours of therapy the clotting time was less than 20 mins and the dog was normal. However, on the second day the dog evinced severe pain of right forelimb and swelling of right limb alone was noted. Inj. Tramadol was given @ 2mg/kg IM to reduce the pain on 2nd day. On third day no abnormal clinical signs were noticed. The swelling of both the limbs also reduced. The antibiotic therapy was continued for five days and the dog recovered uneventfully.

In the Indian subcontinent the common venomous snakes encountered are the Indian Cobra (*Naja naja*), Russell's viper (*Daboia russelli*) and the Common Krait (*Bungarus caeruleus*) (Hussain *et al*, 2011). Snake bite cases are more common in horses and dogs when compared to other animals such as cattle, sheep and goat (Inbaraj *et al*, 2023).

Pets, driven by curiosity, often unknowingly mishandle snakes, leading to fatal bites and even death. In the present case, the owner saw the dog bitten by the snake (Russell's Viper) but remained helpless. Russell's Viper venom comprises various components, with notable ones including proteases, hemorrhagins, amino acid esterases, phospholipase A2, phospholipase B, and neurotoxins. The venom's diverse activities result in endothelial cell damage, high vascular permeability, bleeding, and fluid extravasation into inflamed tissues (Shiloah *et al*, 1973).

Clinical signs following envenomation may be delayed, and the severity is influenced by factors such

as bite location, victim body mass, and snake size (Gilliam and Brunner, 2011). Canine viper envenomations commonly occur in the head and neck area (80%), leading to local signs like swelling, edema, hematoma, and acute lameness, where as in the present case it is seen in forelimbs. Systemic signs may include shock, tachypnea, tachycardia, lymphadenomegaly and cardiac arrhythmias (Peterson, 2008).

Complications of Viper envenomation in dogs range from bacterial infections and local necrosis to tremors, dilated pupils, weakness, paralysis, bleeding, respiratory obstruction, acute renal failure, and coagulation disorders, including venom-induced consumptive coagulopathy (VICC). Despite reported complications, the mortality rate in dogs with viper envenomation is relatively low, ranging from 3.7% to 6% (Wagner, 2017).

Diagnosis is primarily based on observational history, owner reports, and the presence of bite marks. A field test, such as the whole blood clotting time test, can confirm envenomation, with prolonged clotting time indicating hypofibrinogenemia (Achara *et al*, 2020). Treatment relies on supportive therapy, antivenom administration, correction of coagulation deficits, analgesia, and meticulous nursing care. A snake bite severity score system aids in the quantitative assessment of the patient and monitoring treatment response (Peterson, 2013). The dosage of antivenom varies based on the dog's size and envenomation severity. The use of glucocorticoids in snake envenomation cases is debated. While some studies suggest no effect or even negative consequences, glucocorticoids may be beneficial in treating hypersensitivity reactions caused by antivenom (Rao *et al*, 2008). Antibiotics are recommended for extensive tissue necrosis and abscess formation (Carr and Schultz, 2015). Prognosis depends significantly on the timeliness of appropriate treatment. The more time that elapses between envenomation and receiving appropriate care (fluids, antivenom) the worse the prognosis (Peterson, 2013).

In conclusion, Russell's Viper envenomation in dogs poses a serious threat, necessitating prompt and comprehensive veterinary intervention. Understanding the clinical manifestations, complications and treatment strategies is crucial for improving outcomes in affected animals.

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Fig. 1 Labrador dog on lateral recumbency due to Viper snake bite



Fig. 2&3 Bite marks at Right and left forelimbs



Fig. 4 Unclotted blood (clotting time > 20 min)

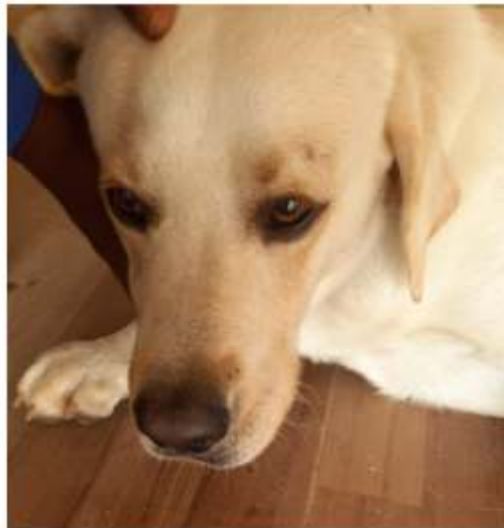


Fig.5 Dilated pupil in the dog with viper snake bite



Fig.6 Dog after polyvalent snake venom antiserum

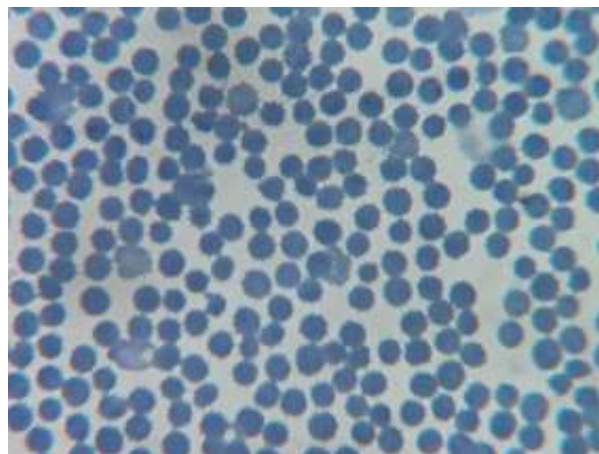


Fig. 7 Echinocytes in the blood smear of the dog with snake envenomation

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Trypanosomiasis in a Dog - A Case Report

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ABSTRACT

The present case of trypanosomiasis is reported in a five-year-old, male, non-descriptive dog that is presented with the clinical signs of inappetence, lethargy and onset of corneal opacity of both the eyes for three days. On clinical examination, high temperature, congested conjunctival mucus membranes but slightly pale buccal mucus membrane, enlargement of prescapular lymphnode were evident. Hemato-biochemical findings revealed moderate anemia with mild neutrophilia, hypoglycemia, hypoalbuminemia and elevated creatinine values. Confirmation of case was done by microscopic examination of *Trypanosoma sp.*, organism in wet blood smear and also thin blood smear with Giemsa Stain. The dog was put on therapeutic regimen comprised of Diminazine aceturate @ 3.5 mg/kg deep IM two doses on alternative days along with parenteral fluids, Oxytetracycline injection intravenously at the dose rate of 10mg per kg body weight, NSAID, multivitamins and hematinics. The dog responded well on third day of therapy with normal appetite and was active and alert. Hemato-biochemical parameters were back to near normal levels on seventh day and blood smear was also negative for *Trypanosoma sp.* The cornea of both the eyes were clear on seventh day of post therapy.

Key Words: Trypanosomiasis, Dog, Bilateral corneal opacity, Diminazine aceturate

INTRODUCTION

Trypanosomiasis is a hemoprotozoan disease caused by various members of *Trypanosoma sp.*, an extracellular parasite affecting different species of domestic and wild animals. Canine trypanosomiasis is divided into two primary types: The American form (Chagas disease), due to *Trypanosoma cruzi* infection, and the African form (sleeping sickness or surra), provoked by *Trypanosoma evansi*. However, in the Indian sub-continent, trypanosomiasis of dog is mostly due to *T. evansi* (Behera *et al*, 2018). This disease was originally enzootic and affected only wild animals, including mammals and birds, which served as reservoirs. Later, it spread to domestic animals such as horses, cattle and dogs. Dogs are significantly affected, because they participate in the transmission and maintenance cycles of these parasites viz., consumption of fresh animal carcasses that are infected by trypanosomiasis (Eloy and Lucheis, 2009). The disease is reported to be transmitted mainly by various biting flies like Tsetse, Tabanus, Stomoxys, Culicoides

etc. (Green, 2006). Severity of canine Trypanosomiasis ranges from acute, subacute to chronic. In dogs an acute and fatal type is commonly seen and death possibly occurs in 2 - 4 weeks if left untreated. Clinical signs are characterized by weight loss, progressive weakness, anorexia, anaemia, intermittent fever, conjunctivitis, edema of limbs, enlarged superficial lymph nodes, apathy and corneal opacity which are characteristic findings in trypanosomiasis (Thirunavukkarasu *et al*, 2004 and Eloy and Lucheis, 2009). The acute phase of the disease in dogs can be diagnosed by direct demonstration of the presence of parasite in the blood or by a blood smear stained by the Giemsa method. There are a number of effective trypanosomacidal agents for dogs including suramin, quinapyramine and diminazene (Rani and Suresh, 2007). Diminazene aceturate has been shown to be an effective treatment for *T. evansi* in dogs, as it presents a higher therapeutic index than other drugs, in addition to a low incidence of resistance (Doyle, 2006).

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CASE HISTORY AND OBSERVATION

A five year old, male, non-descriptive dog was presented to the Department of Veterinary Clinical Complex, College of Veterinary Science (SVVU), Garividi with the history of inappetance, lethargy and onset of corneal opacity of both the eyes since three days. On further questioning, the owner reported that the dog fed on raw mutton offal ten days back. Upon clinical examination, high temperature (103.8°F), congested conjunctival mucus membranes but slightly pale buccal mucus membrane, enlargement of prescapular lymphnode, Skin tenting test <3-4 seconds were evident. Ophthalmic examination revealed

complete cloudiness of cornea of both the eyes (Figure 1). The heart rate, pulse rate and respiratory rate were within the normal range. Examination of peripheral wet blood smear revealed presence of *Trypanosoma sp.* However, whole blood, serum and peripheral thin blood smear were sent for hemato-biochemical analysis. Moderate anemia with mild neutrophilia, hypoglycemia, hypoalbuminemia and elevated creatinine values with normal ALT, AST and ALP values were noted. Slight elevation in total protein was recorded (Table 1). Giemsa Stain blood smear revealed *Trypanosoma sp.*, organism (Figure 2&3).

Table 1. Hematology and Serum biochemical values of *Trypanosoma* affected dog

Parameters	Reference range	Day 0 (Pre therapy)	Day 7 (Post therapy)
Hemoglobin (g/dl)	12 -15	9.4	10.1
Total RBC (million/ μ l) count	5.5 - 8.5	6.2	6.5
PCV (%)	37 - 55	41	42
Total WBC count (thousands/ μ l)	6 - 17	10.45	10.23
Neutrophils (%)	60 - 77	80	72
Lymphocytes (%)	12 - 30	14	22
Monocytes (%)	3 - 10	0	02
Eosinophils (%)	0 - 9	06	04
Total protein (g/dl)	5.4 - 7.1	7.6	6.9
Albumin (g/dl)	2.3 - 3.8	1.7	2.45
Glucose (mg/dl)	65 - 118	46.17	78.0
Urea nitrogen (mg/dl)	10 - 28	22.5	20.05
Creatinine (mg/dl)	0.5 - 1.5	3.2	0.9
ALT (U/L)	21 - 102	83.74	68.3
AST (U/L)	23 - 66	45.2	39.8
ALP (U/L)	20 - 156	96.74	73.0

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Figure 1: Bilateral Corneal opacity in the affected dog

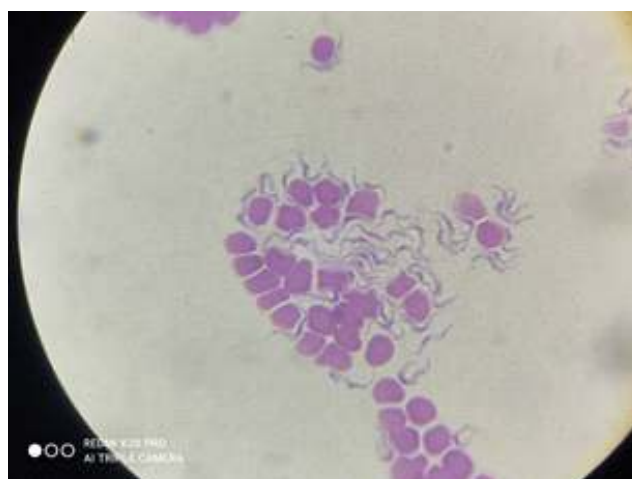
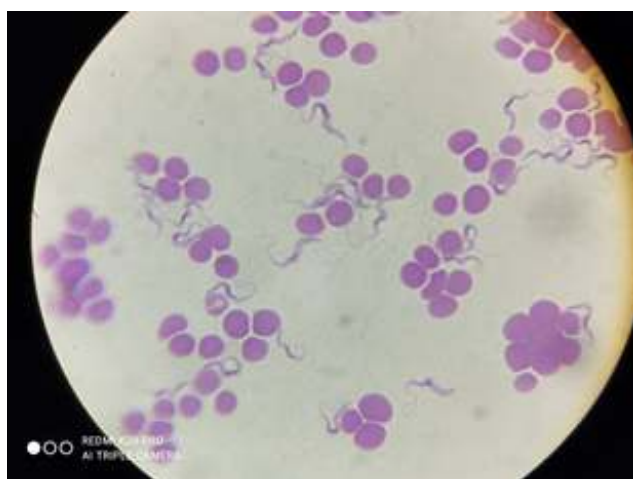


Figure 2 & 3: Giemsa Stain blood smear - *Trypanosoma sp.*, organism

TREATMENT

The dog was treated with Diminazine aceturate @ 3.5 mg/kg intramuscularly two doses on alternative days along with Inj. DNS @10ml per kg body weight intravenously, Inj. Oxytetracycline injection intravenously @ 10mg per kg body weight, Inj. Melonex® @0.5 mg per kg body weight intramuscularly, Inj. Neuroxin M® @ 1ml intramuscularly and oral hematinics (Syp. aRBCe® @5ml BID peros).

