



Effect of Nano Urea on Jamun (*Syzygium cuminii* L.) Grafts cv Konkan Bahadoli

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was conducted during the period 2023-2024 at College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri. The experiment was laid out in Randomized Block Design (RBD) with twelve treatments viz., T₁: Control (Soil + FYM No nano urea treatment), T₂: Top dressing (Soil +FYM mixture 2:1 + 2g urea /plant, T₃ : Foliar spray of nano urea 500 ppm, T₄ : Foliar spray of nano urea 1000 ppm, T₅ : Foliar spray of nano urea 1500 ppm, T₆: Foliar spray of nano urea 2000 ppm, T₇ : Foliar spray of nano urea 2500 ppm, T₈ : Drenching of nano urea 1500 ppm, T₉ : Drenching of nano urea 2000 ppm, T₁₀ : Drenching of nano urea 2500 ppm, T₁₁ : Drenching of nano urea 3000 ppm, T₁₂ : Drenching on nano urea 3500 ppm. All the treatments replicated thrice. From the findings, it is concluded that grafts drenched with 3000 ppm of nano urea showed outstanding results as that of control. At 270 days, after drenching of 3000 ppm of nano urea, grafts recorded maximum plant height (21.42%), highest stem girth (21.23%), number of branches (15.31 %), number of leaves (18.21 %), leaf area (23.05 %), absolute growth rate (34.73 %), dry weight of shoot (21.50%), dry weight of root (26.89 %), root length (30.72 %). Thus, it can be concluded that drenching of nano urea (3000 ppm) gives significant result to growth of jamun grafts.

Keywords: Nano urea: drenching: top dressing. jamun (*Syzygium cuminii*); foliar application; top dressing.

1. INTRODUCTION

Jamun (*Eugenia jambolana* or *Syzygium cuminii* Skeels) is a significant yet under-exploited indigenous fruit tree in India. This large, evergreen tree grows extensively throughout the Indian subcontinent and is known by various names, including java plum, black plum, jambul, and Indian blackberry. It belongs to the Myrtaceae family, with the genus *Syzygium* comprising approximately 75 indigenous species, a few of which are of commercial importance.

Originating from India, jamun also grows naturally in Thailand, the Philippines, and Madagascar, and has been successfully introduced in many other tropical regions such as the West Indies, California, Algeria, and Israel. India is the second-largest producer of jamun globally, with Maharashtra being the leading state in production, followed by Uttar Pradesh, Tamil Nadu, Gujarat, Assam, and others [1,2]. Fruit of jamun provides wholesome nutrients to the human body as it contains most of the essential components ranging from protein to carbohydrates along with minerals like iron etc. [3,4]. Its pharmacological properties include hypoglycaemic, diuretic, analgesic, anti-inflammatory, antiplaque, antimicrobial, antidiarrheal, antioxidant, gastro-protective, and astringent effects. Notably, jamun is recognized for its potential in managing blood sugar levels due to the presence of glucosides like jamboline and

ellagic acid, which inhibit the conversion of starch into sugar [5,6].

Nitrogen is essential for chlorophyll synthesis and the production of proteins, nucleic acids, growth hormones, and vitamins, contributing to dark green foliage and robust vegetative growth [7]. Plant growth and crop yield typically improve with the addition of nitrogen (N), even though nitrogen is present in soils. This is because most of the nitrogen in soils is stored in the soil humus in forms that are not readily accessible to plants. Chemical fertilizers supply nitrogen in forms that plants can use immediately or after a brief conversion [8]. This had led to higher use of nitrogenous fertilizer especially urea. Its use as fertilizer is associated with high losses. Such losses pollute the environment and increase greenhouse gas production and other environmental events associated with high ammonia volatilization and nitrous oxide emission. The mismatch between nitrogen fertilizer usage and the actual nitrogen requirements in Indian agriculture is a significant concern. Overuse of nitrogen poses environmental threats, while underuse negatively impacts crop yields [9]. Nano urea, a novel nitrogenous fertilizer, offers a potential solution by providing 4% nitrogen by weight, equivalent to a conventional urea bag, but with over 80% efficiency compared to the 30-40% efficiency of traditional urea (Lohar *et al.*, 2023; Reddy *et al.*, 2024) [10]. Its nano-sized particles (30 nm) have a vastly greater surface area, facilitating better absorption and nutrient use

