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Impact of improved technologies on productivity enhancement of Greengram cultivation in Rainfed condition of Rajasthan

Aishwarya Dudi and ML Meena

Abstract

The study in total 40 frontline demonstrations were conducted on farmers' fields in villages viz., Kishanagar, Bedkallan, Boyal, Kushalpura and Balara of Pali district during 2015, 2016 and 2017, 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. After sowing application (within two days of sowing) of weedicide *Pendimethalin* at 1.0 kg/ha in 500 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 982 kg/ha which was 35.5% higher than obtained with farmers' practice (755 kg/ha). Higher mean net income of Rs. 46030/ha with a Benefit: Cost ratio of 4.3 was obtained with improved technologies in comparison to farmers' practices (Rs. 38775/ha). The frontline demonstrations conducted on greengram at the farmers' field revealed that the adoption of improved technologies significantly increased the yield as well as yield attributing traits of crop and also the net returns to the farmers. So, 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 realizing for higher returns.

Keywords: adoption, frontline demonstration, Greengram and gap analysis

Introduction

Pulses are important food crops for human consumption and animal feed. Being leguminous in nature, they are considered to be important components of cropping systems because of their viability 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. Moong-wheat cropping system is predominant and is continuously practiced by the farmers in the arid zone of Rajasthan. There is evidence of system productivity stagnation, nutrient water imbalances and increased insect-pest and diseases incidence due to prolonged use of this cereal dominated system source. Greengram (*Vigna radiate* L. Wilczek.) is the third important pulse crop in India. It can be grown both as kharif greengram and summer green gram. With the advent of short duration, MYMV (Mungbean yellow mosaic virus) tolerant and synchronous maturing varieties of greengram (55-60 days), there is a big opportunity for successful cultivation of greengram in green gram-wheat rotation without affecting this popular cropping pattern.

Greengram belonging to family *legueminoseae*, is a tropical and sub-tropical grain legume, adapted to different types of soil conditions and environments (*kharif*, spring, summer). It ranks third in India after chickpea and pigeonpea. It has strong root system and capacity to fix the atmospheric nitrogen into the soil and improves soil health and contributes significantly to enhancing the yield of subsequent crops (Jat *et al*. 2012). However the production and productivity is very low in greengram mainly due to its cultivation in resource poor lands with minimum inputs, non-synchronous maturity and indeterminate growth habit. Greengram yield is also affected by insect-pests and diseases, especially by greengram yellow mosaic virus (MYMV) and *Cercospora* leaf spot (CLS). There is a strong need to develop the lines/varieties which give outstanding and consistent performance in *kharif* season over diverse environment. Development of varieties with high yield and stable performance is a prime target of all greengram improvement programmes. The total production of pulses in the world was 14.76 billion tones from the area of 14.25 billion hectares in the year 2013-14 while in India total pulses production was 19.78 million tons from the area of 23.63 million hectares in the year 2013-14. Whereas in Rajasthan, the total pulses production was 1.55 million tons from the area of 3.78 million hectares.

The greengram production among pulses was 3.73 lacs tons from the area of 8.85 hectares in Rajasthan in the year 20013-14. The major cultivation of greengram is based upon rainfed conditions (Govt. of Rajasthan, 2016-17). Pali district stands first rank in term of area and production of greengram in the state. In this district, the greengram crop is grown in an area of 2.46 lacs ha with an annual production of over 1.30 tones (Govt. of Rajasthan, 2016-17).

The Front Line Demonstration is an important method of transferring the latest package of practices in totality to farmers. By which, farmers learn latest technologies of oilseeds and pulses production under real farming situation at his own field, which may lead to higher adoption. Further, these demonstrations are designed carefully where provisions are made for speedy dissemination of demonstrated technology among 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 scientists are required to study, the factors contributing to higher crop production, field constraints of production and thereby generating production factor and feed-back information. 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 and to promote the FLD on greengram production.

