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Dissemination of scientific package of practices of chickpea through cluster front line demonstration in Chitrakoot District of Uttar Pradesh

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Abstract

A study was carried-out to popularization of Chickpea production technologies during Rabi seasons of 2015-16 and 2016-17 at farmer's fields in 5 villages of Chitrakoot District of Uttar Pradesh. Clusters Front Line Demonstration (CFLD) on Chickpea crop was conducted on an area of 50 ha. Total 125 demonstration were conductedon125 farmers' fields with improved technologies composed of JG -14 and DCP 92-3 varieties and recommended production practices. The objective was to find out the best suitable variety of Chickpea for the Bundelkhand area and convincing farmers to adopt Chickpea as a suitable option in *Rabi* season for higher crop productivity with improved soil health. The maximum grain yield (1.61t ha^{-1}) was obtained from variety DCP 92-3 which was 27.68 % higher than the yield of farmers practice. This was followed by JG -14 which gave yield 1.53t ha^{-1} with an increment of 24.20 % over farmers practice. It was obtained due to varietal intervention grown with recommended package of practices. The mean Biological yield of 3.29t ha^{-1} and 3.24t ha-1 was obtained from DCP 92-3 and JG-14 variety during two year, respectively. Highest pooled harvest index (48.08 %) was recorded from the demonstrated package of practice (PoP). Maximum mean gross return (Rs. 80020 ha^{-1}) and, net return (Rs. 43195 ha^{-1}) was fetched during two observation years. However, the pooled maximum B: C ratio (2.17) was registered with the recommended package of practices.

Keywords: CFLD, Chickpea Variety DCP 92-3, JG-14, Yield, Economics.

1. Introduction

India is 2nd populated country in the world with domination of veg-dietary habits. Pulses are the rich and chief sources of veg-proteins, minerals, iron and fibre. The pulse Recommended Dietary Allowances (RDA) for adult male and female is 60 g and 55 g per day, while its per capita availability is @ 42 g per day (Anonymous 2019). India is the largest producer and consumer of pulses with maximum area coverage in the world. Yet, with stagnation of production in spite of increase in demand, there has been an increasing demand supply gap for pulses in India which create huge economic load in terms of import to meet out the domestic demands. According to vision 2030 of ICAR-Indian Institute of Pulse Research, Kanpur

growth rate of 4.2% has to be ensured to meet out projected demand 32 MT of pulses by 2030 (Tiwari and Shivhare, 2017).In order to ensure self-sufficiency, the pulse requirement in the country is projected to be about 39 million tonnes by 2050 which necessitates an annual adopt of Chickpea as a suitable option in Rabi season for higher crop productivity and profitability with improved soil health.

Focus on pulses production and consumption can help overcome malnutrition as well as micronutrient deficiencies in growing population of the country. Pulses are grown worldwide on about 85.40 M ha with production of 87.40 (Mt) at 1023 k*g*ha^{-1} yields level. India, ranks first in area *(*29.3 M ha) and production (245 lakh tonnes) with 34 per cent and 26 per cent contribution, respectively (Anonymous 2018). A remarkable increase in productivity of pulses over 11th(662 kg ha-1) and 12thplans*(*745 kg ha^{-1}) was reported in 2016-17 (835 kg ha^{-1}). Chickpea with 11.5 MT production from 14.56 M ha area and 1266.08kg ha^{-1} productivity also make a record in 2018-19 in the country. The contribution of Uttar Pradesh in Chickpea production was 6.42 % (58.9 lakh ton) from 5.05 lakh ha area with average productivity of 1166 kg ha^{-1}. Widely it has created externalities affecting the ecosystem and human health. These externalities have been caused by intensive food grains cropping systems and by the lack of crop diversity. However, over the same period, production of pulses in India increased only by about 47*% (*Anonymous 2018(I).

Chickpea (*Cicer arietinum*) is one of the oldest pulses crops that have been grown for over 8,000 years (Dhuppar *et al*. 2012). Because of special ability of pulses to fix atmospheric nitrogen, pulses are traditionally indispensable components of cropping systems in India. Moreover, pulses are climate resilient and can be sown in rain-fed areas. Before the inception of chemical fertilizers, pulses were treated as soil fertility charger. Pulses enrich the soil in nitrogenous compounds and improving sustainability of the production system and also nutritional security.

