Bundelkhand Journal of Academic Research

Combined Effect of Nano Urea and Sulphur on Growth, Development and Yield of Mustard

Randhir[1], Sanju Kumawat[2]

1. MSc. Scholar, USAS, Rayat Bahra University Mohali, Punjab.

2. Assistant Professor, USAS, Rayat Bahra University Mohali, Punjab.

(**Corresponding Author:** kumawatsanju5@gmail.com)

https://doi.org/10.5281/zenodo.21790708

Abstract

A field experiment was conducted during the Rabi season to evaluate the effect of nano urea and sulphur levels on growth, yield attributes, nutrient content, and quality parameters of Indian mustard (Brassica juncea L.). The experiment comprised four levels of nano urea (N_0: Control, N_1: 25 ppm, N_2: 50 ppm, N_3: 75 ppm) and four levels of sulphur (S_0: 0 kg/ha, S_1: 10 kg/ha, S_2: 20 kg/ha, S_3: 30 kg/ha) laid out in Factorial Randomized Block Design with three replications. Results revealed that application of nano urea at 50 ppm (N_2) significantly improved growth parameters, yield attributes, seed yield (2459 kg/ha), stover yield (4820 kg/ha) and oil content (41.05%). Similarly, sulphur application at 20 kg/ha (S_2) recorded the highest seed yield (2492 kg/ha), stover yield (4800 kg/ha), oil content (41.19%), and protein content (20.02%). The study concludes that combined application of nano urea at 50 ppm and sulphur at 20 kg/ha can be recommended for optimizing productivity and quality of Indian mustard.

Article Info			
	Received: 06 May, 2026	**Accepted:** 28 May, 2026	**Published:** 30 June, 2026
	Table: 03	**Figures & Graphs:** 02	**Sources & Ref.:** 13
	Keywords:	Growth Attributes, Indian Mustard, Nano Urea, Sulphur, Yield, oilseed.	

1. Introduction: Indian mustard (Brassica juncea L.) is one of the most important oilseed crops cultivated in India, occupying a prominent position among Rabi oilseed crops. It is grown extensively in Rajasthan, Uttar Pradesh, Haryana, Punjab, and Madhya Pradesh, contributing significantly to the country's edible oil economy. The crop is valued for its high-quality oil (40-45%) and protein-rich seed meal (30-35%), making it an important commodity for both domestic consumption and export (Singh and Kumar, 2022).

Nitrogen is a primary nutrient that plays a crucial role in plant growth and development, significantly influencing yield and quality parameters of oilseed crops (Fageria and Baligar, 2020). However, conventional nitrogen fertilizers suffer from low nutrient use efficiency (30-40%) due to losses through volatilization, denitrification, and leaching, leading to environmental pollution and economic losses (Bijay-Singh and Craswell, 2021). Nano fertilizers have emerged as a promising alternative to conventional fertilizers, offering enhanced nutrient use efficiency through controlled release mechanisms (Liu and Lal, 2021). Nano urea, with its sub-micron particle size and high surface area-to-volume ratio, facilitates better penetration and absorption of nutrients, potentially reducing fertilizer application rates while maintaining or improving crop productivity (Khan and Ahmad, 2023; Zhang and Zhang, 2020).

Sulphur is an essential secondary nutrient for oilseed crops, playing a vital role in oil synthesis, protein formation, chlorophyll synthesis, and various metabolic processes (Meena and Das, 2020). Oilseed crops have a high sulphur requirement, and its deficiency has become widespread due to the use of sulphur-free fertilizers and reduced atmospheric sulphur deposition (Sharma and Gupta, 2023). Adequate sulphur nutrition is crucial for enhancing oil content, improving seed quality, and optimizing overall crop productivity (Verma and Singh, 2023).

Given the importance of integrated nutrient management for sustainable oilseed production, this study was undertaken to evaluate the individual and interactive effects of nano urea and sulphur on growth, yield, and quality parameters of Indian mustard.

