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Innovative Approaches to *In-Vitro* Cultivation of Banana Meristems Using Plant Growth Regulators

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ABSTRACT

This paper deals with the use of different plant growth regulators for micropropagation of Banana cultivar 'Grand Naine' (G9. The following experiments research various PGR treatments to define the optimal conditions for shoot, root, and leaf initiation. Among the tested treatments, 1 mg/L BAP, 1 mg/L NAA, and 1 mg/L GA3 exhibited the highest efficiency for shoot, root, and leaf initiation, as well as the best root and shoot lengths. Therefore, the experiment is significant in coming up with better ways of culturing banana tissues, which is an effective means of ensuring the production of quality banana plants.

Keywords : Banana (Grand Naine), Micropropagation, Plant Growth Regulators, Tissue Culture, Meristems

INTRODUCTION

Bananas, one of the main tropical staple fruits, are grown and produced because they are nutritionally rich and of high economic value. Among the several cultivars of bananas, 'Grand Naine' finds the most preferred one because of its high productivity, enhanced fruit quality, and resistance to many diseases like Panama disease. It is still in high demand and traditional propagation methods, mainly by suckers, are not able to satisfy the growing demand. This hence calls for the need to devise more efficient propagation methods.

An answer may lie in the tissue culture technique of micropropagation, which makes it possible to produce disease-free and genetically uniform banana plants in an extraordinarily short period of time. However, micropropagation depends to a large extent on optimized culture conditions-one of which is the use of plant growth regulators. PGRs have been recognized as fundamental controls of cell division, differentiation, and organogenesis.

Earlier studies have shown the possibility of different PGRs, such as auxins like NAA and IBA, cytokinins like BAP and Kinetin, and gibberellins like GA3, to enhance the efficiency of micropropagation in bananas. However, the optimal combination and concentration among these PGRs for the 'Grand Naine' cultivar need detailed research. This is an evaluation of effects of different PGR combinations on 'Grand Naine' banana plantlets with respect to shoot, root, and leaf initiation and development. The present research is an approach towards the development of a reliable and efficient protocol for the micropropagation of 'Grand Naine' bananas using the best PGR treatments. This relates to and contributes greatly to the sustainable growing and production of bananas.

MATERIALS AND METHODS

Plant Material

Explant used were meristems from 'Grand Naine' banana suckers. The suckers were collected from disease-free mother plants grown in the Experimental Orchard of the Faculty of Agriculture, Guru Kashi University..

Media Preparation and Culture Conditions

In the present investigation, Murashige and Skoog (MS) medium was used as basal medium, to which different PGRs combinations were made for investigating their interactions on micropropagation::

Treatments

Original Media Name	Assigned Treatment Name
MS media control	T1
MS + 1 mg/l NAA	T2
MS + 1.5 BAP + 0.5 kin	T3
Ms + 0.5 mg/l BAP + 1 NAA	T4
MS+1.5 mg/l IBA + 1.5 mg/l NAA	T5
MS + 1 mg/l BAP + 1 NAA + 1 mg/l GA3	T6
MS + 4.5 mg/l IBA + 1.5 mg/l NAA	T7
MS media + 2.5 mg/l BAP + 1mg/l kinetin + 3 mg/lNAA	T8

Cultures were maintained at 26°C under a 16-hour photoperiod with cool white fluorescent light.

Sterilization and Explant Preparation

Explants were surface-sterilized using 0.2% HgCl2 solution, followed by three rinses with sterile distilled water. They were then trimmed to approximately 0.5 cm^3 cubes containing the apical meristem. The sterilized explants were inoculated onto the prepared MS media with different PGR treatments.

Evaluation Parameters

The effects of different PGR treatments on shoot, root, and leaf initiation were evaluated. The parameters recorded included the number of days to shoot initiation, the number of shoots per explant, the number of days to root initiation, the number of roots per explant, the number of leaves per shoot, as well as shoot and root lengths.

RESULTS AND DISCUSSIONS

Shoot Initiation

Shoot initiation was observed to vary significantly among the different PGR treatments. The combination of 1 mg/L BAP, 1 mg/L NAA, and 1 mg/L GA3 (T6) resulted in the fastest shoot initiation, with an average of 10 days. In contrast, the MS medium without any PGRs (T1) showed delayed shoot initiation, averaging 18 days. Treatments T5 and T3 also showed relatively quick shoot initiation, averaging 12 and 13 days, respectively.

Table 1 : Explant response, days taken for shoot initiation and root initiation.

Treatments	Explant response	No. Of days taken for shoot induction	No. Of days taken for root induction
T1	90	5±1	4±1
T2	70	7±1	9±1
T3	84	8±1	4±1
T4	87	6±1	7±1
T5	77	5±1	8±1
T6	89	6±1	5±1
T7	79	8±1	4±1
T8	70	3±1	8±1

Shoot Multiplication

The number of shoots per explant varied with different treatments. The highest multiplication rate was observed in treatment T6, with an average of 6.2 shoots per explant. Treatment T3 also showed a high multiplication rate, with an average of 5.8 shoots per explant. Treatments T4 and T7 had moderate success, averaging 4.3 and 4.0 shoots per explant, respectively. The shoot length was also measured, with T6 producing the longest shoots at an average of 7.5 cm, followed by T3 with 6.8 cm.

