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OPTIMIZING NITROGEN AND SULPHUR FERTILIZATION FOR ENHANCED GROWTH AND YIELD OF INDIAN MUSTARD (*BRASSICA JUNCEA* L.) IN DEHRADUN VALLEY

Ombreta Yendrembam[1], Shambhavi Tiwari[2], Abdul Mazeed[3*], Riya Mehrotra[3], Vipin Chandra Mishra[4] and Sourav Mandal[6]

[1]Department of Agronomy, Jigyasa University, Dehradun, Uttarakhand, India
[2]Department of Agriculture, Tulas Institute, Dehradun, Uttarakhand, India
[3]Department of Agriculture, Integral Institute of Agricultural Science & Technology (IIAST), Integral University, Lucknow-226026, U.P., India
[4]Project Assistant, ICAR NBAIM, Mau, UP, 275103, India
[5]Odisha University of Agriculture and Technology Bhubaneswar, Odisha, India
*Corresponding author E-mail: abdulmazeed0007@gmail.com
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ABSTRACT

Indian mustard (*Brassica juncea* L.) is an important rabi oilseed crop in India, contributing substantially to domestic edible oil production. Despite its wide cultivation, productivity in Uttarakhand remains low compared to leading mustard-growing states such as Rajasthan, highlighting the need for improved nutrient management strategies. A field experiment was conducted during the Rabi season of 2023–24 at the Agronomy Research Farm, Dehradun, Uttarakhand, to evaluate the influence of varying doses of nitrogen (0, 60, 120, and 180 kg ha^{-1}) and sulphur (0, 20, 40, and 60 kg ha^{-1}) on the growth, yield attributes, and final yield of mustard (variety HY-805). The treatments were arranged in a Randomized Block Design (RBD) with three replications. Observations were recorded for vegetative growth parameters including plant height, number of leaves, and dry matter accumulation, as well as reproductive and yield attributes such as siliqua length, number of siliquae per plant, number of seeds per siliqua, 1000-seed weight, seed yield, stover yield, biological yield, and harvest index. Results demonstrated that increasing levels of nitrogen and sulphur significantly enhanced all vegetative and reproductive growth parameters. The combined application of 180 kg N ha^{-1} and 60 kg S ha^{-1} consistently produced the tallest plants, highest number of leaves, and maximum dry matter accumulation at all growth stages. Similarly, siliqua length, number of siliquae per plant, number of seeds per siliqua, and 1000-seed weight were markedly higher under this treatment, reflecting improved reproductive efficiency. The highest seed yield (1750.69 kg ha^{-1}), stover yield (5094.58 kg ha^{-1}), and biological yield (6845.27 kg ha^{-1}) were recorded under the 180 N + 60 S combination, significantly surpassing lower nutrient treatments and control. Although the harvest index showed minor variations, it remained statistically non-significant, indicating proportional increases in seed and stover yield with higher nutrient levels. The study concludes that balanced nitrogen and sulphur fertilization plays a crucial role in maximizing both vegetative and reproductive growth of Indian mustard. The synergistic effect of nitrogen and sulphur enhances nutrient uptake, photosynthetic efficiency, and assimilate partitioning, thereby improving overall biomass production and yield potential.
***Keywords*: *Brassica juncea*, nitrogen, sulphur, growth attributes, yield, Dehradun Valley

Introduction

India ranks as the world's fourth-largest producer of mustard (*Brassica juncea* L.), with major cultivation concentrated in Rajasthan (40.82%), Haryana (13.33%), Madhya Pradesh (11.76%), Uttar Pradesh (11.40%), West Bengal (8.64%), and Uttarakhand (5.36%). Despite its wide cultivation, the productivity of mustard in Uttarakhand remains low at 19.17 kg ha^{-1}

compared to Rajasthan's 1466 kg ha^{-1} (Government of India, Ministry of Agriculture and Farmers Welfare, 2023–24). Mustard contributes approximately 26% to India's total oilseed output, yet only half of the domestic edible oil demand is met through internal production, with the rest being imported. Enhancing mustard productivity is therefore critical to bridging the gap between oilseed demand and supply.