2. Materials and Methods:

2.1. Experimental Site: The field experiment was conducted during the Rabi season of 2025-26 at the research farm of the Department of Agronomy, Rayat Bahra University Mohali, Punjab. The experimental site is located at 30°47'N latitude and 76°43'E longitude at an altitude of 310 m above mean sea level. The soil of the experimental field was sandy loam in texture, with pH 7.2, organic carbon 0.48%, available N 218 kg ha^{-1}, available P_2O_5 21.6 kg ha^{-1}, and available K_2O 202.5 kg ha^{-1}. The agro-meteorological data is presented in Fig. 1.

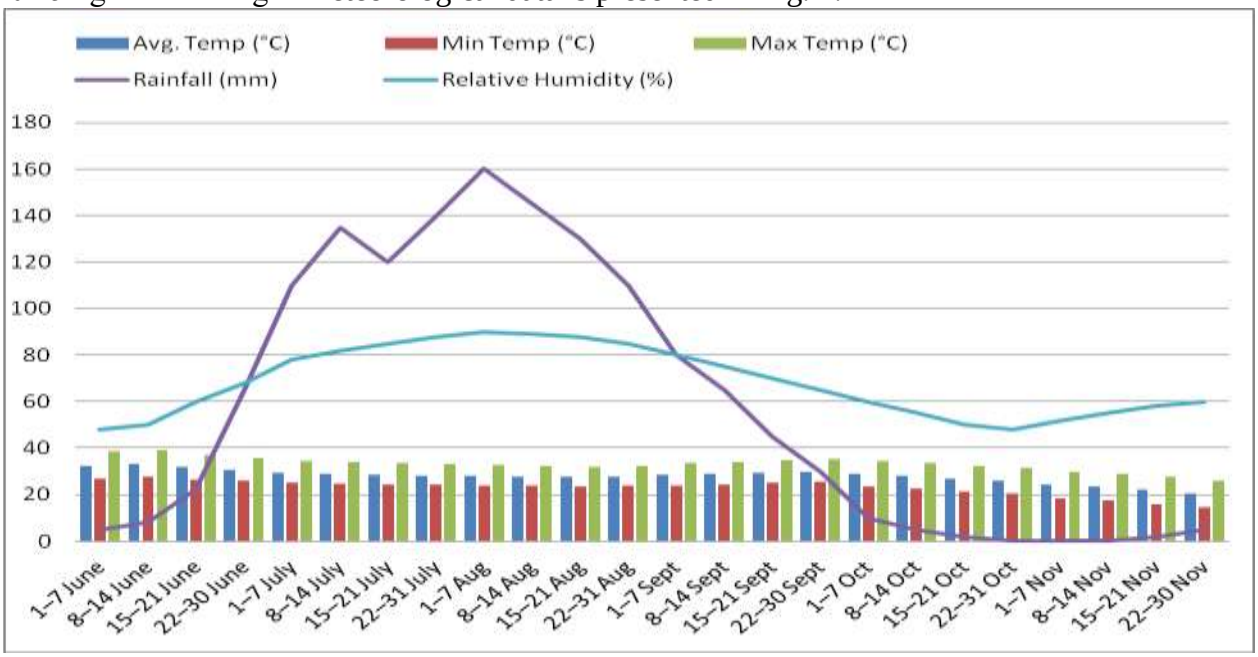

Fig. 1: Meteorological weather prameters recorded during crop growing season kharif, 2025-26

2.2. Experimental Design and Treatments: The experiment was laid out in a factorial randomized block design (RBD) with sixteen treatments replicated thrice. The treatments comprised (A) levels of nano urea as N_0: Control (No nano urea), N_1: 25 ppm nano urea, N_2: 50 ppm nano urea, N_3: 75 ppm nano urea and (B) sulphur levels S_0: 0 kg S/ha, S_1: 10 kg S/ha, S_2: 20 kg S/ha, S_3: 30 kg S/ha. The RDF for maize was 120:60:40 kg N:P_2O_5:K_2O ha^{-1}. The common fertilizer dose of 50-50 P2O5 – K2O kg/ha was applied as basal in all plots through DAP fand MOP fertilizers, respectively. Nano urea was applied as spray at 25, 35 and 45 DAS while, sulphur was applied as basal as per treatments through Cosavet.

