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Assessment of 6-Benzylaminopurine (BAP) in macropropagation of plantain genotypes

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ABSTRACT

Plantain (Musa spp) being so important suffers constraints in production through unavailability of healthy planting materials during planting season. This constraint could be lifted using macropropagation technique. In an attempt to enhance this technique, three landraces comprising 'Mbelepaul', 'Atagafong' and 'Owom' were used and each treated with four treatments being different6-benzylaminopurine (BAP) concentrations (0.0, 15.0, 30.0 and 45.0 ml) in 25 litres of water. These were used to irrigate the corms during propagation and their responses observed. From the result, 'Mblepaul' yielded highest number of shoots being 5 at 30 and 45 ml BAP after four weeks. After six week, 'Owom' at 30 ml and 'Atagafong' at 15 ml showed highest shoot production and root per corm respectively. 'Mblepaul' had 100% sprout at 0 and 30 ml BAP within the first four weeks and also at 15 and 45 ml BAP. 'Owom' sprouted 100% at the sixth week at 30 and 45 ml BAP.Significant difference was observed acrossgenotypes and BAP concentrations at P < 0.05 leaf length and leaf width. Conclusively, macropropagation technique is better enhanced when irrigation is carried out with water containing BAP at 30 or 45 ml per 25 litres of water for 'Mbelepaul', 45 ml per 25 litres of water for 'Owom' and no BAP concentration for 'Atagafong' plantain landrace.

Keywords: Assessment, 6-Benzylaminopuiine, macropropagation, plantain, genotypes.

INTRODUCTION

Plantains (*Musa* spp) are the most important tropical fruit crops [1] which ranked among the most preferred foodstuffs, highly valued and contributes in feeding more than 250 million people in countries of West and Central Africa [2]. The demand for this local product is very high in rural and urban markets thereby leading to a decline in its availability.

The suckering ability of plantain is very low with an average of about 3 to 7 suckers per year per stool depending on agro-climatic conditions and cropping practices [3]. The lack and poor quality of planting materials are threatening plantain production and limit the expansion of plantations [4]. The quantity and quality of the planting material are major factors for successful crop production [5]. This could be achieved through macropropagation techniques which [6], described as alternative technique for mass production of plantain planting materials under *in vivo* conditions. Compared to the micropropagation, this technique is relatively simple, less expensive and provides in a short period pest-free and genetically identical plantlets [7]. It exploits the entire potential of the corms to produce large quantities of healthy planting materials within a short period from secondary buds [8]; [9]; [10].

In our society today, there is increasing growth of the population which has led to a consequent increase in food demand, especially plantain. There is now pertinent need to enhance the macropropagation technique, so as to increase the rate it induces shooting, possibly, using tissue culture shooting hormone. Any positive impact of the hormone on shooting of plantain through macropropagation will assist in increasing the availability of plantlets for farmers. Nevertheless, information about the response of plantain to macropropagation method in combination with 6-Benzylaminopurine (BAP) at different concentrations is hardly known. BAP is an adenine-based cytokinin popularly used for induction of axillary and adventitious shoots in plantain [11]; [12]; [13] and rarely used for macropropagation [14]. The testing of this technique in combination with BAP at different concentrations may allowidentify a concentrationwhich may trigger strong production of suckers from corms. Therefore, this study was aimed at evaluating the shootingeffect of different concentrations of BAP on macropropagation of plantain genotypes ('Atagafong', 'Owom' and 'Mblepaul').

METHODOLOGY

Materials

The materials include Plantain sword suckers of 'Owom', 'Mblepaul' and 'Atagafong', Polythene bag, Top soil, Cow dungs, Jik (sodium hypochlorite), kitchen knife, Hand gloves, Saw dust, Manual irrigator, Shovel, BAP, Old oil Drum, Propagator and Water.

Construction of Propagator

Propagator was constructed using wood plank which measured 180cm × 180cm × 30cm. The propagator was divided into 3 segments for the three plantain genotypes comprising ('Atagafong', 'Owom' and 'Mblepaul'). Each of the propagator's segment was filled with enough quantity of sawdust which was steamed for 60 seconds and aireda day to cool before being poured into the chambers, using sterilized shovel.

