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# Generation and proliferation rate assessment of saba banana (*Musa balbisiana*) as affected by irrigation levels and plant growth enhancers under glasshouse condition

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**Key words:** Banana, Growth enhancer, Irrigation levels, Macropropagation, Proliferation rate

**Abstract**

The main production constraint of banana is the availability of disease-free and healthy planting materials. Tissue culture is a technique that could provide these materials, but it requires high cost and technical expertise. Macropropagation offers simpler and more affordable processes that could enhance seedling production. This study evaluated the effects of irrigation levels and growth enhancers on macropropagation of saba banana under glasshouse conditions using factorial in completely randomized design. Factor A consisted of irrigation levels: $A_1$=50%RR, $A_2$=100% RR and $A_3$=150%RR. Different growth enhancers were used for Factor B: $B_0$=Control, $B_1$=Coconut water, $B_2$=Seaweed extract and $B_3$=Benzyl Amino Purine. Results clearly suggests the advantage of using plant growth enhancers and appropriate irrigation level for macropropagation of banana. The irrigation level of 50% of recommended rate or 4liters/day plus the application of BAP (2mg/l) or the plant growth enhancers may be recommended for obtaining maximum growth, more plantlets produced and irrigation water efficiency of banana. It could not only save water for plants but also accelerates the growth and production of banana.

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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.

The main production constraint of banana is the availability of disease-free and affordable banana seedlings. To establish new farms, farmers have relied on conventional suckers that are harvested from their existing farms. The traditional production of suckers in the field is inadequate to meet the demand, especially of large scale plantations. To increase banana production in small-scale systems, there is a need for affordable and streamlined process for seedling production.

Macropropagation is a simple and low-cost technique that can boost banana production. The technology involves stimulation of lateral growth of multiple latent buds in a corm within a chamber where different levels of irrigation and plant growth enhancers were applied to enhance the capability of the corms to produce and developed disease-free banana plantlets/seedlings. This study was conducted to assess the generation and proliferation rate of saba banana through the use of different plant growth enhancers and levels of irrigation under glasshouse condition.

## Materials and methods

*Location of the Study*

The study was conducted at the Research Experimental area at the Research Department, ISU, Echague, Isabela.

*Experimental Area and Soil Media Preparation*

To ensure high humidity and temperature glasshouse was used in this study. The propagation compartments inside the glasshouse measuring 1.0m width, 6.0m long and 1.0m high were filled with sterilized mixtures of sandy loam soil and decomposed rice hull as the propagation soil media.

*Source of Planting Materials*

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

*Macropropagation Process*

Macropropagation was done in two cycles or generations. Corms of healthy sword suckers of saba cultivar 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.

The exposed apical meristem and axillary buds of the mother corm was cut transversely 2cm above the rhizome collar region. The apical meristem was removed leaving a cavity of 2cm diameter and 4cm depth to suppress the apical dominance and induce sprouting, respectively (Singh *et al.*, 2011; Macias, 2001).

The corms were soaked in plant growth enhancers solution for 12 hours. Thereafter, the corms were removed from the solution and planted into the prepared propagators.

*Cultural Practices and Management*

Corms under propagation were irrigated well to keep the propagation compartment moist and monitored for sucker development.

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 (Calvo, 2007).

*Experimental Treatments*

The experimental treatments consisted of two factors. Factor A comprised of irrigation levels at 50% recommended rate (4 liters per day), 100% recommended rate (8 liters per day) and 150% recommended rate (12 liters per day).

Factor B consisted of different types of plant growth enhancers: Control (no PGE applied), CW (Coconut Water at 5ml/liter), SE (Seaweed Extract at 10ml/liter) and BAP or Benzyl Amino Purine at 2mg/liter).

*Experimental Layout and Analysis*

The experiment was laid out following the factorial in Completely Randomized Design (CRD) with three replicates. All data were recorded, tabulated and analyzed using the software Statistical tool for agricultural research (STAR). The treatments with significant results were compared using the Least Significant Difference (LSD).

## Result and discussions

*Climatic Condition*

This study was conducted from July 2017 to March 2018 at the glasshouse of the research experimental area, ISU, Echague, Isabela. The average precipitation, average temperature and average humidity in the duration of the study were 6.8 mm, 31.26 ºC and 79.3% respectively. Monthly climatic data collected during the course of this study are shown in Fig. 1.

