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Response of Phosphorus and Sulphur levels on Growth Yield Attributes and Yield of Indian Mustard (*Brassica juncea* L.)

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ABSTRACT: A field experiment was conducted during the *Rabi* season of session 2023-24 at the Agricultural Research Farm, School of Agricultural Sciences and Technology, RIMT University, Mandi Gobindgarh, Punjab to study the "Response of phosphorus and sulphur levels on growth yield attributes and yield of Indian mustard (*Brassica juncea* L.)". The experiment was laid out in Factorial Randomized Block Design and replicated thrice. The experiment comprised of twelve treatment combinations with three levels of phosphorus and four levels of sulphur. The results revealed that the application of 40 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1} treatment had produced significantly higher growth parameter *viz.*, plant population (22.70 plants m^{-2}), plant height (204.27 cm), number of branches plant^{-1} (19.47), yield attributes and yield *viz.*, number of siliquae plant^{-1} (151.20), number of seed silique^{-1}(15.13), test weight (4.87g), grain yield (22.37q ha^{-1}), biological yield (83.23q ha^{-1}) and harvest index (27.47%). It may be concluded that the treatment T_{12}: 40 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1} enhanced the growth parameter, yield attributes and yield.

Keywords: Indian mustard, phosphorus, sulphur, growth parameters, yield attributes and yield.

INTRODUCTION

Indian mustard (*Brassica Juncea* L.) is *Rabi* season oilseed crop of north India, is second most important edible oilseed crop after groundnut which accounts nearly 30 per cent of total oilseed production of India. The Indian mustard is commonly known as brown mustard, leaf mustard, Chinese mustard. The genus Brassica belongs to *Cruciferae* or *Brassicaceae* family (Anita *et al*., 2023). Indian mustard or brown mustard is natural amphidiploids having chromosome no. (2n=36). It is self-pollinated but certain amount (2-15%) pollination occurs due to insects and other factors (Gupta *et al*., 2023). At global scale the area and production of rapeseed-mustard is 35.95 million hectares and 71.49 million tonnes during 2019-20, respectively (ICAR-DRMR, 2021). While in India, oilseed crops are grown an area of 30.24 million hectares with production of 41.36 million tonnes and productivity of 1368 kg ha^{-1} (Anonymous, 2022-23). In India mustard is predominantly cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh and Gujarat. Rajasthan ranks first in area and production of rapeseed and mustard with 2.50 million ha area and 3.71 million tonnes production (Anonymous, 2017). Rapeseed and mustard are one of the most important edible oils of northern and eastern parts of Indian (Verma *et al.,* 2011). Oilseed crops have been the backbone of agricultural economy of India from time immemorial. In India Brassica species are mostly grown in North India Region consisting of Rajasthan, Uttar Pradesh, Parts of Madhya Pradesh, Gujarat, Punjab, Haryana and parts of Himachal Pradesh are adopted to varies agro-climatic condition. In Punjab, rapeseed and mustard were grown on 43.9 thousand hectares with a production of 6.3 thousand tonnes during 2021-22 in the state. The average yield was 15.79 qha^{-1} (6.39 quintals per acre) (Anonymous, 2023-24).

The role of phosphorus is critical in plant metabolism which plays an important role in energy transfer, respiration and photosynthesis. It is a key structural component of nucleic acids, co-enzymes, phosphoproteins and phospholipids thatproperly balanced supply of phosphorous and application of plant growth regulators (PGRs) is one among the foremost important factors to extend higher yield and oil content in oilseed crops. PGRs play a crucial role in mitigating stress, increasing flower set, yield, and physiological efficiency of the crop.It participates in metabolic activities as a constituent of nucleoprotein and nucleotides and also plays a key role in the formation of energy rich bond like adenosine diphosphate (ADP) and adenosine triphosphate (ATP). Favourable response of mustard to applied P_2O_5 was reported by Gangwal *et al.* (2011); Solanki *et al.* (2016). In areas where mustard is traditionally grown without P_2O_5, poor growth and low yields are common features. Further, it improves seed size, stimulates proper seed filling and increases oil content. The function of phosphorus is fundamental to many of the chemical transformation that take place in plant. Organic phosphorus compounds are involved in energy transfer reaction and respiration. Phosphorus is a consistent of nucleic acid and nucleoproteins and, therefore intimately involve in the transformation of hereditary characteristics.

