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Studies on growth and yield of sesame (*Sesamum indicum*) as influenced by different levels of nitrogen and nano urea

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ABSTRACT

A field experiment entitled 'Studies on growth and yield of sesame (*Sesamum indicum*) as influenced by different levels of nitrogen and nano urea' was conducted at Agronomy fields of Lovely Professional University, Phagwara, Punjab during the *kharif* season of 2022-23. The experimental field had sandy loam soil with pH 8.27. The experiment consisted twelve treatments arranged in Split Plot Design which was replicated thrice. The main plot consisted of three levels of mineral nitrogen (urea) *viz.* F_1-0%, F_2- 50% , F_3- 100% and subplot consisted of four levels of nano urea form of nitrogen *viz.* N_1- 0%, N_2- 10%, N_3- 20%, N_4- 25%. Among the mineral nitrogen application, highest of all growth and yield parameters were recorded with F_3 and lower growth and yield parameters recorded with F_1. Similarly in case of nano nitrogen foliar application, highest of growth and yield parameters recorded with N_4 which was found to be on par with N_3 and the lowest of all the parameters recorded with N_1. However, their interaction was found to be non-significant for all the parameters of the study.

Key words: *Sesame, Mineral nitrogen, Nano urea, Foliar application*

Introduction

Sesame (*Sesamum indicum L.*) is the most established native oilseed crop with the most extended history. Sesame is known as the "Queen of Oilseeds" due to the high quality of its seed, oil, and meal. It is one of the important oil seed crop after ground nut and rapeseed. The area under sesame cultivation in India was 3.34 lakh ha in the year 2021 -22 and its production was 7.62 lakh tonnes for the same year (Directorate of eco and stat). In Punjab sesame was cultivated in a total land area of 2.5 thousand ha with a production of 1.0 thousand tonnes. Sesame is of great economic importance as it is rich in oil (38-54%) and protein (18-20%). Sesame is an essential source of high-quality oil and protein (Johnson *et al*., 1979, Elleuch *et al*., 2007). The oil has a low cholesterol content and a high proportion of polyunsaturated fat (approximately 80% unsaturated fatty acids) (Bedigian, 2010 and Ogundare *et al*., 2016). Therefore used for cooking purposes and is known as 'poor man's substitute for *ghee*'.Sesame proteins are vital in the essential sulfur-containing amino acids methionine and tryptophan. The seeds include sesaolion and sesamin, substances that might aid in lowering cholesterol and enhancing heart health. Even though having such potential the crop is unable to yield to its maximum productivity, this could be attributed to many reasons like- poor agronomic practices, usage of only traditional varieties, poor

fertilizer application resulting into malnourished plants, unawareness of package of practices. Out of all the reasons the most important one, which is tried to be explained through the experiment is non-use of balanced fertilizers. Amongst the fertilizers, much light is put on nitrogenous fertilizers and its source.

Nitrogen is the one of the three important primary nutrients that any crop requires to complete its life cycle. Nitrogen application tends to increase leaf area, chlorophyll content and thus associated with overall increase in vegetative growth of the plant. Further, this vegetative growth will determine the dry matter accumulation in the plant. (Zenawi *et al*., 2019). Since sesame is rich in protein content (18-20%) and to sustain this protein level in the seed adequate application of nitrogen is a must. Also it was stated that, application of nitrogen tends to increase the number of capsules per plant and seeds per capsules (Ofosuhene-Sintim and Yeboah-Badu., 2010). Thus optimal application of nitrogenous fertilizers is a mandate to achieve these qualities in sesame.

In this study an effort has been made to determine the effect of various sources of nitrogenous fertilizers on growth and yield of sesame.

Material and Methods

The experiment was conducted at Agronomy research fields of Lovely Professional University. The field is located at an latitude of 31.25ºN and longitude of 75ºE along with the altitude of above mean sea level 234m. Total area of the experiment was 1041 m^2, having uniform topography with gentle slope. This region falls under the central agro-climatic zone of Punjab. The experimental soil was sandy loam in texture with a pH of 8.27. The experiment was laid out in Split Plot Design with three levels of mineral nitrogen (urea) in main plot *viz.* F_1- 0%, F_2- 50% , F_3- 100% and in subplot four levels of nano urea form of nitrogen *viz.* N_1- 0%, N_2- 10%, N_3- 20%, N_4- 25% (note:two application of nano urea was carried out , first at 30 DAS and second at 60 DAS). Therefore a total of twelve (3x4) treatments were replicated thrice. The seeds of variety Punjab *til* No. 2 was sown on 25th July 2022 and the crop was harvested on 2nd November 2022.

Results and Discussion

Growth parameters

Among the mineral nitrogen application (urea), significantly taller plants, maximum number of leaves, thicker stem and higher dry matter production per plant at harvest were recorded with treatment F_3 (119.01 cm, 10.53, 3.54 cm and 43.55 g/plant respectively), while the lowest of all the above parameters were recorded with the treatment F_1 (51.10 cm, 7.03, 2.39 and 20.42 respectively). The findings were in line to those recorded by Kumar *et al*., (2022). This

Table 1. Effect of different levels of nitrogen and nano urea on plant growth parameters of sesame

Treatments	Plant height	Number of leaves	Stem girth	Dry matter production per plant
Mineral Nitrogen				
F_1- 0% N	51.10	7.03	2.39	20.42
F_2- 50%N	97.65	8.53	3.11	33.02
F_3-100%N	119.01	10.53	3.54	43.55
S.Em ±	1.85	0.17	0.06	1.07
CD at 5%	7.26	0.65	0.25	4.20
Nano Urea				
N_1-0% N	83.89	8.22	2.80	28.13
N_2- 10% N	87.02	8.22	2.89	30.68
N_3- 20 % N	90.98	9.00	3.12	34.27
N_4- 25% N	95.14	9.33	3.24	36.23
S.Em ±	1.79	0.25	0.07	0.91
CD at 5%	5.31	0.73	0.22	2.71
Interaction				
S.Em ±	3.10	0.43	0.13	1.58
CD at 5%	**NS**	**NS**	**NS**	**NS**

could be attributed to the fact that, application of urea enhances protein synthesis, cell enlargement which in turn increases vegetative growth of the crop.