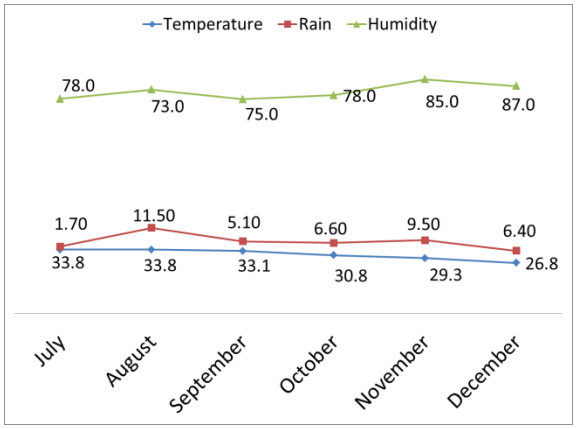


**Fig. 1.** Weather variable observed during the duration of the study.

*Generation and Proliferation Rate of Saba Banana during the First Cycle*

Results indicate that different levels of irrigation had a very high significant (P ≤ 0.01) influence on the number of days of emergence and number of shoots emerged in the first cycle (Table 1).

Banana corm applied with 50%RR produced the first shoot earlier at 19.05 days and produced the largest number of shoots at 17.62.

**Table 1.** Effect of irrigation levels and plant growth enhancers on the growth attributes of banana (First cycle).

| Treatments | Plant height | No. of days of emergence | No. of shoots emerged | Shoot collar diameter | Leaf area |
|---|---|---|---|---|---|
| Irrigation levels | | | | | |
| 50% RR | 33.48 | 19.05a | 17.62b | 3.08 | 1,447.41 |
| 100% RR | 33.08 | 23.08b | 16.57a | 3.01 | 1,399.38 |
| 150% RR | 32.61 | 23.00b | 16.12a | 3.00 | 1,379.19 |
| Significance | ns | ** | ** | ns | ns |
| Plant Growth Enhancer | | | | | |
| Control | 32.25 | 27.02c | 10.45a | 2.22a | 572.73a |
| CW | 33.14 | 23.26b | 17.35b | 2.74b | 794.40a |
| SE | 32.70 | 21.11b | 18.48c | 3.23c | 1,316.85 b |
| BAP | 34.13 | 15.44a | 20.81d | 3.91d | 2,950.66 c |
| Significance | ns | ** | ** | ** | ** |
| Irrigation levels x Plant Growth Regulator | | | | | |
| 50% RR x Control | 32.31 | 22.60c | 11.74 | 2.18 | 509.55 |
| 50% RR x CW | 33.70 | 20.33b | 17.79 | 2.72 | 811.36 |
| 50% RR x SE | 33.37 | 19.20b | 18.80 | 3.29 | 1,391.83 |
| 50% RR x BAP | 32.92 | 14.46a | 22.16 | 3.84 | 2,804.02 |
| 100% RR x Control | 34.36 | 28.73e | 10.94 | 2.27 | 615.91 |
| 100% RR x CW | 33.90 | 23.53c | 17.00 | 2.74 | 762.92 |
| 100% RR x SE | 32.52 | 22.26c | 18.05 | 3.11 | 1,253.70 |
| 100% RR x BAP | 33.12 | 17.80b | 20.30 | 3.89 | 2,964.97 |
| 150% RR x Control | 30.08 | 29.73e | 8.67 | 2.23 | 592.721 |
| 150% RR x CW | 31.83 | 21.86c | 17.26 | 2.77 | 808.93 |
| 150% RR x SE | 32.20 | 25.93d | 18.59 | 3.30 | 1,305.02 |
| 150% RR x BAP | 36.34 | 14.67a | 19.98 | 4.01 | 3,082.98 |
| Significance | ns | * | ns | ns | ns |

In a column, having common letter(s) do not differ significantly but dissimilar letter differ significantly. ns, *, **, mean non-significant, significant at 5%, significant at 1%, respectively.

Moreover, application of plant growth enhancers had a very high significant effect on the number of days of emergence (P ≤ 0.01), number of shoots emerged (P ≤ 0.01, shoot collar diameter (P ≤ 0.01) and leaf area (P ≤ 0.01) during the first cycle.

It was observed that banana corms treated with BAP at 2mg/l produced the first shoots earlier at 15.44 days, produced the largest number of shoots at 20.81, produced the largest shoot diameter at 3.91cm and largest leaf area of 2,950.66cm². Furthermore, the combination of the different irrigation levels and growth enhancers used in this study produced a significant effect on the number of days of emergence ($P \leq 0.05$) while no significant effect on the other growth parameters tested on banana was observed during the first cycle.Results implies that early in days of emergence, largest number of shoots produced, large collar diameter and large leaf area might be due to the timely supply of low amounts of water and growth enhancers in synchrony with the crop demand which resulted in the early physiological maturity of crop.