Sulphur plays a multiple role for better productivity as well as quality of oilseeds (Biswas *et al.,* 1995). In oilseed, sulphur plays a vital role in quality, production and plays an important role in protein synthesis of essential amino acids like cysteine and methionine. However, the information regarding optimum dose of sulphur and its influence on mustard is necessary to augment the productivity and quality of Indian mustard. Sulphur is an important nutrient required by mustard plants for completing its various biological processes such as synthesis of amino acids, proteins, oils, activation of enzyme system. It plays a significant role to increase crop yields, quality, productivity, disease resistance and protection from insects and animals and is often utilized as a soil amendment. Sulphur is a component of essential amino acids like cystine, methionine, sulpholipids and several coenzymes such as biotin, thioredoxin, lipoic acid, thiamine pyrophosphate and coenzyme A (Chandel *et al*., 2003). So keeping these facts in view, the present study entitled "Response of phosphorus and sulphur levels on growth yield attributes and yield of Indian mustard (*Brassica juncea* L.)" was conducted.

MATERIALS AND METHODS

The experiment was conducted at the Agriculture Research Farm, School of Agricultural Sciences and Technology, RIMT University, Mandi Gobindgarh, Punjab during *rabi* 2023-24. Geographically, the experimental site (Mandi Gobindgarh) is situated in Punjab at 30.6642°N latitude and 76.2914°E longitude at an altitude of 268 meters above mean sea level. The climate of the location is denominated as sub-tropical to semi-arid. The maximum temperature mostly overcome 40°C during summer and the minimum temperature falls below 6^0C. The total rainfall during the crop season was 106.3 mm. The soil of the field was low in organic carbon (0.38 %) and available nitrogen (143.6 kg N ha^{-1}). However, medium in soil available phosphorus (17.3 P_2O_5 ha^{-1}) and high in soil available potassium (168 kg K_2O ha^{-1}). The soil pH and electrical conductivity were within the normal range.

The experiment was laid out in factorial randomized block design with twelve treatment and three replications. The treatments comprised ofT_1 20 kg P_2O_5 ha^{-1} + 0 kg S ha^{-1}, T_2 20 kg P_2O_5 ha^{-1} + 20 kg S ha^{-1}, T_3 20 kg P_2O_5 ha^{-1} + 30 kg S ha^{-1}, T_4 20 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1}, $T_5$30 kg P_2O_5 ha^{-1} + 0 kg S ha^{-1}, T_6 30 kg P_2O_5 ha^{-1} + 20 kg S ha^{-1}, T_7 30 kg P_2O_5 ha^{-1} + 30 kg S ha^{-1}, T_8 30 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1}, T_9 40 kg P_2O_5 ha^{-1} + 0 kg S ha^{-1}, T_{10} 40 kg P_2O_5 ha^{-1} + 20 kg S ha^{-1}, T_{11} 40 kg P_2O_5 ha^{-1} + 30 kg S ha^{-1} and T_{12} 40 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1}. The gross plot size was 4.5x5 m^2, and the net plot size was 3.6 × 4 m^2. Observations during the research period were recorded on growth parameter, *viz.*, plant height, number of branches plant^{-1}, plant population and number of leaves plant^{-1}. Yield attributes and yield, *viz.*, number of siliquae plant^{-1}, number of seed siliqua^{-1}, test weight, grain yield, biological yield and harvest index was recorded.

