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Impact of cluster front line demonstration on chickpea through improved technology in Jamui district (Bihar)

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Abstract
The study was carried out during rabi season of 2019 – 2020 and 2020 - 2021 in 12 villages of the Jamui district in Bihar to exhibit the improved production technologies and compared it with farmers practice. Chickpea is one of the major protein supplying pulse crop in India. Chickpea is the main pulse crop of the district, it is cultivated 4000 ha. area. All 50 (fifty) demonstrations on chickpea was carried out in an area of 37.5 acres by the active participation of 102 farmers form different villages. The improved technologies consisting use of improved variety, seed treatment with fungicide and rhizobium culture, balanced fertilizer application and integrated pest management. The result was compared between front line demonstration (FLD) plots and farmers practice (PF) plots. From the FLD, it was observed that the improved Chickpea variety GNG 1581 recorded higher yield 11.8 q. ha^{-1} and 12.2 compared to FP 8.80 q. ha^{-1} in the year of 2019 – 2020 and 2020 – 2021 respectively. The increase in the demonstration yield over farmers practice were 38.5% and 38.6%. The increment in yield of chickpea under FLD was due to improved variety, seed treatment with fungicide, seed inoculation with bio fertilizer, recommended seed rate, time of sowing, proper dose of fertilizer and plant protection measures. Seed treatment with fungicide and rhizobium culture is a better option to increase root nodules length of roots, increase plant height, increase no. of branches per plant, increase no. of pods per plant and other growth parameters under rainfed condition. In spite of increase in yield of chickpea, technological index existed. The improved technology gave higher gross return, net return with higher benefit cost ratio as farmers practice.

Keywords: Chickpea, cluster front line demonstration, potential yield, technology gap, extension gap, technology index, seed treatment, gross return and net return

Introduction
In India, frequency of pulse consumption is much higher than any other source of protein, which indicates the importance of pulses in their daily food habits. Pulse constitute an essential part of the Indian diet for nutritional security and environmental sustainability. They are important food crops due to their protein content 20 to 25 percent. Carbohydrate 55 to 60 percent, rich in calcium and iron also. All pulses play a key role in improving of soil fertility through biological nitrogen fixation with the help of Rhizobium bacteria found their root nodules playing an important role in enhancing the fertility of soil in term of yield of subsequent crop. Increase in yield of subsequent crop to the tune of about 20-40 percent has been recorded (joshi 1998) [3]. Area Production and productivity of Chickpea are (9.93 mha), (9.93MT) and 960 kg ha^{-1}) respectively in INDIA (IIPR, 2013 -14). Bihar ranks 9th in terms of production with a contribution of 0.52 millions tons to the national pulse pool. It is third most populous state sharing 2.8 percent of geographical area and 8.6 percent population of India. Food grains are the major agricultural commodity, produced on about 93 percent of cropped area, of which pulses share nerely 7.06 percent. Bihar one of the important pulsr growing and consuming state in India contributes about 2.35 percent of area which is 7 – 8 percent of the gross cropped area in the state and 3.06 percent of production. The productivity of pulses range between 819 kg ha-1 in 2000 – 01 to 897 kg ha-1 in 2013 – 14. It is mostly grown in rain fed condition and resulting in high yield fluctuation every year. Chickpea once the most important pulse crop of Bihar is at present most affected by change in cropping preference of farmers. In 1965-66 it covered an area of 450.9 thousand ha with production of 334.4 thousand tones and yield of 742 kg ha-1. Thereafter there has been steady decline in chickpea area with nearly 50% reduction in 1970 – 71 with 244.4 (‘000ha), 195.8 (‘000ha) in 1980-85, 176.7 (‘000ha) in 1990-95 and 76.2 (‘000ha) in 2000-01. In 2013-14 the area under chickpea was only 61.3 thousand ha.

