**Response of Nano DAP on Growth and Yield of Wheat (*Triticum aestivum* L*.*) in Southern Rajasthan, India**

# Abstract

A field experiment was conducted at experimental farm, Department of Agronomy, Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan) during Rabi season of 2024-25 to study evaluated the response of Nano DAP on growth and yield of wheat variety Raj-3077. The result revealed that the maximum plant height (40.22, 64.46 and 86.74 cm at tillering, jointing and harvest stage), number of total tillers (307), chlorophyll content (21.45), leaf area index (2.12) and yield parameter such as number of effective tillers (294), number of grains per spike (46.78), grain yield (44.25 q/ha), straw yield (59.78 q/ha) and biological yield (404.03 q/ha) with application of T10-T4 + ST with Nano DAP @ 5 ml/kg seed + first FS with Nano DAP @ 4 ml/L of water at 40 DAS and second spray – before one week of flowering stage So, it was concluded that treatment T10-T4 + ST with Nano DAP @ 5 ml/kg seed + first FS with Nano DAP @ 4 ml/L of water at 40 DAS and second spray – before one week of flowering stage was better combination of nano DAP for the higher yield of wheat.

**Key words: Foliar application; Nano fertilizer; DAP; Yield**

# 1. Introduction

The most extensively grown food crop in the world, wheat (*Triticum aestivum* L.), has a prominent place among the cultivated cereals. Wheat is the second most significant cereal crop in India, behind rice, and accounts for around 35% of the country's food basket. It is also crucial to the country's food and nutritional security. According to this growing trend, one of the few viable methods to feed the world's estimated 9.6 billion people by 2050 or later without adversely harming ecosystems and the environment is through the creation and application of innovative fertilisers. In order to feed billions of people, especially in developing and impoverished countries, the agricultural sector has been forced to increase crop productivity due to the recent boom in the world's population. Large-scale chemical fertilizer usage increased crop yields but also upset the mineral balance of the soil and reduced soil fertility (Jain *et al.* 2021). Phosphorus (P), in addition to the other key minerals, is a necessary ingredient for plant growth. It is anticipated that the need for phosphate fertilizers would rise as a result of ongoing population expansion and increased global food consumption. It is a crucial component of plant and animal nutrition and, in many agricultural contexts, the second-most limiting nutrient for crop yield and plant development after nitrogen (Torri *et al.* 2017).

Both soil scientists and environmentalists are interested in nano fertilizer because of its potential to increase productivity, enhance soil fertility, reduce pollution, and have an impact on the most crucial area of agriculture. Prodigious farming and environmental cleanup operations may be able to reduce costs by utilizing nanoscience and nanotechnology (Adhikari *et al*. 2012). Often referred to as "nanotechnology," nanoscale science, engineering, and technology is a new multidisciplinary field that has enormous potential to impact our civilization. Nano fertilizers are cutting-edge, inexpensive, eco-friendly fertilizers used in agriculture (Jain *et al.* 2021). These intelligent fertilizers have been extensively researched in relation to plant and soil systems, and they have the potential to increase agricultural productivity. Nano DAP (liquid) has a promising future in agriculture and is thought to be a solution for accurately supplying plants with nutrients through a more effective nutrient delivery mechanism (Iyarin and Kumar, 2019).

# 2. Materials and Methods

A field experiment was conducted during Rabi season of 2024-25 at experimental farm, Department of Agronomy, Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan). Soil of the experimental field was sandy loam in texture, saline in reaction with a pH value of 7.6, poor in organic carbon (0.32%), deficient in available zinc (0.48 ppm) and iron (1.2 ppm) low in available nitrogen (176 kg/ha) and phosphorus (20.2 kg/ha) but medium in available potassium (320 kg/ha). The experiment was laid out in randomized block design with three replications consisting of nine treatments *viz.* T1-Control, T2-50% RDF, T3-75% RDF, T4-100% RDF, T5-T2 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 2 ml/L of water at 40 DAS, T6-T2 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 4 ml/L of water at 40 DAS, T7-T3 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 2 ml/L of water at 40 DAS, T8-T3 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 4 ml/L of water at 40 DAS, T9-T4 + ST with Nano DAP @ 5 ml/kg seed + first FS with Nano DAP @ 2 ml/L of water at 40 DAS and second spray – before one week of flowering stage and T10-T4 + ST with Nano DAP @ 5 ml/kg seed + first FS with Nano DAP @ 4 ml/L of water at 40 DAS and second spray – before one week of flowering stage. The required quantities of fertilizers as per treatments were applied. The doses of NPK were applied in the form of urea, diammonium phosphate, murate of potash respectively. The half dose of nitrogen gives basal dose and remain two split doses after irrigation and full dose of potassium at basal dose and phosphorus doses giving according to treatments.

