RESEARCH ARTICLE

IMPACT OF FRONTLINE DEMONSTRATIONS ON CHICKPEA (*CICER ARIETINUM*) PRODUCTION, PRODUCTIVITY AND PROFITABILITY IN TRANSITIONAL PLAIN OF INLAND DRAINAGE ZONE OF RAJASTHAN

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Abstract: Pulses are well known richest source of vegetable protein and poor man's food because of its essential component of diet. The frontline demonstrations of chickpea crop was carried out by Krishi Vigyan Kendra, Nagaur-I, Agriculture University, Jodhpur during rabi seasons from 2011-12 to 2019-20 on 178.5 ha area with 382 demonstrations in different clusters of Nagaur district of Rajasthan. The results shows that demonstrations produced on an average 18.02 q/ha grain yield of chickpea, which was 24.18 per cent higher as compared to prevailing farmers practice (14.51 q/ha). The front line demonstrations fetched more average gross returns (Rs.60161/ha), net return (Rs. 37963/ha) and B:C ratio (2.76) with slightly higher investment on cost of cultivation (Rs.1663/ha) as compared to farmers practice. The increase in gross and net returns was in the tune of Rs.11960 and Rs. 10285 per hectare with incremental benefit: cost ratio of 0.33. The average extension gap, technology gap and technology index was 350kg/ha, 608 kg/ha and 25.2 per cent, respectively. It is also observed that majority of the respondent farmers expressed high (51.83%) to the medium (32.72%) level of satisfaction regarding the performance of chickpea under demonstrations.

Keywords: Chickpea, Front Line Demonstrations, Gap, Return, Satisfaction, Yield

INTRODUCTION

In terms of agricultural importance, pulses are next to cereal crops and are also known as excellent option for agriculture diversification and intensification in sustainable farming. India is the largest producer and consumer of pulses and contribute in about 35 per cent share in global area and production. India is the largest chickpea producing country, which is accounting for 64% of the global chickpea production (Gaur *et al*. 2010). In India, chickpea crop was grown in an area of 9.93 million hectares with the production of 9.53 million tons and the productivity of 960 kg/ha (Anonymous, 2014). In Rajasthan state chickpea crop grown in an area of 12.35 lakh hectare with production of 7.50 lakh tones and productivity of 607 kg.ha (Kumar and Kumawat, 2019). In Nagaur district, it is grown in an area of 0.80 lakh hectares and 0.10 lakh tones production and 1004 kg/ha productivity.

Over the last six years, the on-going National Food Security Mission (NFSM) has been converged with multi-pronged strategies to enhance the production and productivity of pulses in the country (Anonymous, 2018) which results in enhanced per hectare productivity. The year 2017-18 witnessed a record pulse production of 25.23 million tonnes (Anonymous, 2018), a grand success story and revolution in pulses self-sufficiency.

The country is now trying to meet the target of 35 million tonnes by 2030 with the challenging reasons like unavailability of quality seed, lack of technical guidance, ignorance of Integrated Pest Management techniques and non-adoption of integrated nutrient management (Kumar *et al*. 2014; 2016). Besides this, major abiotic stress *i.e.* low organic content in soil, low moisture content in the soil, types of soils, seasonal drought due to low rainfall are also responsible for low productivity of the pulses crops (Dubey *et al*. 2017). Among biotic stress, legume pod borer, *Helicoverpa armigera* (Hübner) is responsible for 50 to 60 per cent grain yield losses (Balikai *et al*. 2001) and losses exceeded Rs.12,000 million per year (Anonymous, 1996). Therefore, it is a great deal for extension scientists, policy makers, and farming community to meet out the pulses availability demand over the country population in terms of household nutritional security.

To overcome the pulses hunger, government tried to improving pulses production and productivity in the country with Indian Council of Agricultural Research by taking major big step for the same by conducting Cluster Frontline Demonstrations nationwide through Krishi Vigyan Kendras with the mandate of out scaling of farm innovations through FLDs to highlight the specific benefits/ worth of technologies on farmer's fields. Besides this, various programmes like Technology Mission in 1986, National Pulse Development Project in 1990-91, Integrated Scheme of Oilseeds, Pulses, Oil palm, and Maize in 2004, National Food Security Mission in 2007-08 and Accelerated Pulses Production Programme (A3P) has

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been started by the government (Kumar *et al*. 2018) but gap between demand and supply is still bigger and this demand gap is tried to overcome through import of pulses.

The utmost objective of the frontline demonstration is to large scale technological demonstrate latest technologies of crop production and management practices under diverse climatic conditions as well as farming situations to fill the per cent yield gap. Therefore, the effect of frontline demonstrations on production and productivity of chickpea crop has been studied in Transitional plain of Inland drainage zone of Rajasthan.