efficiency [11]. The increased efficiency of nano urea stems from its enhanced ability to penetrate plant leaves, initiate nutrient pathways, and reduce environmental impact. Benefits include easy application, minimal bulk volume, controlled release, and low salt accumulation, making it an attractive option for sustainable and precise farming practices [11]. Nano urea holds significant potential for sustainable agriculture, primarily due to its reduced environmental impact. It can potentially decrease nitrogen leaching and greenhouse gas emissions compared to traditional urea, thus mitigating environmental pollution. Additionally, nano urea enhances nutrient use efficiency, leading to improved crop yields with lower input requirements. Its formulations can be customized for specific crops, soil types, and environmental conditions, offering flexibility and precision in nutrient management. Furthermore, nano urea requires less water for application and can be integrated with drip irrigation systems, contributing to water conservation efforts. However, several limitations must be addressed for the widespread adoption of nano urea. Firstly, its production process and technology make it more expensive than conventional urea, which may limit its affordability for small-scale farmers in certain regions. Regulatory approvals for nano urea formulations vary across countries, potentially restricting its use or subjecting it to specific guidelines and regulations. Although initial results are promising, long-term studies on the efficacy, environmental impact, and safety of nano urea remain limited, necessitating further research and validation. Additionally, a comprehensive risk assessment is needed to evaluate the potential accumulation of nanoparticles in soil, water, and food chains, along with their impact on human health and ecosystems. In the Konkan region, the hot and humid climate exacerbates the infestation of anthracnose and leaf-eating caterpillars, which affects the growth and survival of jamun grafts. While nano urea offers substantial benefits, addressing these limitations through continued research, technological advancements, and policy support is crucial for its successful implementation in sustainable agriculture. Given the rising popularity of jamun for its medicinal and nutritional value, particularly its anti-diabetic properties, there is an increasing demand for early-bearing, dwarf trees with high yield potential. Traditional seed propagation is less desirable due to delayed fruiting. Clonal propagation methods like patch budding, T-

budding and softwood grafting are more effective in preserving desirable traits. To meet the rising demand, foliar application of nutrients, including nitrogen, can accelerate seedling growth, reducing production time and costs [12,13]. This study aims to evaluate the effect of nano urea on the growth and survival of jamun seedlings, particularly in the hot and humid climate of the Konkan region.

2. MATERIALS AND METHODS

The present experiment was carried out during the period 2023-2024 at the Department of Fruit Science, College of Horticulture, Dapoli, Dist. Ratnagiri. The experiment was carried out in Randomized Block Design (RBD) with Three replications and Twelve treatments. T₁: Control (Soil + FYM No nano urea treatment), T₂: Top dressing (Soil +FYM mixture 2:1 + 2g urea /plant, T₃ : Foliar spray of nano urea 500 ppm, T₄ : Foliar spray of nano urea 1000 ppm, T₅ : Foliar spray of nano urea 1500 ppm, T₆ : Foliar spray of nano urea 2000 ppm, T₇ : Foliar spray of nano urea 2500 ppm, T₈ : Drenching of nano urea 1500 ppm, T₉ : Drenching of nano urea 2000 ppm, T₁₀ : Drenching of nano urea 2500 ppm, T₁₁ : Drenching of nano urea 3000 ppm, T₁₂ : Drenching on nano urea 3500 ppm. A group of 40 grafts formed a unit. In this experiment, the observations on plant height (cm), stem girth (mm), number of leaves, number of branches, leaf area (cm²), absolute growth rate (cm/day), relative growth rate (cm/cm/day), survival percentage (%), dry weight of shoot (g), dry weight of roots (g), root shoot ratio, plant N, P, K and Soil N, P, K, pH, EC, Organic carbon were taken and were analysed by standard method of analysis of variance as given by Panse and Sukhatme [14].

3. RESULTS AND DISCUSSION

At the end of the nine months after grafting, all the parameters i.e. survival and morphological parameters were significantly influenced by various nano urea treatments.

