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Effect of nano urea and nano dap on the growth of jamun (*Syzygium cuminii* L.) graft cv. Konkan Bahadoli

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Abstract
The current investigation entitled "Effect of Nano Urea and Nano DAP on the growth of jamun (*Syzygium cuminii* L.) graft cv. Konkan Bahadoli" was conducted at College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri. The experiment laid out Randomized Block Design (RBD) with twelve treatments and three replication *viz*., T_1: Control, T_2: Soil application (Urea 2g/plant), T_3: Foliar spray Nano Urea @500 ppm, T_4: Foliar spray Nano Urea @1000 ppm, T_5: Foliar spray Nano Urea @ 1500 ppm, T_6: Foliar spray Nano DAP @ 500 ppm, T_7: Foliar spray Nano DAP @ 1000 ppm, T_8: Foliar spray Nano DAP @ 1500 ppm, T_9: Drenching Nano Urea @ 1500 ppm, T_{10}: Drenching Nano Urea @ 2000 ppm, T_{11}: Drenching Nano DAP @ 1500 ppm, T_{12}: Drenching Nano DAP @ 2000 ppm. From this investigation, it concluded that treatment T_{11} i.e drenching Nano DAP @ 1500 ppm showed best result in survival percentage (97.52%), graft height (66.73 cm), graft girth (12.52 mm), number of leaves (15.13), leaf area (59.18 cm^2), dry root weight (16.17 g), dry shoot weight (14.08 g) and treatment T6, i.e Nano DAP at 500 ppm, observed maximum root length of (26.58 cm). Thus, it concluded that drenching of nano DAP at 1500 ppm gives significant result on growth of graft.

Keywords: Jamun graft, nano urea, nano DAP

Introduction
Jamun which botanically known as *Syzygium cuminii* (L.) belongs to family Myrtaceae) which also known as *Eugenia cumini* and *Syzygium jambolanum*. It is frequently called Jamun, Duhat, Jam, and Jaman in Hindi, Brahaspati in Sanskrit, in marathi jambhul and Nerale in Kannada and jambul, Malabar plum, Plum, Jambolan. In different parts of the nation, the local names include Indian jamblang, blackberry, black plum, and javana plum and which originates from the Andaman Islands, India, Burma, and Ceylon (Zeven and de Wet, 1982) [18]. Chromosomal number of *Syzygium cuminii* is 2n = 40, while recently reported that the somatic chromosome number of *Syzygium cuminii* is 2n = 66 (Jena *et al*., 2003) [6].
It is located in tropical and subtropical regions of India such as Punjab, Haryana, and Uttar Pradesh. Maharashtra, Rajasthan, Gujarat, Madhya Pradesh, Bihar, Chhattisgarh, Jharkhand, and the South components (Singh *et al*., 2011) [15]. The genus *Syzygium* comprises nearly 75 native species, among which only a few species have commercial value. *S. densiflora*, which withstands termite infestations and can thus can serve as rootstock for *S. cuminii*, with other species like *S. fruiticosum* and *S. uniflora*, generate tiny, consumable fruits (Singh and Srivastava, 1999) [14].
Jamun trees can be located occasionally in tropical and subtropical regions of India, as well in remote regions of the lower Himalayan mountains, reaching elevations of up to 1600 meters above sea level (Mishra *et al*., 2014) [10]. It is capable of endure the salinity, sodic soil, and waterlogged conditions, yet thrived more effectively in low salinity and conditions of shallow water (Habbar *et al*., 2002) [5].
Jamun offers numerous health benefits, including antibacterial, antifungal, antiviral, and anti-inflammatory effects. Its parts, including fruits, leaves, seeds, and bark, are traditionally used in ayurvedic practices. Jamun's mild, spicy flavor is popular as a sweet treat and can be used in various beverages and pickles (Namasivayam *et al*., 2008) [11].

Cost-effective compared to traditional urea and decreases farmers' expenses, resulting in higher yields, farmer's earnings (Baboo, 2021) [2] The Nano DAP product contains 8.0 per cent nitrogen (N) and 16.0 per cent phosphorus (P_2O_5) by weight. Creation of this formulation results in a superior supply of easily absorbable nitrogen (N) and phosphorus (P_2O_5) is necessary for all types of plants. Nano DAP (Liquid) possesses a higher ratio of surface area to volume due to its smaller size. Particle size is less than 100 nano meters (nm) due to this unique characteristic, it is simple entrance to the outer layer of the seed along with stomata and other plant apertures.