Temperature was normal (101.7°F) on second day and the dog was active and alert. Post therapy on third day dog was back to its normal appetite. Treatment was continued for five days. However, Inj. DNS was discontinued on fourth day of therapy. The dog recovered well on fifth day of therapy. The cloudiness of cornea cleared off on seventh day post

therapy and hemato-biochemical parameters were also back to near normal levels on seventh day. Further, blood smear was negative for *Trypanosoma sp.* both on wet blood smear and also Giemsa stain blood smear.

RESULTS AND DISCUSSION

Trypanosomiasis is an important and widely prevalent extracellular erythrocytic protozoan disease caused by *T. evansi* in Indian sub-continent which affects a wide variety of domestic, wild and zoo animals and transmitted by biting flies particularly Tse tse, Tabanus, Stomaxys, Culicoides etc (Greene, 2006). However, dogs can also get the infection by ingestion of fresh animal carcasses that died recently from trypanosomiasis and through oral experimental infection (Nwoha, 2013). Higher prevalence of *T. evansi* infection was observed in Mongrel than in

Pomeranian, Cross breeds, German Shepherd, Doberman and Labrador breeds in Andhra Pradesh (Prasad *et al*, 2015). The clinical signs in the present study is in accordance with Behera *et al* (2018) and Saurabh Kumar (2010), who also reported corneal opacity, high temperature and lymphnode enlargement. Moderate anemia, hypoglycemia, hypoalbuminemia, elevated creatinine levels and slightly elevated protein levels are also reported by Ramesh *et al*, (2016) and Eloy and Lucheis (2009), respectively. Microscopic examination of Giemsa stained blood smear and wet film examinations are the tools used for diagnostics purpose (Rjeibi *et al*, 2015). However, it was difficult to distinguish the species of *Trypanosoma*. So there is need of serological and molecular tests for the diagnosis of species of *Trypanosoma*. Anemia was a consistent finding as reported previously in different hosts infected with *T. evansi* due to hemolysis as a result of erythrophagocytosis, hemodilution and depression of erythropoiesis. In the present case mild neutrophilia was evident which is due to secondary bacterial infection. Hypoglycemia is due to utilization of blood glucose by parasites in circulation thereby lowering blood glucose levels. Hypoalbuminemia reported in this study are in agreement with findings of other workers on trypanosomiasis (Nwoha *et al*, 2013, Behera *et al*, 2018 and Ramesh *et al*, 2016). Increased serum protein levels with a reduced albumin/globulin ratio have been reported frequently in various infected hosts. Increased serum total protein in dogs is due to elevated globulin levels and a parallel drop in albumin concentration (Franciscato *et al*, 2007) and may also be attributed to high antigenic stimulation associated with trypanosomiasis (Aquino, 2002). Elevated creatinine levels in this study are in agreement with Kwem *et al* (2000) and Ramesh *et al*, (2016) who reported that elevated BUN and creatinine levels observed could be due to kidney dysfunction due to tissue damage caused by parasitemia. But, in the present study the BUN value was within the range. However, Nwoha *et al* (2013) reported initial increase and subsequent decrease in BUN values in their study on trypanosomiasis.

Most of the literature reported single use of Diminazine aceturate @3.5 mg per kg body weight intramuscularly. However, in the present report two doses of Diminazine aceturate is administered on alternative days. Inj. Oxytetracycline @10 mg per kg

body weight intravenously was given to treat secondary bacterial infection as in the present case mild neutrophilia was evident. Inj. DNS was administered to compensate dehydration and hypoglycemia and NSAIDs was given to control the temperature and any inflammation in the body. Hematinic was advised to tackle anemia in the present case. Vitamin supplement (Neuroxin- M) was administered to support the nutritional losses, neurological support and to aid in faster recovery. The dog recovered uneventfully with improvement in clinical signs in three days and in one week the hemato-biochemical parameters were back to normal in seven days and cornea was clear on seventh day. Himanshu *et al* (2020) and Saurabh (2017) also reported clinical recovery in one week in trypanosome positive dog.

CONCLUSION

Few diseases can be confused with clinical cases of trypanosomiasis in dogs and these include canine babesiosis, anaplasmosis and confined ophthalmic disorders. So Veterinarians should consider this disease in dogs presented with a history of anorexia, high fever, corneal opacity, anemia and hypoglycemia along with increased creatinine values. In the present study, clinical signs, microscopical confirmation and therapeutic management of *Trypanosoma* sp., has been reported so that it may be included as one of the differential diagnosis in canine medicine with the above said clinical signs.

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Use of Different Agro-Wastes as Substrate for Oyster Mushroom (*Pleurotus Florida*) Cultivation

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ABSTRACT

The study was conducted to compare the effects of different agro-wastes on the growth and yield of oyster mushrooms (*Pleurotus florida*). Thirteen substrate formulas including wheat straw, corncob, newspaper, sugarcane waste alone and in combination of 80:20 (wheat straw and corncob), 80: 20 (wheat straw and newspaper), 80: 20 (wheat straw and sugarcane waste), 100 (wheat straw), 100 (corn cob), 100 (newspaper), 100 (sugarcane waste), 25: 25: 25: 25 (wheat straw, corncob, newspaper and sugarcane waste), 40: 20: 20: 20 (wheat straw, corncob, newspaper and sugarcane waste), 50: 50 (wheat straw and corncob), 50: 50 (wheat straw and newspaper), 50: 50 (wheat straw and sugarcane waste), 50: 50 (corncob and sugarcane waste) were investigated. The results indicated that different substrate formulas gave a significant difference in total colonization period, characteristics of fruiting bodies, yield per bag, and total yield. All the treatments significantly increased days taken to spawn running, days taken to pinning, number of mushrooms per bag, yield per bag (kg), total yield (kg) and total dry weight (kg). The best treatment was found to be T₄ treatment (100 wheat straw).

Key Words: Growth, Mushroom, Oyster, Substrates, Yield.

INTRODUCTION

An oyster mushroom is botanically identified as *Pleurotus* spp. This mushroom belongs to class Basidiomycetes and family Agaricaceae. Traditionally it is known as 'dhingri mushroom' in our country. This mushroom grows naturally in the moderate or temperate, sub-tropical and tropical forests on decaying and dead wooden logs, sometimes on dying tree or plants trunks of deciduous or coniferous woods. It may also grow on weak, decaying and dead organic matter. The fruit bodies of oyster mushroom are particularly shell/ spatula shaped with dissimilar shades of cream, grey, light brown, pink, white and yellow depending upon the species. This is one of the most suitable fungus for producing protein rich food from various agro-wastes/ forest wastes/ different substrate without composting. *Pleurotus species* is the second extensively cultivated mushroom worldwide following the *Agaricus bisporus* (Sanchez, 2010; Kues and Liu, 2000). However, Obodai *et al* (2003) reported that oyster mushroom is the 3rd largest commercially grown mushrooms in the world. *Pleurotus* species are

popular and widely cultivated throughout the world mostly in Asia, America and Europe because of their simple, low cost production technology and high biological efficiency (Mane *et al*, 2007). Moreover, the interest on cultivation of oyster mushroom is increasing largely due to its taste, nutritional value, and medicinal properties. *Pleurotus* species can efficiently degrade agricultural wastes and they grow at a wide range of temperatures (Sanchez, 2010). In comparison to other edible mushrooms, *this* species needs a short growth time and their fruiting bodies are not often attacked by diseases and pests (Tesfaw *et al*, 2015 and Baysal *et al*, 2003).

Pleurotus species require materials containing cellulose, hemicellulose and lignin i.e., rice and wheat straw, cotton seed hulls, sawdust (SD), waste paper, leaves, and sugarcane residue can be used as mushroom substrates. However, the yield and the quality of oyster mushroom depends on the chemical and nutritional content of substrates (Badu *et al*, 2011 and Patil *et al*, 2010). *Pleurotus species* are rich source of protein, minerals (P, Ca, Fe, K, and Na) and vitamin (thiamine,

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riboflavin, folic acid, and niacin) Szabova *et al* (2013). Apart from food value, their medicinal value for diabetics and in cancer therapy has been emphasized (Sivrikaya *et al*, 2002). Several species of oyster mushrooms are very important as medicine. *Pleurotus cystidiosus* is a strong antioxidant (Li *et al*, 2007) while *Pleurotus ostreatus* also possesses antitumor activity.

MATERIALS AND METHODS

The experiment was conducted under lab. and indoor condition of Pithoragarh and Dehradun region. The experiment was laid out in completely randomized design with three replications. Each replication consisted of thirteen treatments. T₁ treatment 80:20 (WS & CC)

T₂ treatment 80: 20 (WS & NP)

T₃ treatment 80: 20 (WS & SW)

T₄ treatment 100 (WS)

T₅ treatment 100 (CC)

T₆ treatment 100 (NP)

T₇ treatment 100 (SW)

T₈ treatment 25:25:25:25 (WS, CC, NP & SW)

T₉ treatment 40:20:20:20 (WS, CC, NP & SW)

T₁₀ treatment 50: 50 (WS & CC)

T₁₁ treatment 50: 50 (WS & NP)

T₁₂ treatment 50: 50 (WS & SW)

T₁₃ treatment 50: 50 (CC & SW)

* WS = Wheat Straw, CC = Corn Cob,

NP = News Paper, SW = Sugarcane Waste

RESULTS AND DISCUSSION

The growth of *P. florida* mycelia was relatively faster on wheat straw

Days taken to spawn running

The data (Table 1) showed that the days taken for spawn running have a significant effect on mushroom cultivation. Compared to other substrates, the T₄ treatment using 100 percent wheat straw took least number of days 18 to complete the spawn run, followed by the T₁ treatment (a mixture of 80 % wheat straw and 20 % corncob). T₆ treatment (100 % newspaper) took 25.00 days to complete the spawn run compared to other substrates. The number of days to complete the spawn run ranged from 18 to 25 days and the average number of days was 20.74.

Days taken to pinning

The data revealed that there was a significant difference in the time taken from spawning to first pinhead formation among the different substrates. The T₄ treatment with 100 per cent wheat straw took the least number of days 24.67 to become pinhead formation followed by the T₁ treatment with a mixture of 80 percent wheat straw and 20 percent corncob, taking 25.33 days. T₆ treatment (100 % of the newspaper) had the longest number of days 32.33 from spawning to pinhead formation. The time from spawning to pinhead formation ranged from 24.67 to 32.33 days. The average day from spawning to pinhead was 28.36.

