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Appraisal of Cluster Front Line Demonstration on Rapeseed and Mustard in Bihar and Jharkhand

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ABSTRACT

Performance of ten varieties of rapeseed and mustard were assessed through cluster front line demonstration (CFLD) under different agro-climatic condition of Bihar and Jharkhand continuously for four years (2017-18 to 2020-21) by the KVKs of Bihar and Jharkhand. Among the agro-climatic zones of Bihar, highest yield was recorded in the demonstrated plot from zone III (B) i.e. South-West alluvial plain in case of variety RH 0749 (15.29 q/ha) and in Jharkhand state from zone I (Central and North astern plateau) with variety NRCHB 101 (13.31 q/ha). Lowest technology index was observed for variety Rajendra Sufalam in all the zone (-4.96, 5.53, 7.18 and 22.92 % in zone I, III (B), III (A) & II) of Bihar and NRCHB 101 (23.15% in zone I) in Jharkhand. The range of extension gap was1.38 to 4.37 and 1.13 to 4.86 q/ha under the agro-climatic zone of Bihar and Jharkhand, respectively. Pooled data shows that in Bihar, maximum net return (Rs. 46986 /ha) was obtained in variety Rajendra Sufalam in agro-climatic zone III A of Bihar with benefit cost ratio 3.85:1 whereas under agro-climatic condition of Jharkhand maximum net return (Rs. 39598 /ha) was recoded from variety NRCHB 101 with benefit cost ratio 2.80:1.

INTRODUCTION

Rapeseed and mustard is one of the important sources of edible oil in India, Canada, China, Australia and European Union and other countries. The main reason of its popularity is its availability and cultivation in irrigated as well as rain-fed condition as a sole crop or mixed crop and simultaneously, it offers high net return with low cost of cultivation. It contains 37 to 49 per cent oil. After extraction of oil its cake is used as protein rich feed of cattle and in decomposed form as farm manure. The crushed seed and oil are also used as condiment in the preparation of pickles, vegetables, hair oils, medicines and in industry as lubricants. The tender leaves mustard is used as green vegetables. Green stem and leaves are a good source of green fodder for cattle during winter. India holds fourth ranks in area and production of rapeseed and mustard and accounts 17.19 per cent of global area but only 8.54 per cent contribution in production. In India after soybean, rapeseed and mustard are leading oilseed crop with 23.33 per cent share in area and 26.24 per cent in production (DRMR). In the rainfed area of the country it is a major source of income especially for small and marginal farmers (Sangwan et al., 2021). Rapeseed and mustard was cultivated on only 0.08 mha area in Bihar with production 0.10 mt which covers only 1.32 and 1.17 per cent of total area and production of India. Relatively Jharkhand has more area (0.31 mha) and production (0.22 mt) than Bihar and it contributes 5.10 and 2.59 per cent in national area and production but average productivity of Bihar (12.45 q/ha) was higher than Jharkhand (7.15 q/ha) (DAC & FW). Unavailability of critical inputs particularly high yielding variety and lack of scientific cultivation practices are the possible reasons for lower productivity (Ranawat et al., 2011; Rai et al., 2016). Katare et al., (2011) stated that depending on identification and use of farming situation, specific interventions may have greater implications in enhancing system productivity. But available agricultural technology does not show fruitful reaches

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and not adopted by the farmers in mass level. Cluster front line demonstration (CFLD) is a novel approach to provide a direct interface between researcher and farmer for the transfer of technologies developed by scientist/ researcher and to get direct feedback from farming community from large cluster. Keeping this in view the present study was undertaken to know the effect of demonstrations on farmer's field under different agro-climatic conditions of Bihar & Jharkhand along with critical inputs provided.

