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INFLUENCE OF NANO UREA ON GROWTH PARAMETERS OF BANANA CV. GRAND NAINE

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Abstract—

The present investigation entitled "Influence of Nano Urea on Growth Parameters of Banana cv. Grand Naine" was conducted during 2024–25 and 2025–26 at the Regional Horticultural Research Station, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat. The experiment comprised seven treatments laid out in a Randomized Block Design with three replications. The recommended dose of nitrogen (RDN) through conventional urea was applied to the soil at the 2nd, 3rd, 4th, and 5th months after planting, while foliar sprays of nano urea and conventional urea were applied at the 3rd, 4th, and 5th months after planting. The pooled results of two years revealed that the application of 80 % RDN (240 g N plant^{-1}) through soil-applied urea supplemented with three foliar sprays of nano urea @ 4 ml L^{-1} at the 3rd, 4th, and 5th months after planting significantly improved the growth parameters of banana cv. Grand Naine by recording the maximum pseudostem height at the 3rd (1.10 m), 4th (1.17 m), and 5th (1.31 m) months after planting and at harvest (2.09 m), maximum pseudostem girth at the 3rd (39.08 cm), 4th (43.75 cm) and 5th (48.67 cm) months after planting and at harvest (68.33 cm), along with the highest number of leaves (12.00) and maximum leaf area (13.22 m²). Based on the pooled analysis of two years, it can be concluded that the application of 80 % RDN (240 g N plant^{-1}) through soil-applied urea combined with three foliar sprays of nano urea @ 4 ml L^{-1} at the 3rd, 4th, and 5th months after planting was the most effective treatment for enhancing the growth parameters of banana cv. Grand Naine

***Keywords**: Banana, Growth and nano urea*

I. INTRODUCTION

Banana (*Musa paradisiaca* L.) belongs to the family Musaceae and is native to the tropical regions of South East Asia. It is a herbaceous, perennial, monocotyledonous and monocarpic crop. Banana is one of the most important fruit crops cultivated in tropical and subtropical regions and ranks among the leading fruit crops in global agricultural production and trade (Lamassa, 2021). Its year-round availability, affordability, wide varietal diversity,

pleasant taste and high nutritional and medicinal value make it one of the most preferred fruits across all sections of society.

Nitrogen and potassium are the two major nutrients required for achieving higher yield and superior fruit quality in banana. The demand for these nutrients is highest during the active vegetative growth phase, while nutrient uptake declines after shooting (Veerannah *et al*., 1976). Therefore, maintaining an optimum nutrient supply throughout the crop growth period is essential, as both deficiency and excess adversely affect growth, yield and fruit quality. Among all essential plant nutrients, nitrogen plays a fundamental role in plant growth, metabolism, chlorophyll synthesis, protein formation and overall productivity. Banana requires relatively high amounts of nitrogen; however, only a small proportion of the total nitrogen present in soil is readily available to plants because nearly 98 per cent exists in organic forms that cannot be directly absorbed by roots. Furthermore, nitrogen applied through conventional fertilizers is often lost through leaching, ammonification, volatilization and denitrification, resulting in a low nitrogen use efficiency (NUE) of only 30–50 per cent (Marschner, 2012). Although urea is the most widely used nitrogenous fertilizer, a substantial amount of applied nitrogen is lost if it is not properly incorporated into the soil, thereby reducing crop productivity and NUE.

Recent advances in nanotechnology have led to the development of nano fertilizers, which offer an innovative and sustainable approach to improving nutrient use efficiency. Nano urea is a nanotechnology-based liquid nitrogen fertilizer designed to supply nitrogen more efficiently to plants while minimizing environmental losses. Owing to its extremely small particle size (20–50 nm), nearly 10,000 times greater surface area than a conventional 1 mm urea prill and approximately 55,000 nitrogen particles per 1 mm urea prill, nano urea exhibits enhanced bioavailability and absorption by plants. The nanoparticles can readily enter plant tissues through leaf stomata or the cell wall and are subsequently translocated via the phloem, plasmodesmata, aquaporins, ion channels and endocytosis pathways to various plant parts where they are metabolized (Kumar *et al*., 2021). Through its proprietary patented technology, the IFFCO Nano Biotechnology Research Centre (NBRC), Kalol, Gujarat, developed the world's first commercially available nano urea (liquid).

Unlike conventional granular urea, which is applied to the soil, nano urea is applied as a foliar spray during critical growth stages of the crop. A 500 ml bottle of nano urea has been promoted as a partial replacement for a 45 kg bag of conventional urea. Following foliar application, nano urea is rapidly absorbed through leaf stomata and translocated via the phloem from source to sink according to crop demand. The absorbed nitrogen is temporarily stored in plant vacuoles and released gradually, ensuring a continuous nitrogen supply for plant growth and development while reducing nutrient losses to the environment. Therefore, nano urea has emerged as a promising technology for enhancing nitrogen use efficiency, reducing fertilizer consumption, improving crop productivity and promoting sustainable banana cultivation.

II. METHODOLOGY

The experiment was carried out in E-1 block at Regional Horticultural Research Station, ASPEE College of Horticulture, NAU, Navsari. The experiment included seven treatments in a randomized block design and repeated thrice *viz*., T_1 - 100 % RDN through urea (control), T_2 - 80 % RDN through urea + 3 spray of nano urea @ 2 ml/l, T_3 - 60 % RDN through urea + 3 spray of nano urea @ 2 ml/l, T_4 - 80 % RDN through urea + 3 spray of nano urea @ 4 ml/l, T_5 - 60 % RDN through urea + 3 spray of nano urea @ 4 ml/l, T_6 - 80 % RDN through urea + 3

spray of conventional urea @ 1 % and T_7 - 60 % RDN through urea + 3 spray of conventional urea @ 2 %. The experimental plot was prepared by deep ploughing and harrowing. The pits of 30 cm × 30 cm × 30 cm were dug out at a spacing of 2.4 m × 1.2 m and well composed fine textured farm yard manure at the rate of 10 kg per pit was applied at the time of planting.

