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Priyanka Kumari
Department of Horticulture and
Post-harvest Technology, Institute
of Agriculture, Visva-Bharati,
Sriniketan, West Bengal, India

Goutam Mandal
Department of Horticulture and
Post-harvest Technology, Institute
of Agriculture, Visva-Bharati,
Sriniketan, West Bengal, India

Rishikant Choudhary
Department of Horticulture and
Post-harvest Technology, Institute
of Agriculture, Visva-Bharati,
Sriniketan, West Bengal, India

Corresponding Author:
Priyanka Kumari
Department of Horticulture and
Post-harvest Technology, Institute
of Agriculture, Visva-Bharati,
Sriniketan, West Bengal, India

Influence of nano-urea and potassium on post-harvest parameters of tissue culture banana cv. Grand Naine

Priyanka Kumari, Goutam Mandal and Rishikant Choudhary

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Abstract

The present study was conducted to know the influence of nano-urea and potassium on Post-harvest parameters of tissue culture banana cv. Grand Naine. Three levels of Nano-urea ($U_1 = 0.2\%$ Nano-Urea/plant, $U_2 = 0.3\%$ Nano-Urea/plant, $U_3 = 0.4\%$ Nano-Urea/plant) three levels Potassium ($K_1 = 1\%$ SOP/plant, $K_2 = 1.5\%$ SOP/plant, $K_3 = 2\%$ SOP/plant) and combination of Nano-urea and SOP ($1\% \text{ SOP} + 0.2\% \text{ Nano-urea}$, $1.5\% \text{ SOP} + 0.3\% \text{ Nano-urea}$ and $2\% \text{ SOP} + 0.4\% \text{ Nano-Urea/plant}$) were studied in a randomized block design (RBD) with three replications. The results revealed that the combine application of $1.5\% \text{ SOP} + 0.3\% \text{ Nano-urea/plant}$ and $2\% \text{ SOP} + 0.4\% \text{ Nano-Urea/plant}$ showed more significant increase in green life of fruit (12.0 and 11.67 days), fruit weight (138g and 132g), pulp weight (104.67g and 96.55g) and peel weight (33.33g and 35.50g) of plant and decreases physiological loss in weight. The application of these two fertilizers their combination would be the most appropriate level for getting the superior post-harvest parameter of banana in tissue culture as well as in ratoon crop.

Keywords: Nano-urea, nitrogen, potassium, post-harvest parameters and banana

Introduction

Banana (*Musa x paradisiaca*), often referred to as the "Apple of Paradise," is a major fruit crop cultivated extensively in tropical and subtropical regions, providing both food security and economic value (Arthi *et al.*, 2023) ^[1]. It is a mesophytic plant and requires abundant nutrients and soil moisture for good growth and development, leading to the production of a heavy bunch and quality fruits. In the banana plant system, nitrogen and potassium are key elements in banana nutrition. The earliest reference to the analysis of the banana plant SOP (full form) showed a high concentration of potassium in the plant. This observation has been continuous for many researchers all over the world (Twfors, 1967). Banana absorbs more nutrients per unit area than almost any other crop (Martin, 1984) ^[7]. Banana require more potassium for their growth, production and quality compared to nitrogen and phosphorus. Bananas are a potassium-loving crop; the farmers in India are applying potassium @ 8000 to 1600 kg ha⁻¹ depending upon the availability of soil potassium. Muriate of potash (MOP) is commonly used as the source of potassium; chloride toxicity is often seen in bananas, hindering the crop growth, yield and quality (Nalina, 2002) ^[8]. Under the traditional farming system, the banana crop receives its last dose of fertilizers (nitrogen and potassium) at seven months after planting (just before the shooting) to support the requirement of nutrients until harvest, since a large quantity of photosynthates is to move from the source to the sink, i.e. developing bunches at this phase. Soil-applied fertilizers at this stage are often ineffective due to slow absorption, resulting in poor fruit development and reduced yield. Foliar application of nutrients has emerged as a promising strategy to overcome these limitations, providing rapid and targeted delivery of essential elements directly to the plant (kumari *et al.*, 2026) ^[6]. Nano-fertilizers, with their reduced particle size and high surface area, further enhance penetration and nutrient use efficiency, offering an innovative approach to improve plant growth and productivity. Nano-based agricultural products, such as nanofertilizer, offer innovative solutions to enhance crop performance while minimising environmental impacts (Lal, 2008) ^[4]. In light of this, Indian Farmers Fertiliser Cooperative Limited (IFFCO) has created a new nano-fertiliser called IFFCO nano-urea (liquid) with the intention of replacing or minimising the negative impacts of the

application of urea. This new fertiliser molecule has been evaluated on a variety of crops in various research institutes and state agricultural universities, as it has been discovered that the majority of crops are reacting well to nano-urea (Kumar *et al.*, 2021)^[3]

