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Influence of sources and levels of sulphur on productivity, quality and economics of mustard (*Brassica juncea* L.)

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ABSTRACT

A field experiment was carried out during winter season 2020-21 at the Research Farm, A.K.S. University, Satna (M.P.) to study the influence of sources and levels of sulphur on productivity, quality and economics of mustard. The findings concluded that amongst the sulphur levels 45 kg S/ha performed the best giving maximum seed yield of mustard var. Giriraj (15.56 q/ha), seed oil content (41.25%) and economical gain (Rs. 95881/ha) with B:C ratio 3.45. In case of sources of sulphur, gypsum resulted in maximum seed yield (13.66 q/ha), seed oil (39.64 %) and economical gain (Rs. 81105/ha) with 3.01 B:C ratio. Thus 45 kg S/ha applied through gypsum proved the most beneficial of the mustard growers of this region.

Key words: Sources, levels, sulphur, mustard.

INTRODUCTION

Sulphur is now rightly called the fourth major element of the plant next to N, P and K. In mustard crop apart from N, P and K, the need for sulphur is frequently felt and deficiency of this nutrient has deleterious effect on plant productivity. It is a constituent of protein and plays an important role in oil synthesis. Besides, performing many physiological functions like synthesis of cysteine, methionine and chlorophyll in oilseed crops (Rathore *at al*. 2015).

Sulphate-containing fertilizers immediately provides sulphur to plants in the form of sulphate but these S-sources are susceptiable to leaching losses. Ammonium sulphate, ammonium phosphate sulphur (APS) (15% S), single superphosphate (SSP) having 12% S, potassium sulphate (18% S), potassium magnesium sulphate (22% S) and gypsum (19% S) etc. are example of sulphate containing fertilizers. But elemental sulphur containing fertilizers need to convert into sulphate form before the plants can access it. Elemental sulphur sources contain very high concentrations of sulphur (70-100%). They may offer the benefits of continual and slow releases of sulphate during the growth season and the reduce the leaching losses. Similarly, molten sulphur mixed

with sodium/calcium, bentonite etc. results in a product that is safe and easy to apply. Looking to all these facts, the present research work was taken up for the recommendation as the best source and level of sulphur to the mustard growers of this region.

MATERIALS AND METHODS

The field experiment was conducted during winter season of 2020-21 at the Research Farm, A.K.S. University, Satna (M.P.). The soil of the experimental field was silty clay-available-N 205.8 kg/ha, available-P_2O_5 14.5 kg/ha available-K_2O 239.7 kg/ha and available-S 7.88 ppm. The total rainfall received during the cropping season (October to March) was 10.42 mm. The treatments comprised four sulphur levels (0, 15, 30, 45 kg/ha) and three treatments of sources of sulphur (gypsum, iron pyrite and bentonite). Thus the 12 treatment combinations were laid out in the field in a factorial randomized block design keeping three replications. Mustard var. Giriraj was sown @5 kg seed/ha in rows 30 cm apart on 21 October, 2020. An uniform doses of 30 kg N, 30 kg P_2O_5 and 30 kg K_2O/ha was applied through DAP and MOP as basal in all the treatments. The sulphur levels were applied as basal through different sources. The mustard was grown as per recommended package of practices. The crop was harvested on 2nd week of March, 2021. The seed oil was determined by Soxhlet's extraction method.

RESULTS AND DISCUSSION

Yield-attributing characters :- The data in Table 1 reveal that the factors which are directly responsible for ultimate seed production viz. number of siliquae per plant, number of seeds/siliqua, 1000-seed weight and seed weight/plant were augmented almost significantly due to increased supply of sulphur upto 45 kg/ha. The probable reason may be ascribed as a result of greater accumulation of carbohydrate, protein and their translocation to the reproductive organs, which in turn, increased the higher number of siliquae as well as other yield-components. Sulphur is the main constituent of the S-containing amino acids and protein, therefore, the application of sulphur has been found to increase the yield of mustard. The increased response to applied sulphur indicated that the sulphur reserve in the experimental field soil was not enough to fulfill the requirement of high-yielding mustard var. Giriraj. These results are in close agreement with the findings of Patel and Tiwari (2021), Jena *et al*., (2021).