Corm preparation and planting

A total number of 48 Plantain sword suckers comprising three varieties; 'Owom', 'Mblepaul' and 'Atagafong' (16 corms each) were carefully collected from healthy mother plant at Ebonyi State University, Plantain germ plasm Abakaliki for this analysis. The roots were removed and the pseudostem cut off 6 inches close to the corm. The corm was thoroughly washed with clean running water to remove any adhering soil and plant debris. Using sharp kitchen knife the meristem was properly exposed after removing the leave sheet. Then a hole was drilled in the middle of the stem to kill the meristem**.** About 250 ml of Sodium hydrochloride (Jik) was mixed with 15 litres of water and the pared corms soaked in the solution for 20 minutes in order to sterilize the surface. The corm was removed and air dried for one day before initiation. Four corms were selected from each of the three varieties of *Musa*genotypes and were planted at 10 cm interval from each other. Planting was done in propagator with a depth of 3 inchesand were completely covered with sawdust.

Figure 1: propagator filled with sterilized Sawdust

BAP Preparation and Watering

A quantity of 50 mg of BAP was dissolved in 1 ml of NaOH and made up to 100 ml with water (0.5 mg/ml of BAP). In the three separate 25 litters of water, three different concentrations were added as follows: 15 ml, 30 ml and 45 ml respectively. Using manual irrigator, each segment of propagator was well watered immediately after planting with 12litres of the solution and subsequently watered when necessary. In the control, the same method of planting was used but there was no BAP added to the water for watering.

Acclimatization

For produced plantlets to be introduced into the field, it was first acclimatized. Here, substrate was filled into perforated nylon pots by mixing top soil with cow dung at a ratio of 3:1. After about 3 weeks, sprouted primary shoot having 2 - 3 leaves were detached. The detached plantlets were into the nylon pot, using one plant per bag. The sprouted plantlets were subsequently detached on weekly basis once they attain 2-3 leaves.The acclimatization was attained within 10-14 days of planting.

Data Collection and Analysis

Significance difference was determined on the data generated from below parameter using analysis of variance (ANOVA) and mean separation was done using least significant difference (LSD). The results are represented in tables and bar charts.The parameters include;

I. **Number of shoots:** The number of shoots per corm were counted and recorded.
II. **Shoot height (cm):** The shoot height was determined by measuring the distance between the point of attachment and the pseudostem to the point of first leaf emergence, using meter rule.
III. **Number of roots:** The number of roots per corm was counted and recorded.
IV. **Percentage sprouted corms:** (Number of corms sprouted × 100%) /4 corms planted**.**
V. **Number of leaf:** The number of leaves per shoot was counted and recorded.
VI. **Leaf width and length (cm):** The width and length of the largest leaf per corm was measured using a meter rule and recorded.

RESULTS

Across the whole corms being watered with different BAP concentrations after four weeks (Table 1), the result showed that 'Mblepaul' produced highest shoot number of 5 in both 30 and 45 ml, with highest number of root per corm (17) in 15 ml, and highest number of leaf per corm (15), shoot height (58cm), leaf

length (46cm) and leaf width (28cm) in 30 ml. Whereas 'Owom' and 'Atagafong' showed poor responses to BAP except in 30 ml where 'Atagafong' showed high leaf length.

At the sixth week of propagation (Table 2), 'Owom' at 30 ml and 'Atagafong at 15 ml showed highest shoot production and root per corm respectively. Also, at 30 ml, 'Owom' had highest number of leaf (20), shoot height (60 cm), leaf width (30 cm) and leaf length (47 cm).

Table 1: Shooting and growth responses of plantain genotypes to various BAP concentration after 4 weeks.

