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Macropropagation of Malbhog (AAB) Banana

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Abstract—*An experiment on "macropropagation of Malbhog (AAB) banana" was conducted at Instructional cum Research farm of Department of Horticulture, B. N. College of Horticulture during 2014-15 to standardize the suitable initiation media for macropropagation of Malbhog banana and to determine the response of Malbhog banana to macropropagation. The experiment was laid out in factorial randomized block design with three replications under polyhouse condition. Sawdust (M_1), paddy husks (M_2) and cocopeat (M_3) were used as three different growing (substrate) media. There were four treatments in each media consisting of twelve treatment combinations. The treatments were T_1 (Control), T_2 (Trichoderma virdii), T_3 (Azospirillum @ 200 g mixed in 10 kg of vermicompost + PSB (200 g mixed in 10 kg of vermicompost) and T_4 (BAP @ 0.04%). The complete process of macro-propagation took 6-7 months for producing suckers to be ready for planting in the main field. Considering the shortest time taken for primary sucker emergence (18.57 days), decortications of primary suckers (49.95 days), separation of tertiary suckers (82.55 days), highest number of primary (3.88), secondary (8.26) and tertiary suckers (23.84), higher number of leaves (5.80) and roots (25.16) and bigger sucker (316.92 g); cocopeat might be considered as the best growing medium for macropropagation. The highest number of primary (4.17), secondary (8.35) and tertiary suckers (24.02) per corm and bigger sucker (335.89 g) were found in T_4 treatment (BAP 0.04%). The treatment combination of cocopeat and BAP (0.04%) could be recommended for production of quality planting materials of 'Malbhog' banana through macropropagation.*

Keywords*: Macropropagation, Malbhog, substrate, BAP*

1. INTRODUCTION

Banana is an important fruit crop of many tropical and subtropical regions of India. The major banana growing states in India are Tamil Nadu, Maharashtra, Karnataka, Gujarat, Andhra Pradesh, Assam and Madhya Pradesh. Assam ranks ninth position in both area and production of banana in India. Area and production of banana in Assam are 50.51 thousand hectares and 857.72 thousand MT, respectively in 2013-14 with the productivity of 16.9 MT/ha as compared to the national productivity of 37.0 t/ha. The highest productivity of banana has been recorded in Madhya Pradesh (66.0 t/ha) followed by Gujarat (63.5 t/ha), Maharastra (58.2 t/ha) and Tamil Nadu (47.9 t/ha) in 2013-14 [2].

Farmers generally prefer naturally produced suckers for establishing new plantations of banana. This may cause attack of the pest and diseases resulting in reduced productivity and shortening of life cycle of new plantation [7]. There is always shortage of naturally produced planting materials for planting in large scale. Huge number of quality planting materials may be made available by tissue culture technique. Propagation of banana plants from tissue culture has some advantages *viz.* early maturity, free from the attack of diseases and produces good quality fruits [3]. However, planting materials produced through tissue culture becomes costlier and the small and marginal farmers cannot effort the higher cost. Under the above circumstances, the new technology *i.e.* macropropagation of banana becomes popular. Banana production is greatly constrained by lack of affordable quality planting material [11]. Macropropagation technique has been proposed as one of the more cost effective methods for producing healthy seedlings. Macropropagation aims overcoming two challenges - it allows the rapid production of more numbers of planting materials which are free from pest and diseases [12]. The system of acropropagation has become popular because of higher yield and farmers are demanding a constant supply of such quality planting materials. Generally, paddy husk and sawdust are used as substrates in macropropagation. Macropropagation is a farmer friendly technology complementing field sucker production. This technology may be adopted by using whole suckers, large pieces of the parent corm or sword suckers to produce planting materials by suppressing the apical dominance to stimulate lateral bud development.

