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Production of Saba Banana Using Misting System and Different Growth Enhancers Under Glasshouse Condition

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ABSTRACT

The main production constrain is the availability of reliable and safe planting material. Planting materials obtained through conventional methods do not meet the increasing demand for planting and they are of poor quality. Tissue culture approach can solve these problems but it is yet to benefit majority of small scale farmers because of the high costs and sophisticated skills associated with the technology. Therefore, to increase banana production in small scale systems, there is a need for affordable and simple technique for seedling production. Macro propagation is one such technique and can improve banana production if adopted. In view of these characteristics, the effect of the humidifier and types of growth enhancer were evaluated using factorial in completely randomized design. The main plots consisted of types of humidifier with 2 levels: A1=with misting system, A2=without and for sub plots different growth enhancer was applied at 3 levels: B0=Control, B1=Benzyl Amino Purine at 1.5mg/L and B2= Naphthalene acetic acid at 0.93g/L. Result showed that humidifier led to a significant increase ($p<0.01$) in all the growth parameter tested during the 1st and 2nd cycle. On the other hand, growth enhancer affects significantly the number of days to emergence ($p<0.01$) First Generation Shoots (FGS), Second Generation Shoots (SGS), number of shoots emerged ($p<0.01$) (FGS, SGS), shoot collar diameter emergence ($p<0.01$) (FGS), ($p<0.05$) (SGS) and total leaf area ($p<0.05$) (FGS), ($p<0.01$) (SGS). However, no significant effect was observed on the interaction of the two factors for FGS but interaction of factors during SGS affect significantly the number of days to emerge ($P \leq 0.05$), number of shoots emerged ($P \leq 0.01$) and total leaf area ($P \leq 0.05$). Interaction of factors did not significantly affect the shoot collar diameter.

Keywords: Growth enhancer, Humidifier, Misting System, Macro propagation, Generation

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INTRODUCTION

Banana stands out as the most important fruit crop in the Philippines, constituting a significant portion in the country's export revenue. It is one of the important sources of food in the rural areas where Saba banana, in particular, is often used to extend, supplement or substitute staple food such as rice and corn.

Tissue culture (TC) propagation technique has been in the region for so many years but it is yet to benefit majority of small scale farmers. This is because of the high costs and sophisticated skills associated with the technology. Therefore, to increase banana production in small scale systems, there is a need for affordable and simple technique for seedling production. Macropropagation is one such technique and can greatly boost banana production if adopted. The technology involves stimulation of lateral growth of multiple latent buds in a corm within a chamber where misting system was used to enhance ventilation and shading, reduce temperatures and increasing humidity levels which can help to avoid greenhouse overheating disasters. One corm is capable of producing 10 to 30 plantlets in four months, but the productivity may vary with banana cultivar and kind of bud manipulation.

This study was conducted to evaluate the effect of the use of humidifier or misting system and different growth enhancers on the proliferation and generation plantlets of saba banana through *macropropagation technique*. Specifically, it aimed to determine the performance of the different growth enhancers and humidifier as a single factor and their interactions under in-vivo propagation technique and determine which among the treatments and treatment combinations will give the best results.

MATERIALS AND METHODS

Preparing the Soil Media and Experimental Area

Sandy loam soil and decomposed rice hull with the ratio of 1:1 were mixed thoroughly and was used as the soil media [1]. The experimental area was prepared following the procedure with slight modifications [3]. Cemented propagators were used measuring 1.0 m width, 6.0 m long and 1.0 m high. The propagators were filled up with the prepared soil media. After which, the soil media was drenched with hot water for sterilization. It was left for one day to allow the soil mixture to cool down before planting the prepared corm.

Source of Planting Materials

For this study, healthy maiden and sword suckers that were about to flower were selected for macropropagation from visibly suitable mother plants. Corms of recently harvested banana plants that have good yielding characteristics were also selected.

Preparation of Corms

Healthy sword suckers of saba cultivar weighing 2.5 to 3.0 kg of saba was used in this study. The corms were washed in running water. The roots of the corms were removed and washed in soapy water. The corms were disinfected with 40% hypochlorite solution in 15 minutes. The outer sheaths were removed to exposed axillary buds using sterilized sharp knife.