Number of pinheads per bag

The total number of pinheads of oyster mushrooms from the different substrate treatments differed significantly. T₄ treatment 100 per cent wheat straw was recorded the highest 47.33 number of pins followed by T₁₀ treatment 50 per cent wheat straw and 50 per cent corn cob 46.0 days recorded. The minimum number of pinheads per bag recorded was 42.0 in T₆ treatment using 100 per cent newspaper. The number of pinheads was recorded from 42.00 to 47.33.

Days taken to the first fresh mushroom harvesting

The first harvest from each of the substrate investigated was statistically significant. T₄ treatment (100 % wheat straw) took about 30.67 days to harvest the first fresh mushroom crop, followed by 31.67 days for the T₁₀ treatment (50 % wheat straw and 50 % corncob). The T₆ treatment using 100 percent newspaper took late harvesting 38.00 days for the first harvest and the number of days to reach the first harvest ranged from 30.67 to 38.00 days.

Yield per bag (kg)

The fresh mushroom yield per bag by the different substrate treatments was significantly different and is shown in table and figure 2. The T₄ treatment which used 100 percent of wheat straw had the highest yield of 2.900 kg followed by the T₁ treatment which used a mixture of 80 per cent wheat straw and 20 per cent corncob was recorded a yield of 2.850 kg. Compared to other substrates the 100 per cent newspapers used in the T₆ treatment had the minimum yield of 2.033 kg. The average mushroom yield per bag was 2.519 kg and yield of oyster mushroom ranged from 2.033 to 2.900 kg per bag was recorded.

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Total yield/ fresh weight (kg)

The total fresh mushroom yield (fresh weight) by the different substrate treatments was significant different. The T₄ treatment used 100 per cent wheat straw yielded the highest of 8.700 kg followed by T₁ treatment containing 80 per cent wheat straw and 20 percent corncob mixture yielding 8.550 kg. The yield of T₆ treatment in which 100 per cent newspaper was used was found to be minimum (6.100 kg) as compared to other substrates. The average mushroom yield was 7.557 kg and yield of oyster mushroom ranged from 6.100 to 8.700 kg was recorded.

Total dry weight (kg)

The total dry mushroom yield (dry weight) by the different substrate treatments was significant different. The highest dry weight of oyster mushroom was recorded at 1.194 kg in T₄ treatment using 100 per cent wheat straw, followed by T₅ treatment using 100 per cent corncob which recorded 0.944 kg dry weight of oyster mushroom. The T₂ treatment containing 80 percent wheat straw and 20 per cent newspaper mixture recorded the lowest dry weight of oyster mushrooms at 0.694 kg compared to other substrates. The average dry weight was 0.908 kg and dry weight ranged from 0.694 to 1.194 kg.

Table 1. The effects of different substrates on the days taken to spawn running, days taken to pinning, number of pinheads per bag and days taken to the first harvesting of oyster mushrooms (*Pleurotus florida*) in Uttarakhand.

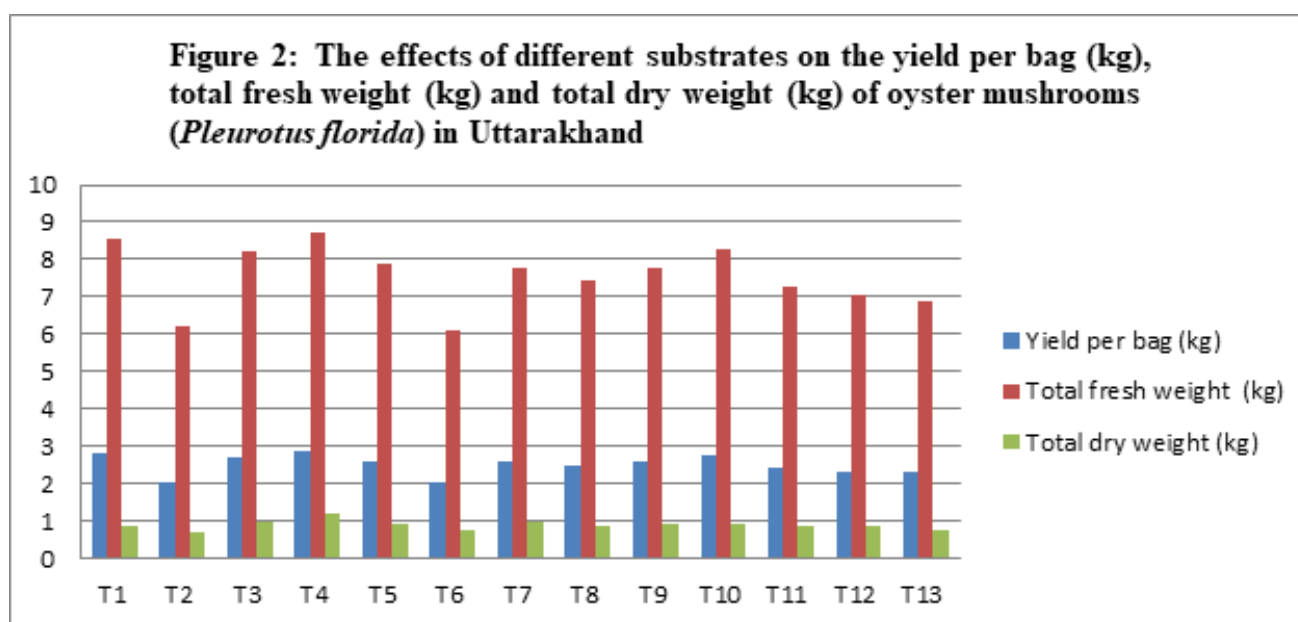
Sr. No	Treatment	DTSR	DTP	NP	DTFH
1	T ₁ treatment 80:20 (wheat straw & corncob)	18.33	25.33	43.00	33.00
2	T ₂ treatment 80: 20 (wheat straw & newspaper)	23.33	30.00	42.33	36.33
3	T ₃ treatment 80: 20 (wheat straw & sugarcane waste)	19.00	26.33	43.33	32.33
4	T ₄ treatment 100 (wheat straw)	18.00	24.67	47.33	30.67
5	T ₅ treatment 100 (corncob)	18.67	27.00	42.67	33.33
6	T ₆ treatment 100 (newspaper)	25.00	32.33	42.00	38.00
7	T ₇ treatment 100 (sugarcane waste)	20.00	28.67	43.33	35.33
8	T ₈ treatment 25: 25: 25: 25 (wheat straw, corncob, newspaper & sugarcane waste)	21.67	30.00	42.33	36.00
9	T ₉ treatment 40: 20: 20: 20 (wheat straw, corncob, newspaper & sugarcane waste)	21.33	28.67	41.67	34.67
10	T ₁₀ treatment 50: 50 (wheat straw & corncob)	19.33	26.67	46.00	31.67
11	T ₁₁ treatment 50: 50 (wheat straw & newspaper)	22.67	31.67	43.00	37.67
12	T ₁₂ treatment 50: 50 (wheat straw & sugarcane waste)	21.00	28.00	44.67	34.33
13	T ₁₃ treatment 50: 50 (corncob & sugarcane waste)	21.33	29.33	44.33	35.67
S.E.M.		0.71	0.95	1.58	1.33
CD at 5%		2.06	2.75	4.58	3.88
CV		5.92	5.79	6.27	6.69

* DTSR= Days taken to spawn running, DTP= Days taken to pinning, NP= No. of pinheads per bag, DTFH= Days taken to the first harvesting

Table 2. The effects of different substrates on the yield per bag (kg), total fresh weight (kg) and total dry weight (kg) of oyster mushrooms (*Pleurotus florida*) in Uttarakhand.

Sr. No.	Treatment	Y	TFW	TDW
1	T ₁ treatment 80:20 (wheat straw and corncob)	2.850	8.550	0.885
2	T ₂ treatment 80: 20 (wheat straw and news paper)	2.067	6.200	0.694
3	T ₃ treatme nt 80: 20 (wheat straw and sugarcane waste)	2.733	8.200	1.013
4	T ₄ treatment 100 (wheat straw)	2.900	8.700	1.194
5	T ₅ treatment 100 (corncob)	2.633	7.900	0.944
6	T ₆ treatment 100 (news paper)	2.033	6.100	0.763
7	T ₇ treatment 100 (sugarcane waste)	2.600	7.800	0.990
8	T ₈ treatment 25: 25: 25: 25 (wheat straw, corncob, news paper and sugarcane waste)	2.483	7.450	0.868
9	T ₉ treatment 40: 20: 20: 20 (wheat straw, corncob, news paper and sugarcane waste)	2.600	7.800	0.940
10	T ₁₀ treatment 50: 50 (wheat straw and corncob)	2.767	8.300	0.942
11	T ₁₁ treatment 50: 50 (wheat straw and news paper)	2.433	7.300	0.901
12	T ₁₂ treatment 50: 50 (wheat straw and sugarcane waste)	2.350	7.050	0.895
13	T ₁₃ treatment 50: 50 (corncob and sugarcane waste)	2.300	6.900	0.780
S.E.M.		0.14	0.42	0.079
CD at 5%		0.41	1.22	0.230
CV		9.60	9.60	15.106

* Y= Yield per bag (kg), TFW= Total fresh weight (kg), TDW= Total dry weight (kg)



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COCLUSION

The findings of this study will have a direct impact on those farmers, who due to lack of knowledge, are unable to use these crop waste materials or burn it in the field.

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Utilization of Time Saving Cleaning and Clothing Care Devices by Working and Non-Working Women

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ABSTRACT

This study investigated the adoption and utilization of time-saving cleaning and clothing care devices among both working and non-working women, shedding light on how such technologies impact their daily routines. The data were collected through a survey of 160 women representing diverse socioeconomic backgrounds in Ludhiana city of Punjab. The research examined the adoption rates and preferences for modern cleaning and clothing care appliances including vacuum cleaners, dishwashers, washing machines, and garment steamers while considering the demographic and occupational factors influencing their usage. The study employed a mixed-methods approach, combining surveys and interviews to collect data. Findings revealed that working women tend to embrace these devices more readily, attributing them to enhanced productivity and work-life balance. In contrast, non-working women exhibited a more diverse range of responses, influenced by factors such as financial constraints and traditional gender roles. The paper highlighted the significance of technological innovations in easing the domestic burden and underscored the importance of considering socio-economic and cultural factors in promoting equitable access to time-saving technologies.

Key Words: Cleaning, Clothing care, Gender, Time saving, Technology, Devices, Adoption, Working, Non-Working.

INTRODUCTION

The dynamics of household management have undergone a profound transformation in recent years, largely propelled by advancements in technology and evolving societal roles. Ludhiana, a thriving industrial city in the heart of India's Punjab region, is no exception to this shift. This study examines the utilization of time-saving cleaning and clothing care devices by women, both in the workforce and those managing households full-time. The women play pivotal roles in maintaining households, balancing work, and sustaining their families' well-being. However, the ever-increasing demands of modern life have placed a premium on time and efficiency, prompting a reevaluation of traditional household chores. Previous studies have explored the relationship between household technology and time management, emphasizing the potential of these devices to alleviate the burden of domestic responsibilities. Since Becker's 1965 publication, time allocation in the home has been extensively studied. Possession of time-saving appliances has been included into Becker's model in recent literature. This concept is used by Greenwood *et al* (2005) to explain the rise in women labor force participation (LFP). They asserted that devices notably

washing machines, microwave and refrigerators "liberated" women from domestic duties and the amount of time spent on household labour was reduced with the invention of household appliances which gave them more time to devote to their occupations (Greenwood, 2019). Data from China (Tewari and Wang, 2021) and the United States (Coen-Pirani *et al*, 2010) have been utilized to assess their model, and both studies indicate that women with time-saving devices have higher LFP. The study explores the extent to which Ludhiana's women are embracing and integrating time-saving cleaning and clothing care devices into their daily routines, thereby seeking to enhance productivity, save precious time, and potentially redefine gender roles within households.

An effort was made to uncover patterns, preferences, and disparities between working women, who must navigate the demands of both their careers and homes, and non-working women, who dedicate themselves entirely to domestic responsibilities. Therefore, this study contributes to a deeper understanding of Ludhiana's socio-cultural fabric and provides valuable insights into the ongoing transformation of domestic life in this vibrant urban center.

