Original Research Article

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

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

Mustard is the third important oilseed crop after soybean (*Glycine max*) and palm oil (*Elaeisguineenisjacq*.). The crop can be raised well under both irrigated and rainfed conditions. Mustard is a Rabi crop that requires relatively low temperature. During growing season it requires fair supply of soil moisture and dry period during harvest **(Rehman*et al.* 2009)**. Mustard seed contain 30-45% protein content and 37-49% oilcontent. Oilseeds play an important role in the Indian Agricultural economy next only to food grains. 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 occupies an important position among oilseed crops grown in

India. Mustard (*Brassica spp.*) belongs to family *Brassicaceae* occupies about 23% area and 14.6% production in India **(Kumar *et al.* 2017).** India is the third largest mustard producer in the world after China and Canada with 12% of world total production. Mustard cultivation is carried out widely in 13 states of India. Rajasthan ranks first in total mustard production (48.6%) followed by Uttar Pradesh (13.4%) and Haryana (11.4%) **(Anonymous, 2015).**

Nitrogen (N) is essential for vigorous growth, high yield and quality of mustard. Nitrogen is essential in the production of plant proteins and chlorophyll, and is needed in the greatest amount compared to the other macronutrients. Nitrogen uptake and utilization takes place throughout the entire growth cycle. When plants are deficient in N they will have pale green to yellow foliage and the plants will often be spindly. Yellowing of the older leaves is another indication that the mustard may be deficient in N. Nitrogen is distributed from old leaves to younger leaves in the plant resulting in deficiency symptoms first appearing on older leaves. On a canopy level, when a crop is N deficient, the canopy will likely be thin and open and the flowering period will be shortened leading to reduced pod set and lower yield. Sulphur is essential for increasing oil content (%) and oil yield. Sulphur application greatly influenced chlorophyll synthesis, carbohydrate as well as protein metabolism. It is essential for synthesis of amino acids, proteins, oils 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. Sulphur is also involved in the formation of chlorophyll, glucosides and glucosinolates (mustard oils), activation of enzymes and sulphydryl (SH-) linkages that are the source of pungency in oilseeds. Sulphur levels significantly influenced the seed and stover yield of mustard **(Sharma *et al.*2009).**

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.

Comment [P1]: The aim of the study

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 ten treatments replicated thrice. The experiment comprising nine treatment possible combination of above factor, *viz.*, T1- Nitrogen 40kg/h + Sulphur 10kg/ha, T2- Nitrogen 40kg/h + Sulphur 20kg/ha, T3- Nitrogen 40kg/h + Sulphur 30kg/ha, T4- Nitrogen 60kg/h + Sulphur 10kg/ha, T5- Nitrogen 60kg/h + Sulphur 20kg/ha, T6- Nitrogen 60kg/h + Sulphur 30kg/ha, T7- Nitrogen 80kg/h + Sulphur 10kg/ha, T8- Nitrogen 80kg/h + Sulphur 20kg/ha, T9- Nitrogen 80kg/h + Sulphur 30kg/ha. The mean (maximum and minimum) temperature was 34.44 ^{o}C and 6.00 ^{o}C 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 of crop.

Comment [P2]: With 9 or 10 treatments

Comment [P3]: Where is the control treatment .

Comment [P4]: What is the fertilizer type of sulphur

Comment [P5]: What is the parameters recorded

Statistical analysis

The experimenal data analyzed statistically by applying the technique of analysis of variance (ANOVA) prescribed for the design to test the significance of overall difference among treatments by the F test and conclusion were drawn at 5% probability level. Economics of treatments was also worked out **(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).**

(Anonymous, 2010).

Comment [P6]: What is this Reference

Results and Discussions

Growth attributes

Data pertaining to growth parameters which are plant height (cm), dry weight (g/plant), Crop growth rate (g/m2/day) and Relative growth rate (g/g/day) were recorded and tabulated in Table 1.

Comment [P7]: What is themethodof Crop growth rate recorded

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, 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/m2/day) At 60-80 DAS, treatment with Nitrogen 80kg/h + Sulphur 30kg/ha recorded significantly highest Crop Growth Rate (14.24 g/m2/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 40kg/h + Sulphur 10kg/ha recorded significantly highest Relative Growth Rate (0.0257 g/g/day) and there was significant difference between the treatments. Nitrogen is the most important nutrient, which determines the

Comment [P8]: It need areferenc

growth of the mustard crop and increases the amount of yield**.** Phosphorus and potash are known to be efficiently utilized in the presence of nitrogen. It promotes flowering, setting of siliqua and in increase the size of siliqua and yield. Sulphur is also an important nutrient and plays an important role in physiological functions like synthesis of cystein, methionine, chlorophyll and oil content of oil seed crops. It is also responsible for synthesis of certain vitamins (B, biotin and thiamine), metabolism of carbohydrates, proteins and oil formation of flavored compounds in crucifers. Brassica has the highest sulphur requirement owing to the presence of sulphur rich glucosinolates. **(Singh*et al.*, 2004).** Nitrogen increase in size of cell, which expressed morphologically increased in plant height, leaf area and branches/plant. Nitrogen provide deep green colour to leaves due to better chlorophyll synthesis which increase the effective area of photosynthesis and resulting in higher dry matter. These results are in conformity with finding of **Singh and Kumar, (2014).** The increase in growth parameters may be attributed mainly due to the fact that sulphur application improved the nutritional environment for plant growth at active vegetative stage as a result of improvement in roots growth, cell multiplication, elongation and cell expansion in the plant body which ultimately increased the plant height and plant dry weight. Similar finding was also reported by **Katiyar*et al.* (2014).**

Comment [P9]: All this **Discussions**need a **References**

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 yield of mustard due to nitrogen application may be because of the fact that nitrogen played an important role in synthesis of chlorophyll and amino acids, which constitute building of protein blocks. Nitrogen influenced the seed yield through a source-sink relationship and in addition to higher production of photosynthates it leads to increased translocation to reproductive parts. Nitrogen being a most important plant nutrient needed for growth and development of plant and is known to increase the yield of Brassica species **(Singh *et al.* 2002).** The number of silique/plant, length of siliqua, and the number of seeds/siliquae were noticed maximum. Improvement in the growth and yield attributes of Indian mustard due to nitrogen application appeared quite logical. It is well known that nitrogen being the constituent of amino acids, proteins, chlorophyll and protoplast would directly influence the growth and yield attributing characteristics through better utilization of photosynthates. **Singh and Kumar (2014)** also reported increase in growth and yield attributes of rapeseed - mustard due to nitrogen application.

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.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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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