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Response of potassium and sulphur on growth and yield of mustard

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Abstract

A field experiment was conducted during Rabi 2024–25 at the Crop Research Farm, Department of Agronomy, PRSU, Prayagraj (U.P.). The soil of the experimental field was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36%), available nitrogen (171.48 kg/ha), available phosphorus (15.2 kg/ha), and available potassium (232.5 kg/ha). The experiment was laid out in a Randomized Block Design (RBD) with ten treatments and three replications. The study was undertaken to evaluate the response of potassium and sulphur levels on the growth and yield of mustard. The treatments comprised T_1– Potassium 30 kg/ha + Sulphur 20 kg/ha, T_2– Potassium 30 kg/ha + Sulphur 25 kg/ha, T_3– Potassium 30 kg/ha + Sulphur 30 kg/ha, T_4– Potassium 40 kg/ha + Sulphur 20 kg/ha, T_5– Potassium 40 kg/ha + Sulphur 25 kg/ha, T_6– Potassium 40 kg/ha + Sulphur 30 kg/ha, T_7– Potassium 50 kg/ha + Sulphur 20 kg/ha, T_8– Potassium 50 kg/ha + Sulphur 25 kg/ha, T_9– Potassium 50 kg/ha + Sulphur 30 kg/ha, and T_{10}– Control. The treatments were evaluated under randomized block design with three replications to determine their effect on growth attributes, yield attributes, seed yield, stover yield, and economics of mustard cultivation. The data obtained from the experiment were subjected to statistical analysis and treatment means were compared using the appropriate critical difference at the prescribed level of significance.

Keywords: Response of potassium and sulphur on growth and yield of mustard

Introduction

Mustard (*Brassica spp.*) is a key oilseed crop worldwide, belonging to the *Brassicaceae* family. It holds significant economic importance in several countries, notably India, which ranks as the third-largest producer of mustard seeds after Canada and China. Mustard is among the oldest cultivated crops, with historical evidence of its use documented globally. Initially consumed as paste or whole seeds, its applications have broadened considerably due to advances in understanding its nutritional and phytochemical properties. Today, mustard serves not only as a food ingredient but also in the production of various industrial products such as soaps, leather goods, fertilizers, honey, and pharmaceuticals. Research efforts have further enhanced mustard cultivation through the development of high-yielding hybrid varieties (Sharma *et al., 2024*). Indian mustard is an amphidiploid species (2n=36), originating from a natural chromosome doubling following an interspecific hybridization between *Brassica campestris* (2n=20) and *Brassica nigra* (2n=16) (Meena *et al., 2022*) [4]. India, with a vast agrarian population constituting 26% of the global agricultural workforce but only 12% of the world's arable land, is a major player in the vegetable oil sector. It stands as the fifth-largest economy in vegetable oil production, contributing 7.4% to oilseed output, 5.8% to oil production, and 6.1% to oil meal production globally, while accounting for 9.3% of edible oil consumption. Oilseeds represent the second most important agricultural commodity in India after cereals, growing at an average rate of 4.1% annually over the past three decades. Mustard alone constitutes approximately 23.5% of the total oilseed cultivation area and 24.2% of oilseed production in India. Despite being the third-largest producer of oilseed Brassica globally with an 11.3% production share, India supplies about 57% of its domestic edible oil demand from mustard (Sharma *et al.,* 2024).

Brassicaceae family encompasses a wide variety of mustard species that hold significant economic value due to their culinary and medicinal uses. Notable members include Asian mustard (*Brassica juncea*), ball mustard (*Neslia paniculata*), black mustard (*Brassica nigra*), garlic mustard (*Alliaria petiolata*), hedge mustard (*Sisymbrium officinale*), Asian hedge mustard (*Sisymbrium orientale*), oilseed rape (*Brassica napus*), rapeseed (*Brassica rapa*), treacle mustard (*Erysimum repandum*), smooth mustard (*Sisymbrium erysimoides*), white ball mustard (*Calepina irregularis*), white mustard (*Sinapis alba*), and Canola. Among these, several species such as *Brassica napus* and *Brassica juncea* are widely cultivated as oilseed crops to meet the global need for plant-based oils that are rich in polyunsaturated fatty acids. In contrast, some species like *Erysimum repandum* and *Sisymbrium erysimoides* grow wild, commonly found along roadsides and in agricultural fields as weeds, and are harvested for their medicinal benefits (Rahman *et al*., 2024).

Material and methods

The present investigation entitled "Effect of different levels of Potassium and Sulphur on growth, of Mustard (*Brassica juncea* L.)" was conducted at the Agricultural Research Farm, Department of Agronomy, Prof. Rajendra Singh (Rajju Bhaiya) University, Naini, Prayagraj, Uttar Pradesh, during the *Rabi* season of 2025-26. The experiment was undertaken to evaluate the effect of different levels of potassium and sulphur on growth parameters, yield attributes, yield, economics and post-harvest soil properties of mustard. The details regarding the experimental materials used and the methodology adopted for conducting the investigation are presented in this chapter.”

