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Standardization of Growing Substrates for Mass Production of Quality Planting Material in Banana Cv. Grand Naine via Macropropagation

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Abstract
The present study was conducted to standardize the suitable growing substrates for macroprogation of Banana cv. Grand naine. Nine growing media viz. Peatmoss (T_1), Cocopeat (T_2), Cocopeat + Peatmoss (1:1) (T_3), Cocopeat + *Azotobacter* (30g) (T_4), Cocopeat + *VAM* (30g) (T_5), Cocopeat + *Trichoderma viride* (30g) (T_6), Cocopeat + IBA 2500 ppm (T_7), Cocopeat + BAP 40 ppm (T_8) and Garden soil (Control) (T_9) were selected for the study. The experiment was laid out in Complete Randomized Design (CRD) with three replications under polyhouse condition. It was observed that the days taken for sprouting was significantly influenced by the growing media. Cocopeat +*VAM* (30g) required shortest period (17.10) while Garden soil (Control) required longer period for sprouting (26.36) and similarly, highest plant height (cm) at saleable stage were also observed when cocopeat was treated with *VAM* (30g). Out of three media used, the highest plant height at saleable stage (27.34 cm) was recorded in treatment cocopeat +*VAM* (30g) which was at par with Cocopeat +*Trichoderma viride* (30g) (24.73 cm) followed by Cocopeat + IBA 2500 ppm (24.42 cm). Cocopeat +*VAM* (30g) treatment also recorded higher number of leaves (12.11), leaf width (15.52 cm) and leaf area (cm^2) (163.81). Lowest number of leaves (7.20), leaf width (7.96 cm) and leaf area (cm^2) (140.85) observed in garden soil (Control) treatment.

Keywords: Macropropagation, Grand naine, growing media, cocopeat and VAM

Introduction
Banana (*Musa spp.)* is oldest among crop plants domesticated by humans. Bananas are consumed as ripe fruits, while plantains remain starchy even when fully ripe and require cooking to be palatable. Originally crops from humid tropics, they have acclimatized to a broad range of climatic conditions. It is tall, non-woody plant classified under the Musaceae family and *Musa* genus Most edible bananas are seedless hybrids of *Musa acuminata* and *Musa balbisiana*. They grow from a false stem (pseudostem) and form fruit without pollination this process called parthenocarpy. The most widely grown type is the Cavendish, part of the *Musa* AAA group. The plant reproduces vegetatively by sucking, although some wild species also reproduce by seeds (Nayak *et al.,* 2019) [4]. Approximately 90% of the vegetative propagation of banana is done mainly using sword sucking and the rest by using other planting materials such as fragments, cuttings and peepers (Suryanarayana *et al.,* 2018) [10]. Naturally produced suckers are more likely to carry pest and diseases. Rapid production of propagating material could be achieved through various vegetative methods like *in-vitro* micropropagation. But it is not accepted by traditional small farmers. That's the reason, Macro-SPA is a relatively simple method, requires minimal investment in the configuration, is an excellent technique for producing high-quality, high-quantity planting materials, and the resulting plants are plant culture, etc. and have uniformity (Baiyeri *et al.,* 2007) [2].
The goal of macro propagation is to overcome obstacles it enables the quick creation of additional planting materials that are disease and pest-free. Due to its increased output, the macro propagation technology has gained popularity and farmers are requesting a steady supply of high-quality planting materials. Macro propagation was developed as a substitute method that requires less money and expertise to get around the issue of micropropagation's high cost and skill requirements. A farmer-friendly technique that enhances field sucker output is macro propagation (Njau *et al.,* 2011) [5].

Macro propagation can be carried out either in the field (*in situ*) or in the nursery (*ex situ*) and mainly involves decapitation, barking and hardening. Here, the principle is that removal of the apical meristem will stimulate regeneration of the lateral meristem (Kacar and Faber, 2012; Uma *et al*., 2014; Saraswathi *et al.,* 2014) [3, 8, 7] and the rate of sucker formation will be increased by complete or partial decapitation on plants grown in the field (*in situ*) or by separation of the bulbs (*ex situ*) (Baiyeri and Aba, 2007) [2].