Column1	shoot per corm	Root per corm	Leaf per corm	shoot height	leaf width	Leaf length
MBLEPAUL	4	17	9	55	22.7	36
ATAGAFONG	2	10	5	26	18	29.5
OWOM	3	1	9	36	14.5	27.5
MBLEPAUL	5	5	15	58	28	46
ATAGAFONG	3	10	11	40	19	29
OWOM	1	1	3	15	12	23
MBLE PAUL	5	7	11	48	21	39
ATAGAFONG	2	5	6	32	13	22
OWOM	4	8	11	56	15	33
MBLEPAUL	4	4	12	54	19	33
ATAGAFONG	4	8	11	54	17	38
OWOM	3	9	12	46	15	26

Table 2: Shooting and growth responses of plantain genotypes to various BAP concentration after 4 weeks.

Column1	Shoot per corm	Root per corm	Leaf per corm	shoot height	leaf width	Leaf length
MBLEPAUL	6	10	18	55	25	45
ATAGAFONG	5	17	14	47	29	31
OWOM	4	14	12	54	15	30
MBLEPAUL	5	12	16	58	24	44
ATAGAFONG	3	11	11	30	29	42
OWOM	7	14	21	60	30	47
MBLEPAUL	2	9	7	22	16	34
ATAGAFONG	4	14	17	45	19	34
OWOM	4	15	12	35	20	29
MBLEPAUL	1	3	3	11	9	25
ATAGAFONG	5	8	16	56	18	37
OWOM	3	3	12	36	15	32

From Table 3 below, the percentage sprouted corm revealed that 'Mblepaul' had 100% sprout at 0 and 30 ml BAP within the first four weeks and also at 15 and 45 ml BAP. 'Owom' sprouted 100% at the sixth week at 30 and 45 ml BAP.

Table 3: Percentage sprouted corm in response to BAP concentrations

Readings	BAP Conc.	'Mblepaul'	Atagafon	'Owom'
Week 4	0.0 ml	100%	75%	50%
	15 ml	75%	50%	75%
	30ml	100%	75%	25%
	45 ml	75%	50%	75%
Week 6	0.0 ml	50%	50%	75%
	15 ml	100%	50%	50%
	30 ml	50%	75%	100%
	45 ml	100%	75%	100%

DISCUSSION

The non-uniformity of the effect of BAP on the cormsfrom different plantain genotypes as shown in Tables (1, 2 and 3), could be partly due to the genetic makeup of the various genotypes used. This is in agreement with [15] [16] who showed that varieties behaviours are not the same in macropropagation. According to their work, BAP concentration at 1.5 mgL^{-1} increased sucker productivity with 17.11 suckers per corm followed by BAP at 0.0, 3.0 and 6.0 mgL^{-1} with 15.23, 13.08 and 12.96 suckers per corm, respectively. This work showed that various concentration of BAP isessential for quick activation of auxiliary bud shooting (Table 3), and roots proliferation in 'Mblepaul' and 'Owom' as compared with 'Atagafong' which responded lesser to BAP treatment. This also is in agreement with the study of [8] who indicated that the effects of

Cytokinin (BAP) on growth and development of *Musa* spp has highest shoot height (6cm), leaf and root length of 97cm and 3.69 cm respectively, was achieved under 15 ml and 30 ml of BAP.The effectiveness of BAP over other cytokinins in inducing multiplication of shoot tip cultures has been reported in different cultivars of Plantain. Conversely, corms treated with BAP at 450.0 ml had largest collar diameter and tallest shoot followed by corms treated with BAP at 30.0, 15.0 and 0.0 ml. Another similar work was also done by [10], they discovered higher in vitro shoot induction in plantain cv. 'Oniaba' and 'Apantu' when treated with BAP at 4.5 mgL^{-1} as was discovered in this work where 'Mblepaul' produced highest shoot number of 5 in both 30 and 45 ml (Table 1). In a similar experiment, [2] increased shoots proliferation by injecting 4.0 ml of BAP at 45.0 mgL^{-1} in the cavity left by the removal of the apical meristem of the corms. The interaction of plantain genotypes and BAP concentrations had a significant ($P < 0.05$) effect on leaf length and leaf width.

CONCLUSION

In conclusion, availability of healthy plantain planting materials, free from pest can be achieved by the use of macropropagation with the aid of 6-Benzylaminopurine. This is to improve the productivity ofplantain both in urban and rural areas in Nigeria.

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