International Journal of Agricultural Sciences ☞DOI:10.15740/HAS/IJAS/16.2/160-165
Volume 16 | Issue 2 | June, 2020 | 160-165 ■ ISSN : 0973-130X Visit us : *www.researchjournal.co.in*

RESEARCH PAPER

Performance of high yielding varieties of mustard in cluster front line demonstration using sulphur and zinc under Hathras condition

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Abstract : Present study was carried-out during *Rabi* seasons of 2016-17 and 2017-18 at farmer's fields of four blocks in Hathras district of Uttar Pradesh. Clusters front line demonstration (CFLD) on mustard crop was conducted on an area of 30 ha with active participation of 75 farmers with improved technologies composed of RH-749 and Giriraj varieties and integrated crop management (Sulphur @ 40 kg/ha + Zinc Sulphate @ 25 kg/ha +Line sowing following Thinning + seed treated with thiram 75% WP @ 3g/kg seed). The results revealed that maximum mean grain yield 24.89 q/ha with an increase in 24.18 per cent over farmers practice (20.04 q/ha). Improved demonstrated technologies of mustard cultivation recorded increased average grain yield during both the years of study. The RH-749 variety gave higher yield as compared to both Giriraj and local check variety Rohini during both the years. The extension gap can be bridged by popularizing package of practices of mustard including improved variety (RH-749), use of optimum seed rate in line sowing, Sulphur @ 40 kg/ha, Zinc Sulphate @ 25 kg/ha, balanced nutrition and recommended plant protection measures. Improved technologies gave higher net return of Rs. 50,555/ha with benefit cost ratio of 2.53 as compared to net return from farmers practice Rs. 39,778/ha with benefit cost ratio of 2.40.

Key Words : Mustard Variety RH-749, Giriraj, Yield, HI, FLD, Benefit cost ratio

View Point Article : Singh, Shyam (2020). Performance of high yielding varieties of mustard in cluster front line demonstration using sulphur and zinc under Hathras condition. *Internat. J. agric. Sci.*, **16** (2) : 160-165, **DOI:10.15740/HAS/IJAS/16.2/160-165.**

Article History : Received : 15.03.2020**; Revised :** 28.04.2020**; Accepted :** 04.05.2020

INTRODUCTION

Vegetable oil has been an indispensable part of Indian households and kitchens. In India, mustard with different species of rapeseed-mustard is grown in different agro climatic conditions. Under marginal resource situation, cultivation of mustard becomes less remunerative to the farmers. This results in a big gap between requirement and production of mustard in India. There are two ways to fulfil this gap, first to increase the area under oilseed and secondly an increment in productivity of oilseed crops. Considering the requirement of food grain for the increasing population it seems the only option is to increase the productivity for which our government have made many efforts earlier. The National Mission on oilseed and Oil palm as the part of the National Food Security Mission (NFSM), is one of

the important schemes launched by Indian government in the year 2014-15 with the objective of enhancing production of oilseeds and domestic availability of edible oils. India is second largest consumer of edible oils, after China and consumed 254.16 Lakh Tonnes in 2016, while China stood first by consuming 350 Lakh tonnes (Agricultural Statistics, 2019). A substantial portion (Sixty six % /153.17 Lakh tonnes) of our requirement of edible oil is met through import of palm oil from Indonesia and Malaysia. It is, therefore, necessary to exploit domestic resources to maximize production to ensure edible oil security for the country. Out of total oil from nine oilseed (73.09 Lakh tonnes), mustard contribution was maximum 33.84% (24.74 Lakh tonnes) (*Source:* Directorate of Vanaspati, Vegetable Oils and Fats). However, the per capita consumption still has potential to grow, with India at 19.5/km (kg) against the global average of 25/kg (*Source:* Economic Survey 2019-20, Ministry of Finance). During the year 2017-18 in gross cropped area the share of food grain crops, pulses and oilseeds was 64.31 per cent, 15.03 per cent and 12.36 per cent, respectively and a total of 31.46 Million tonne oilseeds was produced from 24.51 million ha area (Agricultural Statistics, 2019). Nearly 34 per cent area is rainfed under these crops (Kumar and Chauhan, 2005). Because of its low water requirement (80-240 mm), rapeseed mustard crops fit well in the rainfed cropping system and hence, among all the nine oilseed crops grown in India it occupies a prominent place, next to groundnut (Gautam *et al*., 2017). Uttar Pradesh accounts for 10.85 per cent and 11.96 per cent of area and production, respectively in the country with the average yield of 10.17 q/ha which is little less to the national average (11.83 /ha) during 2015-16 (Agricultural Statistics, 2019). Mustard is third important crop (7610 ha 2015-16) in district Hathras after potato and wheat during *Rabi* season but the productivity of mustard is (12.68q/ha) which is quite low and it could be increased. Demonstration of promising technologies on farmer's fields is an effective method of extension. Knowledge and skills gained through the demonstration plots can be easily transferred from farmer to farmer. The productivity of mustard per unit area could be increased by adopting recommended scientific and sustainable management practices using a suitable high yielding cultivar. Taking into account the above considerations, clusters frontline demonstrations (CFLD) were carried out in a systematic manner on farmers' field to show the worth of new varieties and convincing farmers to adopt improved production management for enhancing productivity of mustard.