If we look at the yield data we observe that there has been slight rise with 1182 kg ha^{-1} in 2010-11 and 1147 kg ha^{-1} in 2013-14 but production has drastically fallen due to rapid decline in area. This area has also reduced drastically because the existing varieties are not responsive to high input conditions and show excessive (Pushpa Singh 2016) [7]. The productivity of Chickpea in Bihar (1000 kg ha^{-1}) is significantly higher than the national average. Despite of huge potential and comparative advantage, the production of chickpea in the state has experienced a major setback, owing to a drastic decline in the area under the crop about 60 percent till 2011, to identify the problem and opportunity, the study revealed that the average productivity of improved package of practices of chickpea in CFLD villages ranged between 12.5 quintal ha^{-1} for improved varieties to 8.20 quintal ha^{-1} for local varieties. Over the last few years, the area and production of chickpea in the district was increased tremendously due to inception of Cluster Front Line Demonstration concept at farmer's field. Traditional or farmers practice are no longer sustainable towards chickpea production as it shows unambiguous gap between traditional and scientific production technologies. Constant efforts are needed to bridge this gap through transfer of technology. To make stronger the extension services for educating the cultivars in the implementation of improved technology with available of quality seed in time is the need of hour. Over a period of time, a number of improved pulses varieties and production technologies have been developed, but full potential of theses varieties as well as technologies could not be exploited due to lack of awareness on varieties, low rate of adoption and low yields. Keeping the above point in view the cluster front line demonstration on chickpea on Chickpea using improved production technologies was conducted with the objective of sowing the productivity potentials of the improved production technologies under actual farm situation.

Materials and Method

The present study was carried out by the Krishi Vigyan Kendra, Jamui (Bihar Animal Sciences University, Patna) in rabi season at farmers field of 12 village of Jamui district. during rabi season of 2019 – 2020 and 2020 - 2021. All 102 front line demonstrations in 37.5 acre area were conducted in adopted villages. Before conducting front line demonstration a list of farmers was prepared from group meeting and specific skill training was imparted to the selected farmers regarding different aspects of cultivation etc. were followed as suggested by Choudhary (1999) [1]. In general the soil of the district is sandy loam in texture (62% sand, 25% silt and 12% clay) bulk density (1.4 g/cc) low water holding capacity (30.5%) with slightly acidic in soil reaction (p^H 6.93) with non saline conductivity (0.26 dsm^{-1}), medium in organic carbon content (0.58%), and the available nitrogen, available phosphorus and available potash were 278 kg ha^{-1}, 13.2 kg ha^{-1} and 140 kg ha^{-1} respectively. Materials for the present study with respect to front line demonstration and farmers practice has been given in table – 1. The technologies were demonstrated for the present study with respect to FLD are given here under.

Improved variety (GNG 1581)
Seed treatment with fungicide, insecticide and rhizobium culture.
Line Sowing (30X 10 cm.)
Weed management (Pendamethalin at 1.00 kg ai ha^{-1})
Balance Fertilizer (N:P) 20:40 kg ha-1
Adoption of IPM

The improved technology included newly released variety, seed treatment, line sowing recommended dose of fertilizers, timely irrigation and need based plant protection measures were demonstrated in the farmer's field through front line demonstration of different locations whereas in local check (adjoining farmers field) existing practices being used by farmers followed. The sowing was done during November month with the seed rate of 80 ka ha-1 and row spacing was 30X10 cm. Uniform dose 20 kg Nitrogen per hectare and 40 kg Phosphorus per hectare were applied as basal dose. Pre-emergence herbicide Pendamethalin 1000 ml. ha^{-1} was applied within two days of seeding. Only critical inputs like seed and rhizobium culture were provided by KVK remaining inputs supplied by farmers themselves. Field day was organised at demonstration plots to disseminate the message at large scale. The demonstration farmers were facilitated by KVK Scientists in performing like seed treatment, sowing, herbicide spraying, fertilizer application and harvesting etc. The traditional practices were maintained in case of local checks. The data were collected from both front line demonstration plots as well as control plots (FP) and finally the extension gap, technology gap and technology index were worked out (Samui et al., 2000) [9] as given below.