METHODOLOGY

The study involves the data from 2017-18 to 2020-21from the jurisdiction of ATARI, Patna (Bihar and Jharkhand) regarding CFLDs on mustard. From each cluster ten hectare of farm lands were selected and twenty-five farmers for the demonstration. During the four years total 11212 demonstrations were conducted at farmer's field covering 4509.5 ha land with ten varieties and bunch of technological inputs including specific package of practices recommended by the agricultural university or research station for that agro-climatic zone. Three varieties of Indian mustard (*Brassica juncea*) viz; Rajendra Sufalam, RH 0749 and RGN 48, one variety of toria (*Brassica rapa* var. Toria) viz; Uttara and one variety of yellow sarson (*B. rapa* var. yellow sarson) viz; NRCYS 05-02 were demonstrated in different agro-climatic zones of Bihar. Rajendra Sufalam was studied in all the agro-climatic zone whereas variety RH 0749 in north and south alluvial plain (zone I and III B), RGN 48 in south east and south west alluvial plain (zone III A and III B), Uttara in north east alluvial plain (zone II) and NRCYS 05-02 in south west alluvial plain (zone III B) with 4740, 1763, 1253, 153 and 300 demonstrations, respectively. Total five varieties of Indian mustard appraised under the agro-climatic situation of Jharkhand. Pusa mustard 30 was studied under all the three zone with 1483 demonstration whereas Pusa mustard 26 studied in central and north eastern plateau and western plateau (zone I and II) with 601 demonstrations. Pusa mustard 28 and NRCHB 101 were studied in in central & north eastern plateau (zone I) with 618 and 154 demonstrations whereas Pusa mustard 27 in south eastern plateau (zone III) with 412 demonstrations. The critical inputs required for demonstration were provided by the KVKs under project on cluster front line demonstration (CFLD) and concerned subject matter specialist regularly monitored the demonstrated plot and recorded the data periodically. Before organizing of CFLD baseline information regarding package of practice of rapeseed and mustard cultivation adopted by the farmers were collected by the KVKs as suggested by Choudhary (1999). The farmer's field maintained by the farmers according to their own practices and considered as control plot. Immediately after harvesting of crop yield data were recorded from both demonstration plot and farmer's field and extension gap, technology gap and technology index were worked out as suggested by Samui et al., (2000) along with per cent increase over control to assess the impact of cluster front line demonstration on yield. Economic analysis was based on the value of crops and required inputs in local market. Benefit cost ratio of demonstration and farmer's plot were calculated to check the economic viability of demonstration.

RESULTS AND DISCUSSION

Positive effect of critical input and technology intervention on the demonstration plot and farmer's field in terms of grain yield were recorded and related data viz; technology gap, extension gap, per cent increase over control and technology index were calculated and presented in Table 1. Result revealed that average yield in demonstration ranged from 7.48 to 15.29 and 7.58 to 12.64 q/ha under different agro-climatic zone of Bihar and Jharkhand respectively whereas the respective farmer's field yield was5.89 to 11.86 and 4.70 to 8.73 q/ha.

Demonstration yield of varieties

Data presented in Table 1 indicate that highest demonstration yield was recorded from var. RH 0749 (15.29) in south west alluvial plain (zone III B) and followed by the same var. in north alluvial plain (zone I) i.e. 14.80 q/ha under agro-climatic condition of Bihar. Among ten demonstrated varieties only variety Rajendra Sufalam had shown higher demonstration yield (13.75 q/ha) which was higher than the potential yield (13.10 q/ha) in zone I (Bihar). In zone III of Bihar demonstration yield (12.16 & 12.38 q/ha in III A & III B) were nearer to potential yield. Lower demonstration yield (10.10 q/ha) in comparison to potential yield was recorded in var. Rajendra Sufalam under north east alluvial plain (zone II) of Bihar. Differences in demonstration yield of the same variety in different agro-ecological zones may be due to variation in soil health and other climatic conditions. These findings are in accordance with the finding of Khavse et al., (2014) who also found variation in yield of mustard at three different location of Chhattisgarh. Indian mustard var. RGN 48 almost performed equally in terms of demonstration yield (13.42 and 13.56 q/ha) in south alluvial plain of Bihar. Yield of yellow mustard var. NRCYS 05-02 (12.79 q/ha) was almost parallel with yield of Indian mustard var. Rajendra Sufalam and RGN 48 under demonstration in the zone III (B) but little lesser than the demonstration yield of var. RH 0749 of that zone. Toria var. Uttara had demonstration yield (7.48 q/ha) in north east alluvial plain and was poorest performed variety. Under the agro-climatic condition of Jharkhand state maximum demonstration yield (13.31 q/ha) was recorded in var. NRCHB 101 under central and north eastern plateau (zone I) followed by variety. Pusa mustard 28 (12.64 q/ha). Variety Pusa mustard 30 (12.01 q/ha) had shown better performance in zone I than other zones followed by Pusa mustard 26. Yield enhancement in CFLD was also reported by many workers in different crops (Hiremath et al., 2007; Dhaka et al., 2015).

