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Brassica juncea L. based Diversification Approaches and Operational Practices for Productivity and Economics under Eastern Zone of Haryana

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***Abstract*:** Cluster frontline demonstrations technology for production potential of latest improved technology of mustard crop covering 205.68 ha area were carried out by Krishi Vigyan Kendra at 354 farmers' fields in Karnal district of Haryana during five consecutive *Rabi* seasons 2017-18 to 2021-22. The critical inputs were identified in improved production technology through Participatory Rural Appraisal (PRA) of adopted villages. Traditional farmers' practices were treated as control treatment for comparison with recommended practices treatments. The average yield of mustard under latest improved technology ranged from 16.0 to 21.50 q/ha as compared to 12.30 to 16.00 q/ha under farmers practice. The maximum seed yield (21.50 q/ha) was in 2018-19, and was 34.37 per cent more over the farmers practice. The average yield registered 29.09 percent higher over the farmers practice. The average of technology gap, extension gap and technology index were found to be 11.21 q /ha, 4.09 q/ha and 36.85 per cent respectively. The perceived technical gap may be due to differences in crop management practices, soil fertility and agro-climatic situation of Karnal district. The extension gap suggested the need to aware the farmers through various extension system for the adoption of latest improved technologies. Average net profitability was Rs. 53709/ha as compared with farmers practices (Rs. 37527/ha) and average benefit cost ratio i.e., 3.13 and 2.58 in demonstrated field and farmers practice respectively.

***Keywords*:** Chickpea, CFLD, Extension and technology gap, B:C ratio

Indian mustard (*Brassica juncea* l.) is one of the major *Rabi* oilseed crops of India; Mustard is cultivated in Canada, China, Australia, Germany, France, Poland and Pakistan. In India, it is the second largest mustard growing countries in the world and ranks 3rd among the major mustard producer countries (Bharat et al 2022). The area, production, and productivity of mustard in India is 6.78 million ha, 9.12 million tons and 1345 kg per ha respectively (DES 2021). The mustard occupies the highest productivity in Haryana 2058 kg per hectare and is grown in an area of 0.61 million ha with production 1.25 million tones. In the production and productivity of mustard is mainly influenced by climatic condition, water and fertilizers management and soil physical properties. Mustard grown well under irrigated/rainfed situations. The temperature required for seed germination is 25°C and grow well in low temperature. The sandy to heavy clay soil is good for mustard (Pal et al 2017). Among the commonly applied fertilizers nitrogen and sulphur is the major element in mustard productivity as these are essential for synthesis of amino acids, protein, oil, activates enzymes and component of Vit-A. among these Sulphur are the sources of pungency in oilseeds (Dubey et al 2022). Inspite the high value and quality of oil in mustard crop and adaptability in various agro-climatic conditions, the area, production and productivity of mustard have been up and down due to various abiotic and biotic stress and limited use of improved technological intervention to-gather with domestic price support programme is the major reason for low area and production in the district. In present frontline demonstrations were organized in participatory mode with the aim to increase production potential of mustard crop at the farmers' field under different cluster of districts Karnal.

MATERIAL AND METHODS

Cluster Frontline demonstrations of Mustard were carried out by KVK Karnal (Haryana) during *Rabi* season 2017-18 to 2021-22. The CFLD were conducted in village using the participatory approach where farmers are engaged it all level. The total rainfall received during the experimental seasons was 70.2 mm in 2017-18, 71.8 mm in 2018-19, 303.1 mm in 2019-20, 124.2 in 2020-21 and 191.2 mm in 2021-22 respectively, respectively (Fig. 1).

The technology to be demonstrated for mustard was identified based on Participatory Rural Appraisal technique. The control fields were maintained by the farmers with their own cultivated practices. KVK Karnal provide critical input

such as improved variety seed, soil ameliorates, Bio-fertilizers, integrated diseases and insects control. Under FLD programme 0.4 ha area is allotted under demonstration at farmer's field and adjacent 0.4 ha was used farmers field advised to use improved package of practices of mustard crop recommended for district Karnal. KVK scientist regularly visited the demonstration fields for proper guidance and interaction to the farmers. During the course demonstration, group meeting, skill training, field visit, field day and Kisan gosthties were regularly conducted for creating mass awareness about the technology demonstrated. The fact sheet also been provided to each participatory farmers to record all the data regarding development of crop. During the period a total 354 Demonstrations were conducted in 205.68 area of district Karnal. The major mustard varieties demonstrated under period are showed in (Table 1). Data were collected from both the demonstration as well as farmers field. Yield from the demonstration and farmer's field were obtained using crop cutting technique and analyzed statically. The technology gap, extension gap and technology index were calculated using the following formula by (Kumar 2014a). Other parameters such as gross return, net return, cost of cultivation and benefit-cost ration were also calculated as per (Leharwan et al 2021)