In the present study, attempts have been made to enhance the rate of plantlet production through macro-propagation by the addition of bio-fertilizer like VAM, *Trichoderma viride*, Azospirillum, Bacillus subtilis. Phytohormones (BAP and IBA) to the explants/substrate for breaking the apical dominance of banana for the production of number of side suckers from the corms and for thereby improved multiplication rate of banana suckers. Cocopeat as a substrate gives anchorage, moisture supply and aeration to the newly emerging roots from the decapitated and decorticated corm. Cytokinins such as BAP and kinetin are known to suppress the apical dominance during meristematic shoot formation of banana, thereby inducing both axillary and adventitious shoots.

Materials and Methods

The experiment carried out at Horticulture Nursery, College of Agriculture, Dhule on Standardization of Growing Substrates for Mass Production of Quality Planting Material in Banana Cv. Grand Naine via Macropropagation, during the year of 2024 - 2025. The material under study was constituted of sword suckers of healthy mother plants and the experiment was laid out in a Completely Randomized Design (CRD) with Nine treatments and Three replications of using different growing media as Peatmoss, Cocopeat and different type of bio-fertilizers and phytohormones BAP 40 ppm and IBA 2500 ppm and combination of each other. The treatment consists of Peatmoss (T_1), Cocopeat (T_2), Cocopeat + Peatmoss (1:1) (T_3), Cocopeat + *Azotobacter* (30g) (T_4), Cocopeat + *VAM* (30g) (T_5), Cocopeat + *Trichoderma viride* (30g) (T_6), Cocopeat + IBA 2500 ppm (T_7), Cocopeat + BAP 40 ppm (T_8) and Garden soil (Control) (T_9).

Healthy and disease-free sword suckers were selected. Collected rhizomes were pared to remove older roots including the superficial layers. The pseudo stem of mother corm or sword sucker was cut transversely 2 cm above the collar region. The apical meristem was removed using sharp pointed sterilized knife, leaving a cavity of 2 cm diameter and 3 cm depth. Corm was given criss-cross incisions to a depth of 1-1.5 cm ending down to a rhizome collar.

These corms were dipped in 1 per cent Bavistin / carbendazim solution for about 5 minutes to eradicate surface pathogens. Treated corms were shade dried for 20 minutes. These corms were imposed with treatments and were planted in the initiation media by covering with the media 2-3 cm above the corm. Regular watering was done. The pseudo stem of plantlets grown from primary decapitated and decorticated corms were again cut transversely 2 cm above the collar region at 3 leaf stage without separating it from main corm. A 2 cm diameter by 3 cm deep void was left behind after the apical meristem of the secondary decapitated plantlets was scooped out. The little corm was covered with media 2 cm above it after having crisscross incisions that proceeded from 1 to 1.5 cm deep and ended at a rhizome collar, just as the primary decortication. Continue watering and weeding throughout the duration of evaluation. New plantlets growing from secondary decapitation and decortication were detached after 30 to 40 days, along with roots and a portion of corm at the 3-4 leaf stage. They were then planted as new individual plants for hardening in a new polybag filled with medium.

Results and Discussion

Growth Parameter's

Time taken for sprouting

The treatment T_5 [Cocopeat +VAM (30g)] took minimum number of days for sprouting (17.10 days) which was significantly lower than other treatments. This treatment was statistically on par with T_3 [Cocopeat + Peatmoss] which took 18.98 days for first bud emergence. On the other hand, maximum number of days required for bud emergence was observed in T_9 [Garden soil (Control)] taking 26.36 days (Table 1). The treatment T_5 performed better due to the presence of optimum level of cytokinin (PGR) which help to induce early bud sprouting (Sajith *et al.,* 2014) [8]. The similar results were reported by Thungon *et al.,* (2015) [11] for macro-propagation in banana.

Plant height at saleable stage

At saleable stage treatment T_5 [Cocopeat +VAM (30g)] showed maximum plant height (27.34 cm) as compare to other treatments. Treatment T_6 (24.73 cm) and T_7 (24.42 cm) found statically at par with T_5. On the other side lowest plant height found in treatment T_9 [Garden soil (Control)] (20.43 cm) at saleable stage respectively (Table 1). The treatment T_5 was superior for good plant height might be due to presence of beneficial microorganism *VAM*, which improve the quality of the media, The physical composition of the growing medium significantly influences the availability of water, nutrients and air to the developing plantlets and also plays an important role in providing anchorage as well as determining the medium's nutrient and water retention capacity and there by improve the growth and development of plant. The similar results were reported by Abirami *et al*., (2010) as well as Tripathi *et al..,* (2014), Rosales *et al..,* (1998) [1, 12, 7].

