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Research Article

Effect of Sulphur Levels and Varieties on Growth, Yield and Quality of Mustard (*Brassica juncea* L.)

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ABSTRACT

Sulphur and varieties are yield limiting factors for rapeseed production in the sandy loam soil (Inceptisols) of the Madhya Pradesh, India. A field experiment was conducted to study the effect of Sulphur and varieties on growth, yield and quality of mustard at student instructional farm of department of Agronomy, Faculty of Agriculture, AKS University, Sherganj, Satna (M.P.) during winter season of 2020-21. The experiment consisted of randomize block design having factorial arrangement with three replications. In this experiment, 12 treatment combinations including four levels of Sulphur and treatments were S_0- 0 kg/ha, S_1- 50 kg/ha, S_2- 60 kg/ha and S_3- 70 kg/ha, while three mustard varieties were tested are V_1- Varuna, V_2- Shekhar and V_3- Pusa bold. Higher plant height and number of branches per plant at maximum crop growth stage of 90 DAS (162.19 cm and 24.03, respectively) was recorded in plots treated with Sulphur @ 70 kg/ha with mustard variety Varuna. Similarly, resulted in maximumnumber of siliquae per plant (425.99), number of seeds/siliquae (17.47), test weight (4.39 g), seed and Straw yield (18.56 and 59.04 q/ha, respectively)as well as oil content (39.80 %) recorded under same treatment combination of Sulphur @ 70 kg/ha with mustard variety Varuna. It was concluded from the results that application of Sulphur @ 70 kg/ha with mustard variety Varunaimproved yield and yield components of mustard.

Keywords: *Mustard, Sulphur, Variety, Siliqua, Straw yield.*

INTRODUCTION

Rapeseed mustard is the second-most important oilseed crop in India, next only to soybean, with almost one-fourth share in both area and production (Jat et al., 2019). It is cultivated in an area of 6.3 million hectares with a production of 8.0 million tones yielding 1324 kg/ ha (DOAC, 2017). There exists a huge gap between the global productivity (20.47 q/ ha) and India's productivity (13.24 q/ ha) which need to be bridged with the expansion of area under high yielding varieties (hybrids) due to their improved genetic potential (Rana et al., 2019).

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The area, production and productivity of rapeseed-mustard in India is 6.90 million ha, 8.18 million tones and 1185 kg h-1, respectively (Anonymous, 2012). Globally, India account for 21.7% and 10.7% of the total acreage and production (USDA, 2010).

In early 1990's S deficiencies in Indian soils were estimated to occur in about 130 districts and recently about 45% districts of our country showed more than 40% Sulphur deficiency (Tandon, 1991). Mustard has highest requirement of Sulphur with optimum level ranging from 20 to 60 kg S/ ha depending on the soil Sulphur status and yield potential (Sarmah & Debnath, 1999). Indian mustard markedly responded to Sulphur fertilization in oilseeds. Sulphur plays a vital role in quality and development of seed. The chemical fertilizers being used for supplementing the major nutrient are generally either deficient or low in sulphur content. The importance of Sulphur fertilization for increasing yield and quality of Indian mustard is being increasingly recognized. However, the information regarding optimum level of Sulphur as well as source of Sulphur and its influences on seed yield and quality of mustard is meager. Probably for these reasons mustard crop needs comparatively higher amount of Sulphur for proper growth and development and higher yields. Sulphur levels significantly influenced the seed and Stover yield of mustard (Sharma et al., 2009).

The selection of improved mustard varieties with better yield potential and wide range of adaptability to soil and environmental conditions is of prime importance in increasing mustard production. Improved varieties, if sufficiently provided with the higher oil content may result in further increase in yield. Different varieties respond differently to nutrients due to their variable physiological behaviour and hence differ in yield and yield components.The present study was planned to estimate the exact application rates of Sulphur and its impact on growth and yield of different mustard cultivars.