Table 2 : Average No. Of leaves per explant at 7^{th}, 14^{th}, and 21^{st} day.

Treatments	At 7 days	14 days	21 days
T1	4 ±1	8±1	9 ±1
T2	2±1	5±1	6 ±1
T3	5±1	7 ±1	9 ±1
T4	4±1	6 ±1	8±1
T5	3 ±1	4 ±1	6 ±1
T6	4 ±1	5 ±1	7 ±1
T7	2 ±1	5 ±1	7 ±1
T8	3 ±1	4 ±1	5 ±1

Table 3: Average no. of shoots per explant at 7th, 14th, and 21st day.

Treatments	At 7 days	14 days	21 days
T1	2.5	5	8
T2	3	5	7
T3	2	4	9
T4	1.5	6	7
T5	1	3	4
T6	3.5	4	5
T7	4	6	7
T8	3	5	8

Root Initiation

Root initiation followed a similar trend to shoot initiation. Treatment T6 showed the quickest root initiation, taking an average of 12 days. Treatment T1 also showed relatively fast root initiation, averaging 14 days. The highest number of roots per explant was also recorded in treatment T6, with an average of 7.5 roots per explant. Treatment T3 produced an average of 6.9 roots per explant. The average root length was significantly higher in treatment T6, measuring 6.8 cm, compared to other treatments.

Leaf Initiation

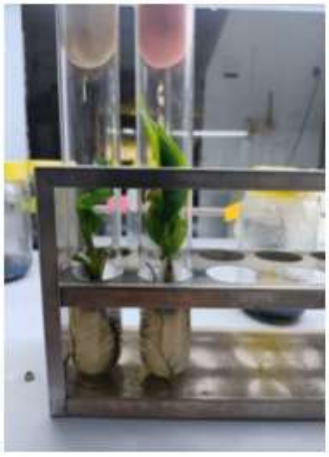
Leaf initiation and development were influenced by the PGR treatments. Treatment T6 led in leaf initiation, producing an average of 4.3 leaves per shoot. Treatment T3 followed closely, with an average of 4.1 leaves per shoot. Treatments T4 and T1 also showed good leaf initiation, with averages of 3.8 and 3.5 leaves per shoot, respectively.

Table 4: Average No. Of roots per explant at 7th, 14th, and 21st day.

Treatments	At 7 days	14 days	21 days
T1	3±1	5±1	8 ±1
T2	0	1±1	3 ±1
T3	2 ±1	4±1	7±1
T4	3 ±1	4±1	7±1
T5	4 ±1	5 ±1	8±1
T6	2 ±1	4 ±1	5 ±1
T7	4±1	6±1	8±1
T8	0	2±1	4±1

Table 5: Average Length of roots per explant(cm) at 7th,14th, and 21st day.

Treatments	At 7 days	14 days	21 days
T1	3	4. 5	7
T2	4	5.5	6
T3	3	6	8
T4	1.5	4	6
T5	2	3. 5	5.7
T6	3.2	3.8	5
T7	1.9	3.3	5.5
T8	0	2	4. 2


Overall Plant Development

Overall plant development was assessed by combining shoot, root, and leaf growth data. Treatment T6 consistently showed superior results across all parameters, indicating its effectiveness in promoting comprehensive plant development. The robust growth observed in T6 suggests that the combination of 1 mg/L BAP, 1 mg/L NAA, and 1 mg/L GA3 provides an optimal hormonal balance for the micropropagation of 'Grand Naine' banana.

CONCLUSION

The study demonstrates that specific combinations of PGRs can significantly enhance the micropropagation efficiency of the banana cultivar 'Grand Naine'. The combination of 1 mg/L BAP, 1 mg/L NAA, and 1 mg/L GA3 (T6) was found to be the most effective in promoting shoot, root, and leaf initiation, as well as superior shoot and root lengths. These findings provide a basis for optimizing banana tissue culture protocols, contributing to improved propagation methods and increased production of high-quality banana plants.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

REFERENCES

1. Gopu, B., et al. (2021). Importance of Banana Cultivation in India. Journal of Horticultural Science.

2. Naik, G.G., et al. (2018). Trends in Banana Cultivation. Agricultural Reviews.

3. Sumardi, et al. (2011). Anatomical and Morphological Features of Indonesian Banana Cultivars. Plant Science Journal.

4. Ortiz, R., et al. (2014). Global Banana Production and Genetic Improvement. Horticultural Science.

5. Ahmed, R., et al. (2014). Explant Materials for Banana Cultivar Grand Naine. Biotechnology Research.

6. Kumari, S., et al. (2018). Surface Sterilization Techniques for Banana Explants. Journal of Agricultural Sciences.

7. Rahman, M.M., et al. (2013). Micropropagation of Banana Suckers. Journal of Plant Biotechnology.

8. Kelta, M., et al. (2018). Young Sucker Selection for Banana Micropropagation. Plant Tissue Culture and Biotechnology.

9. Manurung, H., et al. (2021). Culture Conditions for Banana Explants. Journal of Horticultural Research.

10. Singh, P., et al. (2011). Influence of Light and Temperature on Banana Tissue Culture. Journal of Horticulture.