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Effect of Nitrogen and Sulphur Levels on Quality Parameter of Mustard [*Brassica juncea* (L.)]

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ABSTRACT: A research trial was conducted at Research Farm, Vivekananda Global University, Jaipur during *Rabi* season of 2018-19, to know the effect of nitrogen and sulphur on quality and yield of mustard [*Brassica juncea* (L.)]. The experiment was performed according to randomized block design with three replications. The treatments consisting of 9 treatment combinations *viz.*, 125% RDN + Sulphur 10 kg ha^{-1} (T_1), 125% RDN + Sulphur 20 kg ha^{-1} (T_2), 125% RDN+ Sulphur 30 kg ha^{-1} (T_3), 100% RDN + Sulphur 10 kg ha^{-1} (T_4), 100% RDN+ Sulphur 20 kg ha^{-1} (T_5), 100% RDN + Sulphur 20 kg ha^{-1} (T_5) 100% RDN + Sulphur 30 kg ha^{-1} (T_6), 75% RDN + Sulphur 10 kg ha^{-1} (T_7), 75% RDN + Sulphur 20 kg ha^{-1} (T_8) and 75% RDN + Sulphur 30 kg ha^{-1} (T_9) were applied to the mustard *var.* Laxmi (RH-8812). Results revealed that various nitrogen and sulphur treatments considerably boosted mustard's quality and yield. With the application of 125% of the recommended nitrogen dose plus 30 kg of sulphur per hectare (T3), the maximum nutrient content (N and S) in seed and stover, nutrient uptake (N and S) in seed and stover, protein content (%) in seed, oil content in seed and oil yield of mustard were achieved. As a result, this treatment was advised for achieving best quality with increased yield.

Keywords: Economics, Mustard, Nitrogen, Sulphur, Quality and Yield.

INTRODUCTION

In 'Rape seed and Mustard' group of oil seeds, Indian mustard (*Brassica juncea*) occupies the prime position in India. Mustard is a Rabi season crop that needs relatively cool temperature, a fair supply of soil moisture during its growing season and a dry period during harvest. The mustard seeds contain 40 to 42% oil content and 30 to 45% protein content with a high nutrition value. Additionally, it is utilised in the production of hair oils, medications, soap, and grease by combining it with mineral oils for lubrication. Additionally, the seed is added to vegetables to flavour curries and is used as a condiment in the making of pickles. After the recovery of oil from rape and mustard seed, the residual meal is the rape or mustard cake. The oil cake contains 25-30% crude protein, 5% nitrogen, 1.8-2.0% phosphorus and 1.0-1.2% potassium content. The oil cakes is used as a cattle feed and manure. It is cultivated both under irrigated (79.2%) and rainfed (20.8%) conditions. India is the third largest rapeseed-mustard producer in the world after Canada and China. Mustard accounts for nearly one-third of the oil produced in India, making it the country's key edible oilseed crop. In India, it is grown on 9.12 million tonnes from an area of 6.78 mha with an average productivity of 1345 kg ha^{-1} (Ahmad *et al*., 2005). Rajasthan is largest mustard producing states in the country, have first ranks both in area and production of rapeseed and mustard in the country with an annual production of 2.95 mha with production of 4.22 million tonnes. The average productivity of Rajasthan is 1659 kg ha^{-1} (Anonymous, 2021).

Crop production largely depends on cultivation of high yielding cultivars and requirement based application of nutrients thus for maximizing the yield, it is essential that mustard should not suffer due to inadequate moisture supply and mineral nutrition especially nitrogen. Nitrogen (N) is the most important nutrient, and being a constituent of protoplasm and protein, it is involved in several metabolic processes that strongly influence growth, productivity and quality of crops (Reddy *et al*., 1998). The deficiency of soil sulphur in the agriculture soils has been reported frequently over the past several years (Ahmad *et al*., 2005). One of the six macronutrients necessary for healthy plant development is sulphur (S). Reduced sulphur, which is integrated into the amino acids cysteine and methionine, is crucial for the catalytic centres and disulfide bridges of proteins (Hell *et al*., 1997). Additionally, thiol compounds and the so-called secondary sulphur compounds, which have a

considerable impact on plant defence against stress and pests, are synthesised from sulphur, as are amino acids, protein, and a variety of other cellular components. Although mustard production in Rajasthan is higher than the country as a whole, it still falls short of global productivity. With all of the aforementioned information in mind, the current experiment was carried out to ascertain how nitrogen and sulphur affected the growth, yield, and quality of mustard (*Brassica juncea* (L.)).