2.3 Crop Management and observations: Mustard variety "GSC-7" was sown with a seed rate of 23 kg ha^{-1} at a spacing of 30 cm × 10 cm. Standard agronomic practices were followed throughout the crop growth period. Irrigation was provided as per the requirement of the crop. Plant height, number of primary and secondary branches, number of siliqua per plant, length of

siliqua, test weight and yield were measured by standard methods. Oil content content and N, P, K and S content in grain and stover were analysed in lab by standard methods. The data collected were statistically analyzed using analysis of variance (ANOVA) for randomized block design. The significance of differences between treatment means was tested using the critical difference (CD) at P=0.05.

3. Results and Discussion:

3.1. Effect on Growth Attributes: Nano urea and sulphur application significantly influenced plant height at all growth stages (Table-1). At 60 DAS, N_2 (50 ppm) recorded the tallest plants (116 cm), followed by N_3 (112 cm), N_1 (105 cm), and N_0 (102 cm). Similar trends were observed at 90 DAS and at harvest, with N_2 consistently recording the highest values (144 cm and 160 cm, respectively). Sulphur application also significantly increased plant height, with S_2 (20 kg/ha) producing the tallest plants at all growth stages. These results are in agreement with the findings of Singh et al. (2022) who reported enhanced plant height in mustard with balanced nutrient application.

Table-1: Effect of Nano urea and sulphur on growth attributes of Indian mustard

Treatments	Plant height (cm)			Number of branches per plant	
	At 60 DAS	At 90 DAS	At Harvest	Primary	Secondary
Levels of Nano urea (N)					
N_0 : Control	102	127	141	5.27	13.94
N_1 : 25 ppm	105	133	148	6.52	15.05
N_2 : 50 ppm	116	144	160	7.11	16.31
N_3 : 75 ppm	112	139	155	6.66	15.37
S.Em.±	2.86	3.90	4.23	0.19	0.42
C.D. at 5 %	8.25	11.26	12.21	0.55	1.21
Levels of Sulphur (S)					
S_0 : 0 Kg/ha	103	129	142	5.98	14.37
S_1 : 10 Kg/ha	105	132	147	6.27	14.77
S_2 : 20 Kg/ha	114	143	159	6.83	16.07
S_3 : 30 Kg/ha	113	140	155	6.47	15.45
S.Em±	2.86	3.90	4.23	0.19	0.42
C.D. at 5 %	8.25	11.26	12.21	0.55	1.21
Interaction (N x S)					
S.Em.±	5.71	7.80	8.46	0.38	0.84
C.D. at 5 %	NS	NS	NS	NS	NS
C.V. %	9.11	9.93	9.70	10.34	9.59

The number of primary and secondary branches per plant showed significant improvement with nano urea and sulphur application (Table 1). N_2 (50 ppm) recorded the highest number of primary branches (7.11) and secondary branches (16.31), followed by N_3 (6.66 and 15.37), N_1 (6.52 and 15.05), and N_0 (5.27 and 13.94). Similarly, S_2 (20 kg/ha) produced the maximum number of primary branches (6.83) and secondary branches (16.07). The enhanced branching under adequate nutrition can be attributed to increased meristematic activity and better assimilate availability, which promotes the development of lateral shoots (Sharma and Gupta, 2023). These findings corroborate with the observations of Yash and Kumar (2022) who reported positive effects of nitrogen and sulphur on branching pattern in mustard.