Banana is heavy feeder of nutrients, so each plant was fertilized with 10 kg FYM at time of planting to all the treatments. The recommended dose of fertilizers is 300 g N, 90 g P_2O_5 and 120 g K_2O. The complete dose of phosphorus was applied at the 2nd month after planting, while potash was applied in three equal splits at the 3rd, 4th and 5th months after planting. Nitrogen doses 60, 80 and 100 % were applied at 2nd, 3rd, 4th and 5th month after planting in four equal splits doses as per treatment. Nano urea and conventional urea were sprayed at 3rd, 4th and 5th month after planting on plants.

III. RESULTS AND DISCUSSION

It is apparent from the data given in Table 1 that soil as well as foliar application of urea showed significant effect on growth parameters. Significantly the maximum pseudostem height at 3rd (1.10 m), 4th (1.17 m), 5th (1.31 m) MAP and at harvest (2.09 m), pseudostem girth at 3rd (39.08 cm), 4th (43.75 cm), 5th (48.25 cm) MAP and at harvest (68.33 cm), number of leaves (12.00) and leaf area (13.22 m^2) were recorded in T_4 treatment (80 % RDN through urea + 3 sprays of nano urea @ 4 ml/l). The probable reason for higher pseudostem height and girth might be due to both soil and foliar application of nitrogen which leads to vigorous growth. When sprayed on leaves, nano urea easily enters through stomata and other openings and is assimilated by the plant cells. It is easily distributed through the phloem from source to sink inside the plant as per its need. Unutilized nitrogen is stored in the plant vacuole and is slowly released for proper growth and development of the plant. Similar, findings were also observed by Vinayaka *et al*. (2022) in jamun, Bhatti *et al*. (2023) in guava and Ganvit *et al.* (2024) in custard apple. The results of the present study revealed that the application of nano urea in banana resulted in a higher number of leaves and greater leaf area. This might be due to the combined effect of optimal basal fertilization along with foliar application of nano urea, which ensures balanced and sustained nutrient availability during the active growth stage. This, in turn, leads to higher chlorophyll content and improved photosynthetic efficiency, ultimately contributing to increased leaf production and expansion. Similar, results were reported by Sonkar *et al*. (2024) in strawberry and Ganvit *et al.* (2024) in custard apple and Bhadu *et al*. (2023) in cluster bean.

Table 1: Effect of urea application on growth of banana cv. Grand Naine (Mean of two years)

Treatments	Pseudostem height (m)				Pseudostem girth (cm)				Number of leaves	leaf area (m^2)
	3rd MAP	4th MAP	5th MAP	At the time of harvest	3rd MAP	4th MAP	5th MAP	At the time of harvest		
T_1	0.96^{d}	1.04^{c}	1.13^{c}	1.82^{c}	32.71^{a}	36.42^{c}	40.79^{c}	59.13^{d}	10.13^{d}	11.45^{d}
T_2	1.02^{bc}	1.08^{bc}	1.21^{b}	1.93^{b}	36.71^{ab}	40.96^{ab}	46.13^{ab}	63.63^{bc}	10.83^{bcd}	12.36^{bc}
T_3	1.01^{cd}	1.08^{bc}	1.19^{bc}	1.92^{bc}	36.38^{a}	40.79^{b}	45.21^{b}	63.25^{bc}	10.83^{bcd}	12.25^{bc}
T_4	1.10^{a}	1.17^{a}	1.31^{a}	2.09^{a}	39.08^{a}	43.75^{a}	48.25^{a}	68.33^{a}	12.00^{a}	13.22^{a}
T_5	1.04^{bc}	1.13^{ab}	1.22^{b}	1.96^{b}	37.29^{ab}	41.71^{ab}	46.29^{ab}	64.92^{abc}	11.21^{bc}	12.81^{ab}
T_6	0.99^{cd}	1.07^{c}	1.18^{bc}	1.90^{bc}	35.38^{b}	39.71^{b}	44.08^{b}	61.58^{cd}	10.50^{cd}	12.00^{cd}
T_7	1.07^{ab}	1.14^{a}	1.25^{ab}	1.99^{ab}	37.75^{ab}	42.25^{ab}	46.96^{ab}	65.88^{ab}	11.38^{ab}	12.95^{ab}
S.Em. ± (T)	0.02	0.02	0.02	0.03	0.79	0.91	0.94	1.17	0.24	0.25
CD at 5 % (T)	0.05	0.05	0.06	0.10	2.30	2.66	2.75	3.43	0.71	0.72
S.Em. ± (Y)	0.01	0.01	0.01	0.02	0.42	0.49	0.50	0.63	0.13	0.13
CD at 5 % (Y)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
S.Em. ± (Y×T)	0.03	0.03	0.03	0.05	1.11	1.29	1.33	1.66	0.34	0.35
CD at 5 % (Y× T)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV %	4.31	4.17	4.25	4.18	5.29	5.46	5.08	4.51	5.40	4.88

IV. CONCLUSION AND FUTURE SCOPE

The results of present study of two years inferred that the soil application of 80 % (240 g) RDN through urea + 3 sprays of nano urea @ 4 ml/l at 3rd, 4th and 5th month after planting significantly influenced the growth parameters of banana cv. Grand Naine.

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