MATERIALS AND METHODS

The experiment was carried outat Agronomy instructional farm, Faculty of Agriculture, AKS University,Satna (M.P.) during *rabi* season 2020- 21. The experiment was conducted in randomize complete block design having Factorial concept with three replications. Different rates of Sulphur and varieties will be allocated to the plots as per treatments. Seed rate used as 5 kg/ha on flat beds with 30.0 x 10.0 cm distance. The treatments were S_0- 0 kg/ha, S_1- 50 kg/ha, S_2- 60 kg/ha and S_3- 70 kg/ha, while three mustard varieties were tested are V_1- Varuna, V_2- Shekhar and V_3- Pusa bold. The gross and net plot size was 5.0 m x 3.5 m and 4.0 m x 3.0 m, respectively. Full recommended dose of phosphorus and potassium at the rate of 40 kg P_2O_5/ha and 30 Kg K_2O /ha, respectively and half dose of nitrogen (60 kg N /ha) was uniformly applied to each plot as basal dose before sowing. Remaining half dose of nitrogen (60 kg N /ha) was applied as top dressing in the form of urea in two equal splits at 35 DAS and at 70 DAS of mustard. Nutrient, Sulphur was applied as per treatment.Fertilizers were applied by placement i.e., 5 cm away from seed row and of 5 cm below the seed zone. All the other agronomic practices were applied uniformly to all the treatments.

RESULTS AND DISCUSSION

The result shows that plant height, number of branches per plant, number of siliquae per plant, number of seeds/siliquae, test weight, seed, straw yield and oil content was influenced significantly due to different concentrations of Sulphur and varieties and reported in Table 1.

Statistical analysis of the data revealed that maximum plant height and number of branches per plant (159.04 cm and 22.92, respectively) were recorded in plots treated with the application of Sulphur @ 70 kg/ha while, lowest values were observed in plot that received no Sulphur. However, variety varunagave maximum plant height and number of branches per plant value of 157.06 cm and 21.96, respectively. The significantly higher plant height and branches per plant of mustard was recorded under the application of Sulphur @ 70 kg /ha with mustard variety of

Varuna with the respective values of 162.19 cm and 24.03, respectively.

Statistical analysis of data revealed that effect of Sulphur and variety significantly affected plant height and number of branches per plant were found significant. Such enhancement effect might be also attributed to the favorable influence of these nutrient on metabolism and biological activity and stimulatory effect on photosynthetic pigments and enzymatic activity which in turn increase vegetative growth of plants.

The increase in plant growth in this treatment might be due to genetic character of cultivar with sufficient quantity of nutrient might have improved the soil physical, chemical properties and leading to the adequate uptake of nutrients by the plants which might have promoted the maximum volume of plant while the minimum plant growth was due to non-availability of balanced nutrition. These result to be in agreement with the findings of Rao et al. (2013), Katiyar et al. (2014) and Vishal et al. (2017).

The overall improvement in crop growth under the influence of recommended dose of NPK and Sulphur application could be attributed to better environment for growth and development that might be due to increased availability of nitrogen to the growing plants. Further, addition of phosphatic fertilizers in the soil increases the concentration of readily available $H_2PO_4^-$ ions in the rhizosphere. The increased availability of phosphorus to plant might have enhanced early root growth and cell multiplication leading to more absorption of other nutrients from deeper layers of soil ultimately resulting in increased plant growth in terms of plant height, dry matter production and crop growth rate. Supply of adequate nutrients with Sulphur @ 70 kg/ha results in better utilization of carbohydrates to form protoplasm leading to the production of large cells with thin walls which increased the leaf area. Higher leaf area with adequate nutrition under dryland condition was reported by Jat et al. (2017) in Indian mustard. Further, the differential behaviour among the varieties could be explained by the variation in their genetic makeup and their differential behavior under different climatic conditions.

Statistical analysis of the data revealed that maximum number of siliquae per plant, number of seeds/siliquae, test weight, seed, straw yield and oil content (403.59, 15.87, 4.14 g, 17.16 q/ha, 55.86 q/ha and 38.77%, respectively) were recorded in plots treated with the application of Sulphur @ 70 kg/ha while, lowest values were observed in plot that received no Sulphur. However, variety varuna gave maximum value of above parameters of 388.86, 15.20, 3.82 g, 16.38 q/ha, 55.01 q/ha and 37.76%, respectively.

Similarly, in interaction effect the maximum number of siliquae per plant (425.99), number of seeds/siliquae (17.47), test weight (4.39 g), seed and Straw yield (18.56 and 59.04 q/ha, respectively) as well as oil content (39.80 %) value was recorded from plot receiving Sulphur @ 70 kg/ha with mustard variety varuna, while minimum was recorded from plot receiving 0 kg/ha Sulphur with mustard variety of shekhar.

Application of recommended dose of NPK with Sulphur levels, @ 70 kg/ha helps in enhancing the availability of major nutrients in soils resulting consequent availability to plants by reducing soil pH at micro sites, chelating action of organic acids produced by them and intraphyl mobility in the fungal filaments (Chhonkar, 2002). The increased yield attributes and yield might be due the increased supply of almost all plant essential nutrients by translocation of the photosynthates accumulated under the influence of the nutrients. Further, the translocation and production of photosynthates in the economic sinks, resulted in increased grain, stover and biological yields. Similar finding has also seen reported by Upadhyay et al. (2018), Gautam et al. (2019) and Sonam et al. (2020). Combined nutrient application recorded in enhancing the oil content leading to higher oil yield as a result of enhanced seed yield. Similar findings were reported by Singh et al. (2010).