Mustard, a vital rabi oilseed crop in India following groundnut and soybean, thrives best in cool climates (10–25 °C) and well-drained soils of near-neutral pH. Its moderate water requirement (240–400 mm) makes it suitable for rainfed regions. The crop holds immense economic and nutritional value: mustard oil is used in culinary, pharmaceutical, and industrial applications, while the oil cake serves as a nutrient-rich manure and livestock feed. Nutrient management, particularly the balance of nitrogen (N) and sulphur (S), is crucial for improving mustard growth and yield. Nitrogen plays a central role in chlorophyll formation, vegetative growth, and protein synthesis, leading to vigorous plant development (Mukesh *et al*., 2017). Sulphur, on the other hand, is vital for amino acid synthesis, enzyme activation, and oil formation (Ray *et al*., 2015). Studies have shown that balanced application of N and S enhances growth parameters such as plant height, branch number, and dry matter accumulation, ultimately improving yield and oil quality. However, unbalanced or insufficient fertilization often results in poor growth and lower yield performance. Excess nitrogen without adequate sulphur may lead to increased vegetative growth but reduced oil content, whereas adequate sulphur supplementation enhances both seed and oil yield by promoting biosynthesis of glucosinolates and storage proteins (Borpatragohain *et al*., 2019). Hence, determining the optimum doses of nitrogen and sulphur under specific agro-climatic conditions is essential to maximize yield potential.

Effect of nitrogen and sulphur doses on growth attributes of mustard

Plant height and leaf area index. Several trials show a positive, often dose-dependent, response of plant height and leaf area to increasing N and/or S. Application of 120 kg N ha^{-1} produced the tallest plants and highest LAI in studies at Bharatpur (205 cm; LAI 5.4) and other locations. In Uttar Pradesh and Meerut environments, increments from 0 up to 120 kg N ha^{-1} raised plant height (e.g., from baseline up to 175.2–199.8 cm across reports) and LAI Nitrogen × sulphur factorial studies (Pandey *et al*., 2024) similarly recorded maximum leaf area and plant height under combined N and S applications (leaf area up to 4.14 cm; plant height ≈147–194 cm depending on trial and variety).

Effect of sulphur alone and S levels. Multiple experiments found substantial growth responses to applied S. Optimum S rates reported range from modest (8 kg S ha^{-1} yielding highest plant height and branches to medium–high rates (25–60 kg S ha^{-1} producing highest plant height, branches and dry weight in Kumar *et al*., 2023. For instance, 60 kg S ha^{-1} often produced superior plant height and LAI compared with lower or zero S.

Interactive effects and variety/ location dependence. Several studies document significant N×S interactions affecting growth traits. Reported optimal N levels commonly fall between ~80–120 kg N ha^{-1} while effective S rates vary more (8–60 kg S ha^{-1}), indicating that site, cultivar and baseline soil S status strongly influence the response (Bais *et al*., 2022). Variety differences (e.g., Giriraj, Varuna, Pusa Bold) and cropping environment (open field vs. polyhouse; Dehradun vs. Rajasthan vs. Madhya Pradesh) explain much of the quantitative variability among trials (Pandey *et al*., 2024; Kumar *et al*., 2023).

Effect of nitrogen and sulphur doses on yield, yield attributes and economic yield of mustard

Sulphur effects on yield components and seed yield. Multiple trials report marked improvements in siliqua number, seed per siliqua and test weight with S application, commonly in the 25–60 kg S ha^{-1} range. Singh *et al*. (2016) observed maximum siliquae plant^{-1} and seeds siliqua^{-1} at 60 kg S ha^{-1}. Patel *et al*. (2022) also documented substantial seed-yield gains (up to ~25–37.5% increases in some reports) with S application (notably 45–60 kg S ha^{-1} or appropriate sources like gypsum), underscoring the crop's responsiveness to S fertilization.