Decortication, Application of Growth Hormones and Planting

The exposed apical meristem and axillary buds of the mother corm was cut transversely 2 cm above the rhizome collar region. The apical meristem was removed leaving a cavity of 2 cm diameter and 4 cm depth to suppress the apical dominance and induce sprouting, respectively [7,8]. The corms were soaked in Benzyl Amino Purine, BAP (2.0 mg/l) and Naphthalene acetic acid, NAA(0.93g/L) for 12 hours [6,10]. Thereafter, the corms were removed from the solution and were planted into the prepared propagators. Shoots were allowed to develop at the collar of the rhizome. The first shoots that were come out from the corm were allowed to grow for three weeks [9]. These were the first generation plantlets (GP1). The suckers were dissected again using the procedure described above.

Culture and Management

Corms under propagation were regularly monitored for sucker development and well-watered to keep or maintain high humidity or moist using misting system. Fertilizer application was also done using recommended fertilizer (46-0-0). A rate of 1.5 grams of 46-0-0 per plant was applied once in a month to enhance the growth of plantlets. Spraying of insecticides was also done as often as necessary. Mechanical weeding was also done to maintain the sanitation of the experimental area [1].

Establishment of Misting System

The misting system is controlled by a computerized irrigation controller and is set in a way to turn on the mist for 5 minutes to wet the corms and turn off for 2.5 hours. In general, the misting system operated 8 hours per day with the nominal operating pressure of mister is 14.22 psi. The emission uniformity of misting system can be defined using the equation:

$$EU = \frac{Q_{min}}{Q_{avg}} \times 100 \quad (1)$$

Where:

EU = emission uniformity (%), Q_{min} = minimum emitter discharge (lpm), Q_{avg} = average emitter discharge (lpm).

Care and Management

Weeding was done as soon as weeds appear in the cemented propagator. Insecticides and fungicides were sprayed to control and prevent the occurrence of diseases and insect damage.

Weather Data Collection

The daily outdoor temperature (°C) and RH (%) measurements were obtained directly from the SARAI Automatic Weather Station (AWS) located at ISU, Echague, Isabela. Indoor temperature and humidity measurements were also conducted using the digital hygrometer meter.

Experimental Layout and Design

All data were recorded, tabulated and analyzed following the factorial in Completely Randomized Design (CRD). The gathered data were subjected to Analysis of Variance (ANOVA) using the software Statistical tool for agricultural research (STAR). The treatments with significant results were compared using the Least Significant Difference (LSD).

Legends:

Factor A : (Misting System or Humidifier) **Factor B : (Growth Enhancer)**

A1 - with misting system
A2 – without

B_0 - CONTROL
B_1 – BAP (Benzyl Amino Purine)
B_2 – NAA (Naphthalene acetic acid)

RESULTS AND DISCUSSIONS

Emission Uniformity

The results on the hydraulic characteristic of misting system (Table 1) gave 0.89 l/min for average misters discharge or 95.98% emission uniformity. The emission uniformity was excellent [2]. The 90% is excellent, (80-90%) is good and (70-80%) is acceptable but less than 70% is not acceptable.

Growth Parameters of banana using Humidifier and Growth Enhancers to Produce First Generation Shoots (FGS)

Table 2 shows the growth parameters of banana using Humidifier and Growth enhancers to Produce First Generation Shoots (FGS). It can be noted that humidifier (Factor A) as a single factor has a highly significant effect ($P \leq 0.01$) in all the parameters tested where applying with misting system vary significantly with non-misting system.
Growth enhancers as a single factor affects significantly the number of days to emergence ($P \leq 0.01$), number of shoots emerged ($P \leq 0.01$), shoots collar diameter (cm) ($P \leq 0.01$) and total leaf area (cm^2) ($P \leq 0.05$). Furthermore, the interaction of humidifier (Factor A) and growth enhancers (Factor B) has no significant effect on the growth parameters of banana. Results seem to imply that humidifier and growth enhancers independently influence all the parameters tested.

Table -1 Discharge Rate (L/min)

Mister	Mister Discharge (L/min)		
	Line 1	Line 2	Line 3
1	0.90	0.88	0.85
2	0.89	0.90	0.87
3	0.90	0.89	0.89
Qmin	**0.85**		
Qave	**0.89**		
Emission uniformity (Eu)	**95.98%**		

Table -2 Growth Parameters of Banana (Musa spp.) using Humidifier and Growth Enhancers to Produce First Generation Shoots (FGS) from Corms

