

Research Paper

Impact of cluster frontline demonstration on increasing productivity and profitability of pigeonpea in Bihar

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ABSTRACT

The present investigation was conducted on cluster frontline demonstration (CFLD) on pigeonpea with improved pigeon pea varieties (Malviya Chamawtkar or MAL-13, LRG-41 and IPA-203) in Kharif season over three at 104 farmer's field covering 40 ha rainfed/upland areas of 12 villages of Bhagalpur district to know the field gap, technology gap, extension gap, economic return, the extent of farmer's satisfaction and constraints faced by the farmers, especially pigeon pea growers. Based on three years' mean data the highest pigeon pea yield (16.98 q/ha) was received from the demonstration plot, which was 39.6% higher as compared to existing common farmers' practice. Extension gap, technology gap, and technological index were found as 4.82 q/ha, 5.51 q/ha, and 23.8%, respectively. The highest net return (Rs. 80,292/ha) and B:C ratio (3.75) were also calculated in CFLD technology as compared to existing common farmers' practices.

Key words: Economics, extension gap, pigeonpea, technology gap, technological index, yield

INTRODUCTION

Pigeonpea (*Cajanus cajan* L.) is also called arhar, red gram, and tur in different parts of the country. Globally, India ranks first in respect to area and production of pigeonpea. It is the second most important pulse crop in India after chickpea in terms of production and consumption. For the majority of the Indian population, pulses are the main source of supply high-quality proteins as compared to other crops. Pigeonpea contains 20-22% protein, 1.2% fat, 65% carbohydrate, and 3.8% ash and it is mainly used as split dal, green pod, and green seeds in the form of green vegetables (Anonymous, 2010). The pigeonpea is hardy, drought-tolerant, and water-susceptible and belongs to the family Leguminosae. Its cultivation involves less input due to the ability to fix atmospheric nitrogen by about 40kg/ha. It is generally cultivated in dry land and rainfed areas. There are several factors like unavailability of high-yielding varieties, quality seeds, high seed rate, early sowing, imbalance use of fertilizers without using bio-fertilizers, improper weed management, and non-adoption of suitable plant protection measures especially for pod borer and wilting which hamper Pigeon pea yield drastically. Rahman (1990) reported that the pod borer in pigeonpea damaged about 30-

40% of crop yield. Mehra *et al.* (2018) also found that the low yield of pigeonpea was due to the poor quality of the seed, poor adoption of the package, and the practices of production. To overcome these challenges and to increase the productivity and profitability of pigeonpea there is a need to create awareness among the farmers about site-specific improved varieties and packages and practices of production. Keeping the facts in mind, the present study was conducted to examine the impact of CFLD by Krishi Vigyan Kendra, Bhagalpur from 2017-18 to 2019-20 on the profitability and yield gap of pigeonpea production.

MATERIALS AND METHODS

A cluster frontline demonstrations (CFLDs) was conducted on pigeonpea from Kharif 2017-18 to 2019-20 by Krishi Vigyan Kendra, Bhagalpur, Bihar on 40 ha upland rainfed areas of 104 farmers from 12 villages of four blocks *i.e.* Sanhaura (village-Phulwariya and Bora), Shahkund (village-Amba, Sadapur and Bhatthachak) Pirpainti (village-Kirtaniya, Jurawanpur and Kangali Chouki) and Kahalgaon (village-Akabarapur, Kushwahanagar and Bhalui Sujan) of Bhagalpur district. Group meetings and training programs were organized at

the village level before conducting demonstrations for the selection of sites as well as farmers interested in technology adoption. All four types of land-holding farmers (marginal, small, medium, and large land holding) were selected for conducting CFLD. Demonstration was conducted based on low-yield attributing causes identified from PRA and preliminary discussion as suggested by Choudhary (1999) and Venkatta Kumar *et al.* (2010). In control plots, the existing farmer's practices were followed. Critical inputs like seed, carbendazim, Chloropyrifos, pheromone trape, Emamectin benzoate, *Rhizobium* and PSB culture were provided by Krishi Vigyan Kendra, Bhagalpur, and remaining inputs were arranged by farmers.