Nitrogen effects and combined N–S responses. Nitrogen doses in the range of ~80–120 kg N ha^{-1} frequently produced the best yield outcomes. Singh *et al*. (2016) reported higher seed/stover and biological yields at 100–120 kg N ha^{-1}. Several factorial studies (Mani *et al*., 2021; Sai *et al*., 2022) indicate that combined N+S treatments (for example 80–125% recommended N with 25–30 kg S ha^{-1}) maximize both yield components and final seed and oil yield, suggesting synergistic interactions where adequate S improves N-use efficiency and partitioning to reproductive sinks (Sharma *et al*., 2023).

Yield quality, nutrient uptake and source effects. Source of S (gypsum, ammonium sulphate, SSP, bentonite-S) influenced both yield and uptake: Dwivedi *et al.* (2021) showed gypsum and ammonium sulphate as effective sources for improving siliqua metrics and yields. Sharma *et al.* (2023) found that 125% RDF + 30 kg S ha^{-1} improved seed protein, oil content and N/S uptake, demonstrating effects on both quantity and quality of produce.

Economic yield and resource-use efficiency. Several studies that included economic analysis reported higher net returns and favourable harvest indexes with balanced N and S fertilization (Patel *et al.*, 2022; Sai *et al.*, 2022). However, the economic optimum often differs from the biological maximum because of input costs: treatments with moderate N (e.g., 80–100 kg ha^{-1}) combined with 25–30 kg S ha^{-1} frequently provided good trade-offs between yield gain and fertilizer expense (Mani *et al.*, 2021; Sai *et al.*, 2022).

Material and Methods

Experimental Site

The field experiment was conducted during the *Rabi* season of 2023–2024 at the Agronomy Research Farm, Department of Agriculture, Jigyasa University (Formerly Himgiri Zee University), Dehradun, Uttarakhand. The experimental site lies in the Shivalik foothills of the lower Himalayas at 650 m above mean sea level, located at 30.339°N latitude and 77.879°E longitude. The soil of the site was *sandy loam* in texture, slightly alkaline (pH 7.48), with low organic carbon (0.45%) and available nitrogen (151.36 kg ha^{-1}), medium phosphorus (12.83 kg ha^{-1}), and potassium (178.64 kg ha^{-1}).

Climate and Weather

The climate of the experimental area is subtropical, characterized by hot summers and cold winters. During the cropping period (October–March), the maximum temperature ranged from 30.7°C to 18.6°C, and the minimum from 10.6°C to 1.9°C. Relative humidity fluctuated between 37.4% and 97.6%. Total rainfall recorded during the season was 12.6 mm.

Experimental Design and Treatments

The experiment was laid out in a *Randomized Block Design (RBD)* with 16 treatments replicated thrice. The treatments consisted of varying combinations of nitrogen (0, 60, 120, and 180 kg N ha^{-1}) and sulphur (0, 20, 40, and 60 kg S ha^{-1}) applied through urea and gypsum, respectively. The study comprised sixteen treatments involving various combinations of nitrogen (N) and sulfur (S) levels. T_1 was maintained as the control without any fertilizer application. Treatments T_2, T_3, and T_4 consisted of sulfur applications at 20, 40, and 60 kg S ha^{-1}, respectively, with no nitrogen. Treatments T_5, T_6, T_7, and T_8 included 60 kg N ha^{-1} combined with 0, 20, 40, and 60 kg S ha^{-1}. Similarly, treatments T_9, T_{10}, T_{11}, and T_{12} received 120 kg N ha^{-1} along with corresponding sulfur levels of 0, 20, 40, and 60 kg S ha^{-1}. The highest nitrogen dose of 180 kg N ha^{-1} was applied in treatments T_{13}, T_{14}, T_{15}, and T_{16}, each paired with sulfur rates of 0, 20, 40, and 60 kg S ha^{-1}, respectively.

Crop and Cultural Practices

The Indian mustard variety HY-805 was sown on 25th October 2023 at a spacing of 30 cm × 10 cm. Each plot measured 4 m × 3 m, giving a gross plot area of 12 m^2. Recommended doses of phosphorus (80 kg P_2O_5 ha^{-1} as DAP) and potassium (40 kg K_2O ha^{-1} as MOP) were applied uniformly across treatments. Half the nitrogen dose and the full doses of P, K, and S were applied as basal, and the remaining half nitrogen was top-dressed at 30 DAS.

