International Journal of Advanced Biochemistry Research 2025; 9(7): 1112-1115

International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating: 5.29
IJABR 2025; 9(7): 1112-1115
www.biochemjournal.com
Received: 04-05-2025
Accepted: 08-06-2025

Kumar Amlendu
Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Akankhya Pradhan
Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Kumar Raj
Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Dr. Rajesh Singh
Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Kumar Amlendu
Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Effect of levels of phosphorus and sulphur on yield and economics of toria (*Brassica campestris* L.)

Kumar Amlendu, Akankhya Pradhan, Kumar Raj and Rajesh Singh

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i7n.4901

Abstract
A field experiment was carried out during the *Rabi* season of 2024 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, to assess the "Effect of Phosphorus and Sulphur Levels on Growth and Yield of Toria." The study involved three phosphorus levels (50, 60, and 70 kg/ha) and three sulphur levels (30, 45, and 60 kg/ha), along with a recommended fertilizer dose and a control (80:40-N-P kg/ha). The experiment was designed using a Randomized Block Design (RBD) with 10 treatment combinations, each replicated three times. The findings demonstrated that Treatment 9 (Phosphorus 70 kg/ha + Sulphur 60 kg/ha) produced significantly superior results in terms of plant height (121.95 cm), plant dry weight (12.94 g), number of siliquae per plant (202.80), number of seeds per siliqua (17.60), test weight (3.94 g), seed yield (1.71 t/ha), and stover yield (3.83 t/ha). Furthermore, the same treatment also achieved the highest gross returns (169,592.00 INR/ha), net returns (100,855.00 INR/ha), and benefit-cost ratio (1.47), indicating its effectiveness in both productivity and economic viability.

Keywords: Toria, yield attributes, economics, phosphorus, sulphur

Introduction

Toria (*Brassica campestris* L.), a member of the Cruciferae family, is one of the major oilseed crops cultivated in India. It holds significant importance, ranking second only to groundnut in terms of area and production for fulfilling the country's fat consumption needs. Toria is believed to have originated in eastern Afghanistan and neighboring regions of India and Pakistan. It is also commonly referred to as sarson, rai, raya, or lahi. As a short-duration crop, toria is often grown as a catch crop in the Tarai regions of Uttar Pradesh, Assam, and Odisha. *Brassica* crops, including toria, are typically grown under rainfed and resource-limited conditions, making them suitable for small and marginal farmers with limited means. These crops play a vital role in supporting the livelihoods of such farmers, especially in areas dependent on rainfall (Kumar *et al*., 2015). India is the leading global producer of *Brassica*, cultivating it on approximately 6.32 million hectares, which contributes around 7.39 million tonnes to the global production (Mahanta *et al*., 2019) [7]. Oilseeds are the second most important crop group in Indian agriculture after cereals. They provide essential fatty acids, serve as ingredients for cattle feed, and are widely used in the pharmaceutical, biofuel, and oleochemical sectors. Among oilseeds, rapeseed and mustard rank as the second-most valuable edible oilseed crops in India. Although they are relatively low-yielding, they respond positively to proper fertilization. Mustard oil finds diverse applications in producing vegetable ghee, hair oils, medicines, soaps, lubricants, and in the tanning industry. The oil content in mustard seeds ranges between 37% and 49% (Bhowmik *et al*., 2014) [1].

Phosphorus stimulates pod setting, helps in improving the seed weight and peroxides and an extensive and vigorous root system. It also helps in better partitioning of photosynthates to reproductive parts which increase the seed: stover ratio (Prasad *et al*., 1991) [12]. The present investigation was therefore carried out to study the effect of phosphorus and sulphur levels on the performance of Indian mustard.

Sulphur plays a vital role in various physiological processes, such as the synthesis of cysteine, methionine, chlorophyll, and the oil content in oilseed crops. It is also crucial for the production of specific vitamins like biotin and thiamine, and is involved in the metabolism of carbohydrates, proteins, and the development of flavor compounds in cruciferous plants. Among crops, *Brassica* species have the highest sulphur demand due to the presence of sulphur rich glucosinolates (Karthikeyan and Shukla 2008) [3]. Sulphur is essential for the formation of amino acids, proteins, and oils, and it is a component of vitamin

A. It also activates several enzyme systems within plants. Three sulphur containing amino acids, methionine (21% sulphur), cysteine (26%), and cystine (27%) are key protein building blocks, with about 90% of plant sulphur concentrated in these compounds. Additionally, sulphur contributes to the synthesis of chlorophyll, glucosides, glucosinolates (mustard oils), enzyme activation, and sulphydryl (SH) linkages, which are responsible for the pungent flavor in oilseeds. Hence, an adequate supply of sulphur is critical for the proper growth and development of oilseed crops (Singh *et al.,* 2018) [11]. Sulphur application has a significant impact on mustard's seed and stover yield as well as sulphur uptake, and it contributes to the production of nutritionally and commercially superior crop quality (Kumar *et al.,* 2018) [2].