Materials and Methods

In total 40 frontline demonstrations were conducted on farmers' field in villages Kishanagar, Bedkallan, Boyal, Kushalpura and Balara Jaitaran block of Pali district of Rajasthan, during *kharif* season 2015, 2016 and 2017 in raifed condition. Each demonstration was conducted on an area of 0.4 ha, and 1.0 ha area adjacent to the demonstration plot was kept as farmers' practices. The package of improved technologies like line sowing, nutrient management, seed treatment and whole package were used in the demonstrations. The variety of greengram IPM 2-03 was included in demonstrations methods used for the present study with respect to FLDs and farmers' practices are given in Table 1. In case of local check plots, existing practices being used by farmers were followed. In general, soils of the area under study were sandy loam and medium to low in fertility status. The spacing was 30 cm between rows and 10 cm between plants in the rows. The thinning and weeding was done invariably 30-35 days after sowing to ensure recommended plant spacing within a row because excess population adversely affects growth and yield of crop. Seed sowing was done in the first week of July with a seed rate of 15-20 kg/ha. Other management practices were applied as per the package of practices for *kharif* crops by Department of Agriculture, Agro-climatic Zone IIb Jalore (DOA, 2016). Data with respect to grain yield from FLD plots and from fields cultivated following local practices adopted by the farmers of the area were collected and evaluated. Potential yield was taken in to consideration on the basis of standard plant population (404440 plants/ha) and average yield per plant 22.5 gm/plant under recommended package of practices with 30 X 10 cm crop geometry (Chandra 2010) [1]. Different parameters as suggested by Yadav *et al.* (2004) [21] was used for gap analysis, and calculating the economic. The details of different parameters and formula adopted for analysis are as under:

Extension gap = Demonstration yield – Farmers' practice yield

Technology gap = Potential yield – Demonstration yield

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

Additional cost = demonstration Cost – $Farmers' Practice\ Cost$

Effective gain = Additional Returns – Additional cost

Additional returns = Demonstration returns – Farmers' practice returns

$$\text{Incremental B: C ratio} = \frac{Additional\ Returns}{Additional\ Cost}$$

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

Operation	Existing practice	Improved practices demonstrated
Line sowing	Broad casting of seed	Spacing 40 cm between rows and 10 cm between plants in the rows
Seed treatment	No seed treatment	Seed treatment with *Bavistin* 2gm/kg seed
Weed management	No weed management	Weeds control by using herbicide *Pendimethaline* 1kg/ha in 500 liter of water as pre-emergence treatment for effective control of weeds within two days after sowing.
Nutrient management	Only FYM and no fertilizer application	10 tons/ha farm yard manure and 20kg/ha nitrogen
Whole package	Farmers are cultivating the greengram 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 for raising the crop

Results and Discussion

Yield attributing traits

The number of productive pods per plant under improved technology were 25.8, 22.6 and 24.2 as against local check (farmers' practices), 19.7, 17.3 and 18.9 (Table 2) during the year 2015, 2016 and 2017, respectively. There was an increase of 30.9, 30.6 and 28.0 % in number of productive pods under demonstration of improved technology over farmers' practice. The average number of productive pods per plant in improved technology was 24.2 and 18.6 under farmers' practice, thus there were 29.8% more pods per plant under improved technology demonstrations. The findings confirm with the findings of Yadav *et al.* (2007) [22].

Table 2: Yield attributing traits of greengram

Year	Number of pods/plant			Number of seeds/pods			Seed weight (in 100 pods gm)		
	IT	FP	% increased	IT	FP	% increased	IT	FP	% increased
2015	25.8	19.7	30.9	10.5	6.7	56.7	55.7	39.8	39.9
2016	22.6	17.3	30.6	9.0	5.9	52.5	60.0	42.7	40.5
2017	24.2	18.9	28.0	9.5	6.5	46.1	55.0	35.4	55.4
Average	24.2	18.6	29.8	9.7	6.4	51.8	56.9	39.3	45.3

IT= Improved Technology; FP = Farmers Practice

Seed yield (kg/ha)

The productivity of greengram under improved production technology ranged between 920-1045 kg/ha with mean yields of 982 kg/ha (Table 3). The productivity under improved technology was 920, 1045 and 980 kg ha^{-1} during 2015, 2016 and 2017, respectively as against a yield range between 730 to 785 kg ha^{-1} under farmers' practice. In comparison to farmer's practice, there was an increase of 17.2, 43.2 and 30.2% in productivity of greengram under improved technologies in 2015, 2016 and 2017, respectively. The increased grain yield with improved technologies was mainly because of line sowing use of nutrient management and weed management. The findings are confirm with the findings of Singh and Meena (2011) [20], Poonia and Pithia (2011) [16], Meena *et al.* (2012) [11, 15], Meena and Singh (2016) [13] and Mahadik and Talathi (2016) [9].