Technology gap = Potential Yield – Demonstration Yield

Extension Gap = Demonstration Yield – Farmers Yield

$$\text{Technology Index} = \frac{\text{Technology gap}}{\text{Potential Yield}} \text{X } 100$$

Result and Discussion

Yield attributing parameters

The yielding attributing parameters like number of branches per plant, no. of pods per plant of chickpea obtained over the year under recommended practices as well as farmers practices are presented in table 3. The no. of pods per plant of chickpea ranged from 15.4 to 15.7 under recommended practices on farmers field as against a ranged from 11.5 to 11.6 under farmers practices. Similarly no. of pods per plant were recorded under recommended practices ranged from 53.4 to 54.4 as compared to farmers practices ranged from 42.3 to 42.4. The higher values of number of branches per plant, no. of pods per plant following recommended practices as well as farmers practices was due to improved seeds, seed treatment, use of bio fertilizers, line sowing, weeds management practices, balance use of fertilizers and need based plant protection measures during study periods of demonstration similarly results have been reported earlier by Sagar Chandra (2004) [8]. The grain yield of chickpea obtained over the years under recommended practices as well as farmers practices are present in table 2. The grain yield of Chickpea ranged from 11.8 q ha^{-1} to 12.2 q ha^{-1} with mean yield of 12.00 q ha^{-1} under recommended practices on farmers field as against a yield ranged from 8.5 q ha^{-1} to 8.8 q ha^{-1} with a mean of 8.6 recorded under farmers practice. In comparison to farmers practice, there was an increase of 38.5% and 38.6% higher grain yield of chickpea crop,

respectively during 2020 and 2021 following recommended practice. The result indicated that front line demonstrations gave good impact over the farming community of Jamui district as they were motivated by the new agricultural technologies applied in the FLD plots similarly results reported by A.D. Raj *et al.* 2013 [12]; Kumar *et al.* 2015 [4]; Sanjeev Kumar *et al* 2016 [5].

Economics of front line demonstration

The inputs and outputs prices of commodities prevailed during both the year of demonstrations were taken for calculating cost of cultivation, net returns and benefit cost ratio in table 4. The cultivation of chickpea under recommended practices ranged from Rs. 21,000 to 21,850 per ha. with a mean value of 21,425 per ha. against farmers practice where the variation in cost of production were Rs. 19,800 to 19,850 with a mean value of Rs. 19,875. Cultivation of Chickpea crop under recommended practices gave higher net returns of Rs. 35,640 to 39,150 per ha compared to Rs. 22,400 and 24,050 per ha under farmers practice during 2020 and 2021 respectively. The average benefit cost ratio of recommended practices was 2.3, varying from 1.8 to 2.7 and that of farmers practice was 1.15 varying from 1.1 to 1.2. This may be due to higher yields obtained under improved practices compared to farmers practices. Similarly results have been reported earlier on Chickpea by Mokidue *et al.* (2011) [6], Sharma *et al.* (2012) [11] and A.D. Raj *et al.* (2013) [12].

Extension gap, Technology gap and Technology index

The extension gap showed an increasing trend. The extension gap ranging between 3.0 q ha^{-1} to 3.4 q ha^{-1}. This emphasizes the need to educate the farmers through various means for adoption of improved agricultural production technologies to reverse the trend. The average extension gap was observed 3.2 q ha^{-1}. The technology gap is the difference between the demonstration yield and potential yield. The technology gap ranged between 0.7 q ha^{-1} and 0.3 q ha^{-1} during both the years. This gap exists due to variation in the soil fertility and climatic conditions. The average technology gap was observed 0.5 q ha^{-1}. Technology index showed the feasibility of evolved technology at the farmers field. The lower is the value of technology index, the more is the feasibility of technology demonstrated. The wider in technology index ranging between 2.4% and 5.6% during the period may be attributed to the difference in the soil fertility status, weather condition and insect-pest attack on the crop. This finding is in corroboration with the finding of Sanjeev Kumar *et al.* 2017 [10], D. Vijaya Lakshmi *et al.* 2017 [2] and A D Raj *et al.* 2013 [12].