Materials and Methods

A field experiment was conducted during the Rabi season of 2024 at the Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P). The experimental soil was sandy loam in texture, with a pH of 7.04. It contained 0.72% organic carbon and had available nutrient levels of 228.48 kg/ha nitrogen, 30.80 kg/ha phosphorus, and 140.24 kg/ha potassium.

The study involved treatments with three phosphorus levels (50 kg/ha, 60 kg/ha, and 70 kg/ha) and three sulphur levels (30 kg/ha, 45 kg/ha, and 60 kg/ha). The experiment was arranged in a Randomized Block Design (RBD) with 10 treatment combinations, each replicated three times. The treatment combinations were as follows as the treatment combination are T_1 [Phosphorus 50kg/ha + Sulphur 30kg/ha], T_2 [Phosphorus 50kg/ha + Sulphur 45kg/ha], T_3[Phosphorus 50kg/ha + Sulphur 60kg/ha] , T_4 Phosphorus 60kg/ha + Sulphur 30kg/ha] ,T_5 [Phosphorus 60kg/ha + Sulphur 45kg/ha],T_6 [Phosphorus 60kg/ha + Sulphur 60kg/ha] ,T_7 [Phosphorus 70kg/ha + Sulphur 30kg/ha] T_8 [Phosphorus 70kg/ha + Sulphur 45kg/ha],T_9[Phosphorus 70kg/ha + Sulphur 60kg/ha], T_{10} [N-P 80:40 kg/ha].Data were collected at harvest on various yield-related parameters, including the number of siliquae per plant, number of seeds per plant, seed yield, stover yield, and harvest index.

Results and Discussion

Yield

Number of siliqua/plant

The results indicated that the highest and statistically significant number of siliquae per plant (202.80) was observed with the application of Phosphorus 70 kg/ha and Sulphur 60 kg/ha. The significant increase in siliquae per plant with the application of 70 kg/ha phosphorus can be attributed to improved phosphorus uptake, which enhances net CO_2 fixation and photosynthetic activity, ultimately leading to a greater allocation of photosynthates for pod formation (Nath *et al*., 2018) [8]. Additionally, the notable rise in siliquae number with the application of 60 kg/ha sulphur may be due to its positive effects on plant nutrition, metabolic activity, and stimulation of reproductive organ development. These findings are consistent with those reported by Pachauri and Trivedi (2012) [13].

Number of seeds per siliqua

The data showed that the highest and statistically significant number of seeds per siliqua (17.60) was recorded with the application of Phosphorus 70 kg/ha and Sulphur 60 kg/ha. The notable increase in seeds per siliqua with the application of 70 kg/ha phosphorus can be attributed to enhanced phosphorus uptake, which improves CO_2 fixation and photosynthetic efficiency. This results in greater photosynthate production, supporting the formation of more pods per plant (Nath *et al.*, 2018) [8]. The application of 60 kg/ha sulphur significantly contributed to the increase in seed count per siliqua, likely due to improved development of floral structures, particularly reproductive organs, which directly influence siliqua and seed production. These observations align with the findings of Pachauri and Trivedi (2012) [13].

Test weight (g)

The data indicated that the highest and statistically significant test weight (3.94 g) was recorded with the application of Phosphorus 70 kg/ha and Sulphur 60 kg/ha. The significant increase in test weight observed with the application of 70 kg/ha phosphorus may be attributed to enhanced dry matter accumulation, improved phosphorus uptake, and better yield-related traits such as the number of pods per plant, seeds per pod, 1000-seed weight, and overall seed yield (Khatkar *et al.,* 2009) [5]. In test weight with 60 kg/ha sulphur application could be due to its influence on optimal development of siliquae in terms of number, size, and length during critical growth stages. These findings are supported by Kumar *et al.,* (2017) [4].

Seed yield (t/ha)

Results showed that the highest and statistically significant grain yield (1.71 t/ha) was recorded with the application of Phosphorus 70 kg/ha and Sulphur 60 kg/ha. The significant increase in seed yield with the application of 70 kg/ha phosphorus can be attributed to enhanced phosphorus availability and uptake, which promoted extensive nodulation and improved symbiotic nitrogen fixation. This, in turn, positively influenced photosynthetic activity and ultimately contributed to higher yields (Khatkar *et al.,* 2009) [5]. Additionally, the application of 60 kg/ha sulphur significantly boosted seed yield, likely due to improved nutrient assimilation, better metabolic function, and enhanced development of reproductive structures, all of which support greater seed production, which may result in the development of longer and more numerous siliquae, along with increased flower and seed production. These findings are consistent with those reported by Rajput *et al.,* (2018) [9].

