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Shravya Reddy
M.Sc. Research Scholar,
Department of Agronomy,
College of Agriculture, PJTAU,
Rajendranagar, Hyderabad,
Telangana, India

Dr. D Swetha
Scientist (Agronomy), ARS,
Tornala, Siddipet, Telangana,
India

Dr. P Sri Ranjitha
Assistant Professor (Agronomy),
APT, Jogipet, Sangareddy,
Telangana, India

Dr. S Sridevi
Professor, Department of Soil
Science & Agricultural Chemistry,
College of Agriculture,
Rajendranagar, Hyderabad,
Telangana, India

Corresponding Author:
Shravya Reddy
M.Sc. Research Scholar,
Department of Agronomy,
College of Agriculture, PJTAU,
Rajendranagar, Hyderabad,
Telangana, India

Effect of nano urea plus and nano DAP on growth and yield attributes and yield of sunflower (*Helianthus annuus* L.) during *rabi*

Shravya Reddy, D Swetha, P Sri Ranjitha and S Sridevi

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Abstract

A field experiment was carried out during *rabi*, 2025-26 at Agricultural Research Station, Tornala, Siddipet to study the effect of nano urea plus and nano DAP on growth and yield attributes of sunflower (*Helianthus annuus* L.) under *Alfisol*. The experiment was laid out in Randomized Block Design (RBD) with ten treatments replicated thrice. The treatments were T₁ - 100% RDF (75: 90: 30 N: P₂O₅: K₂O kg ha⁻¹), T₂ - 60% RDN + nano urea plus @ 4 ml L⁻¹ at 30 & 45 DAS, T₃ - 80% RDN + nano urea plus @ 4 ml L⁻¹ at 30 & 45 DAS, T₄ - 60% RDNP + seed treatment with nano DAP @ 5 ml kg⁻¹ seed + nano DAP @ 4 ml L⁻¹ at 30 DAS and 45 DAS, T₅ - 80% RDNP + seed treatment with nano DAP @ 5 ml kg⁻¹ seed + nano DAP @ 4 ml L⁻¹ at 30 DAS and 45 DAS, T₆ - 60% RDNP + seed treatment with nano DAP @ 5 ml kg⁻¹ seed + nano DAP @ 4 ml L⁻¹ at 30 DAS + nano urea plus @ 4 ml L⁻¹ at 45 DAS, T₇ - 80% RDNP + seed treatment with nano DAP @ 5 ml kg⁻¹ seed + nano DAP @ 4 ml L⁻¹ at 30 DAS + nano urea plus @ 4 ml L⁻¹ at 45 DAS, T₈ - 100% RDNK (75: 30 N: K₂O kg ha⁻¹), T₉ - 100% RDPK (90: 30: P₂O₅: K₂O kg ha⁻¹), T₁₀ - Control -No N and P application. The results revealed that the growth and yield attributes of sunflower influenced significantly due to the different treatments. Application of 80% RDNP + seed treatment with nano DAP @ 5 ml kg⁻¹ seed + nano DAP @ 4 ml L⁻¹ at 30 DAS and 45 DAS (T₅) recorded significantly highest stem girth (7.8 cm) and head diameter (16 cm) and it was on par with 80% RDNP + seed treatment with nano DAP @ 5 ml kg⁻¹ seed + nano DAP @ 4 ml L⁻¹ at 30 DAS + nano urea plus @ 4 ml L⁻¹ at 45 DAS (T₇) and 100% RDF (T₁). Whereas, 100% RDF (T₁) recorded significantly highest plant height (188.8 cm), 100 seed weight (5.5 g), seed yield (1779 kg ha⁻¹) and stalk yield (2814 kg ha⁻¹), found on par with T₅ and T₇.