Table 1: Difference between technological intervention and farmers practices under CFLD on Chickpea

S. No.	Particulars	Demonstration plot	Local Check (FP)	Gap
01.	Variety	GNG 1581	Local	Full gap
02.	Seed Rate	80 kg ha^{-1}	100-110 kg ha^{-1}	High seed rate
03.	Seed treatment	Carbendazim @ 2 g, Chloropyriphos @ 5 ml & Rhizobium @ 1 kg ha^{-1}	No seed treatment	Full gap
04.	Method of Sowing	Line sowing	Broadcasting	Full gap
05.	Weed management	Pendimethalin 1.00 litre ha^{-1}	Not used	
06.	Basal Application of Fertilizer	20:40 (N:P)	Irrational used of nitrogenous fertilizers and non use of Phosphorus	Full gap
07.	Use of Bio fertilizer	Seed inoculation with Rhizobium	No inoculation	
08.	Control of Pod Borer	Spray Profenophos 50 EC 750 ml ha^{-1}	Nil	Full gap
09.	Plant Protection	Need Based	Improper measures	Partial gap
10.	Technical Guidance	Time to Time	Nil	Full gap

Table 2: Performance of Chickpea on productivity under front line demonstration and farmers practice

Year	Area in ha	No. of Farmers	Yield q ha^{-1}			% Percent increase over local check
			Potential	Demo	FP	
2019-20	10	84	12.5	11.8	8.5	38.5
2020-21	05	18	12.5	12.2	8.8	38.6
Polled				12.0		

Table 3: Yield parameters under demonstrations and existing farmers practices

Years	No. of branches/plant		No. of pods/plant		Test weight (g)	
	Demo.	FP	Demo.	FP	Demo.	FP
2019-2020	15.4	11.6	53.4	42.4	111.5	100.2
2020-2021	15.7	11.5	54.2	42.3	111.7	100.5
Polled	15.5	11.5	53.8	42.35	111.6	100.35

Table 4: Economic analysis of front line demonstration plots and farmers practice

Year	Cost of cultivation Rs. ha^{-1}		Gross Return Rs. ha^{-1}		Net Return Rs. ha^{-1}		B:C Ratio	
	FLD Plots	Farmers Practice	FLD Plots	Farmers Practice	FLD Plots	Farmers Practice	FLD Plots	Farmers Practice
2019-20	21,000	19,800	56,640	42,240	35,640	22,400	1.8	1.1
2020-21	21,850	19,950	61,000	44,000	39,150	24,050	2.7	1.2
Pooled	21,425	19,875	58,820	43,120	39,152	23,225	2.3	1.15

Table 5: Performance of Chickpea on technology gap, extension gap and technology index under front line demonstration and farmers practice

Year	Technology Gap (q. ha^{-1})	Extension Gap (q. ha^{-1})	Technology Index%
2019-20	0.7	3.0	5.6
2020-21	0.3	3.4	2.4
Pooled	0.5	3.2	4.0

Conclusion

The present study conclusively indicated that the CFLD programme is an effective tool for increasing the production and productivity of Chickpea and changing the knowledge, attitude and skill of farmers. The productivity enhancement under CFLD over traditional method of chickpea cultivation created greater awareness and motivated the other farmers to adopted appropriate production technology. The selection of specific technology like improved variety, seed treatment, line sowing, timely irrigation and need based plant protection measures were undertaken in a proper way. Front line demonstration was effective in changing attitude of farmers towards chickpea cultivation. Front line demonstration also helped in replacement of local unrecommended varieties with improved recommended varieties. This also improved the relationship between farmers and scientist and built confidence between them.

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