Amongst the S-sources, gypsum performed the best with respect to boost yield-attributes of mustard upto maximum extent this was followed by iron pyrite and then bentonite. The variation in yield-attributes was exactly in accordance with the growth parameters encouraged under the different S-sources. The significant increases in yield-attributes of mustard due to gypsum have also been obtained by several workers (Singh *et al*., 2015, Rathore *et al*., 2015 and Rakesh and Banik, 2016).

Productivity of mustard:-Application of 45 kg S/ha resulted in the significantly higher seed and straw yield of mustard as compared to preceding sulphur levels. The overall seed and straw yield of mustard cv. Giriraj was found higher by 5.31 and 8.63 q/ha, respectively due to S_{45} over S_0. The trend of increases in seed and straw yield obtained due to these treatments was exactly in accordance with the similar increases in the yield-attributes. These results corroborate with those of Jena *et al*. (2021), Dwivedi *et al*. (2021).

The trend of maximum increases in seed and straw yield obtained due to gypsum, followed by iron pyrite and bentonite was exactly in accordance with the similar increases recorded in the yield attributes under these S-sources. These findings agree with those of other workers (Rathore *et al*., 2015; Singh *et al*, 2015; Rakesh and Banik, 2016).

Oil content in seed :-The oil content in seed was found highest (41.28%) under S_{45} as against only 36.54 % from S_0. The variation in seed oil content among the S-levels might be due to variation in the synthesis of fatty acids and their esterification by accelerating biochemical ractions in glyoxalate cycle (Dwivedi and Bapat, 1998). The percentage of oil-content in seed was increased up to maximum (39.64%) under gypsum application, followed by 39.11% by iron pyrite and then 38.67% by bentonite soruces of sulphur. The variation in oil content in seed among these S-sources might be owing to the differences in the synthesis of fatty acids and their esterifiction by accelerating biochemical reactions in glyosalate cycle. These results agree with those of many research workers (Rathore *et al*., 2015; Singh *et al*., 2015 and Rakesh and Banik, 2016).

Net return per hectare:-The highest level of sulphur (S_{45}) brought about the highest net-return (Rs. 95881/ha) with 3.45 B:C ratio. It was higher by Rs. 40928/ha over no

sulphur (control). Amongst the sulphur sources, gypsum gave maximum net return (Rs. 81105/ha), followed by iron pyrite (Rs. 75066/ha) and bentonite (Rs. 70151/ha). Application of gypsum with S_{45} further raised the net income upto Rs. 103333/ha with 3.45 B:C ratio. This was eventual as the higher net return was directly correlated with the higher productivity and its market value.

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Table 1 Yield attributes, yield, seed oil and economics from mustard as influenced by sources and levels of sulphur

Treatments	Siliquae/ plant	Seed/ siliqua	1000-seed weight (g)	Seed yield/ plant (g)	Seed yield (q/ha)	Straw yield (q/ha)	Seed Oil (%)	Net income (Rs./ha)	B:C ratio
S-levels (kg/ha)									
0	275	13.79	**5.91**	12.13	10.25	18.88	36.54	54953	2.61
15	298	15.79	6.12	13.57	12.02	21.68	38.80	68559	2.92
30	307	16.96	6.89	14.28	13.80	24.82	39.94	82370	3.20
45	321	18.15	7.16	15.20	15.56	27.51	41.28	95881	3.45
S.Em ±	**1.73**	**0.04**	**0.02**	**0.02**	**0.026**	**0.07**	**0.14**	-	-
C.D. (P=0.05%)	**4.90**	**0.11**	**0.06**	**0.05**	**0.072**	**0.21**	**0.40**	-	-
S-sources									
Gypsum	317	16.83	7.03	14.71	13.66	25.44	39.64	81105	3.14
Iron pyrite	298	16.10	6.43	13.84	12.96	22.73	39.11	75066	3.00
Bentonite	286	15.59	6.11	12.85	12.10	21.50	38.67	10151	3.01
S.Em ±	**1.50**	**0.03**	**0.02**	**0.02**	**0.022**	**0.06**	**0.12**	-	-
C.D. (P=0.05%)	**4.24**	**0.09**	**0.05**	**0.05**	**0.062**	**0.18**	**0.35**	-	-

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Interaction	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**NS**	**-**	**-**