Original Research Article

EFFECT OF SULPHUR LEVELS ON GROWTH AND YIELD OF INDIAN MUSTARD (*Brassica juncea*(L.*)*

Abstract

A field experiment was laid out in randomized block design (factorial) with three replications at Agriculture Research farm of Sage University, Bhopal (M.P.) during the rabi season 2022. Six treatments comprised of four levels of Sulphuri.e., 15, 30, 45 and 60 kg S/ha and one variety namely Rani to find out appropriate dose of Sulphur and suitable variety for higher production. The experiment was sown on December 8, 2023 in the field, having the soil texture, black soil pH 6.5, O.C 0.32%, EC 0.33ds/m and available N, available P, available K, available S and available Zn were 180.4 kg/ha, 18.4 kg/ha, 290 kg/ha, 7.3 (ppm) and 0.59 (ppm), respectively. Among the various treatments sulphur dose 60 kg S/ha significantly influenced the plant height, number of branches/plants, leaf area index, number of siliqua/plants, length of siliqua, number of seeds/siliqua and dry matter accumulation/plant, which was at par 15, 30, 45 and 60 Kg S/haand significantly superior over rest levels of sulphur whereas, effect of sulphur on Harvest index, 1000 grain weight (g), nitrogen and protein content were found non-significant. Seed yield, Stover yield and sulphur content in seed and stover was significantly increased with increasing dose of sulphur up to 60 Kg/ha superior over control.

Keywords: Mustard, Sulphur, growth and yield.

Introduction:

Indian mustard (*Brassica juncea L.*) is a major winter oilseed crop belongs to the family of Cruciferae. Rapeseed and mustard are important oilseed crops which ranks third in vegetable oils after soybean and palm [1]. Rapeseed-mustard (*Brassica juncea L.*) in world production India ranks third after Canada and China. In India, soybean, groundnut and rapeseed-mustard are the major oilseed crops contributing nearly 88% of the total production. Its seed contains 37- 49% oil [2]. The oil and seeds are used as condiment in the preparation of pickles and for flavoring curies and vegetables. The mustard oil is utilized for human consumption throughout northern India in cooking and frying purposes. It is also used in the preparation of hair oils and medicines. The oil cake is used as cattle feed and manure, which contains about 4.9 percent nitrogen, 2.5 percent phosphorus and 1.5% potash [2]. The oilseed crops especially Brassica species play a vital role in the agriculture economy of India. Among these, *Brassica juncea* is an important rabi crop of eastern India comprising Uttar Pradesh, Bihar, West Bengal and Assam. India occupies the

thirdposition in rapeseed-mustard production in the world after China and Canada. In India, during 2009-10, the rapeseed/ mustard crop had production of 7.8mt from an area of 6.50 million hectares with an average productivity of 1208 kg/ha. However, in Uttar Pradesh it is grown on 6.39 lakh ha area with production of 7.9 lakh metric tonnes. The average productivity of Uttar Pradesh is 1236kgha-1 which is more than the national average productivity (Anonymous, 2013). The continuous mining of nutrients from soils coupled with inadequate and imbalanced fertilizer use has resulted in emergence of multi nutrient deficiencies. Mainly at least six nutrients (N, P, K, S, Zn and B) were observed deficient in Indian soils. Sulphur is involved directly or indirectly in different metabolic pathways of plants and play important role in the metabolic activities. The involvement of sulphur is an important component of several enzymes and metabolic processes in plants [5]. Sulphur is the fourth major plant nutrient after nitrogen, phosphorus and potassium for Indian agriculture. It is essential for synthesis of amino acids, proteins, oils, and a component of vitamin A and activates enzyme system in plant. Three amino acids viz. methionine (21% S), cysteine (26% S) and cystine (27%S) contain S which are the building blocks of proteins about 90% of sulphur is present in these amino acids. Sulphur is also involved in the formation of chlorophyll, glucosides and glycosylates (mustard oils), activation of enzymes and sulfhydryl (SH-) linkages that are the source of pungency in oilseeds. Adequate sulphur is therefore very much crucial for oilseed crops. The importance of sulphur fertilization for increasing yield and quality of Indian mustard is being increasingly recognized.

In view of the contents and facts narrated above the present investigation entitled Effect of Sulphur levels on growth and yield of Indian mustard have been proposed to conduct field trial, at the experimental farm SAGE University, Bhopal during rabi season 2022-2023.

Materials and Methods:

Experimental site

The experimental field was located at School of Agriculture SAGE University, Bhopal, Madhya Pradesh.

Observations recorded

Pre harvest Observation

Plant height (cm)

The height was taken at 30, 45, 60, 90, Days after sowing and at harvest from point of root-shoot interaction to the top of main raceme with scale for five tagged plants and their average was worked out.

Number of primary branches (per plant)

The number of primary branches were counted separately from five selected plants drawn for biomass observation at 30, 45, 60, 90, Days after sowing and at harvest and their average was worked out.

Post -harvest observations

Yield attributing characters

The yield attributes listed below were studied from the sample of already tagged 5 plants, collected at the time of harvest.

Number of siliquae (per plant)

Total number of siliquae were counted on five selected plants and then converted into number of siliquae per plant.

Number of seeds (per siliqua)

Fifty siliquae were drawn randomly from five selected plants and were threshed and cleaned. The number of seeds was counted by numegral seed counter and then the average number of seeds per siliqua was calculated.

1000-seed weight (g)

1000 seed (randomly drawn seed sample out of net plot produce) were counted on numeral seed counter and then weighed by electronic balance to record 1000-seed weight (test weight) in grams.