Table 3: Seed yield of greengram as affected by improved and farmer practices in farmers' fields

Year	Area (ha)	Demonstration (No.)	Yield kg/ha		Additional yield (kg/ha) over farmer practice	% increased in yield over farmers' practice
			IT	FP		
2015	05.5	10	920	785	135	17.2
2016	10.5	15	1045	730	315	43.2
2017	10.5	15	980	750	230	30.2
Average	08.8	13.3	982	755	267	35.4

Gap analysis

Evaluation of findings of the study (Table 4) stated that an extension gap of 284 to 320 kg ha^{-1} was found between demonstrated technology and farmers' practice and on average basis the extension gap was 267 kg ha^{-1}. The extension gap was highest (315 kg ha^{-1}) during 2016 and lowest (135 kg ha^{-1}) during 2015. Such gap might be attributed to 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 study further exhibited a wide technology gap during different years. It was lowest (305 kg ha^{-1}) during 2016 and highest (430 kg ha^{-1}) during 2015. The average technology gap of all the years was 368 kg ha^{-1}. The difference in technology gap in different years is due to better performance of recommended varieties with different interventions and more feasibility of recommended technologies during the course of study.

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 three years study, overall 27.3% technical index was recorded, which was reduced from 31.9%, 22.6 and 27.4 during 2015, 2016 and 2017, respectively.. Hence, it can be inferred that the awareness and adoption of improved varieties with recommended scientific package of practices have increased during the advancement of study period. These findings are in the conformity of the results of study carried out by Chandra (2010) [1], Meena and Singh (2013) and Dayanand *et al.* (2012) [3].

Table 4: Technological gap analysis of frontline demonstrations on greengram farmers' field

Years	Number of FLDs	Potential yield ($kgha^{-1}$)	FLD yield ($kgha^{-1}$)	FP yield ($kgha^{-1}$)	% increased	EG (kgha-1)	TG ($kgha^{-1}$)	TI ($kgha^{-1}$)
2015	10.5	1350	920	785	17.2	135	430	31.9
2016	15.5	1350	1045	730	43.2	315	305	22.6
2017	15.5	1350	980	750	30.2	230	370	27.4
Average	08.8	1350	982	755	35.4	267	368	27.3

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

Economics

Different variables like seed, fertilizers, bio-fertilizers and pesticides were considered as cash input for the demonstrations as well as farmers practice and on an average additional investment of Rs. 1533 per ha was made under demonstrations. Economic returns as a function of gain yield and MPS sale price varied during different years. The maximum returns (Rs. 8784) during the year 2016 were obtained due to high grain yield and higher MPS sale rates as declared by GOI. The higher additional returns and effective gain obtained under demonstrations could be due to improved technology, non-monetary factors, timely operations of crop cultivation and scientific monitoring. The lowest and highest incremental benefit cost ratio (IBCR) were 5.7 and 3.1 in 2016 and 2017, respectively (Table 5) depends on produced grain yield and MPS sale rates. Overall average IBCR was found 4.3. The results confirm with the findings of front line demonstrations on pulses by Yadav *et al*. (2004) [21], Gauttam *et al.* (2011) [5], Lathwal (2010), Chaudhary (2011), Meena and Singh (2011) [12], Dayanand *et al.* (2012) [3], Meena and Dudi (2012) [11], Menaa and Singh (2017) [14] and Kumar *et al.* (2014) [7].

Table 5: Cost of cultivation (Rs./ha), net return (Rs./ha) and benefit: cost-ratio of greengram as affected by improved and farmers' practice

Years	Cost of cash input (Rs./ha)		Additional cost in demo. (Rs./ha)	Sale price (MSP) of grain (Rs./qtl.)	Total returns (Rs./ha)		Additional returns in demo. (Rs./ha)	Effective gain (Rs./ha)	INC B:C ratio (IBCR)
	IP	FP			IP	FP			
2015	6000	4500	1500	4500	41400	35100	6300	4800	4.2
2016	6300	5000	1300	4620	48510	39726	8784	7484	5.7
2017	7000	5200	1800	5000	49000	41500	7500	5700	3.1
Average	6433	4900	1533	4706	46303	38775	7528	5995	4.3

IT= Improved Technology; FP= Farmers Practices

Conclusion

It may be concluded that the frontline demonstrations conducted on greengram at the farmers' field revealed that the adoption of improved technologies significantly increased the yield as well as yield attributing traits of the crop and also the net returns to the farmers. So, 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 realizing for higher returns.

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