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Enhancing production of dwarf saba banana plantlets using macropropagation techniques

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Abstract

This study was conducted to evaluate the variety of corm manipulation on macropropagation of saba banana that are appropriate and affordable to small farmers to increase their production and meet their demand. The study was conducted at the research experimental area, Isabela State University, Echague, Isabela. Four different corm manipulations on macropropagation process (T_0 – Conrol/WCT, T_1 - MRT, T_2 - SCT and T_3 – EBT) were used and set as treatment. Data analysis was done using the Analysis of Variance for Randomized Complete Block Design. Results showed that MRT significantly ($p<0.01$) produced banana plantlets early and produced largest number of plantlets per corm. Moreover, corms manipulated using WCT, SCT and MRT significantly ($P\leq0.05$) produced taller banana plantlet. Similarly, corms manipulated using WCT and SCT had significantly ($P\leq0.05$) produced larger girth diameters of banana plantlets. Result also showed that corms manipulated using different corm manipulations has no significant effect on the total leaf area on banana plantlets produced.

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Introduction

Banana is one of the most important fruit crop in the Philippines. Its production has extended across different parts of the country that it is significantly contributing to the livelihood of most smallhold farmers in rural areas. One particular banana cultivar that is important to the region is saba. However, the production of banana is challenged by the unavailability of disease-free and affordable planting materials. The existing use of tissue culture for this purpose is found to be highly sophisticated and expensive. On the other hand, conventional practices further harbour pest and diseases in banana plantations.

Aside from tissue culture propagation techniques, banana can now be propagated using macropropagation technique, a more simple and low-cost technique that could be acceptable to low income, unskilled and small scale banana farmers to enhance their produce and to meet their demand. This propagation method uses healthy sword suckers or maiden suckers of banana cultivar for macropropagation process.

At present, there are varieties of macropropagation technique that have been utilized around the world to boost banana production. These techniques can rapidly multiply plantlets or maximize the rate of production and multiplication of banana planting materials for small-scale banana farmer. However, there are still questions and challenges regarding the effectiveness, practicality and potential of these techniques. This study was undertaken therefore to determine the performance of dwarf saba banana to different corm manipulations and to determine the most appropriate method on banana macropropagation process that can rapidly multiply and maximize the generation rate of banana planting materials.

Materials and methods

Construction of Propagators

Concrete propagators were used for sprouting of new seedlings and hardening of the subsequent sprouts. The propagators were covered with polyethylene sheets to maintain the humidity during the propagation.

Preparation of Soil Media

Sandy loam soil and decomposed rice hull with the ratio of 1:1 was mixed thoroughly and used as the soil media (Calvo, 2007). The propagators were filled up with the prepared soil media. The soil was sterilized using hot water before planting.

Selection of Suckers

Healthy sword suckers or maiden suckers of dwarf saba banana cultivar was selected and extracted from the mother plants for macropropagation.

Macropropagation Process

Four different corm manipulations were used in this study. These are the whole-corm, split, excised and meristem removal technique.

Whole corm technique

The roots of the corms were removed and corm sheets maintained. The pseudostem girth of the corm was removed by cutting transversely 2cm above the rhizome collar region and creating a 1cm depth by cross cut incision on the exposed apical meristem region of the corm. The corms were soaked in the solution for 12 hours before planting.

Split

The roots of the corms were removed and corm sheets maintained. The pseudostem girth of the corm was removed by cutting transversely 2cm above the rhizome collar region and cut the corm into two or more bits depending on the corm size.

Excised bud.

The roots and sheets of the corm were removed to expose all the corm buds. The pseudostem girth of the corm was removed by cutting transversely 2cm above the rhizome collar region and creating a 1cm depth by cross cut incision on the exposed apical meristem region of the corm.

Meristem removal

The roots and sheets of the corm were removed to expose all the corm buds. The pseudostem girth of the corm was removed by cutting transversely 2cm above the rhizome collar region and removing the apical

meristem of the corm by making a cavity of 2cm diameter and 4cm depth to suppress the apical dominance and induce sprouting.

Culture and Management

Watering was done immediately after planting. Corms under propagation were irrigated and monitored for sucker development. Fertilizer application was done once in a month to enhance the growth of plantlets. Spraying of insecticides was also done as often as necessary. Mechanical weeding was done to maintain the sanitation of the experimental area (Calvo, 2007).

