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RESEARCH PAPER

Economic evaluation of cluster front line demonstrations on chickpea (*Cicer arietinum* L.) in Faridkot district of South Western Punjab

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Abstract : A study was conducted in South Western Punjab (India) during 2016-18 to assess the economic performance of clusterwise front line demonstration on chickpea (var PBG-7). One hundred ninety five front line demonstrations (FLDs) were conducted at farmers' fields to demonstrate the effect of improved technologies on the productivity of chickpea using cluster village approach in Faridkot district of Punjab during *Rabi* 2016-17 and 2017-18. The productivity of chickpea under demonstration plots ranged between 11.9 to 13.2 q and 12.2 to 14.1 q/ha during year 2016-17 and 2017-18, respectively, whereas, under farmers' practice the productivity varied from 9.5 to 10.7 q and 9.0 to 11.2 q/ha for respective years. The extension gap in the demonstration plots over potential yield was the lowest *i.e.*, 1.8 q/ha in cluster I, whereas, the highest extension gap was recorded in cluster II (3.35q/ha) while the average extension gap over all the clusters was 2.57q/ha. The highest value of technology gap of 7.95 q/ha was recorded in cluster I, however, the least value was recorded in cluster IV (6.35) with the average technology gap of 7.10 q/ha over all the clusters. The technology index (%) was 31.75 for cluster IV, 33.50 for V, 35.5 for III, 37.0 for II and the highest, 39.75 per cent for cluster I, while, the mean technology index was 35.5 per cent. The value of net returns per ha under demonstration plots was Rs. 23550 and Rs. 26310, whereas, farmers practice gave net returns of Rs.14110 and Rs.14180 per ha, respectively, for the years 2016-17 and 2017-18. The benefit : cost ratio ranged from 1.80 to 2.00 for 2016-17 and 1.81 to 2.10 for 2017-18 under demonstration plots while the value of same varied between 1.42 to 1.59 and 1.31 to 1.63 under farmers' practice for year 2016-17 and 2017-18, respectively.

Key Words : Cluster front line demonstrations, Chickpea, Productivity, Economic evaluation

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INTRODUCTION

Protein malnutrition is prevalent among men, women and children in India. Pulses contribute 11 per cent of the total intake of proteins in India (Reddy, 2010). That's why, pulses, popularly known as 'poor man's meet' are considered an important source of protein, vitamins and minerals (Singh *et al.*, 2015). In India, frequency of

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pulses consumption is much higher than any other source of protein, which indicates that it is important to increase pulses production to ensure balanced diet among the socially and economically backward classes. More importantly, the 20 per cent demand of pulses in India is met by imports only. Being the largest producer and consumers of pulses, India accounts for 29 per cent of the world area and 19 per cent of the world production (19.5 MT) of pulses. By 2050, the domestic needs of pulses would be 26.5 MT, necessitating stepping up production by 81.5 per cent *i.e.* 11.9 MT additional produce at 1.86 per cent annual growth rates (Singh *et al.*, 2013).

The chickpea is a prime pulse crop of India, producing about 5.67 MT from 5.81 m ha area. Its cultivation is known to have several advantages *viz.*, it can be grown under limited moisture conditions and with limited inputs, secondly its ability to fix atmospheric nitrogen, thereby improving the soil fertility.

As wheat is being grown predominantly during *Rabi* season in Punjab, chickpea is cultivated on otherwise marginal land just to fulfill domestic needs. In spite of number of improved varieties and production technologies, the full potential of these varieties and technologies could not be tapped due to low rate of adoption and low yield. The gap between recommendations made by the scientists and actual use by farmers is frequently encountered. To address these challenges, there is dire need to transfer the effective farm technology to the end users for wider adoption among farmers to raise their productivity, farm gains, and livelihood (Choudhary *et al.*, 2009).

To sustain the production, productivity and consumption of chickpea, changing the knowledge, attitude and skill of farmers, Department of Agriculture, Co-operation and Farmer Welfare, GOI initiated the project Cluster Front line Demonstrations through National Food Security Mission. Krishi Vigyan Kendra Faridkot, implemented the project with the objective to boost the production and productivity demonstrating site specific improved technologies.

