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Evaluation of technological interventions, yield attributes, yield and economics of cluster frontline demonstration mustard in Banka district of Bihar

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ABSTRACT

The study were conducted by cluster frontline demonstrations (CFLD) on mustard during 2018-2021 in the eleven villages covering 250 farmers and 100 ha area of Banka district of Bihar to evaluate the technological interventions, yields and economic feasibility. Yield parameters i.e., plant height, primary, secondary branches/plant, siliqua/plant, seeds/siliqua, siliqua length, dry matter/plant and 1000-seed weight were recorded 219, 4.3, 13.8, 743, 13.5, 5.2, 123 and 5.7, respectively in mustard cv. RGN-48 along with improved practices in comparison to the farmers' practices. Significantly higher grain yield (1508 kg/ha) was recorded under demonstrated plots over farmers' practice Extension gap (3.92), technology gap (11.30), technology index (42.82%) and adaptation rate (38.33%) were markedly recorded under the demonstration plot than farmers' practice. Similarly gross (Rs. 66820) and net returns (41250) obtained in demonstration plots than farmer's plot. With the adoption of a better set of techniques as developed by the cluster frontline demonstration at the farmers' fields, crop yield and financial returns of mustard increased. A wider viewpoint of farmers was persuaded to implement the intervention by the demonstrations' improved economic feasibility.

Keywords: Extension gap, Technology index, Technology gap, Yields, Economics, Mustard

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INTRODUCTION

Oil seed crops are the second largest agricultural commodity in India. After cereals sharing around 13 per cent of gross cropped area and accounting for 11 per cent of value of all agricultural products. Rapeseed and mustard are the major rabi oil seed crops of the India. India produced 8.43 million metric tons of rapeseed and mustard in financial year 2018-19 (FAOSTAT, 2018-19). The area under rapeseed and mustard in India is 6.63 million hectares, with a productivity of 1270 kg/ha during 2018-19 (FAOSTAT, 2018-19). Proper weed control and knowledge about different production recommendations affects productivity of mustard (Kumar *et al.*, 2018). Crop productivity per unit area could be increased by adopting the improved practices in a systematic manner along with high yielding varieties (Rai *et al.*, 2016). CFLD is an applied approach to accelerate the dissemination of proven technologies at farmers' fields in a participatory mode with an objective to explore the maximum available resources of crop production and also to bridge the productivity gaps by enhancing the production in national basket (Kumar and Jakhar, 2020). Therefore, CFLD in oilseed is an effective technological intervention to demonstrate the production potential on farmers' field for harnessing the productivity potential of oilseed crops in the country. Keeping this in view, the present CFLD were planned with the objective to evaluation and analysis of technological interventions on yield and economics of mustard in Banka district of Bihar.

MATERIALS AND METHODS

The study was conducted at the farmers' fields in all eleven blocks viz. Banka, Barahat, Bounsi, Shambhuganj, Amarpur, Belhar, Fullidumar, Chandan, Katoriya, Rajoun and Dhoraiya during *rabi* season of 2018-21 by the Krishi Vihyan Kendra (KVK), Banka, Bihar. Baseline information regarding crop production practices adopted by farmers from selected villages was collected before organization of CFLDs. High level of gap was identified for use of high yielding varieties, seed treatment and weed management methods, while fertilizer management and plant protection measure showed partial adoption gap which ultimately reduced production potential of crop.

Thus, CFLD was planned on farmers' field according to a package and practices recommended by Bihar Agricultural University (BAU), Sabour, Bhagalpur. About 250 beneficiary farmers were selected purposively as the samples for present investigation. Kisan Gosthi, group meeting, skill trainings were conducted for selected farmers regarding different aspects of production and protection technologies of mustard crop. Critical inputs such as seed, fertilizers, biofertilizers and IPM were provided to the farmers for demonstration plots. The farmers' practice was considered as local check plot in cluster demonstration. These control plots were maintained by the farmers according to their own cultivation practices. The yield data of demonstrated plots as well as control plots were recorded immediately after. Data were analyzed for different parameters using following formula as given below:

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Per cent increase in yield = Yield gain in demonstrated plot (q/ha) –Yield gain in Farmers' practice plot (t/ha)/Yield gain in Farmers' practice plot (t/ha) × 100
The following formula was used for the calculation of Benefit: Cost ratio.
B:C ratio = Gross return/Cost of cultivation× 100
The extension gap, technology gap and technology index were calculated as suggested by (Dayanand *et al.*, 2012).
Extension gap = Demonstrated yield –Farmers' practice yield
Technology gap = Potential Yield - Demonstrated Yield
Technology index (%) = Potential Yield - Demonstrated Yield / Potential Yield x100
Adoption Rate (%) = No. of new farmers/Total no. of farmers.