3.2 Effect on Yield Attributes and Yield: Nano urea application significantly increased the number of siliquae per plant, siliquae length and test weight (Table-2). The highest number of siliquae, length and test weight were recorded under N_2 (271, 4.87 cm and 5.04 g), followed by N_3 and N_1. Similarly, sulphur application at S_2 produced the maximum values of these parameters

(268, 4.90 cm and 4.97 g), followed by S_3 and S_1. This could be due to the synergistic effect of nitrogen (from nano urea) and sulphur in promoting flower development and pod set (Kumar and Singh, 2022; Verma and Singh, 2023). The significant interaction (CD at 5% = 37.77) confirms that the response of siliquae number to one nutrient depended on the level of the other.

Table-2: Effect of nano urea and sulphur on yield attributes, oil content and Crude protein content of Indian mustard

Treatments	Number of siliquae per plant	Length of siliqua (cm)	1000-seed weight (g)	Oil content (%)	Protein content (%)
Levels of Nano urea (N)					
N_0 : Control	212	3.84	3.85	38.10	16.86
N_1 : 25 ppm	244	4.44	4.66	38.75	18.23
N_2 : 50 ppm	271	4.87	5.04	41.05	20.44
N_3 : 75 ppm	258	4.64	4.72	39.48	19.88
S.Em.±	6.54	0.15	0.13	0.74	0.51
C.D. at 5 %	18.88	0.43	0.37	2.15	1.48
Levels of Sulphur (S)					
S_0 : 0 Kg/ha	224	3.88	4.05	37.50	17.31
S_1 : 10 Kg/ha	237	4.47	4.57	39.20	18.48
S_2 : 20 Kg/ha	268	4.90	4.97	41.19	20.02
S_3 : 30 Kg/ha	255	4.55	4.68	39.49	19.61
S.Em.±	6.54	0.15	0.13	0.74	0.51
C.D. at 5 %	18.88	0.43	0.37	2.15	1.48
Interaction (N x S)					
S.Em.±	13.08	0.29	0.26	1.49	1.03
C.D. at 5 %	37.77	NS	0.75	NS	NS
C.V. %	9.20	11.48	9.78	6.54	9.44

The application of nano urea significantly influenced seed yield and stover yield of Indian mustard (Fig. 2). Among the nano urea levels, N_2 (50 ppm) recorded the highest seed yield (2459 kg/ha) and stover yield (4820 kg/ha) followed by N_3 and N_1 (2220 kg/ha). The significant increase in seed yield with nano urea application can be attributed to enhanced nutrient uptake, improved photosynthetic activity, and better partitioning of assimilates towards reproductive structures (Kumar and Singh, 2022). The optimum response at 50 ppm suggests that this concentration provides adequate nitrogen nutrition without causing toxicity or metabolic disturbances. These findings are consistent with Tiwari and Sharma (2021) who reported increased yield in oilseed crops with nano fertilizer application.