MATERIAL AND METHODS

The study was conducted in Faridkot district of Punjab situated between N 30° 40’ 41.4” and E 74° 44’ 22.3” during *Rabi* 2016-17 and 2017-18. During this period 195 front line demonstrations (FLDs) were conducted by Krishi Vigyan Kendra, Faridkot on chick pea (variety PBG-7) to demonstrate the improved production technologies of crop covering an area of 20 hectare during each year. Farmers were selected making five clusters of 34 villages in two blocks *i.e*. Kotkapura and Faridkot blocks of district through survey, group meetings and conducting discussions with them. The necessary steps for selection of site, selection of farmers, layout of demonstrations etc were followed as suggested by Choudhary (1999). Selected farmers were guided about improved production technology recommended by Punjab Agricultural University, Ludhiana through training programmes, farm literature and personal contact method for conducting front line demonstrations at their fields. Existing local cultivation practices were followed in case of check plots. Regular visits by KVK scientists to FLD plots were made to supervise various important farm operations in these FLDs. Extension activities like group meetings and field days were also organized at the demonstration sites so as to provide opportunities for other farmers of the area to interact and to seek benefits from these demonstrations. Feedback from the farmers was taken so that further research and extension activities

Table A : Comparison between demonstration package and existing farmers’ practices of chickpea

Particulars	Demonstration package	Farmers’ practice
Farming situation	Irrigated/ Medium soil	Irrigated/ Medium soil
Varieties	Recommended variety of PAU (PBG-7)	Non descriptive variety
Time of sowing	Mid October to Mid November	End of November
Seed rate (kg/ha)	40 kg	50 kg
Seed treatment	Captan / Thiram (3 g/kg seed)	Absent
Seed inoculation	Rhizobium and Mesorhizobium	Absent
Sowing method	Drill at 30 cm row to row spacing	Broadcast/Drill
Fertilizer application	As per recommendations of PAU or on soil test based (33 kg Urea and 125 kg SSP per ha)	Urea (60-75 kg/ha)
Plant protection	Need-based use of recommended pesticides	Blanket sprays of chemicals for insect pest management

could be taken up. The soil samples were collected and analyzed for soil parameters *viz.*, pH, EC (dsm^{-1}), OC (%), available P (Olsen) and available K (NH_4OAc-extractable) to obtain information of cluster wise fertility status of plots under front line demonstrations.

The data were collected both in FLDs as well as check plots and the extension gap, technology gap, technology index and benefit-cost ratio were worked out by using the formula as suggested by Samui *et al*. (2000).

$$\text{Extension gap (q/ha)} = \text{Demonstration yield (q/ha)} - \text{Farmers' yield (q/ha)}$$

$$\text{Technology gap (q/ha)} = \text{Potential yield (q/ha)} - \text{Demonstration yield (q/ha)}$$

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

$$\text{Per cent increase in yield} = \frac{\text{Demonstration yield} - \text{Farmers' yield}}{\text{Farmers' yield}} \times 100$$

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Seed yield:

The yield data recorded for the year 2016-17 and 2017-18 under front line demonstrations of chickpea (variety PBG-7) in various clusters are presented in Table 1. The productivity of chickpea under improved production technology ranged between 11.9 to 13.2 q/ha and 12.2 to 14.1 q per ha during year 2016-17 and 2017-18, respectively, whereas, under farmers' practice the seed yield varied from 9.5 to 10.7 q and 9.0 to 11.2 q/ha for the year 2016-17 and 2017-18, respectively. The pooled data advocated that over the clusters, cluster IV in Kotkapura block of the district Faridkot produced the highest average yield (13.65 q/ha) under technology demonstrated which was 25.80 per cent higher than farmers' practice (10.85 q/ha) in the cluster IV. It may be attributed due to timely sowing, improved soil health and adoption of site specific improved management practices. Higher weed infestation, injudicious use of nutrients and water under farmers' practice led to lower yield. The results corroborate with the findings of Singh *et al*. (2017) who reported the superiority of row planting over broadcasting to control weed, which resulted in considerable yield increase. Moreover, application of balanced fertilizers along with seed inoculation with *Rhizobium* culture contributed towards the improvement in yield over farmer's practice, where only urea fertilizer was applied. Similar results were reported by Singh *et al*. (2014) as they reported increase in yield of pulses through improved fertilizer application practices.

Extension gap:

The extension gap in the demonstration yield over potential yield was the lowest *i.e.* 1.8 q/ha in cluster I where the highest extension gap was recorded in cluster II (3.35q/ha) while 2.3, 2.8 and 2.6 q/ha extension gap was observed in cluster III, IV and V, respectively. This emphasized the need to motivate the farmers for adoption of improved agricultural production technologies to reverse this trend of wide extension gap. The new technologies will eventually encourage the farmers to discontinue the old technology and to adopt new technology (Hiremath and Nagaraju, 2010). These observations are in similarity with the findings of Poonia and Pithia (2011). Dhakad *et al.*(2018) reported that more and more use of latest production technologies with high yielding varieties will subsequently change this alarming trend of galloping extension gap.