Stover yield (t/ha)

The data indicated that the highest and statistically significant stover yield (3.83 t/ha) was recorded with the application of Phosphorus 70 kg/ha and Sulphur 60 kg/ha. A notable increase in stover yield was associated with the application of 70 kg/ha phosphorus, as reported by Yadav *et al*., (2014) [14]. Furthermore, the application of 60 kg/ha sulphur significantly boosted stover yield, likely due to increased biomass accumulation resulting from greater leaf production and improved yield components such as more seeds and siliquae per plant. The application of sulphur also appeared to promote quicker and more uniform crop maturity, accelerating the development of various plant organs and ultimately contributing to higher stover yield. These findings are in agreement with those of Rajput *et al.*, (2018) [9].

Harvest index (%)
Treatment 10 [Control 80:40- N-P kg/ha] recorded no significant and higher harvest index (38.94%). However, were found to be statistically at par with treatment 10 [Control 80:40 N-P kg/ha].

Economic
Cost of cultivation: The highest cultivation cost (68,737.00 INR/ha) was incurred under Treatment 9 [Phosphorus 70 kg/ha + Sulphur 60 kg/ha], in comparison to all other treatments.

Gross returns: Treatment 9 [Phosphorus 70 kg/ha + Sulphur 60 kg/ha] recorded the highest gross returns (169,592.00 INR/ha) among all treatments.

Net returns: The maximum net returns (100,855.00 INR/ha) were obtained from Treatment 9 [Phosphorus 70 kg/ha + Sulphur 60 kg/ha], outperforming all other treatments.

Benefit-cost ratio: The highest benefit-cost ratio (1.47) was observed in Treatment 9 [Phosphorus 70 kg/ha + Sulphur 60 kg/ha].

Table 1: Effect of Levels of Phosphorus and Sulphur on Yield attributes and Yield of Toria.

Yield attributes and yield							
Sr. No.	Treatment combinations	Number of siliqua/plant	Number of seeds/siliqua	Test weight (g)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest Index (%)
1.	Phosphorous 50 kg/ha + Sulphur 30 kg/ha	158.67	15.53	3.66	1.49	3.03	34.57
2.	Phosphorous 50 kg/ha + Sulphur 45 kg/ha	176.80	15.93	3.74	1.53	2.46	38.87
3.	Phosphorous 50 kg/ha + Sulphur 60 kg/ha	161.87	15.73	3.71	1.52	2.88	34.46
4.	Phosphorous 60kg/ha + Sulphur 30 kg/ha	171.20	16.13	3.70	1.50	2.81	34.81
5.	Phosphorous 60kg/ha + Sulphur 45 kg/ha	168.13	16.33	3.81	1.57	3.15	34.05
6.	Phosphorous 60kg/ha + Sulphur 60 kg/ha	176.73	16.40	3.38	1.54	2.98	34.17
7.	Phosphorous 70kg/ha + Sulphur 30 kg/ha	186.67	17.13	3.80	1.59	3.53	31.08
8.	Phosphorous 70kg/ha + Sulphur 45 kg/ha	198.07	17.53	3.92	1.64	3.49	32.25
9.	Phosphorous 70kg/ha + Sulphur 60 kg/ha	202.80	17.60	3.94	1.71	3.83	30.80
10.	Control (RDF) 80:40 N:P kg/ha	156.53	15.47	3.74	1.38	2.17	38.94
	F Test	S	S	NS	S	S	NS
	SEm (±)	5.06	0.16	0.14	0.02	0.27	1.87
	CD (p=0.05)	15.03	0.48	-	0.05	0.73	-

Table 2: Effect of levels of Phosphorus and sulphur on yield and Economics of Toria

Economics					
S. No.	Treatment combination	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
1.	Phosphorous 50 kg/ha + Sulphur 30 kg/ha	61866.25	149131.25	87265.00	1.41
2.	Phosphorous 50 kg/ha + Sulphur 45 kg/ha	63404.30	151709.30	88305.00	1.39
3.	Phosphorous 50 kg/ha + Sulphur 60 kg/ha	64987.00	153587.00	88600.00	1.36
4.	Phosphorous 60kg/ha + Sulphur 30 kg/ha	63741.25	151111.25	87370.00	1.37
5.	Phosphorous 60kg/ha + Sulphur 45 kg/ha	65279.30	156944.30	91665.00	1.40
6.	Phosphorous 60kg/ha + Sulphur 60 kg/ha	66862.00	156752.00	89890.00	1.34
7.	Phosphorous 70kg/ha + Sulphur 30 kg/ha	65616.25	159331.25	93715.00	1.43
8.	Phosphorous 70kg/ha + Sulphur 45 kg/ha	67154.30	164604.30	97450.00	1.45
9.	Phosphorous 70kg/ha + Sulphur 60 kg/ha	68737.00	169592.00	100855.00	1.47
10.	Control (RDF) 80:40 N:P kg/ha	56958.60	136508.60	79550.00	1.40