MATERIALS AND METHODS

The research was carried out in Ludhiana, located in the Punjab region of India. A total of 160 participants, consisting of 80 working women and 80 non-working women, were chosen randomly from two different neighborhoods within each of the city's four zones: Zone A included Gandhi Nagar and Mata Rani Chowk; Zone B encompassed Partap colony and Bhagat Singh colony; Zone C comprised Janta Nagar and Pritam Nagar; and Zone D covered Sarabha Nagar and Model Town Extension. The data were collected using a self-structured interview schedule. The collected data were subsequently analyzed and interpreted through the utilization of simple frequency distributions, percentages, mean scores and statistical tests such as the z-test and t-test.

RESULTS AND DISCUSSION

Socio-economic profile

A significant proportion of working women (37.50%) fell into the age group of 31-40 yrs., followed closely by the 41-50yr. age group (32.50%). Conversely, non-working women were evenly distributed between the 31-40 yrs. and 41-50 yrs. age groups, each accounting for 36.25%, with a smaller percentage in the 25-30 age group (15.00%). Regarding education, a substantial number of both working women (45.00%) and non-working women (38.75%) held a graduate degree. However, only a small proportion (2.50%) of non-working women had post-graduate qualifications, while 36.25 per cent of working women had completed their post-graduation. All working women had at least a higher secondary education (Table 1).

Marital status showed that the majority of both working (82.50%) and non-working women (86.25%) were married. A smaller percentage was unmarried, with 13.75 per cent of working women and 12.50 per cent of non-working women falling into this category. A very small number of working women (3.75%) and non-working women (1.25%) were widow. In regards to occupation, the largest group of working women (42.50%) were government employees, followed by private employees (32.50%), and self-employed individuals (25.00%). More than half of working women (56.25%) lived in nuclear families, while 27.50 per cent and 16.25 per cent were part of joint and extended families, respectively. Among non-working women, 55.00% lived in nuclear families, while 22.50 per cent each belonged to joint and extended families.

Around 42.50 per cent of both working and non-working women were in medium-sized families (5-7 members). Approximately 30 per cent of working women belonged to large families, while 27.50 per

cent were from small families. In contrast, 31.25 per cent of non-working women belonged to small families, and 27.50 per cent were in large families. The majority of working women (42.50%) had a monthly family income between ₹1,00,001 to ₹2,00,000, whereas most non-working women (60.00%) had a monthly family income of ₹1,00,000 or less. Only a small percentage of both working (7.50%) and non-working women (2.50%) had a family income of ₹3,00,000 or higher (Table 1).

Possession and extent of use of time saving cleaning devices

The data (Table 2) showed that 27.50 percent of working women and a less number of non-working women (12.50 %) possessed a dishwasher which both groups utilized most of the time on a daily basis. There was a significant difference between the possession and extent of use of dishwasher between working and non-working women. These findings were in conformity with Kundoo and Kundu (2016). Geetha and Tyagi (2016) found that the usage of dishwashers was low among Indian households due to factors such as lack of awareness, high cost, and cultural preferences for hand washing of dishes. Likewise, it was observed that the possession of a dishwasher was relatively low as compared to other time saving devices

Nearly 41 per cent of the working women possessed a vacuum cleaner, while 25 percent of non-working women possessed a vacuum cleaner. Working and non- working women utilized this device most of the time. It can be discerned that there was a significant difference between the possession and extent of use of vacuum cleaner between working and non-working women. Vijaya and Milcah (2019) found that a small percentage of Indian consumers used vacuum cleaners for cleaning and did not prefer vacuum cleaning. The possession and extent of use of vacuum cleaners by working women and non-working women can vary widely and are influenced by a range of factors. Further research is needed to fully understand these differences and their implications for product design and marketing.

All of the respondents possessed a standing floor mop and utilized it most of the time in their daily cleaning activities, while an insignificant amount of both working and non-working women possessed a robotic floor cleaner at 3.75 per cent and 2.50 per cent, respectively which they utilized most of the time. A few number of respondents also possessed an electric spinning scrubber but those who had this utilized it very frequently. These findings were in accordance with Nicholls and Strengers (2019) who found that although consumers were generally interested in the convenience and efficiency of these products (robotic

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floor cleaner and electric spinning scrubber), cost and lack of awareness was a significant barrier to adoption (Table 2).

Possession and extent of use of time saving clothing care devices

The data (Table 3) represent the possession and extent of use of clothing care devices by working and non-working women. It can be clearly seen that majority of working women (90.00 %) possessed a washing machine and used it most of the time. Simultaneously, a significant proportion of non-working women (85.00 %) also possessed a washing machine which they utilized it most of the time as well.

Majority of working women (91.25 %) possessed a dry/steam flat iron but only over a third of them utilized it frequently (35.62 %) and rest of them used it only sometimes (64.38 %). Almost all non-working women (97.5 %) possessed a dry/steam flat iron where over three-quarters (76.92 %) utilized it most of the time and 23.08 percent used it sometimes.

Less than a quarter of working women (23.75 %) possessed a vertical steam iron which they utilized it most of the time. Whereas, a small minority of non-working women (11.25 %) possessed a vertical steam iron which they utilized it most of the time as well. It was discerned that there was a significant difference between the possession and extent of use of vertical steam iron between working and non-working women (Table 3). Dilkes and Sosenko (2023) noted that the use of steam irons was preferred over traditional clothing irons as they were faster and easier to use.

Possession and extent of use of other time saving miscellaneous devices

Almost three-quarters of working women (73.75 %) possessed water geyser and most of non-working women (70.00 %) possessed water geyser which both groups utilized most of the time (Table 4). One third of working women (33.75 %) possessed an electric drill where most of the respondents (92.59 %) used it only sometimes and 7.40 percent utilized it frequently. Non-working women (27.50 %) possessed electric drill but most of the respondents utilized it occasionally (81.81 %) while less than a fifth (17.07 %) used it most of the time. The calculated 'z' value showed no significant difference between the possessions but the calculated 't' value revealed a significant difference in the extent of use of electrical drill. According to Ehrnberger *et al* (2012), the use of electric drills was increasing due to the growing interest in DIY (Do-It-Yourself) home repairs and improvements. They also found that most of the respondents have used an electric drill at least once, with the majority using it for home repairs.

More than two-fifths of working women (46.25 %) possessed sewing machine where half of the respondents (51.35 %) utilized it only sometimes, over a quarter (27.03 %) never used it and just over a fifth (21.62 %) of the respondents utilized it most of the time. There was no significant difference between the possession and the extent of use of sewing machine between the working and non-working women. Meena and Chawla (2019) in India also found that housewives were more likely to own sewing machines than working women. However, it was noted that the extent of use of the machines was similar for both groups, suggesting that working women may be more efficient in their use of time when it comes to sewing. On the whole, there may be differences in the possession and extent of use of sewing machines between working women and non-working women, but the specific patterns may vary depending on the cultural and economic context.

The entirety of the respondents possessed water purifier at their respective households and utilized it most of the time as well. Majority of working women (88.75 %) possessed electric kettle/boiler and 60.56 per cent of these respondents utilized it most of the time, less than one-fourth (22.53 %) utilized it sometimes and more than a fifth of the respondents (16.90 %) never used the water kettle/boiler they possessed. More than two-thirds of working women (67.50 %) possessed smart speaker and most of them used it frequently while slightly more than a third (35.18 %) never used it. Just over half of non-working women (51.25 %) possessed smart speaker where majority of them used this device most of the time and less than a fifth (17.07 %) used smart speaker only sometimes. The calculated 'z' value showed a significant difference between the possessions but the calculated 't' value revealed no significant difference in the extent of use of smart speaker (Table 4). These findings are in accordance with a study by Pandey and Paul (2021). This study explored the adoption of smart speakers in Indian households and finds that smart speaker usage is more prevalent among working professionals than non-working women. Garg *et al* (2021) found that working professionals use smart speakers more frequently and for a wider range of activities than non-working respondents.

CONCLUSION

This study provided valuable insights into the possession and extent of use of time-saving cleaning, clothing care, and miscellaneous devices among working and non-working women. Notably, the study revealed a significant difference in the possession and use of cleaning devices such as dishwashers and

Table 1. Distribution of respondents according to their socio-economic profile. (n=160)

Socio-economic characteristic	Category	Working women (n _w =80)	Non-working women (n _{nw} =80)
Age (yr)	25-30	14(17.50)	12(15.00)
	31-40	30(37.50)	29(36.25)
	41-50	26(32.50)	29 (36.25)
	51-60	10(12.50)	10(12.50)
Education	Middle school (VI -IX)	-	4(5.00)
	High school	-	20(25.00)
	Higher secondary	15(18.75)	23(28.75)
	Graduate	36(45.00)	31(38.75)
	Postgraduate	29(36.25)	2(2.50)
Marital status	Married	66(82.50)	69(86.25)
	Unmarried	11(13.75)	10(12.50)
	Widow	3(3.75)	1(1.25)
Occupation	Govt. employee	34(42.50)	-
	Private-employee	26(32.50)	-
	Self-employed	20(25.00)	-
Family type	Nuclear	45(56.25)	44(55.00)
	Joint	22(27.5)	18(22.50)
	Extended	13(16.25)	18(22.50)
Family size	Small (1-4)	22(27.50)	25(31.25)
	Medium (5-7)	34(42.50)	33(41.25)
	Large (>7)	24(30.00)	22(27.50)
Family income (₹ (monthly)	1,00,000 and below	24(30.00)	48(60.00)
	1,00,001-2,00,000	34(42.50)	22(27.50)
	2,00,001-3,00,000	16(20.00)	8(10.00)
	3,00,001 and above	6(7.50)	2(2.50)

Table 2. Possession and extent of use of cleaning devices by working and non-working women. (n=160)

Cleaning Devices	Working women (n _w =80)					Non-working women (n _{nw} =80)					z test	t test
	Possessed	Extent of use				Possessed	Extent of use					
		Most of the time	Sometimes	Never	Mean Score		Most of the time	Sometimes	Never	Mean Score	Possessed	Extent of Use
Dishwasher	22 (27.50)	22 (100.0)	-	-	3.00	10 (12.50)	10 (100.0)	-	-	3.00	2.37**	0.23**
Vacuum Cleaner	33 (41.25)	33 (100.0)	-	-	3.00	20 (25.00)	20 (100.0)	-	-	3.00	2.18**	0.63**
Standing Floor Mop	80 (100.0)	80 (100.0)	-	-	3.00	78 (97.50)	78 (100.0)	-	-	3.00	1.42	1.42
Robotic Floor Cleaner	3 (3.75)	3 (100.0)	-	-	3.00	2 (2.50)	2 (100.0)	-	-	3.00	0.45	0.45
Electric Spinning Scrubber	4 (5.00)	4 (100.0)	-	-	3.00	2 (2.50)	2 (100.0)	-	-	3.00	0.83	0.83

(Figures in parentheses indicate percentages)

** Significant at 5% level

Mean score range (1-3)

Table 3. Possession and extent of use of clothing care devices by working and non-working women. (n=160)

Clothing Care Devices	Working women (n _w =80)					Non-working women (n _{n0/00} =80)					z test	t test
	Possessed	Extent of use				Possessed	Extent of use					
		Most of the time	Sometimes	Never	Mean Score		Most of the time	Sometimes	Never	Mean Score	Possessed	Extent of Use
Washing Machine	72 (90.00)	72 (100.0)	-	-	3.00	68 (85.00)	68 (100.0)	-	-	3.00	0.95	0.95
Dry/Steam Flat Iron	73 (91.25)	26 (35.62)	47 (64.38)	-	2.36	78 (97.5)	60 (76.92)	18 (23.08)	-	2.77	1.42	0.20
Vertical Steam Iron	19 (23.75)	19 (100.0)	-	-	3.00	9 (11.25)	9 (100.0)	-	-	3.00	2.08**	0.65**

(Figures in parentheses indicates percentages)

** Significant at 5% level

Mean score range (1-3)

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Table 4. Possession and extent of use of other miscellaneous devices by working and non-working women. (n=160)

Other misc. devices	Working women (n _w =80)					Non-working women (n _{nw} =80)					z test	t test
	Possessed	Extent of use				Possessed	Extent of use					
		Most of the time	Sometimes	Never	Mean Score		Most of the time	Sometimes	Never	Mean Score	Possessed	Extent of Use
Water Geyser	59 (73.75)	59 (100.0)	-	-	3.00	56 (70.00)	56 (100.0)	-	-	3.00	0.53	0.77
Electric Drill	27 (33.75)	2 (7.40)	25 (92.59)	-	2.07	22 (27.50)	4 (18.18)	18 (81.81)	-	2.18	0.86	2.01**
Sewing Machine	37 (46.25)	8 (21.62)	19 (51.35)	10 (27.03)	1.95	48 (60.00)	26 (54.17)	17 (35.42)	5 (10.47)	2.44	1.74**	0.18**
Water Purifier	80 (100.0)	80 (100.0)	-	-	3.00	80 (100.0)	80 (100.0)	-	-	3.00	-	-
Electric Kettle/ Boiler	71 (88.75)	43 (60.56)	16 (22.53)	12 (16.90)	2.44	66 (82.50)	31 (46.97)	18 (27.27)	17 (25.76)	2.21	1.13	1.29
Smart Speaker	54 (67.50)	35 (64.81)	19 (35.18)	-	2.65	41 (51.25)	34 (82.93)	7 (17.07)	-	2.83	2.09**	1.31

(Figures in parentheses indicate percentages)

** Significant at 5% level

Mean score range (1-3)

vacuum cleaners, emphasizing the impact of women's employment status on the adoption of household technologies. The findings underscore the need for increased awareness about the benefits of certain devices, as evidenced by the low possession rates of dishwashers and robotic floor cleaners.

