EFFECTS OF VARIETY AND CORM DIAMETER ON CORM PROLIFERATION AND PLANTAIN (*MUSA PARADISIACA L.)* SEEDLING PERFORMANCE USING MACRO CHAMBER PROPAGATION TECHNOLOGY

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ABSTRACT

This work investigates the effect of variety and corm diameter on corm proliferation and plantain seedling performance using macro chamber propagation technology (9 x 6 x 5 ft) at IITA, Ibadan, Oyo State. The experiment was a split plot experiment laid out in a Completely Block Design (CRD) with four replications. The treatments comprised of the eight plantain varieties (Pita 14; 17; 23; 24, Agbagba; Big Ebanga; Mbi Egome; and Obino Lewai) and three corm diameter ranges (20-30 cm, 31-40 cm and 41-50 cm) which gave 24 treatment combinations. The growth chambers were maintained at 60-70% humidity through intermittent misting, warm temperatures of about 27° C and 50% shade. Watering was done after every 2 days to maintain relative humidity. Corms from healthy flowering plants were selected and partially clipped to remove all roots and pseudostem remains. The apical meristems were excised and scarified mechanically by screwing with a sharp knife. Three quarter of the outer leaf sheath were carefully removed to expose the lateral dormant buds. They were sterilized in 70% ethanol for 15 minutes followed by 40% Jik containing 1.5% sodium hypochlorite for an hour to kill root inhabiting nematodes. They were rinsed with distilled water and introduced into the culture medium for 48 hours before planting to cure the injuries and avoid pest infestation. Data collected were analyzed using ANOVA. This study revealed that at $P \leq 0.05$, the evaluated corm sizes produced no significant effect on the studied parameters except for number of days to sprouting and sucker vigour at 12 WAP indicating that the state of physiological maturity of the corms is important in determining the earliness of sprouting in the macro-propagation chamber. Thus, the younger corms (21 – 30 and 31– 40 cm) sprouted early perhaps because they are still in an active growth stage. Also, the interaction between the genotypes and the corm sizes produced no significant variation on any of the studied parameters, denoting that the reproductive ability of the plantain varieties is not dependent on

the physiological stage of the corms. Macro-propagation provides a cheap, simple and a relatively rapid technique for multiplication

I. INTRODUCTION

Plantains (*Musa spp. L.*) are important staple foods for nearly 400 million people in many developing countries, especially in Africa. Total global production ranks plantain fourth after maize, rice and wheat (Lassois *et al*., 2009; Shaibu *et al.,* 2012; Vrydaghs *et al.*, 2009). Plantain is a major starchy staple in the sub-Saharan Africa (SSA) being consumed by both for rural and urban populace, providing more than 25% of the carbohydrates and 10% of the daily calorie intake for more than 70 million people in the continent (Murphy *et al.*, 2020; Mbaka *et al.*, 2008). In other words, a large number of people in West and Central Africa are projected to derive more than one-quarter of their energy requirements from plantains, making plantain one of the most significant sources of food and employment throughout the African lowland humid forest zone. Marketing on the local market is a source of employment and income for rural people (Robinson and Galan Sauco, 2010).

The plant is grown throughout the tropics and plays an important role in the economy of many developing countries (Reyes-Borja *et al*., 2007). Plantain is usually cultivated through sucker. At least 116 plantain cultivars have been identified in West and Central Africa. Triploid cultivars constitute most of the world banana production and are found as either dessert or cooking varieties in the AAA, AAB and ABB genomic groups (Daniells *et al.*, 2001; Denham and Donohue, 2009). Different types of planting materials including the maiden sucker, water sucker, sword suckers, butt, peeper, and bits are used for the establishment of plantations, but they vary in their degree of suitability (Dubois *et al.*, 2006, Baiyeri and Aba, 2005). Similarly, there are many techniques and methods involved in plantain suckers multiplication and production, but there are limitations associated with a good number of them.

