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YIELD AND GAP ANALYSIS OF IMPROVED CROP PRODUCTION TECHNOLOGY IN CLUSTER BEAN THROUGH FARMERS' PARTICIPATORY APPROACH

SATYAJEET[1]*, SATPAL[2], S. K. DHANDA[3] AND JITENDER KUMAR[4]

[1 & 4]CCS HAU, Regional Research Station, Bawal -123501 (Haryana), India
[3]Department of Genetics & Plant Breeding, CCS Haryana Agricultural University, Hisar-125004 (Haryana), India
[3]CCS Haryana Agricultural University, Hisar (Haryana), India
**(e-mail : sjeet.hau@gmail.com)*

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SUMMARY

Farmers' participatory front line demonstrations on integrated crop management (ICM) practices and traditional method of sowing as farmers' practice (FP) were conducted during *kharif* (2013-2015) under CCS, HAU, Krishi Vigyan Kendra, Fatehabad, Haryana. The study revealed that on an average 12.34 q/ha yield of cluster bean (*var*. HG 2-20) was recorded under ICM as compare to 9.65 q/ha in FP which was 27.9 per cent higher over that of the FP. The pooled value of extension gap, technology gap and technology index was to the tune of 2.68, 5.16 q/ha and 30 percent, respectively. The data on economic parameters reveals that a net return of Rs.10329 per ha was in ICM compare to Rs.1447 per ha in FP. The benefit-cost (B:C) ratio was figured 1:1.22 and 1:1.03 in ICM and FP, respectively. Further, increased in an effective Rs. 8882 per ha, suggesting its higher profitability and economic viability of the technology demonstrated.

Key words : Cluster bean, ICM, yield, gap analysis, economics and BC ratio

Cluster bean (*Cyamposis tetragonoloba* L.) commonly known as cluster bean, is a drought and high temperature tolerant, deep rooted summer annual legume of high social and economic significance. It is locally known as guar and thrives well in semi-arid regions. Cluster bean crop is cultivated mainly during *kharif* season. Cluster bean crop has experienced a remarkable journey from a traditional crop grown on marginal lands mainly for food, animal feed and fodder to a crop with various industrial usages ranging from food, cosmetics, printing, pharma textile etc. The unique binding, thickening and emulsifying property of guar gum obtained from cluster bean seed has made it a much sought after product in the international market. Guar is grown in the North-western parts of the country encompassing states of Gujarat, Haryana and Punjab. The state occupied 87 and 82 % of the country's area and production, respectively. But, the productivity of state (530 kg/ha) in comparison to the country (568 kg/ha) and the Barmer district (220 kg/ha) in comparison to state was very low (Anonymous 2014 and Anonymous 2013-14). The western arid region of Rajasthan accounts for 96 percent area of the crop and 82 percent of the production with the productivity of clusterbean is greatly dependent on monsoon pattern. Whenever, timely rains occurs the sowing was done by the farmers in larger area and when monsoon delayed or very less rains received the area of cluster-bean crop is squeezed Singh *et al.* (2014). Besides, this cluster bean can fix atmospheric nitrogen to the tune of 37-196 kg/ha/year in soil and thus improves the soil health (Satpal *et al.,* 2020). India is the largest producer of cluster bean and contributes 80 percent of total cluster bean production in the world. The United States of America is the largest importer of cluster bean and its derivatives from India. Cluster bean has also witnessed price volatility and uncertainty owing to limited area of production, increasing demand, speculation, lack of reliable market information system etc. The analysis of historical data and of relative share of different states in the total production and area shows that Rajasthan is the leading producer but suffers from high fluctuation in production. On the other hand, Haryana has significant contribution in terms of production based on high productivity. Low yield of cluster bean has been reported mainly due to lack of knowledge of high yielding varieties, sowing without proper seed treatment, low rainfall and heavy infestation of insect-pest and diseases. In view of the above factors, frontline demonstrations were undertaken in a systematic manner

on farmer's field to show the worth of a new variety and convince the farmers to adopt improved cultivation practices of cluster-bean Keeping in view the present investigation attempts to study the yield gap between frontline demonstration trails and farmers yield, extend of technology adoption and benefit cost ratio.

