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Impact of cluster frontline demonstration on green gram (*Vigna radiata* L.) Production and contraints in Sikar District semi arid region of Rajasthan

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ABSTRACT

Green gram (*Vigna radiata* L.) is one of the most important short-duration pulse crop in India and plays a significant role in the improvement of soil fertility. Front line demonstration is an appropriate means for demonstration of improved technology and innovations in agriculture for large-scale popularization among the farming community. National Food Security Mission, a centrally sponsored scheme on Pulses, enabled KVK, Sikar to conduct Cluster Front Line Demonstrations on Green gram crop during 2016 to 2021 in 475 demonstration plots in 190 ha, not only to demonstrate improved technology for the yield enhancement with quality but to expand the area under crops (Pulse production) as Sikar district is dominated by Pearl millet crop.The present study was conducted in four blocks namely Dhod, Piprali, Laxmangarh and Fatehpur inSikar district of Rajasthan because maximum area sown under green gram. The findings of the study revealed that the demonstrated technology resulted in a mean yield of 9.28 q/ha as compared to farmers practices 7.64 q/ha. The average yield increased 21.30 per cent over farmer's practices during the six years. The result indicated that the front line demonstration has given a good impact on the farming community of the district about 10.97 q/ha. The higher average gross returns (Rs. 61114 /ha), net return (Rs. 42689/ ha) and effective gain (Rs. 6222/ha) with cost: benefit ratio (3.36) compared to farmers practice as gross return (Rs. 50675/ ha) and net return (Rs. 34358/ ha) with a higher cost: benefit ratio (3.11). The most important constraints 'lack of knowledge about integrated pest management'faced by 91.20 %, followed by high cost fungicides and pesticides (86.40%), lack of knowledge about proper seed treatment (77.60%), high cost of fertilizers (76.80%), lack of knowledge about proper seed rate (72.0%), lack of knowledge about improved varieties (67.20%) and erratic rainfall in the area (65.6%) were reported by green gram growers in rainfed situation. These constraints were responsible for partial and non-adoption of the improved package of practices of green gram in the district.

Key words: Constraints, Green gram, Lack of knowledge, Rainfed farming

Introduction

Green gram (*Vigna radiata* L.) commonly known as 'Mung', 'Mungbean' is one of the most important short duration pulse crop in India and the third important pulse crop after chickpea and pigeon pea (Ready, 2010). India is the major pulses producer country, accounting 25 per cent of global pulses production under 35 per cent of the total area. In a vegetarian country like India, where protein demand is fulfilled through pulses are the cheapest and most concentrated source of dietary amino acids, so it is also considered as "A poor

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man's meat". Pulses occupy a unique position in the world of agriculture by virtue of their high protein content, which is almost double than that of cereals. The requirements of pulses is expected to rise further mainly due to the increasing population and preference for pulses as the cheapest source of dietary protein. It contains 24.5 per cent protein and 59.9 per cent carbohydrate. It also contains 75 mg calcium, 8.5 mg iron and 49 mg Rcarotene per 100 g of split dual. The productivity of crop is below the average owing to several inherent soil related constraints such as low organic matter and poor soil fertility. Hence, it requires sincere efforts to enhance its productivity. The climatic change and global warming have deleterious effects on crop production in terms of the period of maturity and yield. Green gram also plays a significant role in sustainability, soil fertility by improving soil physical properties and leaves have a nitrogen effect on succeeding crops. The green gram held a great promise as a pulses crop because of its short duration, healthy, digestible protein quality and wide adaptability to the different agro-climatic regions and soil types. The green gram is mainly cultivated in *kharif* season (rainfed areas) in Sikar district. The annual world production area of mung bean is about 5.5 million hectares. India is the primary green gram producer and contributes about 75 percent of the world's production.

The production of Pulses in India is 25.23 million tones from an area of 29.99 million hectares and productivity is 841 kg/ha. In India green gram covers an area of 4.25 million hectares, production is 2.0 million tones and productivity is 472 kg/ha and the total share in production 7.96 %. (Anonymous, 2018-19).