Direct propagation of plantain on the field increases susceptibility to pathogenic microbes and general reduction in crop quality. Micro or *In-vitro* propagation method produces healthy, vigorous and free from pests and diseases (Mwangi and Muthoni, 2008) but poorly developed in Nigeria – thus grossly unavailable to the subsistence farmers who are the major stakeholders in the production of plantain. These *In-vitro* propagation (Tissue culture) provides excellent advantages over conventional propagation, including a high multiplication rate, physiological uniformity all year round, rapid dissemination of new plant materials throughout the world, uniformity of shoots, short harvest interval in comparison with conventional plants and faster growth in the early growing stages compared to conventional materials but there are expensive and not easily available to farmers (Singh *et al.*, 2011; Robinson and De Villiers, 2007). A few in-vivo nursery propagation techniques have increased the plantain multiplication

rate in field but present the risk of multiplying contaminated materials by nematodes or weevil (Koné, 2013). Natural regeneration method is unreliable and a major contributor to the spread of pests and diseases. Macro-propagation (*Ex-vitro* multiplication) technique provides cheap, simple, and relatively rapid techniques for vegetative multiplication of *Musa* species that could be suitable to the low-income, unskilled, small- and medium-scale farmers (Koné, 2013; Dzomeku *et al*., 2014).

Despite the importance of plantain, the crop remains insufficient as the domestic, regional and international demands out-weigh the supply. The reason is attributed to poor and viable plantain suckers multiplication techniques coupled with seasonality of the plant production; the use of marginal and sensitive varieties to pests and diseases; poor quality suckers availability for multiplication; lack of good character and high genetic uniformity; and poor quality seedlings. Therefore, this research is aimed at assessing the efficiency of macro-propagation chamber technology with consideration for the response of different varieties and corm sizes to the technique.

II. METHODOLOGY

Experimental Site

The experimental field was established at the International Institute of Tropical Agriculture (IITA), Ibadan, Oyo State in the guinea savanna agro-ecology (Latitude 7.43°N, Longitude 3.9°E, Altitude 227.2 meters above sea level and an average annual rainfall of 1308 mm). Growing conditions such as moisture and radiation are adequate in the area; the site is also not endemic to most of the pathogens and pests associated with plantain growth (Oni *et al.,* 2015). Eight plantain varieties (Table 1) developed at the IITA and selected for their stability and yield were obtained from the plantain and Banana Improvement unit of the Institute and used for the study.

Sample Preparation

Corms from healthy flowering plants were selected and partially clipped to remove all roots and pseudostem remains according to Singh et al. (2011). The apical meristems were then excised and scarified mechanically by screwing with a sharp knife (Baiyeri and Aba, 2005). Three quarter of the outer leaf sheath were carefully removed to expose the lateral dormant buds (Robinson and De Villiers, 2007). After this, they were surface sterilized in 70% ethanol for 15 minutes followed by 40% Jik containing 1.5% sodium hypochlorite for one hour to kill root inhabiting nematodes. They were then rinsed five times with distilled water and introduced

into the culture medium (Wong et al., 2002) and allowed to stay for 48 hours before planting to cure the injuries and avoid pest infestation (Baiyeri and Aba, 2005). Three ranges of corm diameters including 20-30 cm, 31-40 cm and 41-50 cm from each plantain genotype were thereafter selected for the study and they were treated by soaking in cypermethrin solution for 15 minutes. They were subsequently air dried for 24 hours for appropriate curing prior to introduction into the nursery section.

Corm Initiation: The prepared corms were introduced into substrate of sawdust in wooden boxes covered with an ultraviolet nylon called growth chamber and a uniform watering schedule was ensured every two days from the day of planting. The sawdust was mixed with basal salts (Kasyoka, 2013) supplemented with 6 mgl^{-1} benzyl amino purine, 3% sugar and 0.3% phytogel to induce shoot production. The culture was incubated at a temperature of 27±1^{o}C in darkness for 8 hours. Shade was provided by erecting bamboo poles and palm fronds over the nursery section. Water was appropriately supplied to the plants throughout the experimental period.

Table 1: List of Plantain Varieties to be used in this Study

S/N	Variety	Origins
1	PITA 14	Hybrids of East African Varieties and West African landraces
2	PITA 17	Hybrids of East African Varieties and West African landraces
3	PITA 23	Hybrids of East African Varieties and West African landraces
4	PITA 24	Hybrids of East African Varieties and West African landraces
5	Agbagba	West African landrace
6	Big ebanga	West African landrace
7	Mbi egome	French Variety
8	Obino lewai	French Variety

Experimental Layout, Design of the Macro-propagation and Treatments

Growth chambers measuring 9 x 6 x 5 ft made from wooden frames and thatched roof materials was used (Fig. 1). Fifteen corms per genotype were completely buried in the initiation medium consisting of sawdust that had been steam-sterilized, moistened and decomposed for

3 weeks as described by Singh *et al*., (2011). This was done to generate enough suckers for the evaluation of the performance of the suckers. The growth chambers were maintained at 60-70% humidity through intermittent misting, warm temperatures of about 27°C and 50% shade. Watering was done after every 2 days to maintain relative humidity. The experimental treatment comprised of the eight plantain variety and three corm diameter ranges. This gave a 24 treatment combinations. The experiment was a split plot experiment with the eight plantain variety being the main factor and three corm sizes being the sub-plot factor and was laid out in a Completely Block Design (CRD) design with four replications.