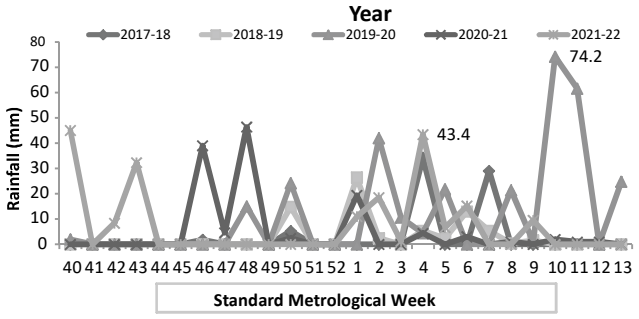

Fig. 1. Average weekly rainfall (RF), during the experimental seasons (October to March)

Technology Gap = Potential yield (Kg/ha) - Yield of improved technology (Kg/ha)

Extension Gap = Yield of improved technology (Kg/ha) - yield under farmer practices (Kg/hg)

$$\text{Technology Index} = \frac{\text{Potential yield} - \text{Yield of improved technology}}{\text{Potential yield}} \times 100$$

Additional cost (Rs/ha) = Improved technology cost-Farmer practice cost

Additional return (Rs/ha) = improved technology return - Farmer Practice return

Effective gains = Additional return – Additional cost

RESULTS AND DISCUSSION

Adopted farmers are dependent on the advice of pesticides dealers having no knowledge about agriculture practices. The farmers were not used recommended POP of mustard crop and major gaps were observed between recommended technology and farmers practices (Singh et al 2019 and Kalita et al 2019). The highest gap (80%) was in use seed treatment followed by weed management, pest and disease management, seed treatment, application of Sulphur and use of variety (Table 2). Farmers are generally use hybrid seed (private company) or local variety instead of the recommended high yielding variety. They were not using seed treatment with fungicide or bio-fertilizers due to lack of knowledge and unavailability of material. Recommended fertilizers were not used due to lack of information. No weed management and control of diseases and pests were adopted due to lack of awareness. On the basis of observed gap, under the demonstration improved variety seed of CS-58, 60, PM-32, RH-725 and RH-761, fungicide and bio-fertilizer for seed treatment, herbicide for weed management and insecticide for plant protection measure were provided to the partner farmers by the Krishi Vigyan Kendra Karnal and other component viz. balanced application of fertilizer and

Table 1. Details of technology intervention and farmer's practices under FLDs on mustard in Karnal district of Haryana

Technology	Recommended practice	Farmer practice	Gap (%)
Variety	CS-58, CS-60, Pusa Mustard-32, RH-725 and RH-761	Local seed and seed of private company	22
Seed rate (kg/ha)	3.69	5	38
Spacing	Row to row 30 cm and plant to plant 10 cm.	No proper spacing	40
Seed treatment	Carbendazim @ 2.5gm/kg seed	No seed treatment	80
Fertilizers	Nitrogen-80 kg/ha., Phosphorus 30 kg/ ha, and Sulphur 12.5 kg /ha. (90%)	Non-judicious use of fertilizers, No use of Sulphur	38
Weed management	Pendimethalin @ 2.5 lit. /ha. was used 1-2 D.A.S as a pre-emergence and hand weeding at 15-20 DAS	No practice of hand weeding	70
Insect management	Spraying of Thiamethoxam 25% WG) 100 gm per hectare	No application	40
Diseases management	Two spray of Metalaxyl 8% WP + Mancozeb 64% @ 3gm/ litre of water at 15 days interval	One spray of Carbendazim 50% WP @ 1gm per litre of water	40

micronutrients and all other crop management practices were timely performed by the partner farmer itself under the supervision of KVK scientist.