Technology gap

Technology gap refers to difference between potential yield and demonstration yield. Under the different agro-ecological condition of Bihar variety Rajendra Sufalam had least technology gap in comparison to other demonstrated variety. Among the comparison of zones, the negative technology gap (-0.65 q/ha) was obtained in north alluvial plain and least technology gap was in south alluvial plain (0.73 & 0.94 from zone III B & III A) and maximum gap was in north east alluvial plain in Bihar state. This indicates that the agro-climatic condition of north and south alluvial plain (zone I and III) are most congenial condition to perform the var. Rajendra Sufalam at par or even better than its potential yield. Though the variety RH 0749 performed better than the other variety but its potential yield could not be achieved. Similar trend

Table 1. Effect of demonstration on grain yield and gap analysis

State	Agroclimatic Zone	Variety and year of release	KVKs	Area (ha)	No. of Demonstration	Yield (q/ha)			Technology gap (q/ha)	Extension gap (q/ha)	% increase over control	Technology index (%)
						Potential	Demonstration	Farmer's field				
Bihar	I	Rajendra Sufalam (2007)	Darbhanga (4)*, E. Champaran (3), Muzaffarpur (4), Muzaffarpur II (2), Samastipur (4), Shehoar (3), Saran (3), Madhubani (2), Siwan (2), W. Champaran (2), Gopalganj (2), Begusarai (2), Vaishali (2)	1320	3230	13.10	13.75(9.25-21.37)**	10.42	-0.65	3.33	31.94	-4.96
		RH 0749 (2013)	Sitamarhi (3)	130	295	34.00	14.80 (14.35-15.20)	11.73	19.20	3.07	26.14	56.47
	II	Rajendra Sufalam (2007)	Araria (3), Saharsa (4), Supaul (3), Madhepura (2), Kishanganj (2)	430	1079	13.10	10.10 (7.63-13.83)	7.64	3.00	2.46	32.17	22.92
		Uttara (2008)	Katihar (2)	60	153	20.00	7.48 (6.85-8.12)	5.89	12.52	1.59	27.04	62.59
	III (A)	RGN 48 (2004)	Banka (3), Bhagalpur (4),	320	669	26.39	13.42 (8.65-19.30)	10.57	12.97	2.85	26.95	49.13
		Rajendra Sufalam(2007)	Lakhaisarai (3), Sheikhapura (2)	130	330	13.10	12.16 (11.00-14.01)	8.58	0.94	3.58	41.72	7.18
	III (B)	RH 0749 (2013)	Kaimur (3), Rohtas (2), Nawada (2), Buxar (2), Bhojpur (2)	580	1468	34.00	15.29 (12.59-18.15)	10.93	18.71	4.37	39.95	55.03
		RGN 48 (2004)	Patna (4), Arwal (2)	230	584	26.39	13.56 (8.66-16.70)	11.86	12.83	1.70	14.37	48.61
		NRCYS 05-02 (2008)	Nalanda (4)	110	300	24.03	12.79 (9.99-14.25)	9.67	11.24	3.12	32.24	46.77
		Rajendra Sufalam (2007)	Jehanabad (2)	40	101	13.10	12.38 (12.00-12.75)	11.00	0.73	1.38	12.50	5.53
Jharkhand	I	Pusa Mustard 30 (2013)	Chatra (4), Ranchi (3), Sahibganh (2)	340	850	31.25	12.01 (6.15-15.06)	7.94	19.24	4.07	51.27	61.57
		Pusa Mustard 28 (2011)	Godda (4), Dumka (2), Deoghar (2)	232.5	618	30.03	12.64 (10.40-15.70)	8.73	17.39	3.92	44.91	57.90
		Pusa Mustard 26 (2010)	Dhanbad (3), Bokaro (2)	200	520	23.53	8.79 (7.80-9.60)	5.70	14.74	3.09	54.21	62.64
		NRCHB101 (2008)	Hazaribagh (2)	50	154	17.32	13.31 (10.00-16.62)	8.46	4.01	4.86	57.42	23.15
	II	Pusa Mustard 30 (2013)	Lohardaga (2), Latehar (2)	80	221	31.25	9.70 (7.66-12.50)	6.80	21.55	2.90	42.68	68.95
		Pusa Mustard 26 (2010)	Latehar (2)	30	81	23.53	7.88 (7.50-8.25)	6.75	15.66	1.13	16.67	66.53
	III	Pusa Mustard 27 (2010)	Saraikela (3)	52	147	22.38	7.58 (4.38-9.50)	4.70	14.81	2.88	61.17	66.15
		Pusa Mustard 30 (2010)	E. Singhbhum (2), W. Singhbhum (2)	175	412	31.25	10.0 1(6.15-12.80)	6.93	21.25	3.08	44.48	67.98
Total				4509.5	11212							