Intercultural operations such as thinning, weeding, and irrigation were carried out as per crop requirements. The crop was harvested on 9th March 2024 and threshed manually after sun-drying.

Observations Recorded

Plant Height (cm) at 30, 60, and 90 DAS

Plant height was measured on five randomly selected healthy plants from each treatment at 30, 60, and 90 days after sowing (DAS). Measurements were taken from the ground level to the tip of the main raceme using a meter scale, and the mean value was recorded for each treatment.

Number of Leaves per Plant (30, 60, and 90 DAS)

The total number of leaves on the same tagged plants used for height measurement was counted manually at 30, 60, and 90 DAS. The mean number of leaves per plant was then calculated for each treatment.

Dry Matter Production (g/m^2)

At 30, 60 DAS, and harvest, plant samples were collected by cutting the plants at ground level within a 50 cm row length starting from the third row of each plot. The samples were oven-dried at 70 ± 2°C for 48 hours to a constant weight, and the dry matter accumulation was expressed as grams per square meter (g/m^2).

Yield Attributes

Number of Siliquae per Plant

Five tagged plants from each treatment were selected to count the total number of siliquae on the main raceme, and the mean value was calculated and expressed as siliquae per plant.

Length of Siliqua (cm)

The siliqua length of five selected plants from each treatment was measured using a graduated scale, and the average siliqua length was calculated and expressed in centimeters.

Number of Seeds per Siliqua Seeds from randomly selected siliquae of five tagged plants per treatment were threshed and counted manually. The average number of seeds per siliqua was then determined.

Test Weight (g)

The weight of 1000 seeds was recorded from each treatment using an electronic balance, and the mean value was expressed in grams.

Seed Yield (kg ha^{-1})

The harvested seed from each net plot was threshed, cleaned, and weighed to obtain the seed yield per plot, which was then converted into yield per hectare and expressed in quintals per hectare (q ha^{-1}).

Stover Yield (kg ha^{-1})

Stover yield was obtained by subtracting the seed yield from the biological yield of the crop and expressed in kilograms per hectare (kg ha^{-1}).

Biological Yield (kg ha^{-1})

Total above-ground biomass (seed + stover) was recorded from each net plot after harvest. The yield was expressed as quintals per hectare (q ha^{-1}).

Harvest Index (%)

The harvest index (HI) was calculated using the formula given by Donald (1962):

$$\text{Harvest Index (\%)} = \frac{\text{Grain Yield}}{\text{Biological Yield}} \times 100$$

Statistical Analysis The data recorded on various growth and yield attributes were analyzed statistically using the Analysis of Variance (ANOVA) technique suitable for a Randomized Block Design (RBD) as suggested by Cochran and Cox (1959). The significance of treatment effects was tested at the 5% level, and the standard error of mean (S.Em ±) and critical difference (CD) were computed for comparison among means.

Results and Discussion

Growth parameters

Data on plant height of mustard as affected by various doses of sulphur and nitrogen at different growth stages are presented in Table 1. The results revealed that plant height increased progressively with crop age and showed significant improvement with increasing doses of both sulphur and nitrogen. The maximum plant height was recorded under treatment T16 (N180S60), which registered 11.51 cm, 55.43 cm, 136.91 cm, and 160.60 cm at 30, 60, 90 DAS, and harvest, respectively. This treatment was statistically comparable to T15 (N180S40) but significantly superior to the control and lower nitrogen–sulphur combinations. The observed increase in plant height due to higher N and S application can be attributed to the synergistic role of nitrogen in promoting vegetative growth and of sulphur in enhancing cell division and chlorophyll synthesis. Nitrogen plays a vital role in meristematic activity and protein formation, while sulphur facilitates amino acid synthesis, particularly cysteine, cystine, and methionine, leading to improved growth vigour. Similar findings were reported by Singh *et al.* (2012) and Ahmad *et al.* (1998), who observed that sulphur fertilization significantly enhanced plant height in mustard due to improved nutrient uptake and physiological activity. The present results are thus consistent with earlier reports, confirming that integrated use of nitrogen and sulphur up to 180 kg N ha^{-1} and 60 kg S ha^{-1} maximized vegetative growth in mustard.