Materials and Methods

The current investigation was conducted in 2024-25 at Department of Fruit Science, College of Horticulture, Dapoli, District Ratnagiri with twelve treatments and three replications were used in the Randomised Block Design (RBD) experiment the treatment details are given below:

T_1: Control, T_2: Soil application (Urea 2g/plant), T_3: Foliar spray Nano Urea @500 ppm, T_4: Foliar spray Nano Urea @1000 ppm, T_5: Foliar spray Nano Urea @ 1500 ppm, T_6: Foliar spray Nano DAP @ 500 ppm, T_7: Foliar spray Nano DAP @ 1000 ppm, T_8: Foliar spray Nano DAP @ 1500 ppm, T_9: Drenching Nano Urea @ 1500 ppm, T_{10}: Drenching Nano Urea @ 2000 ppm, T_{11}: Drenching Nano DAP @ 1500 ppm, T_{12}: Drenching Nano DAP @ 2000 ppm.

Application of the different concentration treatments at 30, 60, and 90-day intervals and observation recorded monthly up to 270 days from application. From this investigation, 10 grafts in total were selected for morphological character observation from each treatment. The following observations were recorded at the end of the experiment: survival%, graft height (cm), graft girth (mm), number of leaves per graft, leaf area (cm^2), fresh root weight (g), dry shoot weight (g), and tap root length (cm)

Results and Discussion

At the end of the investigation, at 270 days after application of treatment, it showed that all the growth parameters, including survival, were significantly influenced by different concentrations of treatment**.**

Survival Percentage

Table 1: Effect of foliar spray and drenching of Nano Urea and Nano DAP on survival (%) of jamun graft cv. Konkan Bahadoli at 270 days.

Treatment details	Survival (%)
T_1- Control	85.00 (67.21)
T_2- Soil application (Urea 2g/plant)	89.17 (70.79)
T_3- Foliar spray Nano Urea @500 ppm	94.17 (76.03)
T_4- Foliar spray Nano Urea @1000 ppm	94.17 (76.03)
T_5- Foliar spray Nano Urea @ 1500 ppm	94.17 (76.03)
T_6 - Foliar spray Nano DAP @ 500 ppm	94.17 (76.03)
T_7- Foliar spray Nano DAP @ 1000 ppm	95.17 (77.30)
T_8- Foliar spray Nano DAP @ 1500 ppm	95.00 (77.08)
T_9- Drenching Nano Urea @ 1500 ppm	95.83 (78.22)
T_{10}- Drenching Nano Urea @ 2000 ppm	95.00 (77.08)
T_{11}- Drenching Nano DAP @ 1500 ppm	97.52 (80.94)
T_{12}- Drenching Nano DAP @ 2000 ppm	95.00 (77.08)
Mean	93.70
SE. m $\pm$	2.17
CD at 5%	6.36
F test	SIG

The data regarding, effect of Nano Urea and Nano DAP on the growth of jamun on survival percentage which given in Table 1. The result showed that the survival rate of jamun graft was maximum in treatment T_{11} (97.52%) i.e drenching of the Nano DAP at 1500 ppm which at par with T_3 (94.17%), T_4 (94.17%), T_5 (94.17%), T_6 (94.17%), T_7 (95.17%), T_8 (95%), T_9 (95.83%), T_{10} (95.00%) and T_{12} (95.00%). However, minimum survival percentage was found in T_1 (85%). Treatment T_{11}, i.e., drenching of Nano DAP at 1500 ppm, was superior than other treatments. It might due to Nano DAP improves root formation, nutrient availability, and transplant shock reduction, all of which have an effect on graft survival rates. It may absorb nutrients more effectively because to its smaller particle size, which enhances the absorption of phosphorus and nitrogen. During the post-grafting phase, the grafted plant and rootstock develop a strong bond because to this increased nutrient availability.

