E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(9): 105-107
Received: 05-07-2024
Accepted: 11-08-2024

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Influence of sulphur and plant growth regulators on yield and economics of mustard

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DOI: https://doi.org/10.33545/2618060X.2024.v7.i9Sb.1436

Abstract
The field experiment titled "Influence of Sulphur and Plant growth regulators on yield and economics of Mustard" was conducted during *Rabi*, 2023 at Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, SHUATS, Prayagraj, Uttar Pradesh. The experiment was laid out in Randomized Block Design with ten treatments which are replicated thrice with three levels of application of Sulphur 30, 40, 50 kg/ha and three levels of application of Plant growth regulators, Gibberellic acid -50 ppm, Naphthalene acetic acid -75 ppm, Salicylic acid- 100 ppm and control. Results revealed that higher Grain yield (2.19t/ha), Stover yield (6.48t/ha) with application of sulphur 50 kg/ha and salicylic acid-100 ppm in mustard crop. And maximum gross return (1,06,896.66 INR/ha), net returns (66,824.00 INR/ha) and B:C ratio was (1.66) wereobtainedbytheapplicationofSulphurattherate50kg/ha along with Salicylic acid 100 ppm.

Keywords: Economics, mustard, sulphur, plant growth regulators, yield

1. Introduction
Mustard [*Brassica juncea* (L.)] is foremost well grown oil seed crop grown in northern states of India. In India, after groundnut, mustard is the most prominent crop under oilseeds, which contributes 28.6% of the oilseed production and 27.8% of the oilseed economy of the country (De *et al*., 2023) [3]. Mustard is cultivated on 8.06 million hectares of area with 11.75 million tonnes production and 1458 kg/ha productivity in India during 2021-22, whereas in Uttar Pradesh state, crop grown on 0.76 million hectares area and produce 1.03 million tonnes with average productivity of 1370 kg/ha (Agricultural statistics at a glance 2022) [1].
Oil seed crops required sulphur largely because oil seed crops need sulphur containing amino acid that are cystine (27%), cysteine (26%) and methionine (21%) which are responsible for vegetative growth of plant and also for protein and oil synthesis in plant. Sulphur has a significant effect on oil, fatty acids and glucosinate content in mustard seeds (Sumi *et al*., 2021) [11]. Sulphur influences the uptake and transportation of essential nutrients such as nitrogen and sulphur within plants, facilitating their overall nutrient absorption (Chaudhary *et al*., 2024) [2]. Sulphur enhances a plant's resilience to environmental stresses like dehydration and heavy metal toxicity, contributing to its overall stress tolerance Gibberellic acid is such a plant growth regulator, which can manipulate a variety of growth and development phenomena in various crops.
NAA (Naphthalene Acetic Acid) is the synthetic auxin with the identical properties to that naturally occurring auxin. It prevents formation of abscission layer and thereby flower drop. (Gangadhar *et al*., 2020) [4].
Salicylic acid (SA) acts as a possible non-enzymatic antioxidant the maximum amount as plant phytohormone, playing a crucial role in regulating a variety of plant physiological processes. Salicylic acid is involved in defense mechanisms by regulating physiological and biochemical functions and has diverse effects on tolerance to biotic and abiotic stress factors. (Gangadhar *et al*., 2020) [4].
Keeping above points in view, the present investigation titled "Influence of sulphur andplant growth regulators on yield and economics of Mustard'' was conducted.

2. Materials and Methods

The experiment was conducted during the *Rabi* season, at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj Uttar Pradesh, which is located at 25°39' 42''N latitude, 81°67'56" E longitude and 98 m altitude above the mean sea level. The soil had a sandy loam texture, having pH 7.2 and organic carbon 0.64%. In experimental field five plants were selected and tagged randomly from every treatment. The observations likeseed yield, stover yield and harvest index were recorded. The data collected for different parameters were statistically analyzed using Gomez and Gomez (1976) [5] analysis of variance for randomized block design. The results are presented at 5% level of significance (p=0.05) for making comparison among treatments.

3. Results and discussion

3.1 Yield parameters: The data regarding grain yield,stover yield and harvest index was embodied in Table 1.

Table 1: Influence of sulphurand plant growth regulatorson yield and economics of mustard