Malbhog (AAB) banana being very much popular with high commercial value has high demand in the markets due to its sweet aroma, taste and longer post harvest life. Though this cultivar gives higher return to the banana growers but the total area of this cultivar is limited in Assam due to the non-availability of disease free suckers. The objective of the present investigation was to standardize the response of Malbhog (AAB) banana to macropropagation.

2. MATERIALS AND METHODS

The experiment was conducted at Instructional cum Research Farm, Department of Horticulture, B. N. College of Agriculture, Assam Agricultural University, Biswanath Chariali during 2014-15. The experiment was laid out in factorial randomised block design with three replications under polyhouse condition. Sawdust (M_1), paddy husks (M_2) and cocopeat (M_3) were used as three different growing (substrate) media. There were four treatments in each media consisting of twelve treatment combinations. The treatments were T_1 (Control), T_2 (*Trichoderma virdii*), T_3 (Azospirillum @ 200 g mixed in 10 kg of vermicompost + PSB (200 g mixed in 10 kg of vermicompost) and T_4 (BAP 0.04%).

Each of partially decomposed substrates was boiled in water at least for one and half hour for sterilization. On next day of sterilization, different bio-fertilizers were mixed with all the substrates separately as per technical programme. The chambers of each replication were filled up with the substrates as per the layout of the experiment.

Four to five months old uniform size suckers weighing from 300 g to 450 g of the Malbhog (AAB) banana were collected from disease free plantation. The rhizomes were cleaned by removing the roots and detopped just above the juncture. The roots were trimmed and the surfaces of the corms were scrapped well with sharp knife. All the suckers were decapitated by cutting the pseudostem just above the corm. The corms were dipped into 0.3 percent Bavistin solution for 30 minutes and were taken out. They were allowed to dry in shade for a day. Decapitated and decorticated corms were planted on 10th July, 2014. Four ml of 0.04 percent BAP was poured into the meristematic cavity of each corm planted in different media.

3. RESULTS AND DISCUSSION

The duration from planting of corm to emergence of primary suckers, subsequent decortications of primary and secondary suckers and finally detachment of tertiary suckers for hardening varied significantly depending upon the different treatments and media used in the present study. In general, 3-5 buds emerge after 30-45 days of decortications of the corms [12]. The shortest duration in emergence, decortications and detachment of tertiary suckers was observed in the corms treated with BAP (0.04 %) while the longest duration was observed in control. In the present study, the primary suckers emerged in 18.97 days which could be decorticated in 29.86 days while secondary suckers were decorticated in 18.96 days after attainment of 3-4 leaves and height of 15-20 cm. The tertiary suckers were detached in 14.14 days after decortications of secondary suckers. The shorter durations observed in the corms treated with BAP (0.04 %) might be due to the faster growth of the lateral shoots after removal of apical dominance. Cytokinins such as benzyl amino purine (BAP) and kinetin are generally known to reduce the apical meristem dominance and induce both axillary and adventitious shoots in the corms [7]. The frequency of bud formation doubled and the fresh weight of buds increased about four times higher in media with BAP at 7 mg/l when compared to media supplemented with 3 mg/l BAP [4].

The main objective of macropropagation is the production of higher number of suckers from each corm. In 'Malbhog' banana, 4-5 suckers are produced naturally which may be increased to 5-6 times more by macropropagation. In the present study, the number of primary, secondary and tertiary suckers increased in all the treated corms over control. The addition of *Trichoderma virdii* with vermicompost (T_2); azospirillum + PSB (phosphate solubilizing bacteria) with vermicompost (T_3) in growing media and BAP (T_4) in the corms might have increased the number of suckers in all the treated corms. The stimulating effect of BAP on the growth of axillary and adventitious buds was also reported by [1] and [5]. Induction of highest number of primary, secondary and tertiary suckers in the corms could be attributed to the enhanced callus formation ability of the synthetic BAP. The earlier work of [6] revealed that there was maximum production of primary, secondary and tertiary suckers per corm of *Musa laterita* (Bronze banana) when decapitated corms were treated with 0.04 percent BAP.