In Rajasthan green gram grown in 2.46 million hectares area, production 1.6 million tones and productivity 496 $kgha^{-1}$ during *kharif* 2018. Whereas, the productivity of Sikar district 856 $kgha^{-1}$ which higher than state productivity (496 $kgha^{-1}$) during *kharif* 2020.

Indian government imports large quantity of pulses to fulfill domestic requirement of pulses. In this regard, to sustain this production and consumption system, the Department of Agriculture, Cooperation and Farmers Welfare had sanctioned the project "Cluster Frontline Demonstrations on kharif pulses from 2016'' to ICAR-ATARI, Jodhpur through National Food Security Mission-Pulses (NFSM) since 2016-17. The basic strategy of the Mission is to promote and extend improved crop management practices and innovative technology, i.e., quality seed, micro-nutrients, soil amendments, weed management, integrated pest management, irrigation scheduling along with capacity building of farmers. The ICAR through its Krishi Vigyan Kendras (KVKs) across the country has been implementing this CFLD programme on different pulse crops to boost the production and productivity of pulses with improved varieties and location specific technologies. This project was implemented by Krishi Vigyan Kendra, Sikar, as grass root level organization meant for application of technology through assessment, refinement and demonstration of proven technologies under different micro farming situation in a district. Keeping this in view, cluster front line demonstrations were organized in participatory mode to enhance the productivity and economic returns with the objective analyze the yield gaps and impact of technology on green gram cultivation on the newly recommended package of practice.

The main objective of front line demonstrations is to demonstrate newly released crop production technologies and its management practices in the farmers' field under different farming situations and at different agroclimatic regions. These demonstrations are carried out under the supervision of agricultural scientists. The newly and innovative technology having higher production potential under the specific cropping system can be popularized through FLD programme. The present study has been undertaken to evaluate the difference between demonstrated technologies vis-a-vis practices followed by the local farmers in green gram crop.

Research Methodology

The field experiments of 0.40 ha each were conducted in purposively selected four blocks namely Dhod, Piprali, Laxmangarh and Fatehpur of the Sikar district. In these selected blocks, 475 cluster front line demonstrations in 190 hectare area were conducted under rainfed farming situations in ten adopted villages during kharif-2016 to 2021 by KVK, Fatehpur-Sikar. The Demonstrations were conducted at farmers' field in ten adopted villages of Sikar district of Rajasthan under cluster frontline demonstration (CFLD) of National Food Security Mission (NFSM) during six consecutive Kharif seasons of 2016 to 2021, to evaluate economic feasibility of improved technology in green gram. Before conducting CFLDs, a list of farmers was prepared from group meeting and specific skill training was given to the selected farmers regarding package of practices. The difference between the demonstration package and existing farmers practices is given in Table 1. The improved technology demonstration included high yielding varieties, seed treatment, timely sowing, fertilizer management, plant protection measures and irrigation management. The sowing was done in the month of July. The spacing was 30x10 cm apart and the seed rate of green gram was 15 $kgha^{-1}$. The fertilizers were given as per soil testing value; however, the average recommended dose of fertilizer applied in the demo plots was 15 kg N, 40 kg P_2O_5, 0 kg K_2O and 25kg Zinc per hectare. The NPK fertilizers were applied through Urea, SSP elemental S respectively, at the time of sowing. The two sprays of $FeSO_4$ and $ZnSO_4$ were done due to deficiency occurring during the growth period of the crop. Soils under study were sandy in texture with a pH range of 8.4 to 8.8. The soils poor in available nitrogen, medium in phosphorous varied between 250-260 and 15-19kg ha^{-1}, respectively. However, the soils were deficient in micronutrients particularly, zinc and ferrous. In demonstration plots, critical inputs in the form of quality seeds of improved varieties, micronutrient fertilization, herbicide, timely sowing, and need-based of pesticides as well as, irrigation time were emphasized by the KVK, and comparison has been made with the existing practices (Table 1). The necessary step for the selection of site and farmers, and layout of the demonstration were followed as suggested by Chaudhary (1999).

