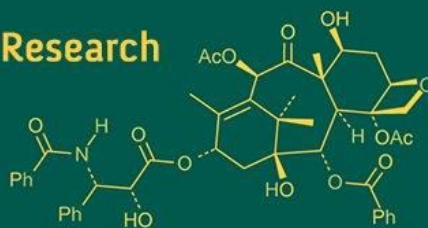
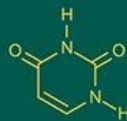
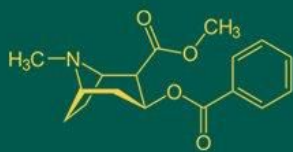


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Effect of seed treatment on growth of royal palm seedlings [*Roystonea regia* (Kunth)]

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Abstract

The experiment was laid out in a Completely Randomized Design with 3 repetitions. The experiment was comprised of eleven seed treatments viz., T₁: control T₂: Scarification 3 min 30 second, T₃: GA₃ 1000 ppm for 2 days, T₄: GA₃ 1500 ppm for 2 days, T₅: Bio-NP 10 ml for 2 days, T₆: Bio-NP 20 ml for 2 days, T₇: Cow urine 50% for 2 days, T₈: Bijamrut for 2 days, T₉: H₂SO₄ 10% for 5 minutes, T₁₀: Scarification + GA₃ 1000 ppm for 2 days, T₁₁: Scarification + Bio-NP 10 ml for 2 days. The observations on growth attributes were studied during the course of investigation and was subjected to statistically analysed. The study results revealed that the growth attributes regarding germinated seedlings viz. plant height at 120 DAS (31.93 cm) and 150 DAS (39.91 cm), number of leaves at 150 DAS (2.53), width of leaves at 120 DAS (1.59 cm) and 150 DAS (1.82 cm), root length at 150 DAS (26.50 cm), number of rootlets at 150 DAS (104.53), fresh weight of plant at 150 DAS (3.708 g), dry weight of plant at 150 DAS (0.943 g), root-shoot ratio at 150 DAS (0.62) and seedling vigour index at 150 DAS (5478.19) were observed higher in GA₃ 1500 ppm for 2 days treatment.

Keywords: Growth, royal palm, seed treatments, *Roystonea regia*, seedlings

Introduction

Arecaceae is a palm family that include 2400-2600 plant species. Palm have been bred for several generations being an integral part of human existence and adding a lot to the world economy. People living in tropical areas have been depended on palm species for their sustenance and source of income because the palms has been known to be useful for a diverse of commercial products such as food products, cosmetics, bio fuel etc. Functionality of many palm species is manifold integrated into the cultural and socioeconomic environment of many countries worldwide. Royal palm which is also known as *Roystonea regia* is a member of this family. Royal palm fruit is purplish in colour having only one seed. Generally, the fruit wall (pericarp) consists of the exocarp, mesocarp and endocarp. The endocarp or 'shell' may be thick and stoney (drupe) to thin, papery or fleshy (berry); in some taxa, it is undifferentiated (Corner, 1966; Uhl and Dransfield, 1987; Tomlinson, 1990) [1, 9, 8]. Seed dormancy in most of the palm species may be due to seeds contain immature embryos or small embryos and covering layers or integuments restricting water inhibition or hard seed coat or gas presence penetrability or leaching of inhibition of growth regulators etc. in general palm seeds do not imbibe sufficient moisture for germination due to nature of hard seed coat which impermeable to water generally palm seeds do not imbibe sufficient moisture for germination. Hard seed coats are reason for causing impermeable to water. (Ingole *et al.*, 2020) [4].