MATERIALS AND METHOD

Experimental site: The field test was conducted at Vivekananda Global University's Research Farm in Jaipur during the Rabi season of 2018-19. The study area is situated in Rajasthan's agro-climatic zone III A (Semi-arid Eastern Plain Zone), at latitude 26°81′17″ north and longitude 075°88′99″ east. The climate of the area is categorized as semi-arid and is distinguished by the aridity of the atmosphere, extreme summer and winter temperatures (45.5°C and 4°C, respectively), and an annual rainfall range of 500–700 mm. The soil in the experimental field had a loamy sand texture and reacted somewhat alkalinity.

Experimentation and crop husbandry: - The experiment was laid out in Randomized Block Design with three replications. The treatments consisting of nine treatment combinations *viz.*, 125% RDN + Sulphur 10 kg ha^{-1} (T_1), 125% RDN + Sulphur 20 kg ha^{-1} (T_2), 125% RDN + Sulphur 30 kg ha^{-1} (T_3), 100% RDN + Sulphur 10 kg ha^{-1} (T_4), 100% RDN + Sulphur 20 kg ha^{-1} (T_5), 100% RDN + Sulphur 20 kg ha^{-1} (T_5) 100% RDN + Sulphur 30 kg ha^{-1} (T_6), 75% RDN + Sulphur 10 kg ha^{-1} (T_7), 75% RDN + Sulphur 20 kg ha^{-1} (T_8) and 75% RDN + Sulphur 30 kg ha^{-1} (T_9) were applied to the mustard *var*. Laxmi (RH-8812). Weeding, fertilizer application, and crop protection management were all done according to standard crop production procedures.

Data collection:

Nitrogen: Nitrogen was estimated by digesting the samples with sulphuric acid using hydrogen peroxide to remove black colour. Estimation of nitrogen was done by colorimetric method using Nessler's reagent to develop colour (Snell and Snell 1949). Nitrogen content was calculated and expressed in percentage.

Sulphur: Sulphur was determined by turbidimetric method (Tabatabi and Bremner 1970). Plant samples were digested with tri-acid (HNO_3, $HClO_4$ and HCl) using gelatin barium chloride solution for development of turbidity. The turbidity was measured by colorimeter and S content was expressed in percentage on dry weight basis.

Nutrient uptake

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Per cent nitrogen and sulphur content in seed or straw} \times \text{Seed or straw yield (kg ha}^{-1})}{100}$$

The uptake of nitrogen and sulphur by seed and straw was estimated by using the following formula.

Protein content. Protein content in seed was calculated by multiplying per cent nitrogen in seed with a constant factor 6.25 (A.O.A.C., 1960).

Oil content and oil yield.

$$\text{Oil yield (kg ha}^{-1}) = \frac{\text{Oil content in seed (\%)} \times \text{Seed yield (kg ha}^{-1})}{100}$$

Oil content in mustard seed was determined by Soxhlet apparatus using petroleum ether (60-80°C) as an extractant (A.O.A.C., 1960). Oil yield was worked out on the basis of oil percentage in seed using following formula.

Statistical analysis: In order to determine the trend of the treatments used in accordance with Gomez and Gomez statistical analysis of the experimental data was performed using the suitable method of analysis of variance assuming homogeneity (Gomez and Gomez 1984). The crucial difference (CD) values were generated for comparison between the treatment means wherever the F values were determined to be significant at the 5% level of probability.

RESULTS AND DISCUSSION

Growth: - Data revealed that all nitrogen and sulphur treatment exhibited significant impact on growth attributes of mustard. The application of 125% recommended dose of nitrogen + 30 kg sulphur ha^{-1} (T_3) significantly increased the nutrient content Nitrogen in seed (3.42) and stover (0.594), Sulphur in seed (0.439) and stover (0.312), nutrient uptake Nitrogen in seed (73.49) and stover (26.51), Sulphur in seed (9.45) and stover(14.92), protein content (21.4%) in seed, oil content in seed (39.39) and oil yield (845 kg) of mustard which was closely followed by 125% RDN + Sulphur 10 kg ha^{-1} and 125% RDN + Sulphur 20 kg ha^{-1} and found significantly higher than 100% RDN + Sulphur 10 kg ha^{-1}, 100% RDN + Sulphur 20 kg ha^{-1}, 100% RDN + Sulphur 20 kg ha^{-1}, 100% RDN + Sulphur 30 kg ha^{-1}, 75% RDN + Sulphur 10 kg ha^{-1}, 75% RDN + Sulphur 20 kg ha^{-1} and 75% RDN + Sulphur 30 kg ha^{-1}. With the application of higher levels of nitrogen and sulphur, the tissue differentiations (from the somatic to reproductive), meristematic activity and the development of floral primordial might have been enhanced the growth of mustard. Such a positive effect of nitrogen and sulphur application observed, might be due to this nutrition which 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 photosynthates accumulation in plant and their translocation, which reflect in terms of increased growth of crop. The favorable effect of higher dose of nitrogen and sulphur on sink component could be attributed to better development of the plants in terms of plant height and dry biomass production leading to increased bearing capacity due to optimum quality on account of increased in nitrogen and sulphur dose. Best quality with increasing rate of nitrogen was also reported by Dhruw *et al*. (2017); Keerthi *et al*. (2017); Kumar *et al*. (2018); Mandeewal *et al*. (2020); Rajput *et al.* (2018);

Reddy *et al*. (1998); Sahoo *et al.* (2017); Verma and Dawson (2018).