Keywords: Sunflower, RDF, nano urea plus, nano DAP, foliar sprays, growth and yield attributes, seed yield

Introduction

Sunflower (*Helianthus annuus* L.), belonging to the family Asteraceae, is an important oilseed crop valued for its high-quality oil rich in unsaturated fatty acids (Heiser, 1978; Rai, 2002) [5, 9]. The seeds contain approximately 45-50% oil, 14-19% protein, 21-27% hull, 7-9% soluble sugars and 30-35% carbohydrates. In India, sunflower is the fourth most important oilseed crop, cultivated over 1.51 lakh hectares with a production of 1.73 lakh tonnes and an average productivity of 1144 kg ha⁻¹ (Indiastat, 2025) [6]. In Telangana, it is grown on about 0.100 lakh hectares with a production of 0.283 lakh tonnes and a higher productivity of 2833 kg ha⁻¹ (Indiastat, 2025) [6], indicating its strong potential under favourable conditions. Its short duration, wide adaptability and suitability across diverse cropping systems make it an ideal crop under varied agro-climatic situations. However, despite these advantages, productivity in India remains suboptimal due to factors such as moisture stress, climatic variability and inefficient nutrient management (Rath *et al.*, 2022) [11].

Efficient management of nitrogen and phosphorus is critical for enhancing sunflower productivity. Conventional fertilizer practices are often associated with low nutrient use efficiency, with 40-70% of nitrogen and 80-90% of phosphorus lost through leaching, volatilization and fixation before plant uptake. These losses not only reduce crop yield and farm profitability but also contribute to environmental degradation. Moreover, excessive and imbalanced fertilizer application can deteriorate soil health, disturb microbial activity and impair ecosystem stability. Such limitations restrict sunflower production and contribute to stagnation in oilseed output.

In this context, nano fertilizers offer a promising approach to address these challenges by enhancing nutrient use efficiency, improving crop performance and minimizing environmental impacts. Therefore, the present investigation was undertaken to evaluate the combined effect of nano urea and nano DAP on the growth, yield attributes and productivity of sunflower.

Materials and Methods

The field experiment was conducted at Agricultural research station, Tornala, Siddipet, PJTAU, Telanagana state during the *rabi* season of 2025-26. The soil of experimental site was well drained which was favourable for optimum growth of the crop. The soil samples from 0 to 30 cm depth were taken from randomly selected plots all over the experimental field before laying out the experiment. The soil pH was 6.8, available nitrogen (184 kg ha^{-1}), available phosphorous (30.1 kg ha^{-1}) and available potassium (292 kg ha^{-1}). The field experiment was laid out in a Randomized Block Design (RBD) with ten treatments and replicated thrice. The treatments in detailed were T_1 - 100% RDF (75: 90: 30 N: P_2O_5 : $K_2O \text{ kg ha}^{-1}$), T_2 - 60% RDN + nano urea plus @ 4 ml L^{-1} at 30 & 45 DAS, T_3 - 80% RDN + nano urea plus @ 4 ml L^{-1} at 30 & 45 DAS, T_4 - 60% RDNP + seed treatment with nano DAP @ 5 ml kg^{-1} seed + nano DAP @ 4 ml L^{-1} at 30 DAS and 45 DAS, T_5 - 80% RDNP + seed treatment with nano DAP @ 5 ml kg^{-1} seed + nano DAP @ 4 ml L^{-1} at 30 DAS and 45 DAS, T_6 - 60% RDNP + seed treatment with nano DAP @ 5 ml kg^{-1} seed + nano DAP @ 4 ml L^{-1} at 30 DAS + nano urea plus @ 4 ml L^{-1} at 45 DAS, T_7 - 80% RDNP + seed treatment with nano DAP @ 5 ml kg^{-1} seed + nano DAP @ 4 ml L^{-1} at 30 DAS + nano urea plus @ 4 ml L^{-1} at 45 DAS, T_8 - 100% RDNK (75: 30 N: $K_2O \text{ kg ha}^{-1}$), T_9 - 100% RDPK (90: 30: P_2O_5 : $K_2O \text{ kg ha}^{-1}$), T_{10} - Control -No N and P application. Each plot had a gross size of $5.4 \text{ m} \times 4.8 \text{ m}$ and a net size of $4.5 \text{ m} \times 4.4 \text{ m}$. Sowing of sunflower hybrid Tillhan Tech SUNH-1 was carried out on 14th November, 2025, with spacing of $45 \text{ cm} \times 20 \text{ cm}$ by using the dibbling method and a seed rate of 5 kg ha^{-1} . The recommended dose of fertilizer 75:90:30 NPK kg ha^{-1} was applied as per treatments through urea, DAP and MOP. The foliar application of nano urea plus and nano DAP were taken as per the treatments i.e. at 30 and 45 DAS. Growth and yield parameters were recorded periodically on tagged plants. All recommended agronomic practices and need based plant protection measures were followed to ensure a healthy crop. All observations were recorded according to standard procedures. Data on various variables were statistically analysed by analysis of variance (Panse and Sukhatme, 1967) [8].