The data presented in Table 1 indicate that the number of leaves per plant increased significantly with successive growth stages and higher doses of sulphur and nitrogen. The maximum number of leaves was recorded under T16 (N180S60), producing 5.72, 23.77, and 67.35 leaves per plant at 30, 60, and 90 DAS, respectively. This treatment was statistically at par with T15 (N180S40) but significantly superior to the control and other treatments. The enhanced leaf number under higher nitrogen and sulphur levels may be due to increased synthesis of chlorophyll and nucleic acids, resulting in enhanced photosynthetic activity and leaf expansion. Nitrogen is a structural component of chlorophyll and enzymes, while sulphur aids in protein and coenzyme synthesis, promoting vigorous canopy development. Similar improvements in leaf number with S application were reported by Dongarkar *et al*. (2005), who attributed the increase to better nutrient balance and enhanced metabolic activity. Thus, the combined application of 180 kg N

ha^{-1} and 60 kg S ha^{-1} proved most effective for enhancing vegetative leaf growth.

Dry matter accumulation per plant increased steadily with crop growth and was significantly influenced by different nitrogen and sulphur doses (Table 1). The highest DMA values were recorded under T16 (N180S60), which produced 2.77 g, 26.87 g, 54.28 g, and 112.77 g at 30, 60, 90 DAS, and harvest, respectively. This treatment was statistically similar to T15 (N180S40) but significantly superior to the control and all lower nutrient levels. The marked increase in dry matter production under higher N and S doses can be attributed to greater leaf area development, higher photosynthetic rate, and efficient translocation of assimilates. Sulphur's involvement in the synthesis of essential amino acids and coenzymes, coupled with nitrogen's role in promoting chlorophyll and protein formation, resulted in enhanced biomass accumulation. These findings agree with those of Makeen *et al.* (2008), who reported increased dry matter accumulation with S fertilization in oilseed crops. Overall, the results clearly indicate that combined application of 180 kg N ha^{-1} and 60 kg S ha^{-1} significantly enhanced all growth attributes plant height, number of leaves, and dry matter accumulation-over control and lower doses. This improvement may be ascribed to the synergistic effect of nitrogen and sulphur in optimizing vegetative growth and metabolic activity, consistent with earlier observations by Ahmad *et al.* (1998) and Singh *et al.* (2012). Increasing levels of nitrogen and sulphur markedly improved mustard growth parameters. Treatment T16 (N180S60) consistently recorded the highest values for plant height, leaf number, and dry matter accumulation, statistically at par with T15 (N180S40), confirming that 180 kg N ha^{-1} combined with 60 kg S ha^{-1} is the most beneficial for vigorous vegetative growth and biomass production in mustard.

Yield Attributes and Yield

Data presented in Table 2 show that the length of siliqua increased significantly with higher doses of sulphur and nitrogen. The maximum siliqua length (4.736 cm) was recorded under treatment T16 (N180S60), which represented a 14.69% increase over the control. Treatments with 180 kg N ha^{-1} and 60 kg S ha^{-1} produced significantly longer siliquae than other nutrient combinations. The improvement may be attributed to better nutrient availability, enhanced photosynthate translocation, and efficient assimilate partitioning towards the reproductive parts. The data in Table 2 indicate a marked improvement in the number of seeds per siliqua with increasing sulphur and nitrogen levels. The highest number of seeds per siliqua (11.65) was obtained in T16 (N180S60), recording a 22.64% increase over the control and being statistically at par with T15 (N180S40). The increase may be attributed to balanced nutrient uptake and the stimulatory effect of sulphur and nitrogen on flower retention, ovule fertilization, and pod filling. Sah *et al.* (2013) also observed that combined application of N and S significantly increased the number of seeds per siliqua, possibly due to enhanced protein synthesis and photosynthate translocation.

