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Impact of front line demonstration on the yield and economics of chickpea in Udaipur district of Rajasthan

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Abstract
A study was carried-out to popularization of Chickpea production technologies during *Rabi* seasons 2018-19, 2019-20 and 2020-21 at farmer's fields in tribal belt of Udaipur District of Rajasthan. Clusters Front Line Demonstration (CFLD) on Chickpea crop was conducted on an area of 46 ha. Total 115 demonstrations were conducted on 115 farmers' fields with improved technologies composed of GNG 1958 variety and recommended production practices. Krishi Vigyan Kendra has an innovative science–based institution, plays an important role in bringing the research scientists face to face with farmers. The main aim of Krishi Vigyan Kendra is to reduce the time lag between generation of technology at the research institution and its transfer to the farmers for increasing productivity and income from the agriculture and allied sectors on sustained basis. The average yield of demonstration plots of chick pea achieved by improved production technology was 18.97q/ha compared to farmers' practice 15.52q/ha. Adoption of improved production technology increased yield by 22.23 per cent over farmers' practices. Average technological gap, extension gap and technological index were calculated *i.e*, 7.83q/ha, 3.45q/ha and 29.23 per cent, respectively. When economics viability was taken into consideration it was found that average net return was Rs. 64508/- per ha was recorded under CFLDs plot over farmer practices of Rs 47373/- per ha which is highly encouraging and it is suggested to adopt these technologies for sustainable production of chickpea in tribal belt of Udaipur district of Rajasthan.

Keywords: chickpea, technology & extension gap, yield, CFLDs, technology index, economics

Introduction

Chickpea, one of the major pulses cultivated and consumed in India, is also known as Bengal gram. Chickpea is a major and cheap source of protein compared to animal protein. In India, chickpea accounts for about 45% of total pulses produced in the country. Similar to the case of other pulses, India is the major producing country for chickpea, contributing for over 75% of total production in the world. Among the major state in India, Rajasthan is leading producer of chickpea. In Udaipur district, 9181 ha area under chickpea cultivation in 2017-18 with 238233 quintals production and the productivity of 1320 kg/ha. It indicates that the productivity of chickpea in Udaipur is comparatively low, primarily due to unavailability of suitable variety(s) as well as lack of improved production technologies, more specifically the method of sowing and nutrient management. The productivity of chickpea could be increased by adopting recommended scientific and sustainable management production practices (Singh *et al.*, 2017) [25, 29]. Front line demonstration is the new concept of field demonstration with main objective to demonstrated newly released variety with improved practices technologies and its management practices at farmer's field under different agro climatic regions of the country with varying farming situations. Productivity of chickpea per unit area can be increased by adopting feasible, scientific and sustainable management practices by selecting a suitable variety. With this in view, front line demonstrations held at farmer's field, in a systemic manner, to show case the high yielding new varieties, to convince them to about the potential of improved production technologies to enhance yield of chickpea. Pulses are generally grown on marginal and sub-marginal lands, low inputs and suffer heavily due to biotic and abiotic stresses, resulting into low productivity. Resulting in non-appreciable dissemination of improved production technology and synergy among production, marketing, processing and policy related issues. The existing production technology is capable of increasing productivity at least by 30% as amply demonstrated by Cluster Front Line Demonstration. This coupled with technological interventions and operational synergy among planners, administrators, researchers, extension workers and developmental agencies in mission mode to translate the vision into reality (Jayalakshmi, *et al*., 2018) [1].

Keeping this in view, cluster front line demonstrations of chickpea were conducted in order to demonstrate the productivity potential and economic benefit of improved technologies under farmer's conditions.

Materials and Methods

The frontline demonstrations were conducted by Krishi Vigyan Kendra, Vallabhanagar in Udaipur district during *Rabi* 2018-19, 2019-20 and 2020-21, a total 115 front line demonstrations on chickpea variety GNG 1958 was conducted at farmer's field in the Tribal belt of Udaipur district. The yield and economic performance of frontline demonstrations, the data on output were collected from FLDs as well as farmer plots and finally the grain yield, cost of cultivation, net returns with the benefit cost ratio was worked out. For the purpose of investigation, Udaipur district, where FLDs were conducted during 2018-19, 2019-20 and 2020-21. For selection of beneficiary farmers, a list of farmers where FLDs on chickpea were conducted (Table 1) during *Rabi* 2018-19, 2019-20 and 2020-21 was prepared and taking equal representation.