S. No.	Treatment Combinations	Grain yield	Stover yield	Harvest Index
1.	30 Kg/ha S +Gibberellic acid-50 ppm	1.39	4.65	23.04
2.	30 Kg/ha S +Naphthalene acetic acid -75 ppm	1.46	4.88	22.98
3.	30 Kg/ha S + Salicylic acid-100 ppm	1.51	5.27	22.28
4.	40 Kg/ha S +Gibberellic acid-50 ppm	1.70	5.50	23.63
5.	40 Kg/ha S +Naphthalene acetic acid-75 ppm	1.80	5.69	24.05
6.	40 Kg/ha S +Salicylic acid-100 ppm	1.97	5.82	25.26
7.	50 Kg/ha S +Gibberellic acid-50 ppm	2.10	6.01	25.86
8.	50 Kg/ha S +Naphthalene acetic acid -75 ppm	2.13	6.26	25.39
9.	50 Kg/ha S + Salicylic acid-100 ppm	2.19	6.48	25.24
10.	Control(RDF-20:60:20NPKkg/ha)	1.14	4.46	20.39
	F test	S	S	S
	SEm(±)	0.04	0.06	0.46
	CD (p=0.05)	0.11	0.18	1.38

3.1.1 Grain yield: At harvest, significantly higher grain yield (2.19t/ha) was observed in treatment with the application of 50 Kg/ha S + Salicylic acid 100 ppm. However, application of 50 Kg/ha S+ Naphthalene acetic acid 75 ppm (2.13 t/ha), 50 Kg/ha S +Gibberellic acid-50 ppm (2.10 t/ha) is statistically par with the application of 50 Kg/ha S + Salicylic acid 100 ppm.

3.1.2 Stover yield: At harvest, significantly higher Stover yield (6.48 t/ha) wasobservedin50 Kg/ha S + Salicylic acid 100 ppm. However, application of 50 Kg/ha S+ Naphthalene acetic acid 75 ppm (6.26 t/ha) is statistically at par with the application of 50 Kg/ha S + Salicylic acid 100 ppm

3.1.3 Harvest Index: At harvest, significantly higher harvest index (25.86%) wasobservedin50 Kg/ha S + Gibberellic acid 50 ppm. However, application of 50 Kg/ha S+ Naphthalene acetic acid 75 ppm (25.39%), 40 Kg/ha S + Salicylic acid (25.26%), 50 Kg/ha S + Salicylic acid 100 ppm (25.24%) is statistically at par with the application of 50 Kg/ha S + Gibberellic acid 50 ppm.
S fertilization also played multiple roles in metabolism as an essential component of amino acids, improved vegetative structures, and improved assimilation, maintaining a balanced source-sink (Singh *et al*., 2022) [10]. Application of SA created better nutritional environment in soil plant system resulted in minimize environmental stress i.e. temperature and drought stress which ultimately increase physiological processes and efficient translocation of photosynthates towards reproductive organs which reflected in higher seed yield of mustard. (Meena *et al*., 2020) [7].

3.2 Economics: The data regarding cost of cultivation, gross returns, net returns and B: C ratio were embodied in Table 2.

Table 2: Influence of Sulphur and Plant growth regulator son Economics of Mustard

S. No.	Treatments	Costo cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C Ratio
1.	30 Kg/ha S +Gibberellic acid-50 ppm	36,377	78,513.33	42,136.0	1.15
2.	30 Kg/ha S +Naphthalene acetic acid -75 ppm	36,428	82156.66	45,728.1	1.25
3.	30 Kg/ha S + Salicylic acid-100 ppm	36,668	86,166.66	49,498.0	1.35
4.	40 Kg/ha S +Gibberellic acid-50 ppm	38,077	95,256.66	57,179.4	1.50
5.	40 Kg/ha S +Naphthalene acetic acid-75 ppm	38,128	100,316.66	62,188.1	1.63
6.	40 Kg/ha S +Salicylic acid-100 ppm	38,368	107,846.66	69,498.4	1.81
7.	50 Kg/ha S +Gibberellic acid-50 ppm	39,777	114,196.66	74,419.4	1.87
8.	50 Kg/ha S +Naphthalene acetic acid -75 ppm	39,828	116,630.00	76,801.5	1.92
9.	50 Kg/ha S + Salicylic acid-100 ppm	40,068	119,933.33	79,865.0	1.99
10.	Control(RDF-20:60:20NPKkg/ha)	31,272	67,003.33	35,731.0	1.14

3.3 Cost of cultivation: The highest cost of cultivation was found in with the application of Sulphur 50 kg/ha + Salicylic acid 100 ppm (40,068 INR/ha) as compared to other treatments.

3.4 Gross returns: The highest gross return was found in with the application of Sulphur 50 kg/ha + Salicylic acid 100 ppm (119,933.33 INR/ha) as compared to other treatments.

3.5 Net returns: The highest net return was found in with the application of Sulphur 50 kg/ha + Salicylic acid 100 ppm (79,865 INR/ha) as compared to other treatments.

3.6 B: C ratio: Higher B: C ratio was found in with the application of Sulphur 50 kg/ha + Salicylic acid 100 ppm (1.99) as compared to other treatments.

4. Conclusion

It was concluded that application of sulphur 50kg/ha along with salicylic acid 100 ppm recorded higher yield and economics as compared to their treatments in mustard.

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