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Effect of Sulphur Levels on Mustard (*Brassiaca juncea*) yield in Muzaffarpur District of Bihar

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ABSTRACT

An on farm trial was conducted consequently two years in Rabi seasons of the year 2011-12 and 2012-13 to optimize the dose of sulphur to achieve markedly higher growth attributes, yield attributes and yield of mustard (*Brassica juncea* L.) cv, 'Rajendra suflam'. Results of the trial revealed that growth and yield attributes like plant height, no. of branches plant^{-1}, no. of siliqua plant-1and test weight were recorded significantly higher with the application of 40 kg Sulphur ha^{-1} but it was statistically at par with the 30 kg Sulphurha^{-1}. The significantly higher seed (13.93 and 13.98 q ha^{-1}) and stover yield was recorded with the application of sulphur @ 40 kg Sulphur ha^{-1} which was at par with 30 kg Sulphur ha^{-1}, whereas lowest seed yields (10.13 and 10.14 q ha^{-1}) was associated with farmers' practice i.e. no sulphur during both the years of experimentations. However, the highest gross return (Rs. 51541 and Rs.51736 ha^{-1}), net return (Rs.31923 and Rs. 31311 ha^{-1}) and B: C ratio (2.63 and 2.53) was recorded @ 40 kg S ha^{-1} and lowest economics parameters were recorded with no sulphur application.

Key words : Mustard, Sulphur, Silique, Yield attributes, Yield, Net Return, B:C ratio

INTRODUCTION

Mustard (*Brassica juncea* L.) is the second most important edible oil seed crop, its oil is used as cooking oil and also for condiments, medicine and industrial purposes. In Bihar, mustard is grown in an estimated area of 0.82 lakh ha with the total production of 0.76 lakh tonnes and 926 kg ha^{-1} of productivity. However, in North parts of Bihar, mustard is mostly cultivated under irrigated conditions on sandy loam soils. Cereal-based crop sequences such as rice-wheat are detrimental to soil health and have decreased the productivity of both the crops (Pillai *et al.*,1987). But, mustard being a deep-rooted crop performs well after rice due to better exploitation of nutrients from the soil pool, besides mustard gives higher economic returns than wheat when grown after rice (Singh *et al.*,1984).The main causes for low production of mustard are large acreage under marginal land, which is deficient in major nutrients and imbalanced nutrient management. Among the plant nutrients, nitrogen and sulphur are the most important for increasing the productivity of mustard, particularly in soil low in available nitrogen and sulphur (Kachroo and Kumar, 1997). Sulphur can be rightly called as the 'fourth major elements' in plant nutrition after nitrogen, phosphorous and potash (Goswami,1986).Sulphur nutrition plays a key role in protein production, chlorophyll formation and oil synthesis, besides it enhances cell multiplication, elongation, expansion and imparts a deep green colour to leaves due to better chlorophyll synthesis, which in turn increases the effective area for photosynthesis, resulting in relatively greater amount of dry matter accumulation in comparison to sulphur deficient plants (Mehriya and Khangarot, 2000). In the soil of India, sulphur deficiencies occur in scattered manner in about 180 districts and yield response of oil seed crop to sulphur application under field condition (Tandon,1991). When a soil is deficient in sulphur and this deficiency is not rectified, then the full yield potential of a crop cannot be realized in spite of other nutrients applied in balance, adoption of improved varieties and top class crop management practices. Keeping above mentioned views in consideration and realizing the importance of sulphur in integrated nutrient management for mustard, the present investigation was formulated and carried out.

MATERIALS AND METHOD

The on farm trial was conducted at the randomly selected plots of 10 farmers fieldin Muzaffarpur district under supervision of Krishi Vigyan Kendra, Saraiya, Muzaffarpur, Bihar in Rabi season during years 2011-12 and 2012-13. The study area are located in Muzaffarpur district lies at longitude 85019' N, and latitude 26005'E of 51.81 m above sea level in part of the Indo- Gangetic North-West Alluvial plain of Bihar. The climate of this area is tropical humid to sub-humidwith having average rainfall in the area 1234 mm, average temperature 25.30C and relative humidity 67 percent. The

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soils of trial were by and large sandy loam with having pH 8.4, EC 0.33ds m^{-1}, organic carbon 0.55 percent, available nitrogen 233 kg ha^{-1}, available phosphorus 28.50 kg ha^{-1}, available potash 185.25 kg ha^{-1} and sulphur 9.88 ppm. The trial was laid in Randomized Block Design (RBD) with four levels of sulphur viz. Control (without sulphur), 20 kg ha^{-1}, 30 kgha^{-1} and 40 kg ha^{-1}. The mustard cv. 'Rajendra Suflam' was sown in row to row distance of 30 cm and plant to plant 10 cm using a seed rate 5.0 kg ha^{-1} on 09 and 11 November and harvesting on 15 and 20 March during 2011-12 and 2012-13 respectively. The crop was fertilized with recommended dose of 80 kg N, 40 kg P_2O_5 $ha^{-1}$and 40 kg K_2O ha^{-1}. Half dose of N and full dose of P_2O_5 and K_2O were applied as basal application through urea, DAP and MOP, remaining 40 kg N ha^{-1} was applied as top dressing at 20-35 days after sowing or at flowering stage. Sulphur was applied in soil through bentonite sulphur %) as per treatment. The crop received thinning, one hand weeding at 35 days after sowing and one spray of insecticide + fungicide in second week of January. The crop stand was optimum during the crop season. The crop received 155 and 160mm rainfall during 2011-12 and 2012-13, respectively. Observations on yield attributes and yield of mustard were recorded at harvest stage.

