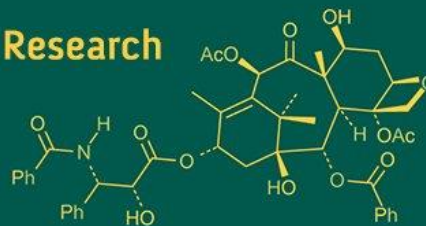


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Influence of nano urea on growth and flowering parameters of banana cv. grand naine

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Abstract

The present experiment entitled “Influence of nano urea on growth and flowering parameters of banana cv. Grand Naine” was conducted during 2024-25 and 2025-26 at Regional Horticultural Research Station, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat. The experiment included seven treatments in a randomized block design and repeated thrice. The recommended dose of nitrogen was applied in soil at 2nd, 3rd, 4th and 5th month after planting, while nano urea and conventional urea were sprayed at 3rd, 4th and 5th month after planting in banana cv. Grand Naine. The results revealed that application of 80% RDN through urea + 3 spray of nano urea @ 4 ml/l significantly increased the growth characters viz., maximum pseudostem height at 3rd (1.10 m), 4th (1.17 m), 5th (1.31 m) month after planting and at harvest (2.09 m), pseudostem girth at 3rd (39.08 cm), 4th (43.75 cm), 5th (48.67 cm) month after planting and at harvest (68.33 cm), number of leaves (12.00) and leaf area (13.22 m²). Moreover, it significantly hastened crop development by recording the minimum number of days to shooting (221.63 days), harvesting (100.79 days) and overall crop duration (322.42 days). 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 and flowering parameters of banana cv. Grand Naine

Keywords: Banana, nano urea, growth

Introduction

Banana (*Musa paradisiaca* L.) belongs to the family Musaceae. It is native to tropical region of South East Asia. It is herbaceous, perennial, monocotyledonous and monocarpic crop. Banana is an important fruit crop in the tropical and subtropical region. Banana is a leading crop in world agricultural production and trade (Lamassa, 2021) ^[1]. It's year-round availability, affordability, varietal range, taste, nutritive and medicinal value makes it the favourite fruit among all classes of people.

Nitrogen and potassium are two major nutrients essential for enhancing the yield and quality of banana, along with other essential plant nutrients. These nutrients are required in higher amounts during the peak growth stages of the crop, whereas their uptake rate declines after shooting (Veerannah *et al.*, 1976) ^[2]. Therefore, an optimum supply of these nutrients is crucial, as both deficiency and excess may adversely affect yield and fruit quality. Among plant nutrients, nitrogen plays a pivotal role in plant growth and metabolism and plant life is not possible without it. Adequate nitrogen nutrition is essential for achieving higher yield and better productivity in fruit crops. Plant requires more nitrogen than any other nutrients, but only a small fraction of soil nitrogen is accessible to plants, because about 98% of organic forms cannot be absorbed by plant roots. Broadcasting application of nitrogen fertilizers are lost through leaching, ammonification, volatilization, and denitrification, hence, result in low Nitrogen Use Efficiency (NUE) 30 to 50% (Marschner, 2012) ^[3]. Urea is the most common source of N and, if not incorporated in the soil, can lead to N losses through ammonia volatilization, lower crop yields and NUE.

Nano urea is a nanotechnology based revolutionary agriculture input which provides nitrogen to plants. Nano urea is a sustainable option for farmers towards smart agriculture and combat climate change. Thus fulfil the plant nutrient requirement as a fertilizer since nano urea is bio available to plants because of its desirable particle size about 20 to 50 nm and more surface

area (10,000 times over 1 mm urea prill) and number of particle (55,000 nitrogen particles over 1 mm urea prill). They can easily penetrate through the cell wall or through leaf stomatal pores. After entering the plant, they are transported to other plant parts via phloem cells, plasmodesmata (40 nm diameter) or can bind to carrier protein through aquaporin, ion channels and endocytosis and metabolized inside the plant cell (Kumar *et al.*, 2021) [4]. Through a proprietary patented technology, IFFCO-Nano Biotechnology Research Centre (NBRC) Kalol, Gujarat developed nano urea (Liquid) fertilizer for the first time in the world.