RESULTS AND DISCUSSION

A. Growth Parameter

The application of 40 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1}were reported significantly higher in plant population (plants m^{-2}) at harvest, plant height (cm) at harvest and number of branches plant^{-1} at harvest than all the other treatments. The minimum growth parameter were found in the treatment combination with 20 kg P_2O_5 ha^{-1} + 0 kg S ha^{-1} than all the other treatments (Table 1). Application of phosphorus increase in plant population and necessary plant growth substance. Similar result was also given by Sandhu *et al.* (2015); Satyajeet and Nanwal (2007). A plant's ability to grow taller could be attributed to the important function that phosphorus plays in processes like photosynthesis, cell elongation, shoot development, sugar and starch transformation, and nutrient transfer throughout the plant. Comparable outcomes were documented by Gurjar *et al.* (2017). The influence of growing plants' metabolism on the application of sulphur may be the cause of the mustard plant's increases in height. It has to do with cell division; strong root development and the production of chlorophyll lead to increased photosynthesis, which may have caused a rise in plant height. Similar results were reported by Kumar *et al.* (2001); Negi *et al.* (2017). The different phosphorus and sulphur levels brought about significant changes in the number of branches plant^{-1} and also significantly influenced by the incensement of phosphorus and sulphur levels. Similar result was also given by Sahoo *et al*. (2017).

B. Yield and Yield Attributes

The significantly higher number of silique plant^{-1}, number of seeds siliqua^{-1}, test weight of seeds (g), grain yield (q ha^{-1}), biological yield (q ha^{-1}), harvest index (%) were recorded in the treatment and T_{12} : 40 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1} than all the other treatments. And the significantly lower yield attributes and yield was found in treatment T_1 : 20 kg P_2O_5 ha^{-1} + 0 kg S ha^{-1} than all the other treatment (Table 2). The application of fertilizer would have helped to increase the crop's availability of phosphorus and sulphur because the soil was deficient in these nutrients (Vijayeswarudu and Singh 2021). Sulphur increased the supply of photosynthates to flowering initiation which might have increased the number of seeds siliqua^{-1}. These results obtained are in close conformity with the finding of Kumar and Yadav (2007). The better development of test weight with phosphorus fertilizers might be due to its key role in root development, energy translocation and metabolic processes of plant through which increased translocation of photosynthesis towards sink development might have occurred. These results are in close conformity with the finding of; Khatkar *et al*. (2009). The maximum biological yield was also obtained at higher application phosphorus and sulphur over the higher application phosphorus and sulphur. Similar findings were reported by Nath *et al.* (2018), who observed expanding seed size on application of increasing quantities of phosphorus. This might be due to increased dry matter with higher levels of phosphorus which resulted increased supply of phosphorus to plant for proper growth and metabolic process as well as its resultant positive effect on yield attributes led to enhanced seed yield. The findings corroborate the results of Khatkar *et al.* (2009); Gangwal *et al.* (2011).

Table 1: Effect of phosphorus and sulphur on plant population at harvest, plant height at harvest and number of branch at harvest.

Treatments	Plant population at harvest (plants m^{-2})	Plant height at harvest (cm)	Number of branches plant^{-1}
T_1 :20 kg P_2O_5 ha^{-1} + 0 kg S ha^{-1}	18.70	188.67	13.83
T_2 :20 kg P_2O_5 ha^{-1} + 20 kg S ha^{-1}	20.53	193.50	14.73
T_3 :20 kg P_2O_5 ha^{-1} + 30 kg S ha^{-1}	20.46	195.60	15.33
T_4 :20 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1}	21.70	196.50	16.73
T_5 :30 kg P_2O_5 ha^{-1} + 0 kg S ha^{-1}	19.20	190.03	14.40
T_6 :30 kg P_2O_5 ha^{-1} + 20 kg S ha^{-1}	21.73	195.60	15.30
T_7 :30 kg P_2O_5 ha^{-1} + 30 kg S ha^{-1}	21.60	196.67	16.93
T_8 :30 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1}	22.67	199.70	18.13
T_9 :40 kg P_2O_5 ha^{-1} + 0 kg S ha^{-1}	20.73	194.60	14.90
T_{10} :40 kg P_2O_5 ha^{-1} + 20 kg S ha^{-1}	21.63	196.57	16.13
T_{11} :40 kg P_2O_5 ha^{-1} + 30 kg S ha^{-1}	22.40	199.53	18.07
T_{12} :40 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1}	22.70	204.27	19.47
C.D.(p=0.05)	0.46	1.52	0.43
SEm ±	0.16	0.51	0.14
C.V.	6.17	5.21	9.57

Table 2: Effect of phosphorus and sulphur on number of silique plant^{-1}, number of seeds siliqua^{-1}, test weight of seed, grain yield, biological yield, harvest index.

