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

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 T_{10}-T_4 + 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 T_{10}-T_4 + 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

Wheat (*Triticum aestivum* L.) is the world's most widely cultivated food crop occupies significant position among the cultivated cereals. In India, wheat is the second most important cereal crop next to rice contributing nearly 35% to the national food basket and plays an important role in food and nutritional security of the nation. The development and use of novel fertilizers is one of the only practical ways to feed the world's projected 9.6 billion people by 2050 or beyond without negatively affecting ecosystems and the environment, according to this rising trend. 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 intexture, saline in reaction with a pH value of 7.6, poor in organic carbon (0.32%), deficient inavailable 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.* T_1-Control, T_2-50% RDF, T_3-75% RDF, T_4-100% RDF, T_5-T_2 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 2 ml/L of water at 40 DAS, T_6-T_2 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 4 ml/L of water at 40 DAS, T_7-T_3 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 2 ml/L of water at 40 DAS, T_8-T_3 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 4 ml/L of water at 40 DAS, T_9-T_4 + 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 T_{10}-T_4 + 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

A significant effect of nano- DAP was observed on the plant height are presented in table 1.0. A significant effect of nano- DAP was observed on the plant height of wheat at tillering stage. Among the different treatments at tillering stage, maximum plant height (40.22 cm) was observed with T_{10}-T_4 + 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 minimum plant height was recorded with control treatment (28.25 cm). A significant effect of nano- DAP was observed on the plant height of wheat at jointing stage. Among the different treatments at jointing stage, maximum plant height (64.46 cm) observed with T_{10}-T_4 + 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 minimum plant height was recorded with control treatment (52.49 cm). A significant effect of nano- DAP was observed on the plant height of wheat at harvest. Among the different treatments at harvest stage, maximum plant height (86.74 cm) observed with T_{10}-T_4 + 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 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).

A significant effect of nano- DAP was observed on the growth attributes are presented in table 2.0. A significant effect of nano- DAP was observed on the number of total tillers per m row length of wheat. Among the different treatments maximum number of total tillers per m row length (307) was observed with T_{10}-T_4 + 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 minimum number of total tillers per m row length was recorded with control treatment (256). A significant effect of nano- DAP was observed on the chlorophyll content at tillering stage of wheat. Among the different treatments maximum chlorophyll content (21.45) was observed with T_{10}-T_4 + 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 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 T_{10}-T_4 + 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 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 3.0 and 4.0. A significant effect of nano- DAP was observed on the effective tillers per m row length of wheat. Among the different treatments maximum effective tillers per m row length (294) was observed with T_{10}-T_4 + 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 minimum effective tillers per m row length was 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 T_{10}-T_4 + 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 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 T_{10}-T_4 + 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 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 T_{10}-T_4 + 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 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 T_{10}-T_4 + 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 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).

Conclusion: -

On the basis of one year experimentation, it was concluded that treatment T_{10}-T_4 + 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 T_{10}-T_4 + 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 1.0 Effect of nano DAP on plant height of wheat at various stages

Treatments	Plant height (cm)		
	At tillering stage	At Jointing stage	At harvest
T_1-Control	28.25	52.49	74.77
T_2-50% RDF	31.25	55.49	78.12
T_3-75% RDF	32.54	56.78	79.06
T_4-100% RDF	36.78	61.02	83.30
T_5-T_2 + 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
T_6-T_2 + 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
T_7-T_3 + 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
T_8-T_3 + 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
T_9-T_4 + 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
T_{10}-T_4 + 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 2.0 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
T_1-Control	256	27.00	1.78
T_2-50% RDF	285	19.25	1.85
T_3-75% RDF	287	30.20	1.88
T_4-100% RDF	293	31.36	1.98
T_5-T_2 + 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
T_6-T_2 + 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
T_7-T_3 + 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
T_8-T_3 + 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
T_9-T_4 + 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
T_{10}-T_4 + 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 3.0 Effect of nano DAP on yield attributes of wheat

Treatments	Number of effective tillers per m row length	Number of grains per spike
T_1-Control	244	33.35
T_2-50% RDF	273	37.84
T_3-75% RDF	275	38.65
T_4-100% RDF	281	41.15
T_5-T_2 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 2 ml/L of water at 40 DAS	277	39.58
T_6-T_2 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 4 ml/L of water at 40 DAS	279	40.22
T_7-T_3 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 2 ml/L of water at 40 DAS	284	42.36
T_8-T_3 + ST with Nano DAP @ 5 ml/kg seed + FS with Nano DAP @ 4 ml/L of water at 40 DAS	287	43.58
T_9-T_4 + 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
T_{10}-T_4 + 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 4.0 Effect of nano DAP on yield of wheat

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)
T_1-Control	32.43	48.84	82.42
T_2-50% RDF	36.45	51.71	88.49
T_3-75% RDF	37.58	52.84	90.42
T_4-100% RDF	40.12	55.38	95.50
T_5-T_2 + 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
T_6-T_2 + 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
T_7-T_3 + 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
T_8-T_3 + 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
T_9-T_4 + 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
T_{10}-T_4 + 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

References

Abrol V., Singh, A.P., Kumar A., Charya R., Nivasarao C., Sharma P., Singh B., Salgotra S., Kapoor J. and Dhachich H. 2019. Effect of foliar application of nutrients on wheat crop performance, economics, resource use efficiency and soil properties under rainfed conditions. *Indian Journal of Agricultural Sciences* **90** (1): 138-41.