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Vermicompost Technology: An Alternative Solution for the Sustainable Agriculture in the Cold Arid Region of Ladakh

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ABSTRACT

The present study was conducted at PFDC High Mountain Arid Agriculture Research Institute Stakna Leh. The purpose of this study was to use advance vermicomposting technique of plain because of harsh climatic conditions of Ladakh as its temperature varies from -30°C to +35 °C and thus the organic compost is not properly decomposed. This advance vermicomposting technology of plain area was replicated to hilly areas, by applying different methodology procedure. This technique reduced mortality of worms by 80% under winter conditions and able to increase decomposing rate from 40% to 90% which resulted in reducing its time from 12month to 4 month for vermicompost. Further, the composition of macro and micro nutrients (0.50–1.61 %) N, (0.19-1.02%) P and (0.15-0.70%K) in plain area, and (1.79-2.63%) N, (0.17-1.03)P, (0.09-0.162)K in cold arid region also varied. Improved technique improved socioeconomic status of farmers and became an alternative solution for sustainable agriculture income generation.

Key Words: Environment factor, Low fertility, Organic Compost, Socio- Economic.

INTRODUCTION

Vermicomposting is a waste management technology utilizing earthworms to convert organic wastes into high quality castings and vermicomposts of high economic values while vermiculture is the art and science of worm rearing. Vermicompost is an organic fertilizer obtained from the earthworms by passing out the organic wastes through the digestive systems. Earthworm improves and restores soil fertility and boost up crop productivity by the use of their excretory products known as vermicast. It is popularly known as Black gold because of rich in nutrients, growth promoting substances, beneficial soil micro flora, having properties of inhibiting pathogenic microbes and synergistic relationship in plant rhizospheres. Being stable, multifunctional organic manure which enriches the soil quality by improving physio-chemical and biological properties needs to be promoted (Datta *et al*, 2016). Vermicompost is becoming popular day by day as it provides quality products through major component of organic farming system (Yadav *et al*, 2013). Mixture of leguminous and non-leguminous crop residues enriches the quality of Vermicompost. Its moisture content remains in between 45- 65% which is ideal for land applied compost and pH values near

neutral due to the production of CO₂ and organic acids. Vermicompost is a safe, non-polluting and one of the most economical and convenient way of solving the waste disposal problems and recycling of organic waste. It is an excellent form of natural manure which is cost effective, easy to make, handling and contain high nutrients with growth hormones and are 4-5 times powerful growth promoter than all other organic fertilizers and over 30- 40% higher than the chemical fertilizer (Narkhede *et al*, 2011, Attarde *et al*, 2012). Various workers reported that Vermicompost contain 17-36 % Humic acid and 13-30% Fulvic acid of total concentration of organic matter. The purpose of this study was due to harsh climatic condition of Ladakh and its temperature variation from -30°C to +35 °C the organic compost is not properly decompose. Farmers having small land holding with low fertility and short season. Vermicompost technology is biggest challenges to adopt in this region due to climatic condition, religious issues, and mortality of worms, lack of knowledge regarding this technology. Therefore, an attempt was made to study and replicate an advance vermicompost technology of plain area to introduce in hilly area Ladakh condition.

MATERIALS AND METHODS

The present study was conducted in HMAARI SKUAST-K Leh in 2018-20 in district of Leh state Union Territory Ladakh during 2018-20 in Precision Farming Development Centre. The present study was carried on factor affecting the time period of vermicompost procedure. Comparative study of different macro and micronutrient of plain Vermicompost, hilly vermicompost, compost and its variation were analysed in Soil Laboratory Wadura and also decomposing rate and worms mortality rate were studied during this period.

Material Used For Vermicomposting during Study

Any types of biodegradable wastes such as crop residues, weed biomass, vegetable waste, leaf litter, saw dust, green leaves, alfa alfa, agriculture residues were used for the preparation of vermin compost.



Bedding

It is one of the most important parameters in vermicomposting. Any material used should be relatively stable habitat for the worms. Some of the commonly used bedding materials are hay, straw, sawdust, shrubs, leaves, of plants and vegetables, alfa alfa without seed chopped into small pieces gives impetus for production of good quality vermicompost. Bedding materials should have high moisture absorbance as the worms breathe through their skins and therefore must have a moist environment in which to live. Although the worms do consume their bedding as it breaks down, it is very important that this can be a slow process. High protein/nitrogen levels in bedding material can result in rapid degradation and its

associated heating, creating inhospitable, often fatal, conditions. Vermiculture bed or worm bed (3 cm) can be prepared by placing saw dust or husk or in the bottom of vermi bag. A layer of fine sand (3 cm) should be spread over the culture bed followed by a layer of garden soil (3 cm). All layers must be moistened thoroughly with water. This will give impetus for production of good quality vermicompost and allows usage of all kinds of biomass such as straw, leaves, stalks, weed without seed biomass etc in ratio of C: N 30:1. In bedding we not use acidic food, sweets, sour material it's strictly prohibited to reduce mortality. Keep precaution of aunt, lizard, birds, rabbit, rate, etc

Location for Vermicompost Unit

Proper site selection for vermicompost unit is very necessary. Normally in plain area designing of vermicompost unit, mostly recommended shady, high humidity and cool surrounding area. But in places like Ladakh where temperature goes +30 to -30 °C to maintain temperature of vermicompost unit is very challenging. So for places like Ladakh we recommended maximum solar receiving direction mostly south facing direction. Minimum wind hindrance. Nearby cowshed, easily watering assessable points and road side for easy in transportation and storing.

Moisture

Putting all bedding material in vermicompost bags of 4"X 4"X2" and applied 100% moisturized. In initial most of water come out and can't soak properly. Within two three days once it applied the water. Its 100% soaked and the wet heaped should be covered with moist gunny bags, then plastic black mulching to more trap heat. In night covered with blankets. Keep it for Pre digestion/ partial decomposition of organic waste for 30 days for Ladakh but 15 to 20 days in (plain area). This process partially digests the material and fit for earthworm consumption. Cattle dung and biogas slurry may be used after drying. Fresh Wet dung should not be used directly for vermicompost production as it released toxic gas liberation which increases the chances of worm's mortality. In this study we used vermicompost bags instead of cemented tanks keeping the temperature variation in mind. In summer we keep this bag in open space but in winter we can shift these bags in green house to maintain the temperature and reduce mortality of worms. Sizes of

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Vermicompost bag should not be too large or too small so we preferred 4'X4'x2' to maintain the heat and also easy to handle. Volume of bags is 1.099 m³ and each Capacity of bag is 5 quintals of raw material.



Completely moist the raw material and covered with black plastic and transparent plastic bags for at least 30 days so it becomes partially decompose manure. In plan area its needed 7-10 days.



Worms Application

Put earthworms in each bed @30 worms/sq.ft. or 1.5 kg of worms (2000 nos.) required for each vermi bags and check the proper moisture content by squeezing method at least 50-60% is must. Covered the vermi bag with wet gunny bags and to maintain temperature use black or transparent plastic sheet over it. The optimum temperature for worms is + 25°C to +32°C in which worm's production is more and rapid decompose rate. So to achieve this temperature we use blanket in day and night according to temperature in summer and in winter we switch this vermi bags to green house and covered with heavy blankets. Places like mountains especially Ladakh were temperature goes to +35 to -35 degree Celsius. *Eisenia foetida* proved as the best species for the cold arid region. Number of cocoons and hatchling period varies for each species and depend upon the environmental conditions. The life span of the earthworm in the wild is not certain, but researchers estimate a normal lifespan of about 3 years. The earthworm population is self controlled and limited by available food, space, and environmental conditions. Keeping under consideration the rate of average reproduction in Ladakh varies from 4 to 6 worms per cocoon. Beside tolerant harsh climate it also highlighted for more decomposition rate with high reproduction.



Aeration

Frequently monitoring of temperature, moisture content through squeeze method, proper mixing for aeration and sprinkler of water is very essential for proper decompose of vermicomposting after every 15-20 days interval.

Last Appearance

The physical appearance of complete vermicompost manure turn its colour brown(raw material) into black colour fine granular particles with odour less. Silky smooth fine particles were achieved then only we can say its "BLACK GOLD" or vermicompost. Mostly it takes 3 to 3.5 month for proper vermicompost production in summer and in winter its take 5- 6 month. The pH of vermicompost at initial stage was 5.9 to 6.5 and 7.1- 7.6 at final stage we observed.

Before



After



Generally in places like plain areas the harvesting time are 45 to 65 days but places like Ladakh due to harsh climatic condition the harvesting time increases and reached up to 180 to 210 days. The harvesting of vermicompost done manually through 2mm sieve size. Before sieving stop watering for few days. Make a heap of dry part and allowed to stand for a

few hours. Most of the worms move to the bottom of the mound to avoid light and for moisture. Used 2mm sieve and pick the dry part of heap on sieve and last fine product will receive in form of vermicompost or in form of black gold and store in dark or shaded place to maintain the moisture in vermicompost up to 20%.

Harvesting vermicomposting



RESULTS AND DISCUSSION

Vermicompost worms consume various organic wastes and reduce the volume by 40–60%. Each earthworm weighs about 0.5 to 0.6 g, eats waste equivalent to its body weight and produces cast equivalent to about 50% of the waste it consumes in a day. These worm castings were analyzed for macro and micro nutrient analysis given in table 2. It took 3 to 3.5 month in summer and 4-6 month in winter under

Ladakh condition. The moisture content of castings ranged between 32 and 60% and the pH of the castings is around 7 to 7.5 and the castings were odour less at final stage. The worm castings contain higher percentage of both macro and micronutrients than the compost. Even it differs area wise from plain to hilly area (Table 2). Similarly, the rate of decompose of vermicompost and indigenous compost are shown in graphically in Fig 1.

Vermicompost Technology: An Alternative Solution for the Sustainable Agriculture

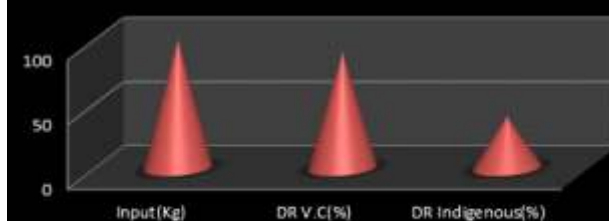
Table 2. Comparative Nutrient composition study of Vermicompost of plain and hilly area and Compost.