All the participating farmers were trained on various aspects of green gram production technologies. Field days are organized with active involvement of state line departments to make awareness among farmers. Data on results of CFLDs collected by KVK Sikar from partner farmers where CFLDs were undertaken. Parameters on which data collected were total area demonstrations under CFLDs, yield under farmers practice and CFLDs, weighted mean, enhanced yields, gap minimized in comparison to district and potential yield, net return, benefit cost ratio, net income were calculated to draw meaningful results. The data were collected through personal interview schedule consisting of a set of questions related to package of practices, which were asked to the green gram growers by the investigator in face-to-face situation to give their response about constraints faced by them. The collected information on constraints were classified into technical, economical, plant protection & environmental related aspects. The extension gap, technology gap and technology index along with the incremental benefit-cost ratio were worked out (Raj *et al*., 2013, Katare *et al*., 2011 and Samui *et al*., 2000) as given below:

Extension gap= Demonstration yield- local yield

Technology gap= Potential yield – Demonstration yield

Technology index = (Potential yield – Demonstration yield x 100) / Potential yield

Effective gain = Additional Returns - Additional cost

Additional returns = Demonstration returns - Farmers' practice returns

B:C ratio = Gross returns/gross Cost

To identify the constraints faced by the green gram grower in the adoption of recommended package of practices, all 475 beneficiary farmers of ten villages were purposively selected where Cluster Front Line Demonstrations (CFLDs) were laid out during kharif-2016 to 2021 by KVK, Fatehpur-Sikar. The major constraints expressed by them were noted and categorized in five groups namely technical, economical, plant protection, environmental and other related aspect.

Results and Discussion

Differentiation in demonstration package and farmer practice in green gram crop Results of cluster front line demonstration indicate that major differences were observed between demonstration package and local farmer's practice regarding improved variety, proper seed rate, seed treatment, sowing method, nutrient management and plant protection measures. Table 1 show that under the demonstrated plot recommended improved variety, bio-fertilizers, herbicide and insecticide for plant protection measure were given to the farmers by the KVK and all other package and practices were timely performed by the farmer on participatory mode under the supervision of KVK scientists. Under farmer practice they generally show seed of green gram var. RMG-62 and SML-668, (Green Moti and Swati) at low seed rate without treatment. Similar findings have also been observed by Singh *et al.,* (2012), Raj *et al.,* (2013), Singh and Singh (2020) and Meena *et al.,* (2020).

Performance of CFLD programme on production and economics of green gram

Seed yield (q/ha). The average yield of CFLD was 9.28 q/ha as compared to farmers practices 7.64 q/ha. The average yield increased 21.30 per cent over farmers practices during the six years. The result indicated that the cluster frontline demonstration has given a good impact over the farming community of the district about 10.97 q/ha. The average highest yield has been recorded during 2016-17 year, while the average yield was 8.95 q/ha in farmers practices during the year 2016-17. The farmers of the district have been motivated by the improved agriculture technologies applied in the CFLD these findings are in corroboration with the finding of many others (Table 2). This finding is in corroboration with the findings of Poonia and Pithia (2010), Singh and Singh (2020). The results clearly showed positive response of CFLDs over the existing practices toward enhancing the yield of pulses in the region due to technological interventions effect on yield attributes. The above findings are in accordance with Dwivedi *et, al.* (2014), Singh *et al.* (2018), Mitnala *et al.* (2018), Saikia *et al.* (2018), Dwivedi *et al.* (2019) and Singh *et al.* (2020).