The Chitrakoot district of Bundelkhand area has a total geographical area of 3218 km^2 and net sown area 173183 ha with 131 % cropping intensity and about 43.25percent irrigated. This Bundelkhand zone having heavy clay soils varies in texture from clay loam to clay. The condition of the area leads pulses dominated crop rotations. Moreover, the negative growth in area, production and productivity of the Chickpea in Uttar Pradesh have been reported by Nasim Ahmad *et al.* (*2*018) during the years 2001-2016. Several causes are responsible for low yield of Chickpea of which the use of traditional varieties, poor plant growth, heavy insect attack and poor crop management practices constitute the major ones. In spite of agricultural modernization in pulse crops, farmers are still facing diverse technological gap in cultivation. Khedkar *et al.* (2017) have reported 15 % to 75 *%* technological gap in different interventions of pulse production. To improve this technological gap in adoption of pulse production technologies, large scale demonstration of newer technologies at farmers field are needed (Prahraj *et al*. 2018). Singh *et al.*(2020) and Venkanna *et al.* (2020) also convinced with importance of cluster frontline demonstration to increase yields and economics of pulses. Considering the deteriorating soil health, drastically depleting ground water level the Chickpea could be adapted and grown well in large area of Chitrakoot with maximum productivity and economic outcome. Keeping these points in view, Clusters frontline demonstrations (CFLDs were carried out in a systematic manner on farmer's field with the objective to find the best suitable variety of Chickpea for the area and convincing farmers to adopt Chickpea as a suitable option in Rabi season for higher crop productivity, improved soil health and more economic return.

2. Materials and Methods

Cluster Front line demonstrations on Chickpea were conducted under the National Food Security Mission (NFSM), during Rabi seasons of 2015-16 and 2016-17 at farmer's fields. The demonstrations were laid out in 5 villages in Chitrakoot District of Uttar Pradesh. Frontline Demonstrations were conducted in a block of 3 to 5 hectares land in order to have better impact of the demonstrated technologies on the farmers and extension functionaries working agriculture development in rural areas. Such 2-3 blocks were identified in the location of each village. The cluster of Chickpea growing farmers was selected in villages where crop covered a notable area under Chickpea to increase the impact and further dissemination of demonstrations. A training programme on scientific cultivation of Chickpea was conducted to upgrade the knowledge and skill of farmers and ensuring appropriate adoption of inputs and methods. Each demonstration was conducted in a 0.4 ha area in order to have better impact of the technologies demonstrated against the local checks. Total 125 demonstrations were conducted and a total area of 50 ha was put under Chickpea.

All standard packages of practices were applied in demonstration plots (Table 1). The farmers were provided with DCP 92-3 and JG-14Chickpea seed @ 80 kg ha^{-1}. The input for famers practice was arranged by farmers themselves during both the years. The seed of new varieties DCP 92-3 and JG-14 was provided from Krishi Vigyan Kendra, Chitrakoot and made available to farmers. Most of the soils under rain-fed condition are low-to-medium in available phosphorus, therefore they respond positively to P-fertilizer application (Hojjat and Taherzadeh, 2013). The phosphorus efficient genotypes would be helpful to get the highest response from lower-P soils.

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

Sr. No.	Intervention	Demonstrated package	Farmers' practice
1.	Farming situation	Rain-fed	Rain-fed
2.	Variety	DCP 92-3 and JG-14	Awarodhi/Udai
3.	Seed treatment	Thirum (2 gm) + Carbendazim (1gm)/kg seed, *Culture:* Rhizobium + PSB, 2 packet each for 10 kg seed.	Nil
4.	Time of Sowing	15-25 October during both year	10-25 November
5.	Sowing Method	Line sowing at 30 cm Line to Line	Line sowing at 20 cm Line to Line
6.	Irrigation	Pre flowering stage	Nil
7.	Seed rate	80 kg ha^{-1}	80-100 kg ha^{-1}
8.	Fertilizer dose	DAP @100 $kgha^{-1}$	60 kg ha^{-1}
9.	Plant protection	2 spray of insecticide to control pod borer at 75% flowering and pod filling stage	Nil
10.	Weed management	One hand weeding at 30 DAS	One hand weeding at 35-40 DAS
11.	Harvesting time	20-25 March, 2016 25-30March, 2017	15-20 March

The soil of all demonstration plots was clay loam and it was low in nitrogen and phosphorus and high in potash. The pH was reported in the range of 6.5 to 7.2The Recommended dose of fertilizer (100 kg $DAPha^{-1}$) in each demonstration was applied at sowing time as basal application. Sowing of Demonstration was done on 15-20 October during 2015-16 and 20-25 October during 2016-17 while check plots were sown between 10-25 November during both years. The 80kg ha^{-1} treated seed was used in sowing keeping 30 cm row spacing with seed drill and 100 kg seeds was used in control with 20 cm row spacing. Bundelkhand climate become highly dried in the month of Dec- Jan which leads low soil moisture. For sufficient growth of the crop one light irrigation was given at the time of flowering in demonstration fields. Farmers usually do not go for any irrigation in Chickpea crop. Similarly, pod borer is major constraints in Chickpea production so two spray of insecticides were adopted in demonstration field for complete management of pod borer.

