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Effect of Nitrogen and Sulphur on Growth and Yield of Mustard Grown on Sandy Loam Soil

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Abstract

A field experiment was conducted at Research farm, Vivekananda Global University, Jaipur during *Rabi* season¸ 2025-26 on sandy loam soil. The experiment comprises eight treatments of nitrogen chemical fertilizers, nitrogen through vermicompost and sulphur (100 % RDN through chemical fertilizers, 100% RDN through Vermicompost, 100% RDN through Vermicompost + 10 kg S ha^{-1}, 100% RDN through Vermicompost + 20 kg S ha^{-1}, 100% RDN through Vermicompost + 30 kg S ha^{-1}, 100% RDN through Vermicompost + 40 kg S ha^{-1}, 100% RDN through Vermicompost + 50 kg S ha^{-1} and 100% RDN through Vermicompost + 60 kg S ha^{-1} was laid out in randomized block design and replicated thrice. The results indicated that among the treatments applied as application of 100% RDN through chemical fertilizers recorded significantly higher growth and yield parameters *viz*., plant height, dry matter accumulation, branches per plant, Siliquae per plant, seed per siliquae, test weight, seed yield (1815 kg ha^{-1}), stalk yield (5845 kg ha^{-1}) of mustard. Which found at par with application of T_8 (100% RDN through Vermicompost + 60 kg S ha^{-1}), T_7 (100% RDN through Vermicompost + 50 kg S ha^{-1}) and T_6 100% RDF through Vermicompost + 40 kg S ha^{-1}). The similar trend was found with application of 100 % RDN through chemical feritilizers in respect to net return (₹ 58183/ha) and B: C ratio (2.80). However, seed yield was significantly and positively correlated with number of siliquae per plant, seeds per siliquae, test weight and availability of N, P and K. The economic optimum combination of vermicompost and sulphur application in mustard as derived from response function was found to be 100% RDN through vermicompost + 40 kg S ha^{-1}. The integration of organic and inorganic nutrient sources significantly improved growth attributes, yield components, and nutrient availability, thereby enhancing overall crop performance. Seed yield showed a strong positive correlation with siliquae per plant, seeds per siliqua, test weight, and soil nutrient status.

Keywords: Sulphur, Nitrogen, Vermicompost, RDF

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Introduction

Indian mustard (*Brassica juncea*) is predominantly cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, and West Bengal which occupied 82.22% area and 85.32% production (Anonymous, 2022), out of which about 46.0% of total production contributed by Rajasthan state alone. Domestic production of edible oils meets only 50% of the total requirements, while rest is imported. Huge gap between the consumption and domestic production of edible oils can be filled up by increasing the area under oilseed crops like rapeseed and mustard, sunflower and soybean or increasing production per unit area. The productivity is quite lower due to sub-optimal application of fertilizers and cultivation on marginal lands under rainfed conditions. Further the quality of mustard oil and its cake is an important aspect affected greatly by mineral nutrition [1]. The combined application of chemical fertilizers and organic manures is essential for improving soil health, as it enhances soil physical properties, microbial activity, and nutrient availability, thereby sustaining crop productivity over time [2-4]. Chemical fertilizers/organic manures alone cannot sustain the desired levels of crop production under continuous farming. Integrated nutrient management is very essential which is not only sustains high crop production over the years [5] but also improves soil health and ensures safer environment . The nutrient supplied to crops through INM not only restoring the soil fertility but also sustain desired level of production over the years [6]. Adoption of integrated plant nutrient supply and management strategies

for enhancing soil quality, input use efficiency and crop productivity is extremely important for food and nutritional security in Indian agriculture.

Materials and Methods

Experimental site

The experiment was conducted at Research farm, Vivekananda Global University, Jaipur during *Rabi* season 2025-26. Geographically, is situated Geographically this place is situated at 750 47' East longitude, 260 51' North latitude and at altitude of 390 m above mean sea level in Jaipur district of Rajasthan. This region falls under Agro-climatic zone IIIa (Semi-arid eastern plain zone) of Rajasthan.

Climate and weather conditions

The climate of this place is semi-arid characterized by aridity of the atmosphere and extremity of temperature both in summer (45.5 ºC) and winter (4ºC). The average rainfall of this region is between 500-700 mm per annum which is mostly received during July to September. The sporadic showers in winters are also common. There was rainfall of 25.60 mm during the crop season 2025-26, respectively during the crop period.