MATERIALS AND METHODS

Front line demonstrations on chickpea were conducted by Krishi Vigyan Kendra, Nagaur-I, Agriculture University, Jodhpur during *rabi* seasons from 2011-12 to 2019-20. Total 382 demonstrations on 178.5 ha area were conducted in different clusters in Nagaur district. Nagaur district falls under agro climatic zone II-A called as transitional plans of inland drainage and situated between 260.25” to 270.40” North latitude and 730.18” to 750.15” East longitude. The average rainfall of the zone is 360 mm. In general, soils of the area under study were sandy to sandy loam in texture with average pH 7.7, organic carbon 0.34, low in nitrogen and medium in phosphorus and potash.

Cluster selections, farmer selection, problem diagnosis, layout of demonstration were carried out according to Choudhary (1999). Assessment of gap in adoption of recommended technology was done before laying out FLD’s through personal discussion with selected farmers (Table 1). Trainings was organized about detailed technological intervention with improved package and practice for successful cultivation of pulses. In the demonstrated FLDs the recommended package of practices were followed for crop cultivation and compared with the farmer’s practices (Table 1). In case of farmers practice plots, existing practices being used by farmers were followed.

Scientists visited regularly demonstrated fields and farmer’s fields. The feedback information from the farmers was also recorded for further improvement in research and extension programmes. The extension activities i.e. trainings, interaction with farmers and field days were organized at the cluster frontline demonstration sites. The basic information were recorded from the farmer’s field and analyzed to comparative performance of demonstrated plot and local check. Data on yield parameters from demonstrated plots and farmers practices were collected by random crop cutting method.

The technology gap, extension gap and technology index were calculated using the following formulae given by (Samui *et al*., 2000).

Technology gap = Potential yield - Demonstration yield

Extension gap = Demonstration yield - yield under existing practice

Technology index = {(Potential yield - Demonstration yield)/Potential yield} x 100

The satisfaction level of participating as well as neighbouring farmers’ for the performance of improved variety demonstrated was also assessed. In all, 382 participating farmers’ were selected to measure satisfaction level of farmers’ for the performance of improved variety demonstrated. The selected respondents were interviewed personally with the help of a pre-tested and well structured interview schedule. Client Satisfaction Index was calculated as below.

Client satisfaction index = (Individual score obtained/ Maximum score possible) x 100

The data collected were tabulated and statistically analyzed to interpret the results. The economic-parameters (gross return, net return and C: B ratio) were worked out on the basis of prevailing market prices of inputs and Minimum Support Prices of outputs.

Table 1. Technologies demonstrated under pulses FLDs and farmer’s practices

Components	Demonstration of recommended technology	Farmer’s practices	Gap analysis (%)
*Variety(s)	GNG-1581, RSG-974, GNG-1958	Local/old variety (RSG 896)	50-60
*Seed rate	75 kg/ha	90-95 kg/ha	50-55
*Seed treatment	*Trichoderma viride* @ 6-8 gm/Carbendazim 50WP @ 2 gm/kg seed, PSB+Rhizobium culture@ 500 gm/ha	30-40 % farmers do seed treatment with Carbendazim	60-70
Sowing method	Line sowing (30 x 10 cm)	Broadcasting/ line sowing	50-60
Irrigation	At 60 DAS as a life saving irrigation with sprinkler	No irrigation	65-75
*Nutrients	N-18 kg/ha; P-46 kg/ha, FYM @ 2.5 tones/ha	Improper use of fertilizers	70-80
*IPM measures	Pendimethalin @ 0.6 kg/ha as pre-emergence, manual weeding @ 30-35 DAS, Emamectin	40-50 % farmers use irrelevant IPM	50-60

	Benzoate 5 SG @ 250 gm/ha for pod borer management.	measures	
Trainings	Audio-video On & Off campus training	No training	100

*Demonstrate the technology/ input provided

RESULTS AND DISCUSSION

The performance and extension gap, technology gap and technology index of chickpea crop owing to the adoption of improved technologies was assessed over a period of seven years from 2011-12 to 2019-20 and is presented in Table 2 & 3. The economics of the data regarding cost of cultivation, gross return, net return, additional cost, additional return and benefit: cost ratio were analyzed and presented in Table 4 & 5.

Effect on grain yield:

The grain of chickpea crop owing to the adoption of improved technologies was assessed over a period of seven years and is presented in Table 2. Results of front line demonstrations showed that the cultivation practices comprised under FLDs *viz.*, use of improved varieties, seed and soil treatments, optimum seed rate, balanced application of fertilizers, line sowing, timely management weeds, insects and disease, produced on an average 18.02 q/ha grain yield of chickpea, which was 24.18 per cent higher as compared to prevailing farmers practice (14.51 q/ha). The higher grain yield from demonstrated plots was due to use of high yielding varieties and other integrated crop management practices.