The crop was harvested manually at physiological maturity in third and fourth week of March during 2015-16 and 2016-17, respectively. However, the plots of farmers practice were matured and harvested about one week earlier than demonstrations during both the years. The cost of cultivation was calculated on the basis of local rate of inputs and other operation prevailing at that time, similarly the local sale price of Chickpea was considered for calculation of gross and net income. Grain and biological yields data were recorded by crop cutting method of yield estimation from three demonstrations plots randomly selected from each cluster/ village. After three days sun-drying in the field, the total biomass (grain + stover) was weighed and threshed. Grain yield was reported at 14% moisture content. The total biomass on a dry weight basis was considered as biological yield. Frequent visit of all clusters was made by scientists of Krishi Vigyan Kendra, Chitrakoot. Field day was also conducted at demonstration plot at harvesting stage of the crop.

3. Results and Discussion

3.1 Grain Yield

The data pertaining to performance of Chickpea crop in both demonstration and farmers practice is given in table 2 and 3. It is evident from the table that grain yield, biological yield and harvest index of both the demonstrated varieties grown with recommended package of practices was higher than the local variety used by most of the farmers of Chitrakoot district. The maximum grain yield (1.61t ha^{-1}) was obtained from variety DCP 92-3 which was 27.68 % higher than the yield of farmers practice. This was followed by JG-14 which gave 1.53t ha^{-1} with an increment of 24.20 % over farmers practice. It is clear from the data shown in the table 2 that the highest commercial yield, was obtained due to varietal intervention grown with recommended package of practices. Kundu *et al. (*2014) also ob-served significant differences in yield of the Chickpea varieties. This might be due to the proper supply of phosphorus (Starter dose)and one irrigation before flowering stage to the crops which play important role in a number of metabolic functions and is especially important for grain formation (Balyan and Singh, 2005). It is needed in relatively large amounts by legumes for growth and nitrogen fixation, and it was found to increase biomass, yield, nodulation, and nutritional quality in Chickpeas (Yemane and Skjelvag, 2003). For higher and sustainable Chickpea yield in vertisols, application of 20 kg P ha^{-1} has been recommended earlier by Zike *et al*. (2017). Moreover, Singh *et al*. (2011) also suggested that the application of nitrogen and phosphorus is essential for obtaining high grain yields of Chickpea. Similar findings were also reported by Singh *et.al.*2018, Saikia *et al*. (2018) and Singh *et al.* (2020).Most of the soils under demonstration are low-to-medium in available phosphorus, therefore they respond positively to P-fertilizer application (Hojjat and Taherzadeh, 2013). The phosphorus efficient genotypes would be helpful to get the highest response from lower-P soils.

Table: 2. Yield performance of demonstrated Varieties Vs Farmers Variety

Year	Farmers variety (t ha^{-1})	Demonstrated DCP92-3 variety			Demonstrated JG-14 variety		
		Grain (t ha^{-1})	Biological (t ha^{-1})	Increase (%)	Grain (t ha^{-1})	Biological (t ha^{-1})	Increase (%)
2015-16	1.12	1.48	3.06	24.32	1.52	3.20	26.32
2016-17	1.20	1.74	3.52	31.03	1.54	3.28	22.08
Mean	**1.16**	**1.61**	**3.29**	**27.68**	**1.53**	**3.24**	**24.20**

Table: 3. Yield range of Chickpea obtained under demonstration v/s farmer's practice

Year	Grain Yield Obtained (t ha^{-1})						Pooled Yield Increase (%)
	Check (Farmer's POP)			Demo(Recommended POP) pooled of two varieties			
	Max.	Min.	Average	Max.	Min.	Average	
2015-16	1.31	0.93	1.12	1.68	1.32	1.50	26.67
2016-17	1.38	1.02	1.20	1.72	1.56	1.64	28.21
Mean	**1.35**	**0.98**	**1.16**	**1.70**	**1.44**	**1.54**	**27.44**

3.2 Biological Yield and Harvest Index

It is revealed from the data that the use of latest package of practices with combination of high yielding varieties enhanced the Biological Yield over farmers practice. The highest pooled Biological yield 3.29t ha-^{1} and 3.24t ha-1 was obtained from DCP 91-3 and JG-14in demonstration fields (Table 4). The higher biological yield may be attributed to higher level phosphorus fertilization which increases the dry matter accumulation as phosphorus is directly involved in a number of metabolic functions and is especially important for grain formation (Balyan and Singh, 2005). The higher biological yield of Chickpea is joint output of sufficient soil moisture and starter dose of P which leads the increasing availability of soil nutrients and their uptake by plants, which resulted in higher dry matter accumulation in leaves and stem at earlier growth stages and better translocation to seed during later stages.

