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Impact of cluster frontline demonstrations (CFLD) on chickpea production, productivity, profitability and transfer of technologies in Solapur district of Maharashtra, India

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Abstract
Technology Cluster Front line demonstration on chickpea variety Phule Vikram was conducted by Krishi Vigyan Kendra, Mohol during 2019-2020, 2020-2021 and 2021-2022 in Solapur district of Maharashtra. Full gap was observed in the case of high yielding verities, seed treatment, farm manure, fertilizer dose, weed management, irrigation management, which was the reason for not achieving potential yield. The results revealed that the demonstration on chickpea an average seed yield recorded 1322.66 kg/ha under demonstrated plots as compare to farmers practice 983.33 kg/ha. The highest seed yield in the demonstration plot was 1610 kg/ha during 2021-22. The average yield of chickpea increased 34.87 per cent (Table 2). Adoption of scientific package of practices like seed treatment, integrated nutrient management, bio-pesticide, micro irrigation at critical growth stage, seed treatment with bio-fertilizers and need based right plant protection practices resulted in higher yields. On an average extension gap observed in three years under CFLD implemented villages was 339.33 kg/ha. The highest extension gap 430 kg/ha was recorded in 2021-22 followed by 296 kg/ha (2020-21) and 292 kg/ha (2019-20). On an average technology gap observed in three years under CFLD implemented villages was 327.33 kg/ha. The highest technology gap 618 kg/ha was recorded in 2019-20 followed by 324 kg/ha (2020-21) and 40 kg/ha (2021-22) (Table 2). On an average technology index observed was 19.83 % for three years where cluster front line demonstrations were conducted. This shows the efficiency and effectiveness of the improved technologies as a result of successful technical interventions to increase the yield performance of chickpea. The cultivation of chickpea under improved technologies CFLD gave higher net returns of Rs. 20358, Rs. 27626 and Rs. 40730 per hectare as against to farmers practices i.e., Rs. 9020, Rs. 11530 and Rs 16514 per hectare during the years 2019-20, 2020-21 and 2021-22 respectively (Table 3). Benefit: cost ratio of chickpea observed during different years 2019-20, 2020-21 and 2021-22 under improved cultivation practices were 1.81, 1.69 and 1.93 respectively while it was 1.39, 1.28 and 1.36 under farmers practice for the respective years. The highest Benefit: cost ratio in demo plots is because of higher yields obtained under improved technologies compared to farmers practices during all the three years (Table 3).

Keywords: Cluster frontline demonstration, chickpea, technological intervention, technology gap, extension gap, net income

Introduction

Pulses are an integral part of many diets across the globe and they have great potential to improve human health, conserve our soils, protect the environment and contribute to global food security. India is the largest producer, consumer and importer of the pulses in the world. The pulses are integral part of cropping system all over the country. Pulses are considered as lifeblood of agriculture because they occupy a unique position in every known system of farming as a main, catch, cover, green manure, intercrop, relay and mixed crop. India, particularly Maharashtra state, from last few years is facing severe problem of vagaries of monsoon like late onset, early withdrawal, prolonged dry spell between two rains etc. As a result of this, crop failure due to lack of water availability has become a common phenomenon. Lack of moisture at pod development stages is one of the major reasons that limits yield of crops. As well as shortage of labor is also an important factor. Chickpea is one of the most important pulse crop and occupies a major position among pulses in Maharashtra state. Chickpea plays a significant role in improving soil fertility by fixing the atmospheric nitrogen. Chickpea meets 80% of its nitrogen (N) requirement from-symbiotic nitrogen fixation and can fix up to 140 kg N ha'1 from air. It leaves substantial amount of residual nitrogen for subsequent crops and adds plenty of organic matter to maintain and improve soil health and fertility. Because of its deep tap, root system, chickpea can avoid drought conditions by extracting water from deeper layers in the soil profile. Though chickpea is widely grown in Solapur district, various factors influences potential yield of the crop such as, faulty sowing practices, lack of knowledge about high yielding and disease resistant varieties. Lack of awareness about seed treatment, integrated nutrient management, integrated pest management and varieties suitable for mechanical harvesting and use of micro irrigation at critical growth stage etc. Above all in the district predominantly noticed problems for chickpea cultivation are high incidence of wilt, terminal drought condition, labor shortage for harvesting etc. Hence climate resilient variety appears to be major challenges to increase productivity. High yielding and climate resilient crop variety with consistently higher yields under rainfed and labor shortage situation is paramount importance. This can be achieved by means of use of high yielding, climate resilient and suitable for mechanical harvesting variety and improved cultivation practices. With this background, Cluster Front line demonstrations were conducted to show the worth of high yielding, climate resilient and mechanically harvested improved variety of chickpea.