MATERIALS AND METHODS

Farmers' participatory front line demonstrations on integrated crop management (ICM) practices (*Variety*, HG 2-20) as demonstrated technology and traditional method of sowing as farmers' practice (FP) were conducted at ten locations selected from the cluster villages covering an area of 0.4 hectare at each location under demonstration and same area was also devoted under farmers' practice during *kharif* (2013-2015) under CCS, HAU, Krishi Vigyan Kendra, Fatehabad (Haryana), India.The soil of the experimental locations were sandy loam in texture, low in available N, medium in P and K with slightly alkaline in reaction (pH - 8.0 to 8.2). Recommended ICM practices *viz.* fertilizer dose, high yielding variety, seed treatment with fungicide (15 g *streptocycline* per hectare) and *Rhizobium* culture followed by spray of fungicide (75 g *streptocycline* + 500 g *copper oxychloride*) in 500 litre of water per ha. The data on yield and other observations were recorded from time to time at farmers' field as well as feedback was taken from the farmers. The economics and benefit cost (B:C) ratio was worked out by simple tabular analysis. The following formulae given by Samui *et al.* (2000) were used to estimate the technology gap, extension gap and technology index.

Extension Gap (kg/ha) = Demonstration yield - Farmer practices yield (Local check).

Technology Gap (kg/ha) = Potential yield - Demonstration yield.

Technology Index = Potential yield- Demonstration yield/Potential yield × 100

Effective gain (Rs) = Additional return - Additional cost.

RESULTS AND DISCUSSION

Grain yield

The yield of any crop plant depends upon the source sink relationship and is the cumulative function of various growth parameters and yield attributing components of sink *viz*. pods per plant and seeds per pod etc. The perusal of data (2013 - 2015) in Table 1 revealed that cluster bean yield ranged from 12.50 - 12.68 q/ha under demonstration (ICM) as compared to farmers practice (FP) 9.61 to 9.65 q/ha during the study period. The technological intervention thus gave yield enhancement to the tune of 24.9 to 30.1 % over FP. The pooled data (2013 - 2015) indicated that average yield of cluster bean was to the tune of 12.34 q/ha in ICM as compare to 9.65 q/ha in FP, which was 27.9 % higher than that of FP. More and less similar yield enhancement in different crops in front line demonstration has amply been documented by Rajput *et al.* (2016) and Patel *et al.* (2013). The average numbers of pods/per plant and no. of grain/ pod of three year study was found 44.4 and 7.53 under ICM as compare to 40.7 and 6.27 in FP. It was the impact of the use of high yielding improved variety, balanced application of fertilizer and control of insect & disease at economic threshold level. Results are also in agreement with that of Balbhim *et al*. (2015).

Gap analysis

Extension gap is a parameter to know the yield differences between the demonstrated technology and farmers practice whereas as technology gap is a measures difference between potential yield and yield obtained under improved technology demonstration. The extension gap of consecutive three year study presented in Table 2 was estimated to be 2.89, 2.36 and 2.80, respectively with a pooled value of 2.68 q/ ha during the study period. There exists a gap between the potential yield and demonstration yield. Technology gap is of great significance than other parameters as it indicates the constraints in implementation and drawbacks in our package of practices, these could be environmental or varietal. Technology gap ranging from 4.82 - 5.67 q/ha was found between ICM and FP during the different time line. The pooled technology index of cluster bean was to found to be 30 during study period. This may be due the due to numerous resources which affect the crop yield like weather condition, less application of inputs etc. Patel *et al.* (2013) and Jain (2018) also corroborated these findings.

Economic analysis

A thorough understanding of the pooled data

TABLE 1
Effect of different treatments on yield and yield attributes of cluster bean (Pooled data (2013 - 2015)

Year	Seed yield (q/ha)		% increase over FP	No. of pod/ Plant		No. of seed/ Pod	
	ICM	FP		ICM	FP	ICM	FP
2013	12.50	6.61	30.7	44.1	41.2	7.58	6.42
2014	11.83	9.47	24.92	42.6	38.3	7.37	6.13
2015	12.68	9.88	28.34	46.5	42.6	7.63	6.26
Pooled	12.34	9.65	27.88	44.4	40.7	7.53	6.27

TABLE 2
Effect of different treatments on economics of cluster bean (Pooled data 2013 - 2015)