Nkaa *et al.* (2014) also reported the similar effect of applied phosphorus on dry matter accumulation. These results indicate that nutrients have played a role in metabolism, chlorophyll formation and photosynthesis activities of the plant and all these resulted in increased biological yield (Fageria, 2009).

Table: 4. Grain Yield, Biological yield and Harvest Index of Chickpea obtained under demonstration v/s farmer's practice.

Year	Check (Farmer's POP)			Demo(Recommended POP) pooled of two varieties		
	Grain Yield (t ha^{-1})	Biological Yield (t ha^{-1})	HI (%)	Grain Yield (t ha^{-1})	Biological Yield (t ha^{-1})	HI (%)
2015-16	1.12	2.40	46.67	1.50	3.13	47.92
2016-17	1.20	2.60	46.15	1.64	3.40	48.24
Mean	**1.16**	**2.50**	**46.41**	**1.58**	**3.27**	**48.08**

In present study the data of mean comparison suggested that the highest pooled harvest index (48.08%) was recorded in demonstration during the years. The farmers practice recorded slightly lower (46.41%) harvest index. This result agreed with Hussain *et al.* (2002) and Shah *et al*. (2000) who reported differed harvest index from different cultivars. Increased mean harvest index of Chickpea was obtained with higher grain yield and biological yield ratio. These results were also in consistence with Mauriya *et al* (2017) and Neelam *et al.* (2019).

3.3.Economics

The cost of cultivation for both the demonstrated varieties of Chickpea grown with recommended package of practices recorded higher with Rs. 35200 ha^{-1} and Rs.38400 ha^{-1}than the farmer's practice Rs. 28900 ha^{-1} and Rs.30200 ha^{-1}during the years 2015-16 and 2016-17, respectively (Table 5). This difference in cost of cultivation was due to quality seed, fertilizer, irrigation and insecticide cost applied in recommended package of practice. Both of the demonstrated varieties of Chickpea grown with recommended package of practices showed beneficial effect on grain, biological yield as well as economics as compared to farmers practice. Maximum and higher pooled mean gross return (Rs. 80020 ha^{-1}) and, net return (Rs. 43195 ha^{-1})) was fetched with recommended package of practices. Similar pattern was also reported by Singh *et al.* (2017) and Singh *et al.* (2019). However, the maximum mean B: C ratio (2.17) was registered with the recommended package of practices. This was due to the increased net return in corresponding to the cost of cultivation. Similar results of yield increment, irrespective of varieties with maximum net return due to application of 20 kg P ha-^{1} and plant protection measures have also been reported earlier by Zike et al. (2017), Mitnala *et al.* (2018) and Undhad *et al*. (2019).

Table: 5. Economics of demonstration and farmer's practice.

Year	Expenditure and returns (Rs./ha)								Net Increase (Rs ha^{-1})
	Check (Farmer's POP)				Demo(Recommended POP) pooled of two varieties				
	Gross Cost (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net Return (Rs ha^{-1})	B:C ratio	Gross Cost ((Rs ha^{-1})	Gross return (Rs ha^{-1})	Net Return (Rs ha^{-1})	B:C ratio	
15-16*	28900	51840	22940	1.79	35200	72560	37360	2.06	14420
17-18**	30200	60680	30482	2.00	38450	87480	49030	2.28	18540
Mean	**29550**	**56260**	**26711**	**1.90**	**36825**	**80020**	**43195**	**2.17**	**16484**

*Sale Price 2015-16 Grain @Rs.4400 per qt and Stover@ Rs. 200 per qt.
**Sale Price 2016-17Grain @Rs.4800 per qt and Stover@ Rs. 220 per qt.

4. Conclusion

On the basis of results of CFLDs conducted during two consecutive years. It was concluded that for obtaining higher grain yield, straw yield, gross and net income with higher B: C ratio from Chickpea, variety DCP 92-3 may be adopted with recommended package of Practice under Bundelkhand climatic conditions of District Chitrakoot. It would help the farmers in increasing the farm income with additional benefit of improving soil health.

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