Data gathered

Growth parameters data on banana such as number of days to emergence, number of shoots emerged per corm, shoot height, shoot collar diameter and leaf area were gathered.

Experimental Treatments

Four different corm manipulations were used as treatments in this study. These are the Whole-corm Technique, (T_0 – Conrol = WCT), Meristem Removal Technique (T_1 =MRT), Split Corm Technique (T_2 = SCT) and Excised Buds Technique (T_3 = EBT)

Data Analysis

The data gathered were recorded, tabulated and analyzed using using the software Statistical tool for agricultural research (STAR) following the Randomized Complete Block Design. The Analysis of Variance was used to test the significance of the differences among the treatment means.

Results

Based on the result of the study, different corm manipulations significantly (P≤0.01) affect the number of days from planting to first shooting emergence of banana (Table 1). Banana corms manipulated using MRT produced plantlets earlier at 31.66 days followed by the corms manipulated using EBT, WCT and SCT with 33.58, 37.08 and 42.33 days, respectively.

The number of plantlets emerged per corm was also significantly influenced (P≤0.01) by the different corm manipulations used.

Corms manipulated using MRT produced the largest number of plantlets per corm at 13.67 followed by the corms manipulated using EBT, WCT and SCT, with number of plantlets per corm of 10.50, 9.33 and 8.33 respectively (Table 1).

The banana corms manipulated using MRT shortened the number of days to plantlets emergence and produced more plantlets as compared with other corm manipulations used. This result is due to the effect of the removal of the apical meristem of the corm, wherein the activity of the apical meristem of the corm was suppressed and activates its lateral buds to induce more side shoots.

Table 1. Number of days to plantlets emergence and number of harvested plantlets of dwarf saba banana as affected by different corm manipulations.

Treatments	Days to plantlets emergence	Number of emerged plantlets
T_0 – WCT (Control)	37.08^b	9.33^a
T_1 – MRT	31.66^a	13.67^c
T_2 – SCT	42.33^b	8.33^a
T_3 – EBT	33.58^a	10.50^b
F-test	**	**
CV%	8.1	18.9

**-significant at p<0.01, *-significant at p<0.05, ns-not significant

Moreover, corms manipulated using SCT, WCT and EBT significantly (P≤0.05) produced taller banana plantlets with the height of 34.61cm, 32.47cm and 32.23cm followed by MRT with plantlets height of 28.95cm, respectively. Similarly, corms manipulated using SCT and WCT had significantly (P≤0.05) produced larger diameters of 2.81cm and 2.52cm followed by corms manipulated using EBT and MRT with girth diameters of 2.42cm and 2.34cm, respectively (Table 2).

The banana corms manipulated using SCT generated taller and larger collar diameter of banana plantlets as compared with other corm manipulations used. The significant increase in height and diameter of banana plantlets generated from corms matches well with the number of plantlets generated.

The lower the number of plantlets generated the higher the plantlets height and the larger corm diameter produced due to reduction in competition among the plantlets for resources such as nutrients, water and light.

Moreover, leaf area of banana plantlets produced was not significantly affected by the different corm manipulations applied.

Table 2. Plantlets height, collar diameter and leaf area of dwarf saba banana as affected by different corm manipulations.

Treatments	Height of plantlets, cm	Collar diameter of plantlets, cm	Leaf Area, cm^2
T_0 – WCT (Control)	32.47^b	2.52^a	448.94
T_1 – MRT	28.95^a	2.34^a	490.20
T_2 – SCT	34.61^b	2.81^b	469.37
T_3 – EBT	32.23^a	2.42^a	506.86
F-test	*	*	ns
CV%	13.2	16.5	19.9

**-significant at $p<0.01$, *-significant at $p<0.05$, ns-not significant

Conclusion

Generally, results showed that different corm manipulations used in this study performed well in terms of the number of days to plantlets emergence, number of plantlets produced, plantlets height, plantlets collar diameter and total leaf area. Moreover, results also showed that the MRT or the meristem removal technique was the most suitable and affordable corm manipulation on macropropagation process to rapidly produce and multiply banana planting materials for small scale farmers.

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