The experiment was conducted to study the effect of different levels of potassium and sulphur on growth, yield, yield attributes, economics and soil properties of mustard (Brassica juncea L.). The experiment was laid out in a Randomized Block Design (RBD) with 10 treatment combinations replicated thrice. The treatments consisted of three levels of potassium (30, 40 and 50 kg ha⁻¹) and three levels of sulphur (20, 25 and 30 kg ha⁻¹) along with one control treatment. Thus, a total of 30 plots were maintained with an individual plot size of 3 m × 3 m (9 m²).

Site of Experiment: Research Farm, Department of Agronomy, Faculty of Agriculture, Prof. Rajendra Singh (Rajju Bhaiya) University, Prayagraj, Uttar Pradesh

The mustard variety Vipro Gold was sown during the *Rabi* season of 2025-26 by manual line sowing method. Healthy and bold seeds were used for sowing. The crop was sown by maintaining a spacing of 45 cm between rows and 15 cm between plants.

Seeds were placed uniformly in furrows and covered manually with soil for proper germination and establishment Recommended dose of fertilizers (40:40:20 kg N:P:K ha⁻¹) was applied uniformly to all plots as basal dose, while potassium and sulphur were applied according to the respective treatment combinations. Fertilizers were applied carefully in furrows before sowing to ensure proper nutrient availability to the crop

Irrigation was applied uniformly to all plots as per crop requirement at critical growth stages. Proper care was taken to avoid water stagnation and maintain adequate soil moisture throughout crop growth.

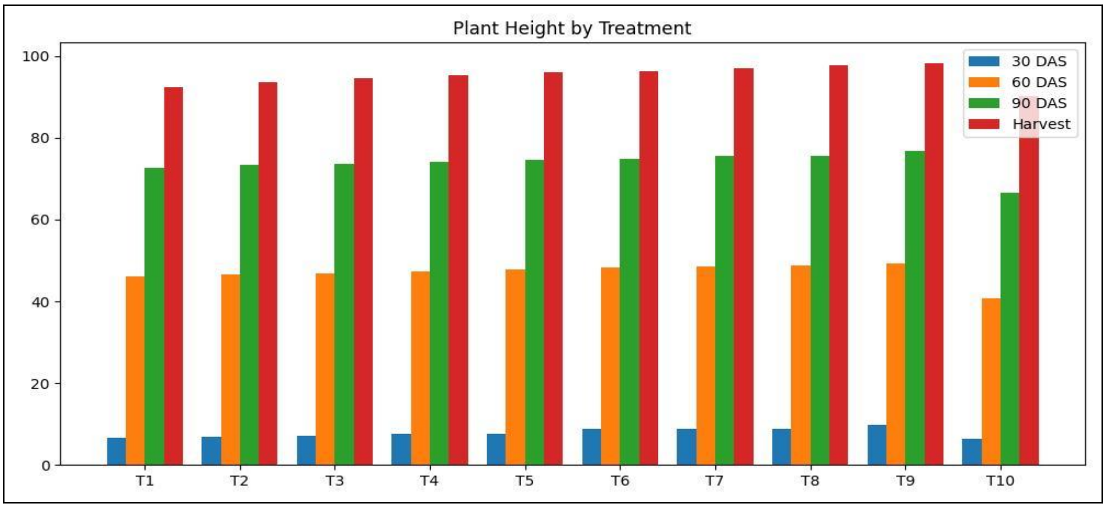
The crop was harvested manually at full maturity stage from each plot separately. Border rows were excluded to avoid border effects and only the net plot area was harvested for yield observations. Harvested produce from each plot was bundled, tagged and dried properly before threshing. After threshing, cleaned seeds were weighed plot-wise to record seed yield. Stover yield was calculated separately, and harvest index was worked out accordingly.

