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Productivity Enhancement and Gap Analysis of Moth Bean (*Vigna acontifolia (Jacq.)*) through Improved Production Technologies on Farmers' Participatory Mode

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ABSTRACT: A total 81 of frontline demonstrations were conducted on farmers' fields in villages *viz*., Kalali, Rampura, Jhitra, Dalpatgarh and Mukanpura of Pali district in Rajasthan state during 2010, 2011, 2012, 2013 and 2014 to demonstrate production potential and economic benefit of improved technologies comprising sowing method, nutrient management and chemical weed control and adoption of whole package of practices for the crop. Pre-emergence application of herbicide *Pendimethalin* at 1.0 kg a.i/ha in 550 liters of water used for effective control of the weeds during *kharif* season in rainfed condition. The findings of the study revealed that improved technology recorded a mean yield of 629 kg/ha which was 53.5% higher than obtained by farmers' practice (414 kg/ha). The higher mean net income of ₹ 24730/- ha with a Benefit: Cost ratio of 3.6 was obtained with improved technologies in comparison to farmers' practices (₹ 12950/ha). Yield gap analysis revealed that though there was mean additional return of ₹ 11780/ha with a mean additional gain of ₹ 7820/ha, still there was an extension gap of 215 kg/ha seed yield, indicating that along with many move front line demonstrations there is a need to disseminate the improved technologies among the farmers with effective extension methods like training and demonstrations. However, the mean technology gap of 639 kg/ha seed yield clearly indicates that research efforts are needed in realizing the potentiality of the moth bean crop in Rajasthan state.

Key words: Adoption, frontline demonstration, productivity, moth bean and gap analysis

Introduction

Pulses are important food crops for human consumption and animal feed. Being leguminous in nature and ability to fix atmospheric nitrogen, they are considered important components of cropping systems produce reasonable yields with low inputs under harsh climatic and soil conditions. Moth bean-wheat cropping system is the predominant system and is being practiced by the farmers in the arid zone of Rajasthan. There is productivity stagnation, nutrient water imbalances and increased insect-pest and disease incidence due to prolonged use of this cereal dominated system (Kumar, 2014).

The production and productivity of moth bean are very low mainly due to its cultivation in resource poor lands with minimum inputs, non-synchronous maturity and indeterminate growth habit. The total production of pulses in the world was 14.76 billion tonnes from the area of 14.25 billion hectares in the year 2013-14. While, in India, was 19.78 million tons from the area of 24.63 million hectares in the year 2013-14. Whereas in Rajasthan, the total pulse production was 9.02 lacs tons from the area of 20.4 lacs hectare, respectively. The contribution of moth bean production among pulses was 3.73 lacs tons from the area of 8.85 lacs hectares in Rajasthan in the year 20013-14 indicating low productivity level of the crop.

In its context, the Front Line Demonstration is an important method of transferring the latest package of practices to farmers by which farmers learn latest technology production factors under real farming situations on their own fields, which in turn may lead to higher adoption of improved package of practices. Further, these demonstrations are designed carefully where provisions are made for speedy dissemination of demonstrated technology among the farming community through organization of other supportive extension activities, such as field days and farmers convention. The main objective of the Front Line Demonstration is to demonstrate newly released crop production and protection technologies and management practices at the farmers' field under different agro-climatic regions and farming situations. While demonstrating the technologies at the farmer's field, the analysis of the technology gap will help to strengthen the research. Front Line Demonstrations are conducted in a block of two to four hectares of land in order to have better impact of the demonstrated technology on the farmers and field level extension functionaries with full package of practices. Keeping in view, the present study was done to analyze the performance of production technologies among farming community through the FLDs on moth bean production.

Materials and Methods

During kharif 2010-2014, a total of 81 frontline demonstrations were conducted on farmers' field in villages Kalali, Rampura, Jhitra, Dalpatgarh and Mukanpura Pali district in Rajasthan state under raifed conditions. Each demonstration was conducted in an area of 0.5 ha, and 1.0 ha area adjacent to the demonstration plot was kept as farmers' practice. The package of improved technologies like line sowing, nutrient management, seed treatment and whole package were used in the demonstrations. The test variety was RMO-344 in demonstration plots. The details of practices in FLDs and farmers' practices are given in Table 1. In general, soils of the area under study were sandy loam with medium to low fertility status. The spacing was 45 cm between rows and 20 cm between plants in the rows. Thinning

Table 1 : Particulars showing the details of moth bean grown under FLD and farmers' practice