Year	Economics of ICM				Economics of FP			
	Gross Cost (Rs./ha)	Gross Returns (Rs./ha)	Net Returns (Rs./ha)	BC ratio	Gross Cost (Rs./ha)	Gross Returns (Rs./ha)	Net Returns (Rs./ha)	BC ratio
2013	45850	57500	11650	1.25	42225	43245	1020	1.02
2014	46070	54418	8348	1.18	42350	43562	1212	1.03
2015	46070	57060	10990	1.24	42350	44460	2110	1.05
Pooled	45997	56326	10329	1.22	42308	43756	1447	1.03

TABLE 3
Effect of different treatments on gap analysis of cluster bean (Pooled data 2013 - 2015)

Year	Extension Gap (q/ha)	Technology Gap (q/ha)	Technology Index (%)	Additional Cost (Rs./ha)	Additional Return (Rs./ha)	Effective gain (Rs./ha)	Incremental BC ratio
2013	2.89	5.00	29	3625	14255	10630	3.93
2014	2.36	5.67	32	3720	10856	7136	2.92
2015	2.80	4.82	28	3720	12600	8880	3.39
Pooled	2.68	5.16	30	3688	12570	8882	3.41

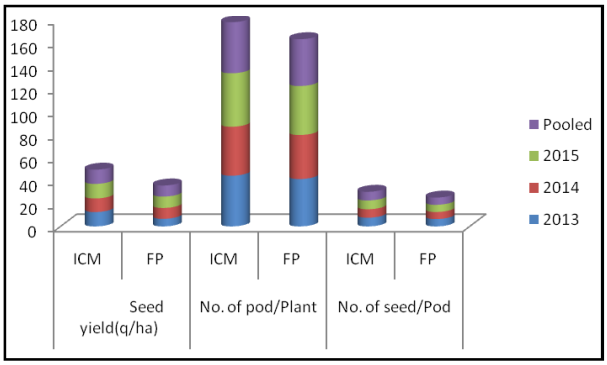

Fig. 1. Effect of different treatments on yield and yield attributes of cluster bean.

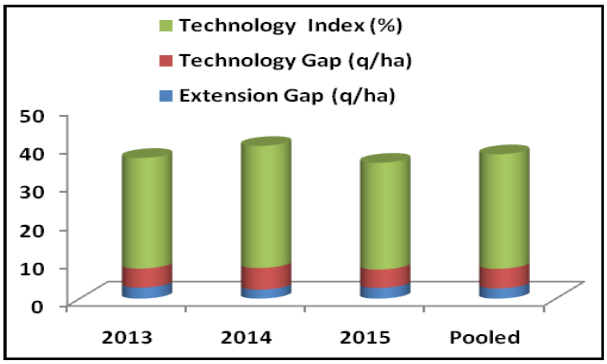

Fig. 2. Effect of different treatments on gap analysis of cluster bean.

shows that average gross return and net return was Rs. 56326; 43756 and 10329; 1447 under ICM and FP, respectively. Economic returns was observed to be a function of grain yield and market sale price of the commodity which varied along different years. An additional net return ranging from Rs. 10856 - 14255 with an average effective gain of Rs. 8882 per ha was found under the technology demonstrated. The

higher additional returns under demonstrations could be due to improved technology, non-monetary factors, timely operations of crop cultivation and scientific monitoring. In the quick view of the data the average Benefit: Cost ratio of three years study was figured 1:1.22 and 1:1.03 with an incremental B:C ratio 1:3.41 under ICM as compared FP, respectively (Table 2 and Table 3). The results are in conformity with the findings of Jain (2016) and Jain *et al*. (2019).

CONCLUSION

The findings of the study revealed that wide gap existed in potential and demonstration yield in high yielding cluster bean varieties due to technology and extension gap in Fatehabad District of Haryana, However, the adoption level of ICM technology in cluster bean is very low but the results of trials conducted on farmer's field have been very promising and the farmers have sown good enthusiasm to adopt the technology. There is a need for analysis of factors affecting adoption and acceptance of ICM technology among the farmers. The study emphasizes the needs to educate the farmers in adoption of ICM practices to narrow the extension gaps through various technology transfer centers.

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