Table 1: Comparison between demonstrated package of practices and existing farmer's Practice of Chickpea Production in tribal belt of Udaipur.

S. No.	Intervention	Demonstrated package	Farmers' practice
1.	Farming situation	Irrigated	Irrigated
2.	Variety	GNG 1958	Dahod Yellow
3.	Seed treatment	Seed treatment with *Trichoderma* (8gm/kg) and bio-fertilizer culture *Rhizobium* +PSB(600+600gm/ha)	No seed treatment with Trichoderma and bio-fertilizer culture
4.	Time of sowing	15-25 October	10-25 November
5.	Sowing method	Line sowing at 30 cm Line to Line	Line sowing at 20 cm Line to Line
6.	Irrigation	Irrigation at critical stage (branching 40DAS & pod initiation 65DAS)	Lack of irrigation at critical stage
7.	Seed rate	80 kg per ha	80-100 kg per ha
8.	Fertilizer dose	Fertilizer management -20Kg N+ 40 Kg P_2O_5 /ha under irrigated condition	Use of fertilizer (50kg DAP/ha) i.e. 9kgN:23kgP_2O_5
9.	Plant protection	• Use of Indoxacarb (15.8 %EC) 350ml/ha at initiation of flower for management of Pod borer • Installation of pheromone for monitoring pest (12-15/ha)	Without use of plant protection measure
10.	Weed management	One hand weeding at 30 DAS	One hand weeding at 35-40 DAS
11.	Harvesting time	20-25 March	15-20 March

The data were collected through personal contacts with the help of well-structured interview schedule. The gathered data were processed, tabulated, classified and analyzed in terms of mean percent score and ranks in the light of objectives of the study. More than 10 percent difference between beneficiary and non-beneficiary farmers' was considered as significant difference. The extension gap, technology gap and technology index were calculated using the formula as suggested by Samui *et al.*, (2000) [21].

Extension gap (q/ha) = Demonstration yield– Farmer's yield

Technology gap (q/ha) = Potential yield – Demonstration yield

Technology index (%) = [Potential yield – Demo yield / Potential yield] x 100

Results and Discussion

It was observed during the study that demonstration trials have increased the yield over the farmers' practices (Table 2). It was also observed that full gap in most of the production technology was also reason of not achieving potential yield.

Yield (q/ha)

During the period of study, it was observed that in cluster front line demonstrations of improved technologies increased productivity over respective farmer's practice (Table 2). Result revealed that an average yield was recorded 18.97q/ha under demonstrated plots as compared to farmers' practice 15.52 q/ha. The highest yield of CFLD plot was 19.20q/ha during the year 2020-21 and in farmers' practice 15.60q/ha in the same year and lowest yield was recorded in the year 2018-19. Average yield of chick pea increased per hectare by 22.23 per cent. The results clearly indicate that higher average yield in demonstration plots over the years compared to local check was due to knowledge and adoption of full package of practices i.e. improved varieties such as GNG 1958, timely sowing, seed treatment with *Rhizobium spp* and *Phosphate Solubalizing Bacteria* (PSB), use of balance fertilize, method and time of sowing with proper spacing, weed management, water management, need based plant protection. The above findings were support with the findings of Singh and Bajpai (1996) [26], Kumar, *et al*., (2003) [6], Roy *et al*., (2006) [20], Yadav *et al*., (2007) [33], Mukharjee (2008) [14], Narwale *et al*., (2009) [15], Mitra and Samajdar (2010) [12], Mokidue *et al*., (2011) [13], Singh *et al*., (2012) [23], Meena and Dudi (2012) [10], Kundu, *et al*., (2014) [5], Singh *et al*., (2014) [24], Tiwari and Tripathi (2014) [30], Lakshmi, *et al*., (2017) [7], Raju, *et al*., (2017) [19], Singh *et al*., (2017) [25, 29], Khedkar, *et al*., (2017) [4], Meena, (2017) [9], Jayalakshmi, *et al*., (2018) [1], Mitnala *et al*., (2018) [11], Neelam, *et al*., (2019) [17], Undhad *et al*., (2019) [31], Ojha and Bisht (2020) [18] and Singh *et al*., (2020) [22, 27, 28]. Higher yield of chickpea under improved technology was due to use of latest high yielding varieties, integrated nutrient management and integrated pest management.