**3. Results and Discussion**

**3.1 Growth attributes**

Table 1 shows that there was a considerable impact of nano-DAP on plant height. The height of the wheat plant during the tillering stage was shown to be significantly impacted by nano-DAP. The highest plant height (40.22 cm) among the various treatments at the tillering stage was recorded with T10. With the control treatment, the lowest plant height was measured at 28.25 cm. Wheat plant height at the jointing stage was shown to be significantly impacted by nano-DAP. The highest plant height (64.46 cm) among the various treatments at the jointing stage was recorded with T10, which was done one week before to the flowering stage. 52.49 cm was the lowest plant height measured with the control treatment. The height of the wheat plants at harvest was shown to be significantly impacted by nano-DAP. The highest plant height (86.74 cm) among the various treatments at the harvest stage was recorded with T10 prior to observed with T10. The minimum plant height was recorded with control treatment (74.77 cm). These findings also supported by Khemshetty *et al.* (2024), Prasad *et al*. (2017) sand Kumar and Dahiya(2024).

Table 2 shows that the growth properties were significantly impacted by nano-DAP. Nano-DAP was found to have a considerable impact on the total number of tillers per m of wheat row length. Among the various treatments, T10 produced the highest number of total tillers per m row length (307). With the control treatment, the smallest number of total tillers per m row length (256) was noted. The amount of chlorophyll in wheat during the tillering stage was shown to be significantly impacted by nano-DAP. Among the different treatments maximum chlorophyll content (21.45) was observed with T10. The minimum chlorophyll content was recorded with control treatment (15.00). A significant effect of nano- DAP was observed on the leaf area index of wheat. Among the different treatments maximum leaf area index (2.12) was observed with T10. The minimum leaf area index was recorded with control treatment (1.78). Similar result also observed by Manjunatha *et al.* (2016), Sorour *et al.* (2020), Tomar *et al.* (2024), Kumar *et al.* (2021) and Thakur *et al.* (2024)

**3.2 Yield and yield attributes**

A significant effect of nano- DAP was observed on the yield attributes and yield are presented in table 3 and 4. A significant effect of nano- DAP was observed on the effective tillers per m row lengthof wheat. Among the different treatments maximum effective tillers per m row length(294) was observed with T10before one week of flowering stage. The minimum effective tillers per m row lengthwas recorded with control treatment (244). A significant effect of nano- DAP was observed on the number of grains per spike of wheat. Among the different treatments maximum number of grains per spike (46.78) was observed with T10. The minimum number of grains per spike was recorded with control treatment (33.35). A significant effect of nano- DAP was observed on the grain yield of wheat. Among the different treatments maximum grain yield (44.25 q/ha) was observed with T10. The minimum grain yield was recorded with control treatment (32.43 q/ha). A significant effect of nano- DAP was observed on the straw yield of wheat. Among the different treatments maximum straw yield (59.78 q/ha) was observed with T10. The minimum straw yield was recorded with control treatment (48.84 q/ha). A significant effect of nano- DAP was observed on the biological yield of wheat. Among the different treatments maximum biological yield (104.03 q/ha) was observed with T10. The minimum biological yield was recorded with control treatment (82.42 q/ha). Similar concluded by Abrol *et al*. (2019), Divya *et al*. (2019), Patil *et al.* (2020), Kumar *et al. (*2020), Alam *et al.* (2015), Borana *et al*. (2024) and GS *et al*. (2024).

**Conclusion:**

On the basis of one year experimentation, it was concluded that treatment T10-T4 + ST with Nano DAP @ 5 ml/kg seed + first FS with Nano DAP @ 4 ml/L of water at 40 DAS and second spray – before one week of flowering stage was found superior in growth and yield of wheat. So, it was concluded that treatment T10-T4 + ST with Nano DAP @ 5 ml/kg seed + first FS with Nano DAP @ 4 ml/L of water at 40 DAS and second spray – before one week of flowering stage was better combination of nano DAP for the higher yield of wheat.

**Table 1 Effect of nano DAP on plant height of wheat at various stages**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments** | **Plant height (cm)** | | |
| **At tillering stage** | **At Jointing**  **stage** | **At harvest** |
| T1-Control | 28.25 | 52.49 | 74.77 |
| T2-50% RDF | 31.25 | 55.49 | 78.12 |
| T3-75% RDF | 32.54 | 56.78 | 79.06 |
| T4-100% RDF | 36.78 | 61.02 | 83.30 |
| T5-T2 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 2 ml/L of water at 40 DAS | 33.45 | 57.69 | 80.02 |
| T6-T2 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 4 ml/L of water at 40 DAS | 34.85 | 59.09 | 81.37 |
| T7-T3 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 2 ml/L of water at 40 DAS | 37.52 | 61.76 | 84.04 |
| T8-T3 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 4 ml/L of water at 40 DAS | 38.58 | 62.82 | 85.10 |
| T9-T4 + ST with Nano DAP @ 5 ml/kg seed + first FS with Nano DAP @ 2 ml/L of water at 40 DAS and second spray – before one week of flowering stage | 39.95 | 64.19 | 86.47 |
| T10-T4 + ST with Nano DAP @ 5 ml/kg seed + first FS with Nano DAP @ 4 ml/L of water at 40 DAS and second spray – before one week of flowering stage | 40.22 | 64.46 | 86.74 |
| S. Em. ± | 0.81 | 1.17 | 1.17 |
| CD% | 2.42 | 3.47 | 3.47 |