Materials and Methods

The experiment was conducted at the Flower and Ornamental Nursery, College of Horticulture, Anand Agricultural University, Anand. Seeds were collected from palms of the same age and growth stage and then uniformly sown in seed bags. The experiment was done by using eleven seed treatments viz., T₁: control T₂: Scarification 3 min 30 second, T₃: GA₃ 1000 ppm for 2 days, T₄: GA₃ 1500 ppm for 2 days, T₅: Bio-NP 10 ml for 2 days, T₆: Bio-NP 20 ml for 2 days, T₇: Cow urine 50% for 2 days, T₈: Bijamrut for 2 days, T₉: H₂SO₄ 10% for 5 minutes, T₁₀: Scarification + GA₃ 1000 ppm for 2 days, T₁₁: Scarification + Bio-NP 10 ml for 2 days.

Results and Discussion

Effect of seed treatment on plant height of royal palm seedlings

The data about the impact of seed treatment on plant height in royal palm is shown in Table 1. Observation of plant height was taken at 120 and 150 DAS. Significant difference in plant height was observed at 120 and 150 DAS in royal palm seedlings. The significantly highest plant height was reported in seeds treated with T₄ GA₃ 1500 ppm (31.93 cm and 39.91 cm) at 120 and 150 DAS respectively, which was

at par with seeds treated with T₁₀ scarification and GA₃ 1000 ppm and T₂ scarification. In contrast seeds treated with T₁ control produced the reduced plant height (13.40 cm and 17.97 cm) at 120 and 150 DAS respectively. The reason for the rise in seedling height following GA₃ treatment was that the hormone enhanced osmotic uptake of nutrients, which led to cell elongation and multiplication in the cambium tissue of internodal region, thus increasing the plant height (Shanmugavelu, 1970) [7].

Table 1: Effect of seed treatment on vegetative growth of royal palm seedlings

Treatments	Plant height (cm)		Width of leaves (cm)		Root length (cm) (150 DAS)	Number of rootlets (150 DAS)	Number of leaves (150 DAS)
	120 DAS	150 DAS	120 DAS	150 DAS			
T ₁ Control	13.40	17.97	0.780	1.19	15.19	29.07	1.00
T ₂ Scarification	30.66	38.18	1.510	1.70	24.96	70.40	2.33
T ₃ GA ₃ 1000 ppm for 2 days	23.42	34.36	1.300	1.62	21.14	55.37	2.20
T ₄ GA ₃ 1500 ppm for 2 days	31.93	39.91	1.590	1.82	26.50	104.53	2.53
T ₅ Bio NP 10 ml for 2 days	16.41	25.18	1.053	1.43	19.74	54.00	1.87
T ₆ Bio NP 20 ml for 2 days	20.50	28.19	0.963	1.34	20.69	54.80	1.93
T ₇ Cow urine 50% for 2 days	13.84	19.25	0.957	1.31	15.23	53.67	1.40
T ₈ Bijamrut for 2 days	14.06	19.95	0.963	1.33	16.30	47.67	1.47
T ₉ H ₂ SO ₄ 10% for 5 minutes	14.80	21.11	0.933	1.22	17.23	43.27	1.53
T ₁₀ Scarification + GA ₃ 1000 ppm for 2 days	30.82	38.95	1.530	1.71	25.11	62.27	2.40
T ₁₁ Scarification + Bio NP 10 ml for 2 days	20.54	28.26	1.123	1.54	21.13	65.47	2.07
S.E.m. _±	0.45	0.84	0.039	0.04	0.57	1.73	0.08
CD at 5%	1.33	2.45	0.115	0.13	1.67	5.06	0.24
CV%	3.76	5.11	5.867	5.22	4.86	5.14	7.39

Effect of seed treatment on width of leaves of royal palm seedlings

Table 1 presents a comprehensive analysis of the effects of different seed treatment methods on leaf width.

Leaf width was measured twice at 120 and 150 days after sowing (DAS). A significant variation in leaf width was observed at both the times. The highest leaf widths were recorded (1.510 cm and 1.70 cm) under treatment T₄ GA₃ at 1500 ppm at 120 DAS and 150 DAS respectively. It was statistically at par with T₁₀ scarification and GA₃ at 1000 ppm and T₂ scarification, indicating their comparable

effectiveness in promoting leaf expansion. In contrast the lowest leaf widths (0.780 cm and 1.19 cm) were observed in the seeds kept as control treatment T₁ at 120 and 150 DAS respectively.