() *: number of year for during which demonstration conducted by the respective KVK ()** : range of yield

Agro-climatic zone of Bihar

I : North alluvial plain
II : North east alluvial plain
III (A) : South east alluvial plain
III (B) : South west alluvial plain

Agro-climatic zone of Jharkhand

I : Central and north eastern plateau
II : Western plateau
III : South eastern plateau

in case of variety RGN 48 was also observed. For the state of Jharkhand minimum technology gap was recorded in variety NRCHB 101 (4.01 q/ha) under central and south eastern plateau. Higher value of technology gaps indicates that there exists wide scopes to improve demonstration yield through improvement in technology intervention. These finding are in partial agreement with the finding of Chaudhary et al., (2018); Sangwan et al., (2021).

Extension gap

Extensions gap is the difference between yield of demonstration plot and yield under existing farmer's practice and it can be reduced with the help of different extension activities like cluster demonstration, training awareness programmes, *kisan gosthis* etc. For the state of Bihar among the demonstrated variety least extension gap was found in var Rajendra Sufalam (south west alluvial plain) followed by variety Uttara (north east alluvial plain) and RGN 48 (south west alluvial plain) with corresponding values 1.38, 1.59 and 1.70 q/ha, respectively. Under the agro- ecological condition of Jharkhand relatively less extension gap was recorded from western plateau region (zone II). The variety Pusa mustard 30 had more extension gap than other variety in the entire agro-ecological zone. Lower value of extension gap indicates that farmers of that area are aware about the scientific technology of cultivation and took benefits from the activities of KVKs regularly.

Per cent increase among the five different varieties of rapeseed and mustard demonstrated under agro-climatic zone of Bihar the *per cent* increase over control ranged from 12.50 to 41.72. The maximum increase over control was recoded from variety Rajendra Sufalam in south east alluvial plain (41.72%) followed by var. RH 0749 in south west alluvial plain (39.95%). Relatively per cent increase over control was higher for the agro-climatic zone of Jharkhand than Bihar which may be due to poor performance of farmer's choice varieties and it ranged 16.67 (PM 26 in zone II) to 61.17 (PM 27 in zone III). Similar type of the findings was obtained by Kumar et al., (2010); Jha et al., (2020).

Technology index

Technology index referred to the ratio between technology gap and potential yield and expressed in terms of per cent. The lower value of technology index shows the efficacy of better performance of technological interventions. In all the agro-climatic region of Bihar variety Rajendra Sufalam had lowest technology index in comparison to other demonstrated varieties of that zone. It was negative in north alluvial plain (-4.96) and lower in south west alluvial plain (5.53%). It shows the feasibility and performance of the demonstrated technology at the farmers' field. In other variety yellow sarson var. NRCYS 101 got most acceptability of the demonstration at farmer's field. Under the agro-climatic condition of Jharkhand lowest technology index was recorded in var. NRCHB 101 (23.15%) and followed by Pusa mustard 28 (57.90%) in zone I. These results are in line with the results of Sangwan et al., (2021).