Even though nitrogen and potassium are abundant in many banana-growing soils, the bulk of soil nitrogen and potassium is unavailable to plants due to both plant and environmental factors; therefore, additional application through foliar spray has been found beneficial. In high value crop like banana quality standards have become the most important factor influencing yield and farmers' income. The main aim of this study was to assess the Influence of nano-urea and potassium on the post-harvest parameters of tissue culture banana cv. Grand naine

Materials and Methods

The study was conducted at the Horticultural Farm, Department of Horticulture and Post-harvest Technology, Palli-Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan, West Bengal (23°42' N, 87°40'30" E; 40 m above sea level) during the 2022–23 and 2023–24 cropping seasons. The site experiences a sub-humid, subtropical climate, with hot summers and moderately cool, short winters. The soil is red lateritic with a loamy sand texture, pH 4.97, EC 0.28 dS m⁻¹, organic carbon 0.6%, and available N, P, and K of 237.44, 17.13, and 114.68 kg ha⁻¹, respectively. The experiment employed a Randomized Block Design (RBD) with ten treatments and three replications. Tissue culture-derived banana plantlets (cv. Grand Naine) were transplanted in the month of August (2022) at 1.8 × 1.8 m

spacing into 50 × 50 × 50 cm pits. Treatments included foliar applications of SOP (1.0%, 1.5%, 2.0%), nano-urea (0.2%, 0.3%, 0.4%), and their combinations (1.0% SOP + 0.2% nano-urea, 1.5% SOP + 0.3% nano-urea, 2.0% SOP + 0.4% nano-urea), with water as a control. The basal dose of fertilizers (200 g N, 160 g P, 200 g K per plant) was applied at planting and one and two months post-planting. Foliar sprays were applied at 3, 5, 7, and 9 months after planting, following standard agronomic practices and SOP as a source of potassium and IFFCO Nano urea as a source of nitrogen used in treatment. After harvesting, the selected three fingers from each treatment having true representation were analysed for post-harvest parameters, and the average was worked out and subjected to statistical analysis. The green life of the fruit was evaluated on the basis of visual observation. Fruit weight, pulp weight, and peel weight were calculated by a weighing machine in gm. The following formula calculates the physiological loss in weight.

PLW (%) = Initial weight (g) - Final weight (g) × 100 / Initial weight (g)

Statistical Analysis

The data recorded from the experiment were subjected to statistical analysis using the randomized block design (RBD) with three replications. Mean differences were evaluated using the F-test at the 5% level of significance. Whenever the F-test indicated significant differences among treatments, the Critical Difference (CD) at the 5% level of significance was calculated to facilitate pairwise comparison of treatment means.

Table 1: Influence of Nano-urea and Potassium on the Post-harvest Parameters of Tissue Culture Banana cv. Grand Naine in 2022-23

S. No.	Treatments	Green life (days)	Physiological loss in weight (%)	Fruit weight (g)	Pulp weight (g)	Peel weight (g)
T ₁	1.0% SOP	9.67	15.33	107.67	82.67	25.33
T ₂	1.5% SOP	10.33	15.00	112.00	84.67	28.33
T ₃	2.0% SOP	10.67	14.33	117.67	88.00	29.67
T ₄	0. 2% Nano-urea	9.33	16.00	91.67	65.67	26.00
T ₅	0. 3% Nano-urea	9.00	16.67	89.00	63.67	25.33
T ₆	0. 4% Nano-urea	8.67	17.00	83.00	59.33	23.67
T ₇	1% SOP + 0.2% Nano-urea	10.67	12.67	122.67	93.33	28.34
T ₈	1.5% SOP + 0.3% Nano-urea	12.00	11.00	138.00	104.67	33.33
T ₉	2% SOP + 0.4% Nano-urea	10.77	12.58	125.33	96.00	28.33
T ₁₀	Control	6.67	19.00	78.33	58.33	20.00
	SE(m)	0.41	0.18	1.73	1.62	0.94
	CD	1.23	0.54	2.83	3.52	2.79

Table 2: Influence of Nano-urea and Potassium on the Post-harvest Parameters of Tissue Culture Banana (Ratoon) cv. Grand Naine in 2023-24

