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Yield gaps and economic analysis in chickpea (*Cicer arietinum*) under front line demonstrations at tribal farmer's fields in Dhar district of Madhya Pradesh

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Abstract
The present study was carried out by Krishi Vigyan Kendra, Dhar, Madhya Pradesh to study the Yield gaps and economics analysis in chickpea (*Cicer arietinum*) under front line demonstrations at tribal farmer's fields in Dhar district of Madhya Pradesh. The results revealed that, an average highest yield (17.03 and 18.09 q/ha) was recorded in front line demonstrations plots of chickpea by adopting integrated crop management technology as compared to farmers practice (12.69 and 13.12 q/ha). By the adoption of improved production technology of chickpea, the yield was found in increasing trend *i.e.* 36.12 percent over farmer practices. The average technological gap (2.97 and 1.91 q/ha), extension gap (4.34 and 4.97 q/ha) and technological index (14.85 and 9.55 %) were noticed during both the years (2016-17 and 2017-18) of study, respectively. The maximum gross monetary return (Rs. 85133 and Rs. 72400/ha) was recorded under demonstration over farmer's practice (Rs. 50768 and Rs. 53200/ha) during both the years, respectively. Similarly, the highest net profit (Rs. 61208 and Rs.49900/ ha) was recorded under front line demonstrations' plots over farmer's practice (Rs 29748 and Rs. 31700/ha) during both years of study, respectively. The maximum yield was recorded in demonstration plots over both the years as compared to local check due to adoption of knowledge and full package of practices.

Keywords: Front line demonstrations, technological gap, extension gap, technology index, yield and economics

Introduction

The chickpea (*Cicer arietinum*) is also known as Bengal gram, Gram, and *Chana* in Hindi. It belongs to the family leguminous. It is the major pulse crop used in diet of vegetarians in India. It is a rich source of vegetable protein (20-24%) which is almost three times that of cereals and other minerals and vitamins. In addition, it is also used as nutritive fodder, especially for milch animals. Chickpea is a major pulse crop of India accounting for more than 40% of the total pulses area and production. Madhya Pradesh is one of the leading pulses producing state (having first position among other states of India) contributing about 25 percent pulse area (3.59 million hectares) and production (1280 kg/ha) of the country [1]. In addition, the chickpea crop improves the soil fertility by fixing atmospheric nitrogen in the soil by fixing atmospheric N up to 140 kg/ha.

Chickpea is an important *rabi* pulse crop for livelihood and nutritional security of tribal farmers in Dhar district of Madhya Pradesh and it is mostly sown in October-November and harvested in March. The productivity (1200 kg/ha) of chickpea in the Dhar district is far below as compared to the potential yield (2000 kg/ha) due to non-availability of quality seed of improved varieties, infestation of wilt disease, deterioration in soil health and poor adoption of improved cultivation practices. For the sustainable production of chickpea, numbers of technologies are available but farmers' perception towards adoption of good agricultural practices is very poor and they are still practicing the unscientific methodologies. Many production technologies for chickpea cultivation have been evolved for increasing the productivity but farmers has hardly adopted a few of them and those in a non-scientific manner. To sustain production of chickpea, several steps are still required. In this regard, to sustain the potential production and consumption system, the Indian Institute of Pulse Research, Kanpur had sanctioned the project "Frontline Demonstrations on rabi pulses under Tribal sub Plan from 2016-17'' to ICAR-Agriculture Technology Application Research

Institute, Zone-IX, Jabalpur. The basic strategy of the Mission is to promote and extend improved technologies along with capacity building of farmers.

In view, the aim of frontline demonstrations is to identify the production constraints of the technology and extension gap in chickpea through various extension methods and technologies. Krishi Vigyan Kendra, Dhar implemented Tribal Sub Plan project on pulses with main objective to boost the production and productivity of pulses through front line demonstrations with latest and specific transfer of technologies at tribal farmers' fields.

Materials and Methods

The Frontline demonstrations were conducted at tribal farmer's field to demonstrate the impact of integrated crop management technology on chickpea productivity over two years during *rabi* 2016-17 to 2017-18. Each frontline demonstration was conducted on 1.0 acre area and adjacent 1.0 acre was considered as control for comparison (farmer's practice). The demonstrations were conducted at tribal farmer's field of 7 and 2 different tribal villages during the year 2016-17 and 2017-18 of Dhar district of Madhya Pradesh. During both the years of study, a total of 80 and 25 numbers of beneficiaries were selected, respectively.

