J. Soils and Crops 35 (2) 261-265, December 2025

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

EFFICACY OF FOLIAR APPLICATION OF NITROGEN AND BORON ON GROWTH AND YIELD OF DIFFERENT CULTIVARS OF GOBHI SARSON (*Brassica napus* L.)

Vaibhav Sharma[1], Rakesh Kumar[2] and Pardeep Kaur[3]

ABSTRACT

A field experiment was conducted to study the effect of foliar application of nitrogen (N) and boron (B) on growth and yield attributes of different cultivars of gobhi sarson (*Brassica napus*) at Student's Research Farm, Khalsa College, Amritsar during *rabi* season of 2023-24. The experiment was laid out in a factorial randomized block design comprising two factors: Factor A (three cultivars) - V_1(GSC6), V_2(GSC7), and V_3(PGSH1707); and Factor B (four foliar treatments) - Control F_0 (recommended NPK only), F_1 (1% Borax at flowering + siliqua formation), F_2 (1% Urea at flowering + siliqua formation) and F3 (1% Borax + 1% Urea at flowering + siliqua formation). A total of twelve treatment combinations were tested with three replications on sandy loam and slightly alkaline soil. Results of the study revealed that V_2 exhibited superior growth parameters, including maximum plant height (166.4 cm), dry matter accumulation (64.5 g plant^{-1}), number of primary branches (7.62), and secondary branches (10.62), which were significantly higher than V_1 but at par with V_3. Among the foliar sprays, the highest plant height (165.2 cm), dry matter accumulation (65.1 g plant^{-1}), and number of primary (7.38) and secondary branches (10.5) were observed under treatment F_3 which was significantly higher than F_2, F_1, and F_0. The highest number of yield attributes *i.e.*, siliquae plant^{-1} (343), number of seeds siliqua^{-1} (15.8), siliqua length (5.49 cm), and test weight (3.86 g) were recorded under V_2(GSC7). Similarly, foliar treatment F_3 resulted in the highest siliquae plant^{-1} (349.3), number of seeds siliqua^{-1} (15.6), siliqua length (5.69 cm), and test weight (4.11 g). In terms of productivity, V_2 (GSC7) achieved the maximum seed yield (20.5q ha^{-1}), straw yield (76.2q ha^{-1}), and biological yield (97.1q ha^{-1}), while among the foliar sprays F_3(1% Borax + 1% Urea at flowering + siliqua formation) produced the highest seed yield (20.5 q ha^{-1}), straw yield (76.5 q ha^{-1}) and biological yield (95.5 q ha^{-1}).

(Key words: Foliar application, nitrogen, boron, gobhi sarson)

INTRODUCTION

Gobhi Sarson (*Brassica napus* L.), commonly known as rapeseed-mustard, is one of the most significant oilseed crops grown in India. It holds great economic and agricultural importance. It is widely preferred by farmers due to its adaptability to diverse agro-climatic conditions, relatively short growth cycles, and high economic returns. Globally, rapeseed mustard ranks as the third most significant edible oilseed crop (Pujari *et al*., 2024). During the 2018-19 season, the global area under rapeseed mustard cultivation was approximately 36.59 million hectares (m ha) with a total production of 72.37 million tonnes (mt), and an average yield of 1980 kg ha^{-1}(Anonymous, 2018) . India is a major contributor to global rapeseed-mustard production, accounting for about 19.8% of the cultivated area and 9.8% of total production (Anonymous, 2023). In India, Punjab is a prominent rapeseed-mustard producing state with an estimated area of 45 thousand hectares and a production of 73 thousand tonnes during 2022-23 season (Anonymous, 2024). The state's significant contribution underscores the importance of rapeseed-mustard cultivation to both regional and national agricultural economies (Singh and Bansal, 2020).

Indian mustard is highly susceptible to deficiencies of boron (B), nitrogen (N), and sulphur (S), which significantly impair the growth, yield, and overall productivity of the crop (Vanisha *et al*., 2013; Sanwal *et al*., 2016). Intensive agricultural practices and repeated application of imbalanced and insufficient fertilizers have led to nutrient depletion and overall degradation of soil health, thereby reducing the responsiveness of crops to the standard recommended NPK fertilizers in this region (Sharma *et al*., 2021). Fertility analysis of Indian soils has indicated that the soils are deficient in microorganisms and nutrients (Vaishnav *et al*., 2024).Among the essential nutrients, deficiencies of boron and nitrogen are recognized as significant limiting factors for crop productivity

