# Influence of nitrogen and sulphur on growth attribute, yield and yield attribute of mustard (*Brassica juncea*) Prayagraj condition

**Article type:** *Original Research Article*

## ABSTRACT

A field experiment was conducted during *rabi* season of 2021-22 at SHUATS Crop Research Farm (CRF), Department of Agronomy, SHUATS, Prayagraj (UP) on sandy loam soil to investigate the effect of nitrogen and sulphur on growth and yield of mustard (*Brassica juncea*). The treatment consisted of 3 levels of nitrogen *viz.*, Nitrogen at 40 kg/ha, Nitrogen at 60 kg/ha and Nitrogen at 40 kg/ha. 3 levels of sulphur *viz.*, Sulphur at 10 kg/ha, Sulphur at 20 kg/ha and Sulphur at 30 kg/ha. The experiment was laid out in randomized block design with ten treatments replicated thrice. Study revealed that with application of Nitrogen 80 kg/h + Sulphur 30 kg/ha recorded significantly higher plant height (99.10 cm) and maximum plant dry weight (23.10 g) at harvest stage as compared to other treatment combinations. The treatment with application Nitrogen 80 kg/h + Sulphur 30 kg/ha also recorded significantly higher number of siliqua/plant (342.41), number of seed/siliqua (16.17), test weight (5.63), seed yield (25.10 q/ha) and stover yield (58.45 q/ha) as compared to all the treatment combinations.

**Keywords***:* *Mustard, Nitrogen, Sulphur, Growth, Yield.*

## Introduction

After soybean (*Glycine max*) and palm oil, mustard is the third most important oilseed crop (*Elaeis guineenisjacq*.). Both irrigated and rainfed settings are suitable for growing the crop. It requires a steady supply of soil moisture during the growth season and a dry time during harvest (Rehman *et al.* 2009). Mustard seed has a protein level of 30-45 percent and a fat content of 37-49 percent. Oilseeds are second only to food grains in importance in the Indian agricultural sector. They occupy an important position in daily diet as being rich source of fats and vitamins and occupy14.87 percentage gross cropped area of the country. India is the fourth largest oilseed producer in the world besides USA, China and Brazil and covers an area of 27.86 m ha with production and productivity of 27.98 mt and 10.04 q $ha^{-1}$ respectively. Mustard is one of the most important oilseed crops farmed in India. Mustard (*Brassica spp.*) is a member of the Brassicaceae family that accounts for roughly 23% of land and 14.6 percent of production in India (Kumar *et al.* 2017). India, after China and Canada, is the world's third-largest mustard grower, accounting for 12% of global output. (Anonymous, 2015).

Mustard requires nitrogen (N) for robust growth, high yield, and quality. Nitrogen is required in the highest amounts relative to the other macronutrients in the formation of plant proteins and chlorophyll. Another sign of a nitrogen deficiency in mustard is yellowing of the elder leaves. In the plant, nitrogen is transferred from older leaves to younger ones, causing deficient symptoms to show first on older leaves. When a crop is weak in nitrogen, the canopy will likely be thin and open, and the blooming time will be shortened, resulting in poorer pod set and yield. Sulphur is necessary for improving oil output and content (percentage). Sulphur treatment has a significant impact on chlorophyll production, glucose metabolism, and protein metabolism. It is required for the production of amino acids, proteins, and oils, as well as the activation of the plant's enzyme system. Sulphur is found in three amino acids: methionine (21 percent S), cysteine (26 percent S), and cystine (27 percent S). These amino acids contain approximately 90% sulphur. Sulphur is also involved in the synthesis of chlorophyll, glucosides and glucosinolates (mustard oils), enzyme activation, and the pungency-producing sulphydryl (SH-) connections in oilseeds. Sulphur levels had a major impact on mustard seed and stover output (Sharma *et al.* 2009). In terms of agricultural yields and quality, fertilizer is the complementary use of nitrogen and sulphur sources of plant nutrients to maintain and sustain soil fertility and boost crop output in an environmentally friendly, socially appropriate, and economically feasible manner.