Nutrient	Vermicompost Plain (%)	Compost (%)	Vermicompost Ladakh (%)
Nitrogen	0.50–1.61	0.8	1.79-2.63
Phosphorus	0.19-1.02	0.38	0.17-1.03
Potassium	0.15-0.72	0.49	0.09-0.16
Calcium	1.19-7.6	2.26	1.14-5.98
Magnesium	0.093-0.568	0.55	0.00355-0.0662
Sodium	0.059–0.159	< 0.01	0.059–0.159
Zinc	0.0042–0.110	0.0011	0.00743–0.018
Copper	0.0026–0.0047	0.0017	0.00317–0.0079
Iron	0.2050–1.3312	1.1690	0.1575–1.3312
Manganese	0.0105–0.2037	0.0414	0.00355–0.06622

CONCLUSION

Vermicompost technology played a significant role for entire region, as its macro and micronutrients content varied from plain area to Hilly area. Vermicompost saved time of farmers by increasing decomposing rate by 90% in 4 month as compared to traditional method 40% in 12 month. Similarly, mortality rate of worms also reduce up to 80% especially in winter condition. The rate of average reproduction in Ladakh varied from 4 to 6 worms per cocoon. The time of vermicompost production can be reduce if you have high quality green house where temperature remain optimum +25 °C to 32°C in summer you can get in 2.5 to 3 month as well. It was observed that after winter Feb –March, the reproduction of worms starts increasing but in winter its stop doing reproduction due to harsh temperature and hard to survival. Besides, vermicompost technology disseminated in entire Ladakh remotest region which not only uplifted the sustainable agriculture of soil and water health but also improved socio economic status of farmers and rural youth by income generation in the cold arid region.

Fig. 1. Comparative study of Indigenous manure and Vermicompost Decomposting rate



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Well-being and Stress Levels among Women Experiencing Infertility in district Hisar of Haryana state

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ABSTRACT

Infertility is a serious psycho-social issue that affects a couple's mental, physical and social well-being and marital stability. Feelings of despair, anger, shame, and even a sense of loss might result from being unable to conceive naturally or bring a pregnancy to term. This present study aimed to contribute in an effort to better understand well-being of infertile women and stress levels of infertility and factors influencing the well-being of infertile women. To find out the correlation between stress and well-being among women experiencing infertility. A sample of 100 infertile women between the age of 25 to 40 years was chosen for the investigation. Data collection methods included questionnaire for different variables. Well-being of infertile women was assessed using a self-designed questionnaire, stress levels of infertile women was assessed using Depression anxiety stress scale (DASS). Observed findings indicated that nearly half of women faced moderate levels of stress. Also, higher levels of stress were associated with lower levels of well-being. The present study has revealed that the factors influencing the well-being of infertile women included age, duration of marriage and duration of infertility. Women experiencing infertility faced depression and stress which affected their well-being and various factors were responsible for lower levels of stress and well-being.

Key Words: Anxiety, Childlessness, Depression, Infertility, Stress, Well-Being.

INTRODUCTION

The family life cycle is a series of stages that defines and predict how families emerge and develop, starting with marriage, childbearing and rearing, education of children, vocational adjustment and ending with financial recovery. Couples with infertility are stuck in the marriage and establishment stage for a longer period of time than other couples (Sethia, 2009). Pregnancy is an important phase of life that eternally changes the life of parents, redirects their goals in life, gives new meaning to their life, they focus their attention to the upbringing of a new member. Failure to conceive, they feel that they lost direction in life, they lose hope for future life. They miss all the activities which they can perform with the children.

Infertility can affect both men and women but there is a misconception that only women are responsible for not having children. When couples are unable to produce biological children they may encounter stress, their well-being may be affected. This phase may be very annoying to some and others may handle this phase easily and may take another route of

IVF (test tube baby) and adoption. Infertility is a disease of the men or women reproductive system defined by the failure to achieve a pregnancy after 12 months or more of regular unprotected sexual intercourse (WHO, 2021). According to WHO reports 48 million couples and 86 million individuals suffer from infertility. It is a big concern because it affects a large number of married couples in the current worldwide situation. Primary and secondary infertility are the two most common types of infertility. Infertility that has never resulted in pregnancy is referred to as primary infertility; infertility that has resulted in at least one previous pregnancy is referred to as secondary infertility (WHO, 2021).

Particularly infertile women may not even notice the importance of a healthy diet and regular exercise. The WHO recommends more than 150 minutes of vigorous physical activity every week to reduce the likelihood of infertility. An uneven protein and calorie diet leads to severe under or overweight, which changes ovarian function and raises the risk of infertility.

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Well-being refers to the positive mental state which accompanies physical and social health. Infertility truly affects a couple's life satisfaction, sexual relationships and social relationships and it produces lasting effects on the lives of infertile couples and their families. Mostly women are blamed in many societies for not having children leading to discrimination, poor quality of marital life and even abandonment from homes.

A person's stress is a mental and physical strain that he/she is concerned about. The body's reaction to external and internal stimuli is known as stress (WHO, 2021). The original definition of "stress" was a generalized body reaction to a need for change, and any stimulus capable of causing it was referred to as a "stressor." Stress refers to the manner in which stressful stimuli promote physiological processes and biological tissues, despite its negative meaning. As a result, stress may reflect a trained body's ability to achieve the best athletic performance or the evolutionary pressure that individuals continue to face as they age (Palomba *et al*, 2018). In addition, a past study has revealed that, when compared to men, women with infertility tend to be more vulnerable to mental health issues induced by infertility stress. Infertility has a long-term emotional, spiritual, sexual, and physical impact on women's mental health. Low self-esteem, guilt, and loneliness, as well as social isolation and psychological stress, can all be symptoms of infertility. Depression and anxiety are more common among infertile patients than other mental problems (Cui *et al*, 2021).

The study aimed at making the women understand the stress that was the outcome of infertility and the factors that may affect the well-being of women. Further, this shall also help partners to fight together in this journey and enjoy their lives their way.

MATERIALS AND METHODS

The current study was conducted in the District Hisar of Haryana state. Data were collected randomly from infertility centres in Hisar City and Community Health Centres were also visited. The snowball technique is also used for data collection. The present study was conducted on a sample of 100 infertile women i.e., 50 women from rural areas and 50 women from urban areas. A self-designed questionnaire was used to study the well-being of infertile women, to assess stress levels of infertile women depression

anxiety stress scale (DASS) by Lovibond and Lovibond (1995) and a self-designed questionnaire was used to assess coping mechanisms. Frequency, percentages, means, standard deviation, z-test, ANOVA and correlation and chi-square tests were used to evaluate the data.

Data Analysis

The collected data were classified and tabulated in accordance with the standards laid down in order to arrive at meaningful and relevant inferences as per the objectives. For analysis of data, categorization, coding, tabulation and statistical analysis was done.

RESULTS AND DISCUSSION

The data (Table 1) revealed that out of total sample, 40 percent respondents were in the age group 36 to 40 years followed by 25 to 30 years (34%) and 31 to 35 years (26%). Data related to the duration of infertility revealed that 24 percent of women were infertile for 16 to 20 years followed by (10%) were infertile for 11 to 15 years, (36%) of women were infertile for 6 to 10 years and (30%) of women were infertile for up to 5 years. Regarding cause of infertility, (14%) of women faced low egg count problem, followed by 22 percent women faced fallopian tube blockage problem and 10 percent women faced swelling in uterus as the cause of infertility. More than half (54%) women faced infertility due to other reasons (including implantation problem, weak uterus, PCOD and no reason).

A study discovered that a variety of factors, including the history and treatment of infertility, the length of a woman's marriage, and her educational background, residence, and previous unsuccessful pregnancy affect the psychological well-being of infertile women. Also, it was discovered that women with higher educational levels exhibit fewer depression symptoms and experience fewer familial and societal challenges than women with lower economic and educational status (Sohbati *et al*, 2021). Additional risk factors for primary infertility included higher education level, age at marriage grew to more than 25 years, not having a child within the first year of marriage, excessive weight gain, polycystic ovarian syndrome (PCOS) and the age at which first time periods begin is also decreased. So, efforts must be made to prevent infertility by spreading awareness (Saoji, 2014).

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Table 1 Personal profile of infertile women.

Sr. No.	Place of residence Personal variables	Urban (n=50) f (%)	Rural (n=50) f (%)	Total (n=100) f (%)
1.	Age (years)			
	25 to 30	19(38.0)	15(30.0)	34(34.0)
	31 to 35	11(22.0)	15(30.0)	26(26.0)
	36 to 40	20(40.0)	20(40.0)	40(40.0)
2.	Duration of marriage (years)			
	1 to 5	08(16.0)	05(10.0)	13(13.0)
	6 to 10	11(22.0)	17(34.0)	28(28.0)
	More than 10	31(62.0)	28(56.0)	59(59.0)
3.	Age at the time of marriage (years)			
	18 to 23	33(66.0)	29(58.0)	62(62.0)
	24 to 29	10(20.0)	18(36.0)	28(28.0)
	30 to 35	07(14.0)	03(06.0)	10(10.0)
4.	Type of marriage			
	Arrange marriage	48(96.0)	49(98.0)	97(97.0)
	Love marriage	02(04.0)	01(02.0)	03(03.0)
5.	Education			
	Illiterate	13(26.0)	4(08.0)	17(17.0)
	1 to 10 th	09(18.0)	15(30.0)	24(24.0)
	11 to 12 th	08(16.0)	08(16.0)	16(16.0)
	Graduation	20(40.0)	23(46.0)	43(43.0)
6.	Occupation			
	Housewife	45(90.0)	43(86.0)	88(88.0)
	Job	05(10.0)	07(14.0)	12(12.0)
7.	Duration of infertility (years)			
	1 to 5	18(36.0)	12(24.0)	30(30.0)
	6 to 10	10(20.0)	26(52.0)	36(36.0)
	11 to 15	06(12.0)	04(08.0)	10(10.0)
	16 to 20	16(32.0)	08(16.0)	24(24.0)
8.	Cause of infertility			
	Low egg count	08(16.0)	06(12.0)	14(14.0)
	Fallopian tube blockage	13(26.0)	09(18.0)	22(22.0)
	Swelling in uterus	06(12.0)	04(08.0)	10(10.0)
	Other	23(46.0)	31(62.0)	54(54.0)

Level of well-being among infertile women

Table 2 showed that 16% of urban women and 8% of rural women had low well-being levels, making the total percentage of women with low well-being levels 12%. The majority of women had moderate well-being levels, while a significant portion of women had high well-being levels. The results of the study are in line with the study carried out by Sharma *et al* (2022) which revealed that infertility was the major stressor among infertile women which disturbed their well-being and also mentioned that mental well-being was

often ignored while treating infertility, so proper counselling must be provided to ensure a healthy pregnancy. In India, it is customary for married couples to have children within the first year of their marriage to avoid societal pressure, stigma, and discrimination. Poor psychological well-being in women is linked to illiteracy and a sedentary lifestyle. The factors that significantly correlate with psychological well-being in fertile women include exercise and age during menarche.

Table 2 Level of well-being among infertile women.

Sr. No.	Place of residence Well -being	Urban n=50 f (%)	Rural n=50 f (%)	Total n=100 f (%)
I.	Well -being			
	Low (20-31)	8(16.0)	4(08.0)	12(12.0)
	Moderate (32 -43)	25(50.0)	26(52.0)	51(51.0)
	High (44 -55)	17(34.0)	20(40.0)	37(37.0)

Level of stress among infertile women

The level of stress among infertile women revealed that nearly half of the population reported moderate level of overall stress whereas one-fifth of the population reported high level of overall stress, indicating moderate to high level of stress. The difference between urban and rural populations was not significant. The findings highlighted the need for mental health support and interventions to address stress-related issues among infertile women residing in both urban and rural areas.

Similarly, a study (Khan *et al*, 2019) investigated that infertility affects 15% of people globally and found that infertile women were shown to have much higher rates of depression, anxiety, and stress than fertile ones. Infertile women are more stressed all of the time than fertile women, and they report higher levels of psychological discomfort, which may further diminish their chances of becoming pregnant. Infertile women were also enrolled in rehabilitation and capacity-building programs so that they may resume a normal routine and improve their quality of life. A study also found that the prevalence of anxiety and depression in Telangana was observed to

be 27.1% and 55.3%, respectively. Anxiety or depression were typically the emotional reactions to infertility that were most frequent. Men are not even asked about their fertility status, while women are the who undergo different investigations and therapies, some of which may involve hormone therapy that led to stress and depression. Moreover, there is a constant fear of being abandoned and blamed for infertility. Indian religion helps its people overcome various problems including infertility stress (Gupta *et al*, 2022).