Seed yield (g) per plant

The five selected plants were threshed, cleaned and seeds were weighed and then converted into seed yield (g per plant).

Final yield

Seed yield (kg ha-1)

The crop harvested from net plot area of 3 m x 2 m (6 m^2) was threshed manually after 2-3 days of sun drying. The seed yield was then converted into kg ha^{-1}.

Moisture studies

Soil profile moisture content (%)

Soil profile moisture content was determined by gravimetrical method. Plot- wise soil samples were drawn at depth intervals of 0 to 15 cm, 15-30 cm, 30-45 cm, 45-60 cm, 60-90 cm soil layers at sowing, before and after each irrigation and at harvest using a screw auger and weighed the samples to obtain fresh weight (W_1). Thereafter, soil samples were oven dried at 90 °C for 48 h to obtain dry weight (W2). Soil moisture content of soil samples was worked out by using the following formula:

$$\textbf{Soil moisture content (\%)} = \frac{W_1 - W_2}{W_1} \times 100$$

Were,

W_1=Fresh Weight of Soil (g)

W_2= Dry weight of Soil (g)

Water use efficiency (kg ha^{-1} mm)

The water use efficiency (kg ha^{-1} mm) for a given treatment was calculated by dividing the seed yield (kg ha^{-1}) with the respective total consumptive water use (mm) for the crop period. The water use efficiency was worked out with the help of the following formula:

$$\text{WUE} = \frac{\text{Seed yield (kg ha}^{-1})}{\text{Consumptive water use (mm)}}$$

Table-1: Growth attributes of mustard as influenced by sulphur levels.

Treatments	Plant Height (cm)	No. of leaves/plant	Dry Matter Accumulation (g/plant)	No of branches/plant
	90 DAS	90 DAS	At harvest	60 DAS
Sulphur levels (kg/ha)				
Control	138.73	33.33	35.15	9.80
100% RDF	139.13	34.13	37.88	10.60
100% S + 100% RDF	149.46	37.66	41.39	12.26
75% S+ 100% RDF	146.66	37.53	41.00	11.80
50% S + 100% RDF	145.00	35.20	40.00	11.33
25% S + 100% RDF	144.40	34.93	39.83	11.20
SEM±	4.51	1.63	0.91	0.41
C.D.(P=0.05)	N/A	N/A	2.63	1.32

*Growth attributes of mustard as influenced by sulphur levels

Results & Discussion-

Growth attributing character: Growth character viz. plant height, leaf area index, branches/plant, dry matter accumulation/plant were significantly influenced by the sulphur levels on growth character at all stages. Growth character increased successively with increasing the sulphur levels up to 60 Kg/ha significantly. Maximum growth contributing character was recorded under 60 Kg S/ha which was at par 30 and 45 Kg S/ha and significantly superior over 15 Kg S/ha and control at all this crop growth stages. Inherent genetic variability in plant was notice among varieties. The growth character (plant height, leaf

Table-2: Yield attributes of mustard as influenced by sulphur levels and varieties.

Treatment	No. of siliquae/ plant	Length of siliqua (cm)	Seeds/ siliqua	Test weight (g)	Seed yield (q/ha)	Stover yield (q/ha)	Harvest index (%)
Sulphur levels (kg/ha)							
Control	76.93	5.00	16.00	3.78	1030	3239	22.06
100% RDF	87.46	5.20	16.06	4.12	1301	3485	22.39
100% S + 100% RDF	98.20	5.80	17.73	4.63	1479	3880	22.46

75% S + 100% RDF	97.90	5.63	16.80	4.57	1452	3848	22.45
50% S + 100% RDF	92.40	5.40	16.73	4.55	1439	3812	22.43
25% S + 100% RDF	89.40	5.23	16.26	4.51	1384	3762	22.40
SEM±	4.23	0.03	0.75	0.28	119	109	0.46
C.D. (P=0.04)	13.51	0.11	N/A	N/A	N/A	348	N/A

*Yield attributes of mustard as influenced by sulphur levels and varieties.

area index, branches/plant, dry matter accumulation/ plant) was significantly increased with the Rani variety.

The increase in plant height might be due to adequate availability of sulphur attributed to better nutritional environment for plant growth at active vegetative stages as a result of enhancement in cell multiplications, cell elongation and cell expression in the plant body which ultimately increased the height of plant. The results of present investigation are also in agreement with the findings of Khanpara*et al.* (1993) and Singh and Saran (1993). Sulphur is directly involved in multiplication, elongation and expansion of cells which ultimately produced the greater number of branches/plant where adequate supply of sulphur was done with higher doses of sulphur in comparisons to sulphur deficient plants. These results were also confirmed with the findings of Sharma *et al.* (1991) and Kumar *et al.* (2000). Dry matter production successively increased till maturity due to favourable effect of sulphur on the growth and development of plants. Increase in number of primary and secondary branches/ plant, plant height and number of leaves/plants is directly responsible for increasing the dry matter accumulation in plants at higher levels of sulphur. Singh and Dhiman (2005) also reported the similar results.

Conclusion: Among the sources of sulphur tested in current experiment, a significantdifference was noticed in growth, yield attributes, yield, content and uptake ofnutrients in mustard. Among the levelsofsulphur, 60 kg S ha^{-1} (T_3) had significantly increased growth, yield attributes, yield, content and uptake of nutrients in mustard and was on par with 45 kg S ha^{-1} (T_4).

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