The corms planted in cocopeat and sawdust produced considerably higher number of suckers over the corms planted in paddy husk. Among different media, cocopeat produced highest number of suckers followed by sawdust while the lowest was recorded in paddy husk. On the other hand, the number of suckers increased in all the media which were treated with different treatments. The higher production of suckers could be attributed to the positive effect of interaction between the treatments applied in different media.

The results of the present study revealed that number of roots, length of roots, secondary roots were considerably higher in T_2 (*Trichoderma virdii*), T_3 (Azospirillum + PSB) and T_4 (BAP) treatment. These might have occurred due to the beneficial effects of *Trichoderma virdii*, azospirillum, PSB and hormonal effect of BAP. Higher number of primary and secondary roots, longer roots with greater girth might be the result of inoculation of plant growth promoting bacteria that stimulated the root growth and development resulting. It was reported earlier that azospirillum inoculation in wheat resulted enhanced cell division in root tips [10] while in maize it increased girth and length of lateral roots [9] and promoted secondary root development.

The complete process of macro-propagation took 6-7 months for producing suckers to be ready for planting in the main field. Considering the shortest time taken for primary sucker emergence (18.57 days), decortications of primary suckers (49.95 days), separation of tertiary suckers (82.55 days), highest number of primary (3.88), secondary (8.26) and tertiary suckers (23.84), higher number of leaves (5.80), and roots (25.16) and bigger sucker (316.92 g); cocopeat might be

considered as the best growing medium for macropropagation. Similarly, the highest number of primary (4.17), secondary (8.35) and tertiary suckers (24.02) per corm and bigger sucker (335.89 g) were found in T_4 treatment *i.e.* BAP (0.04%). The treatment combination of cocopeat and BAP (0.04%) could be recommended for production of quality planting materials of 'Malbhog' banana through macropropagation.

Table 1: Days for first primary sucker emergence after planting

Treatment	T1	T2	T3	T4	Mean
Sawdust (M_1)	23.17	21.00	19.83	19.20	20.80
Paddy husk (M_2)	23.83	22.53	21.33	21.00	22.18
Cocopeat (M_3)	21.67	19.07	16.83	16.70	18.57
Mean	22.89	20.87	19.33	18.97	
S.Ed$^{\pm}$	T: 0.79 M: 0.69 T x M: 1.37				
CD $_{0.05}$	T: 1.64 M: 1.42 T x M: 2.84				

Table 2: Days for decortications of primary suckers after planting

Treatment	T1	T2	T3	T4	Mean
Sawdust (M_1)	59.17	53.28	51.78	47.67	52.97
Paddy husk (M_2)	64.83	59.56	57.06	54.67	59.03
Cocopeat (M_3)	56.50	50.83	48.33	44.15	49.95
Mean	60.17	54.56	52.39	48.83	
S.Ed$^{\pm}$	T: 1.78 M: 1.54 T x M: 3.09				
CD $_{0.05}$	T: 3.70 M: 3.20 T x M: 6.41				

Table 3: Days for decortications of secondary suckers after planting

Treatment	T1	T2	T3	T4	Mean
Sawdust (M_1)	82.33	74.28	71.61	66.87	73.77
Paddy husk (M_2)	88.67	82.09	78.39	75.67	81.20
Cocopeat (M_3)	78.17	69.90	65.17	60.85	68.52
Mean	83.06	75.42	71.72	67.79	
S.Ed$^{\pm}$	T: 1.94 M: 1.68 T x M: 3.35				
CD $_{0.05}$	T: 4.01 M: 3.48 T x M: 6.95				