MATERIAL AND METHODS

Cluster front line demonstrations on mustard were conducted under National Mission on oilseed and Oil palm (NMOOP) scheme as the part of the National Food Security Mission (NFSM), during *Rabi* seasons of 2016-17 and 2017-18 at farmer's fields. The demonstrations were laid out in four blocks of Hathras district of Uttar Pradesh. Frontline demonstrations were conducted in a block of two to five hectares land in order to have better impact of the demonstrated technologies on the farmers

Table A : Comparison between demonstrated package of practices and existing farmer's practice of mustard production in Hathras

Sr. No.	Intervention	Demonstrated package	Farmers' practice
1.	Farming situation	*Rabi*	Rainfed
2.	Variety	RH-749 and Giriraj	Rohini
3.	Seed treatment	Seed treated with Carbendazim @2g/kg seed	Nil
4.	Time of sowing	01st to 15th October	20th to 300th September
5.	Sowing method	Line sowing at 30 cm LtoL and 10 cm P to P	Broadcasting
6.	Thining	At 15-20 DAS to maintain 10-15 cm Plant to Plant	At 35-50 DAS used as green fodder
7.	Seed rate	5 kg/ha	6 kg/ha
8.	Fertilizer dose	120:60:50:40:25 (NPKSZn kg/ha)	100:40:0:0:0 (NPKSZn kg/ha)
9.	Plant protection	Mencozeb (Dithane M-45) or Ridomil M Z 72 WP @ 2.5g/litre of water to control White rust disease. Dinocap @1.0g or Wet able sulphur @ 2.5g/litre of water control of powdery mildew.	Nil
10.	Weed management	Pendamethaline @1.0 kg a.i./ha as pre-emergence followed by one hand weeding at 30 days after sowing	One hand weeding at 30-35 days after sowing

and field level extension functionaries. The cluster of mustard growing farmers was selected in villages where crop covered a handsome area under mustard to increase the impact of demonstrations. After selection of farmers a training programme on scientific cultivation of mustard was conducted to upgrade the knowledge and skill of farmers and ensuring correct usage and method. Each demonstration was conducted in a block of 0.4 ha area in order to have better impact of the technologies demonstrated against the local checks. Total 75 demonstrations were conducted and a total area of 30 ha was put under CFLD.

As depicted in Table A all standard package of practices were applied in demonstration plots. The farmers were provided with RH-749/Giriraj mustard seed @ 2 kg, Sulphur @ 16 kg and Zinc sulphate @10 kg to lay out the demonstration. The input for famers practice was arranged by farmers themselves during both the years.

The seed of new varieties Giriraj and R H -749 was purchased from ICAR- Directorate of Research on Oilseed and Mustard, Bharatpur and made available to farmers. The soil of each demonstration plot was tested for pH, EC, O.C. and macro nutrients N, P and K. The recommended dose of fertilizer in every demonstration was applied on soil test basis. However, the zinc sulphate and sulphur was applied @ of 25 and 40 kg/ha, respectively. The soil of all demonstration plots was sandy loam and low in nitrogen and phosphorus and medium in potash. The pH was reported in the range of 7.2 to 8.5. The whole amount of phosphorus, potash, sulphur and zinc and half of the nitrogen was applied at sowing time as basal and rest half nitrogen was top dressed after first irrigation at 35 DAS. Sowing was done 5 September to 5 October during both the years. The 5 kg/ha treated seed was used in sowing with seed drill. Thinning cum first weeding was done at 7 to 15 DAS and second weeding was done at 35 DAS both the years. Farmers do the thinning cum weeding at 30 DAS. Two irrigations at 30 and 50 DAS were applied to demonstrations plots. No disease and insect incidence occurred in crop. Crop was harvested in first week of March (148-153 DAS) during both the years. However, the plots of farmers practice were matured and harvested about one week before the demonstrations during both the years. The cost of cultivation was calculated on the basis of local rate of inputs and other operation prevailing at that time, similarly the local market rate of mustard was considered for calculation of gross and net income. The yield data were recorded by crop cutting method of yield estimation from three demonstrations randomly selected from each cluster/ village. Frequent visit of all clusters was made by scientists of Krishi Vigyan Kendra, Hathras. Field day was also conducted at demonstration plot at maturity stage of the crop.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Grain yield:

The data pertaining to performance of both demonstrated and farmers practice mustard varieties is given in Table 1. It is evident from the table that commercial yield, biological yield and harvest index of both the demonstrated varieties grown with sulphur and zinc application was higher than the local variety (Rohini) used by most of the farmers of Hathras district during both the years. The maximum grain yield (24.89 q/ha) was obtained from variety R H-749 which was 24.2 per cent higher (24.73 and 23.63 % during 2016-17 and 2017-18, respectively) than the yield of farmers practice. This was followed by Giriraj which gave 24.33 q/ha with an increment of 21.4 per cent (19.93 and 22.90 % during 2016-17 and 2017-18, respectively) over farmers practice. It is clear from the data shown in the Table 1 that the highest commercial yield, was obtained due to varietal intervention and application of sulphur @ 40 kg with 25 kg zinc per hectare. It was the combined impact of new varieties and sulphur with zinc applied. These

Table 1 : Grain yield of mustard obtained under demonstration v/s farmer's practice

Sr. No.	Variety	Duration (Days)	2016-17		2017-18		Average of two years	
			Grain yield (q/ha)	Yield increase (%)	Grain yield (q/ha)	Yield increase (%)	Grain yield (q/ha)	Increase %
1.	Rohini	135.14	20.62	-	19.46	-	20.04	-
2.	Giriraj	151.35	24.73	19.93	23.93	22.90	24.33	21.4
3.	RH-749	150.74	25.72	24.73	24.06	23.63	24.89	24.2

results are in conformity with those of Kumar *et al.* (2018) who reported yield increment in mustard due to sulphur and zinc and in the reports of NAAS (2017) and AICRP (2019) where the superiority of variety RH-749 over check variety have also been recorded. The improved plant nutritional environment as a result of increased S and Zn supply might have favourably influenced the carbohydrate metabolism. This favourable effect of S and Zn led to increased translocation of photosynthates towards seeds resulting in formation of bold seeds and ultimately higher yield. Results are also supported by findings of Jat *et al.* (2017) who suggested that the application of 30 kg S ha^{-1} enhanced the 1000 grain weight which contributed to yield. The increase in grain yield of demonstration plots may be attributed to zinc which play important role in biosynthesis of indole acetic acid (IAA) and it also play important role in initiation of primordial for reproductive parts and partitioning of photosynthates towards them, which ultimately resulted in better flowering, fruiting and grain yield. The findings confirm the results of Singh and Pandey (2017).

Biological yield:

It is evident from the data that application of zinc and sulphur enhanced the biological yield over farmers practice. The highest biological yield of 113.1 q/ha (115.3 q/ha during 2016-17 and 110.9 q/ha during 2017-18) was obtained from RH-749 followed by Giriraj 111.5 q/ha (112.8 q/ha during 2016-17 and 110.2 q/ha during 2017-18). The higher biological yield may be attributed to higher level sulphur fertilization which increases the dry matter accumulation as sulphur is directly involved in better absorption of applied nutrients and cell multiplication as well as expansion of deep green colour leaves due to higher chlorophyll synthesis resulting into increase in photosynthetic rate and ultimately higher biological yield in comparison with plants deficient in sulphur. Kumar and Yadav (2007) suggested that the longer crop duration of Giriraj and RH -749 might be another cause of higher biological yield of these varieties.

Economic traits:

Economics *viz.*, cost of cultivation, gross return, net return and benefit cost ratio of mustard under farmers practice and demonstrated technologies have been tabulated in Table 3. Returns were calculated from the market price of mustard Rs. 3300/q and Rs. 3500/q during 2016-17 and 2017-18. Among the farmers practice (Rohini withouts and zinc) and demonstrated technologies (R H-749 and Giriraj with 40 kg sulphur and 25 kg Zn ha^{-1} with line sowing) maximum total cost of cultivation (Rs. 32300/ha and 33300/ha during 2016-17 and 2017-18, respectively) were recorded in demonstration. Gross return was also highest (53860 ha^{-1}) with variety RH-749 with 40 kg sulphur and 25 kg Zn/ha with line sowing followed by variety Giriraj with 40 kg sulphur and 25 kg Zn/ha with line sowing. Similarly, maximum net returns (52576/ha and Rs. 50910/ha during 2016-17 and 2017-18, respectively) and highest B:C ratio (2.55 and 2.52 during 2016-17 and 2017-18, respectively) was also recorded with same treatment *i.e.* variety R H-749 with 40 kg sulphur and 25 kg Zn/ha with line sowing and followed by variety Giriraj with 40 kg sulphur and 25 kg Zn/ha with line sowing. Such behaviour of economic parameters due to S and Zn was because of changes in