**Table 2 Effect of nano DAP on growth attributes of wheat**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments** | **Number of total tillers**  **per m row length** | **Chlorophyll content at tillering stage** | **Leaf area**  **index** |
| T1-Control | 256 | 27.00 | 1.78 |
| T2-50% RDF | 285 | 19.25 | 1.85 |
| T3-75% RDF | 287 | 30.20 | 1.88 |
| T4-100% RDF | 293 | 31.36 | 1.98 |
| T5-T2 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 2 ml/L of water at 40 DAS | 289 | 30.44 | 1.92 |
| T6-T2 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 4 ml/L of water at 40 DAS | 291 | 30.95 | 1.95 |
| T7-T3 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 2 ml/L of water at 40 DAS | 296 | 31.95 | 2.01 |
| T8-T3 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 4 ml/L of water at 40 DAS | 300 | 31.88 | 2.05 |
| T9-T4 + ST with Nano DAP @ 5 ml/kg seed + first FS with Nano DAP @ 2 ml/L of water at 40 DAS and second spray – before one week of flowering stage | 302 | 32.36 | 2.09 |
| T10-T4 + ST with Nano DAP @ 5 ml/kg seed + first FS with Nano DAP @ 4 ml/L of water at 40 DAS and second spray – before one week of flowering stage | 307 | 3.45 | 2.12 |
| S. Em. ± | 3.80 | 0.75 | 0.04 |
| CD% | 11.30 | 2.25 | 0.13 |

**Table 3 Effect of nano DAP on yield attributes of wheat**

|  |  |  |
| --- | --- | --- |
| **Treatments** | **Number of effective tillers per m row length** | **Number of grains per spike** |
| T1-Control | 244 | 33.35 |
| T2-50% RDF | 273 | 37.84 |
| T3-75% RDF | 275 | 38.65 |
| T4-100% RDF | 281 | 41.15 |
| T5-T2 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 2 ml/L of water at 40 DAS | 277 | 39.58 |
| T6-T2 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 4 ml/L of water at 40 DAS | 279 | 40.22 |
| T7-T3 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 2 ml/L of water at 40 DAS | 284 | 42.36 |
| T8-T3 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 4 ml/L of water at 40 DAS | 287 | 43.58 |
| T9-T4 + ST with Nano DAP @ 5 ml/kg seed + first FS with Nano DAP @ 2 ml/L of water at 40 DAS and second spray – before one week of flowering stage | 289 | 44.75 |
| T10-T4 + ST with Nano DAP @ 5 ml/kg seed + first FS with Nano DAP @ 4 ml/L of water at 40 DAS and second spray – before one week of flowering stage | 294 | 46.78 |
| S. Em. ± | 2.98 | 1.49 |
| CD% | 8.87 | 4.43 |

**Table 4. Effect of nano DAP on yield of wheat**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments** | **Grain yield (q/ha)** | **Straw yield (q/ha)** | **Biological yield (q/ha)** |
| T1-Control | 32.43 | 48.84 | 82.42 |
| T2-50% RDF | 36.45 | 51.71 | 88.49 |
| T3-75% RDF | 37.58 | 52.84 | 90.42 |
| T4-100% RDF | 40.12 | 55.38 | 95.50 |
| T5-T2 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 2 ml/L of water at 40 DAS | 38.85 | 54.12 | 92.97 |
| T6-T2 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 4 ml/L of water at 40 DAS | 39.45 | 54.78 | 94.23 |
| T7-T3 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 2 ml/L of water at 40 DAS | 41.85 | 57.25 | 99.10 |
| T8-T3 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 4 ml/L of water at 40 DAS | 42.75 | 58.12 | 100.87 |
| T9-T4 + ST with Nano DAP @ 5 ml/kg seed + first FS with Nano DAP @ 2 ml/L of water at 40 DAS and second spray – before one week of flowering stage | 43.65 | 58.95 | 102.60 |
| T10-T4 + ST with Nano DAP @ 5 ml/kg seed + first FS with Nano DAP @ 4 ml/L of water at 40 DAS and second spray – before one week of flowering stage | 44.25 | 59.78 | 104.03 |
| S. Em. ± | 1.27 | 1.22 | 2.23 |
| CD% | 3.77 | 3.62 | 6.64 |

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