It was in view of these facts that the present study entitled "Influence of nitrogen and sulphur on growth attribute, yield and yield attribute of mustard (*Brassica juncea*) Prayagraj condition" was conducted at Department of Agronomy, Sam Higginbottom University of Agricultural Technology and Sciences, during *rabi* 2021-2022.

## Materials and Methods

The experiment was carried out during *rabi* season of 2020-21 at CRF (Crop Research Farm), Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (UP). The farm is geographically situated at 25° 24' N latitude and 81° 51' Elongitude. The experiment was laid out in Randomized Block Design (RBD) with nine treatments replicated thrice. The experiment comprising nine treatment possible combination of above factor, *viz.*, $T_1$- Nitrogen 40 kg/ha + Sulphur 10 kg/ha, $T_2$- Nitrogen 40 kg/ha + Sulphur 20 kg/ha, $T_3$- Nitrogen 40 kg/ha + Sulphur 30 kg/ha, $T_4$- Nitrogen 60kg/ha + Sulphur 10 kg/ha, $T_5$- Nitrogen 60kg/ha + Sulphur 20 kg/ha, $T_6$- Nitrogen 60 kg/ha + Sulphur 30 kg/ha, $T_7$- Nitrogen 80 kg/ha + Sulphur 10 kg/ha, $T_8$- Nitrogen 80 kg/ha + Sulphur 20 kg/ha, $T_9$- Nitrogen 80 kg/ha + Sulphur 30 kg/ha. The mean (maximum and minimum) temperature was 34.44 $^oC$ and 6.00 $^oC$ respectively, mean (maximum and minimum) relative humidity was 96 percent and 49 percent during the crop growing season. The experimental soil was sandy loam in texture, nearly neutral in soil reaction (pH 7.6), low in organic carbon (0.36%), medium in available N (.028 kg/ha), medium available P (13.05 kg/ha) and medium available K (156.44 kg/ha). Fertilizers were applied in the form of urea, single super phosphate and murate of potash, respectively. Entire dose of N half dose, P and K was applied as basal through placement during sowing. The remaining ½ dose of N was applied as top dressing after 40 days after sowing. Sulphur as were applied as per the treatment combinations at the time sowing. Mustard seeds were treated with Rhizobium bacteria and Trichoderma @ 2.5 kg/ha and 4g/kg of seeds respectively. Gypsum as a soils application was applied at the rate of 500 kg/ha at 30 days after sowing. The furrows were opened and seed were dibbled with a spacing of 35 cm x 10 cm and covered by soil. Harvesting was done manually, seeds were winnowed, and cleaned and seed weight per net plot was recorded on hectare basis and expressed in kg/ha. The observation regarding yield were recorded after harvesting number of siliqua per plant, number of seed per silique, test weight (gm), seed yield (q/ha), stover yield (q/ha) and harvest index (%) of crop.

**Statistical analysis**

The experimental data was statistically evaluated using the analysis of variance (ANOVA) approach suggested for the design to test the significance of overall differences among treatments using the F test, with conclusions derived at a 5% probability level. Treatment costs were also calculated (Gomez and Gomez, 1984).

## Chemical analysis of soil

Composite soil samples are collected randomly before the layout of experiment was laid so as to determine the soil properties initially. The soil samples are collected from 0-15 cm depth and were dried under shade, then powdered with the help of a wooden pestle and mortar then sieved through a 2 mm sieve and was then subjected to further analysis. The physical properties of soil were evaluated by using the Bouyoucos hydrometer method outlined by Bouyoucos (1927) and for organic carbon by rapid titration method by Nelson (1975). Available nitrogen was estimated by alkaline permanganate method by Subbiah and Asia (1956), available phosphorus by Olsen's method as outlined by Jackson (1967), available potassium was determined by use of flame photometer normal ammonium acetate solution and estimating by using the flame photometer (ELICO Model) as outlined by Jackson (1973).