The improved performance of mustard with higher sulfur rates could be ascribed to sulfur functioning in a favorable nutritional

environment of the rhizosphere as well as plant system. In addition, sulfur also accelerates the differentiation of vegetative tissue to reproductive one stimulating floral primordial development leading to improved yield attributes and higher seed yield. Similar findings were also reported by Rajput et al. (2018) and Shivran et al. (2018). Sulfur application increased metabolic activity and promoted meristematic growth leading to improved growth characters and yield. The results are also substantiated by the findings reported by Singh et al. (2017) and Yadav and Dhanai (2018).

The marked increase in yield attributes under Varuna might be due to its genetic potential when grown under semi-arid conditions and improved growth at successive stages as reflected by higher production of dry matter production at different stages and at harvest. The yield attributes indicating the suitability of variety for growing in a prevailing climatic and soil moisture conditions. Seed yield is the net resultant effect of various agronomic input influencing growth and yield attributing characters during the life cycle of crop. These findings are in agreement with the findings of Yogesh et al. (2017) and Biswas et al. (2019).

Table 1: Responce of Sulphur Levels and Varieties on Growth, Yield and Quality of Mustard

Treatment	Plant height (cm)	Number of branches/ plant	Number of siliquae per plant	Number of seeds/siliquae	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Oil content (%)
	Effect of Sulphur							
S_0	148.13	19.33	326.37	10.93	2.46	12.20	46.66	34.12
S_1	154.63	21.13	369.10	13.82	3.57	15.32	52.79	36.62
S_2	156.76	21.62	385.73	14.87	3.99	16.31	54.71	37.96
S_3	159.04	22.92	403.59	15.87	4.14	17.16	55.86	38.77
S. Em±	0.64	0.59	6.00	0.38	0.17	0.33	0.98	0.55
C.D.	1.89	1.73	17.59	1.12	0.49	0.96	2.87	1.61
	Effect of varieties							
V_1	157.06	21.96	388.86	15.20	3.82	16.38	55.01	37.76
V_2	151.18	20.23	345.65	11.83	3.13	13.46	48.21	35.52
V_3	155.68	21.57	379.08	14.58	3.67	15.91	54.29	37.32
S. Em±	0.74	0.68	6.93	0.44	0.19	0.38	1.13	0.64
C.D.	2.18	2.00	20.31	1.29	0.56	1.11	3.31	1.86
	Interaction effect between Sulphur and varieties							
S_0V_1	150.10	19.93	335.45	11.60	2.68	13.03	47.49	34.17
S_0V_2	156.97	21.67	387.54	15.40	4.04	16.50	55.97	37.89
S_0V_3	159.00	22.20	406.44	16.33	4.18	17.44	57.56	39.16
S_1V_1	162.19	24.03	425.99	17.47	4.39	18.56	59.04	39.80
S_1V_2	146.57	18.93	317.33	9.87	2.33	11.28	45.72	34.06
S_1V_3	150.94	20.33	345.21	11.80	2.81	13.42	47.90	34.51
S_2V_1	153.21	20.67	354.63	12.47	3.61	14.36	49.53	36.33
S_2V_2	154.00	21.00	365.43	13.20	3.76	14.78	49.71	37.20
S_2V_3	147.71	19.13	326.32	11.33	2.36	12.31	46.78	34.14
S_3V_1	155.99	21.40	374.55	14.27	3.87	16.06	54.50	37.44
S_3V_2	158.07	22.00	396.12	15.80	4.18	17.14	57.05	38.40
S_3V_3	160.94	23.73	419.35	16.93	4.28	18.14	58.83	39.30
S. Em±	0.37	0.34	3.46	0.22	0.10	0.19	0.56	0.32
C.D.	0.77	0.71	7.18	0.46	0.20	0.39	1.17	0.66

CONCLUSION

It was concluded from the results that application of Sulphur @ 70 kg/ha with mustard variety varunaimprove the yield and yield components of mustard. It is recommended that Sulphur @ 70 kg/ha with mustard variety varunashould be used to improve the yield and yield components of mustard.

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Conflict of Interest

The author(s) declares no conflict of interest.

Author Contribution

Both authors contributed equally to establishing the topic of the research and design experiment.

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