Table 2: Yield and yield difference of chickpea under front line demonstrations

Year	No. of CFLDs	Area (ha)	Yield (q/ha)		Additional yield over local check (kg/ha)	Per cent increase yield over Local Check
			DP	FP		
2018-19	15	6	18.80	15.45	335	21.68 %
2019-20	50	20	18.90	15.50	340	21.93 %
2020-21	50	20	19.20	15.60	360	23.08 %
Mean / Total	115	46	18.97	15.52	345	22.23 %

Technology gap (q/ha)

It means the differences between potential yield and demonstration plot yield. The demonstration plot yield was 8.0q/ha, 7.9q/ha and 7.6q/ha during 2018-19, 2019-20 & 2020-21, respectively (Table 3). An average on technology gap of three years CFLD programme was 7.83qha. The technology gap observed might be attributing to the dissimilarity in soil fertility status and weather conditions. Verma (2013) [32] have also opined that depending on identification and use of farming situation, specific interventions may have greater implications in enhancing system productivity. Similar findings were also recorded by Mitra *et al*. (2010) [12], Katare *et al*. (2011) [2], Tiwari and Tripathi (2014) [30], Raju, *et al*., (2017) [19], Singh *et al*., (2017) [25, 29], Khedkar, *et al*., (2017) [4], Meena, (2017) [9], Jayalakshmi, *et al*., (2018) [1], Mitnala *et al*., (2018) [11], Meena, (2017) [9], Lakshmi, *et al*., (2017) [7], Undhad *et al*., (2019) [31], Neelam, *et al*., (2019) [17], Kaur *et al*., (2019), Ojha and Bisht (2020) [18] and Singh *et al*. (2020) [22, 27, 28]

Extension gap (q/ha)

Extension gap means the differences between demonstration plot yield and farmers practice yield. Extension gap 3.35q/ha, 3.40q/ha and 3.60q/ha was observed during the year 2018-19, 2019-20 & 2020-21, respectively (Table 3). An average of extension gap under CFLD programme was 3.45q/ha which is need to educate the farmers through various extension *i.e.* cluster front line demonstration for adoption of improved production and protection technologies, to revert the trend of wide extension gap. More and more use of latest production technologies with high yielding varieties will subsequently change this alarming trend of full-fill the extension gap (Singh, *et al*., 2014, Raju, *et al*., 2017, Lakshmi, *et al*., 2017, Meena, 2017, Singh, *et al*., 2017 [24, 19, 7, 9, 25, 29], Neelam, *et al*., 2019 [17], Kaur *et al*., 2019, Singh *et al*., 2020 [22, 27, 28] and Ojha and Bisht 2020 [18].

Technology Index (%)

Technology index indicates the feasibility of the involved technology on farmers' fields. Lower the value of technology index, higher is the feasibility of the improved technology. The technology index varied from 28.36 to 29.85 per cent (Table 3). An average technology index was observed 29.23 per cent during the CFLD programme, which showed the efficacy of good performance of technical interventions. This will accelerate the adoption of demonstrated technical intervention to increase the yield performance of chick pea. Technology index shows the feasibility of evolved technology at the farmer's field and lower the value of technology index more is the feasibility of the technology (Singh *et al*., 2014, Tiwari and Tripathi 2014, Lakshmi, *et al*., 2017, Meena, 2017, Singh *et al*., 2017 [24, 30, 7, 9, 25, 29], Kaur *et al*., 2019, Neelam, *et al*., 2019 [17], Ojha and Bisht 2020 [18] and Singh *et al*., 2020) [22, 27, 28].

Table 3: Yield gap and technology index in front line demonstrations

Year	No. of FLDs	Improved Variety	Potential Yield (q/ha)	Technology gap (q/ha)	Extension Gap (q/ha)	Technology Index (%)
2018-19	15	GNG 1958	26.8	8.0	3.35	29.85
2019-20	50	GNG 1958	26.8	7.9	3.40	29.48
2020-21	50	GNG 1958	26.8	7.6	3.60	28.36
Mean	115		26.8	7.83	3.45	29.23