Result and conclusion

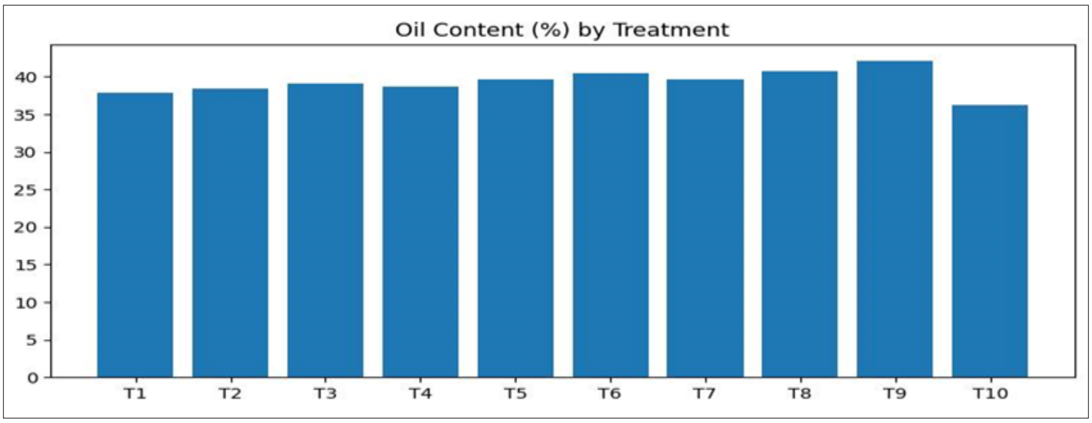
Treatments		**Plant height (cm)**			
		30 DAS	**60 DAS**	**90 DAS**	**At harvest**
T_1	Potassium 30 kg/ha + Sulphur 20 kg/ha	6.76	46.18	72.68	92.48
T_2	Potassium 30 kg/ha + sulphur 25 kg/ha	6.84	46.57	73.36	93.52
T_3	Potassium 30 kg/ha + sulphur 30 kg/ha	7.19	46.84	73.64	94.63
T_4	Potassium 40 kg/ha + sulphur 20 kg/ha	7.56	47.38	74.23	95.37
T_5	Potassium 40 kg/ha + sulphur 25kg/ha	7.73	47.84	74.65	95.97
T_6	Potassium 40 kg/ha + sulphur 30 kg/ha	8.95	48.23	74.86	96.31
T_7	Potassium 50 kg/ha + sulphur 20 kg/ha	8.82	48.51	75.47	96.98
T_8	Potassium 50 kg/ha + sulphur 25 kg/ha	8.74	48.76	75.67	97.74
T_9	Potassium 50 kg/ha + sulphur 30 kg/ha	9.75	49.29	76.87	98.34
T_{10}	Control (Farmer Practices)	6.46	40.63	66.57	90.15
SEm (±)		1.37	2.28	4.21	3.17
F-Test		NS	S	S	S
CD at 5 %		-	6.69	12.64	9.30

The superior plant height recorded under T_9 (Potassium 50 kg ha⁻¹ + Sulphur 30 kg ha⁻¹) may be attributed to the synergistic effect of potassium and Sulphur in enhancing physiological and biochemical processes within the plant. Potassium improves photosynthetic efficiency, translocation of photosynthates, enzyme activation and water-use efficiency, while Sulphur promotes chlorophyll synthesis, protein formation and amino acid metabolism. The combined application of higher levels of potassium and sulphur improved nutrient utilization and vegetative growth, resulting in significantly taller plants.

Treatment		**Oil Content (%)**
T_1	Potassium 30 kg/ha + Sulphur 20 kg/ha	37.82
T_2	Potassium 30 kg/ha + sulphur 25 kg/ha	38.42
T_3	Potassium 30 kg/ha + sulphur 30 kg/ha	39.13
T_4	Potassium 40 kg/ha + sulphur 20 kg/ha	38.74
T_5	Potassium 40 kg/ha + sulphur 25kg/ha	39.63
T_6	Potassium 40 kg/ha + sulphur 30 kg/ha	40.53
T_7	Potassium 50 kg/ha + sulphur 20 kg/ha	39.66
T_8	Potassium 50 kg/ha + sulphur 25 kg/ha	40.74
T_9	Potassium 50 kg/ha + sulphur 30 kg/ha	42.15
T_{10}	Control	36.23
F-Test		0.42
S.Ed. (±)		S
C.D. at 5%		1.26