Adhikari, T., Kundu, S., Biswas, A. K., Tarafdar, J. C., & Rao, A. S. (2012). Effect of copper oxide nano particle on seed germination of selected crops. *Journal of Agricultural Science and Technology. A*, **2**(6A), 815.

Alam, J., Sultana, F. and Iqbal, M. D., 2015, Potential of iron nanoparticles to increase germination and growth of wheat seedling. *J. Nanosci. Adv. Tech.,* **1**(3): 14-20.

Borana, H., Singh, I., Verma, J. R., Ram, M., & Kumhar, B. L. (2024). Effect of Nano Fertilizers on Growth and Yield of Wheat (*Triticum aestivum* L.). *International Journal of Plant & Soil Science*, **36**(9), 223-230.

Divya, B. B., Solanki, M. S., Barkha, R. and Gaurangbhai, V. F., 2019, Effect of different levels of chemical and nano potassic fertilizer on yield and yield attribute of maize crop (*Zea mays* L.) cv. Amber. *J. Pharmacog. Phytochem*., **8**(5): 58-61.

Iyarin, T. M. and Kumar, B. N., 2019, Foliar application of nano fertilizers in agricultural crops -A review., *J. Farm Sci.,* **32**(3): 239- 249.

Jain Devendra, Sanadhya Suman, Saheewala Heena, Joshi Arunabh, Bhojiya Ali & Mohanty R.2021. An effective approach to increase nutrient use efficiency. *Agricultural Biotechnology* **10**(4): 493-510.

Khemshetty, A., Patil, D. H., Rathod, P. S., Patil, A. S., & Basavaraj, K. (2024). Studies on Nano DAP on Growth, Yield and Quality of Chickpeas under Rainfed Conditions of Northeastern Dry Zone of Karnataka. *Journal of Experimental Agriculture International*, **46**(3), 139-145.

Kumar Yogendra, Tiwari K, Singh Tarunendu, Sain Naveen, Sri Laxmi, Verma Ramesh, Sharma Girish & Raliya Ramesh. 2020. Nano fertilizers for enhancing nutrient use efficiency, crop productivity and economic returns. *Annals of Plant & Soil Research* **22**(4): 324-335.

Kumar, K., & Dahiya, S. (2024). The comparative impact of chemical fertilizers, nano-urea and nano-DAP on growth and yield of wheat crop. *International Journal of Advanced*

Biochemistry Research, **8**(7), 1133-1139.

Kumar, Y., Singh, T., Raliya, R., & Tiwari, K. N. (2021). Nano fertilizers for sustainable crop production, higher nutrient use efficiency and enhanced profitability. *Indian Journal of Fertilisers*, **17**(11), 1206-1214.

Manjunatha, S. B., Biradar, D. P., & Aladakatti, Y. R. (2016). Nanotechnology and its applications in agriculture: A review. *J farm Sci*, **29**(1), 1-13.

Patil SS, Balpande SS, Mairan NR, Sajid Mohammad, Ghodpage R M.2020. Influence of integrated nutrient management using nano phosphatic fertilizer on nutrient use efficiency and yield of wheat. *International Journal of Chemical Studies* **8**(6): 757-762.

Prasad, R., Bhattacharyya, A., & Nguyen, Q. D. (2017). Nanotechnology in sustainable agriculture: Recent developments, challenges and perspectives. *Frontiers in Microbiology*, 8, 1014.

Sorour F A, Metwally Tamer, Eleisawy E M.2020. The effects of nano phosphatic fertilizer application on the productivity rice. *Applied Ecology & Environmental Research* **18**(6): 7673-7684.

Thakur, D., Kumar, N., Manuja, S., Hetta, G., Chakraborty, M., Kumari, P., & Saqib, A. (2024). Effect of foliar spray of Nano DAP on growth of wheat (*Triticum aestivum* L.). *Himachal Journal of Agricultural Research*, 284-290.

Tomar, M., Malgaya, G., Dubey, S., Singh, A., & Jalsingod, J. (2024). Effect of Nano DAP on Growth and Yield Performance of *Triticum aestivum* (L.) East Nimar Region, Khandwa, Madhya Pradesh, India. *International Journal of Plant & Soil Science*, **36**(8), 682-692.

Torri SI, Correa RS, Renella G.2017. Biosolid application to agricultural land a contribution to global phosphorus recycles. *Pedosphere*. **27**(1): 1–16.