As shown in Table 2, the number of siliquae per plant increased significantly with increasing doses of sulphur and nitrogen. The highest number (296.14 siliquae $plant^{-1}$) was observed in T16 (N180S60), which was higher than the control and significantly superior to all other treatments. The higher siliqua number may be due to prolonged flowering duration and better nutrient utilization efficiency under optimum nitrogen and sulphur supply. These findings agree with those of Sah *et al.* (2013), who reported that adequate S and N improved flower initiation and reduced flower drop, resulting in more siliquae formation per plant. Data in Table 2, reveal that 1000-seed weight increased significantly with higher levels of sulphur and nitrogen. The maximum test weight (3.984 g) was recorded under T16 (N180S60), which was 10.72% higher than the control, and statistically comparable with T15 (N180S40). This improvement can be attributed to enhanced nutrient translocation and better filling of seeds due to higher photosynthetic activity. Sulphur contributes to oil and protein synthesis in mustard seeds, while nitrogen promotes overall seed development. Similar increases in test weight due to N and S fertilization were reported by Lakshman *et al.* (2017).

The seed yield of mustard responded significantly to increasing sulphur and nitrogen levels (Table 2; Figure 1). The highest seed yield (1750.69 kg ha^{-1}) was recorded under T16 (N180S60), which was 51.85%, 42.80%, and 38.47% higher than the control, 60 kg N, and 120 kg N treatments, respectively. This improvement can be attributed to the positive effect of N and S on yield attributes such as siliqua number, siliqua length, and seed weight. Sah *et al.* (2013) also observed significant enhancement in mustard seed yield with N and S application due to improved nutrient assimilation and reproductive efficiency. The higher seed yield in T16 may be ascribed to better partitioning of assimilates and a greater number of fertile siliquae per plant. Stover yield was significantly influenced by sulphur and nitrogen levels (Table 2; Figure 2). The maximum stover yield (5094.58 kg ha^{-1}) was recorded under T16 (N180S60), which was markedly higher than the control (3516.51 kg ha^{-1}) and on par with T15 (N180S40). The increase in stover yield with higher N and S doses may be attributed to enhanced vegetative growth, greater dry matter accumulation, and improved photosynthetic efficiency. Biological yield (seed + stover) followed a similar trend (Table 2; Figure 2). The maximum biological yield (6845.27 kg ha^{-1}) was obtained with T16 (N180S60), which was significantly higher than all other treatments and statistically comparable with T15 (N180S40). The increase in biological yield reflects the cumulative improvement in both seed and stover yield, indicating enhanced nutrient use efficiency and assimilate production under balanced N and S fertilization. Similar results were reported by Lakshman *et al*. (2017), who found that higher sulphur levels increased total biomass in mustard due to better nutrient uptake and chlorophyll content. As shown in Table 2, sulphur and nitrogen application had a non-significant effect on the harvest index. The highest HI (26.57%) was recorded under T16 (N180S60). Although the differences were not statistically significant, a slight increase in HI was observed with higher N and S levels due to a favorable seed-to-stover ratio. This could be linked to improved partitioning of assimilates to reproductive organs under optimal nutrient conditions.

Conclusion

The study confirms that balanced nitrogen and sulphur fertilization is critical for optimizing mustard growth and yield. The combination of 180 kg N ha^{-1} and 60 kg S ha^{-1} (T16) consistently produced superior vegetative growth, reproductive attributes, and final seed, stover, and biological yields. The synergistic effect of nitrogen and sulphur improves nutrient uptake, photosynthetic efficiency, and assimilate partitioning, resulting in enhanced biomass and productivity. These results provide clear guidance for site-specific nutrient management of Indian mustard in the Dehradun Valley to achieve maximum yield potential.