Operation	Farmers' practice	Improved practices demonstrated
Line sowing	Broad casting of seed	Spacing 45 cm between rows and 20 cm between plants in the rows
Seed treatment	No seed treatment	Seed treatment with *Carbendazim* 2g/kg seed
Weed management	No weed management	Weeds control by using herbicide *Pendimethalin* 1kg a.i/ha in 550 liter of water as pre-emergence treatment for effective control of weeds.
Nutrient management	Only FYM and no fertilizer application	10 tons/ha FYM and 20kg/ha nitrogen
Whole package	Farmers are cultivating the moth bean crop without adoption of any improved technology	All the crop (production and protection) management practices as per the package of practices for *kharif* crop by SKRAU, Bikaner, were followed.

and weeding was done at 10 and invariably 30-35 days after sowing respectively to ensure recommended plant spacing within a row since excess population adversely affects growth and yield of the crop. Seed sowing was done in the first week of July with a seed rate of 15-20 kg/ha. Data with respect to grain yield from FLD plots as well as from farmers' practice plots were collected and evaluated. Potential yield was taken into consideration on the basis of standard plant population (334350 plants/ha) and average yield per plant 22.7 g/plant under recommended package of practices with 45 X 20 cm crop geometry (Chandra, 2010). Different parameters as suggested by Yadav *et al.* (2004) was used for gap analysis and calculating the economics. The details of different parameters and formulae adopted for analysis are as under:

Extension gap = Demonstration yield – Farmers' practice yield

Technology gap = Potential yield – Demonstration yield

$$\text{Technology index} = \frac{\text{Potential yield} - \text{Demonstration yield}}{\text{Potential yield}} \times 100$$

Additional cost = Demonstration cost – Farmers' practice cost

Effective gain = Additional returns – Additional cost

Additional returns = Demonstration returns – Farmers' practice returns

$$\text{Incremental B:C ratio} = \frac{\text{Additional returns}}{\text{Additional cost}}$$

Results and Discussion

Yield attributing traits

The numbers of productive pods per plant under improved technology were 54.8, 52.7, 55.4, 56.3 and 53.9 with a mean of 54.6 pods/plants as against 35.9, 33.5, 34.7, 39.3 and 40.9 in farmers' practice with a mean of 36.4 pods/plant (Table 2) during 2010, 2011, 2012, 2013 and 2014, respectively. There was an increase of 52.6, 57.3, 59.0, 43.3 and 31.8% in the number of productive pods under the demonstration of improved technology over farmers' practice. Thus, there were 48.8% more pods per plant under improved technology demonstrations. The findings confirmed by the findings of Yadav, et *al.* (2007) and Kumar *et al.* (2014). A similar trend was observed with no. of seeds/pod and seed weight 100 pods.

Seed yield (kg/ha)

The productivity of moth bean under improved production technology ranged between 550 and 750 kg/ha with mean yields of 629 kg/ha (Table 3). The productivity under improved technology was 550, 654, 600, 590 and 780 kg/ha during 2010, 2011, 2012, 2013 and 2014, respectively, as against 390, 410, 480, 375 and 460 respectively over the seeds with yield range from 330 to 480 kg/ha under farmers' practice. In comparison to farmer's practice, there was an increase of 41.0, 59.5, 25.0, 87.8 and 63.0% in productivity of moth bean under improved technologies in 2010, 2011, 2012, 2013 and 2014, respectively. The increased grain yield with improved technologies was mainly because of the line sowing, use of nutrient management

Table 2 : Yield attributing traits of moth bean as influenced by improved and farmers' practices in FLDs

Year	Number of pods/plant			Number of seeds/pods			Seed weight (in 100 pods) (g)		
	IT	FP	% increased	IT	FP	% increased	IT	FP	% increased
2010	54.8	35.9	52.6	5.9	3.9	51.3	26.7	15.2	75.7
2011	52.7	33.5	57.3	6.0	3.6	66.7	24.1	17.8	35.4
2012	55.4	34.7	59.0	6.6	5.1	29.4	20.5	14.9	37.9
2013	56.3	39.3	43.3	5.8	3.6	61.1	18.5	13.9	33.1
2014	53.9	40.9	31.8	6.5	4.8	35.4	23.8	14.0	70.0
Average	54.6	36.9	48.8	6.2	4.2	48.8	22.7	16.2	50.4

IT= Improved technology; FP = Farmers practice

Table 3 : Seed yield of moth bean as affected by improved and farmer practices in FLDs

Year	Area (ha)	Demonstration (No.)	Yield (kg/ha)		Additional yield (kg/ha) over farmer practice	% increase in yield over farmers' practice
			IT	FP		
2010	5.0	15	550	390	160	41.0
2011	4.0	12	654	410	244	59.5
2012	5.0	15	600	480	120	25.0
2013	4.0	12	590	330	260	78.8
2014	5.0	15	750	460	290	63.0
Average	4.6	13.8	628.8	414.0	214.8	53.5

and weed management. The findings confirm with the findings of Singh and Meena (2011), Poonia and Pithia (2011), Meena *et al.* (2012) and Math *et al*. (2014).