Treatments	Days to emergence	Shoots emerged	Collar diameter (cm)	Total Leaf Area, cm^2
Factor A: Humidifier				
A_1- with misting system	16.89^b	9.00^a	4.02^a	1948.92^a
A_2- without	19.78^a	7.56^b	3.51^b	1459.42^b
Factor B: Growth Enhancers				
B_0 - CONTROL	22.33^a	6.00^c	3.40^c	1142.79^c
B1 – Benzyl Amino Purine	15.00^c	11.33^a	4.17^a	2270.09^a
B_2 – Naphthalene acetic acid	17.67^b	7.50^b	3.73^b	1699.62^b
AXB: Humidifier x Growth Enhancers				
A1B0	21.33	6.67	3.60	1329.10
A1B1	13.67	12.33	4.47	2587.73
A1B2	15.67	8.00	4.00	1929.93
A2B0	23.33	5.33	3.20	956.480
A2B1	16.33	10.33	3.87	1952.46
A2B2	19.67	7.00	3.47	1469.30
C.V%	**7.4**	**11.4**	**4.3**	**21.9**
F-Test				
A	**	**	**	**
B	**	**	**	*
AXB	**ns**	**ns**	**ns**	**ns**

* significant at 1% level; ** significant at 5% level

Growth Parameters of banana using Humidifier and Growth enhancers to Produce Second Generation Shoots (SGS)

Table -3 shows the growth parameters of banana using Humidifier and Growth Enhancers to Produce Second Generation Shoots (SGS). It can be noted that humidifier (Factor A) as a single factor has a highly significant effect ($P \leq 0.01$) on number of days to emergence, number of shoots emerged, collar diameter (cm) and total leaf area (cm^2) where applying with misting system vary significantly with non-misting system. Growth enhancers as a single factor affects significantly ($P \leq 0.01$) the number of days to emergence, number of shoots emerged, collar diameter (cm) and total leaf area (cm^2). Furthermore, the interaction of humidifier (Factor A) and growth enhancers (Factor B)

shows significant effect on the number of days to emerge ($P \leq 0.05$), number of shoots emerged ($P \leq 0.01$) and total leaf area ($P \leq 0.05$). On the other hand, interaction of factors did not significantly affect the shoot collar diameter.

The result implies that humidifier influences the number of days to emergence, number of shoots emerges, shoot collar diameter and total leaf area. In terms of growth enhancers application, it appears that application of growth enhancers following the recommended rate shorten the number of days to emerge, produces larger number of shoots, diameter and leaf area. It also appears that humidifier respond differently to enhancers in terms of days to emerge, number of shoots emerged and total leaf area.

Table -3 Growth parameters of Banana (Musa spp.) using Humidifier and Growth Enhancers to Produce Second Generation Shoots (SGS) from Corms

Treatments	Days to emergence	Shoots emerged	Collar diameter (cm)	Total Leaf Area, cm^2
Factor A: Humidifier				
A_1- with misting system	24.89^b	55.44^a	3.66^a	2125.90^a
A_2- without	31.78^a	36.00^b	3.32^b	1270.19^b
Factor B: Growth Enhancers				
B_0 - CONTROL	35.17^a	27.33^c	3.03^c	1044.05^c
B1 –Benzyl Amino Purine	24.83^b	73.00^a	4.00^a	2490.35^a
B_2 – Naphthalene acetic acid	25.00^b	41.33^b	3.43^b	1559.75^b
Humidifier x Growth Enhancers				
A1B0	29.33^b	33.33^c	3.10	1228.89^c
A1B1	21.33^c	94.33^a	4.30	3219.92^a
A1B2	24.00^c	47.67^b	3.57	1928.90^b
A2B0	41.00^a	21.33^d	2.97	859.197^c
A2B1	28.33^b	51.67^b	3.70	1760.78^b
A2B2	26.00^b	35.00^c	3.30	1190.60^c
C.V%	**9.1**	**12.2**	**4.6**	**17.8**
F-Test				
A	**	**	**	**
B	**	**	*	**
AXB	*	**	**ns**	*

* significant at 1% level; ** significant at 5% level

CONCLUSION

From the results of this study the following conclusions can be drawn: Both humidifier and growth enhancers independently influence the growth parameters of banana to produce first (FGS) and second (SGS) generation of shoots in terms of number of days to emergence, number of shoots emerged, shoot collar diameter and total leaf area. The effect of humidifier is not influence by the type of growth enhancers used in terms of the number of days to emergence, number of shoots emerged, shoot collar diameter and total leaf area during the first cycle (FGS). However, the effect of humidifier is greatly influence by the type of growth enhancers used in terms of the number of days to emergence, number of shoots emerged and total leaf area during the second cycle (SGS). On the other hand, different result was observed in terms of shoot collar diameter during the second generation of plantlets of saba banana.

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