*Generation and Proliferation Rate of Saba Banana during the Second Cycle*

Results indicate that different levels of irrigation had a very high significant influence on the number of shoots emerged ($P \leq 0.01$) and total leaf area ($P \leq 0.05$) in the second cycle as shown in table 2. Banana corm applied with 50%RR produced the largest number of shoots and leaf area of 24.07 and 1,372.17cm² respectively.

Moreover, application of plant growth enhancers had a very high significant effect on the plant height ($P \leq 0.01$), number of days of emergence ($P \leq 0.01$), number of shoots emerged ($P \leq 0.01$), shoot collar diameter ($P \leq 0.05$) and total leaf area ($P \leq 0.01$) during the second cycle. It was observed that banana corms treated with BAP at 2mg/l produced the tallest shoots at 40.59cm, first shoots earlier at 14.82 days, produced the largest number of shoots at 381.33, produced the largest shoot diameter at 2.96cm and largest leaf area of 2,050.50cm².

Furthermore, the combination of the different irrigation levels and growth enhancers used in this study has no significant effect on all the parameters tested on banana during the second cycle.

Result shows that application of different levels of irrigation and growth enhancers increased the number of shoots emerged on the second cycle as compared to the first cycle.

This might be attributed to less time taken by the plant crop for establishment after planting and it clearly benefitted well from the established soil environment.

**Table 2.** Effect of irrigation levels and plant growth enhancers on the growth attributes of banana (Second cycle).

| Treatments | Plant height | No. of days of emergence | No. of shoots emerged | Shoot collar diameter | Leaf area |
|---|---|---|---|---|---|
| Irrigation levels | | | | | |
| 50% RR | 33.37 | 18.51 | 240.07c | 2.47 | 1,372.17b |
| 100% RR | 33.27 | 18.28 | 220.12b | 2.42 | 1,104.98a |
| 150% RR | 33.08 | 19.48 | 191.55a | 2.33 | 1,349.04b |
| Significance | ns | ns | ** | ns | * |
| Plant Growth Enhancers | | | | | |
| Control | 27.38a | 22.33d | 107.79a | 1.79a | 745.06a |
| CW | 30.44b | 20.11c | 215.70b | 2.22b | 930.44a |
| SE | 34.54c | 17.57b | 252.12c | 2.67c | 1,375.57b |
| BAP | 40.59d | 14.82a | 293.49d | 2.96d | 2,050.50c |
| Significance | ** | ** | ** | ** | ** |
| Irrigation levels x Plant Growth Enhancers | | | | | |
| 50% RR x Control | 28.47 | 23.80 | 129.70 | 2.10 | 777.28 |
| 50% RR x CW | 29.14 | 19.66 | 237.56 | 2.28 | 1,018.32 |
| 50% RR x SE | 33.54 | 17.26 | 275.46 | 2.56 | 1,431.09 |
| 50% RR x BAP | 42.32 | 13.33 | 317.55 | 2.95 | 2,261.98 |
| 100% RR x Control | 28.26 | 23.13 | 113.30 | 1.70 | 736.09 |
| 100% RR x CW | 32.25 | 20.13 | 219.94 | 2.29 | 887.69 |
| 100% RR x SE | 34.61 | 16.20 | 257.80 | 2.72 | 1,162.46 |
| 100% RR x BAP | 37.96 | 13.66 | 289.80 | 2.98 | 1,633.67 |
| 150% RR x Control | 25.42 | 20.06 | 80.36 | 1.58 | 721.81 |
| 150% RR x CW | 29.92 | 21.13 | 189.60 | 2.08 | 885.31 |
| 150% RR x SE | 35.48 | 19.26 | 223.12 | 2.74 | 1,533.17 |
| 150% RR x BAP | 41.50 | 17.46 | 273.12 | 2.94 | 2,255.85 |
| Significance | ns | ns | ns | ns | ns |

In a column, having common letter(s) do not differ significantly but dissimilar letter differ significantly. ns, *, **, mean non-significant, significant at 5%, significant at 1%, respectively.

## Conclusion

The study clearly shows the advantage of using plant growth enhancers and level of irrigation for macropropagation of banana. The irrigation level at 50% of RR (4liters/day) plus the application of plant growth enhancers (BAP at 2mg/li) may be recommended for

obtaining maximum growth and more plantlets produced of banana. Therefore, using this combination through macropropagation technique could not only save water for plants but also accelerates the generation and proliferation rate of saba banana to produce quality and healthy planting materials for banana production.

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