Among the nano-urea spray, significantly taller plants (95.14), maximum number of leaves (9.33), thicker stem (3.24 cm) and dry matter production (36.23 g/plant) at harvest were recorded with treatment N_4 and this was found to be significantly on par with N_3, while the shorter plants (83.89 cm), lower number of leaves (8.22), minimum stem girth (2.80 cm) and dry matter production per plant (28.13 g/plant) were recorded with the treatment N_1. Similar findings were reported by Navya *et al*., 2022. Nano urea foliar spray is a form of urea fertilizer that has been processed into nanoparticles to enhance its efficiency and effectiveness when applied to plants. When this nano urea foliar spray is used, it can increase plant's vegetative growth due to improved nutrient uptake, enhanced nutrient mobility, faster nutrient assimilation and reduced nutrient loss.

The interaction of mineral nitrogen and nano urea application were not found to be significant at any stages of plant growth.

Yield parameters

Among the mineral nitrogen application, significantly higher grain yield/ha were recorded with treatment F_3 (6.36 q/ha), while the minimum was recorded with the treatment F_1 (2.22 q/ha). Similar trends were followed in case of straw yield and biological yield. Whereas in case of harvest index, the results were found to be non-significant. Similar findings were quoted by Ali *et al.* (2015).

Among the nano urea spray, significantly maximum grain yield/ha were recorded with treatment N_4 (4.60 q/ha) and N_3 was found to be significantly on par (4.43 q/ha), while minimum grain yield/ ha was recorded with the treatment N_1 (4.17). Similar trend was followed in case of straw yield pod and biological yield (Goud *et al*.,2022). In case of harvest index, the results were found to be non-significant.

However the interaction of mineral nitrogen application and nano urea application did not had any significant impact on the any of the yield parameters.

The increased yield might be because of increased plant biomass. Nitrogen is a key component of proteins and enzymes, which are essential for plant growth and development. Adequate nitrogen availability stimulates the synthesis of proteins, resulting in increased plant biomass. This increased biomass can lead to higher grain and straw yields. Also due to the presence of higher yield attributing characters.

Economics of the experiment

Among the mineral nitrogen application, highest gross return recorded with treatment F_3 (52,290.93 Rs/ha), while the minimum was recorded with the treatment F_1 (18214.69 Rs/ha).In case of net return, F_3 had the highest monetary advantage of Rs

Table 2. Effect of different levels of nitrogen and nano urea on yield of sesame

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)	Harvest index(%)
Mineral Nitrogen				
F_1- 0% N	2.22	4.18	6.37	34.97
F_2- 50%N	4.49	8.90	13.36	33.61
F_3-100%N	6.39	14.47	20.96	30.68
S.Em ±	0.10	0.16	0.27	0.30
CD at 5%	0.39	0.61	1.05	NS
Nano Urea				
N_1-0% N	4.17	8.69	12.79	33.39
N_2- 10% N	4.26	8.86	13.24	33.51
N_3- 20 % N	4.43	9.43	13.86	32.78
N_4- 25% N	4.60	9.76	14.37	32.66
S.Em ±	0.07	0.15	0.20	0.24
CD at 5%	0.21	0.45	0.59	NS
Interaction				
S.Em ±	0.12	0.26	0.34	0.41
CD at 5%	**NS**	**NS**	**NS**	**NS**

Table 3. Effect of different levels of nitrogen and nano urea on economics sesame

Treatments	Cost of cultivation (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	B:C ratio
Mineral Nitrogen				
F_1- 0% N	31080.20	18214.69	-12867.16	0.59
F_2- 50%N	31228.95	36565.72	5332.15	1.17
F_3-100%N	31218.25	52290.93	21067.33	1.68
Nano Urea				
N_1-0% N	31143.06	34309.06	3163.11	1.10
N_2- 10 % N	31195.23	34835.45	3636.28	1.12
N_3- 20% N	31070.88	36127.01	5053.42	1.16
N_4- 25% N	31294.06	37490.26	6190.28	1.20

21,067.33 while F_1 there is a loss of Rs. 12,867.16 pointing that the treatment did not benefited economically. The highest B:C ratio recorded with F_3 (1.68) and lowest with F_1 (0.59).

Among the nano urea foliar application, highest gross return recorded with treatment N_4(37490.26 Rs/ha), while the minimum was recorded with the treatment N_1 (34309.06 Rs/ha). In case of net return, N_4 had the highest monetary advantage of Rs 6190.28 while N_1 had the lowest monetary advantage of Rs. 3163.11. The highest B:C ratio recorded with N_4 (1.20) and lowest with N_1 (1.10).

Conclusion

It can be concluded from the study that, both the sources of nitrogen were effective in producing effective growth and yield in sesame when compared to the respective control treatments. As the dose of nitrogen increases, the growth of the crop also increased since nitrogen increases the overall vegetative growth in plants. This also had a positive impact on the overall yield of the crop. Therefore application of nitrogen fertilizers will boost the economy of the farmer by improving the overall growth and development of the crop.

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