Table 1 : Effect of Nitrogen and Sulphur Levels on Growth Attributes of Crop

Treatment		Plant Height				No. of Leaves/ plant			Dry Matter			
		30 DAS	60 DAS	90 DAS	At Harvest	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	At Harvest
T1	Control	9.15	48.72	129.07	139.63	4.64	18.79	64.75	1.20	21.11	42.60	88.59
T2	N0S20	9.16	48.73	128.86	148.84	4.69	18.85	64.92	1.25	21.18	42.54	88.71
T3	N0S40	9.18	48.77	129.17	154.20	4.71	18.89	64.48	1.31	21.11	42.42	88.86
T4	N0S60	9.26	49.05	129.30	153.98	4.71	18.87	64.83	1.31	21.24	42.45	88.83
T5	N60S0	9.21	48.71	128.79	154.56	5.41	18.79	64.34	1.42	21.56	42.64	89.55
T6	N60S20	9.18	48.95	128.85	153.81	5.39	18.83	64.36	1.45	21.53	42.70	89.43
T7	N60S40	9.61	48.89	128.79	154.20	5.45	18.80	64.38	1.44	21.29	42.66	93.16
T8	N60S60	9.57	48.98	128.82	153.98	5.19	18.83	64.37	1.39	21.38	42.63	95.03
T9	N120S0	9.59	50.84	132.89	155.31	6.14	19.75	65.56	1.48	22.38	42.79	99.88
T10	N120S20	9.63	49.66	132.21	156.26	6.16	19.76	65.64	1.48	22.69	44.01	101.81
T11	N120S40	10.12	49.04	135.18	156.80	6.15	19.78	65.71	1.72	23.18	44.65	105.07
T12	N120S60	10.14	48.84	132.94	156.53	6.15	19.79	65.64	2.25	23.25	44.88	105.74
T13	N180S0	10.28	50.84	134.81	158.27	6.14	20.44	66.70	2.43	23.88	48.55	106.35
T14	N180S20	10.74	53.77	135.21	159.02	5.86	21.24	66.69	2.55	24.89	48.44	110.48
T15	N180S40	11.28	54.38	136.59	159.82	5.39	22.30	67.08	2.61	25.52	48.70	112.53
T16	N180S60	11.51	55.45	136.91	160.60	5.72	23.77	67.35	2.77	26.87	54.28	112.77
SE(m)±		0.17	0.75	1.07	1.19	0.12	0.2	0.26	0.08	0.42	0.27	1.35
C.D. at 5%		0.49	2.17	3.09	3.47	0.33	0.56	0.69	0.21	1.22	0.79	3.91

Table 2 : Influence of Nitrogen and Sulphur Levels on yield attributes and yield of Crop

Treatment		No. of siliqua /plant	Length of Siliqua (cm)	No. of seed siliqua^{-1}	1000-seed weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
T1	Control	216.19	4.077	9.01	3.563	842.82	2409.14	3251.96	26.04
T2	N0S20	216.20	4.079	9.41	3.574	1001.34	2884.86	3886.20	25.82
T3	N0S40	216.29	4.080	9.61	3.569	1077.10	2993.23	4070.32	26.63
T4	N0S60	216.46	4.076	9.62	3.560	1057.65	2952.55	4010.20	26.46
T5	N60S0	216.36	4.083	9.63	3.577	1196.33	3406.93	4603.26	26.17
T6	N60S20	216.42	4.071	9.64	3.579	1290.91	3840.17	5131.08	25.27
T7	N60S40	217.18	4.069	9.66	3.576	1326.82	3758.97	5085.79	26.23
T8	N60S60	217.75	4.061	9.67	3.580	1285.67	3644.85	4930.52	26.13
T9	N120S0	219.92	4.040	9.68	3.590	1356.75	3789.87	5155.63	25.71
T10	N120S20	226.01	4.063	10.30	3.603	1409.00	4158.52	5567.52	25.32
T11	N120S40	229.24	4.830	10.60	3.613	1292.37	3778.03	5070.40	25.59
T12	N120S60	229.67	4.079	10.26	3.620	1355.82	3761.52	5117.34	26.61
T13	N180S0	239.84	4.087	10.03	3.637	1129.60	3178.25	4307.85	26.38
T14	N180S20	286.06	4.076	10.87	3.676	1478.56	4346.88	5825.44	25.56
T15	N180S40	270.09	4.339	11.23	3.952	1552.59	4357.95	5910.55	26.36
T16	N180S60	296.14	4.736	11.65	3.984	1750.69	5094.58	6845.27	26.57
SE(m)±		7.31	0.104	0.23	0.061	78.588	315.843	388.144	0.81
C.D. at 5 %		21.2	0.303	0.67	0.177	228.077	916.635	1126.46	N/A