1. P.G. Student, Post Graduate Dept. of Agriculture (Agronomy), Khalsa College, Amritsar-143002, Punjab, India
2. Assoc. Professor, Post Graduate Dept. of Agriculture (Agronomy), Khalsa College, Amritsar-143002, Punjab, India (Corresponding author)
3. Asst. Professor, Dept. of Botany, Khalsa College, Amritsar-143002, Punjab, India

(Sillanpaa, 1982; Dhaliwal *et al*., 2022). Approximately one-third of the cultivated soils in India are reported to be deficient in these critical nutrients (Gupta *et al*., 2008). Foliar application of nutrients like N, P, K, S, and B at critical phenological stages has proven beneficial in enhancing crop performance (Manonmani and Srimathi., 2009). Moreover, the combination of N and B showed a synergistic effect on morphological and yield attributing characteristics of the plant due to improved nutrient uptake and assimilation in the aerial parts of the plant. Moreover, the combined application of N and B has been shown to exert a synergistic effect on various morphological and yield-contributing traits of the plant. This enhanced response is attributed to improved absorption, translocation, and assimilation of nutrients, particularly within the aerial parts such as stems, leaves, and reproductive structures (Dhaliwal *et al*., 2022).

MATERIALS AND METHODS

A field experiment was conducted at Student's Research Farm, Khalsa College, Amritsar during *rabi* season of 2023-2024. The soil of the experiment field was characterized as sandy loam in texture with a slightly alkaline pH, low N, and medium levels of P and K. Three Gobhi sarson cultivars- GSC6, GSC7 and PGSH1707 were sown on 15th October, 2023 with a spacing of 45×30 cm.

The experiment was conducted in a Factorial-Randomized Block Design comprising twelve treatments *viz*.,T1: (GSC6 + recommended NPK (Control), T2: (GSC6 + 1% Borax at flowering+ siliqua formation), T3: (GSC6 + 1% Urea at flowering + siliqua formation), T4: (GSC6 + 1% Borax + 1% Urea at flowering + siliqua formation), T5: (GSC7 + recommended NPK (Control), T6: (GSC7 + 1% Borax at flowering + siliqua formation), T7: (GSC7 + 1% Urea at flowering + siliqua formation), T8: (GSC7 + 1% Borax + 1% Urea at flowering + siliqua formation), T9:(PGSH 1707+ recommended NPK (Control), T10:(PGSH 1707 + 1% Borax at flowering + siliqua formation), T11: (PGSH 1707+ 1% Urea at flowering + siliqua formation), T12: + 1% Urea at flowering + siliqua formation) replicated thrice. Spraying was done with the help of a manually operated knapsack sprayer fitted with a flat nozzle. Observations on highest plant height, dry matter accumulation, number of primary and secondary branches plant^{-1} were recorded at harvest. Data on yield attributes *viz.,*Number of siliquae plant^{-1}, length of siliquae (cm), and number of seeds siliqua^{-1}, test weight were determined during post-harvest period. Data regarding seed yield (q ha^{-1}), straw yield (q ha^{-1})and biological yield (q ha^{-1})were also recorded. The data was statistically analysed by using statistical procedures and treatments were made at 5% level of significance (Panse and Sukhatme,1967).

RESULTS AND DISCUSSION

Effect on growth parameters

Significant variations in growth parameters were observed among different cultivars and foliar spray treatments in Gobhi Sarson. Among the tested cultivars, GSC 7 (V_2) showed superior growth characteristics, recording the highest plant height at various growth stages *i.e.,* 17.7 cm at 30 days after sowing (DAS), 58.9 cm at 60 DAS, 139.3 cm at 90 DAS, and 166.4 cm at 120 DAS. Additionally, it noted the greatest dry matter accumulation (DMA), with values of 4.38 g plant^{-1} at 30 DAS, 27.6 g plant^{-1} at 60 DAS, 45.2 g plant^{-1} at 90 DAS, and 64.5 g plant^{-1} at 120 DAS. Furthermore, cultivar V_2 also outperformed when compared with other cultivars in terms of branching ability, producing an average of 7.62 primary branches and 10.62 secondary branches plant^{-1}. These values were significantly higher than GSC6 (V_1) but were at par with those in PGSH 1707 (V_3).