Correlation between stress and well-being of infertile women

It was observed that there is a consistent negative relationship between well-being and the other variables. Higher levels of depression, anxiety, and stress tend to be associated with lower levels of well-being. The results of the study were supported by Cui *et al* (2021) that infertile women exhibited higher rates of stress and anxiety, which might have contributed to low self-esteem. Similarly, Teklemicheal *et al* (2022) found that the prevalence of psychological stress among Ethiopia women having infertility was very high.

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Table 3 Level of stress among infertile women.

Sr. No.	Place of residence Level of stress	Urban n=50 f (%)	Rural n=50 f (%)	Total n=100 f (%)
I.	Overall Stress			
	Low (12-41)	17(34.0)	14(28.0)	31(31.0)
	Moderate (42 -71)	22(44.0)	27(54.0)	49(49.0)
	High (72 -101)	11(22.0)	09(18.0)	20(20.0)
II	Components of Stress			
1.	Depression			
	Low (0-12)	16(32.0)	14(28.0)	30(30.0)
	Moderate (13 -25)	23(46.0)	27(54.0)	50(50.0)
	High (26 -38)	11(22.0)	09(18.0)	20(20.0)
2.	Anxiety			
	Low (2-12)	15(30.0)	17(34.0)	32(32.0)
	Moderate (13 -23)	24(48.0)	24(48.0)	48(48.0)
	High (24 -34)	11(22.0)	09(18.0)	20(20.0)
3.	Stress			
	Low (0-11)	08(16.0)	10(20.0)	18(18.0)
	Moderate (12 -23)	27(54.0)	30(60.0)	57(57.0)
	High (24 -35)	15(30.0)	10(20.0)	25(25.0)

Table 4 Correlation between stress and well-being of infertile women.

Sr. No.	Stress Well-being	Depression (r)	Anxiety (r)	Stress (r)
I.	Well-being	-0.38*	-0.32*	-0.35*

*Correlation is significant at the 5% level of significance

Association of personal variables and well-being among infertile women

χ^2 was used to assess the relationship between personal variables and well-being. A significant association was found between the duration of marriage and well-being ($\chi^2= 08.45^*$, $p<0.05$) which indicated that longer durations of marriage generally

result in higher well-being. Similarly, results regarding association of well-being and personal variables suggested that a significant positive association was found between duration of infertility, family type, family size and family monthly income with well-being. Kamboj *et al.* (2023) highlighted the prevalence of a number of common mental illnesses in infertile women; these illnesses were independent of

demographic characteristics, lifestyle choices, and reproductive outcomes. Zorlu and Erbaş (2023) found that women experienced psycho-social problems like stress, stigma, social isolation and discrimination due to their infertility. Also, women thought that when family members were engaged in treatment processes, they formed irrational expectations about having children from infertile women, which in turn served as a stressor. Women also mentioned that they made an

effort to stay away from family events in order to avoid queries. This particular act of avoiding the situation saved women from the psychological pressure of being questioned. In seeking infertility treatment, nurses were the ones who got to know the patient and her thoughts, so they must counsel them in their hard times and help them cope with psycho-social problems. Hence, intervention programs can be developed which shall contribute to their well-being.

Table 5 Association of personal variables and well-being among infertile women.

Sr. No.	Well-being Personal variable	Association(χ^2)
1.	Age	05.75
2.	Education	04.86
3.	Duration of marriage	08.45*
4.	Age at the time of marriage	02.83
5.	Type of marriage	01.29
6.	Occupation	01.00
7.	Duration of infertility	10.11*
8.	Family type	06.28*
9.	Family size	08.37*
10.	Income	11.39*
11.	Place of residence	01.59

*Significant at the 5% level of significance

Galst (2018) suggested assisting patients in regaining control, encouraging open communication between couple members, identifying women and men who are more likely to experience emotional difficulties while dealing with infertility, and providing concrete suggestions for dealing with stress before, during, and after treatment. Encourage medical programs to provide information regarding the medical, emotional, and financial elements of treatment to reduce patient stress. The current study considerably contributes to the literature on infertility

and makes a novel contribution to the body of knowledge in the field by examining the stress, well-being of infertile women and the factors affecting the well-being and stress levels.

CONCLUSION

The desire of having children is very prominent and a person's individual decision. When unable to do so, couples and especially women develop stress and affects the well-being of infertile couples. The implications of these findings are important as the

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study offers an insightful picture of the well-being and stress levels which can serve as a foundation for life span teachers to educate students about the hardships of infertility. The study will assist family members and other society members in assisting women in overcoming stress instead of embarrassing and weakening the self-esteem of women. This study will be a valuable resource for references in related research in the future. The results of this study may help in the development and use of psycho-social programs for infertile women.

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Successful Treatment and Management of Uterine Prolapse in Ongole Cattle- A Case Report

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ABSTRACT

Uterine prolapse is a major obstetrical problem, which affects reproductive and productive performance of cattle by delaying the postpartum return to estrus, conception rate and calving interval. A case of such post-partum total uterine prolapse in an ongole cattle associated with inflamed caruncles was presented and the prolapsed mass was successfully reduced, repositioned, and application of retention which was achieved by rope truss after proper epidural anesthesia with 2% lignocaine. Hypocalcemia which was the major cause of the present uterine prolapse was corrected by giving intravenous calcium therapy (450 ml; I/V) and managed further by oral route. Animal was well handled during treatment and utmost care was taken in such a way that its future production and fertility was not hindered. The cow was successfully recovered from the prolapse without any complications.

Key Words: Cattle, Uterine prolapse, Pluriparous, Treatment, Reposition, Retention.

INTRODUCTION

Uterine prolapses occur *after calving* when the uterus inverts itself through the cervix and the vagina out of the cow. Post-partum prolapse of uterus is an obstetrical complication that occurs 48 to 72 hours after parturition. It usually occurs in third stage of labor in the cow (Joseph *et al*, 2001). Bovine uterine prolapse is a sporadic but life-threatening postpartum condition. Spontaneous uterine prolapse in cows is an occasionally encountered post parturient complication requiring immediate attention. Uterine prolapse should be regarded as a condition which requires emergency treatment. Without timely intervention the prognosis for life is grave (Miesener and Anderson, 2008). It is most common in dairy cattle and can occur in beef cows occasionally with hypocalcemia. Animals suffering from uterine prolapse either remain in sternal or in lateral recumbency. The incidence of the condition has been reported to be between 0.002 and 1% of calvings (Carluccio *et al*, 2020). The proposed mechanism for its development is decreased myometrial tone combined with an open cervix – which explains why hypocalcaemia, and dystocia (which can result in myometrial fatigue), are risk factors for the condition (Murphy *et al*, 2002). Forced extraction of the calf and

dystocia have been incriminated as causes of uterine prolapse in dairy (Hopper, 2007; Noakes *et al*, 2001a) and beef cattle. The ruminants are predisposed to post-partum uterine prolapse due to the long myometrium contractions, violent straining, low plane of nutrition, hypocalcaemia, relaxed atonic flaccid uterus, lack of exercise and extreme laxity of perineum and vulvar lips etc. (Kumbhar *et al*, 2009). The lower calcium, lower phosphorus and higher magnesium serum concentration were also observed in animals suffering from uterine prolapse (Ahmed *et al.*, 2005; Akhtar *et al.*, 2008).

Case History and Observation

A pluriparous cow aged 7yrs in its third parity was presented to the Veterinary Clinical complex, College of Veterinary Science, Garividi with a history of uterine prolapse (Fig 1) after 48 hrs of calving. All the physiological parameters like temperature (101°C), pulse rate (50 beats per minute), respiration (30 breaths per minute) were within the normal range. The cow expressed severe tenesmus and the prolapsed mass was soiled with dirt, straw and dung. The prolapsed mass was swollen, edematous, necrotic especially at the caruncular area. Blood and serum were collected for

examination. Haematological (Hb-11g/dl; PCV-25%) and Biochemical parameters (BUN-15mg/dl; Creatinine-1mg/dl; Glucose-65mg/dl) were normal except hypocalcemia (7.5mg/dl) was noticed. The case was diagnosed as total uterine prolapse (Fig 1) and the treatment was indicated.

Treatment and Discussion

Initially, animal's straining was reduced and provided satisfactory regional analgesia by injecting 2% Lignocaine (6 ml) epidurally at the Sacro-coccygeal space. After that, the prolapsed mass was cleaned with antiseptic solution such as potassium permanganate to remove all the dirt, and dung. The three main principles indicated in the treatment of current prolapsed mass was reduction, replacement/reposition and retention. Firstly, the swollen prolapsed mass was reduced by applying pop in spray and placental attachments were removed without excessive bleeding and trauma. After 10-15mins, the mass was replaced in its normal place by elevating the mass to the level of the ischium; this enables easier reduction and helps relieve vascular compromise and retention of urine. The prolapsed mass was replaced by applying pressure with the fist of the hand on the mass until it was kept in its original location. Once the uterus is replaced, a hand was inserted to the tip of both uterine horns to ensure there was no remaining invagination that could incite abdominal straining and another prolapse. Retention was achieved by application of rope truss extending from the neck to vulval lips of the animal (Fig 2). After proper retention, the animal was administered with Inj Melonex (15ml; I/M), Inj Ceftriaxone (4gm; I/V), Inj Dextrose Normal saline (3 liters; I/V), Inj Tribivet (15ml; I/V) and Inj Calcium boro gluconate (450ml; slow I/V) and advised to continue the antibiotic, analgesic and oral calcium therapy for 5 days. The farmer was advised to elevate the cow's hind quarters to prevent the recurrence of the prolapse as per Blate (2023). An uneventful recovery was noticed. The prolapse of the uterus is seen most commonly in pluriparous dairy cows which was seen in the present case. The usual sequelae of uterine prolapse is hemorrhage, shock and infertility. However careful removal of dung and dirt by potassium permanganate solution prevented the uterine infection in this case which was also noticed by Simon *et al.* (2015). To

retain the prolapsed mass after proper reduction, various through and through trans vulvar suturing techniques have been tried (Noakes *et al*, 2001b; Roberts, 2004; Anonymous, 2006; Bhattacharyya *et al*, 2007), but they are prone to tear the vulva particularly in cases showing subsequent violent straining (Noakes *et al*, 2001b). Therefore, in this case, rope truss was applied instead of vulvar sutures with least damage. Hypocalcemia results in atony of the uterus and a delay in cervical involution, both of which could predispose to uterine prolapse in dairy cows which was majorly observed in this case. Therefore, Calcium borogluconate therapy is recommended, along with a course of parental antibiotic which was in agreement to Noakes *et al* (2001a) because hypocalcemia is the main reason for uterine prolapse. In the current case, immediate and proper treatment of this condition not only saved the life of the cow but also its future fertility as the most common sequelae of uterine prolapse is establishment of septic metritis and endometritis.

CONCLUSION

In uterine prolapse, tension is placed on the large uterine vessels. This tension on the vessels puts the cow at risk of rupturing, which can cause the animal to go into hypovolemic shock and bleed out internally and therefore it is every time regarded as an emergency case. It was concluded from the present case that the uterine prolapse can be treated by following 3 main principles such as reduction, reposition/replacement and retention by rope truss method along with fluid and calcium therapy. In this case, the reason for the prolapse was majorly attributed to hypocalcemia. Successful treatment in the current case was achieved with 100% recovery of the dam.

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Heavy Infection of *Ascaris suum* and *Balantidium coli* Infection in Pig Farm

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ABSTRACT

Ascaris suum and *Balantidium coli* are the common parasites that can affect pigs in a farm setting. Both *A.suum* and *B. coli* can pose significant challenges to pig farm. Tamworth and Desi pigs of Pig farm were presented with a history of diarrhoea, weight loss, reduced appetite and respiratory issues such as coughing and increased respiratory rate. A total of 140 faecal samples from 71 (< 3 months), 44 (< 6 months) and 25 (>6 months) pigs including pregnant sows and adult boars were collected. *Ascaris* spp ova and *Balantidium coli* cysts was detected in 129 and 131 faecal samples respectively. Still birth was found in three (3) sows. Faecal examination revealed concurrent infection of *Ascaris suum* and *Balantidium coli*. Pigs were managed successfully with specific therapy of fenbendazole (orally @ 5mg/kg body weight) and metronidazole (@ 20mg /kg body weight) with Furazolidone (@ 10 mg/kg body weight). The present paper reports an impact due to Ascariosis and Balantidiosis and its therapeutic management in T& D pigs of Pig breeding farm, Ranchi.