Table 1: Difference between technological intervention and farmer's practices under CFLDs on Mustard

Particulars	Technological intervention in CFLDs	Farmers practices	Gap
Farming situation	Irrigated medium land	Irrigated medium land	No gap
Variety	RGN-48	Local/own seed	Full gap
Seed rate	5 Kg/ha	10 Kg/ha	High seed rate
Sowing Method & Spacing	Line sowing	Broad casting, uneven plant population	Partial gap
Seed treatment	Carbendazim 50 WP @ 2g/kg of seed	No seed treatment	Full gap
Time of sowing	15 October to 15 November	20 November to 10 December	Full gap
Weed Management	Pendimethalin 30 EC@ 1 kg a.i/ha	Manual weeding at 40 DAS	Full gap
Fertilizer Management	Balanced fertilizer application as per soil test values 60 kg N, 40 kg P2O5, 40 kg K2O	Imbalanced use of fertilizer 50 kg urea as top dressing and 50 kg of DAP as basal dose/ha	Full gap
Micro nutrient application	20 kg Bentonite sulphur/ha	No use of Micro nutrient	Full gap
Plant protection	Need based timely spraying of Carbendazim 12 WP + Mancozeb 63 WP for fungal disease and Imidacloprid 17.8 SL to protect the crop against Mustard aphid	Injudicious use of insecticides and fungicides based on advice of input dealers	Partial gap with high cost

RESULTS AND DISCUSSION

Yield attributes

Yield parameters i.e. plant height (cm), primary & secondary branches/plant (no.), siliqua/plant, seeds/siliqua, siliqua length (cm), Dry matter/plant and 1000-seed weight were recorded 219, 4.3, 13.8, 743, 13.5, 5.2, 123 and 5.7, respectively in case of newly introduced mustard cv. RGN-48 along with improved practices than farmers' practices 163, 2.7, 8.9, 743, 516, 10.6, 4.0, 71.4 and 5.4, respectively under same conditions is presented in Table 2. Superior growth parameters like more number of primary branches and siliqua/plant and more numbers of seeds/ siliqua in CFLD plots were the reason for higher yield. The result is in conformity with the finding of (Chaudhary *et al.*,2018).

Extensions gap

Extensions gap referred to the difference between demonstrated yield and yield under existing farmer's practice. Extension gap of 400, 391 and 385 kg/ha was observed during 2018-19, 2019-20 and 2020-21, respectively (Table 3). The average extension gap was recorded as 392 kg/ha in the demonstration and it need to be reduced with the help of different extension activities like training programmes on latest/improved production and protection technologies with high yielding varieties, awareness programmes, kisan gosthi on integrated pest and nutrient management etc. These programmes have the potential to help the farmers to adopt new and improved practices for crop production which lead to reduction in extension gap. Technology gap referred to difference between the potential yield of the variety and yield of demonstration. The technology gap of 1179, 1119, and 1093 kg/ha during 2018-19, 2019-20 and 2020-21, respectively (Table 3). The average technology gap was observed as 1130 kg/ha.

Yield attributes	2018-19		2019-20		2020-21		Average	
	Demo	Check	Demo	Check	Demo	Check	Demo	Check
Plant height (cm)	215	161	220	162	224	165	219	163
Primary branches/plant	4.2	2.7	4.3	2.6	4.3	2.8	4.3	2.7
Secondary branches/plant	13.5	8.8	14	8.9	14	8.9	13.8	8.9
Siliqua/plant	740	512	744	513	744	523	743	516
Seeds/siliqua	13.3	10.5	13.5	10.6	13.7	10.7	13.5	10.6
Siliqua length (cm)	5.1	3.9	5.2	4.0	5.3	4.0	5.2	4.0
Dry matter/plant (g)	121	70.4	121	71.4	126	72.4	123	71.4
1000 grain weight	5.6	5.4	5.7	5.4	5.7	5.4	5.7	5.4

This gap shows that still there is gap in technology demonstration as a result of which the potential yield of the crop could not be harvested by the farmers. This might be due to the variable fertility status of soil, microclimatic conditions and faulty agriculture practices. The findings of the present study are in line with the findings of (Chaudhary *et al.*,2018).