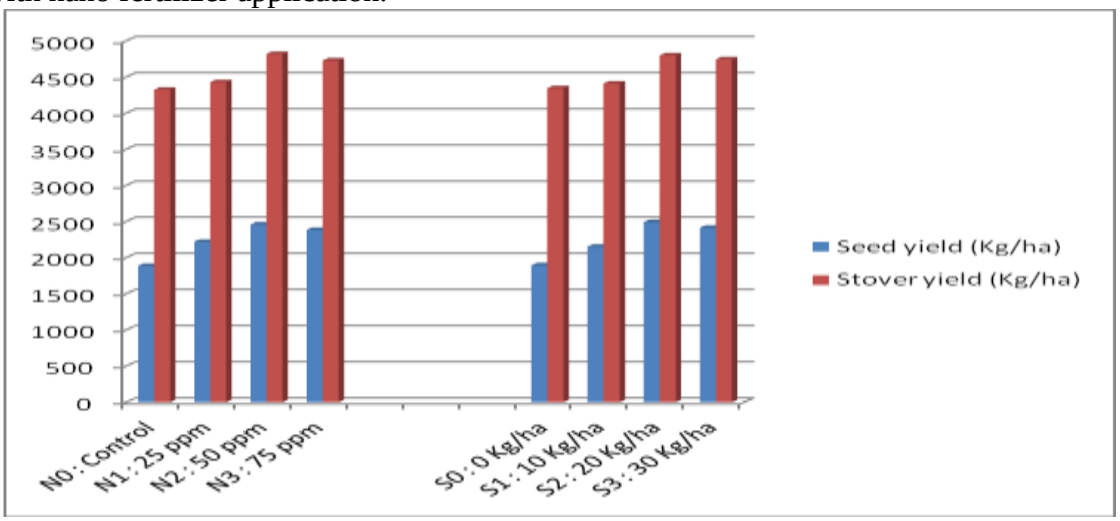

Fig.2: Effect of integrated nutrient management on seed and straw yield of mustard.

Sulphur application also significantly enhanced seed and stover yields. The treatment S_2 (20 kg S/ha) produced the highest seed yield (2492 kg/ha) and stover yield (4800 kg/ha). The positive response to sulphur application can be attributed to its role in chlorophyll synthesis, enzyme activation, and oil formation (Meena and Das, 2020). Sulphur is a constituent of essential amino acids (cysteine, methionine) and is crucial for the synthesis of glucosinolates and oil (Verma and Singh, 2023).

3.3 Effect on Quality Parameters: Oil content is a crucial quality parameter determining the economic value of mustard seed (Table-3). Nano urea application significantly influenced oil content, with N_2 (50 ppm) recording the highest oil content (41.05%) and the highest N content in seed (3.27%) and stover (0.61%). Phosphorus content in seed was not significantly affected by nano urea or sulphur application, though slight variations were observed. The enhanced N content with nano urea application can be attributed to improved nitrogen uptake efficiency and better translocation of nitrogen to reproductive organs (Liu and Lal, 2021; Zhang and Zhang, 2020).

Table-3: Effect of nano urea and sulphur on nutrient content in seed and stover of Indian mustard

Treatments	Nutrient content in seed (%)				Nutrient content in stover (%)			
	N	**P**	**K**	**S**	**N**	**P**	**K**	**S**
Levels of Nano urea (N)								
N_0 : Control	2.70	0.56	0.73	0.79	0.55	0.13	1.06	0.22
N_1 : 25 ppm	2.92	0.57	0.74	0.82	0.56	0.15	1.09	0.24
N_2 : 50 ppm	3.27	0.62	0.82	0.88	0.61	0.15	1.18	0.26
N_3 : 75 ppm	3.18	0.60	0.79	0.83	0.60	0.14	1.16	0.24
S.Em.±	0.08	0.02	0.03	0.03	0.02	0.01	0.03	0.01
C.D. at 5 %	0.24	NS	0.07	NS	0.05	NS	0.09	NS
Levels of Sulphur (S)								
S_0 : 0 Kg/ha	2.77	0.57	0.73	0.78	0.54	0.13	1.07	0.22
S_1 : 10 Kg/ha	2.96	0.59	0.75	0.81	0.58	0.14	1.09	0.23
S_2 : 20 Kg/ha	3.20	0.60	0.81	0.88	0.60	0.15	1.17	0.27
S_3 : 30 Kg/ha	3.14	0.59	0.79	0.84	0.59	0.15	1.16	0.24
S.Em.±	0.08	0.02	0.03	0.03	0.02	0.01	0.03	0.01
C.D. at 5 %	2.77	0.57	0.73	0.78	NS	NS	NS	0.03
Interaction (N x S)								
S.Em.±	0.16	0.04	0.05	0.05	0.04	0.01	0.07	0.02
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	9.44	11.71	11.44	10.50	10.57	13.25	10.03	15.54

Similarly, sulphur application at S_2 (20 kg/ha) resulted in maximum oil content (41.19%) and sulphur content in seed (0.88%). The increase in oil content with sulphur application is particularly noteworthy, as sulphur is essential for the synthesis of glucosinolates and oil (Verma and Singh, 2023). Sulphur-containing amino acids (cysteine and methionine) are precursors to various oil-related compounds (Meena and Das, 2020). The increase in S content with sulphur application indicates enhanced sulphur uptake, which is desirable for improving oil quality and protein synthesis (Meena and Das, 2020).