In terms of foliar treatments, combined application of Borax 1% and Urea 1% (F_3) at flowering and siliqua formation stages consistently demonstrated positive effects on plant growth. This treatment recorded the maximum plant height, measuring 138.7 cm at 90 DAS and 165.2 cm at 120 DAS. It also resulted in the highest dry matter accumulation, with values of 45.1 g plant^{-1} at 90 DAS and 65.1 g plant^{-1} at 120 DAS. Furthermore, F_3 treatment significantly enhanced the number of primary branches (7.38 plant^{-1}) and secondary branches (10.5 plant^{-1}). These results were notably better than those observed with F_0 (control), F_1 (Borax 1%), and F_2 (Urea 1%) treatments, underscoring the synergistic efficacy of combined borax and urea application in promoting vegetative growth and branching in gobhi sarson. The enhanced vegetative growth under F3 treatment might be due to application of nitrogen and boron in canola plant.Nitrogen promotes cell elongation and is essential for synthesis of proteins, enzymes, chlorophyll, and growth hormones. It stimulates meristematic activity, leading to an increase in internode length, protein synthesis, and photosynthetic area, and consequently taller plants and higher dry matter production (Biswas and Poddar, 2015).Additionally, boron facilitates IAA formation and protein synthesis that leads to an efficient partitioning of assimilates toward reproductive structures, as reported by Sadiq *et al*. (2000) and Kaur *et al*. (2023),further supporting the improvement in branching and biomass accumulation observed under F3 treatment. Interactions were found non-significant in relation to all growth parameters.

Table 1. Effect of foliar application of nitrogen and boron on periodic plant height (cm), dry matter accumulation (g plant^{-1}) and number of branches plant^{-1} of different gobhi sarson cultivars

Treatments	Plant height (cm)	DMA (g plant^{-1})	Primary branches	Secondary branches
Cultivars (Factor A)				
V_1	140.3	54.1	5.50	7.57
V_2	166.4	64.5	7.62	10.62
V_3	161.0	62.2	7.18	9.86
SE(m)±	2.07	0.96	0.16	0.31
CD at 5%	6.23	2.88	0.48	0.93
Foliar sprays (Factor B)				
F_0	150.4	58.1	6.30	8.63
F_1	152.5	58.8	6.54	8.97
F_2	155.5	60.4	6.75	9.36
F_3	165.2	65.1	7.38	10.50
SE(m)±	2.40	1.10	0.18	0.35
CD at 5%	7.20	3.32	0.55	1.07
Interactions				
SE(m)±	4.48	2.07	0.34	0.67
CD at 5%	-	-	-	-

Effect on yield attributes

Significant variations in yield attributing characters were observed among different cultivars and foliar spray treatments of gobhi sarson. Among the cultivars, GSC7 (V_2) demonstrated the maximum siliqua length (5.49 cm), significantly outperforming cultivar GSC6 *i.e.*, V_1 (4.47 cm) while being statistically at par with GSC7 *i.e.*, V_3 (5.27 cm). Application of foliar spray also significantly influenced siliqua length with treatment F_3 (Borax 1% + Urea 1% applied at flowering and siliqua formation stages), achieving the longest siliqua (5.69 cm), surpassing treatment F_2 (5.13 cm), F_1 (4.81 cm), and F_0 (4.70 cm). Regarding the number of siliquae plant^{-1}, cultivar V_2 recorded the highest count (343), which was significantly greater than V_1 (317.3), but at par with V_3 (337.8). Similarly, application of Borax 1% + Urea 1% applied at flowering and siliqua formation stages (F_3) resulted in the maximum number of siliquae plant^{-1} (349.3), followed by application of F_2 (Urea 1%) (332.2), F_1 (Borax 1%) (327.5) and F_0 (control) (323.2). Treatments F_2, F_1, and F_0 were found statistically at par with each other. The number of seeds siliqua^{-1} was highest in cultivar V_2 (15.8) and significantly greater than V_1 (12.4), and at par with V_3 (15.1). Foliar treatments followed a similar trend, where F_3 recorded the highest number of seeds siliqua^{-1} (15.6), followed by F_2 (14.3), F_1 (13.9), and F_0 (13.7). Treatments F_2, F_1, and F_0 showed non- significant differences among them. Test weight was significantly higher in cultivar V_2 (3.86 g) when compared with V_1 (3.66 g), but at par with V_3 (3.82 g). Among the foliar treatment, F_3 recorded the highest test weight (4.11 g) and significantly outperforming F_2 (3.77 g), F_1 (3.67 g), and F_0 (3.61 g) but treatment F_2 was found significantly superior to F_0 but at par to F_1. These results suggest that the combined foliar application of nitrogen and boron led to larger photosynthesizing area, resulting in greater accumulation of photosynthates. The increased availability of assimilates for translocation towards sink sites (pods and seeds) contributed to improve siliqua size, higher seed count siliqua^{-1} and increased seed weight. Similar observations have been reported by Katiyar *et al*. (2014), highlighting the role of balanced nutrient supplementation in enhancing reproductive efficiency and yield components of mustard. Interaction effect was found to be non- significant in respect of yield attributes.