## Results and Discussions

### Growth attributes

Data pertaining to growth parameters which are plant height (cm), dry weight (g/plant), Crop growth rate ($g/m^2$/day) and Relative growth rate (g/g/day) were recorded and tabulated in Table 1.

At 80 DAS, treatment with Nitrogen 80 kg/ha + Sulphur 30 kg/ha recorded significantly highest plant height (99.10 cm). However, treatment with Nitrogen 80 kg/h + Sulphur 20kg/ha was statistically at par with the treatment Nitrogen 80 kg/h + Sulphur 30 kg/ha. This might be due to as sulphur is directly or in directly involved in the production of chlorophyll and foliar application is known to be very responsive as the availability of food in the plant affected by soil pH in tandem which ensures higher yield, Khatkar *et al.* (2009). while in case of plant dry weight per plant treatment with, Nitrogen 80 kg/h + Sulphur 30 kg/ha At 80 DAS, treatment with Nitrogen 80 kg/ha + Sulphur 30 kg/ha recorded significantly highest plant dry weight (23.10 g). However, treatment with Nitrogen 80 kg/h + Sulphur 20 kg/ha was statistically at par with the treatment Nitrogen 80 kg/h + Sulphur 30 kg/ha. Data related to Crop growth rate ($g/m^2$/day) At 60-80 DAS, treatment with Nitrogen 80 kg/h + Sulphur 30 kg/ha recorded significantly highest Crop Growth Rate (14.24 $g/m^2$/day) and there was significant difference between the treatments. Data related to Relative growth rate (g/g/day) At 60-80 DAS, treatment with Nitrogen 40 kg/h +

Sulphur 10 kg/ha recorded significantly highest Relative Growth Rate (0.0257 g/g/day) and there was significant difference between the treatments. Nitrogen is the most significant nutrient in the mustard crop, as it determines its growth and enhances production. In the presence of nitrogen, phosphorus and potash are known to be efficiently utilized. It helps to stimulate flowering, siliqua setting, and siliqua size and yield. Sulphur is an important nutrient that is involved in physiological activities such as cystein, methionine, chlorophyll, and the oil content of oil seed crops. In crucifers, it is also responsible for the production of some vitamins (B, biotin, and thiamine), carbohydrate and protein metabolism, and oil creation of flavorful chemicals. Due to the presence of sulphur-rich glucosinolates, Brassica has the greatest sulphur requirement. Singh et al. (Singh *et al.* 2004). Nitrogen increases cell growth, resulting in morphologically increased plant height, leaf area, and number of branches per plant. Nitrogen causes leaves to turn a deep green colour as a result of improved chlorophyll production, which increases the effective area of photosynthesis and leads to more dry matter. These findings are consistent with Singh and Kumar's findings (2014). Sulphur administration improved the nutritional environment for plant growth at active vegetative stage as a result of improved root growth, cell multiplication, elongation, and cell expansion in the plant body, resulting in higher plant height and dry weight. Reported a similar conclusion Katiyar *et al.* (2014).

**Yield and yield attributes**

No. of pods/plant, No. of kernels/pod, Seed index were recorded and tabulated in Table 2.

