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Comparison for yield potential of chickpea in Cluster Front Line Demonstrations and Farmer's Practices in *rainfed* areas of Bilaspur district of Himachal Pradesh

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Abstract

Realizing the importance of cluster frontline demonstrations in transfer of latest technologies, Krishi Vigyan Kendra are regularly conducting CFLDs on pulse crops at farmer's field with the objective of convincing farmers and extension functionaries together about the production potentialities of production technologies for further wide scale diffusion. To boost the production and productivity of chickpea pulse crop and to find out the yield gap, a total of 312 numbers of cluster frontline demonstrations on chickpea were conducted in 156 numbers of adopted villages of the four blocks of the Bilaspur district of Himachal Pradesh under *rainfed* conditions for consecutive 4 years (2015-16 to 2018-19). For comparison with recommended practices prevailing farmers' practices were treated as control. The findings of the study revealed that irrespective of the chickpea varieties used in demonstrations, percent increase in demonstrations yield over farmers practice ranged from 24.6 to 95.1 per cent. It was further observed that in terms of economics chickpea crop recorded higher net returns per hectare in demonstration plots compared to farmer's practice during all the years of studies. The extension gap and technological gap ranged between1.5-5.9 q/ha and 0.9-12.4 q/ha, respectively. The benefit cost ratio which indicates that whether CFLD technology is profitable or not varied from 2.22, to 3.8 during the study period and was always higher in demonstrations plots over farmers practice. The per cent technology index varied from 6.92 to 51.67 per cent indicating urgent need to make aware and motivate the farmers to adopt improved and economically viable technologies for chickpea production.

Key words: Chickpea, Cluster Front Line Demonstrations, Technology gap, Extension gap.

The nutritional value of pulses for humans and the importance they have for improving sustainability of agricultural systems had been acknowledged by declaring 2016 as the International Year of Pulses (IYP). Pulses are a Smart Food as these are critical for food basket (dal-roti, dal-chawal), important source of plant protein and help address obesity, diabetes etc. In addition pulses are highly water efficient, can grow in drought prone areas and help to improve soil fertility by fixing soil nitrogen. Over the last decade, pulse production has shown a significant jump from 11.08 million tonnes in 2000-01 to reach its record high of 25.42 million tonnes in 2017-18 (Anonymous, 2019[a]). The increase in the total production of pulses has been on account of improvements in the production levels of gram, tur, urd and moong. Productivity of pulses has also increased from 544 kg per hectare in 2000-01 to 806 kg per hectare in 2017-18 (Anonymous, 2019[b]). The Government of India is giving top priority for increasing the production of pulses. Around 50 percent of the budget under the National Food Security Mission (NFSM) is allocated for pulses. Under NFSM, 638 districts of 29 states, including all the districts of the North Eastern and hill states, are covered for promoting the cultivation of pulses. Chickpea being one of the important pulse crop of India commonly known as gram continues to be the largest consumed pulse in home as well as industrial purpose comprising of about 50 per cent of total pulse production in India (Parmar *et al.* 2017). The average productivity of chickpea in the Bilaspur district of Himachal Pradesh is very low (706 kg/ha) compared to national level productivity (1073 kg/ha). This is not because of the unavailability of improved varieties but lack of adoption of improved practices that are recommended by CSK, Himachal Pradesh Agriculture University, Palampur. Keeping in view the above facts, the present investigation was undertaken to demonstrate and transfer the generated

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farm technology through CFLDs' in chickpea under *rainfed* production systems with the objectives of enhancing productivity, profitability and narrowing in the extension yield gaps. A total 312 number of CFLDs on Chickpea were carried out in four blocks of the Bilaspur district on an area of 90 hectares during Rabi 2015-16, 2016-17, 2017-18 and 2018-19, with following full package and practices. The impact analysis of this venture is presented in this paper.