Economics

The economics of treatments is the prime consideration before making any recommendation to the farmers for its adoption. Hence, to evaluate the effectiveness and profitability of the treatments, comprehensive economics in terms of net returns (₹ ha^{-1}) and B:C ratio was calculated so that the most effective and remunerative treatment could be recommended. The details of calculation with prevailing market rates of the inputs and produce are given in appendices at the end.

$$\text{Net returns} = \text{Gross returns} - \text{Total cost of cultivation}$$

$$\text{B: C ratio} = \frac{\text{Gross returns (₹ ha}^{-1}\text{)}}{\text{Cost of cultivation (₹ ha}^{-1}\text{)}}$$

Statistical analysis

In order to test the significance of variation in experimental data obtained for various treatment effects, the data were statistically analyzed as described by Fisher (1950) [7]. The critical differences were calculated to assess the significance of treatment mean wherever the F' test was found significant at 5 per cent level of probability. To elucidate the nature and magnitude of treatment effects, summary tables along with SEm$\pm$ and CD (P=0.05) were prepared and are given in the text of the chapter. Experimental results and their analyses of variance are given in Appendices at the end.

The following formula were used for standard error, critical difference and coefficient of variance estimations-

$$SEm\pm = \sqrt{EMS/r}$$

$$C.D. = SEm\pm \times \sqrt{2} \times t\%$$

$$C.V.\ (\%) = \frac{\sqrt{EMS}}{\text{Grand mean}} \times 100$$

Where, r = Number of replications, t = Number of treatments, D.F. = Degree of freedom, SEm± = Standard error of mean, EMS = Error mean squares, C.D. = Critical difference, C.V. = Coefficient of variance

Results and Discussion

Effect of nitrogen and sulphur on growth parameters

Growth parameters *viz*., Plant height, dry matter as well as branches per plant are important growth parameters contributing to seed yield of any crop. Plant height, dry matter and number of leaves as well as branches per plant represents index of growth and development indicating the infrastructure build-up of plants. It is evident from the data that plant height, dry matter and number of leaves as well as branches per plant increased successively under higher

rate of Sulphur treatments. Among different level of vermicompost and sulphur, T_8 (100% RDN through Vermicompost + 60 kg S ha^{-1}) produced significantly higher plant height (108.62 and 139.26 cm), dry matter (8.62 and 12.62 g $plant^{-1}$) as well as branches per plant (9.15) than others combinations of vermicompost and sulphur. This treatment was found similar to application of T_7 (100% RDN through Vermicompost + 50 kg S ha^{-1}) and T_6 100% RDN through Vermicompost + 40 kg S ha^{-1}) The rate of Sulphur increase in plant height was more at 60 kg S ha^{-1} due to better nutritional environment for plant growth at active vegetative stages as a result of improvement in root growth, cell multiplication, elongation and cell expression in the plant body which ultimately increased the plant height. Increase in growth parameters could be ascribed to the overall improvement in plant growth, vigour and production of sufficient photosynthates through increased leaf area index and chlorophyll content of leaves with S fertilization. It may be attributed to Sulphur's essential role for plant growth through its effect on biochemical functioning related to enzyme activation. The better nutritional environment in plants under application of 60 kg S ha^{-1} with vermicompost seems to have enhanced metabolic activities in plants resulting in higher meristematic activities leading towards increased division, enlargement and elongation of cells which might have helped in attaining higher plant height under its influence. Likewise, these improvement at cellular level might have enhanced root length and branches formation and later on their growth, consequently leads to attainment of higher leaf number by the crop. Higher Sulphur dose was responsible for increased number of leaves and branches causing higher photosynthesis and assimilates metabolic activities which were responsible for overall improvement in vigour and many growth characters of mustard. Rao *et al*., (2013) [8] also reported an increase in growth of mustard due to S application. The increase in growth attributes with the application of vermicompost might be due to improved photosynthetically active leaf area for longer period during vegetative and reproductive phases, led to more absorption and utilization of radiant energy which ultimately resulted in higher dry matter accumulation and significant increase in plant growth. Thus, the higher values of growth parameters under vermicompost might be due to more availability of plant nutrient and growth promoting hormones (*viz*., Auxins, Cytokinins, and Gibberellins) which ultimately resulted in the higher values of the growth parameters. Growth characters like plant height, number of leaves per plant, number of branches per plant are very important parameters, which directly influence the seed yield.