Table 2. Effect of foliar application of nitrogen and boron on number of seeds siliqua^{-1}, number of siliquae plant^{-1}, length of siliqua (cm), and test weight (g) of different gobhi sarson cultivars

Treatments	Number of seeds siliqua^{-1}	Number of siliquae plant^{-1}	Length of siliqua (cm)	Test weight (g)
Cultivars (Factor A)				
V_1	12.4	317.3	4.47	3.66
V_2	15.8	343.0	5.49	3.86
V_3	15.1	337.8	5.27	3.82
SE(m)±	0.30	3.86	0.09	0.03
CD at 5%	0.90	11.60	0.27	0.11
Foliar sprays (Factor B)				
F_0	13.7	323.2	4.70	3.61
F_1	13.9	327.5	4.81	3.67
F_2	14.3	332.2	5.13	3.77
F_3	15.6	349.3	5.69	4.11
SE(m)±	0.34	4.43	0.13	0.04
CD at 5%	1.04	13.3	0.32	0.13
Interactions				
SE(m)±	0.61	7.85	0.18	0.08
CD at 5%	-	-	-	-

Table 3. Effect of foliar application of nitrogen and boron on seed yield (q ha^{-1}), straw yield (q ha^{-1}), biological yield (q ha^{-1}) , and harvest index of different gobhi sarson cultivars

Treatments	Seed yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield(q ha^{-1})	Harvest Index
Cultivars (Factor A)				
V_1	14.8	59.1	73.6	18.9
V_2	20.5	76.2	97.1	21.8
V_3	19.7	74.5	94.4	21.4
SE(m)±	0.35	1.10	1.44	0.31
CD at 5%	1.05	3.31	4.33	0.93
Foliar sprays (Factor B)				
F_0	17.4	67.5	83.8	20.4
F_1	17.8	68.5	85.4	20.6
F_2	18.4	70.1	88.2	20.9
F_3	20.5	76.5	95.5	21.4
SE(m)±	0.40	1.27	1.70	0.36
CD at 5%	1.21	3.82	5.01	-
Interactions				
SE(m)±	0.71	2.24	2.94	0.63
CD at 5%	-	-	-	-

Effect on yield

Significant variations in yield were observed among Gobhi sarson cultivars and foliar treatments. Cultivar GSC7 (V_2) recorded the highest seed yield (20.5 q ha^{-1}) and found significantly superior to GSC6(V_1) (14.8 q ha^{-1}) but at par with PGSH1707 (V_3) (19.7 q ha^{-1}). Similarly, cultivar V_2 achieved the highest biological yield (97.1 q ha^{-1}) and straw yield (76.2 q ha^{-1}), both were significantly higher than V_1 but at par with V_3. Harvest index was also highest in cultivar V_2 (21.8) and were found significantly superior to cultivar V_1 (18.9) but at par with V_3 (21.4). Among foliar treatment, F_3 (Borax 1% + Urea 1%)consistently outperformed the other treatments, producing the highest seed yield (20.5 q ha^{-1}), biological yield (95.5 q ha^{-1}), and straw yield (76.5 q ha^{-1}) and significantly surpassing F_0(Control), F_1(Borax 1%) and F_2(Urea 1%)**.** Although the foliar treatments did not significantly influence harvest index, F_3 recorded the highest value (21.4).The control treatments showed the lowest seed yield, primarily due to limited nutrient availability. In contrast, the combined foliar application of nitrogen and boron improved nutrient absorption and their effective translocation within the plant. Adequate nutrient supply contributed to enhanced vegetative growth and improved yield-attributing traits, ultimately leading to higher productivity (Sunewad *et al*., 2017 and Dhaliwal *et al*., 2022). Interactions were found non- significant in yield.

The present study clearly inferred that both cultivars choice and foliar nutrient management significantly influenced the growth, yield attributes and yield of gobhi sarson (*Brassica napus* L.). Among the evaluated cultivars, GSC7 consistently exhibited superior performance across all growth and yield parameters. Combination of 1% Borax and 1% Urea as a foliar spray at critical phenological stages (flowering and siliqua formation) markedly enhanced growth parameters and yield attributes and ultimately enhanced seed yield. These results suggest that the integration of high-yielding cultivars with targeted foliar nutrient supplementation offers an effective strategy for optimizing gobhi sarson production under field conditions. Further research may explore the long-term effects of repeated foliar applications and their performance across different environmental conditions.

