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Divyansh Singh
Research Scholar, Department of Agronomy, T.D.P.G. College, Jaunpur, Uttar Pradesh, India

Dheeraj Rai
Research Scholar, Department of Agronomy, T.D.P.G. College, Jaunpur, Uttar Pradesh, India

Abhiraj Verma
Research Scholar, Department of Agronomy, T.D.P.G. College, Jaunpur, Uttar Pradesh, India

Shivam Bhargava
Research Scholar, Department of Agronomy, T.D.P.G. College, Jaunpur, Uttar Pradesh, India

Corresponding Author:
Divyansh Singh
Research Scholar, Department of Agronomy, T.D.P.G. College, Jaunpur, Uttar Pradesh, India

Response of sulphur and zinc levels on yield attributes of mustard crop (*Brassica juncea* L.)

Divyansh Singh, Dheeraj Rai, Abhiraj Verma and Shivam Bhargava

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Abstract
The field experiment on the topic "Response of sulphur and zinc levels on yield attributes of mustard crop (*Brassica juncea* L.)" was conducted in Agricultural Research Farm Pili Kothi of Tilak Dhari P.G. College, Jaunpur, Uttar Pradesh in *Rabi* season of 2023-24. The soil of experiment field is well drained sandy loam soil with low organic content and average in nitrogen, phosphorous and potash content. The soil of the field is slightly alkaline nature and the electrical conductivity of the soil is 0.580 dsm^{-1}. The variety of mustard used is VIGOUR-2311. This experiment is conducted with three levels of sulphur (00, 30, 40 kg ha^{-1}) and zinc (00, 5.0, 7.5 kg ha^{-1}) in Factorial Randomized Block Design (FRBD). The yield attributes (number of silique $plant^{-1}$, length of siliqua (cm), number of seeds $siliqua^{-1}$ and test weight) is increasing from 0 to 40 kg ha^{-1} of sulphur doses and from 0 to 7.5 kg ha^{-1} of zinc doses. The highest values in all attributes are got on the application of 40 kg S ha^{-1} and 7.5 kg Zn ha^{-1} doses.

Keywords: Sulphur, zinc, mustard, yield attributes

1. Introduction
Mustard belongs to family Brassicaceae, which is cultivated in northern India. Traditionally grown indigenous varieties encompass Indian mustard (*Brassica juncea*), brown sarson (*Brassica compestris* var. brown Sarson), yellow sarson (*Brassica compestris* var. yellow Sarson), toria (*Brassica compestris* var. toria), and taramira (*Eruca sativa*). In addition, non-traditional species such as gobhi sarson (*Brassica napus*), white mustard (*Brassica alba*), and Ethiopian mustard (*Brassica carinata*) have been introduced into the cultivation landscape. Mustard has an annual temperature range of 6 to 27°C Ministry of Agriculture has estimated the total area under rapeseed and mustard in India was 8.06 million hectares (m ha) with a production of 11.75 million tonnes (m t) in the year 2021-22. The average productivity for the year 2021-22 has been estimated at 1458 kg ha^{-1}. Rajasthan, Haryana and Uttar Pradesh have historically been the leading mustard-producing states in India. In Uttar Pradesh, it is grown on 0.76 million hectares and yields 1.03 million tonnes. The average productivity in the state of Uttar Pradesh in 2021-22 was 1370 kg ha^{-1}. Sulphur and zinc, which are essential for a multitude of biochemical processes, are the primary nutrients required for the robust growth and development of oilseeds. Provided that nitrogen, phosphorus, and potassium are sufficiently available, sulphur emerges as the fourth essential nutrient pivotal to plant development. It is essential for synthesis of amino acids, proteins, oils, component of vitamin A and activates enzyme system in plant. Three amino acids *viz.* methionine (21% S), cysteine (26% S) and cystine (27% S) contain sulphur which are the building blocks of proteins. About 90% of sulphur is present in these amino acids.

2. Materials and Methods
The field experiment was conducted in Agricultural Research Farm Pili Kothi of Tilak Dhari P.G. College, Jaunpur, Uttar Pradesh in *Rabi* season of 2023-24. The soil of experiment field is well drained sandy loam soil with low organic content. The soil of the field is slightly alkaline (pH 8.5) nature and the electrical conductivity of the soil is 0.580 dsm^{-1}. The available nutrient in the field is nitrogen- 51.75, phosphorous- 4.5 and potash- 100.8 kilogram per hectare.

The mustard variety used in the experiment is VIGOUR-2311. This is a highly grown hybrid variety of the duration 110-120 days. The fertilizer used for sulphur is Sulphur bentonite (90% sulphur) and for zinc is Zinc sulphate monohydrate (33% Zinc). The doses of sulphur used in the experiment are 00, 30, 40 kg ha^{-1} and the doses of zinc 00, 5.0, 7.5 kg ha^{-1} in factorial randomized block design within 3 replications. The total number of plot used is 27. The Nitrogen, Phosphorous and Potassium are applied at the rate of 120 kg ha^{-1}, 60 kg ha^{-1} and 40 kg ha^{-1} respectively with the help of Urea (46% N), Single Super Phosphate (16% P_2O_5) and Muriate of potash (60% K_2O) respectively. The complete dose of Phosphorus and Potash are given at the time of sowing (Basal dose). The application of Sulphur and Zinc are done at the time of sowing (Basal dose) according to treatment doses. The application of Nitrogen are as, half dose of nitrogen are applied at the time of sowing (basal dose) and the remaining half dose are applied at the time of first irrigation according to their appropriate treatments. The data of yield attributes (number of siliqua $plant^{-1}$, number of seed $siliqua^{-1}$ and length of siliqua) are demonstrated just before harvesting of crop manually. The test weight is calculated my taking weight of 1000 seeds after harvesting of crop. The treatment number and their combinations are following-

- **S_0**: 00 kg ha^{-1} Sulphur
- **S_1**: 30 kg ha^{-1} Sulphur
- **S_2**: 40 kg ha^{-1} Sulphur
- **Zn_0**: 00 kg ha^{-1} Zinc
- **Zn_1**: 5.0 kg ha^{-1} Zinc
- **Zn_2**: 7.5 kg ha^{-1} Zinc

3. Results and Discussion

The yield attributes in mustard seeds of variety VIGOUR-2311 (Table-1) increased consistently with the incremental application of Sulphur up to 40 kg ha^{-1} and Zinc up to 7.5 kg ha^{-1}. Beyond this level, the increase in yield attributes was marginal, indicating a plateau effect.