Economic analysis

Economic analysis of the demonstrated plot and farmer's field in terms of gross cost, gross return, net return and benefit cost ratio are depicted in Table 2. The data revealed that among all the agro-ecological zone of Bihar highest net return (Rs. 46986 /ha) was recorded from Indian mustard var. Rajendra Sufalam demonstrated in south east alluvial plain (zone III A) followed by yellow sarson var. NRCYS 05-02 with Rs. 45288/ha. The benefit cost ratio also followed almost similar trends with maximum benefit cost ratio in Rajendra Sufalam (3.85:1) from zone III (A) followed by NRCYS 05-02 (3.32:1). This finding is supported by the finding of Kalita et al., (2019), Singh and Kumar (2012); Saravanakumar (2018). Among the agro-climatic zone of Jharkhand maximum benefit from demonstrated plot was obtained from var. NRCHB 101 with net income of Rs.

Table 2. Economic analysis of demonstration and farmer's plot

State	Agro-climatic zone	Variety	Demonstration plot				Farmer's field			
			Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C
Bihar	I	Rajendra Sufalam	21351	56079	34728	2.63	19139	39651	20511	2.07
		RH 0749	23267	61525	38258	2.64	21250	48775	27525	2.30
	II	Rajendra Sufalam	20307	48816	28509	2.40	18679	35883	17203	1.92
		Uttara	12632	28149	15517	2.23	11406	20877	9471	1.83
	III (A)	RGN 48	29527	64144	34617	2.17	29034	50444	21411	1.74
		Rajendra Sufalam	16496	63482	46986	3.85	15260	40750	25490	2.67
	III (B)	RH 0749	22731	65359	42628	2.88	20031	44650	24619	2.23
		RGN 48	25021	48539	23518	1.94	24252	40244	15993	1.66
		NRCYS 05-02	19504	64792	45288	3.32	17831	42098	24267	2.36
		Rajendra Sufalam	19806	49681	29875	2.51	18773	41173	22400	2.19
Jharkhand	I	Pusa Mustard 30	21387	48740	27353	2.28	18035	32281	14245	1.79
		Pusa Mustard 28	22031	53981	31950	2.45	20725	37179	16454	1.79
		Pusa Mustard 26	18440	40720	22280	2.21	14020	25830	11810	1.84
		NRCHB101	22052	61650	39598	2.80	25344	42734	17390	1.69
	II	Pusa Mustard 30	19274	49324	30049	2.56	16000	33528	17528	2.10
		Pusa Mustard 26	16500	34625	18125	2.10	12250	25500	13250	2.08
	III	Pusa Mustard 27	21080	46852	25772	2.22	18665	32019	13354	1.72
		Pusa Mustard 30	15525	43261	27736	2.79	13915	31780	17865	2.28

39598/ha followed by Pusa Mustard 28 (Rs. 31950/ha) in central and north eastern plateau and Pusa mustard 30 (Rs. 30049/ha) in western plateau. The benefit cost ratio was also highest for NRCHB 101 (2.80:1) followed by PM 30 in south eastern plateau (2.79:1) and western plateau (2.56:1). These results are in accordance with the findings of Kumbhare et al., (2014); Singh et al., (2018); Jayalakshmi et al., (2018). Data from Table 2 revealed that benefit cost ratio for the demonstration plot was always higher than farmers plot which may be due to higher yield obtained by use of technology bunch (improved seed, seed treatment, micro nutrient, pest control and training to the farmers) and marketable value of crop due to good crop health. Higher benefit cost ratio of demonstrated plot shows economic feasibility of the demonstration and maximum chance of acceptability among the farmers' community.

CONCLUSION

Based on the study of four-year data on yield (q/ha), technology gap, extension gap, per cent increase over cornel and economics of cluster front line demonstration of rapeseed and mustard under different agro-climatic zone of Bihar and Jharkhand it may be concluded that productivity and economic return in rapeseed and mustard can be enhanced by proper utilization of critical inputs and recent technological intervention. This study observed that CFLD programmes were very effective in motivating and changing the attitude of other farmers to adopt improved cultivation practices and crop management though newer technologies. Higher yield of demonstration plots not only reduced technology gap but it also creates interest of farmers in demonstration technology ultimately it bridged extension gap.

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