Results and Discussion

Growth attributes

Plant Height (cm)

Among the different treatments, application of 80% RDNP + seed treatment with nano DAP @ 5 ml kg^{-1} seed + nano DAP @ 4 ml L^{-1} at 30 DAS and 45 DAS (T_5) recorded significantly highest plant height at 30 DAS (43.5) which was on par with (T_7) i.e. application of 80% RDNP + seed treatment with nano DAP @ 5 ml kg^{-1} seed + nano DAP @ 4 ml L^{-1} at 30 DAS + nano urea plus @ 4 ml L^{-1} at 45 DAS (42.5 cm) and T_1 -100% RDF (37.3 cm) Whereas, at 60 DAS and at harvest T_1 -100% RDF recorded the highest plant height (178.8 cm and 188.8 cm respectively) and was at par with T_7 - (176 cm and 181.1 cm), T_5 - (175.3 cm and 179.1 cm).

The increase in plant height might be due to the rapid absorption of nutrients through stomata, which enhances chlorophyll synthesis, photosynthetic ability, enzymatic activity and auxin metabolism in plants, leading to cell enlargement and elongation.

Additionally, nano fertilizer improves carbohydrate transfer from source to sink, providing continuous energy for vegetative growth, ultimately resulting in taller plant height. These results are in accordance with the findings of Vyankatrao *et al.* (2024) [14], Gaikwad *et al.* (2025) [4] and Kumar *et al.* (2025) [7] in sunflower.

Stem girth plant⁻¹ (cm)

Among the various treatments, T_5 - 80% RDNP + seed treatment with nano DAP @ 5 ml kg^{-1} seed + nano DAP @ 4 ml L^{-1} at 30 DAS and 45 DAS recorded highest stem girth at 30 DAS, 60 DAS and at harvest (3.6 cm, 7.5 cm and 7.8 cm respectively). Further, it was found to be on par with T_1 (3.4 cm, 6.9 cm and 7.3 cm) and T_7 (3.3 cm, 7.2 cm and 7.4 cm). The increased stem girth may be due to balanced nitrogen and phosphorus supply, which enhanced nutrient uptake, photosynthesis and vascular development, leading to improved stem thickness. These findings are consistent with the observations of Rajanikanthreddy *et al.* (2025) [10] and Vyankatrao *et al.* (2024) [14].

Yield attributes and yield

Head Diameter (cm)

Among the different treatments, the maximum head diameter was recorded in T_5 - 80% RDNP + seed treatment with nano DAP @ 5 ml kg^{-1} seed + foliar application of nano DAP @ 4 ml L^{-1} at 30 and 45 DAS (16.0 cm), which was statistically at par with T_1 -100% RDF (15.6 cm) and T_7 - 80% RDNP + seed treatment with nano DAP @ 5 ml kg^{-1} seed + foliar application of nano DAP @ 4 ml L^{-1} at 30 DAS + nano urea plus @ 4 ml L^{-1} at 45 DAS (15.1 cm) The increased head diameter attributed to balanced nutrient supply and improved nutrient use efficiency, which enhanced photosynthetic activity and promoted effective translocation of assimilates towards reproductive structures. The inclusion of nano fertilizers likely improved nutrient absorption and utilization, resulting in better head development. The present results are also in conformity with Rajanikanthreddy *et al.* (2024) [10] and Kumar *et al.* (2025) [7].