Treatments	Number of silique plant^{-1}	Number of seed silique^{-1}	Test weight of seed (g)	Grain yield (qha^{-1})	Biological yield (qha^{-1})	Harvest index (%)
T_1 :20 Kg P_2O_5 ha^{-1} + 0 Kg S ha^{-1}	125.60	13.37	3.70	18.63	70.20	22.30
T_2 :20 Kg P_2O_5 ha^{-1} + 20 Kg S ha^{-1}	132.20	13.77	4.10	20.40	73.40	24.43
T_3 :20 Kg P_2O_5 ha^{-1} + 30 Kg S ha^{-1}	133.47	13.93	4.20	20.72	76.40	25.50
T_4 :20 Kg P_2O_5 ha^{-1} + 40 Kg S ha^{-1}	140.40	14.47	4.20	21.03	78.70	26.50
T_5 :30 Kg P_2O_5 ha^{-1} + 0 Kg S ha^{-1}	125.60	13.70	3.93	19.10	72.10	23.60
T_6 :30 Kg P_2O_5 ha^{-1} + 20 Kg S ha^{-1}	135.53	13.87	4.20	20.67	77.23	25.30
T_7 :30 Kg P_2O_5 ha^{-1} + 30 Kg S ha^{-1}	143.00	13.67	4.23	20.93	78.57	26.47
T_8 :30 Kg P_2O_5 ha^{-1} + 40 Kg S ha^{-1}	149.20	14.83	4.20	22.20	81.73	26.70
T_9 :40 Kg P_2O_5 ha^{-1} + 0 Kg S ha^{-1}	133.47	13.77	3.93	20.40	74.90	24.43
T_{10} :40 Kg P_2O_5 ha^{-1} + 20 Kg S ha^{-1}	144.13	14.50	4.20	21.03	79.20	26.47
T_{11} :40 Kg P_2O_5 ha^{-1} + 30 Kg S ha^{-1}	150.20	14.93	4.57	22.27	82.13	26.67
T_{12} :40 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1}	151.20	15.13	4.87	22.37	83.23	27.47
C.D.(p=0.05)	3.23	0.34	0.22	0.48	0.65	0.39
SEm ±	1.10	0.12	0.08	0.16	0.22	0.13
C.V.	6.03	5.22	5.27	5.05	7.03	7.02

CONCLUSIONS

In conclusion, the result revealed that the treatment T_{12} 40 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1} enhanced the growth parameter *viz.*, plant population, plant height, number of branches plant^{-1} and yield attributes *viz.*, number of silique plant^{-1}, number of seeds silique^{-1}, test weight, grain yield, biological yield. And also performed economically better as compared to other treatments.

FUTURE SCOPE

Indian mustard should explore the long-term effects of phosphorus and sulphur applications, including multi-season trials to assess their impact on soil health and crop productivity, while also investigating nutrient interactions with elements like nitrogen and potassium. Expanding studies to different agro-climatic zones and mustard varieties, along with assessing soil microbial activity, would provide comprehensive insights. Incorporating economic analyses and advanced technologies like remote sensing could enhance decision-making and data accuracy. Addressing soil, fertility, and weather variability, and expanding experiments to larger fields, could offer practical applications, while findings could support breeding programs for more nutrient-efficient mustard varieties.

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Conflict of Interest. None.

REFERENCES

Anita, Gupta, D., Punia, S. S., Gothwal, D. K., Ram, M., Mittal, G. K. and Kumar, A. (2023). Evaluation of heat tolerance genotypes in Indian mustard [*Brassica juncea* (L.) Czern & Coss] based on heat susceptibility index. *Biological Forum– An International Journal, 15*(11), 230-236.

Anonymous (2017). Agriculture statistics at a glance Directorate of Economics & Statistics, DAC & FW.

Anonymous (2022-23). Ministry of Agriculture & Farmers Welfare, Govt of India, GOI.

Anonymous (2023-24). Package and practices for crops of Punjab – *Rabi* 2023-24, PAU, Ludhiana 45-62p.

Biswas, D. R., Ali, S. A. and Khera, M. S. (1995). Response of Gobhisarson (*Brassica napus* L.) to nitrogen and sulphur. *Journal of the Indian Society of Soil Science, 43*, 220-223.