RESULTS AND DISCUSSION

Growth and yield attributes

The sulphur application induced significant increase growth and yield attributes of mustard data presented in Table1. Application of sulphur @ 40 kg ha^{-1} recorded significantlyhigher plant height, no. of branches $plant^{-1}$ and no. of siliqua $plant^{-1}$ as compared to 20 kg S ha^{-1} and control (no sulphur), but test weight was found statistically non-significant. However, 40 kg S ha^{-1} and 30 kg S ha^{-1} were statically at par between themselves in respect of all growth and yield attributes characters. The improvement in the growth and yield attributes characters might have been due to the fact that mustard is a long duration crop and being indeterminate in nature and the favorable effect of sulphur in improving nutritional environment extended over a long duration. Increase in these parameters could be also ascribed to overall improvement in plant growth and vigor with sulphur fertilization that favored both the grain formation and grain development which resulted in to increase in yield of mustard (Mehriya and Khangarot, 2000).

Table 1: Effect of sulphur on growth and yield attributes of mustard

Treatments	Plant height (cm)		No. of branches $plant^{-1}$		No. of siliqua $plant^{-1}$		Test weight (g)	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Control (Farmers, practice/ no sulphur)	158.81	163.83	10.13	11.01	190.77	195.77	4.05	4.15
Sulphur @ 20 kg ha^{-1}	175.94	177.69	12.49	13.09	210.79	206.79	4.49	4.63
Sulphur @ 30 kg ha^{-1}	184.41	185.22	13.31	13.74	220.47	223.67	4.66	4.78
Sulphur @ 40 kg ha^{-1}	189.59	189.56	13.85	14.15	225.22	228.09	4.73	4.93
Sem±	2.94	2.17	0.20	0.28	3.18	6.90	0.11	0.15
CD (P=0.05%)	6.03	4.46	0.41	0.58	6.53	14.15	NS	NS

Seed yield and Harvest index

The seed yield, biological yield and harvest index of mustard were influenced significantly due to the application of sulphur (Table 2). The significantly higher seed yields (13.93 and 1398 q ha^{-1}) were obtained with the application of 40 kg S ha^{-1}, but it was found at par with 30 kg S ha^{-1}which was significantly superior to 20 kg S ha^{-1} and control plot during both the year. However, the highest straw yields in both years (33.83 kgha^{-1} and 34.51 kg ha^{-1}) were recorded with sulphur fertilization @ 40 kgha^{-1} which was at par with 30 kg S ha^{-1}over

Table 2 : Effect of sulphur on yield and HI of mustard

Treatments	Seed Yield (kg ha^{-1})		Stover Yield (kg ha^{-1})		Biological Yield (kg ha^{-1})		Harvest Index (%)	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Control (Farmers, practice/ no sulphur)	1013	1014	2780	2800	3793	3814	26.72	26.58
Sulphur @ 20 kg ha^{-1}	1269	1273	3307	3299	4575	4572	27.74	27.76
Sulphur @ 30 kg ha^{-1}	1356	1349	3358	3423	4713	4771	28.78	28.37
Sulphur @ 40 kg ha^{-1}	1393	1398	3383	3451	4775	4849	29.17	28.83
Sem±	0.24	0.23	0.34	0.40	0.45	0.41	0.43	0.42
CD (P=0.05%)	0.48	0.47	0.71	0.82	0.91	0.84	0.88	0.87

Table 3: Effect of sulphur on economics of mustard

Treatments	Cost of Cultivation (Rs. ha^{-1})		Gross Return (Rs. ha^{-1})		Net Return (Rs. ha^{-1})		B:C Ratio	
	2010	2011	2010	2011	2010	2011	2010	2011
Control (Farmers, practice/ no sulphur)	17450	18645	37481	36778	20031	18133	2.15	1.97
Sulphur @ 20 kg ha^{-1}	18617	19515	46953	47101	28336	27586	2.52	2.41
Sulphur @ 30 kg ha^{-1}	19117	19800	50172	49913	31055	30113	2.61	2.52
Sulphur @ 40 kg ha^{-1}	19618	20425	51541	51736	31923	31311	2.63	2.53

20 kg S ha^{-1} as well as control, although, there was significantly improvement in the harvest index with subsequently increase in S levels only up to 30 kg S/ha. The improvement in the harvest index may be due to better translocation of photosynthates leading to more siliquae plant^{-1}, more seeds plant^{-1} and higher test weight due to sulphur application (Khanpara *et al.*,1993). The increase in seed and straw yield of mustardmight be attributed due to essential role of S for plant growth and yield, as well as its positive effect on biochemical functioning related enzyme activation (Sharma, 1994).

Economics

The maximum net returns (Rs 31923.00 and Rs 31311.00 ha^{-1}) was recorded with sulphur application @40 kg ha^{-1},which was closely followed by 30 and 20 kg S ha^{-1}.whereas the highest benefit: cost ratio was associated with 40 kg S ha^{-1}followed by 30 kg S ha^{-1} and 20 kg S ha^{-1} during both the years (Table 3).

This behavior of net returns and benefit: cost ratio may be attributed to yield trend due to varying sulphur application and relative cost of inputs in relation to output. These results are in conformity with Rana and Rana, 2013.

CONCLUSION

It was concluded that application of 30 kg S ha^{-1} to the mustard crop should be applied for optimum productivity of mustard at farmers' field in Muzaffarpur district of North Bihar.

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