Leaves per plant at saleable stage

Treatment T_5 [Cocopeat +VAM (30g)] recorded the maximum leaves per plant at saleable stage (12.11) and treatment T_7 [Cocopeat + IBA 2500 ppm] (9.42) which is numerically followed by T_5. The lowest number of leaves were found at saleable stage which is found in lowest leaves per plant at T_9 (7.20) (Table 1). Inoculation of *VAM* to the growing media has a positive impact on synthesis of various hormones like auxins, gibberellins and cytokinin which leads to increased cell division and multiplication. The result was in lined with previous findings of Abirami *et al*., (2010) and Tripathi *et al..,* (2014) [1, 12].

Leaf width at saleable stage

The data presented in Table 1 indicating that, at saleable stage significant variation was observed in leaf width among different treatment and interaction effects. At saleable stage the maximum leaf width found in treatment T_5 (15.52), followed by treatment T_4 (11.94). The lowest leaf width was found in treatment T_9 (7.00, 7.96) [Garden soil (Control)] at saleable stage. It may be due to presence of microorganism

VAM with *Bacillus* which enhances nutrient and water uptake, leads to improve plant growth and development, including larger leaves. This was in agreement with the finding of Sajith e*t al.*, (2014) [8].

Leaf area at saleable stage.

The data presented in Table 1. showing leaf area has been significant differences among the treatments due to use of different growth hormones and biofertilizers. At saleable stage treatment T_5 (163.81 cm^2) [Cocopeat +VAM (30g)] was found highest leaf area and treatment T_4 (153.02) was found at par with T_5. While lowest leaf area was found in treatment T_9 (140.85 cm^2/plant). Adding VAM to the growing medium positively influences the production of hormones such as auxins, gibberellins and cytokinins, which in turn stimulate cell division and multiplication. Also, it aids in better nutrient absorption especially phosphorous and increases photosynthetic rate thus enhances growth (Usha *et al.*, 2004). Ravani and Patel (2013) [13, 6]. It also improves nutrient uptake particularly phosphorus and boosts the photosynthetic rate, thereby promoting overall plant growth (Usha *et al.*, 2004) [13].

Conclusion

On the basis of the present investigation on Standardization of Growing Substrates for Mass Production of Quality Planting Material in Banana Cv. Grand Naine via Macropropagation, it can be concluded that, highest plant height (cm) at saleable stage, leaves per plant at saleable stage, leaf width (cm) at saleable stage and leaf area (cm^2) at saleable stage was found in treatment T_5 with lowest time taken for sprouting (days).

Table 1: Effect of different growing media on days taken for sprouting, plant height (cm) at saleable stage, leaves per plant at saleable stage, leaf width (cm) at saleable stage and leaf area (cm^2) at saleable stage of banana in macro-propagation technique

Treatment No.	Treatment Details	Time taken for sprouting (days)	Plant height (cm) at saleable stage	Leaves per plant at saleable stage	Leaf width (cm) at saleable stage	Leaf area (cm^2) at saleable stage
T_1	Peatmoss	23.64	22.44	8.12	9.43	142.40
T_2	Cocopeat	23.23	22.23	7.88	9.46	144.16
T_3	Cocopeat +Peatmoss	18.98	23.26	8.90	8.59	145.06
T_4	Cocopeat +*Azotobacter*	21.47	22.81	8.56	11.94	153.02
T_5	Cocopeat +*VAM* (30g)	17.10	27.34	12.11	15.52	163.81
T_6	Cocopeat +*Trichoderma viride* (30g)	24.44	24.73	8.88	11.24	148.80
T_7	Cocopeat + IBA 2500 ppm	21.09	24.42	9.42	9.25	153.69
T_8	Cocopeat + BAP 40 ppm	24.60	23.47	9.32	9.06	148.14
T_9	Garden soil (Control)	26.36	20.43	7.20	7.96	140.85
SE (m) ±		0.94	1.08	0.53	0.50	2.49
CD at 5%		2.82	3.40	1.67	1.5	7.86

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