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Influence of Technological Interventions on Yield Attributes, Yield of Field Pea and its Diffusion in Jabalpur District of Madhya Pradesh

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ABSTRACT

To realize the impact of field pea improved cultivar, integrated weed, nutrient and pest management techniques, Integrated Crop Management demonstrations were conducted in participatory mode in *rabi* season during four consecutive years from 2018-19 to 2021-22 at 100 farmers' fields located in fourteen randomly selected villages under five blocks of the district. Four years pooled data revealed that pods/plant under demonstration were 25.71 per cent more to that of farmer's practice. Grains/pod, pod length and test weight (1000 grain) were noted to be 8.7, 6.45 cm and 229.85g respectively in ICM demonstrations which were 30.83, 9.69 and 10.29 per cent higher over farmer's existing practice respectively. Average field pea yield under demonstrated plots was found to be 1956 kg/ha which was 28.43 per cent higher to that of farmers existing practice (1523 kg/ha). Four years economics of the technology demonstrations resulted Rs.21150/ha additional net return over the traditional farmers' practice. The adoption of ICM components of field pea, the revenue increased to a great extent and recorded 272.15 crores in 2021-22 with the additional revenue of Rs.137.38 crores in the district in comparison to that of 134.77 crores before technology dissemination in 2017-18.

Key Words: cultivar, ICM demonstration, promising parameters, yield, adoption, diffusion.

INTRODUCTION

Pulses usually contain 20 to 25 per cent protein by weight which is double the protein content of wheat and three times that of rice. Moreover, pulses subsidize substantively to food production system by enriching the soil through biological nitrogen fixation and improving soil physical conditions. Though pulses are consumed all over the world, its consumption is higher in those parts of the world where animal proteins are scarce and expensive (Ofuya and Akhidue, 2005). Being leguminous in nature, pulses are considered to be important components of cropping systems because of their feasibility to fix atmospheric nitrogen, add substantial amounts of organic matter to the soil and produce reasonable yields with low inputs under harsh climatic and soil conditions (Rakhode *et al*, 2011).

Owing to stagnant pulse production and continuous increase in population, the per capita availability of pulses has decreased considerably. The major constraints in pulse production are inadequate supply of quality seeds, low SRR, insufficient use of inputs, cultivation mostly under rainfed conditions because more than 87% of the area under pulses is presently rainfed, biotic and abiotic stress, technology gap, lack of attractive market price, lack of proper procurement and poor storage facilities of the farm produce (Singh *et al*, 2020). According to recent estimates, pulses were cultivated 28.78 million ha area with the production of 25.46 million tonnes at a productivity level of 885 kg/ha in the country during 2020-21 (Anonymous, 2022). Among the major producing states, Madhya Pradesh is the leading state in the country which contributed 25 percent and 5.97 million tonne of the total pulse production.

Madhya Pradesh is the second largest state in field pea production in the country which

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produces 0.91 million tonnes in 0.2 million hectares of land with productivity of 879 kg/ha (Anonymous, 2022) which is quite low than the National average. Field pea widely grown in Kymore Plateau & Satpura Hills region of the state especially in Jabalpur district however the productivity is quite low looking the availability of the resources. Major cropping pattern of the district is rice-wheat, rice-chickpea, Fallow-fieldpea-wheat-greengram. Nearly 77 percent of the net sown area is double cropped with more than 80 per cent irrigated area in the district. Field pea reported to be grown in 23980 ha in the district during *rabi* 2017-18 with the production of 37200 tone at productivity level of 1520 kg/ha (Anonymous, 2018). There are ample possibilities to uplift the productivity looking the climate and prospective availability of natural resources in the region. The area under field pea in the district is progressively increasing due to heightened irrigated area in the district as well as in the agro-ecological region. Integrated crop management practices can improve the field pea production and productivity by improving vegetative growth, better availability and translocation of nutrients (Ganga Devi *et al*, 2017, Gaur and Jadav 2020, Sharma *et al*, 2005 and Singh *et al*, 2009). Keeping in view the significant role in appropriate transfer of technologies and changing methodical nature of the famers, ICM frontline demonstrations on field pea were conducted in different blocks with the intention to have better impact of the demonstrated technologies on the farmers and field level extension functionaries.