Materials and Methods

Krishi Vigyan Kendra, Bilaspur of Himachal Pradesh conducted 312 numbers of Cluster frontline demonstrations on chickpea crop on an area of 90 hectares for consecutive four years during Rabi 2015-16 to 2018-19. A total of 156 numbers of villages were covered in four blocks of the Bilaspur district. In frontline demonstrations plots, use of quality seeds of improved varieties with proper seed rate and spacing, *rhizobium* seed treatment, balanced fertilizer application, timely weed management, need based plant protection measures were emphasized to the farmers whereas in the farmers' practice, existing practices being followed by the farmers of the area were recorded and used for study. A regular monitoring of CFLDs and Field days on crops were also conducted by the KVK Experts. The primary data on yield and farmers' practice was collected from the beneficiary farmers. The yield increase in demonstrations over farmers' practice was calculated by using the following formula:

% increase in yield over farmers' practice (% YIOFP)

$$= \frac{\text{Demonstration yield} - \text{Farmers' plot yield}}{\text{Farmers' plot yield}} \times 100$$

Estimation of technology gap, extension gap and technology index:

The estimation of technology gap, extension gap and technology index was done using following formula (Yadav *et al.,* 2004):

Technology gap = Potential yield – Demonstration plot yield

Extension gap = Demonstration plot yield – Farmer's plot yield

$$\text{Technology Index} = \frac{Pi - Di}{Pi} \times 100$$

Where,

Pi = Potential yield of i^{th} crop

Di = Demonstration yield of i^{th} crop.

Economic analysis of FLD's on oilseeds

Cost of cultivation of chickpea crop include cost of inputs like seed, fertilizers, pesticides etc. not available with the farmers and purchased by the farmers (in farmers practice)/supplied by the KVK (in recommended practice) as well as hired labour (if any), sowing charges by bullocks/tractor (if any) and post harvest operation charges (if any) paid by the farmers. The farmers' family labour was not taken into consideration in the present study. The gross returns, cost of cultivation, net returns and benefit cost ratio (B: C ratio) were calculated by using prevailing prices of inputs and outputs. Additional costs in frontline demonstrations include expenditure on improved technological inputs in frontline demonstrations over farmers' practice. Similarly, benefit-cost ratio was worked out as a ratio of returns and corresponding costs.

Results and Discussion

Comparison of production technologies

The gap between the recommended practices in frontline demonstration and farmers' practice of chickpea in Bilaspur district of Himachal Pradesh is presented in table 1. The perusal of the data revealed that full gap was observed in the use of improved and recommended varieties of chickpea by the farmers. This wide gap in use of improved varieties seed in crop was mainly due to its non availability. In farmers' practice broadcast method of sowing chickpea against the recommended line sowing was followed and higher seed rate was used due to broadcasting method of sowing. Seed treatment with *rhizobium* culture, an important component in increasing the yield and yield attributes of pulse crops (Kumar and Elamathi, 2007) was also not followed by the farmers in farmers practice due to lack of knowledge. No gap in time of sowing of chickpea crop was observed mainly because of *rainfed* farming, the sowing was done only after receiving rains. Data in the table 1 also revealed that farmers did not apply any recommended fertilizer, if at all applied, only urea was given to the crop at the time of sowing. Also partial or full gap in adoption of weed control and plant protection measures was observed in farmers' practice over recommended practice in frontline demonstrations. Similar observations for gap in improved technologies and farmers practices were also observed by the Mishra and Khare (2017), and Dwivedi *et al.* (2019) in chickpea crop.

Yield

The grain yield data depicted in the Table 2 indicated that during all the four consecutive years of study, irrespective of the recommended varieties of chickpea used in frontline demonstrations, the yield was 24.6 to 95.1 per cent higher over farmer's practice where in local and low yielding varieties were used. A bold seeded Variety HPG-17 recorded 8.8 to10.9 q/ha grain yield in demonstrations plots compared to local varieties yielding 5.9 to 6.1 q/ha in farmers practice plots. The grain yield of small seeded varieties in frontline demonstrations varied viz., Himachal chana-1 (7.6 to 9.3 q/ha), Himachal chana-2 (7.9 to 12.1q/ha),

Table 1. Comparison of recommended practices demonstrated and farmers' practice in chickpea technologies in Bilaspur district of Himachal Pradesh

Crop Operation	Recommended Practices demonstrated	Farmers' practice	Gap
Variety	Himachal Channa-1, Himachal Channa-2, HPG-17,GPF-2 and DKG-986	Local	Full
Land preparation	Two ploughings	One or two ploughings	Nil
Seed rate	40 kg/ha for Himachal Channa-1, Himachal Channa-2, GPF-2 and DKG-986 80 kg/ha for HPG-17	50-52 kg/ha	Higher seed rate
Seed treatment	*Rhizobium* culture	Nil	Full
Method of sowing	Line sowing at 30 cm row spacing	Broadcasting	Full
Time of sowing	Mid October	Mid October	Nil
Fertilizer dose	30:60:30 Kg NPK per ha	No fertilizer or urea only.	Full
Method of fertilizer application	*Kera*	Broadcast at the time of sowing	Full
Weed management	Pendimethalin application @ 1.5 l ai/ha.	No or one hand weeding	Full
Plant protection	Need based pesticide and fungicide application	No pesticide and fungicide application	Full
Irrigation	Rain fed	Rain fed	Nil