100-Seed Weight (g)

Among the different treatments, the maximum test weight was recorded in T_1 -100% RDF (5.5 g), which was statistically at par with T_5 - (5.3 g) and T_7 - (5.0 g). The higher test weight may be attributed due to balanced nutrient supply, which enhanced photosynthetic efficiency and ensured better translocation of assimilates towards developing seeds, resulting in improved seed filling. The inclusion of nano fertilizers likely enhanced nutrient use efficiency and availability, thereby supporting superior seed development. Similar observations were reported by Devi *et al.* (2024) [3], Roy and Singh (2024) [12] and Bhakher *et al.* (2023) [1].

Seed Yield

Among different treatments, T_1 (100% RDF) resulted in remarkably higher seed yield (1779 kg ha^{-1}), which was statistically comparable with T_5 - 80% RDNP + seed treatment with nano DAP@ 5 ml kg^{-1} seed + nano DAP @ 4 ml L^{-1} at 30 DAS and 45 DAS (1703 kg ha^{-1}) and T_7 - 80% RDNP + seed treatment with nano DAP@ 5 ml kg^{-1} seed + nano DAP @ 4 ml L^{-1} at 30 DAS + nano urea plus @ 4 ml L^{-1} at 45 DAS (1627 kg ha^{-1}) and these treatments were found to be superior over the remaining treatments. The higher seed yield might be due to improved nutrient availability likely resulted in better vegetative growth viz., plant height, stem girth and improved yield attributes such as larger head diameter, higher seed filling and greater test weight, which ultimately contributed to increased productivity.

These findings align with Bhoomika *et al.* (2025) ^[2] in safflower, Shinde *et al.* (2025) ^[13] in sunflower.

Stalk yield

The maximum stalk yield was recorded in T₁-100% RDF (2814 kg ha⁻¹), which was on par with T₅ (2669 kg ha⁻¹) and T₇ (2658 kg

ha⁻¹). The higher stalk yield might be due to increased higher plant height, no of leaves, stem girth, dry matter accumulation and dry matter partitioning which are closely associated to Stalk yield. These findings are in accordance with Vyankatrao *et al.* (2024) ^[14] and Bhakher *et al.* (2023) ^[1].

Table 1: Effect of foliar spray of nano urea plus and nano DAP on plant height and stem girth