REFERENCES

Anonymous, 2018. Directorate of economics and statistics, DAC and FW. http://www. desagri.gov.in.

Anonymous, 2023. ICAR-Directorate of Rapeseed-Mustard Research, Annual Report 2023.https://drmr.res.in

Anonymous, 2024.Package and practices for crops of Punjab rabi crop 2024. Punjab Agricultural University, pp. 45.

Biswas, B. and R. Poddar, 2015. Yield and nutrient uptake of sunflower (*Helianthus annuus* L.) as influenced by different levels of nitrogen and sulphur. The Bioscan. **10**(1): 439-444.

Dhaliwal, S. S., V. Sharma and A. K. Shukla, 2022. Impact of micronutrients in mitigation of abiotic stresses in soils and plants- A progressive step towards crop security and nutritional quality. Adv. Agron. **173**: 1–78.

Gupta, S. P., M. V. Singh and M. L. Dixit, 2008. Deficiency and management of micronutrients. Ind. J. Fertil. **3**: 57–60.

Katiyar, A. K., A. S. Jat and S. Singh, 2014. Response of sulphur fertilizers on the yield and oil content of mustard in sandy loam soils of Uttar Pradesh. J. Rural Res.**14**: 52-54.

Kaur, B., S. Singh, M. Devi, A. Kaur and N. Kaur, 2023. Effect of foliar application of nitrogen (N) and Zinc (Zn) on the growth and yield of cauliflower (*Brassica oleracea*). J. Soils and Crops. **33**(2): 277-280.

Manonmani, V. and S. Srimathi, 2009.Influence of Mother Crop Nutrition on Seed Yield and Quality of Blackgram, Madras Agric. J. **96**(1-6):125-128.

Panse, V. G. and P. V. Sukhatme, 1967. Statistical methods for agriculture workers, ICAR, New Delhi.

Pujari, N. D., N. B. Das, N. C. Sarma, N. M. Sarma, N. P. Ahmed, N. G. Das and N. S. Kalita, 2024. Yield gap analysis of rapeseed through frontline Demonstration under rainfed conditions in Bongaigaon district of Assam, India. Ecol. Environ. Conserv. **30**: S47–S50.

Sadiq, S.A., M. Shahi, A. Jan and S. N. U. Din, 2000. Effect of various levels of nitrogen, phosphorus and potassium (NPK) on growth, yield and components of sunflower. Pak. J. Biol. Sci.**3**: 338-339.

Sharma, L.K. and S.K. Bali, 2021. Declining fertilizer use efficiency in intensive agriculture : A case study from indo-gangetic plains. Agrics. Ecosyst. Environ. **31** (5) : 107-115.

Sanwal, S. K., A. Mann, P. C. Sharma, S. L. Krishnamurthy and A. Kumar, 2016. "Zinc and iron management for quality seed production of mustard in salt affected soil" in Quality Seed Production, Processing and Certification of Selected Field and Vegetable Crops in Salt Affected Areas (ICAR-Central Soil Salinity Research Institute (CSSRI) pp. 193–196.

Sillanpaa, M. 1982. "Micronutrients and nutrient status of soils, a global study," in FAO Soil Bulletin. No. **48**. (Rome: FAO), 442.

Singh, L. and S. Bansal, 2020. Status of Rapeseed and Mustard crop in India: Trend and Decomposition Analysis. J. Krishi Vigyan. **8**(2): 279.

Sunewad, A. A., A. V. Gutte and V. G. Takankhar, 2017. Effect of foliar nutrition on yield and economics of soybean (*Glycine max* L) under rainfed condition. Agric. Update. **12**: 1059-1062.

Vaishnav, M. D., V. H. Surve and A. D. Raj, 2024. Effect of nitrogen, phosphorus and sulphur on growth, yield and economics of black sesame (*Sesamum indicum* L.). J. Soils and Crops. **34** (1): 51-55.

Vanisha, K., A. K. Atwal, S. S. Dhaliwal and S. K. Banga, 2013. Assessment of diverse sesame (*Sesamum indicum* L.) germplasm for mineral composition. J. Plant Sci. Res. **29**: 29–36.

Rec. on 15.04.2025 & Acc. on 05.05.2025