The results revealed that significantly higher Number of siliqua per plant (342.41) were observed in the treatment Nitrogen 80kg/h + Sulphur 30kg/ha. However, treatments with Nitrogen 80kg/h + Sulphur 20kg/ha, Nitrogen 80kg/h + Sulphur 10 kg/ha and Nitrogen 60 kg/h + Sulphur 30kg/ha were statistically at par with the treatment Nitrogen 80 kg/h + Sulphur 30 kg/ha. While in case of Number of seeds per siliqua revealed that significantly higher (16.17) were observed in the treatment Nitrogen 80 kg/h + Sulphur 30 kg/ha. However, treatment with Nitrogen 80 kg/h + Sulphur 20 kg/ha was statistically at par with the treatment Nitrogen 80 kg/h + Sulphur 30kg/ha. While in case of revealed that Test weight the results significantly highest (5.63 g) was observed in the treatment Nitrogen 80 kg/h + Sulphur 30 kg/ha. However, treatment with Nitrogen 80kg/h + Sulphur 20kg/ha was statistically at par with the treatment Nitrogen 80 kg/h + Sulphur 30 kg/ha. The results revealed that significantly highest Seed yield (2.51 t/ha) was observed in the treatment Nitrogen 80 kg/h + Sulphur 30 kg/ha. However, treatments with Nitrogen 80 kg/h + Sulphur 20kg/ha, Nitrogen 80 kg/h + Sulphur 10 kg/ha and Nitrogen 60 kg/h + Sulphur 30 kg/ha were statistically at par with the treatment Nitrogen 80 kg/h + Sulphur 30 kg/ha. The results revealed that significantly highest Stover yield (5.84 t/ha) was observed in the treatment Nitrogen 80 kg/h + Sulphur 30kg/ha. However, treatment with Nitrogen 80kg/h + Sulphur 20kg/ha was statistically at par with the treatment Nitrogen 80 kg/h + Sulphur 30 kg/ha. The results revealed that significantly Harvest Index (31.30%) was observed in the treatment Nitrogen 80 kg/h + Sulphur 10 kg/ha and there was significant difference among the treatments. The increase in mustard production caused by nitrogen application could be due to nitrogen's role in the synthesis of chlorophyll and amino acids, which are the building blocks of proteins. Nitrogen influenced seed yield via a source-sink relationship, resulting in greater translocation to reproductive regions in addition to higher photosynthate production. Nitrogen is a critical plant nutrient for growth and development, and it has been shown to boost the production of Brassica species (Singh *et al.* 2002). The number of silique per plant, the length of siliqua, and the number of seeds per siliquae were the most noticeable. It seemed obvious that nitrogen administration would improve the development and yield characteristics of Indian mustard. It is well recognised that nitrogen, which is found in amino acids, proteins, chlorophyll, and protoplast, has a direct impact on growth and production by allowing photosynthates to be used more efficiently. Singh and Kumar (2014) also found that nitrogen application improved the growth and yield characteristics of rapeseed - mustard.

## Conclusion

Findings of present research trail well demonstrated the positive effects of nutrients particularly N+S treatment on various growth and yield parameters of groundnut plant. The application Nitrogen 80 kg/h + Sulphur 30 kg/ha obtaining higher yield attributes and yield of Mustard crop useful for eastern Uttar Pradesh condition.

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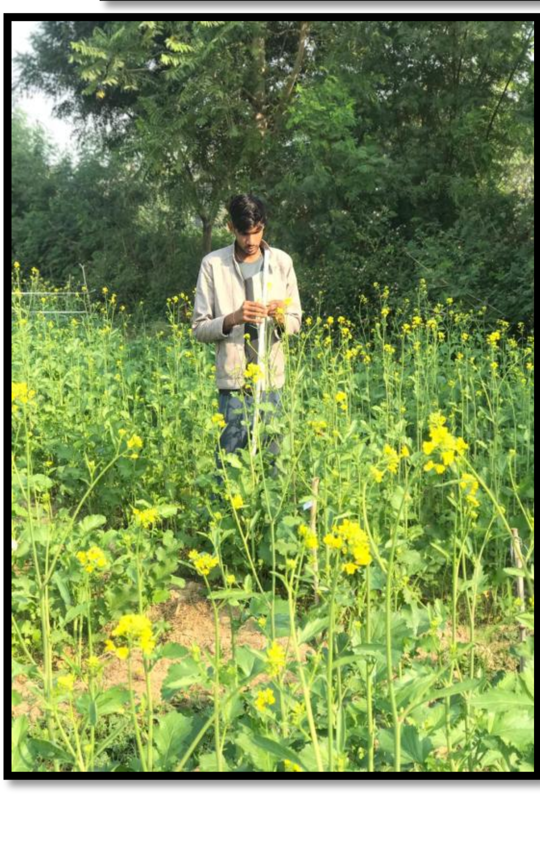
A


B

C

D


**Fig. 1. A and B at growth stage and observation to be recorded C and D at after silique observation to be recorded and with advisor**