Yield data were collected through random crop cutting in the presence of farmers and personnel from both plots of demonstration and existing farmers' practices. The various gaps and technology index were calculated using the procedure suggested by Samui *et al.* (2000) and Kumar (2014) as given below:

Percent increase yield over farmers practice = $[(\text{Demo yield} - \text{yield under farmer practice}) / \text{yield under farmer practice}] \times 100$

District yield gap (%) = $[(\text{Demo yield} - \text{district yield}) / \text{Demo yield}] \times 100$

State yield gap (%) = $[(\text{Demo yield} - \text{state yield}) / \text{Demo yield}] \times 100$

Potential yield gap (%) = $[(\text{Potential yield of variety} - \text{Demo yield}) / \text{Potential yield of variety}] \times 100$

Extension gap (q/ha) = Demo yield - Yield under control plot

Technology gap (q/ha) = Potential yield - Demo yield

Technology index (%) = $[(\text{Potential yield} - \text{Demonstrated yield}) / \text{Potential yield}] \times 100$

Net Return (Rs./ ha) = Gross Return (Rs./ ha) - Cost of cultivation (Rs./ ha)

Benefit: Cost Ratio = Gross Return / Cost of Cultivation

Surplus cost (Rs/ ha) = Demo cost - cost under control plot

Surplus returns (Rs/ ha) = Return under Demo - Return under farmer practice

Surplus gains (Rs/ ha) = Surplus return - surplus cost

RESULTS AND DISCUSSION

Yield performance

The findings of a three-year investigation revealed that the transfer of developed technology under cluster frontline demonstration of pigeonpea resulted in a 39.5% higher yield as compared to existing farmers' practices. Improved technology demonstrated under CFLD yielded 16.98 q/ha mean yield of pigeon pea as compared to 12.57 q/ha in existing farmers' practice (Table 2). The higher yield received from the demonstration plot might be due to the inclusion of quality seeds of high-yielding variety, seed treatment in FIR manner, recommended dose of fertilizer, weed control, and pest control especially for pod borer. The present finding tally with the findings of Mauriya *et al.* (2017) from chickpeas under CFLD, Singh *et al.* (2018) from black gram in CFLD, and Kumar *et al.* (2014) from pigeonpea.

Technological adoption gaps

Hundred percent technological adoption gaps were noticed with respect to high-yielding varieties of quality seed, seed treatment, nutrient management, weed management, pest management, and technical guidance support whereas partially up to 50% technological adoption was found in seed rate, sowing time and soil moisture at sowing time. In the case of land preparation and irrigation, no adoption gap was found (Table 1).

Yield gap

Table 2 further revealed that the highest technological gap was calculated from pigeonpea variety MLA-13 during 2017-18 *i.e.* 8.40 q/ha, and the lowest (3.24 q/ha) from IPA 203 during 2019-20, whereas the mean technological gap was 5.51 q/ha. Technological gaps may be due to variations in soil fertility, lack of insect-pest disease management, changes in weather conditions, skills of farmers, and agronomical practices. The extension gap refers to the differences between demonstration yields to existing farmer practice yields. The highest (5.38 q/ha) extension gap was calculated from LRG-41 pigeon pea variety during 2018-19 and the lowest (4.17 q/ha) extension gap was received from IPA-203 during 2019-20 with a mean 4.82 q/ha extension gap. Similar results were also found by Meshram *et al.* (2022) in pigeonpea.

Further, the data presented in Table 2 revealed that the highest (33.6%) technological index noticed

from MLA-13 variety of arhar during 2017-18 and the lowest during 2019-20 from IPA 203 (16.6%) with 23.8% mean of three years technological index. This finding is in corroboration with the findings of Kumar *et al.* (2023) and Mauriya *et al.* (2023).

The soil of the experimental plot was silty loam to clay loam with the mean value of 7.11 pH, EC 0.31 dS/m, 0.38% OC, 176.24 kg/ha available N, 20.88 kg/ha available P₂O₅ and 236.0 kg/ha available K₂O. The technical intervention was made by participatory rural appraisal and preliminary discussion (Table 1).