GPF-2(9.2 to 11.9 q/ha) and GNG-1581(11.6q/ha). This increase in grain yield of demonstration plots was mainly due to the recommended package and practices followed under the supervision of KVK scientists. Under CFLDs use of improved and recommended varieties of chickpea, seed treatment with *rhizobium* culture, line sowing, judicious and optimum use of fertilizers, integrated weed and need based plant protection measures really increased the yield of chickpea compared to farmers practices where local varieties, broadcasting method of seed sowing, only urea application and no pesticide and fungicide application were followed by the farmers. The findings are in agreement with the findings of Raju *et al*. (2015), Singh *et al.* (2017) and Parmar *et al.* (2017) and Undhad *et al.* (2019).

Technology gap

The technology gap means the difference between potential yield and yield of demonstration plot. Results in table 2 showed that technology gap ranged from 3.4-6.8 q/ha, from 5.1-6.8q/ha, from 0.9-4.4q/ha and from 2.8-12.4 q/ha during *rabi* 2015-16, 2016-17, 2017-18 and 2018-19, respectively. The observed technological gap reflected the cooperation of farmers in carrying out the CFLDs, which was found encouraging and gap observed may be attributed to the dissimilarity in the soil fertility status, insect pest attack and erratic weather conditions that prevailed during crop season at different locations. Similar findings were also recorded by Tiwari and Tripathi (2014) in chickpea crop.

Extension gap

It means the difference between demonstration plot yield and farmer's plot yield. Extension gap varied from 1.5-3.1,1.6-3.1,4.7-5.9 and 3.9-5.3 q/ha during *rabi* seasons of 2015-16, 2016-17, 2017-18 and 2018-19, respectively (Table 2). This emphasized the need to educate the farmers through various extension means i.e. front line demonstration for adoption of improved production and protection technologies, to revert the trend of wide extension gap. The findings are in corroboration with the findings of Bhargva *et al.* (2017) and Kumari *et al.* (2019). Maximum use of recommended and improved production technologies with improved varieties of chickpea by the farmers will help in reducing the extension gaps.

Technology index

The data in Table 2 showed that maximum technology index value of 51.67 % was noticed during *rabi* 2018-19 in variety GNG 1581 followed by 42.50 % in *rabi* 2015-16,and *rabi* 2016-17 in GPF-2 variety, whereas, minimum value of technology index of 6.92% was noticed during *rabi* 2017-18 in Himachal Chana-2 variety. This variation in technology index might be due to uneven weather conditions in the area during the years of study.

Economic Returns

The economic analysis of the data in table 3 clearly revealed that during all the years of study, the gross return, net returns and benefit: cost ratio of gram crop were higher in frontline demonstrations as compared to farmers' practice thereby resulting in higher profitability. The benefit cost ratio of demonstration plots ranged from 2.2 to 3.8. Due to technological interventions the demonstration plots also gave 7984.84 to 45795 rupees per hectare additional net return over local during different years of study. Hence, by adopting proven technologies of gram, yield potential and economic returns from gram cultivation can be raised for the farming community. These results were in line with the earlier findings by Singh *et al*. (2017) and Jat *et al.* (2020).

Conclusion

The study clearly indicated that adoption of recommended practices and improved technologies like high yielding recommended varieties, timely sowing, nutrient management, weed management and plant protection measures taken in accordance of recommended package and practices in demonstration plots not only enhanced the grain yield of gram crop but also gave higher gross and net returns per hectare even under *rainfed* conditions prevailing in Bilaspur district of Himachal Pradesh. Favourable benefit: cost ratio is self explanatory of economic viability of the cluster frontline demonstrations and encouraged the farmers for adoption of interventions imparted. From these findings, it can also be concluded that technology gaps can be minimized by providing scientific intervention to the farmers which will lead to enhance the production and productivity of black gram in the district. Moreover, higher extension gap emphasized that there is further need to educate the farmers for adoption of improved technologies through CFLDs on black gram crop so that poor farmer with limited resources could improve their livelihood and diversify their farming situation.