Extension gap

The highest extension gap of 2.04 qt/ha was recorded in 2020-21 and the lowest was observed in 0.89 qt/ha for 2017-18. This emphasized the need to educate the farmers through various means for the adoption of improved agricultural production technologies to reverse this trend of wide extension gap. More and more use of latest production technologies with high yielding variety will subsequently change this alarming trend of galloping extension gap. The new technologies will eventually lead to the farmers to discontinue the old technology and to adopt new technology (Table 2). It could be reduced through considerable coordination between researchers, extension workers and farmers. These findings are in line

Table 1. Package of practices followed by farmers under Cluster Front–line Demonstrations

Technology	Existing Farmer's practice	Recommended practices	Gap in practices in %
Variety	RMG-62, SML-668, (Green Moti & Swati)	IPM-02-03, IPM-02-14 & MH-421	45
Seed rate	12 kg/ha	15 kg/ha	75
Seed treatment	Partially seed treatment practice followed	Carbendazim 50% WP @ 2gm + 5 ml Rhizobium Culture/kg seed	70
Sowing method	30% farmers adopt Broadcasting & some adopt Mixed cropping	Line sowing 30 X 10 cm Single crop	35
Fertilizer mgt	40 % farmers are using Imbalance dose of fertilizer and no application of Micronutrients	N:P: K= 15: 40:00 (85 Kg/ha) Zinc sulphate @ 25kg/ha	60
Weed mgt	Only manual weeding	Use of weedicide Imazethapyr 10% SL@500 ml /ha. after 25 DAS	75
P.P. Measures Disease mgt	Not apply any fungicide (due to rainfed area)	Soil application of Trichoderma, Spray of Hexaconazole 5% SC @ 500ml /ha	90
Insect mgt	Improper use of Insecticides (Quinalphos 1.5% Dust and Dimethoate for control of Sucking Pest)	Spray of Imidacloprid 17.8% SL @ 250 ml/ha	50

with those of Suryavanshi *et al*., (2020), Patel and Sharma (2021) and Reager *et al*., (2020), Hiremath and Nagaraju, (2010).

Technology gap

The technology gap in the demonstration yield over potential yield was 4.39 qt/ha for green gram. The technological gap may be attributed to the dissimilarity in the soil fertility status and weather conditions (Meena *et al*., 2017) (Table 2).

During 2017 to 2019, demonstration of IPM 02-3 variety, the technology gap was highest (7.0 q/ha) during 2017-18 and lowest (2.42 q/ha) during 2018-19. Further, demonstration of MH 421 variety during 2020 to 2021, the technology gap was highest (5.60 q/ha) during 2020 and lowest (5.2 q/ha) during 2021. The difference in technology gap during different years of demonstration is due to better performance of recommended varieties with different interventions and more feasibility of recommended technologies during the demonstrations and some extent to variation in soil fertility and climate conditions. Hence, a location-specific recommendation appears to be necessary to bridge the technology gap. Similar findings were recorded by (Singh *et al*., 2012; Meena *et al*., (2020) and Patel *et al*., 2013) (Table 2).

Technology index

The technology index for all the demonstrations during different year were in accordance with technology gap. The highest technology index per cent of 53.85 was recorded in the year 2017-18 and the lowest was observed in the year 2016-17 which is 15.62 per cent. 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. The present findings confirm the Meena *et al*., (2012), Raj *et al*. (2013) and Meena and Singh (2017). This may be attributed due to dissimilarity in soil fertility status, variation in climate, insect-pests and disease attacks. These findings are in conformity of the results of study carried out by Meena and Singh (2017), Dwivedi *et al*. (2019), Reager *et al*., (2020) and Dayanand *et al*., (2012). They found more grain yield of CFLD plots than the existing practices.

Table 2. Performance of green gram in improved and farmer practices through cluster front line demonstration at farmer field in Sikar district of Rajasthan

Year	Varieties	No. of demo.	Area (ha.)	Potential Yield Qt	Av. Yield (q/ha)		% increase over local	Av. yield of district (q/ha)	Extension Yield gap (q/ha)	Techno-logy yield gap (q/ha)	Techno-logy index %
					Dem.	Local					
2016-17	SML 668	75	30	13	10.97	8.95	22.57	5.20	2.02	2.03	15.62
2017-18	IPM 02-3	125	50	13	6.00	5.11	17.42	6.37	0.89	7.00	53.85
2018-19	IPM 02-3	125	50	13	10.58	8.94	18.34	7.01	1.64	2.42	18.62
2019-20	IPM 02-3	50	20	13	8.91	7.58	17.55	6.21	1.33	4.09	31.46
2020-21	MH 421	50	20	15	9.40	7.36	27.72	6.50	2.04	5.60	37.33
2021-22	MH 421	50	20	15	9.80	7.89	24.21	6.45	1.91	5.20	34.67
Average		**475**	**190**	**14**	**9.28**	**7.64**	**21.30**	**6.29**	**1.64**	**4.39**	**32.12**