Material and Methods

Technology Cluster Front line demonstration on chickpea variety Phule Vikram was conducted by Krishi Vigyan Kendra, Mohol during 2019-2020, 2020-2021 and 2021-2022 in district of Solapur. The total 100 number of demonstration was conducted on 40 ha area during 2019-20, while total 75 number of demonstration was conducted on 30 ha area each year during 2020-21 and 2021-22. A group of co-operative farmers were identified based on their participation and feedback received during interactive meeting. Farming situation of demonstration plot and farmers controlled plot was rainfed. Critical inputs for the technologies to be demonstrated (Table 3) were distributed to the farmers after the training like improved high yielding variety, recommended agrochemicals and literature and regular visit, monitoring and pest and disease advisory services management by the KVK scientist to the demo farmers. Finally field day was conducted involving demonstration holding farmers, other farmers in the village, Scientists from University, officials from Department of Agriculture and local extension functionaries to demonstrate the superiority of the technology. Crop yield was recorded from the demonstration and control plots for the crops at the time of harvest. The most feasible way by which this could be achieved is by demonstrating the recommended improved technology on the farmer's fields through front line demonstrations with the objectives to work out the input cost and monetary returns between front line demonstration and farmers methods, to identify the yield gaps between farmer's practices and front line demonstrations. The basic information were recorded from the farmer's field and analyzed to comparative performance of cluster frontline demonstrations (CFLD's) and farmer's practice. The component demonstration technology in chickpea was comprised i.e. university recommended improved variety Phule Vikram which was wilt resistant, suitable for mechanical harvesting, high yielding. Machine Harvesting of Chickpea can reduce cost of production, prevent risk of harvest losses, improve resource use efficiency and reduce drudgery for women who carry out the manual harvesting. Machine-harvestable chickpea varieties have the potential to enhance chickpea area and production in India, and can help reach the country, s goal of self-sufficiency in pulse production and doubling farmers income. In the demonstration, one control plot was also kept where farmers practices was carried out. The demonstration were conducted to study the technology gap between the potential yield and demonstrated yield, extension gap between demonstrated yield and yield under existing practice and technology index. The yield data were collected from both the demonstration and farmers practice by random crop cutting method and analyzed by using simple statistical tools. The percent increase yield, technology gap, extension gap and technology index were calculated by using following formula as per Samui *et al.*, (2000) [9], as given below-

$$\text{Percent increase in yield} = \frac{\text{Demonstration yield} - \text{farmers practice yield}}{\text{farmers practice yield}} \times 100$$

Technology gap = Potential yield - Demonstration yield

Extension gap = Demonstration yield – farmers practice plot yield

$$\text{Technology index (\%)} = \frac{\text{Technology gap}}{\text{potential yield}} \times 100$$

Result and Discussion

Cluster Frontline demonstrations studies were carried out in Solapur district of Maharashtra state in Rabi season from 2019-20 to 2020-2021, 2021-22. During three years of demonstration the gap between the existing and recommended technologies of chickpea in Solapur district of Maharashtra presented in Table 1. Full gap was observed in the case of high yielding verities seed treatment, farm manure, fertilizer dose, weed management, irrigation management, which was the reason for not achieving potential yield. During three years of technologies results obtained are presented in Table 2. The results revealed that the demonstration on chickpea an average seed yield recorded 1322.66 kg/ha under demonstrated plots as compare to farmers practice 983.33 kg/ha. The highest seed yield in the demonstration plot was 1610 kg/ha during 2021-22. The average yield of chickpea increased 34.87 per cent (Table 2). These results clearly indicated that the higher average seed yield in demonstration plots over the compare to farmers practice due to integrated crop management practices and awareness of wilt resistant and high yielding Phule Vikram variety. Adoption of scientific package of practices like seed treatment, integrated nutrient management, bio-pesticide, micro irrigation at critical growth stage, seed treatment with bio-fertilizers and need based right plant protection practices resulted in higher yields. The above findings are similar in lines with Rupesh *et al.*, 2017 [7] and Rajan Kumar Ojha *et al.*, 2020 [6].

Based on observation made, extension gap, technology gap and technology index were worked out. The extension gap observed during different years was 292, 296 and 430 kg/ha during 2019-20, 2020-21 and 2021-22 respectively. On an average extension gap observed in three years under CFLD implemented villages was 339.33 kg/ha. The highest extension gap 430 kg/ha was recorded in 2021-22 followed by 296 kg/ha (2020-21) and 292 kg/ha (2019-20). The above findings are similar in lines with NK Singh *et al.*, 2020 and Rajan Kumar Ojha and Harshita Bisht, 2020 [6].

Technology gap is the difference between potential yield and demonstrated plot yield. The technology gap observed during different years was 618, 324 and 40 kg/ha during 2019-20, 2020-21 and 2021-22 respectively. On an average technology gap observed in three years under FLD implemented villages was 327.33 kg/ha. The highest technology gap 618 kg/ha was recorded in 2019-20 followed by 324 kg/ha (2020-21) and 40 kg/ha (2021-22) (Table 2). The above findings are similar in lines with NK Singh1 *et al*., 2020. On an average technology index observed was 19.83 % for three years where cluster front line demonstrations were conducted. This shows the efficiency and effectiveness of the improved technologies as a result of successful technical interventions to increase the yield performance of chickpea.