Similarly, Kumar *et al*. (2019) also reported 0.83 to 14 q/ha grain yield of different pulse crops under demonstrations as compared to 0.72 to 8.40 q/ha in farmer's practices. The per cent yield increase of chickpea crop was 28.57 to 30.28% in the similar dry areas was also reported by Kumar *et al*. 2018 and Choudhary *et al.*, 2020.

Table 2. Chickpea yield performance under FLDs and Farmers practice

Year	Area of demo. (ha)	No. of demo.	Variety(s)	Potential yield (q/ha)	Demo. yield (q/ha)	FP yield (q/ha)	% yield increase over FP
2011-12	10	13	RSG-888	25.0	17.35	13.49	28.61
2011-12	10	12	RSG-963	22.0	17.28	13.35	29.43
2014-15	12.5	25	GNG-1581	24.0	21.38	17.79	20.17
2015-16	16	47	GNG-1581	24.0	16.50	13.30	24.06
2016-17	20	40	GNG-1581	24.0	17.89	15.00	19.27
2017-18	50	125	RSG-974	23.0	14.24	12.26	16.15
2018-19	40	70	GNG-1958	26.8	19.31	15.24	26.71
2019-20	20	50	GNG-1581	24.0	20.19	15.65	29.01
Total	**178.5**	**382**	**Average**	**24.1**	**18.02**	**14.51**	**24.18**

Effect on Extension gap, Technology gap and Technology index:

The extension yield gap was the difference observed between demonstrations technology and farmers practices in the respective crop (Table 3). The extension gaps ranged from 189 to 454 kg/ha during the period of demonstration with average 350 kg/ha, which 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 varieties will subsequently change this alarming trend of galloping extension gap. The new technologies will eventually lead to the farmers to discontinuance of old varieties with the new technology.

According to Parihar *et al*. (2018), the average extension yield gap in lentil crop was 1.83 q/ha under demonstrations which resulted in higher grain yield as compared to farmer's practices. Avoiding the adoption of improved crop production technology by the farmers for better production results in extension yield gaps (Vedna *et al*. 2007).

The results (Table 3) of front line demonstrations and potential yield of chickpea varieties were compared to estimate the yield gaps which were further categorized into technology gap and technology index. The technology gap observed may be attributed to the dissimilarity in the soil fertility status and weather conditions. Hence, variety wise location specific recommendation appears to be necessary to minimize the technology gap for yield level in different situations.

The technology gap shows the wide gap in the demonstration yield over potential yield of chickpea. The average technology gap was 608 kg/ha with maximum (876 kg/ha) in the year 2017-18 and minimum (262 kg/ha) in the years of 2014-15. The observed technology gap may be attributed to dissimilarities in their soil fertility, uneven & erratic rainfall and vagaries of weather conditions in the area as well as management of the farmers.

The results are in accordance to the findings of Parihar *et al.* (2018) and Kumar *et al.* (2019), according to them the technology gap in chickpea crop was 9.5 to 13.0q/ha.

The data (Table 3) further shows that minimum technology index value 10.9 was noticed in the year 2014-15 followed by 15.9 per cent in 2019-20 whereas, maximum value of technology index of 38.1 % in the year 2017-18 with average value of 25.2 per cent. It is obviously due to uneven & erratic rainfall and vagaries of weather conditions in the area. Technology index also shows the feasibility of the technological package at the farmer's field. The lower the value of technology index more is the feasibility.

The hypothesis proposed by Ram *et al.* (2014) and Dayanand *et al.* (2014) are in conformity with the present findings. According to them, the technology index of chickpea crop was 25.2 per cent.

Table 3. Extension gap, Technology gap and Technology index of chickpea production under FLDs

Year	Variety(s)	Extension gap (kg/ha)	Technology gap (kg/ha)	Technology index (%)
2011-12	RSG-888	386	765	30.6
2011-12	RSG-963	393	472	21.4
2014-15	GNG-1581	359	262	10.9
2015-16	GNG-1581	320	750	31.2
2016-17	GNG-1581	289	611	25.5
2017-18	RSG-974	189	876	38.1
2018-19	GNG-1958	407	749	27.9
2019-20	GNG-1581	454	381	15.9
Average		**350**	**608**	**25.2**

Effect on Economics of chickpea:

The economics (Cost of cultivation, gross & net return and B:C ratio) of chickpea under front line demonstrations were estimated and the results have been presented in Table- 4. The front line demonstrations fetched more average gross returns (Rs.60161/ha), net return (Rs. 37963/ha) and B:C ratio (2.76) with slightly higher investment on cost of cultivation (Rs. 1663/ha) as compared to farmers practice. The average increase in gross return, net return, B:C ratio and cost of cultivation was 24.8, 37.2, 13.1 and 8.2 per cent, respectively over farmers practice. The results are the supportive evidences of improved interventions/ technologies under demonstrations practices. Farmers can adopt the demonstrated technology to improve his monetary returns from their fields and leads to improve socio economic status and livelihood under the unpredictable drought conditions of the district.