Chandel, R. S., Sudhakar, P. C. and Singh, K. (2003). Response of sulphur nutrition in mustard. *Agricultural Research Commercial Centre in India, 24*(3), 175-82.

Gangwal, T. V., Patel, M. V. and Jadav, N. J. (2011). Effect of phosphorus, sulphur and phosphate solubilising bacteria on yield, nutrient uptake and soil fertility after harvest of mustard. *Indian Journal of Fertilizers, 7*, 32-40.

Gurjar, R., Chimote, A. and Raut, G. L. V. (2017). Impact of irrigation and nutrient management on growth and yield of flaxseed (*Linum usitatissimum* L.). *Trends in Bioscience, 10*(27), 89-96.

Gupta, K., Jangde, S., Priya, T., Pooja and Yashu, B. R. (2023). Influence of salicylic acid and thiourea on morphological and physiological parameters of mustard [*Brassica juncea* (L.) Czern & Coss] genotypes under high temperature stress. *Biological Forum– An International Journal*, *15*(12), 506-512.

ICAR-Directorate of Rapeseed-Mustard Research (2021). (Indian Council of Agricultural Research) Sewar, Bharatpur 321303 (Rajasthan), India.

Khatkar, Yogesh, D. J., Kishanrao, K., Dixit, P. M. and Khatkar, R. (2009). Effect of nitrogen, phosphorus and sulphur fertilization on growth and yield of mustard (*Brassica Juncea* cos.). *International Journal of Agricultural Sciences, 52*, 396-398.

Kumar, A. B., Singh, Y., Yadav, T. and Dhanker, O. P. (2001). Performance of four-rowed Indian mustard (*Brassica Juncea*) mutant under different levels of nitrogen and phosphorus. *Indian Journal of Agricultural Sciences, 71*(9), 375-377.

Kumar, H. and Yadav, D. S. (2007). Effect of phosphorus and sulphur levels on growth, yield and quality of Indian mustard (*Brassica Juncea*) cultivars. *Indian Journal of Agronomy, 52*(2), 154-157.

Nath, S., Patel, B. T., Meena, O. and Jat, G. P. (2018). Effect of phosphorus and sulphur on yield attributes, yield and economics of mustard (*Brassica Juncea* L.) Czern and Coss] in loamy sand. *Journal of Pharmacognosy Phytochemistry, 7*(5), 498-500.

Negi, A., Pareek, N., Raverkar, K. P. and Chandra, R. (2017). Effect of two sulphur sources on growth, yield and nutrient use efficiency of *Brassica*. *International Journal of Environmental Science and Technology, 6*(12), 236-247.

Sahoo, G. C., Biswas, P. K. and Santra, G. K. (2017). Effect of different sources of sulphur on growth, productivity and oil content of *Brassica campestris* var. toria. *International Journal of Agriculture Environment and Biotechnology, 10*(6), 689-694.

Sandhu, P. S., Mahaland, S. S. and Sardana, V. (2015). Performance of promising hybrids of Indian mustard under varying levels of nitrogen and row spacing. *Journal of Crop and Weed, 11*, 204-207.

Satyajeet and Nanwal, R. K. (2007). Integrated nutrient management in pearl millet-mustard cropping system. *Indian Journal of Fertilizer, 3*, 59-69.

Solanki, R. L., Sharma, M., Sharma, S. K., Sharma, F. L. and Jain, H. K. (2016). Effect of phosphorus sulphur and phosphate solubilizing bacteria on yield and micronutrient cation uptake of mustard [*Brassica Juncea* (L.)] on a Haplustept. *Indian Journal of Fertilizer, 12*, 36-41.

Verma, S. K., Kumar, S., Singh, S. and Singh, T. K. (2011). Effect of nitrogen and sulphur condition. *Indian Journal of Agricultural Science, 81*(2), 145-149.

Vijayeswarudu, C. Y. N. A. and Singh, R. (2021). Effect of biofertilizers and sulphur levels on growth and yield of yellow mustard (*Sinapis alba*). *Biological Forum– An International Journal, 13*(3), 140-143.

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