**Table 1: Effect of nitrogen and sulphur on growth parameters of mustard**

| Treatment No. | Treatment details | Growth attributes 80 DAS | | | |
|---|---|---|---|---|---|
| | | Plant height (cm) | Plant dry weight (g/plant) | Crop growth rate (g/m2/day) | Relative growth rate (g/g/day) |
| 1. | Nitrogen 40 kg/h + Sulphur 10 kg/ha | 74.85 | 15.01 | 4.48 | 0.0245 |
| 2. | Nitrogen 40 kg/h + Sulphur 20 kg/ha | 76.88 | 15.63 | 5.32 | 0.0273 |
| 3. | Nitrogen 40 kg/h + Sulphur 30 kg/ha | 79.50 | 16.80 | 8.32 | 0.0316 |
| 4. | Nitrogen 60 kg/h + Sulphur 10 kg/ha | 81.34 | 17.35 | 5.93 | 0.0263 |
| 5. | Nitrogen 60 kg/h + Sulphur 20 kg/ha | 83.39 | 18.10 | 6.97 | 0.0283 |
| 6. | Nitrogen 60 kg/h + Sulphur 30 kg/ha | 88.05 | 19.05 | 8.91 | 0.0378 |
| 7. | Nitrogen 80 kg/h + Sulphur 10 kg/ha | 90.01 | 20.18 | 8.51 | 0.0329 |
| 8. | Nitrogen 80 kg/h + Sulphur 20 kg/ha | 95.87 | 21.87 | 6.96 | 0.0279 |
| 9. | Nitrogen 80 kg/h + Sulphur 30 kg/ha | 99.10 | 23.10 | 7.68 | 0.0287 |
| | SEd (±) | 3.369 | 1.2587 | 1.112 | 0.005 |
| | CD (p=0.5) | 6.879 | 3.986 | 2.357 | - |

**Table 2. Effect of nitrogen and sulphur on yield attributes of mustard**

| Treatment No. | Treatment details | Yield and yield attributes | | | | | |
|---|---|---|---|---|---|---|---|
| | | Number of siliqua per plant | Number of seed per siliqua | Test weight (gm) | Seed yield (q/ha) | Stover yield (q/ha) | Harvest index (%) |
| 1. | Nitrogen 40 kg/h + Sulphur 10 kg/ha | 274.14 | 12.14 | 4.44 | 18.60 | 41.38 | 31.01 |
| 2. | Nitrogen 40 kg/h + Sulphur 20 kg/ha | 295.17 | 12.88 | 4.56 | 19.52 | 43.12 | 31.16 |
| 3. | Nitrogen 40 kg/h + Sulphur 30 kg/ha | 305.80 | 13.10 | 4.98 | 20.01 | 46.85 | 29.93 |
| 4. | Nitrogen 60 kg/h + Sulphur 10 kg/ha | 321.87 | 13.29 | 5.02 | 20.52 | 47.12 | 30.34 |
| 5. | Nitrogen 60 kg/h + Sulphur 20 kg/ha | 325.12 | 13.97 | 5.12 | 21.05 | 48.80 | 30.14 |
| 6. | Nitrogen 60 kg/h + Sulphur 30 kg/ha | 335.89 | 14.35 | 5.13 | 22.68 | 50.65 | 30.93 |
| 7. | Nitrogen 80 kg/h + Sulphur 10 kg/ha | 336.88 | 14.40 | 5.36 | 23.78 | 52.38 | 31.22 |
| 8. | Nitrogen 80 kg/h + Sulphur 20 kg/ha | 339.17 | 15.56 | 5.48 | 24.80 | 55.50 | 30.88 |
| 9. | Nitrogen 80 kg/h + Sulphur 30 kg/ha | 342.41 | 16.17 | 5.63 | 25.10 | 58.45 | 30.04 |
| | SEd (±) | 3.969 | 0.438 | 0.255 | 0.654 | 1.419 | 0.883 |
| | CD (p=0.5) | 8.415 | 0.929 | 0.540 | 1.386 | 3.009 | 1.873 |