Table 2 : Biological yield and harvest index of mustard obtained under demonstration v/s farmer's practice

Sr. No.	Variety	Biological yield (q/ha) 2016-17		Biological yield (q/ha) 2017-18		Average of two years		Harvest index (%)		
		Yield	Increase %	Yield	Increase %	Yield	Increase %	2016-17	2017-18	Average
1.	Rohini	98.3	-	93.1	-	95.7	-	20.97	20.74	20.85
2.	Giriraj	112.8	14.5	110.2	18.4	111.5	16.5	21.92	21.71	21.81
3.	RH-749	115.3	17.3	110.9	19.1	113.1	18.2	22.30	21.69	21.99

Table 3 : Economics of demonstration and farmer's practice

Sr. No.	Variety	Cost of cultivation (Rs./ha)		Gross income (Rs./ha)		Net income (Rs./ha)		B:C Ratio	
		2016-17	2017-18	2016-17*	2017-18**	2016-17	2017-18	2016-17	2017-18
1.	Rohini	27800	28800	68046	68110	40246	39310	2.44	2.36
2.	Giriraj	32300	33300	81609	83755	49309	50455	2.52	2.51
3.	RH-749	32300	33300	84876	84210	52576	50910	2.55	2.52

*Market price of mustard Rs. 3300/q (2016-17) **Market price of mustard Rs.3500/q (2017-18)

marginal seed yield of the crop with successive increase in fertilizer nutrient and relative costs of inputs in relation to output. The similar effect of sulphur have been reported earlier by Verma *et al.* (2011) and Verma and Dawson (2018). This may be because of the difference in yield between farmers practice and demonstration yield differed largly from each other and varietal intervention and application of sulphur @ 40 kg with 25 kg zinc per hectare produced more seed yield.

Harvest index:

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. Different parameters of plant growth and grain yield affected due to different mustard varieties. However, this variation of different parameters among different varieties ultimately resulted in very much difference in biomass yield but caused inconspicuous differences in seed yield. The maximum average harvest index 21.99 per cent was recorded for demonstrated variety RH-749 (22.30 % during 2016-17 and 21.69% during 2017-18) followed by Giriraj 21.81 per cent (21.92% during 2016-17 and 21.71% during 2017-18) The farmers practice resulted minimum harvest index 20.85 per cent (21.92% during 2016-17 and 21.71% during 2017-18). The higher harvest index in demonstration plots may be attributed to the positive influence of sulphur on siliquae production of rapeseed as reported by Verma *et al.* (2012) and Yeasmin *et al.* (2013) which contribute to grain yield of mustard. This positive response could be due to increased absorption of sulphur from the soil resulting in formation of reproductive structure.

Conclusion:

The investigation designed to study the performance of high yielding varieties of mustard in cluster front line demonstration using sulphur and zinc under Hathras condition, had been undertaken on the farmer's field of four blocks in Hathras district of Uttar Pradesh, India. On the basis of the experimental findings, it is concluded that the demonstrated improved technologies gave higher grain yield (24.89q/ha) and net return of Rs. 50,555/- ha with benefit cost ratio 2.53 as compared to grain yield 20.04 q/ha and net return of Rs. 39,778/- ha with benefit cost ratio 2.40 from farmers practice. Old mustard variety Rohini should be replaced with variety RH-749 which gave higher yield as compared to both Giriraj and locally popular variety Rohini. The productivity of mustard can be increased in Hathras district of Uttar Pradesh by adopting and popularizing the recommended package of practices of mustard including improved variety RH-749/ Giriraj, use of optimum seed rate in line sowing, thinning, balanced nutrition, Sulphur @ 40 kg/ha, Zinc Sulphate @ 25 kg/ha and recommended plant protection measures (Verma *et al*., 2011).

Acknowledgement:

The author is thankful to Director of Extension, C.S.A. University of Agriculture and Technology Kanpur, Uttar Pradesh and Director ICAR-ATARI, Kanpur for giving me opportunity to conduct the cluster front line demonstrations and providing fund during the course of investigation.

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