Mustard yield: CFLD of mustard showed that the average seed yield of mustard through demonstrated improved technology ranged from 16.0 to 21.50 q/ha as compared to 12.30 to 16.00 q/ha under farmers practice (Local check). Average yield was 18.24 q/ha from demonstrated improved technology whereas, from farmer's practices was 14.15 q/ha. There was on an average 29.09 per cent increase in demonstration yield over local check. The variety CS-58 during 2018-19 and 2017-18 gave highest yield 21.50 and 21.05 quintal per hectare followed. The higher yield of mustard under demonstration against farmer practice was due to the use of latest variety, seed treatment with fungicide and bio-fertilizers and use of Sulphur nutrient and recommended package of practices suitable for agro-climatic zone of Karnal district. Fluctuations in productivity were mainly due to of variation in soil condition, its fertility levels, rainfall pattern, sowing time and crop management practices. The detailed analyses of rainfall pattern were given in Figure 1 during the five consecutive years. During 2019-20 and 2021-22, there were occurrences of heavy rainfall 303.1 mm and 191.2 mm respectively at the growth and maturity stage of the mustard crop due to that overall yield potential of mustard crop was reduced as compared to the other season. These observations confirm the findings of Kumar and Yadav (2007), Kumar (2014b) and Kumar (2013).

Technology gap: The technology gap which cover research issues to achieve potential yields ranged from 5 to 20.56 q/ha during different years of demonstration. Technology gap was maximum (20.56 q/ha) with demonstration variety RH-725 during 2021-22 and minimum (5 q/ha) with Pusa vijay during 2017-18. Mean technology gap during five years of demonstrations were 11.21q/ha for mustard cultivation in Karnal district. The perceived technical gap may be due to differences in crop management practices, soil fertility and agro-climatic situation of Karnal district. It showed the limitation in demonstrating of technology and weakness in our demonstrated technology. This also indicates the poor extension methodology, which resulted in low adoption of package of practice by farmer. Hence, extension methodology and a crop wise specific technological recommendation appear to be necessary to reduce the technology gap.

Extension gap: The extension gap ranging between 2.42-6.05 q/ha was observed between demonstrated technology and farmer's practices during five year of demonstration (Table 3). The extension gap was highest 6.05 q/ha and lowest 2.42 q/ha during the year 2017-18 and 2019-20, respectively. On an average extension gap during period of demonstration were 4.09 q/ha for mustard cultivation in Karnal district. So as to increase the farmer's income, there is demand to lesser the wider extension gap, therefore, it is necessity to provide the knowledge to the farmers through various means for more adoption of recommended high yielding latest varieties and implementation of latest crop production methodology (Reager et al 2020, Meena et al 2020).

Technology index: A perusal of data (Table 3) further indicates that values for technology index ranged from 20 to 57.11 percent. During five years of frontline demonstrations the highest technology index 57.11 per cent and lowest 20 per cent was recorded in variety RH-725 and Pusa Vijay

Table 2. Yield performance and yield analysis of demonstrated Mustard variety in Karnal district of Haryana

Year	No. of demo	Area (ha.)	Variety	IT average yield (q/ha)	FP average yield (q/ha)	% increase in yield over FP	IT yield (q/ha) over FP
2017-18	8	3.23	CS-58	21.05	15.00	43.33	6.05
	5	2	Pusa Vijay	20.00	15.00	33.33	5.00
	11	4.45	RH-749	20.25	15.00	35	5.25
2018-19	15	38	CS-56	19.21	16.00	20.06	3.21
	15	38	CS-58	21.50	16.00	34.37	5.5
2019-20	25	10	CS-58	16.00	13.58	17.82	2.42
	25	10	CS-60	16.55	13.58	21.87	2.97
2020-21	125	50	CS-58	18.00	14.68	22.61	3.32
2021-22	125	50	PM-32	17.14	12.30	39.34	4.84
			RH-725	15.44	12.30	25.52	3.14
			RH-761	15.59	12.30	26.74	3.29
Total/Mean	354	205.68	-	18.24	14.15	29.09	4.09

during year of 2017-18, respectively. Variation in technology index during five seasons might be attributed to dissimilarity in the weather parameters. Further, on an average technology index 36.85 per cent was observed during five experimental years of mustard in Karnal district, which shows the efficacy of better performance of technical interventions. This will increase the adoption of demonstrated technical intervention to increase the yield performance of mustard at farmer's field.