MATERIALS AND METHODS

Frontline demonstrations were conducted in participatory mode on field pea in *rabi* season to evaluate the impact of Integrated Crop Management (ICM); a pragmatic approach to the production of crops; using improved cultivar with integrated nutrient, weed and pest management in rice-field pea, and Fallow-fieldpea-wheat-greengram cropping system at 25 farmers' fields during 2018-19 to 2021-22 respectively in fourteen randomly selected villages spread over five blocks namely Panagar, Majholi, Patan, Shahpura and Sihora of the district. Each demonstration was conducted in an area of 0.40 ha with a check plot closest to the demonstration site was kept as farmers' practice. The improved production technology package included powdery and downy mildew tolerant/resistant cultivars Aman, VRP 5, VRP 6 and Pusa Pragati in 2018-19, 2019-20, 2020-21 and 2021-22 respectively in the demonstrations. Seed treatment was carried out with pre-mix fungicide (carbendazim 12% + menkojeb 63%) @ 2g/kg seed, followed by biofertilizers (rhizobium & phosphate solubilizing bacteria) @ 10g/kg seed for increasing the availability of nitrogen to the crop and better phosphorus use efficiency. All the demonstrations were laid in IInd fortnight of November every year using the seed rate of 75 kg/ha. Sowing was carried out with seed-cum-ferti-drill and the distance between the rows and plants within rows was kept 30 and 10 cm respectively. Soil application of FYM @ 5 t/ha, phosphate solubilizing bacteria (PSB), *Trichoderma viridae* @ 5 kg/ha and vesicular arbuscular mycorrhiza (VAM) was done @ 10 kg/ha respectively in each demonstration before sowing. NPK was applied @ 20:50:20 kg/ha on the basis of soil test values through urea (46% N), single super phosphate (16% P_2O_5 and 12% S) and potassium chloride (60% K_2O). Entire quantities of the NPK fertilizers were applied during sowing. Pendimethalin 38.7% CS as pre-plant incorporation (PPI) was applied through flat fan nozzle sprayer @ 750 g a.i./ha for efficient weed management. Foliar application of plant growth promoting rhizobacteria i.e. *Pseudomonas floroscence* was done twice at 25 and 35 DAS @ 2.5 l/ha for better crop vigour and spray of Emamectin Benzoate 5% SG @ 250 g/ha was done at pod formation stage for control of pod borer and sucking pests. The crop was harvested at maturity stage in IInd fortnight of February every year.

RESULTS AND DISCUSSION

Promising Parameters

The mean promising parameters of the technology demonstrations on field pea (Table 1) revealed that the plant height under demonstrated plot was 97.6 cm which was 4.5 per cent greater over farmers practice (93.4 cm). The yield attributing character i.e. pods/plant under demonstration was 18.48 which were 25.71

Table 1. Effect of technology demonstrations on promising parameters of field pea.

Promising parameters	Unit	Observation		Per cent increase over FP
		Farmers' practice	Improved practice	
Plant height	cm	93.4	97.6	4.50
Pods/plant	Number	14.7	18.48	25.71
Grains/pod	Number	6.65	8.7	30.83
Pod length	cm	5.88	6.45	9.69
Test weight (1000 grains)	g	208.4	229.85	10.29

Table 2. Economics of field pea frontline demonstrations (pooled data of four years).

Particulars	Pooled yield (2018-19 to 2021-22) in kg/ha	Cost of Cultivation (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	Additional Net Return (Rs/ha)	Benefit Cost (B:C) Ratio	Incremental BCR
Improved practice	1956	24232	95844	71612	21150	3.96	0.87
Farmer's practice	1523	24165	74627	50462	--	3.09	--

percent greater to that of farmers' practice. Number of grains/pod, one of the important yield attributes, was recorded to be 8.7 in technology demonstrations and it was 30.83 per cent high over farmer's practice (6.65). The data pertaining to test weight (1000 grains) indicated that it was 229.85g in technology demonstrations which was 10.29 per cent higher over existing practice. The findings confirm with the findings of Yadav *et al* (2007), Meena *et al* (2012); and Meena and Singh (2017) who found higher yield attributes in pulses under FLD plots.

Economic Parameters

Four-year ICM demonstration results revealed that the average field pea yield under demonstrated plots was observed to be 1956 kg/ha (Table 2) which was 28.43 per cent higher over farmers existing practice (1523 kg/ha). Increase in grain, straw and biological yield, harvest index and grain and straw ratio by application of integrated crop management practices that helps in better dry matter partitioning, photosynthetic efficiency, plant protection and better utilization of nutrients, moisture, light and space which resulted more growth and yield attributing character and ultimately more grain, straw and biological yield, harvest index and grain and straw ratio in field pea crop (Kumari *et al,* 2012). The economics of the technology demonstrations indicated that an additional net return of Rs.21150/ha recorded over the traditional farmers' practice. The B:C ratio under technology demonstration was noticed to be 3.96 which was 0.87 units greater over farmers practice (3.09). The higher additional returns and effective gain obtained under technology demonstrations could be due to improved technology, non-monetary factors, timely operations of crop cultivation and technical monitoring. The results were in conformity with the findings of frontline demonstrations on pulses by Chaudhary (2012), Dayanand *et al* (2012), Gauttam *et al* (2011), Lothwal (2010), Meena and Dudi (2012), Meena and Singh (2017) and Yadav *et al* (2004).