Technology index and Adoption rate

Technology index referred to the ratio between technology gap and potential yield expressed in percentage. The technology index shows the feasibility and performance of the demonstrated technology at the farmers' field. The lower value of technology index shows the efficacy of good performance of technological interventions. In present demonstration, the technology index varied from 41.41 to 44.67 per cent (Table 3) (Mitra and Samajdar,2010; Dhaka *et al.*,2010). The average technology index was recorded as 42.82 per cent in mustard crop during the three consecutive years of CFLD programmes. Technology index can be reduced with proper adoption of demonstrated technical interventions to increase the yield performance of mustard crop. Adaptation rate (%) referred to the difference between number of new farmers and total number of farmers. Adaptation rate (%) of 40, 41.66 and 33.33 kg/ha was observed during 2018-19, 2019-20 and 2020-21, respectively (**Table 3**). More adaptation rate indicates more number of new farmers are participated in CFLD programme.

Table 3: Gap analysis of cluster front line demonstration on Mustard at farmers' field

Year	Extension Gap (Kg)	Technology Gap (Kg)	Technology index (%)	Adoption Rate (%)
2018-19	400	1179	44.67	40.00
2019-20	391	1119	42.40	41.66
2020-21	385	1093	41.41	33.33
Average	392	1130	42.82	38.33

Grain yield

Grain yield of mustard crop under cluster frontline demonstration were calculated and results are presented in Table 4. Significantly higher grain yield and stover yield was observed under demonstrated plots over farmers' practice which might be due to use of improved technologies i.e. quality seed, seed treatment, nutrient and pest management etc. The average grain yield was 1508 kg/ha reported in mustard demonstrated plots while 1116 kg/ha were reported in control plot. The average stover yield was 4516 kg/ha reported in mustard demonstrated plots while 3226 kg/ha were reported in control plot. This showed that 35.17 per cent increase in the average grain yield of mustard in demonstrated plots over the farmers' practice. Harvest index is the ratio of harvested grain to total biomass. The seed yield of Indian mustard differs to a great extend due to varieties, because of their influence on the yield attributes and quality of the plant at various stages. The harvest index (%) was recorded 25.05 in demonstrated plot and 25.70 in check plot. This increase in yield proves the positive impact of frontline demonstration over existing farmers' practice at allocations. The similar trend of yield enhancement in front line demonstration of oilseeds was reported by (Kalita *et al.*,2019 and Meena *et al.*,2020).

Economics

Cost of cultivation was Rs.25570 and 23500/ha in demonstrated plot and farmers' practice, respectively (Table 5). Significantly higher gross and net returns were observed in demonstrated plots might be higher due to higher grain yield and better market price of produce as well as more B: C ratio. These results corroborate with the finding of (Verma *et al.*, 2012). Average gross and net returns obtained in demonstration plots were Rs. 66820 and 49490/ha while in farmers plot were Rs. 41250 and 25990/ha, respectively (Table 5). In the present demonstration, although cost of cultivation increased by 8.8 per cent with improved technological interventions as compared to farmers practice, but additional net return had more under demonstrated plot as compared to

Table 4: Yield, Harvest index and per cent increase yield of cluster front line demonstration on Mustard at farmers' field

Year	Grain Yield (Kg/ha)		Stover Yield (Kg/ha)		Harvest Index (%)		% increase yield
	Demo	Check	Demo	Check	Demo	Check	
2018-19	1460	1060	4320	3090	25.25	25.54	37.73
2019-20	1520	1129	4590	3280	24.87	25.60	34.63
2020-21	1546	1161	4640	3310	24.99	25.96	33.16
Average	1508	1116	4516	3226	25.03	25.70	35.17

Table 5: Economic performance of Mustard crop under cluster front line demonstration at farmers' field

Year	Economics of Demonstrated Plot				Economics of Check Plot			
	Gross cost	Gross return	Net Return	B:C ratio*	Gross cost	Gross return	Net Return	B:C ratio
2018-19	24500	61320	36820	2.50:1	22600	44520	21920	1.96:1
2019-20	25400	67260	41860	2.64:1	23300	49960	26660	2.14:1
2020-21	26800	71890	45090	2.68:1	24600	53990	29390	2.19:1
Average	25570	66820	41250	2.61:1	23500	49490	25990	2.10:1

farmers' practice. The results are also in conformity with the findings of (Singh *et al.*,2019).

CONCLUSION

Based on three years of CFLD, it may be concluded that crop productivity and economic returns of mustard can be increased with adoption of improved package of practices as developed by the KVK Banka, Bihar at the farmers' field. Better economic viability of the demonstrations convinced farmers at broader perspective to adopt the intervention imparted. Thus, it is suggested that the available technology needs to be popularized to improving the extension gaps and adoptions gaps to increase the income of farming community.

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