Table 1 Effect of nitrogen and sulphur on growth parameters of mustard

Treatments	Plant height of Mustard		Plant dry matter		No. of branches per plant	No. of siliqua per plant
	At 60 DAS	At harvest	At 60 DAS	At harvest		
T_1 100 % RDN through chemical fertilizers	111.35	142.68	9.07	13.43	9.46	220.93
T_2 100% RDN through Vermicompost	90.32	116.40	5.70	9.37	5.73	172.00
T_3 100% RDN through Vermicompost + 10 kg S ha^{-1}	94.35	124.95	7.26	11.26	6.08	180.83
T_4 100% RDN through Vermicompost + 20 kg S ha^{-1}	98.53	129.80	7.70	11.70	6.50	185.67
T_5 100% RDN through Vermicompost + 30 kg S ha^{-1}	102.44	133.75	8.03	12.00	7.04	190.40
T_6 100% RDN through Vermicompost + 40 kg S ha^{-1}	106.36	136.87	8.41	12.41	7.92	206.56
T_7 100% RDN through Vermicompost + 50 kg S ha^{-1}	106.60	138.69	8.48	12.48	8.45	210.15
T_8 100% RDN through Vermicompost + 60 kg S ha^{-1}	108.62	139.26	8.62	12.62	9.15	215.20
SEm±	2.61	2.64	0.34	0.47	0.53	6.81
C.D (P=0.05)	7.93	8.00	1.03	1.43	1.62	20.65

Effect of nitrogen and sulphur on yield attributes and yield

It is evident from the data that number of siliquae per plant, number of seeds per siliqua, test weight, Seed and Stalk yield per hectare increased successively under different treatments. Among different treatments T_8 (100% RDN through Vermicompost + 60 kg S ha^{-1} produced significantly maximum number of siliquae per plant, number of seeds per siliqua, test weight, Seed and Stalk yield per hectare (215.20, 11.48, 4.48 g, 1730 kg ha^{-1} and 5425 kg ha^{-1}) in comparison to other treatments. But above treatment was statistically similar to application of treatment T_7 (100% RDN through

Vermicompost + 50 kg S ha^{-1}) and T_6 100% RDN through Vermicompost + 40 kg S ha^{-1}). Higher Sulphur dose with vermicompost was responsible for increased leaf area and chlorophyll content of leaves causing higher photosynthesis and assimilation, metabolic activities which were responsible for overall improvement in vigour and yield attributes and finally seed yield of mustard. The increase in seed yield might be attributed to number of siliquae per plant and test weight of seeds. The plant supplied with Sulphur are expected to have efficient photosynthetic mechanism and better equipped for efficient translocation site consequently resulting into improved seed yield. Sah *et al.* (2013) [9] reported that significant improvement in the number of siliquae per plant, test weight, seed yield and stover yield was recorded with sulfur fertilization as compared to control. Application of 60 kg S ha^{-1} increased all these parameters significantly over others. Beneficial effect of application of Sulphur on yield attributes might be due to better availability of N, P, K and S and their translocation which is reflected in terms of increased yield attributes of the crop. The improvement in the yield attributes might be due to the fact that mustard is a short duration crop and being indeterminate in nature and the favourable effect of Sulphur in improving nutritional environment extended over a time period. Increase in these parameters might be also ascribed to overall improvement in plant growth and vigour and production of sufficient photosynthates through increased leaf area index and chlorophyll content of leaves with Sulphur fertilization that favoured both the seed formation and seed development which resulted into increase in test weight of mustard seed.

The increase in the yield attributes with the application of vermicompost ascribed to improved physical, chemical and biological properties of soil, direct addition of plant nutrients (macro and micro) and growth regulators and also due to increased microbial population of soil, which accelerated the process of humification, removal of obnoxious smell and detoxification of soil pollutants [10]. The application of vermicompost to the mustard increased availability of major nutrients to plant due to 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 attributes and finally increased crop growth rate. The increased yield attributes and yield might be due the increased supply of the major nutrients (NPK) by translocation of the photosynthates accumulated under the influence of the sources of inorganic nutrients. Further, the translocation and accumulation of photosynthates in the economic sinks resulted in increased seed, straw and biological yields. Similar report has been recorded by Singh *et al*. (2018) [11], Kumar and Sood (2020) [12].