Table 4: Days for separation of tertiary suckers after planting

Treatment	T1	T2	T3	T4	Mean
Sawdust (M_1)	99.33	92.95	90.45	79.93	90.67
Paddy husk (M_2)	121.17	111.56	100.33	91.67	106.18
Cocopeat (M_3)	97.57	81.87	76.57	74.18	82.55
Mean	106.02	95.46	89.12	81.93	
S.Ed$^{\pm}$	T: 1.71 M: 1.48 T x M: 2.96				
CD $_{0.05}$	T: 3.55 M: 3.07 T x M: 6.15				

Table 5: Effect of media (M) and treatments (T) on production of number of primary suckers per corm

Treatment	T1	T2	T3	T4	Mean
Sawdust (M_1)	3.17	3.50	3.83	4.00	3.63
Paddy husk (M_2)	2.83	3.17	3.50	3.83	3.33
Cocopeat (M_3)	3.33	3.67	3.83	4.67	3.88
Mean	3.11	3.44	3.72	4.17	
S.Ed$^{\pm}$	T: 0.21 M: 018 T x M: 0.36				
CD $_{0.05}$	T: 0.43 M: 0.37 T x M: 0.74				

Table 6: Effect of media (M) and treatments (T) on production of number of secondary suckers per corm

Treatment	T1	T2	T3	T4	Mean
Sawdust (M_1)	6.89	7.06	7.61	8.06	7.40
Paddy husk (M_2)	6.28	6.56	7.06	7.76	6.91
Cocopeat (M_3)	7.50	7.83	8.50	9.22	8.26
Mean	6.89	7.15	7.72	8.35	
S.Ed$^{\pm}$	T: 0.17 M: 0.14 T x M: 0.29				
CD $_{0.05}$	T: 0.34 M: 0.30 T x M: NS				

Table 7: Effect of media (M) and treatments (T) on production of number of tertiary suckers per corm

Treatment	T1	T2	T3	T4	Mean
Sawdust (M_1)	20.72	20.95	22.95	24.56	22.29
Paddy husk (M_2)	18.33	19.11	20.06	20.22	19.43
Cocopeat (M_3)	21.00	22.78	24.56	27.28	23.90
Mean	20.02	20.95	22.52	24.02	
S.Ed$^{\pm}$	T: 0.39 M: 0.34 T x M: 0.68				
CD $_{0.05}$	T: 0.82 M: 0.71 T x M: 1.41				

Table 8: Number of primary roots per corm after hardening

Treatment	T1	T2	T3	T4	Mean
Sawdust (M_1)	22.23	22.93	23.97	25.33	23.62
Paddy husk (M_2)	20.07	21.00	21.50	23.33	21.48
Cocopeat (M_3)	23.87	24.45	25.83	26.50	25.16
Mean	22.06	22.79	23.77	25.06	
S.Ed$^{\pm}$	T: 0.97 M: 0.84 T x M: 1.69				
CD $_{0.05}$	T: 2.02 M: 1.75 T x M: NS				

Table 9: Number of secondary roots per corm after hardening

Treatment	T1	T2	T3	T4	Mean
Sawdust (M_1)	23.33	24.67	25.67	29.33	25.75
Paddy husk (M_2)	16.67	21.33	25.00	28.33	22.83

Cocopeat (M_3)	23.67	26.33	28.67	30.00	27.17
Mean	21.22	24.11	26.44	29.22	
S.Ed$^{\pm}$	T: 1.60	M: 1.39 T x M: 2.77			
CD $_{0.05}$	T: 3.32	M: 2.28 T x M: NS			

Table 10: Weight (g/corm) of corm after hardening

Treatment	**T1**	**T2**	**T3**	**T4**	**Mean**
Sawdust (M_1)	274.00	301.00	316.67	344.33	309.00
Paddy husk (M_2)	278.33	293.33	303.33	305.00	295.00
Cocopeat (M_3)	282.67	308.33	318.33	358.33	316.92
Mean	278.33	300.89	312.78	335.89	
S.Ed$^{\pm}$	T: 5.98	M: 5.18 T x M: 10.35			
CD $_{0.05}$	T: 12.39	M: 10.73 T x M: 21.47			

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