INTRODUCTION

Ascaris suum commonly known as the pig roundworm, can have significant implication on pig farms (Roesel *et al*, 2017) whereas *Balantidium coli* is a ciliated protozoan parasite that can infect the large intestine of pigs, other animals and human beings (Ahmed *et al*, 2020). *Ascaris suum* also known as the pig roundworm, is specific species that commonly infect pigs in farm setting. The burden of ascaris in pig farms can be of significant concern due to its impact on pig health and productivity. These parasite can cause various effects, including reduced weight gain, poor feed conversion and increased susceptibility to other diseases. Heavy infestation can lead to intestinal blockages, causing severe health problems and even death in some cases. *Balantidium coli* infected pigs may experience loose watery stool or even dysentery. *B.coli* can contribute to weight loss, reduced growth rates, reduced appetite and abdominal discomfort due to its inflammatory action. These parasites not only impact pig health and welfare but also result in economic losses due to reduced productivity and increased mortality rates.

Prevalence of *Ascaris suum* and *Balantidium*

coli has been reported from various farm settings. in total of 140 pigs faecal samples, 71 were pigs below 3 months, 44 were from pigs younger than 6 months and 25 from pigs older than 6 months including pregnant sows and adult boars. Ova of *Ascaris spp* was detected in 129 faecal sample and *Balantidium coli* cysts were found in 132 faecal sample. Still birth was found in 03 sows. Pigs were successfully treated with fenbendazole (orally @ 5mg/kg body weight) and metronidazole (@ 20mg /kg body weight) with Furazolidone (@ 10 mg/kg body weight). Hence the present study is aimed at determining the impact of these intestinal parasites and further suggests the need to implement control measures.

MATERIALS AND METHODS

One advanced pregnant sow aged 2.5 year of pig farm showing respiratory distress, coughing, passing loose faeces for the past 3- 5 days, and persistently losing body weight meanwhile still birth was found. Similar condition was reported happened to other two pregnant sows. In due course of investigation other male and female pigs, small and large, began to show similar lesions. Pigs were divided in different age groups ie piglets (< 3 months), weaners (3 to 6 months),

and adult boars and sows (>7 months). Out of total of 140 samples from individual pigs were collected and grouped as samples from piglets 71, weaners 44, adult boars 15 and adult sows 10 faecal samples were collected from piglets, weaners, adult boars and sows respectively. Immediately faecal samples of each individual pigs of farm was collected and brought to the laboratory for identification of the pathogen. *Ascaris spp* and *Balantidium spp* were identified on the basis of direct and indirect methods described by (Soulsby,1982) in the Department of veterinary parasitology, College of veterinary science Ranchi. All the samples were systematically examined for the presence of ova and oocyst of any parasites. The data collected during the experiment was statistically analysed using standard methods as described by

(Snedecor and Cochran,1994).

RESULTS AND DISCUSSION

On clinical examination the animal appeared dull, depressed-with, lustreless hair coat and matted hind quarters. Pigs were observed weak, emaciated and dehydrated. The clinical health parameters were found within the normal range except loose faeces and respiratory distress. Faecal smear upon examination with Floatation and Sedimentation technique revealed a good number of ova of *Ascaris suum* measuring approximately 75 µm by 50µm and oocyst of *Balantidium coli* measuring upto 50 to 60 µm. Out of 140 Pig samples examined an overall prevalence of 83.57% of ascaris infection and 90.71% of Balantidium infection in pigs was recorded (Table 1).

Table1. *Ascaris spp* and *Balantidium spp* infection in different age group of pigs.

Sr. No.	Animal group	No of Sample examined	Number of sample infected with <i>Ascaris spp</i>	Ascaris prevalence %	Number of sample infected with <i>Balantidium spp</i>	<i>Balantidium</i> prevalence %
1	Up to 3 m	71	65	91.55	67	94.36
2	3-6 m	44	32	72.73	36	81.81
3	Adult boar	15	12	80	14	93.33
4	Adult sow	10	8	80	10	100
	Total	140	117	83.57	127	90.71

Also Agewise prevalence of *Ascaris* and *Balantidium spp* was recorded in boars, sows, weaners and piglets respectively (Table1). Clinical ascariasis is manifested by reduced weight gain, poor feed conversion and increased susceptibility to other diseases (Roepstorff *et al*, 2011). In balantidiosis symptom may include diarrhoea, weight loss, reduced appetite, abdominal discomfort and anaemia (Ahmed *et al*, 2020). It is important to note that some pigs may show no clinical signs despite being infected, while others may exhibit more severe symptoms. Additionally, co-infection or underlying health conditions can exacerbate the impact of these parasites on pig health.

In this study, pigs suffering from recurrent form of diarrhoea positively responded with the therapeutic intervention in respect of inappetence and consistency of the faeces that regained to normalcy in 3 to 5 day of treatment. The parasite *Ascaris suum* was expelled out after oral medication. Fenbendazole was found to be very much effective against ascariasis in pigs (Brian Lassen *et al*, 2017 and Marchiondo *et al*, 1987). Whereas the use of metronidazole has been found beneficial against balantidiosis (Bauri *et al*, 2012).

Ascariasis and balantidiosis are parasitic diseases that affect pigs, causing significant health issues and economic losses in the swine industry. Prevention and control measures for both diseases include proper sanitation, deworming programs, and biosecurity

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protocols on pig farms. Regular monitoring, diagnosis, and treatment are essential in managing and reducing the impact of these parasitic infections on pig health and productivity.

CONCLUSION

Educating pig farmers and veterinary professionals about the risks, symptoms, and control strategies for ascariasis and balantidiosis is crucial in preventing outbreaks and minimizing the spread of these diseases. Collaboration between stakeholders, research institutions, and government agencies is key in developing effective control strategies and promoting the health and welfare of pigs in the swine industry. Overall, addressing ascariasis and balantidiosis in pigs requires a holistic approach that combines preventive measures, early detection, and prompt treatment to ensure the well-being of pigs and the sustainability of pig farming practices.

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Performance of Papaya (*Carica papaya*) var. Red Lady in Agro Climatic Zones of Assam

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ABSTRACT

Papaya (*Carica papaya* L.) is a tropical fruit which can be cultivated successfully in subtropical conditions. The fruit has a high nutritional and medicinal value and rich in Vitamin A (2020IU/100g) making it very popular among the farmers of Assam. A study was conducted during 2019-2020 and 2020-21 on performance of Red Lady at farmers' field under rainfed conditions representing four agro climatic zones of Assam. The study revealed that the plant height was 281.27 cm tall with maximum fruit weight of 1.65 kg. Additionally, the fruit length, fruit diameter and fruit cavity diameter were found to be 19.22cm, 12.84 cm and 6.51 cm respectively with Yield per plant (40.72 kg), Yield per hectare (119.67 t/ha), B:C ratio (4.27) was found higher against the local varieties in all the locations. From the study, it can be inferred that the farmers may adopt Papaya var. Red lady over their local varieties for better yield and returns.

Key Words: Evaluation, Papaya, Rainfed, Red Lady, Variety.

INTRODUCTION

Papaya is one of the major fruit crop grown throughout the country. It belongs to the family *Caricaceae*. It has many sex expressions such as monoecious, dioecious and gynodioecious and was originated in Southern Mexico and Costa Rica. It is suitable for tropical conditions but can be grown in subtropical region successfully in favourable climate of 28-30 °C of temperature. Assam holds the 9th position (7.21 thousand hectares) in terms of area and 8th (147.40 thousand MT) in terms of production in the country (Anonymous, 2018). Major Papaya growing states are Andhra Pradesh, Gujarat, Kerala, Madhya Pradesh, Maharashtra etc. The fruits are highly valued as a table fruit when ripe and as a vegetable in the unripe condition (Babu, 2000). Unripe Papaya fruits are a rich source of Papain, a photolytic enzyme which helps in protein digestion. The tender fruits are also used as meat tenderizer and for medicinal purposes. The mature and ripe fruits are also used for preparation of

value added products like tooty fruity, jam, candies, ready to serve drinks and many more. The red colour of the flesh is due to accumulation of lycopene and the yellow colour is due to conversion of lycopene to β -carotene and β -cryptoxanthin (Hirschberg, 2001). The adverse climatic factors like temperature, humidity temperature fluctuations cause heavy crop damage which leads to various abnormalities like reduced vegetative growth, delay in flowering, flower and fruit drop, improper fruit development, reduction in quality of fruit in papaya (Jana *et al*, 2010; Meena *et al*, 2012; Singh *et al*, 2010). Farmers in Assam mostly found to practice local cultivars. The local cultivars grown are poor in yield, quality and physico-chemical properties. The knowledge regarding the hybrid varieties are still yet to popularize among the farmers. Considering the situation in view, the present investigation was undertaken to evaluate the performance of Papaya hybrids in various districts of Assam.

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MATERIALS AND METHOD

The study was conducted using observational and field data in the farmers' field under rainfed conditions at different districts *viz.* Kamrup, Golaghat, Karbi Anglong, Barpeta, Sonitpur and Udalguri during the year 2019-20. At the beginning, Papaya variety Red Lady seedlings were raised in poly bags in the month of

February and kept at nursery under shade net houses. The planting was done in the month of May-June in an area of 0.13 ha at each location with a pit size of 45 cm × 45 cm and with a spacing of 1.8 m × 1.8 m as per the Package of Practices of Assam Agricultural University, 2019. The data were collected from 50 plants from each agro climatic zones of Assam.

Table 1. Experimental areas undertaken in the district.

Sr. No.	Agro-climatic Zone	KVKs involved
1	Upper Brahmaputra Valley Zone	Golaghat
2	North Bank Plain Zone	Sonitpur, Udalguri
3	Lower Brahmaputra Valley Zone	Barpeta, Kamrup
4	Hill Zone	Karbi Anglong

RESULTS AND DISCUSSION

It was observed that the papaya variety Red Lady suited well to be cultivated in Assam condition as it was found to perform very well in all the districts taken for the trial. The data (Table 2) revealed that papaya *var.* Red Lady showed encouraging results in comparisons to the local papaya varieties in respect to plant height, fruiting height, Fruit characters etc. The fruit length of Red Lady is high due to its elongated fruit shape. The variation in fruit length, fruit diameter and fruit weight might be based on the fact that every genotype has its own nature in development of fruit which may be varied due to various physiological

phenomenon, *viz.*, photosynthetic efficiency, rate of translocation of photosynthates from source to sink and photo respiration of the plant. The results were contrast with Das (2013) and Tyagi *et al* (2015). The variety Red lady showed encouraging result in yield per hectare of 119.67 t/ha as compared to the local varieties (32.5 t/ha). The data on economics and B:C ratio are represented in the bar diagram (Fig. 2 and 3). The highest gross return, net return and B:C ratio was obtained in Red Lady. It inferred that the variety Red Lady was more profitable for cultivation than the local varieties.

Table 2. Yield attributing parameters.

Variety	Plant height (cm)	Fruiting height (cm)	Avg. fruit weight (Kg)	Fruit length (cm)	Fruit diameter (cm)	Days to flowering	No. of fruits per plant	Shelf Life (days)
Red Lady	198.68	134	1.65	19.22	12.84	153.22	24.68	5.65
Local	281.27	247.06	0.745	15.78	9.89	193.62	39.66	6.75
C.D	23.27	11.57	0.03	0.34	0.56	11.82	2.14	0.25
SE(d)	10.56	5.65	0.01	0.15	0.25	5.78	0.97	0.09

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CONCLUSION

Based on the results obtained from the present investigation, it can be concluded that the papaya variety “Red Lady” is well suited for growing in agro climatic conditions of Assam. Therefore, the farmers can opt for this variety rather than using local varieties for higher yield and productivity with higher returns.

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