Conclusion: The study concludes that foliar application of nano urea at 50 ppm (N_2) and soil application of sulphur at 20 kg/ha (S_2) significantly improved growth, yield, and quality of Indian mustard. N_2 recorded maximum seed yield (2459 kg/ha), stover yield (4820 kg/ha), oil content (41.05%), and protein content (20.44%), while S_2 produced the highest seed yield (2492 kg/ha), oil content (41.19%), and protein content (20.02%). The significant interaction between nano urea and sulphur for seed yield indicates synergistic effects when applied together. Nano urea proved to be

an efficient alternative to conventional nitrogen fertilizers with enhanced nutrient use efficiency. Therefore, combined application of nano urea at 50 ppm and sulphur at 20 kg/ha is recommended for optimizing productivity and profitability in Indian mustard. However, long-term studies on soil health and economic feasibility under diverse agro-climatic conditions are needed for wider adoption.

References:

1. Bijay-Singh and Craswell, E. (2021). Fertilizers and nitrate pollution of surface and ground water: An increasingly pervasive global problem. Soil Research, 59(2), 105-118.
2. Fageria, N. K. and Baligar, V. C. (2020). Enhancing nitrogen use efficiency in crop plants. Advances in Agronomy, 105, 97-185.
3. Gomez, K. A. and Gomez, A. A. (1984). Statistical Procedures for Agricultural Research (2nd ed.). John Wiley and Sons, New York.
4. Khan, I. and Ahmad, R. (2023). Nano urea: A novel approach to enhance nitrogen use efficiency in wheat. Pakistan Journal of Agricultural Sciences, 60(1), 78-89.
5. Kumar, V. and Singh, S. (2022). Response of Indian mustard to nano fertilizers and sulphur under rainfed conditions. Annals of Agricultural Research, 43(1), 56-67.
6. Liu, R. and Lal, R. (2021). Nano fertilizers: A review on their synthesis, characterization, and applications. Soil Science Society of America Journal, 85(4), 956-978.
7. Meena, R. S. and Das, A. (2020). Sulphur nutrition in oilseed crops. Nutrient Cycling in Agroecosystems, 116, 187-201.
8. Sharma, A. and Gupta, R. (2023). Effect of foliar application of nano urea on growth and yield of mustard. International Journal of Plant Sciences, 18(2), 112-125.
9. Singh, V. and Kumar, A. (2022). Integrated nutrient management in Indian mustard. Journal of Soil Science and Plant Nutrition, 22(1), 45-58.
10. Tiwari, R. and Sharma, P. (2021). Nano fertilizers in agriculture: Opportunities and challenges. Asian Journal of Agriculture, 5(2), 89-101.
11. Verma, R. and Singh, P. (2023). Role of sulphur in oilseed production: A review. Agricultural Reviews, 44(1), 34-47.
12. Yash, S. and Kumar, R. (2022). Growth and yield response of mustard to different levels of nitrogen and sulphur. Indian Journal of Agricultural Sciences, 92(3), 456-463.
13. Zhang, W. and Zhang, X. (2020). Application of nanotechnology in fertilizer delivery for sustainable agriculture. Journal of Controlled Release, 325, 145-158.

=====

Cite the article:	Randhir and Kumawat, Sanju (2026). Combined Effect of Nano urea and Sulphur on Growth, Development and Yield of Mustard. Bundelkhand Journal of Academic Research (BJAR), Volume-2, Issue-2, April-June 2026, Page114-119. https://doi.org/10.5281/zenodo.21790708