Table 3. Economic analysis of CFLDs in green gram in Sikar district of Rajasthan

Year	Cost of cultivation (Rs./ha)		Additional cost (Rs.)	Gross return (Rs. /ha)		Net return (Rs. /ha)		Additional returns (Rs.)	Effective gain (Rs.)	B:C Ratio	
	Demo	Local		Demo	Local	Demo	Local			Demon.	Local
2016-17	18400	16000	2400	52665	42630	34265	26630	7635	5235	3.29	2.86
2017-18	16950	14900	2050	29400	24822	12450	9922	2528	478	1.73	1.67
2018-19	18700	16300	2400	75374	63541	56674	47241	9433	7033	4.03	3.90
2019-20	18200	16250	1950	56260	47580	38060	31330	6730	4780	3.09	2.93
2020-21	18900	16850	2050	79060	64515	60160	47665	12495	10445	4.18	3.83
2021-22	19400	17600	1800	73924	60961	54524	43361	11163	9363	3.81	3.46
Total/Av.	18425	16317	2108	61114	50675	42689	34358	8331	6222	3.36	3.11

Economic analysis

The input and output prices of commodities prevailed during the demonstration were taken for calculating gross return, cost of cultivation, net return, effective gain and benefit cost ratio. Use of pricey seeds for crops, sowing date, sowing method, seed rate, seed treatment, recommended dose of fertilizer, Integrated pest management etc., all of these are the main reasons for high cost of cultivation in demonstration fields than local check. Therefore, the average cost of cultivation of 6 years increased in demonstration practices 18425 Rs/ha as compared to farmer practices 16317 Rs/ha (Table 3). The Cluster front line demonstrations recorded higher average gross returns (Rs. 61114 /ha), net return (Rs. 42689/ ha) and effective gain (Rs. 6222/ha) with cost: benefit ratio (3.36) compared to farmers practice as gross return (Rs. 50675/ ha) and net return (Rs. 34358/ha) with higher cost: benefit ratio (3.11). The present findings are in accordance with study of Hiremath and Nagaraju (2010), Kiresur (2011), Kumar (2015), Singh and Singh (2020) and Meena *et al.*, (2020).

Constraints faced by green gram growers

The various constraints faced by the green gram growers are presented in Table 4. The constraints in adoption of any new technology never end. The constraints expressed by them were noted and categorized in five groups namely technical, economical, plant protection, environmental and other related aspects. In case of technological constraints mostly 'Lack of knowledge about proper seed treatment (77.60%) and followed by 'Lack of knowledge about proper seed rate (72.60%), 'Lack of knowledge about improved varieties (67.20%) 'Lack of knowledge about herbicide and their use (64.0%), 'Technical staff (Ag Supervisor) working in the field are not available when needed (52.0%), 'Lack of knowledge about sources of improved varieties seed (51.2%) and Lack of knowledge about recommended dose of fertilizer and their application methods (38.4%) were faced by farmers. Similar finding related to the present work was carried out by Patodiya and Sharma (2014).