The increase in leaf width was attributed to the stimulatory effect of GA₃ on cell elongation and expansion, which contributes to a larger photosynthetic surface area. Consistent results were also reported by Rani and Singh (2013) [6] in tuberose seed treated with GA₃ at 150 ppm resulted in the maximum leaf width.

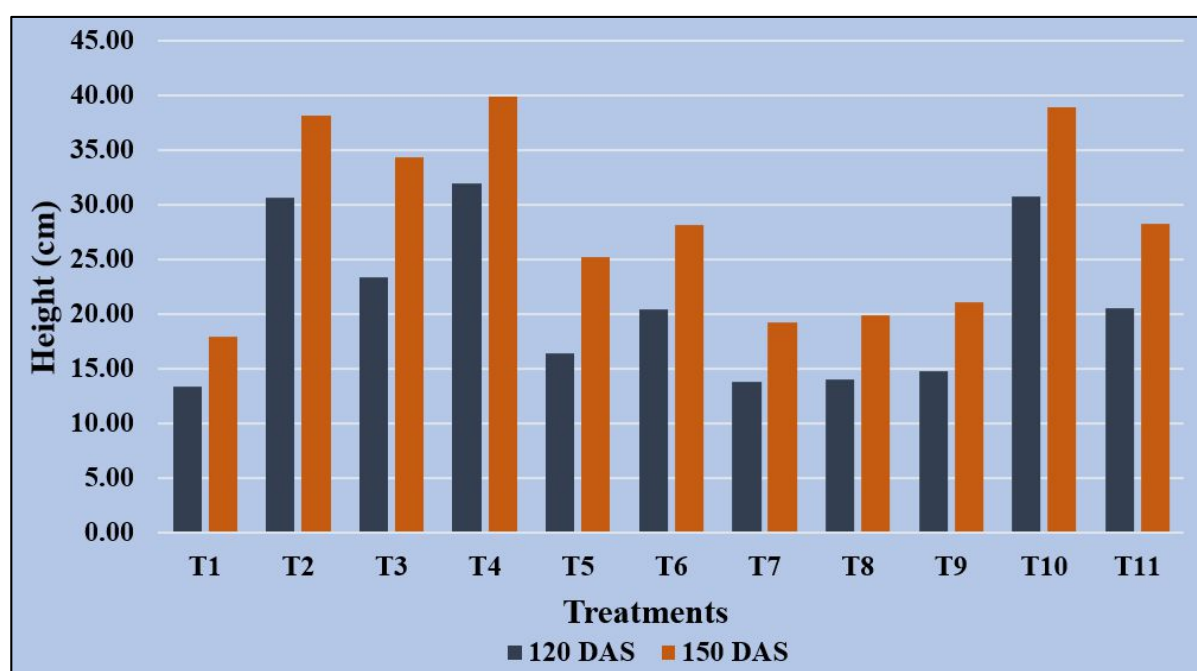


Fig 1: Effect of seed treatment on plant height of royal palm seedlings

Effect of seed treatment on root length of royal palm seedlings

Table 1 contains the data representing the effect of seed treatment on root length (cm) in royal palm.

Root length data was collected at 150 DAS. The maximum root length (26.50 cm) at 150 DAS was recorded in seed treated with treatment T₄ GA₃ 1500 ppm, which was at par with treatment T₁₀ scarification and GA₃ 1000 ppm and T₂ scarification. On the other hand, treatment T₁ which performed as the control, produced the shorter root length (15.19 cm) at 150 DAS.

Effect of seed treatment on number of rootlets of royal palm seedlings

Table 1 displays the results about the impact of seed treatment on the quantity of royal palm rootlets.

Number of rootlets was observed and recorded on 150 DAS. Significantly highest number of rootlets (104.53) at 150 DAS was observed in treatment T₄ (GA₃ 1500 ppm) which was noticeably better than any other treatment in the study. On the other hand, treatment T₁, which functioned as the control, showed the lowest numbers of rootlets (29.07) at 150 DAS.