Graft height (cm)

The data regarding the effect of different treatment of Nano Urea and Nano DAP on graft height (cm) are represented in Table 2. The maximum graft height was recorded in treatment T_{11} (66.73 cm) which was at par with T_{10} (64.93 cm), T_9 (63.36 cm) and minimum graft height was found in T_7 (52.81 cm). Treatment T_{11} i.e drenching of Nano DAP at 1500 ppm was found best among all other treatment. It might due to Nano DAP increased surface area and reduced particle size may enhance nutrient uptake, facilitating cell division, elongation, and vegetative growth. These fertilizers meet plant requirements for nitrogen and phosphate, promoting plant height and biomass accumulation. They also improve photosynthesis, carbohydrate metabolism, protein synthesis, and cell division. Similar result was found by Thakur *et al*. (2024) [4] in wheat (*Triticum aestivum* L.), Ruban *et al*. (2023) [13] in Bhendi (*Abelmoschus esculentus* L. Moench) and Balachandrakumar *et al*. (2024) [3] in cowpea crop.

Graft girth (mm)

The data regarding the effect of Nano Urea and Nano DAP on graft girth (mm) are represented in Table 2. The maximum graft girth (12.52 mm) was found in treatment T_{11} which was at par with T_{12} (11.37 mm) and minimum graft girth (8.83 mm) was found in T_1. Treatment T_{11} i.e drenching of Nano DAP at 1500 ppm was found best among all other treatment. It might due to the nitrogen stimulates protein synthesis in the stem's cambial region, promoting cell division and growth. Phosphorus supports nucleic acid synthesis, ATP synthesis, and graft girth. Nano DAP enhances xylem and phloem growth, increasing stem diameter. Elevated nitrogen levels boost cytokinin production, promoting radial growth. Similar result found by Sudha *et al*. (2023) [16] in Kharif Maize and Kaundal *et al*. (2024) [7] in maize crop.

Number of leaves

The data regarding the effect of Nano Urea and Nano DAP on number of leaves are represented in Table 2. The maximum number of leaves (15.13) was recorded in treatment T_{11} which was at par with T_5 (14.80), T_4 (13.40), T_{10} and T_{12} (13.13), T_9 (12.00). However, minimum treatment was recorded in T_1 (8.67). Treatment T_{11} i.e drenching of Nano DAP at 1500 ppm was showed best result among all other treatment. It might due to the nano particles' large surface area and efficient delivery method enhance nutrient utilization efficiency, resulting in more leaves per plant. They also improve phosphorus and nitrogen availability, promote meristematic activity, and encourage vigorous growth. The nano particles' superior penetration and movement within plant tissues improve chlorophyll production,

cell division, and canopy development. Similar finding were documented by, Maske *et al*. (2025) [9] in chilli (Capsicum annuum. L) and Sudha *et al*. (2023) [16] in maize crop.

Leaf area (cm^2)

The data related to the effect of Nano Urea and Nano DAP on leaf area (cm^2) are represented in Table 2. The maximum leaf area was found in treatment T_{11} (59.18 cm^2) which was at par with T_9 (54.01 cm^2) and T_{12} (52.87 cm^2). However, minimum leaf area was found in T_1 (33.80 cm^2). Treatment T_{11} i.e drenching of Nano DAP at 1500 ppm was showed best result among all other treatment. It might due to the phosphorus enhances leaf area, affects plant development, and enhances chlorophyll production. Nano DAP efficient absorption of nitrogen and phosphorus boosts cell proliferation and leaf growth. Similar research finding documented by, Augustus *et al*. (2023) [1] in Banana Cv. Cavendish, Balchandrakumar *et al*. (2024) in cowpea and Kaundal *et al*. (2024) [7] in maize crop.

Root length (cm)

The data regarding the effect of Nano Urea and Nano DAP on root length (cm) are represented in Table 2. The maximum root length (26.58 cm) was found in treatment T_6 i.e foliar spray of Nano DAP at 500 ppm and minimum root length (12.12 cm) was observed in treatment T_1. Treatment T_6 i.e foliar spray of Nano DAP at 500 ppm, showed best results among the all other treatments for the root length (cm). It might due to Nano-sized DAP particles enhance nutrient absorption, root growth, and early vigor by providing consistent, long-lasting phosphorus supply to the root zone, promoting root elongation and plant development. Similar finding was reported by, Parmar *et al*. (2024) [12] in wheat (*Triticum aestivum* L.) and Todkar *et al*. (2024) [17] in jambheri seedling.