It is observed from Table 4 that maximum re-

Table 4. Constraints faced by green gram growers in the adoption of improved package of practices N=475

S. No.	Constraints	Frequency	Per cent	Rank
A	**Technical constraints**			
1	Lack of knowledge about improved varieties	319	67.2	III
2	Lack of knowledge about sources of improved varieties seed	243	51.2	VI
3	Lack of knowledge about proper seed rate	342	72	II
4	Lack of knowledge about proper seed treatment	369	77.6	I
5	Lack of knowledge about recommended dose of fertilizer and their application methods	182	38.4	VII
6	Lack of knowledge about herbicide & their use	304	64	IV
7	Technical staff (Ag Supervisor) working in the field are not available when needed	247	52	V
B	**Economic Constraints**			
1	High seed cost	289	60.8	III
2	High cost of fertilizer	365	76.8	I
3	Non- availability of fertilizer in proper time	274	57.6	IV
4	Low market price at the time of crop harvest	308	64.8	II
C	**Plant protection related constraints**			
1	Lack of knowledge about recommended IPM	433	91.2	I
2	Less information about sucking pest control	388	81.6	III
3	High cost of fungicide & insecticide	410	86.4	II
D	**Environmental related constraints**			
1	Sowing is not in the time because of uncertainty of rainfall	255	53.6	II
2	Erratic rainfall in the area	312	65.6	I
E	**Misc. constraints**			
1	Non- availability of storage facility	175	36.8	II
2	Non- availability of sprayer & dusters	239	50.4	I

spondents 91.20 per cent were ranked I[st] order in plant protection related constraints lacking of knowledge about integrated pest management followed by high cost of fungicide and pesticides, less information about sucking pest control, lack of knowledge about proper seed treatment were perceived by 86.40 and 81.60 per cent farmers, respectively and as such they were ranked II, and III in their rank order. Similar findings to the present investigation was given by Mane (2012).

In case of economical related major constraints reported by farmers was 'High cost of fertilizer (76.8%) ranked Ist and followed by Low market price at the time of crop harvest (64.8%), High seed cost (60.8%) and Non- availability of fertilizer in proper time (57.6%), were ranked II, III and IV in their rank order. Similar findings to the present investigation was given by Singh and Jat (2014).

In case of environmental related constrains reported by farmers was 'Erratic rainfall in the area (65.6%) ranked I[st] and followed by Sowing in not in the time because of uncertainity of rainfall (53.6%) was ranked II in their rank order. Similar findings to the present investigation was given by Mane (2012) .

In case of miscellaneous other constrains reported by farmers was 'Non- availability of sprayer and dusters (50.4%) ranked I[st] and followed by Non- availability of storage facility (36.8%) was ranked II[nd] in their rank order. Similar work related to the present investigation was carried out by Kadam *et al*. (2014) and Bhati *et al* (2016).

Conclusion

It is concluded that the CFLD programme is an effective tool for increasing area, production and productivity of pulses and changing the knowledge, attitude and skill of farmers on the adoption of improved technologies. The per cent increment in yield of green gram to the extent of 17.42 to 27.72 percent in Green gram CFLDs over the check plots created greater awareness and motivated the other farmers to adopt the improved package of practices of pulses. These demonstrations also built the relationship and confidence between farmers and scientists. The beneficiary farmers of CFLDs also played an important role as source of information on the quality of seeds for wider dissemination of high yielding varieties of greengram for other nearby farmers. B:C ratio of both the green gram crop was higher over farmer practices.

For wide dissemination of improved technologies Horizontal spread of improved technologies may be achieved by the successful implementation of frontline demonstrations and various extensions activities like training programme, field day, exposure visit organized in CFLDs programmes in the farmer's fields. For the wide dissemination of improved technologies recommended by SAUs and other research institutes, more number of front line demonstrations should be conducted. Adoption of improved technology of green gram cultivation can reduce the technology gap to a considerable extent thus leading to increased productivity of green gram in the Sikar district of Rajasthan.

It was concluded from the study that major constraints faced by the majority (91.20%) of green gram growers were ranked I[st] order in plant protection measures related constraints like 'lacking of knowledge about integrated pest management' followed by high cost of fungicide and pesticides (86.40%), less information about sucking pest control (81.6%), lack of knowledge about proper seed treatment (77.60%), high cost of fertilizers (76.80%), lack of knowledge about proper seed rate (72.0%), lack of knowledge about improved varieties (67.20%) and low and erratic rainfall (65.6%) in the area were faced important constraints responsible for partial or non-adoption of improved package of practices of green gram in the district to achieve significant production of pulses in rainfed situations.

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