Farmers were trained to follow the package and practices like soil testing, seed treatment with fungicide and inoculation with bio-fertilizer, fertilizer application, weed management, integrated pest management practices etc. for chickpea cultivation as recommended by the Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) and need based inputs were provided to the beneficiaries (Table 1). Improved variety (JAKI-9218) having bold seeded, 112 days maturity and wilt resistant characters was selected. In case of local check, the traditional practices were followed by using existing varieties. Before conducting front line demonstrations, a list of farmers was prepared from group meeting and specific skill training was imparted to the selected farmers. In demonstration plots, use of quality seeds of Improved variety (JAKI-9218), line sowing and timely herbicide application, need based pesticide as well as balanced fertilizer were emphasized and comparison has been made with the existing practices. Visit of farmers and the extension workers was organized at demonstration plots to disseminate the message at large scale. Critical inputs like seed, fungicide, culture and insecticide were facilitated to the beneficiaries under the programme by KVK scientists during the course of training and visits (Table 2). The traditional practices were maintained in case of local checks. The front line demonstrations were conducted to study the technology gap, extension gap and technology index. The yield data were collected from both the demonstration and farmers practice by random crop cutting method. Qualitative data was converted into quantitative form and expressed in terms of percent increase in yield. The data was further analyzed by using simple statistical tools. The technology gap, extension gap and technological index were calculated [6] as given below.

Technology gap

It means the differences between potential yield and yield of demonstration plot.

Technology gap= Potential yield - Demonstration yield

The Extension gap

It means the differences between demonstration plot yield and farmers yield.

Extension gap= Demonstration yield - Farmer's yield

Technology Index

It indicates the feasibility of the evolved technology in the farmers' fields. Lower the value of technology index, higher is the feasibility of the improved technology.

$$\text{Technology index (\%)} = \frac{\text{Potential yield} - \text{Demo.yield}}{\text{Potential yield}} \text{X } 100$$

Table 1: Comparison between demonstration package and existing practices under FLD

Particulars	Chickpea		
Technology	Demonstration	Farmers Practice	GAP (%)
Farming situation	Irrigated	Irrigated	-
Variety	JAKI-9218	Vishal	100
Time of sowing	Mid July to mid August	September till first week of October	No gap
Method of sowing	Line sowing	Line sowing	No gap
Seed rate	80 kg/ha	120 kg/ha	Higher seed rate
Fertilizer as per STV	NPK 20:60:20 kg/ha	NPK 18:46:00 kg/ha	Full gap
Seed treatment and inoculation	With Carboxin 17.5 + Thiram 17.5 @ 2.5 ml/kg of seed and inoculation with Rhizobium and PSB @ 5 g/kg of seed	Nil	Full gap
Weed management	Pre-emergence herbicide (Pendimethalin)	No herbicide	Full gap
Plant protection	IPM	Indiscriminate use	Full gap
Grading & processing	Grading followed	Not followed	Full gap

Table 2: Details of need based critical inputs/technological packages distributed in front line demonstrations of chickpea

Year	Village covered	No. of demo.	Variety	Technology demonstrated	Need based input distributed
2016-17	Tirla, Manasiya, Amliya, Sunarpada, Mohanpur, Khanankhurd, Sodpur	80	JAKI-9218	Improved variety, seed treatment, inoculation, NM, WM and IPM	Improved seed (80 kg/ha), soil testing, seed treatment with Carboxin 17.5 + Thiram 17.5 @ 2.5 ml/kg of seed and inoculation with Rhizobium and PSB @ 5 g/kg of seed, pendimethalin, Indaxacarb, tricoderma virdii, on and off campus trainings and field day
2017-18	Undeli, Morgaon	25	JAKI-9218	Improved variety, seed treatment, inoculation, NM, WM and IPM	Improved seed (80 kg/ha), soil testing, seed treatment with Carboxin 17.5 + Thiram 17.5 @ 2.5 ml/kg of seed and inoculation with Rhizobium and PSB @ 5 g/kg of seed, pendimethalin, Indaxacarb, tricoderma virdii, on and off campus trainingsand field day

Results and Discussion

Frontline demonstrations are effective educational tools in introducing various new technologies to the farmers to boost the farmer's confidence level by comparison of productivity levels between good agricultural practices in demonstration trials. The performance of chickpea crop owing to the adoption of improved technologies is assessed over a period of two years.

Yield attributing parameters

The maximum number of branches (8.2 and 8.54), number of pods (45 and 48) and seed index (45.8 and 46.3) was recorded in front line demonstration while minimum number of branches (5.6 and 6.2), number of pods per plant (33 and 35) and seed index (32.2 and 32.4 was recorded in farmers' practice. The average highest yield (17.03 and 18.09 q/ha) was recorded in demonstrations when adopted full package of practices over the lowest yield (12.69 and 13.12 q/ha) in farmer's practice during both years of the study, respectively. On two year data basis, the integrated crop management practice in chickpea recorded average 36.12% increase in the yield while the demonstration plot produced 34.22 and 38.01% more yield of chickpea as compared to local practices (Table 3 & 4).