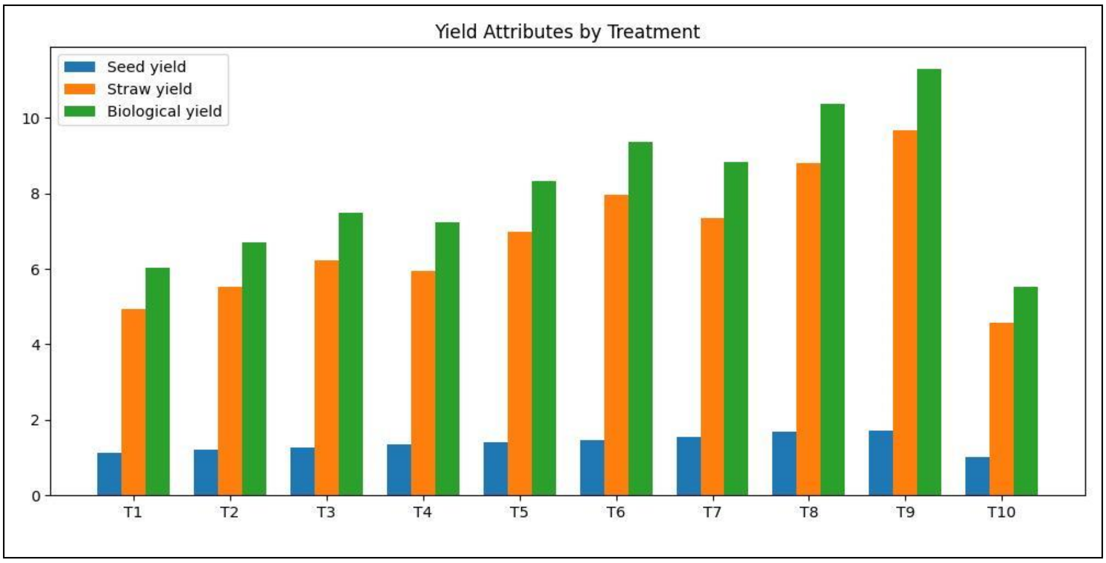


The statistical analysis indicated that treatment effects were significant (F-test: Significant). The standard error of mean [S.Ed. (±)] was 0.42 and the critical difference (C.D.) at the 5% level was 1.26.
Since the differences among treatment means exceeded the corresponding CD value, the variation among treatments was statistically significant. Therefore, treatment T_9 (Potassium 50 kg ha^{-1} + Sulphur 30 kg ha^{-1}) proved to be the most effective treatment for enhancing oil content in mustard.



Treatments		Yield attributes						
		Siliqua/plant	Seed/siliqua	Test weight (g)	Seed yield (t/ha)	Straw yield (t/ha)	Biological yield (t/ha)	Harvest index (%)
T_1	Potassium 30 kg/ha + Sulphur 20 kg/ha	185.86	10.85	2.40	1.13	4.95	6.03	18.74
T_2	Potassium 30 kg/ha + Sulphur 25 kg/ha	208.39	11.00	2.44	1.20	5.54	6.70	17.91
T_3	Potassium 30 kg/ha + Sulphur 30 kg/ha	231.64	11.25	2.51	1.28	6.23	7.48	17.11
T_4	Potassium 40 kg/ha + Sulphur 20 kg/ha	221.84	11.43	2.60	1.34	5.95	7.24	18.51
T_5	Potassium 40 kg/ha + Sulphur 25 kg/ha	251.69	11.64	2.68	1.42	6.97	8.32	17.07
T_6	Potassium 40 kg/ha + Sulphur 30 kg/ha	281.62	12.29	2.83	1.47	7.96	9.37	15.69
T_7	Potassium 50 kg/ha + Sulphur 20 kg/ha	265.74	12.77	2.94	1.54	7.35	8.84	17.42
T_8	Potassium 50 kg/ha + Sulphur 25 kg/ha	301.95	13.62	3.05	1.68	8.79	10.38	16.18
T_9	Potassium 50 kg/ha + Sulphur 30 kg/ha	331.79	14.57	3.14	1.71	9.67	11.31	15.12
T_{10}	Control (Farmer Practices)	175.47	10.65	2.38	1.02	4.56	5.52	18.48
F-Test		6.157	0.57	0.08	0.70	0.001	0.045	0.0021
SEm (±)		S	S	S	S	S	S	NS
CD at 5 %		18.336	1.72	0.24	0.22	0.002	0.127	-

The superior yield performance recorded under T_9 (Potassium 50 kg ha^{-1} + Sulphur 30 kg ha^{-1}) improvement in yield and yield-attributing characters might be due to the beneficial effect of potassium and sulphur on plant growth and development. Potassium helps in enzyme activation, photosynthate translocation, and regulation of stomatal activity, which enhances photosynthetic efficiency and nutrient utilization. Sulphur contributes to chlorophyll formation, protein synthesis, and various metabolic processes. The combined application of these nutrients may have promoted better growth and efficient partitioning of assimilates towards reproductive organs, resulting in higher siliquae per plant, seeds per siliqua, test weight, seed yield, straw yield, biological yield, and harvest index.



Conclusion

Based on the findings of the current study, it can be said that the application of potassium and sulphur had a significant impact on mustard's growth, yield attributes, yield, oil content, economics, and soil fertility status. A sufficient supply of potassium, which boosted photosynthesis, enzyme activation, and assimilate translocation, as well as the application of sulphur, which improved protein synthesis, oil generation, and nutrient utilisation efficiency, may be responsible for T_9 (Potassium 50 kg ha^{-1} + Sulphur 30 kg ha^{-1}) superior performance. Therefore, under the agroclimatic conditions of the Prayagraj region, applying potassium at a rate of 50 kg ha^{-1} and sulphur at a rate of 30 kg ha^{-1} may be advised to produce higher production, better quality, enhanced profitability, and sustained soil fertility of mustard.

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