Data pertaining to gross income, net income and B:C ratio presented in Table 3. Economics returns related to input and output prices of commodities prevailed during the study period, were recorded. The cultivation of chickpea under improved technologies CFLD gave higher net returns of Rs. 20358, Rs. 27626 and Rs. 40730 per hectare as against to farmers practices i.e., Rs. 9020, Rs. 11530 and Rs 16514 per hectare during the years 2019-20, 2020-21 and 2021-22 respectively (Table 3) Similar results were observed with Hrish Kumar Rachhoya *et al*., 2018 and NK Singh et.al., 2020 findings. The Benefit: cost ratio of chickpea observed during different years 2019-20, 2020-21 and 2021-22 under improved cultivation practices were 1.81, 1.69 and 1.93 respectively while it was 1.39, 1.28 and 1.36 under farmers practice for the respective years. The highest Benefi: cost ratio in demo plots is because of higher yields obtained under improved technologies compared to farmers practices during all the three years (Table 3). Similar results were observed with D.K. Raghav *et al*., 2021 [1].

Table 1: Differences between technological intervention and farmers practices under front line demonstration on chickpea

S. No.	Component	Technological intervention	Farmers practice	Gap
1.	Land preparation	Deep ploughing in Summer season and Before Sowing	Ploughing only Before Sowing	Partial
2.	Variety	Phule Vikram	Old mix variety	Full
3.	Seed rate	75 kg/ha	90-100 kg/ha	Higher seed rate
4.	Seed treatment	Trichoderma viride 5gm/ Kg seed	No seed treatment	Full
5.	Seed inoculation	Rhizobium and PSB culture with @25 gm/Kg seed	No seed inoculation	Full
6.	Sowing method	Line Sowing	Line Sowing	Nil
7.	Sowing time	20 September to 10 October	20 September to 15 November	Partial
8.	Spacing	Row to row 30 cm and plant to plant 10 cm	Row to row 45 cm and plant to plant 15 cm	Partial
9.	Farm manure	05 t/ha.	No. farm manure	Full
10.	Fertilizer dose	Balanced Fertilization as per soil test values 25:50:30 Kg/ha (NPK) and foliar application of Chelated Micronutrient	Imbalance use of fertilizers	Full
11.	Water Stress Management	Foliar application of 2 % urea and Potassium Nitrate during flowering and pod filling stage.	No Foliar application	Full
12.	Weed management	Preemergence Application of Pendimethalin weedicide + One hoeing and one hand weeding	No weeding	Full
13.	Irrigation	One Supplemental irrigations at flowering stage through sprinkler	No irrigation	Full
14.	Plant protection	Pheromone trap @ 05/plot.+ bird percher (T-shaped) @ 10/plot.+ spray, First spraying- of Neem Seed Kernel Extract (NSKE) @ 5% at the time of initiation of flower Second spraying - of Heliokil 200 ml/plot, after 10-15 days of first spray Third spraying – of Emamectin Benzoate 5 % SG	1- Only application of chemical insecticide 2- Repeated and untimely use of insecticide.	Partial gap with high cost
15.	Harvesting	Mechanical harvesting by Combine harvester	Manual harvesting	Partial gap with high cost

Table 2: Yield, technology gap, extension gap and technology index in chickpea cultivation during 2019-20, 2020-21 and 2021-22.

Year	Potential Yield (Kg/ha)	Average seed yield (Kg/ha)		Percent increase	Technology gap (Kg/ha)	Extension gap (Kg/ha)	Technology index (%)
		Demo	Farmers Practice				
2019-20	1650	1032	740	39.45	618	292	37.45
2020-21	1650	1326	1030	28.73	324	296	19.63
2021-22	1650	1610	1180	36.44	40	430	2.42
Mean	1650	1322.66	983.33	34.87	327.33	339.33	19.83

Table 3: Economic impact of chickpea cultivated under CFLD and Farmers practice during 2019 20, 2020-21 and 2021-22.

Year	No. of Demo	Area (ha)	Gross Income Rs./ha.		Net Income Rs./ha.		B: C Ratio	
			Demo	Farmers Practice	Demo	Farmers Practice	Demo	Farmers Practice
2019-20	100	40	45408	31820	20358	9020	1.81	1.39
2020-21	75	30	67626	52530	27626	11530	1.69	1.28
2021-22	75	30	84230	61714	40730	16514	1.93	1.36
Mean	83.33	33.33	65754	48688	29571	12354	1.81	1.34

Conclusion

Chickpea variety Phule Vikram gave higher seed yield, gross monetary returns, net monetary returns and B: C ratio under rainfed condition over farmers practice. The productivity gain under CFLD over farmers practices of chickpea cultivation created greater awareness and motivated the other farmers to adopt suitable production technology of chickpea in the district. Under sustainable agricultural practices, with this study, it is concluded that the CFLD Programmes were effective in changing attitude, skill and knowledge of farmers regarding improved package and practices of HYV of chickpea adoption under Rainfed condition.

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