Increasing in monetary returns and benefit: cost ratio in pulses crops have been also reported by earlier workers (Ram *et al.* 2014; Dayanand *et al.* 2014; Lathwal, 2010). Similarly, demonstrations of improved technologies at farmer's field proven best to a great extent in enhancing the production and productivity of chickpea crop (Singh *et al.* 2017; Tomar, 2010).

Table 4. Economic performance of chickpea cultivation under front line demonstrations and Farmers practice

Year	Cost of Cultivation (Rs./ha)		Gross Return (Rs./ha)		Net Return (Rs./ha)		Benefit: Cost ratio	
	Demo.	FP	Demo.	FP	Demo.	FP	Demo.	FP
2011-12	11,108	8,872	32,880	25,551	21,772	16,679	2.96	2.88
2011-12	11,002	8,823	32,677	25,145	21,675	16,322	2.97	2.85
2014-15	23,740	22,100	36,124	27,712	12,384	5,612	1.52	1.25
2015-16	24,500	22,250	57,750	46,550	33,250	24,300	2.36	2.09
2016-17	24,800	23,600	71,560	60,000	46,760	36,400	2.89	2.54
2017-18	25,500	24,600	62,656	53,944	37,156	29,344	2.50	2.20
2018-19	27,853	26,000	89,212	70,409	58,829	41,964	3.20	2.71
2019-20	26,545	25,495	98,426	76,294	71,881	50,799	3.71	2.99
Average	**21,881**	**20,218**	**60,161**	**48,201**	**37,963**	**27,678**	**2.76**	**2.44**

Further, data (Table 5) shows that the average additional cost of cultivation of Rs. 1663 per hectare under integrated crop management demonstrations and has yielded additional net returns of Rs. 10285 per hectare with incremental benefit: cost ratio of 0.33. The results suggested that higher profitability and economic viability of chickpea demonstrations under local agro-ecological situation.

Table 5. Additional cost of cultivation and net return under front line demonstrations compared to farmers practice

Year	Variety(s)	Additional Cost of Cultivation (Rs./ha) in Demonstration	Additional Net Return (Rs./ha) in Demonstration
2011-12	RSG-888	2,236	5,093
2011-12	RSG-963	2,179	5,353
2014-15	GNG-1581	1,640	6,772
2015-16	GNG-1581	2,250	8,950
2016-17	GNG-1581	1,200	10,360
2017-18	RSG-974	900	7,812
2018-19	GNG-1958	1,853	16,865
2019-20	GNG-1581	1,050	21,082
Average		**1,663**	**10,285**

Farmer's Satisfaction

The extent of satisfaction level of respondent farmers over performance of demonstrated technology was measured by Client Satisfaction Index (CSI) and results presented in Table 6. It is observed that majority of the respondent farmers expressed high (51.83%) to the medium (32.72%) level of satisfaction regarding the performance of chickpea under demonstrations. Whereas, very few (15.45%) of respondents expressed lower level of satisfaction. The higher to medium level of satisfaction with respect to performance of demonstrated technology indicate stronger conviction, physical and mental involvement of in the frontline demonstration which in turn would lead to higher adoption. The results are in close conformity with the results of Kumaran and Vijayaragavan (2005).

Table 6. Extent of farmer's satisfaction over performance of demonstrated technology

Satisfaction level	Number	Per cent
High	198	51.83
Medium	125	32.72
Low	59	15.45

*****(n=382)

CONCLUSION

It may be concluded that integrated crop management technology in chickpea has found more productive, profitable and feasible in Transitional plain of Inland drainage zone of Rajasthan as compared to prevailing farmers practice. Even though up to 24 per cent yield increase of chickpea crop over farmer's practices are witnessed of creating confidence and friendly relationships between farm scientists and farming community. Farmers were motivated by results of demonstrations of integrated crop management practices in chickpea and they would adopt these technologies in the coming years. In Nagaur district of Rajasthan, the production and productivity of pulses was quite low earlier. Now, National Food Security Mission a government initiative tried to bridges a connection to enhance the same due to popularization of improved technologies though KVKs at farmer's fields. But, there is still a wide gap between potential and demo yield which needs more extension service among farming community for better crop production, productivity and net monetary returns of pulses with more emphasis.

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