Table 1 : Productivity of chickpea (*Cicer arietinum* L.) under cluster front line demonstrations

Cluster	Block	Demonstration plot (q/ha)			Farmer's practice (q/ha)			Increase in yield (%)	Extension gap (q/ha)	Technology gap (q/ha)	Technology index (%)	Number of demonstration	
		2017	2018	Pooled yield	2017	2018	Pooled yield					2017	2018
I	Faridkot	11.9	12.2	12.05	10	10.5	10.25	17.56	1.8	7.95	39.75	7	21
II	Faridkot	12.3	12.9	12.6	9.5	9	9.25	36.22	3.35	7.4	37.00	15	29
III	Faridkot	12.4	13.4	12.9	10.5	10.7	10.6	21.70	2.3	7.1	35.50	8	12
IV	Kotkapoora	13.2	14.1	13.65	10.5	11.2	10.85	25.81	2.8	6.35	31.75	16	24
V	Kotkapoora	12.7	13.9	13.3	10.7	10.7	10.7	24.30	2.6	6.7	33.50	36	27
	Average	12.5	13.3	12.9	10.2	10.5	10.4	24.03	2.5	7.10	35.50	82	113

Technology gap:

The highest value of technology gap to the tune of 7.95 q/ha was recorded in cluster I followed by cluster II (7.4 q/ha), III (7.1 q/ha), V (6.7 q/ha) and the least was in cluster IV (6.35 q/ha). This might be attributed to adoption of improved technology practices such as proper seed rate, nutrient management, weed control and pest management etc. in demonstrated plots. The variation of technology gap among the clusters and blocks may also be attributed to the heterogeneity of the soil fertility status, variability in time of sowing and prevalent weather conditions. The FLD produces a significant positive result and provided the researcher an opportunity to demonstrate the productivity potential and profitability of the improved technology under real farming situation. Similar findings were reported by Kirar *et al*. (2006) and Singh *et al.* (2014).

Technology index:

The technology index shows the feasibility of the evolved technology at the farmer's fields and the lower the value of technology index more is the feasibility of the technology (Jeengar *et al*., 2006). The technology index was 31.7, 33.5, 35.5, 37.0 and 39.7 per cent for cluster IV, V, III, II and I, respectively while the mean technology index was 35.5 (Table 1). The data shows the potential to accelerate the adoption of demonstrated technical intervention to increase the yield performance of chickpea. Similar opinion was also recorded by Dhakad *et al.* (2018) and Singh *et al.* (2015) that there is a tremendous opportunity for increasing productivity of pulses by adopting improved technologies.

Economic performance:

The economic analysis of CFLDs was presented in Table 2. The data reported that the technology demonstrated gave average gross returns to the tune of Rs. 50000 and Rs. 53200 per hectare for year 2016-17 and 2017-18, respectively, whereas under farmers practice the average gross returns were Rs. 40960 and Rs. 41680 per hectare for the year 2016-17 and 2017-18, respectively. The highest net returns observed were Rs. 26350 (2016-17) and Rs. 29510 (2017-18) in cluster IV. The average value of net returns under demonstration plots was Rs. 23550 and Rs. 26310, whereas, farmers practice gave net return of Rs. 14110 and Rs. 14180 per hactare for the year 2016-17 and 2017-18, respectively. The incremental value of benefit : cost ratio ranged from 1.80 to 2.00 for 2016-17 and 1.81 to 2.10 for 2017-18 under demonstration plots while the value of same under farmer's practices varied between 1.42 to 1.59 and 1.31 to 1.63 for year 2016-17 and 2017-18, respectively. This may be due to higher yields obtained under improved technologies compared to local check. This finding is in corroboration with the findings of Mokidue *et al*. (2011) and Raj *et al*.