Dry root weight (g)

The data regarding the effect of Nano Urea and Nano DAP on dry root weight (g) are represented in Table 2. The maximum dry root weight was recorded in treatment T_{11} (16.17 g). The lowest dry root weight (3.05g) was recorded in treatment T_1. Treatment T_{11} i.e drenching of Nano DAP at 1500 ppm was showed best result among all other treatment. It might due to Nano DAP improves nutrient availability and efficiency, particularly nitrogen and phosphorus, promoting root development and dry biomass accumulation by improving soil mobility, reducing fixation losses, and stimulating root elongation. Similar result was found by Augustus *et al*. (2023) [1] in Banana Cv. Cavendish, Saleem *et al*. (2021) in wheat (*Triticum aestivum* L) and Sudha *et al*. (2023) [16] in Kharif Maize (*Zea mays* L.) crops.

Dry shoot weight (g)

The data regarding the effect of Nano Urea and Nano DAP on dry shoot weight (g) are represented in Table 2. Thus, from the present investigation, it showed that treatment T_{11} (drenching of Nano DAP 1500 ppm) was recorded best with respect to dry shoot weight jamun grafts. It might due to Nano DAP particle size may enhance plant root absorption, improving nitrogen utilization, increasing dry matter accumulation, and promoting robust growth compared to traditional fertilizers. Similar finding were documented by Augustus *et al.*, (2023) [1] in Banana Cv. Cavendish.

Table 2: Effect of Nano Urea and Nano DAP on graft height (cm), graft girth (mm), number of leaves, leaf area (cm^2), fresh root weight (g), dry root weight (g), tap root length (cm) on jamun graft cv. Konkan Bahadoli.

	Graft height (cm)	Graft girth (mm)	Number of leaves	Leaf area (cm^2)	Tap root length (cm)	Dry root weight (g)	Dry shoot weight (g)
T_1- Control	54.57	8.83	8.67	33.80	12.12	3.05	4.35
T_2- Soil application (Urea 2g/plant)	57.61	10.66	10.73	44.35	25.13	5.38	6.48
T_3- Foliar spray Nano Urea @500 ppm	58.34	10.26	10.87	49.55	21.52	6.20	6.36
T_4- Foliar spray Nano Urea @1000 ppm	59.97	10.81	13.40	46.52	20.32	6.68	8.53
T_5- Foliar spray Nano Urea @ 1500 ppm	54.49	10.61	14.80	43.85	18.02	6.79	6.55
T_6 - Foliar spray Nano DAP @ 500 ppm	59.69	10.89	13.73	49.65	26.58	5.65	5.29
T_7- Foliar spray Nano DAP @ 1000 ppm	52.81	10.69	10.27	44.83	18.30	7.24	6.85
T_8- Foliar spray Nano DAP @ 1500 ppm	56.56	10.81	10.47	50.31	22.28	6.50	6.33
T_9- Drenching Nano Urea @ 1500 ppm	63.36	10.67	12.00	49.65	21.03	10.13	9.17
T_{10}- Drenching Nano Urea @ 2000 ppm	64.93	10.95	13.13	51.15	21.22	9.01	9.22
T_{11}- Drenching Nano DAP @ 1500 ppm	66.73	12.52	15.13	59.18	23.93	16.17	14.08
T_{12}- Drenching Nano DAP @ 2000 ppm	62.80	11.37	13.13	52.87	23.52	8.21	8.50
Mean	59.32	10.76	12.19	47.98	21.16	7.58	7.64
SE. m +	2.15	0.39	1.23	2.51	0.49	0.23	0.21
CD at 5%	6.30	1.15	3.62	7.37	1.44	0.67	0.62
F test	SIG	SIG	SIG	SIG	SIG	SIG	SIG

Conclusion

In this experiment overall findings made it clear that, drenching of nano DAP superior than over than other treatment. Out of all the treatments, treatment T_{11} (drenching of nano DAP 1500 ppm) proved to be the most successful.

The overall findings of the experiment suggested that drenching with Nano DAP was preferable to using other treatments. The most effective of all treatments was T_{11}, which involved drenching of Nano DAP at concentration of 1500 ppm.

and which was shown to be better for the foliar application after a thorough investigation. However, the treatments that performed the best were the drenching of Nano Urea at 2000 ppm (T_{10}), the drenching of Nano DAP at 2000 ppm (T_{12}), and the drenching of Nano Urea at 1500 ppm (T_9) with respect to the morphological parameter. Hence, it suggested that drenching of Nano DAP at 1500 ppm is beneficial to impart better vigour to jamun grafts.

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

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