3.1 Effect of Sulphur

The highest number of siliquae $plant^{-1}$ (282.72) was recorded with application of 40 kg Sulphur ha^{-1} being at par with 30 kg Sulphur ha^{-1} and 00 kg Sulphur ha^{-1} and minimum value of number of siliquae $plant^{-1}$ (246.35) was observed.

Length of siliqua of mustard was maximum with application of 40 kg Sulphur ha^{-1} (7.72) being at par with 30 kg Sulphur ha^{-1} and found significantly superior 00 kg Sulphur ha^{-1} and over control.

The number of seeds $siliqua^{-1}$ of mustard was maximum with application of 40 kg Sulphur ha^{-1} (13.67) being at par with 30 kg Sulphur ha^{-1} and found superior 00 kg Sulphur ha^{-1} and over control.

Test weight increased upto 40 kg Sulphur ha^{-1}, while the other levels of Sulphur did not cause significant influence on test weight of mustard.

3.2 Effect of Zinc

The levels of zinc affected the number of siliquae $plant^{-1}$ markebly. The maximum number of siliquae $plant^{-1}$ (270.78) was observed with 7.5 kg zinc ha^{-1} being at par with 5 kg and 00 kg zinc ha^{-1}.

The length of siliqua increased consistently with an increase in each levels of zinc. 7.5 kg zinc ha^{-1} (7.35) exhibited marked superiorly with to length of siliqua over control and being at par with 00 and 5.0 kg zinc ha^{-1}.

The levels of zinc affected the number of seeds $siliqua^{-1}$ of the mustard markebly the maximum number of seeds $siliqua^{-1}$ was observed with 7.5 kg zinc ha^{-1} (13.25) being at par with 5 kg and 00 kg zinc ha^{-1} and found significantly superior over control.

Test weight of mustard increased upto 7.5 kg Zinc ha^{-1}. The levels of Zinc did not cause significant influence on test weight of mustard.

Table 1: Effect of sulphur and zinc levels on Number of silique $plant^{-1}$, Length of siliqua (cm), Number of seeds $siliqua^{-1}$ and Test weight (g) of mustard

Treatments	Number of silique $plant^{-1}$	Length of siliqua (cm)	Number of seeds $siliqua^{-1}$	Test weight (g)
Levels of sulphur (kg ha^{-1})				
00	246.35	6.47	12.28	5.23
30	264.29	7.25	13.16	5.46
40	282.72	7.72	13.67	5.72
S.Em±	5.52	0.20	0.211	0.08
CD at 5%	16.57	0.59	0.634	NS
Levels of Zinc (kg ha^{-1})				
00	258.39	6.94	12.85	5.38
5.0	264.69	7.16	13.00	5.47
7.5	270.28	7.35	13.25	5.55
S.Em±	5.52	0.20	0.211	0.08
CD at 5%	16.57	0.59	0.634	NS

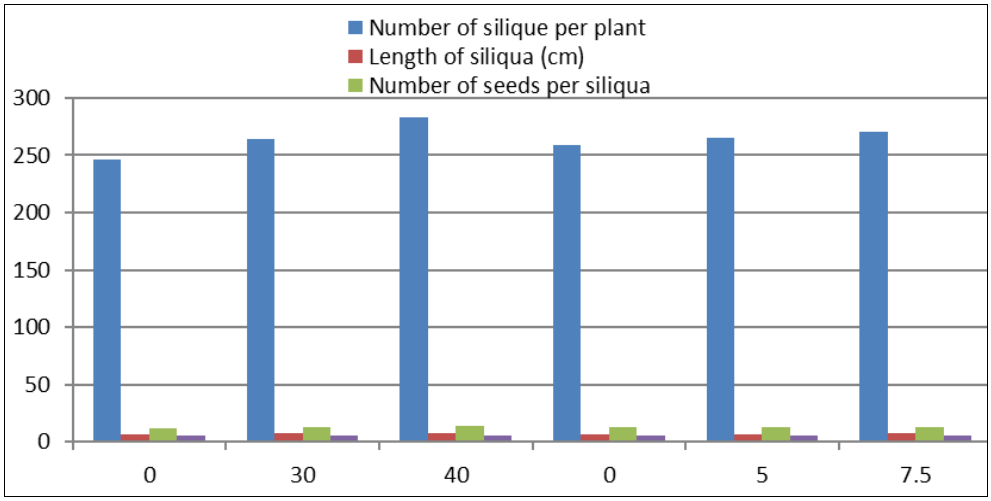

Fig 1: Effect of sulphur and zinc levels on Number of silique $plant^{-1}$, Length of siliqua (cm), Number of seeds siliqua-1 and Test weight (g) of mustard

4. Conclusion

After all this we reached on our final conclusion that the yield attributes of mustard are being relatively higher on the application of 40 kg sulphur ha^{-1} of and 7.5 kg zinc ha^{-1} of treatment number T_9 (S_2Zn_2).

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