Economic return

The economic analysis of the data over three years revealed that chickpea under cluster front line demonstrations recorded higher gross returns. Cost involves in adoption of improved technology in chick pea varies and was more profitable. The cultivation of chick pea under improved technologies gave higher net return of Rs. 59956/-, 64148/- and 69420/- per ha, respectively, as compared to farmers practices Rs 44870/-, 47150/- and 50100/- per ha in the year 2018-19, 2019-20 & 2020-21, respectively (Table 4). An average cost of cultivation, gross return, net return and B: C ratio of demonstration field was Rs. 86856/-, 92138/-, 97920/- per ha and 3.23, 3.29, 3.44, respectively as compared to farmers practice (Rs. 71070/-, 74400/-, 78000/- per ha and 2.71, 2.73, 2.80). These results were in accordance with the earlier findings of Mauria *et al.,* (2017), Singh, *et al*., (2017) [25, 29] and Singh, *et al*., (2020) [22, 27, 28]. The benefit cost ratio of chick pea cultivation under improved practices has higher than farmers' practices in all the years and this may be due to higher yield obtained under improved technologies compared to farmers' practice. This finding was in collaboration with the findings of Mokidue *et al*., 2011 [13], Singh *et al*., 2014 [24], Tiwari and Tripathi 2014 [30], Lakshmi, *et al*., 2017 [7], Singh *et al*., 2017 [25, 29], Meena, 2017 [9], Kaur *et al*., (2019), Neelam, *et al*., 2019 [17], Ojha and Bisht (2020) [18] and Singh *et al*., 2020 [22, 27, 28]. Through technological agent close monitoring of demonstration was constituted in the pragramme under the guidance of experts help to harvest good crop of Chickpea. In comparison to base year (2017-18) the Productivity of chickpea enhanced 21.68% during 2018-19, 21.93% during 2019-20 and 23.08% during 2020-21 respectively.

Table 4: Economics of Cluster front line demonstrations

Year	Cost of Cultivation (Rs/ha)		Gross return (Rs/ha)		Net return (Rs/ha)		Additional net return (Rs/ha)	B:C ratio	
	DP	FP	DP	FP	DP	FP		DP	FP
2018-19	26900	26200	86856	71070	59956	44870	15477	3.23	2.71
2019-20	27990	27250	92138	74400	64148	47150	16575	3.29	2.73
2020-21	28500	27900	97920	78000	69420	50100	18360	3.44	2.80
Mean	27797	27117	92305	74490	64508	47373	16804	3.32	2.75

This also improved linkages between farmers and scientists, and built confidence for adoption of the improved technology. Productivity enhancement under FLDs over farmer practices of Chickpea cultivation created a greater awareness, and motivated other farmers not growing Chickpea to adopt improved technologies in this Pulses crop i.e. Chickpea.

Experience about cluster demonstration conducted on Chickpea

- Through the feedback from different sources *e g*. Progressive farmers, Extension workers and monitoring reports it reveals that the cluster demonstration conducted on chickpea produced about 18.97q/ha grain yield which is about 22.23% higher than farmers practice.
- The farmers were provided inputs like improved seed, INM, IPM as per norms of the programme resulted with increase in productivity under CFLD.
- The improved crop variety of Chickpea under cluster demonstration was GNG 1958 respectively are resistant to diseases and recommended for the state.

Farmers' feedback

- Use of INM (*Rhizobium culture,* PSB) enhanced the productivity at low cost.
- Most of farmers have started taking Pulses in their meal resulting in improvement in their health.
- Return/rupee spent in chickpea cultivation is higher than other rabi season cereals.
- It builds up soil fertility; hence succeeding crop can be grown with minimum use of fertilizers.

Conclusion

Thus, the cultivation of chickpea crops with improved technologies including suitable varieties, Nutrients and Pest Management has been found more productive. The productivity gain under programme over existing practices of chickpea cultivation created greater awareness and motivated the other farmers to adopt suitable production technology. It is concluded from the study that there exists a wide gap between the potential and demonstration yield in wilt tolerant chick pea mainly due to technology and extension gaps and also due to the lack of awareness about newer technology. CFLD produced a significant positive result and provided the researcher an opportunity to demonstrate the productivity potential and profitability of the latest technology (Intervention) under real farming situation, which they have been advocating for long time. Hence, it is suggested that farmers of district may follow the improved agronomic practices adopted under CFLD programme both for higher production and better economic return for the sustainable cultivation of chickpea in district. Technological and extension gaps existed which can be bridged by popularizing package of practices with emphasis on the seed of improved crop varieties, use of proper seed rate, balanced nutrient application and proper use of plant protection measures. Replacement of local varieties with the released varieties of maize, paddy and wheat would increase the production and net income of these crops.

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