Conclusion
It is concluded that in toria with the application of Phosphorus 70 kg/ha and Sulphur 60 kg/ha was recorded with higher yield attributes and benefit-cost ratio

Acknowledgement
I express my gratitude to my advisor Dr. Rajesh Singh, Professor, Department of Agronomy, SHAUTS for his voluminous and invaluable contribution during the research work and my unalloyed appreciation to the Department of Agronomy, Naini Agricultural Institute, Prayagraj, Sam Higginbottom University of Agriculture Technology and Sciences, (UP) India for providing all the necessary facilities during the course of my study.

References
1. Bhowmik B, Mitra B, Bhadra K. Diversity of insect pollinators and their effect on the crop yield of *Brassica juncea* L., from southern West Bengal. International Journal of Recent Scientist Research. 2014;5(6):1207-1213.
2. Kumar V, Tyagi S, Paul SC, Dubey SK, Suman S. Effect of sources and doses of sulphur on S uptake and yield of mustard (*Brassica juncea* L.). International Journal of Current Microbiology and Applied Sciences. 2018;7:5042-5047.
3. Karthikeyan K, Shukla LM. Effect of boron-sulphur interaction on their uptake and quality parameters of mustard (*Brassica juncea* L.) and sunflower

(*Helianthus annuus* L.). Journal of the Indian Society of Soil Science. 2008;56(2):225-230.
4. Kumar M, Singh PKY, Chaurasiya KG, Yadav A. Effect of nitrogen and sulphur nutrition on growth and yield of Indian mustard (*Brassica juncea* L.) in western UP. Journal of Pharmacognosy and Phytochemistry. 2017;:445-448.
5. Khatkar Y, Dawson J, Krishna ZK, Dixit PM, Khatkar R. Effect of nitrogen, phosphorous and sulphur on growth and yield of mustard (*Brassica juncea* Coss). International Journal of Agricultural Sciences. 2009;5(2):396-398.
6. Kumar P, Singh R, Khan W, Shivakumar NE. Effect of sulphur and row spacing on growth and yield of yellow mustard (*Sinapis alba*). Biological Forum - An International Journal. 2021;13(3):139-143.
7. Mahanta N, Kurmi K, Das JC. Conservation of soil moisture and sustenance of yield in late sown toria in Sali rice fallows through moisture conservation and INM practices. International Journal of Current Microbiology and Applied Sciences. 2019;8(6):556-563.
8. Nath S, Patel BT, Meena O, Prasad Jat G. Effect of phosphorus and sulphur on yield attributes, yield and economics of mustard [*Brassica juncea* (L.) Czern & Coss] in loamy sand. Journal of Pharmacognosy and Phytochemistry. 2018;7(5):498-500.
9. Rajput RK, Singh S, Varma J, Rajput P, Singh M, Nath S. Effect of different levels of nitrogen and sulphur on growth and yield of Indian mustard (*Brassica juncea* (L.) Czern and Coss.) in salt affected soil. Journal of Pharmacognosy and Phytochemistry. 2018;7(1):1053-1055.
10. Singh M, Kumar S, Sirothia P, Singh J, Upadhya PK. Effect of sulphur levels on mustard crops. International Journal of Current Microbiology and Applied Sciences. 2018;7(10):481-490.
11. Singh V, Lodhi M, Kumar VN. Effect of phosphorus and sulphur levels on growth and yield of mustard (*Brassica juncea* Coss) variety 'Varuna'. Agricultural Science Digest. 2008;28(1):59-60.
12. Prasad EM, Chandra A, Varshey ML, Verma MNM. Growth, yield, dry matter and nutrient uptake by mustard (*Brassica juncea*) in alluvial soil as influenced by phosphorus and organic matter. New Agriculturist. 1991;2(1):31-34.
13. Pachauri RK, Trivedi SK. Effect of sulphur levels on growth, yield and quality of Indian mustard (*Brassica juncea*) genotypes. Annals of Agricultural Research. 2012;33(3):131-135.
14. Yadav S, Singh BN, Singh MM. Effect of phosphorus and sulphur on growth, yield and economics of Indian mustard (*Brassica juncea* Coss.). Plant Archives. 2014;14(1):379-381.