Table 2 Effect of nitrogen and sulphur on yield attributes and yield of mustard

Treatments	No. of seeds per siliqua	Test weight	Seed Yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Harvest Index
T_1 100 % RDN through chemical fertilizers	11.81	4.52	1815	5845	23.92
T_2 100% RDN through Vermicompost	10.36	3.80	1194	4042	22.85
T_3 100% RDN through Vermicompost + 10 kg S ha^{-1}	10.43	4.00	1361	4626	22.68
T_4 100% RDN through Vermicompost + 20 kg S ha^{-1}	10.55	4.10	1456	4794	23.34
T_5 100% RDN through Vermicompost + 30 kg S ha^{-1}	10.90	4.25	1564	4963	24.04
T_6 100% RDN through Vermicompost + 40 kg S ha^{-1}	11.19	4.30	1659	5240	24.08
T_7 100% RDN through Vermicompost + 50 kg S ha^{-1}	11.28	4.34	1696	5344	24.10
T_8 100% RDN through Vermicompost + 60 kg S ha^{-1}	11.48	4.48	1730	5425	24.18
SEm±	0.56	0.13	90	226	1.63
C.D (P=0.05)	NS	0.40	274	686	NS

Conclusion

The application of 100% RDN through chemical fertilizers produced the highest growth, yield, and economic returns in mustard. However, vermicompost combined with sulphur (especially 40–60 kg S ha^{-1}) performed at par with chemical fertilizers. Integration of vermicompost and sulphur significantly improved growth attributes, yield components, and nutrient availability. Seed yield showed strong positive association with siliquae per plant, seeds per siliqua, test weight, and soil NPK status. The economically optimum treatment was 100% RDN through vermicompost + 40 kg S ha^{-1} for sustainable productivity and profitability.

References

[1] Satyajeet, M., Nagora, M., Jat, M. K., Kumar, J., Nibhoria, A., Kamboj, N. K. and Kumari, K. (2026). Response of rainfed Indian mustard to varying fertilizer levels under different land configurations. Journal of Environmental Biology, 47, 161–168.

[2] Meena, B. L., Meena, R. S., Lal, R., Yadav, G. S. and Mitran, T. (2022). Integrated nutrient management improves soil health and crop productivity: A review. Journal of Cleaner Production, 336, 130391.

[3] Kumar, S., Singh, R., Sharma, P. and Yadav, S. (2023). Long-term effects of integrated nutrient management on soil properties and crop productivity in cereal-based systems. Agriculture, Ecosystems & Environment, 347, 108365.

[4] Singh, V., Jat, M. L., Rai, P. K. and Kumar, A. (2024). Integrated use of organic and inorganic fertilizers for enhancing soil fertility and sustainability in cropping systems. Soil Use and Management, 40(2), 345–358.

[5] Verma, G., Mathur, A.K., Bhandari, S.C. and Kanthaliya, P.C., (2010). Long term effect of integrated nutrient management on properties of a typic Haplustept under maize- wheat cropping system. Journal of the Indian Society of Soil Science. 58(3): 299-302.

[6] Pal, R.L. and Pathak, J., (2016). Effect of integrated nutrient management on yield and economics of mustard. International Journal of Science and Nature, 2: 255-261.

[7] Fisher, R.A. 1950. Statistical Methods for Research Workers. Oliver and Boyd, Edinburg, London, pp. 57-63.

[8] Rao, K.T., Rao, A.U. and Sekhar, D. (2013) Effect of sources and levels of Sulphur on groundnut. Journal of Academia and Industrial Research. 2(5): 268-270.

[9] Sah, D., Sewak, R., Singh, A.K., Swami S. (2013) Growth, yield and profitability of Indian mustard (Brassica juncea (L.) Czern & Coss) with different weed control measures and Sulphur levels. Agricultural Science Digest. 1 :15-20.

[10] Singh, L., Sharma, R. and Singh, N. (2021) Effect of Foliar Application of Sulphur and Integrated Nutrient Management on Yield, Quality and Economics of Bed Transplanted Canola (Brassica napus L.). Indian Journal of Agricultural Research, 55(2):192-196

[11] Singh, H., Singh, R. P., Meena, B. P., Lal, B., Dotaniya, M. L., Shirale, A. O. and Kumar, K. (2018) Effect of integrated nutrient management (INM) modules on late sown Indian mustard [B. juncea (L.) Cernj. & Cosson] and soil properties. Journal of Cereals and Oilseeds, 9(4): 37-44.

[12] Kumar, V. and Sood, M. (2020). The performances of (Linum usitatissimum) on different organic manures and fertilizers under peach based horti medicinal system of agroforestry. International Journal of Chemical Studies. 8(5): 572-576.

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