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Table 2. Technology gap, extension gap and technology index in chickpea crop in Bilaspur district of Himachal Pradesh

Crop/Variety	Season/Year	Area (ha)	Yield (q/ha) DP*	Yield (q/ha) FP*	%YIOFP	Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)
Chickpea								
	Rabi 2015-16							
HPG- 17		2.00	8.8	6.1	44.3	6.2	2.7	41.33
Himachal chana-1		2.20	7.6	6.1	24.6	3.4	1.5	30.91
Himachal chana-2		3.13	7.9	6.1	29.5	5.1	1.8	39.23
GPF-2		2.67	9.2	6.1	50.8	6.8	3.1	42.50
	Rabi 2016-17							
HPG- 17		5.0	8.8	6.3	44.2	6.2	2.5	41.33
Himachal chana-2		12.0	7.9	6.3	25.4	5.1	1.6	39.23
GPF-2		3.0	9.2	6.1	55.3	6.8	3.1	42.50
	Rabi 2017-18							
HPG- 17		2.0	10.6	5.9	79.6	4.4	4.7	29.33
Himachal chana-2		15.0	12.1	6.2	95.1	0.9	5.9	6.92
GPF-2		3.0	11.9	6.5	78.3	4.1	5.4	25.63
	Rabi 2018-19							
HPG- 17		3.6	10.9	6.1	43.5	4.1	4.8	27.33
Himachal chana-2		15.2	10.2	5.9	41.5	2.8	4.3	21.54
GPF-2		1.2	9.3	5.4	41.3	6.7	3.9	41.88
Himachal chana-1		2.8	9.3	5.8	36.9	1.7	3.5	15.45
GNG 1581		17.2	11.6	6.3	44.7	12.4	5.3	51.67

DP* Front line demonstration plots, FP* Farmers practice plots

Table 3. Economic analysis of CFLD's on chickpea crop in Bilaspur district of Himachal Pradesh

Crop/Variety	Season/Year	Cost of cultivation (Rs/ha)		Gross returns (Rs/ha)		Net returns (Rs/ha)		Additional cost of cultivation over local (Rs/ha)	Additional net returns over local (Rs/ha)	Benefit: cost Ratio	
		DP*	FP*	DP*	FP*	DP*	FP*			DP*	FP*
Chickpea											
Rabi 2015-16											
HPG- 17		22389.33	20743.92	61600	42700	39210.67	21956.08	1645.41	17254.59	2.7	2.0
Himachal chana-1		23259.08	20743.92	53200	42700	29940.92	21956.08	2515.16	7984.84	2.2	2.0
Himachal chana-2		23259.08	20743.92	55300	42700	32040.92	21956.08	2515.16	10084.84	2.3	2.0
GPF-2		23259.08	20743.92	64400	42700	41140.92	21956.08	2515.16	19184.84	2.7	2.0
Rabi 2016-17											
HPG- 17		22389	20744	70400	54000	48011	34156	1645.00	13855.00	3.1	2.6
Himachal chana-2		22389	20744	63200	48800	40811	28056	1645.00	12755.00	2.8	2.6
GPF-2		22389	20744	73600	54900	51211	34156	1645.00	17055.00	3.3	2.6
Rabi 2017-18											
HPG- 17		24434	21579	84800	41300	60365	19720	2855.00	40645.00	3.4	1.9
Himachal chana-2		29184	21579	96800	43400	67615	21820	7605.00	45795.00	3.3	2.0
GPF-2		24434	21579	95200	49000	70765	27420	2855.00	43345.00	3.8	2.2
Rabi 2018-19											
HPG- 17		32341.7	22794.2	75600	42700	43258.3	19905.8	9547.50	23352.50	2.3	1.8
Himachal chana-2		27256.7	22794.2	70700	41300	43443.3	18505.8	4462.50	24937.50	2.5	1.8
GPF-2		27256.7	22794.2	64400	37800	37143.3	15005.8	4462.50	22137.50	2.3	1.6
Himachal chana-1		27256.7	22794.2	64400	40600	37143.3	17805.8	4462.50	19337.50	2.3	1.7
GNG 1581		26217.2	22794.2	79800	44100	53582.8	21305.8	3423.00	32277.00	3.0	1.9

DP* Front line demonstration plots, FP* Farmers practice plots

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