Gap analysis:

Evaluation of findings of the study (Table 4) stated that an extension gap of 120 to 290 kg/ha was found between demonstrated technology and farmers' practice and on average basis the extension gap was 215 kg/ha during 2014 and lowest (120 kg/ha) during 2012. Such gap might be attributed to the adoption of improved technology, especially high yielding varieties sown with the help of seed cum fertilizers drill with balanced nutrition, weed management and appropriate plant protection measures in demonstrations which resulted in higher grain yield than the traditional farmers' practices the extension gap was highest 290 kg/ha. The study further exhibited a wide technology gap during different years. It was lowest (500 kg/ ha) during 2013 and the highest (750 kg/ha) during 2014. However, there was a mean technology gap of 639 kg/ha indicating that research efforts are still needed in realizing the potentiality of the moth bean crop in Rajasthan state.

Similarly, the technology index for all demonstrations in the study was in accordance with technology gap. Higher technology index reflected the inadequate transfer of proven technology to growers and insufficient extension services for transfer of technology. On the basis of five years study, overall 51.1% technological index was recorded, which was reduced from 56.0%, during 2010 to 40.0% during 2014. Hence, it can be inferred that the awareness and adoption of improved varieties with the recommended scientific package of practices have increased during the advancement of the study period. These findings are in conformity of the results of study carried out by Chandra (2010), Meena and Singh (2014), Dayanand *et al*. (2012) and Raj *et al.* (2013).

Table 4 : Technological gap analysis of frontline demonstrations on moth bean FLDs

Years	Number of FLDs	Potential yield (kg/ha)	FLD yield (kg/ha)	FP yield (kg/ha)	% increased	EG (kg/ha)	TG (kg/ha)	TI (kg/ha)
2010	15	1250	550	390	41.0	160	700	56.0
2011	12	1250	654	410	59.5	244	594	47.5
2012	15	1250	600	480	25.0	120	650	52.0
2013	12	1250	500	375	78.8	260	750	60.0
2014	15	1250	750	460	63.0	290	500	40.0
Average	13.8	1250	628.8	414.0	53.5	214.8	638.8	51.1

EG= Extension gap; TG= Technology gap; TI= Technology index; FP= Farmers practices

Table 5 : Moth bean affected by improved and farmers' practice

Years	Cost of cash input (₹/ha)		Additional cost in improved practices (Rs/ha)	Sale price (MSP) of seed (₹/qtl.)	Net returns (₹/ha)		Additional returns in improved practices (₹/ha)	Effective gain (₹/ha)	IBCR
	IP	FP			IP	FP			
2010	7350	6200	1150	3550	20450	12100	8350	7200	3.8
2011	8800	6550	2250	4600	21400	12150	9250	7000	3.4
2012	9500	6700	2800	5450	27400	13600	13800	11000	3.9
2013	10200	7800	2400	5790	28000	13900	14100	11700	3.7
2014	11200	9100	2100	5500	26400	13000	13400	2200	3.3
average	9410	7270	2140	4958	24730	12950	11780	7820	3.6

IT= Improved practice; FP= Farmers practices; IBCR: Incremental benefit cost ratio

Economics

Different variables like seed, fertilizers, bio-fertilizers and pesticides were considered as cash inputs for the demonstrations as well as in farmers practice. On an average additional investment of ₹ 2140/ha was made under demonstrations. Economic returns as a function of grain yield and MSP sale price varied during different years. The maximum returns (₹ 11700/ha) during the year 2013 were obtained due to high grain yield and higher MSP sale rates as declared by GOI. The higher additional returns and the effective gain obtained under demonstrations could be due to improved technology, non-monetary factors like timely operations of crop cultivation and scientific monitoring. The highest and lowest incremental benefit cost ratios (IBCR) were 3.9 and 3.3 in 2012 and 2014 respectively (Table 5) depending on grain yield obtained and MSP in the market. The results cofirm with the findings of front line demonstrations on pulses by Yadav *et al*. (2004), Gauttam *et al.* (2011), Lothwal (2010), Chaudhary (2012), Dayanand *et al.* (2012), Meena and Dudi (2012) and Rajni *et al.* (2014).

Conclusion

The frontline demonstrations conducted on moth bean at the farmers' fields revealed that the adoption of improved technologies significantly increased the yield as well as yield attributing traits as well as yield of the crop and also the net returns to the farmers. Hence, there is a need to disseminate the improved technologies among the farmers with effective extension methods like training and demonstrations. The farmers' should be encouraged to adopt the recommended package of practices in realizing higher returns.

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