Similar results have been found in royal palm by Ingole *et al.* (2021) [3]. It was demonstrated that treatment GA₃ 1500 ppm produced the highest number of roots per plant and was determined to be markedly more successful than all other treatments in the study. By enhancing auxin sensitivity and lateral root development, GA₃ increases surface area available for nutrition and water intake.

Effect of seed treatment on number of leaves of royal palm seedlings

Table 1 presents the data regarding the effect of seed treatment on the number of leaves in the royal palm.

Collection of data regarding number of leaves per plant was recorded on 150 DAS. Number of leaves in royal palm was significantly affected by seed treatment. Significantly highest number of leaves (2.53) at 150 DAS was recorded by seeds treated with T₄ GA₃ 1500 ppm, it was at par with treatment T₁₀ scarification with GA₃ 1000 ppm and T₂ scarification. On the other hand, treatment T₁ (Control) had the lowest number of leaves (1.00) at 150 DAS.

Higher number of leaves in GA₃ treated seeds might be due to presence of GA₃ may have increased the number of leaves because its action to produces more nucleoprotein, which increases leaf initiation and expansion.

Effect of seed treatment on Fresh weight of royal palm seedlings

Table 2 presents the results regarding the impact of seed treatment on the fresh weight of royal palm.

Fresh weight of the plants was recorded at 150 days after sowing (DAS). At the end of the study period, a significant variation in fresh weight was observed among all the treatments. The maximum fresh weight (3.708 g) at 150 DAS was recorded in treatment T₄ GA₃ 1500 ppm, which

was statistically at par with treatment T₁₀ scarification and GA₃ 1000 ppm, indicating their effectiveness in promoting vegetative growth. In contrast, the minimum fresh weight (0.677 g) at 150 DAS was observed in the control treatment T₁.

Similar findings were reported in royal palm by Ingole *et al.* (2021) [3], who observed that treatment with GA₃ at 1500 ppm resulted in the highest fresh plant weight, significantly outperforming all other treatments evaluated in the study. The enhanced fresh weight was attributed to the role of GA₃ in promoting biomass accumulation through improved photosynthetic efficiency and increased water uptake, ultimately contributing to vigorous plant growth.

Effect of seed treatment on dry weight of royal palm seedlings

Table 2 presents the data illustrating the effect of different seed treatments on the dry weight of royal palm at 150 DAS. A significant variation in dry weight was observed among seeds treated with various treatments in royal palm. The highest dry weight (0.943 g) was recorded in treatment T₄ GA₃ at 1500 ppm, which was statistically at par with T₁₀ scarification and GA₃ at 1000 ppm, indicating their effectiveness in enhancing biomass accumulation. In contrast, the lowest dry weight (0.256 g) was observed in the seeds kept in control treatment, highlighting the beneficial role of seed treatment in promoting dry matter production.

Biomass accumulation in plants is the net outcome of the dynamic interaction between various anabolic and catabolic processes. Among plant growth regulators, gibberellic acid (GA₃) has demonstrated a significant influence on the accumulation of dry matter across different plant organs. This effect can be attributed to the ability of GA₃ to stimulate key physiological processes, including cell division, cell elongation, enhanced auxin metabolism, increased cell wall plasticity and improved cell membrane permeability. Collective effect of these mechanisms might have contribute to enhanced vegetative growth and higher dry matter production in seeds treated with GA₃ (1500 ppm).

Effect of seed treatment on root-shoot ratio of royal palm seedlings

Data were recorded at 150 days after sowing (DAS). A significant variation in the root-shoot ratio was observed among the treatments at the conclusion of the study. The lowest root-shoot ratio (0.62 g) was recorded under treatment T₄ GA₃ at 1500 ppm, which was statistically the lowest and found to be at par with treatments T₁₀ scarification and GA₃ at 1000 ppm, T₃ GA₃ at 1000 ppm, T₁₁ scarification and Bio NP 10 ml, T₆ Bio NP at 20 ml and T₅ Bio NP at 20 ml. In contrast, the highest root-shoot ratio (0.88 g) was recorded in the control treatment T₁, indicating the influence of seed treatments in modulating the allocation of biomass between root and shoot components.