Table 3. Yield improvement through ICM dissemination of field pea and additional revenue generation in the district.

Field pea area (ha)			Yield (kg ha $^{-1}$)		Yield enhancement %	Total production in metric tonne (yield/ha x area in ha)		Revenue generation in district (in crores)		Added revenue generation in district (in crores)
BTD * (2017 -18)	ATD @ (2021 -22)	AADT # (2021 -22)	FP¶	IP§		BTD	ATD	BTD (@ Rs.40/ kg)	ATD (@Rs. 49/ kg)	
23980	30500	6520	1405	1821	30.58	33691.9	55540.5	134.77	272.15	137.38

*Before technology dissemination, @After technology dissemination, #Absolute area under disseminated technology, ¶Farmer's practice, §Improved practice

Socio-economic and environmental impact of the technology

Cultivation of improved varieties (Aman, VRP 5, VRP 6 and Pusa Pragati) with proper seed treatment reduced the cost of production as it reduced various seed born/aerial diseases and pest infestation as most of the farmers spray the fungicides after disease initiation which does not effectively control the disease but cost of the production increased. Seed treatment with rhizobium & PSB, soil application of *Trichoderma viridae* and PSB increased the beneficial fungi, solubility and availability of P_2O_5, N_2 fixation; and other essential nutrients to plants which saved phosphatic, potassic and micronutrient fertilizers to the greater extent. Similar results were reported by Rudresh *et al* (2005) in chickpea. The impact of four years of ICM demonstration on field pea evaluated through a detailed survey carried out during 2021-22; and agricultural statistics reported by Farmer's Welfare & Agricultural Development (FW&AD) department which reflected that the demonstrated varieties and other technology components disseminated in 30500 ha over the area recorded before technology dissemination during 2017-18 which was 23980 ha (Table 3). Due to adoption of the improved cultivars and technology, a considerable increase in area was noticed and it reached to 30500 ha in 2021-22 (27.2%) and increased net return that ultimately lifted the socio-economic status of the farming community in the district. Due to ICM practices, the revenue from the crop increased to a greater extent and it recorded 272.15 crores in the district in 2021-22 in comparison to that of 2017-18 (134.77 crores). Additional revenue of Rs.137.38 crores generated through the technology demonstrations in the district.

Horizontal spread of the technology

The block wise net sown area and absolute area under demonstrated technology of field pea (Table-4) revealed that highest area under field pea observed in Shahpura block followed by Patan, Panagar and Jabalpur blocks of the district with 3990, 1345, 602 and 255 ha absolute area under disseminated technology respectively. Since field pea crop requires much water than the other *rabi* legumes i.e. lentil and chickpea, hence among the resources, perhaps availability of irrigation facility due to increased irrigated area largely contributed in the better adoption vis-a-vis area enrichment of the demonstrated field pea technology with remarkable increase in yield.

Table 4. Block wise net sown area and absolute area under field pea after technological interventions.

Blocks	Net sown area in ha (2021-22)	Area under field pea (ha)		
		BTD* (2017-18)	ATD@ (2021-22)	AADT#
Jabalpur	26100	645	900	255
Panagar	36401	328	930	602
Kundam	22917	0	52	52
Patan	52633	8655	10000	1345
Shahpura	59976	14130	18120	3990
Sihora	30100	96	258	162
Majholi	27540	126	240	114
Total	**266698**	**23980**	**30500**	**6520**

*Before technology dissemination, @After technology dissemination, #Absolute area under disseminated technology,

Technology adoption and diffusion mechanism

Subsequent to assessment of improved cultivars with integrated nutrient, weed and pest management techniques through on farm trials; integrated crop management demonstrations on field pea were conducted in *rabi* season during the year 2018-19 to 2021-22. Trainings on different aspects were conducted for farmers and farm women in the study villages, besides this farmers' seminar, training to extension personnel, group discussion and field day was organized and the technology was popularized through news coverage, scientific advisories, popular articles and folders/pamphlets. The neighbour villagers also adopted the whole technological package after conducting the frontline demonstrations in the cluster of villages and the mass diffusion of the technology was carried out in convergence with Agriculture Technology Management Agency (ATMA), Farmer's Welfare & Agricultural Development (FW&AD) through various extension tools.

CONCLUSION

It may be inferred that frost tolerance, powdery mildew resistance in particular and high yielding characteristics which were the strength of demonstrated cultivars, resulted in remarkably greater yield when coupled with integrated nutrient, weed and pest management components. The cluster demonstration approach and various extension tools boosted diffusion of the cultivars which not only raise the grain yield but acreage and revenue of the district at the same instance.

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