S. No.	Treatments	Plant height (cm)			Stem girth (cm)		
		30 DAS	60 DAS	at harvest	30 DAS	60 DAS	at harvest
T ₁	100% RDF (75: 90: 30 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹)	37.3	178.8	188.8	3.4	6.9	7.3
T ₂	60% RDN + nano urea plus @ 4 ml L ⁻¹ at 30 & 45 DAS	28.5	158.7	167.6	2.7	6.4	6.7
T ₃	80% RDN + nano urea plus @ 4 ml L ⁻¹ at 30 & 45 DAS	35.3	165.4	172.2	2.8	7.1	7.3
T ₄	60% RDNP + seed treatment with nano DAP @ 5 ml kg ⁻¹ seed + nano DAP @ 4 ml L ⁻¹ at 30 DAS and 45 DAS	31.9	159.4	167.9	3.0	6.5	6.9
T ₅	80% RDNP + seed treatment with nano DAP @ 5 ml kg ⁻¹ seed + nano DAP @ 4 ml L ⁻¹ at 30 DAS and 45 DAS	43.5	175.3	179.1	3.6	7.5	7.8
T ₆	60% RDNP + seed treatment with nano DAP @ 5 ml kg ⁻¹ seed + nano DAP @ 4 ml L ⁻¹ at 30 DAS + nano urea plus @ 4 ml L ⁻¹ at 45 DAS	32.6	162.5	170.9	3.1	6.2	6.5
T ₇	80% RDNP + seed treatment with nano DAP @ 5 ml kg ⁻¹ seed + nano DAP @ 4 ml L ⁻¹ at 30 DAS + nano urea plus @ 4 ml L ⁻¹ at 45 DAS	42.5	176.0	181.1	3.3	7.2	7.4
T ₈	100% RDNK (75: 30 N: K ₂ O kg ha ⁻¹)	33.4	153.7	167.6	2.9	6.6	6.8
T ₉	100% RDPK (90: 30: P ₂ O ₅ : K ₂ O kg ha ⁻¹)	34.9	148.3	166.5	2.3	5.6	6.3
T ₁₀	Control -No N and P application	23.2	96.8	123.6	2.2	4.7	5.6
	SEM±	1.8	5.5	6.7	0.2	0.4	0.3
	CD (P=0.05)	5.4	16.3	20.1	0.6	1.1	0.9

Table 2: Effect of foliar spray of nano urea plus and nano DAP on yield attributes and yield

	Treatments	Head diameter (cm)	100 seed weight (g)	Seed yield (kg ha ⁻¹)	Stalk yield (kg ha ⁻¹)
T ₁	100% RDF (75: 90: 30 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹)	15.6	5.5	1779	2814
T ₂	60% RDN + nano urea plus @ 4 ml L ⁻¹ at 30 & 45 DAS	11.5	4.2	1424	2466
T ₃	80% RDN + nano urea plus @ 4 ml L ⁻¹ at 30 & 45 DAS	13.1	4.7	1515	2548
T ₄	60% RDNP + seed treatment with nano DAP @ 5 ml kg ⁻¹ seed + nano DAP @ 4 ml L ⁻¹ at 30 DAS and 45 DAS	11.7	4.5	1444	2490
T ₅	80% RDNP + seed treatment with nano DAP @ 5 ml kg ⁻¹ seed + nano DAP @ 4 ml L ⁻¹ at 30 DAS and 45 DAS	16.0	5.3	1703	2669
T ₆	60% RDNP + seed treatment with nano DAP @ 5 ml kg ⁻¹ seed + nano DAP @ 4 ml L ⁻¹ at 30 DAS + nano urea plus @ 4 ml L ⁻¹ at 45 DAS	12.0	4.6	1499	2523
T ₇	80% RDNP + seed treatment with nano DAP @ 5 ml kg ⁻¹ seed + nano DAP @ 4 ml L ⁻¹ at 30 DAS + nano urea plus @ 4 ml L ⁻¹ at 45 DAS	15.1	5.0	1627	2658
T ₈	100% RDNK (75: 30 N: K ₂ O kg ha ⁻¹)	12.6	4.8	1326	2208
T ₉	100% RDPK (90: 30: P ₂ O ₅ : K ₂ O kg ha ⁻¹)	10.8	4.6	1115	2193
T ₁₀	Control -No N and P application	7.4	4.0	684	1339
	SEM±	0.8	0.2	79	113
	CD (P=0.05)	2.5	0.6	235	338

Conclusion

The study showed that sunflower growth and yield were significantly influenced by foliar sprays of nano fertilizers in combination with nutrient management practices. The treatment with 80% RDNP combined with nano DAP at seed treatment and foliar spray @ 30 & 45 DAS improved growth and yield attributes viz., plant height, stem girth, head diameter and was comparable to 100% RDF. Although 100% RDF recorded higher yield attributes, the results were on par with T₅, indicating that 80% RDNP with nano fertilizers can sustain productivity while improving nutrient use efficiency.

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