Yield: Data showed that each nitrogen and sulphur treatment had a considerable impact on the mustard crop's yield properties. The application of 125% recommended dose of nitrogen + 30 kg sulphur ha^{-1} (T_3) significantly increase seed yield (2150 kg ha^{-1}), stover yield (4796 kg ha^{-1}) and biological yield (6945 kg ha^{-1}) of mustard which was closely followed by 125% RDN+ Sulphur 10 kg ha^{-1} and 125% RDN + Sulphur 20 kg ha^{-1} and found significantly higher than 100% RDN + Sulphur 10 kg ha^{-1}, 100% RDN+ Sulphur 20 kg ha^{-1}, 100% RDN + Sulphur 20 kg ha^{-1}, 100% RDN + Sulphur 30 kg ha^{-1}, 75% RDN + Sulphur 10 kg ha^{-1}, 75% RDN + Sulphur 20 kg ha^{-1} and 75% RDN + Sulphur 30 kg ha^{-1}.

Table 1: Effect of nitrogen and sulphur on Quality Parameter of Mustard.

Treatment	Harvest index	Nitrogen content (%)		Sulphur content (%)		Nitrogen uptake (kg ha^{-1})		Sulphur uptake (kg ha^{-1})		Protein content	Oil content (%)	Oil yield (kg ha^{-1})
		In seed	In stover	In seed	In stover	In seed	In stover	In seed	In stover			
T_1	31.16	3.36	0.585	0.433	0.306	70.79	27.16	9.12	14.23	21.0	31.24	658
T_2	31.09	3.40	0.589	0.437	0.309	72.30	27.73	9.30	14.56	21.3	35.52	755
T_3	31.01	3.42	0.594	0.439	0.312	73.49	28.51	9.45	14.92	21.4	39.39	845
T_4	31.46	2.82	0.491	0.365	0.256	49.22	18.64	6.37	9.74	17.6	31.39	549
T_5	31.37	2.85	0.496	0.368	0.259	50.35	19.21	6.51	10.02	17.8	35.84	631
T_6	31.22	2.90	0.501	0.371	0.262	51.29	19.62	6.57	10.24	18.1	39.71	703
T_7	31.63	2.26	0.390	0.297	0.207	30.75	11.47	4.03	6.10	14.1	31.73	432
T_8	31.57	2.30	0.396	0.301	0.209	32.19	12.21	4.20	6.39	14.4	36.31	507
T_9	31.52	2.34	0.397	0.304	0.212	33.69	12.39	4.34	6.56	14.6	39.94	573
SEm±	1.54	0.08	0.013	0.010	0.007	3.14	1.17	0.40	0.54	0.50	0.86	35
CD	NS	0.24	0.039	0.030	0.020	9.42	3.50	1.18	1.62	1.49	2.59	105

Table 2: Effect of nitrogen and sulphur on Yield of Mustard.

Yield (kg ha^{-1})		
Treatment	Stover yield	Biological yield
T_1	4647	6750
T_2	4708	6833
T_3	4796	6945
T_4	3803	5547
T_5	3869	5633
T_6	3917	5690
T_7	2945	4305
T_8	3045	4444
T_9	3111	4544
SEm±	201	225
CD	603	673

CONCLUSIONS

The impact of nitrogen and sulphur application on quality parameter and yield was highly significant in mustard. The present study found consistent evidence that the application of nitrogen and sulphur offers substantial agronomic and economic advantages. Based on the results of one year experimentation it may be concluded that for higher profitability and productivity, the mustard crop should be supplied 125% recommended dose of nitrogen+ 30 kg sulphur ha^{-1} as it provides the maximum values of nutrient content (N and S) in seed and stover, nutrient uptake (N and S) in seed and stover, protein content (%) in seed, oil content in seed and oil yield so 125% recommended dose of nitrogen+ 30 kg sulphur ha^{-1} was found suitable for farmer practices on the basis of Best quality and yield of this treatment.

FUTURE SCOPE

This research will be beneficial for all mustard growing farmers for enhancing quality parameters as well as production of crop. For fulfil the requirement of future generation this research will play a vital role in agriculture field.

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Conflict of Interest. None.

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