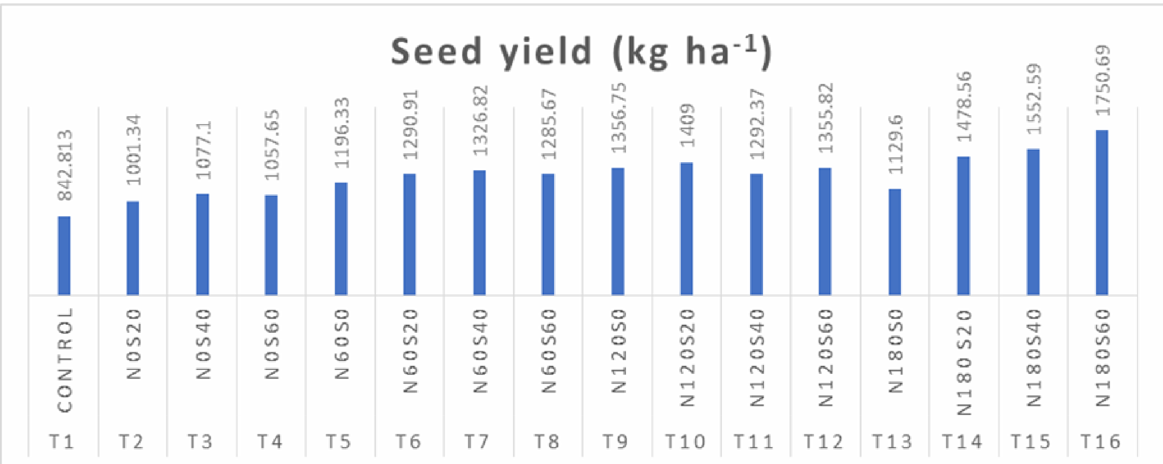

Fig. 1 : Seed yield as influenced by different doses of sulphur and nitrogen.

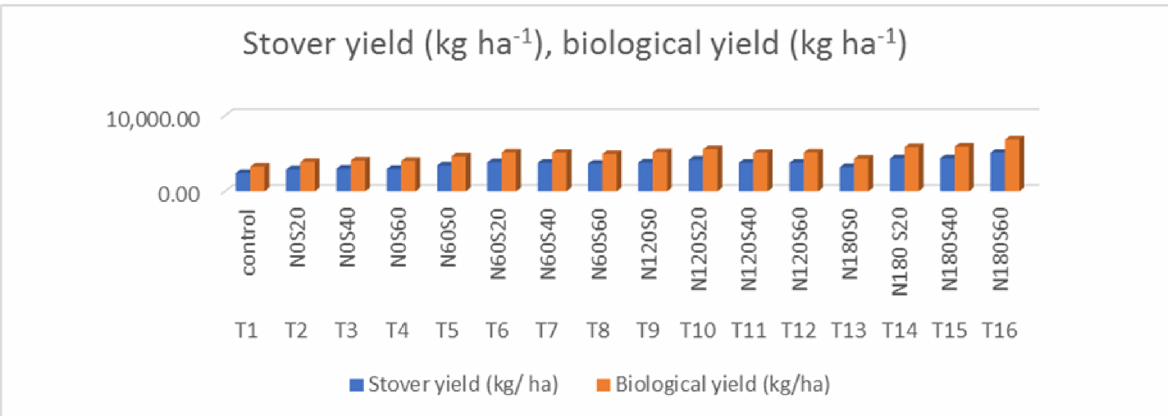

Fig. 2 : Stover yield and biological yield as influenced by different doses of sulphur and nitrogen

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