Economic analysis

Economic analysis of CFLD and existing farmers' practices is presented in Table 3 which revealed that the highest cost of cultivation (Rs. 29,196/ha), gross return (Rs. 1,09,488/ha), net return (Rs. 80,292/ha), benefit cost ratio (3.75) and surplus gain (Rs. 24,591/ha) was calculated from CFLD with involvement of improved production technology as compared to existing common farmer practice. An average net return of CFLD demonstration was 52.0% higher than existing farmers' practice, which may be due to the higher production under CFLD as

Table 1. Variation between improved technologies under CFLD and existing farmers' practices

S. No.	Particular	Improved technologies Under CFLD	Existing farmer's practice	Gap
1	Variety	Latest improved varieties <i>i.e.</i> Malviya Chamawtkar or MAL-13 (2017-18), LRG -41 (2018-19) and IPA-203 (2019-20)	Desila (old and degenerated)	Full gap (100%)
2	Seed treatment	Seed treatment with Carbendazim 50 WP @ 2.5 g / kg seed, Chloropyriphos 20% EC @ 8.0 ml/kg seed, each Bio-fertilizer 1.0 litre/ha (<i>Rhizobium</i> and PSB culture)	Without seed treatment	Full gap (100%)
3	Land preparation	Three ploughing	Three ploughing	Nil
4	Sowing time	15 th June to 30 th June	Second fortnight of May	Partial gap (30%)
5	Sowing in proper Moisture	Yes	Yes/no	Partial gap (30%)
6	Seed rate	20 kg/ha	25-30 kg/ha	Higher seed rate (50%)
7	Fertilizer dose	Balance the dose of fertilizers in an INM manner. Basal dose of nitrogen and phosphorus @ 20 and 50 kg/ha	Imbalance/ No use of fertilizer	Full gap (100%)
8	Weed control	Pendimethalin @ 1.0 kg a.i./ha was applied as pre-emergence and hand weeding was done at 25-30 and 50-55 DAS	No weeding	Full gap (100%)
9	Irrigation	Nil	Nil	Nil
10	Insect management	<i>Helicoverpa armigera</i> control by IPM including insecticide and sex pheromone trap	Nil	Full gap (100%)
11	Disease control	Seed treatment through carbendazim for the control of wilting	Nil	Full gap (100%)
12	Technical guidance	Time to time	Nil	Full gap (100%)

Table 2. Impact of improved technologies under CFLDs on yield and yield Gap of pigeon pea

Year	CFLDs Varieties	Demo Area (ha)	Farmers No	FP yield (q/ha)	Demo Yield (q/ha)	District yield (q/ha)	State yield (q/ha)	Potential yield (q/ha)	Yield gap minimized by CFLD (%)			% increase yield over FP	Extension gap (q/ha)	Technology gap (q/ha)	Technological index (%)
									District	State	Potential				
2017-18	MAL-13	20	56	11.70	16.60	10.75	14.38	25.00	35.2	13.4	33.6	41.9	4.90	8.40	33.6
2018-19	LRG -41	10	18	12.72	18.10	12.44	15.48	23.00	31.3	14.5	21.3	42.3	5.38	4.90	21.3
2019-20	IPA-203	10	30	12.08	16.25	14.53	15.18	19.49	10.6	6.6	16.6	34.5	4.17	3.24	16.6
Total / mean		40	104	12.17	16.98	12.57	15.01	22.50	25.7	11.5	23.8	39.6	4.82	5.51	23.8

Table 3. Impact of improved technologies under CFLDs on economics of pigeon pea

Year	Variety	Farmer's practice				Demonstration plot				Surplus cost (Rs./ha)	Surplus returns (Rs./ha)	Surplus gains	% increase in net return
		Gross Cost (Rs./ha)	Gross return (Rs./ha)	Net Return (Rs./ha)	B:C ratio	Gross Cost (Rs./ha)	Gross return (Rs./ha)	Net Return (Rs./ha)	B:C ratio				
2016-17	MAL-13	25700	76500	50800	2.98	28900	107100	78200	3.71	3200	27400	24200	53.9
2018-19	LRG-41	26413	71801	45388	2.72	29288	100563	71275	3.43	2875	25887	23012	57.0
2019-20	IPA-203	26825	89090	62265	3.32	29400	120800	91400	4.11	2575	29135	26560	46.8
	Mean	26313	79130	52818	3.01	29196	109488	80292	3.75	2883	27474	24591	52.6

compared to farmer's practice A similar result was also found by Dhuware *et al.* (2023).

CONCLUSION

Based on CFLDs conducted in 100 demonstrations in 40 ha, it can be concluded that the intervention of improved varieties, technologies, balanced input resources, and capacity-building development programs of farming communities will be more helpful in reducing the technology gap and increasing the productivity and profitability of pigeon pea along with perception of technology.

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