Instead of applying granular urea into the soil, nano urea in liquid form can be sprayed directly on the leaves during important growth stages of a crop. A 45 kg bag of urea can be replaced with a 500 ml of nano urea. Nano urea is quickly absorbed by plant cells after being sprayed on leaves. It penetrates through stomata and easily transferred throughout the plant *via* phloem from the source to the sink as needed. Unused nitrogen is retained in the plant vacuole and released slowly for appropriate plant growth and development.

Materials and Methods

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., T₁-100% RDN through urea (control), T₂-80% RDN through urea + 3 spray of nano urea @ 2 ml/l, T₃-60% RDN through urea + 3 spray of nano urea @ 2 ml/l, T₄-80% RDN through urea + 3 spray of nano urea @ 4 ml/l, T₅-60% RDN through urea + 3 spray of nano urea @ 4 ml/l, T₆-80% RDN through urea + 3 spray of conventional urea @ 1% and T₇-60% 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 P₂O₅ and 120 g K₂O. 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.

Results and Discussion

Growth Parameters

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 m²) were recorded in T₄ 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) [5] in jamun, Bhatti *et al.* (2023) [7] in guava and Ganvit *et al.* (2024) [6] 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) [9] in strawberry and Ganvit *et al.* (2024) [6] in custard apple and Bhadu *et al.* (2023) [8] 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)
	3 rd MAP	4 th MAP	5 th MAP	At the time of harvest	3 rd MAP	4 th MAP	5 th 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

MAP: Month after planting

Flowering Parameters

A perusal of data presented in Table 2 clearly revealed that soil as well as foliar application of urea had significantly provoked the flowering parameters. The application of 80% RDN through urea + 3 spray of nano urea @ 4 ml/l (T₄) significantly took minimum days to shooting (221.63), days to harvesting (100.79) and crop duration (322.42 days). The application of nano urea may reduce the number of days to shooting and days to harvesting in banana. This effect can be attributed to improved nitrogen availability and enhanced nitrogen use efficiency, which accelerate vegetative growth and physiological processes. Adequate and timely nitrogen supply promotes rapid cell division, leaf development and photosynthetic efficiency, enabling the plant to attain the reproductive phase earlier. Similar, results were in confirmation with that of Deepa *et al.* (2022) ^[10] in banana and Thakre *et al.* (2024) ^[11] in acid lime. The present investigation revealed that the application of nano urea induced early shooting and harvesting which leads to enhance early crop duration as compared to control. Similar, finding was also confirmed with Deepa *et al.* (2022) ^[10] in banana.

Table 2: Effect of urea application on flowering parameters of banana cv. Grand Naine (Mean of two years)

Treatments	Days to shooting	Days to harvesting	Crop duration (days)
T ₁	255.08 ^a	117.21 ^a	372.29 ^a
T ₂	246.21 ^{ab}	107.58 ^{bcd}	353.79 ^{bc}
T ₃	248.92 ^{ab}	109.29 ^{bc}	358.21 ^b
T ₄	221.63 ^d	100.79 ^d	322.42 ^e
T ₅	238.63 ^{bc}	106.17 ^{bcd}	344.79 ^{cd}
T ₆	250.96 ^{ab}	110.88 ^b	361.83 ^{ab}
T ₇	229.71 ^{cd}	103.25 ^{cd}	332.96 ^{de}
S.Em.±(T)	4.98	2.16	4.30
CD at 5% (T)	14.54	6.29	12.56
S.Em.±(Y)	2.66	1.15	2.30
CD at 5% (Y)	NS	NS	NS
S.Em.±(Y × T)	7.05	3.05	6.08
CD at 5% (Y × T)	NS	NS	NS
CV%	5.05	4.90	3.02

Conclusion

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 and flowering characteristics of banana cv. Grand Naine.

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