Table 2: Effect of seed treatment on vegetative growth of royal palm seedlings

	Treatments	Fresh weight of plant (g)	Dry weight of plant (g)	Root-shoot ratio	Seedling vigour index
T ₁	Control	0.677	0.256	0.88	1712.45
T ₂	Scarification	0.931	0.431	0.75	5054.79
T ₃	GA ₃ 1000 ppm for 2 days	2.012	0.858	0.67	4119.11
T ₄	GA ₃ 1500 ppm for 2 days	3.708	0.943	0.62	5478.19
T ₅	Bio NP 10 ml for 2 days	1.120	0.487	0.69	2919.80
T ₆	Bio NP 20 ml for 2 days	1.251	0.696	0.68	3340.48
T ₇	Cow urine 50% for 2 days	0.800	0.389	0.85	1953.66
T ₈	Bijamrut for 2 days	0.727	0.402	0.83	2241.39
T ₉	H ₂ SO ₄ 10% for 5 minutes	0.681	0.363	0.86	2428.82
T ₁₀	Scarification + GA ₃ 1000 ppm for 2 days	3.692	0.887	0.63	4967.88
T ₁₁	Scarification + Bio NP 10 ml for 2 days	1.297	0.736	0.68	3745.91
	S.E.m. _±	0.05	0.02	0.04	114.99
	CD at 5%	0.14	0.079	0.11	337.25
	CV%	5.56	7.94	9.02	5.77

Gibberellic acid (GA₃) seed treatment often results in a reduced root-to-shoot ratio in royal palm (*Roystonea regia*) due to its targeted influence on shoot growth in initial stage of seedling growth. GA₃ is a plant hormone known to significantly promote cell elongation, particularly in the stems and leaves, thereby enhancing shoot development at a faster rate than root growth (Hedden & Thomas, 2012) [2]. This differential stimulation leads to a greater allocation of biomass to the aerial parts of the plant, consequently lowering the root-to-shoot ratio.

Effect of seed treatment on seedling vigour index of royal palm seedlings

Table 2 presents the data on the effect of various seed treatments on the seedling vigour index of royal palm. Seedling vigour index was assessed at 150 days after sowing (DAS) to evaluate the influence of seed treatments on early seedling performance in royal palm. At the conclusion of the study, significant differences in seedling vigour index were observed among the treatments. The highest seedling vigour index (5478.19) was recorded in treatment T₄ GA₃ at 1500 ppm, which was markedly superior to all other treatments, indicating its effectiveness in promoting robust seedling growth. In contrast, the lowest seedling vigour index (1712.45) was observed in the control treatment T₁, underscoring the beneficial impact of GA₃ application on seedling vigour.

The enhanced seedling vigour observed with GA₃ treatment can be attributed to several physiological and biochemical mechanisms. GA₃ promotes the development of larger embryos, accelerates respiration rates and enhances overall metabolic activity. This leads to improved mobilization and utilization of stored metabolites to active growth sites. Additionally, increased enzyme activity stimulated by GA₃ facilitates key metabolic processes such as oxidative reactions, protein hydrolysis and sugar mobilization, all of which contribute to vigorous seedling growth (Puls and Lambeth, 1974) [5]. These hormonal and enzymatic mechanisms collectively support the superior seedling vigour index observed in GA₃ treated.

Conclusion

The present investigation concluded that gibberellic acid enhanced the growth of royal palm seedlings. Seed treated with gibberellic acid 1500 ppm for 2 days provide healthier seedling growth attributed to higher plant height, number of leaves, width of leaves, root length, number of rootlets and biomass of plant.

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