Table 2 : Economic performance of cluster front line demonstration of chickpea

Cluster	Demonstration plot								Farmer's plot							
	Gross cost (Rs.)		Gross returns (Rs.)		Net returns (Rs.)		B:C ratio		Gross cost (Rs.)		Gross returns (Rs.)		Net returns (Rs.)		B:C ratio	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
I	26450	26890	47600	48800	21150	21910	1.80	1.81	26850	27500	40000	42000	13150	14500	1.49	1.53
II	26450	26890	49200	51600	22750	24710	1.86	1.92	26850	27500	38000	36000	11150	8500	1.42	1.31
III	26450	26890	49600	53600	23150	26710	1.88	1.99	26850	27500	42000	42800	15150	15300	1.56	1.56
IV	26450	26890	52800	56400	26350	29510	2.00	2.10	26850	27500	42000	44800	15150	17300	1.56	1.63
V	26450	26890	50800	55600	24350	28710	1.92	2.07	26850	27500	42800	42800	15950	15300	1.59	1.56
Average	26450	26890	50000	53200	23550	26310	1.89	1.98	26850	27500	40960	41680	14110	14180	1.53	1.52

Table 3: Cluster wise analysis of soil properties under cluster front line demonstrations

Cluster	pH	EC (dsm^{-1})	OC (%)	P_2O_5 (kg/ha)	K_2O (kg/acre)
I	8.05-8.15	0.34-0.61	0.40-0.46	15.2-16.5	165-231.5
II	8.15-8.21	0.3-0.52	0.49-0.59	15.4-16.8	145.7-213.8
III	8.11-8.31	0.21-0.39	0.35-0.51	15.6-18.5	141.5-174.5
IV	7.82-8.05	0.15-0.24	0.52-0.69	19.2-20.4	125.2-165.5
V	7.95-8.05	0.15-0.31	0.45-0.55	20.2-22.4	231-235.6

(2013). These results are also in line as reported by Balai *et al.* (2012).

Productivity as affected by soil parameters:

The Table 3 depicted the soil fertility status of plots selected for conducting demonstrations. The organic carbon content of soil varied from as low as 0.35 in cluster III to as high as 0.69 in cluster IV. The yield of chick pea was observed also higher in cluster IV (13.65 q/ha) under demonstration as well as under farmer's practice (10.85q/ha). It was observed that clusters IV and V have well drained loamy soils with higher organic carbon content in comparison to clusters of block Faridkot leading to improvement in yield.

In present scenario, gram is usually grown on the marginal land under drought stress imposing yield restrictions. With the function of biological N fixation in association with rhizobial strains, chickpea could be considered as an excellent rotation and intercropping crop by improving soil fertility and structure in agricultural production system (Khaitov *et al.*, 2016). Legume cropping systems that increase soil fertility, concurrently, enhance plant productivity and prevent deterioration of soil health (Egamberdieva *et al.*, 2014). Incorporating of legume crops in crop rotation system increases the yield of subsequent crops. This might be reasoned that inoculation with *Rhizobium* could improve N nutrition, promote vegetative growth, particularly root growth, as well as benefit root uptake from soil in chickpea. Similar observations reported in other studies where inoculation of chickpea with rhizobia increased plant growth, dry matter, number of pods, seed yield and nitrogen fixation under various climatic conditions (Fatima *et al*., 2008).

As under demonstrations, crop was fertilized with P_2O_5, there after increased level of available nitrogen attributed to the fact that ample supply of phosphorus in soil provides a congenial environment in rhizosphere for microbial population and mineralization through its "energy currency' functions. Besides, on addition of fertilizer to the soil, there might be a sort of triggering action on native soil P, resulting in increased availability. In alkaline soils phosphatase activities are enhanced which also led to increase phosphorus availability, moreover, increased P availability showed synergistic effect on N and P Similar findings were reported by Khoja *et al.* (2002) and Balai *et al*. (2017).

Therefore, location specific application of integrated nutrients and inclusion of legumes not only improves the physico-chemical conditions of soil but also enhances the productivity for sustaining livelihood.

Conclusion:

It is observed that the poor resource availability coupled with low risk bearing ability of the farmers, forced the cultivation of chickpea to be practiced on otherwise marginal land, restricting to tap the potential of improved variety. Therefore, there is a dire need to conduct mass demonstrations of improved technological interventions to enhance the productivity of chickpea adopting cluster village approach. From the results of front line demonstrations, it is concluded that the FLD programme is an effective tool for increasing the production and productivity of chickpea crop and changing the knowledge, attribute and skill of farmers, helped in replacement of unrecommended varieties with improved recommended varieties. The per cent increment in yield of chickpea to the extent of 17.56 to 36.22 per cent in FLDs over the farmers practice created awareness and motivated the other farmers to adopt the improved package of practices of chickpea.

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