Economics: Economic assessment for recommended technology under FLD were calculated (Table 4) on the basis of prevailing market rates and recorded higher gross return (Rs. 90,300 /ha) and net return (Rs. 66,170 /ha) with improved technology demonstration compared to farmer's practice in the year 2018-19 in CS-58 variety. The present findings were concluded that higher net return ranged from Rs 36,055 to 66,170/ha over five years and its mean value was Rs 53,709/ha. However, in farmer's practices the net return ranged from Rs.28148 to Rs. 44,355 /ha over five years and its mean value was Rs.37,527 /ha. The benefit cost ratio was maximum (3.74) in improved technology in year 2018-19 in CS-58 variety and minimum (2.45) was in year 2019-20 in CS-60 variety. However, under farmer practice maximum B:C ratio was recorded (2.94) in 2018-19 and minimum (2.20) in 2019-20. Higher B:C ratio and additional returns clearly shows that demonstrated techniques were found cost effective & feasible for yield enhancement of mustard on farmer fields. Farmers were also found greatly

Table 3. Gap analysis in mustard under front line demonstration and farmer practice

Season and year	Variety	Technology yield gap (q/ha)	Extension yields gap (q/ha)	Technology index (%)
2017-18	CS-58	6.95	6.05	24.82
	Pusa Vijay	5	5.00	20.00
	RH-749	13.75	5.25	40.44
2018-19	CS-56	6.79	3.21	26.11
	CS-58	6.50	5.5	23.21
2019-20	CS-58	12	2.42	42.85
	CS-60	12.45	2.97	42.93
2020-21	CS-58	10	3.32	35.71
2021-22	PM-32	9.96	4.84	36.75
	RH-725	20.56	3.14	57.11
	RH-761	19.41	3.29	55.45
Mean		11.21	4.09	36.85

Table 4. Economic analysis of FLDs on mustard in Karnal district of Haryana

Season and year	Variety Demonstrated	Average cost of cultivation (₹/ha)		Additional cost in IT (₹/ha.)	Sale price (₹q^{-1})	Average gross return (₹/ha)		Additional return in IT (₹/ha)	Average net return (₹/ha)		Effective gain (₹/ha)	Benefit-Cost Ratio	
		IT	FP			IT	FP		IT	FP		IT	FP
Rabi 2017-18	CS-58	23640	22120	1520	4000	84200	60000	24200	60560	37880	22680	3.56	2.71
	Pusa Vijay	23640	22120	1520	4000	80000	60000	20000	56360	37880	18480	3.38	2.71
	RH-749	23640	22120	1520	4000	81000	60000	21000	57360	37880	19480	3.42	2.71
Rabi 2018-19	CS-56	24130	22845	1285	4200	80682	67200	13482	56552	44355	12197	3.34	2.94
	CS-58	24130	22845	1285	4200	90300	67200	23100	66170	44355	21815	3.74	2.94
Rabi 2019-20	CS-58	24745	23456	1289	3800	60800	51604	9196	36055	28148	7907	2.45	2.20
	CS-60	24745	23456	1289	3800	62890	51604	11286	38145	28148	9997	2.54	2.20
Rabi 2020-21	CS-58	27345	25350	1995	4650	83700	68262	19890	56355	42912	13443	3.06	2.69
Rabi 2021-22	PM-32	27475	25650	1825	5100	87414	62730	24684	59939	37080	22859	3.18	2.44
	RH-725	27475	25650	1825	5100	78744	62730	16014	51269	37080	14189	2.86	2.44
	RH-761	27475	25650	1825	5100	79509	62730	16779	52034	37080	14954	2.89	2.44
Mean	-	25313	23751	1562	4359	79022	61278	18148	53709	37527	16182	3.13	2.58

convinced with the mustard varieties CS-58 & Pusa Mustard-32 and other latest technological interventions due to higher economic returns with least additional investment and management practices. The variation in cost benefit ratio during different years might be due to variation in yield performance and input output cost in that particular year with domestic price support programme. Earlier researchers were also observed similar trend (Meena and Singh 2019, Kumar et al 2020, Shivran et al 2020, Singh et al 2020, Puniya et al 2021.

CONCLUSION

The results revealed that both extension and technology gap reduction is essential to further increase the production at farmers field level. It can be achieved by demonstrating/educating recent technologies and methodologies in agriculture to the farming community at micro-level. Demonstration of improved mustard production technology satisfied fellow farmer to adopt the crop diversification technique with improved technology for better income in Karnal district of Haryana.

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