3.1 Effect of Nano Urea on Survival Percentage of Jamun Grafts cv. Konkan Bahadoli

The data related to the effect of nano urea treatments of jamun grafts recorded at 270 days after grafting (DAG) are presented in Table 1. At 270 DAA, the highest survival percentage (87.50%) was recorded in T₁₁ (Drenching of

nano urea 3000ppm) and T₁₂ (Drenching of nano urea 3500ppm), whereas T₆ (Foliar spray of nano urea 2000ppm) recorded lowest survival percentage (75.83%). Similar findings were reported by Augustus and Domingo in banana.

After 270 DAA, all the treatments showed significant effect on survival percentage of grafts. The highest survival percentage (87.50%) was recorded in treatment T₁₁ (Drenching of nano urea 3000 ppm) and T₁₂ (Drenching of nano urea 3500 ppm) The drenching of nano urea showed higher percentage of survival. In this treatment, Nano urea due to its small particle size, ensures better and more efficient nitrogen uptake by plants. This can lead to enhanced growth and vigour in jamun grafts, proper nitrogen availability is crucial for root development. Nano urea can support better root growth, which is essential for successful establishment and survival of grafts [15].

Table 1. Comparison of effect of nano urea on survival of jamun grafts cv. Konkan bahadoli

Treatment	Survival (%) at 270 DAA
T ₁	79.17 (62.84)
T ₂	85.83 (67.89)
T ₃	86.50 (68.50)
T ₄	77.50 (61.88)
T ₅	78.33 (62.26)
T ₆	75.83 (75.83)
T ₇	79.17 (62.84)
T ₈	76.67 (61.12)
T ₉	76.67 (61.12)
T ₁₀	82.50 (65.27)
T ₁₁	87.50 (69.30)
T ₁₂	87.50 (69.30)
MEAN	80.35
F-test	SIG
S.Em.±	2.85
CD @ 5%	8.36

(Figures in parenthesis indicate arcsine transformed values)

3.2 Effect of Nano Urea on Morphological Characters of Jamun Grafts cv. Konkan Bahadoli

The data pertaining to the effect of various nano urea treatments at 270 days after Application on morphological characters are presented in Table 2. At 0 and 30 DAA results regarding height of grafts were found non-significant

whereas from 60 to 180 DAA results were found significant. At 270 DAA, the highest plant height of grafts was recorded by treatment T₁₁ (Drenching of nano urea 3000 ppm) (79.60 cm) and was at par with T₂ (Top dressing Soil +FYM 2:1 +urea 2g/plant) (79.40 cm) and T₁₂ (Drenching of nano urea 3500 ppm) (78.30 cm). Soil application of nano urea was better than foliar application in jamun based on thick cuticular layer on jamun leaves limits the penetration of fertilizer. The higher shoot growth parameters observed in soil application of nano urea can be due to slow release of nutrients from the fertilizer and decreased leaching. Similar results were reported by Augustus [16] he observed that 12 weeks old Banana plantlets recorded maximum plant height in soil application of nano urea (7.75cm) and was significantly superior over foliar application (4.9cm).

At 270 DAA, highest stem girth of grafts was recorded by treatment T₁₁ (13.00mm) and was at par with treatments T₂ (12.69mm) T₁₂ (12.34), T₁₀ (12.24mm).

At 270 DAA, the maximum number of branches of grafts was recorded by treatment T₁₁ (3.07) and was at par with treatments T₂ (3.00) T₁₂ (2.87).

At 270 DAA, the maximum number of leaves of grafts was recorded by treatment T₁ (3.07) which was at par with T₂ (19.13). At 270 DAA, highest leaf area of grafts was recorded by treatment T₁₁ (90.76 cm²) which was significantly superior to others. Similar findings were reported by Augustus [16] observed that 12 weeks old Banana plantlets recorded maximum leaf area in soil application of nano urea (0.29m²) and was significantly superior over foliar application (0.12m²).

At 270 DAA, maximum absolute growth rate was recorded by treatment T₁₁ (Drenching of nano urea 3000 ppm) (0.2096 cm/day).