S. No.	Treatments	Green life (days)	Physiological loss in weight (%)	Fruit weight(g)	Pulp weight (g)	Peel weight (g)
T ₁	1% SOP	9.67	16.33	102.00	75.00	27.00
T ₂	1.5% SOP	10.00	15.67	107.00	77.33	29.67
T ₃	2% SOP	10.33	14.67	115.00	85.00	30.00
T ₄	0. 2% Nano-urea	9.00	17.33	88.00	64.00	24.00
T ₅	0. 3% Nano-urea	8.67	17.50	85.00	59.33	25.67
T ₆	0. 4% Nano-urea	8.67	18.00	71.00	52.00	19.00
T ₇	1% SOP + 0.2% Nano-urea	10.33	14.95	119.00	86.67	32.33
T ₈	1.5% SOP + 0.3% Nano-urea	11.67	13.33	132.00	96.50	35.50
T ₉	2% SOP + 0.4% Nano-urea	10.67	14.17	122.00	88.00	34.00
T ₁₀	Control	8.00	19.50	62.00	46.00	16.00
	SE(m)	0.26	0.4	1.71	1.84	0.79
	CD	0.78	1.19	5.09	5.47	2.34

Results and Discussion

The findings were considerably interpreted and listed in Tables 1 and 2 based on the observations recorded in the present research with the objective of effect of nano-urea and potassium on

postharvest parameters. The data regarding green life, physiological loss in weight (PLW), fruit weight, pulp weight and peel weight showed a significant difference among the treatments in tissue culture plant and it's Ratoon.

Green life (days)

The perusal of data indicated that there exists a significant difference among treatments. The highest green life (12.00 days and 11.67 days) was recorded in T₈ -1.5% SOP + 0.3% nano-urea, followed by T₉ (10.77 days and 10.67 days) in tissue culture and ratoon crop, whereas the lowest green life (6.67 days and 8.00 days) was found in T₁₀ control (Tables 1 and 2). Sandhya *et al.*, (2018)^[10] reported that an increase in green life may be due to the potassium element responsible for cytokinin concentration in plants, but in general, cytokinin delays the senescence process; hence, the green life of the fruit has increased. The result of the present investigation is in close conformity with the findings of Pujari *et al.*, (2010)^[9].

Physiological loss in weight (%)

The data revealed that there is a significant difference among the treatments. The minimum physiological loss in weight (11.00% and 13.33%) was recorded in T₈. 1.5% SOP + 0.3% Nano-urea, followed by T₉ (12.58% and 14.17%) in tissue culture and ratoon crop, whereas maximum physiological loss in weight (19.00% and 19.50%) was registered in T₁₀-control (Tables 1 and 2). The increase in the evapo-transpiration changes with the progress of the storage period might be responsible for the high PLW of fruits. The decrease in weight loss by the application of calcium may be due to its role in the maintenance of fruit firmness, retardation of respiratory rates, as well as transpiration and delayed senescence, which was reported by Bhatt *et al.* (2012)^[2]; Kumar *et al.* (2008)^[5].

Fruit weight (g)

The maximum fruit weight at the ripe stage (138.00 g and 132 g) was obtained T₈. 1.5% SOP + 0.3% Nano-urea followed by T₉ (125.33g and 122g) in tissue culture and ratoon crop whereas minimum fruit weight (78.33 g and 62.00 g) was recorded in T₁₀-control (Table 1 and 2). The decrease in weight loss, thereby maintaining fruit weight by the application of calcium, may be due to its role in the maintenance of fruit firmness, retardation of respiratory rates, as well as transpiration, which will influence the fruit weight. These results are in conformity with Bhatt *et al.*, (2012)^[2] and Sandhya *et al.*, (2018)^[10].

Pulp weight and peel weight (g)

The maximum pulp weight (104.67g and 96.50g) and peel weight (33.33 g and 35.50 g) was observed in T₈ followed by T₉ (96.0g and 46g) at ripe stage in tissue culture plant and ratoon crop, respectively, whereas minimum pulp weight (58.33 g and 46.00), followed by T₉ (28.33g and 34g) and peel weight (20.00 g and 16.00g) at ripe stage was found in T₁₀-control (Table 1 and 2). The maximum amount of pulp content might be due to foliar application of potassium might have made rapid synthesis of metabolites, particularly carbohydrates and their translocation to the fruits, causing relatively greater pulp content, whereas calcium and magnesium influenced peel weight, similar results reported by Singh *et al.* (2010)^[11]; Sandhya *et al.*, (2018)^[10].

Conclusion

The plants treated with foliar spray of nano-urea and SOP water soluble on post-harvest parameters of banana cv. Grand Naine under the lateritic zone of West Bengal. T₈ 1.5% SOP + 0.3% nano-urea proved to be the best. The treatment T₈ had influenced fruit postharvest parameters of banana, and thereby helps farmers to get an enhanced income in the banana cv. Grand Naine under the lateritic zone of West Bengal.

Future scope

The future studies need to be carried out on a combination of secondary nutrients and micronutrients on banana.

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