Technology Gap

The technology gap of demonstration plots were 2.97 and 1.91 q/ha during 2016-17 and 2017-18, respectively (Table-4). On an average technology gap in FLD programme under both years FLD programme was 2.44 q/ha during both the years of study. The technology gap observed during study may be attributed due to dissimilarity in the soil fertility status, production, protection practices and local climatic situation (Table 5).

Extension Gap

Extension gap of 4.34 and 4.97 q/ha was noticed during 2016-17 and 2017-18, respectively (Table-4). On an average extension gap (4.66 q/ha) under two year FLD programme was emphasized the need to educate the farmers through various extension programs *i.e.* front line demonstration for adoption of improved production and protection technologies, to revert the trend of wide extension gap. Timely use of latest production technologies with high yielding varieties will subsequently change this alarming trend of galloping extension gap (Table 5).

Technology Index

The technology index varied from 14.85 to 9.55 percent (Table-4). On an average technology index was observed 12.20 percent during the two years of FLD programme, which shows the efficacy of good performance of technical interventions. This will accelerate the adoption of demonstrated technical intervention to increase the yield performance of chickpea (Table 5).

Economic Returns

Results revealed that the cost involved in the adoption of improved technology in chickpea production varied and was more profitable. The cultivation of chickpea under improved technologies gave higher net return of Rs. 61208 and 49900 per ha over farmer's practice (Rs 29748 and 31700 per ha) during 2016-17 and 2017-18, respectively. The highest B:C (3.56 and 3.21) was recorded under improved package of practices (FLDs) during both years of study, respectively as compared to farmers practice (2.42 and 2.47). This may be due to higher yield obtained under improved technologies compared to local check (Table 6).

Table 3: Data on yield attributes in chickpea

S. No.	Crop	Yield attributing characters					
		Av. no of pods/plant		No of Branches /Plant		Seed index (100 grain wt.)	
		Demo.	FP	Demo.	FP	Demo	FP
1	Chickpea (JAKI-9218)	45	33	8.22	5.6	45.8	32.2
2	Chickpea (JAKI-9218)	48	35	8.54	6.2	46.3	32.4

Table 4: Impact of demonstrations on the yield of chickpea**.**

Year	No. of Demonstrations	Area (ha)	Yield q/ha			% increase in yield over farmers practice
			Potential yields	Demonstration Yields	Farmers practice	
2016-17	80	32	20	17.03	12.69	34.22
2017-18	25	10	20	18.09	13.12	38.01
Average	-		20	17.56	12.90	36.12
Total	105	42				

Table 5: Technology gap, extension gap and technology index in chickpea production.

Year	Area (ha)	No. of farmers	Technology gap (q/ha)	Extension gap (q/ha)	Technical index (%)
					FLD
2016-17	32	80	2.97	4.34	14.85
2017-18	10	25	1.91	4.97	9.55
Average	-	-	2.44	4.66	12.20

Table 6: Economics of demonstrations under chickpea demonstration

S. No	Year	Cost of Cultivation (Rs./ha)		Gross Monetary Return (Rs./ha)		Net Return (Rs.)		B:C ratio	
		Demo.	FP	Demo.	FP	Demo.	FP	Demo.	FP
1	2016-17	23925	21020	85133	50768	61208	29748	3.56	2.42
2	2017-18	22500	21500	72400	53200	49900	31700	3.21	2.47

* Rate of Chickpea during 2016-17 and 2017-18 in the Mandi of Dhar was Rs 5000/q and Rs 4000/q, respectively

Fig 1: Demo. Plots at tribal farmers' fields during 2016-17 and 2017-18

Fig 2: On campus training under TSP

Fig 3: Field day under TSP

Conclusion
It is concluded that the front line demonstrations showed a significant positive result and provided the researcher an opportunity to demonstrate the productivity potential and profitability of the latest technology at the farmers' fields, which have been advocating for long time. The productivity gain under front line demonstrations over existing practices of chickpea cultivation created greater awareness and motivated the other farmers to adopt suitable production technology in the district. It was also observed that potential yield can be achieved by imparting scientific knowledge to the farmers, providing the quality inputs and their proper utilization. Horizontal expansion of improved technologies may be achieved by implementation of various extension activities like field day, exposure visit, training programmes *etc.* organized in front line demonstrations at the farmer's fields.

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