At the end of the experiment, the maximum root length was recorded in the treatment T₁₁ (36.33 cm) which was at par with T₂ (34.67 cm), T₁₂ (33cm). At the end of the experiment, the maximum dry weight of shoot was recorded in the treatment T₁₁ (27.68g) which was significantly superior over others. Maximum dry weight of root was recorded in treatment T₁₁ (22.80g). This may be due to ideal growth of roots in straight direction which helped in steady

Table 2. Effect of Nano urea treatments on morphological character of softwood grafts at end of experiment at 270 DAA

Treatment s	Plant height (cm)	Girth of graft (mm)	Number of branches	Number of leaves	Average leaf area(cm ²)	Absolute growth Rate (cm/day)	Relative growth rate (cm/cm/day)	Dry weight of shoot (g)	Root length (cm)	Dry weight of root (g)	Root Shoot ratio
T ₁	62.55	10.24	2.60	16.30	69.84	0.1368	0.00125	21.73	25.17	16.67	0.76
T ₂	79.40	12.69	3.00	19.13	90.22	0.2075	0.00118	27.61	34.67	22.43	0.81
T ₃	63.34	10.63	2.60	16.53	73.45	0.1403	0.00163	22.40	26	16.85	0.75
T ₄	66.18	10.83	2.63	17.63	79.45	0.1521	0.00128	23.01	26.33	17.52	0.76
T ₅	66.73	11.10	2.63	17.80	83.86	0.1515	0.00123	23.21	28.00	17.70	0.76
T ₆	66.90	11.26	2.63	17.83	85.16	0.1555	0.00123	23.26	29	17.90	0.76
T ₇	69.73	11.53	2.67	18.03	85.41	0.1638	0.00114	24.25	29.30	18.00	0.74
T ₈	70.53	11.81	2.70	18.10	86.75	0.1664	0.00105	24.53	29.67	18.93	0.77
T ₉	71.67	12.00	2.73	18.17	88.32	0.1782	0.00123	24.92	29.67	19.70	0.79
T ₁₀	73.27	12.24	2.73	18.33	89.77	0.1782	0.00149	25.48	30	21.25	0.83
T ₁₁	79.60	13.00	3.07	19.93	90.76	0.2096	0.00066	27.68	36.33	22.80	0.82
T ₁₂	78.37	12.34	2.87	18.50	89.98	0.2023	0.00227	27.25	33	21.40	0.78
Mean	70.69	11.60	2.74	18.03	84.41	0.1702	0.00130	24.61	29.76	19.26	0.78
F-test	SIG	SIG	SIG	SIG	SIG	-	-	SIG	SIG	SIG	SIG
S.E.±	0.50	0.29	0.07	0.43	2.23	0.00	0.00	0.80	0.89	0.80	0.01
C.D. @ 5 %	1.42	0.86	0.22	1.27	6.55	0.00	0.00	2.50	2.60	2.30	0.04

absorption of nutrients and moisture from the rhizosphere, proper drainage and aeration resulted in root respiration and other metabolic activities led to maximum root development.

Nano urea, being highly soluble and provides a steady supply of nitrogen to the roots. This can lead to improved root growth as nitrogen is essential for cell division and elongation. With better nitrogen availability, jamun grafts may experience enhanced root length [15]. Nitrogen is important for synthesis of amino acids, proteins and enzymes that support root elongation. Balyan et. al. [17]. Similar results were documented by Augustus et al. [16] for Banana cv. Cavendish and Laila et al. [18] in Olive. by application of nano urea.

4. CONCLUSION

From the present investigation it is concluded that, the drenching treatment of nano urea was superior over the foliar application treatment. Among all the treatments under experimentation treatment T₁₁ (Drenching of nano urea 3000 ppm) was best. However, the top dressing of urea also performed well and it was the next best treatment.

The Foliar application of nano urea on jamun was not much effective Hence, the experiment suggests that soil drenching of nano urea as well as top dressing of urea are beneficial to impart better vigour of jamun graft.

However, this was only one season experiment and continuation of experiment over 2–3 more seasons with focused attention of nano urea drenching treatment is essential as a future line of work.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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