Fig. 1: The Design of the Macro Propagation Chamber

Scarification and Hardening

The process of scarification was done after buds had emerged from the mother corm and the side shoots attains heights of 15-20 cm and with 3-4 leaves. The method was by cutting the sucker with a sharp knife followed by 3-4 transverse cuts. This was done to encourage production of multiple shoots and scarification was done for 90 days at 2 weeks interval (Faturoti *et al*., 2002). The lateral sprouts of 15-20 cm length was separated into individual plantlets each having roots and a piece of the mother corm. The process is called Hardening. They were then transplanted into polythene bags containing sterilized soil mixed with well decomposed manure. They were sufficiently watered and kept in a shade net containing 70% shade and 80-90 % humidity. After 20 days, the amount of shade was reduced to 50% while humidity was reduced to 40-50%. Watering was done on alternate days and the plants were transferred to the field after 30 days as recommended by Faturoti *et al*., (2002) and Tenkouano *et al*., (2006).

Data Collection

The weight of each corm size was weighed and recorded in grams. Date of first bud proliferation was recorded as the number of days from initiation till the first bud emerges from each variety and corm size. Number of proliferated buds was counted and recorded at different time interval. Height of plantlet was measured with a meter rule and recorded in cm. Leaf area was estimated with the use of a leaf area meter. Girth of the plantlet was measured with a measuring tape at the base of each plantlet. Total number of plantlets was physically counted. Weight of Sucker was recorded after each scarification (g). Plant height was measured from

the base of the pseudo-stem to the V-junction of the last two unfurled leaves (cm). Stem girth was measured at the base of the plant using a tape rule (cm). Leaf area was estimated with the use of a leaf area meter. Number of leaves was physically counted from the base of the plants as active and opened leaves. Plant vigor was visually scored at 12, and 16 weeks after transplanting following a four-point scoring index where 1 was excellent growth and 4 was poor spindle growth. Plant survival after 90 days was calculated using the following formula:

$$\frac{\text{Number of survived plantlet}}{\text{Total number of plantlet}} \times 100$$

Data Analysis

The data was subjected to analysis of variance (ANOVA) using the procedures for general linear model PROC GLM in SAS (SAS Institute, 2011) and significant means were compared using LSD at 5% significance level. The parameters from the Macro propagation chamber were subjected to correlation analysis using SAS.

III. RESULTS

Effects of Variety and Corm Sizes on Corm Proliferation in the Macro Chamber

The varieties had no significant influence on the number of days to sprouting whereas the corm sizes significantly influenced the number of days to sprouting. Obini Lewai sprouted earliest (21 days) while Big Egban sprouted latest (25 days). Also, corm size 21 – 30 cm produced the earliest sprouting (21 days) while the other two corm sizes sprouted later at an average of 24 days. Also, it was found out that the varieties had no significant influence on the corm weight whereas the corm sizes significantly influenced the corm weight. Mbi Egome had the highest mean corm weight (434.77 g) (Table 2) while Pita 23 produced the lowest mean corm weight (371.11 g). On the other hand, corm size 21 – 30 cm produced the significantly highest corm weight (448.40 g) while corm size 31 – 40 cm resulted in the significantly lowest corm weight (379.26 g). Agbagba under corm size, 21 – 30 cm produced the highest corm weight (488.94 g) whereas Pita 23 under corm size 31 – 40 cm produced the lowest corm weight (308.25 g).

However, both the varieties and corm sizes had no significant influence on the number of proliferated buds and the number of surviving shoot. Big Egban had the highest mean number of proliferated buds (18.33) while Pita 23 produced the lowest mean number of proliferated buds (14.33). On the other hand, the mean number of proliferated buds was

comparable. Big Egban under corm size 31 – 40 cm produced the highest number of proliferated (18.81) whereas Pita 24 under corm size 41 – 50 cm produced the lowest number of proliferated buds (12.35). Also, Big Egban had the highest mean number of surviving shoots (15.79) (Table 3) while Pita 23 produced the lowest mean number of surviving shoots (11.77). On the other hand, corm size 41 – 50 cm produced highest mean number of surviving shoots (14.22) while sizes 21 – 30 cm and 31 – 40 cm had similar number of surviving shoots. Thus, Big Egban under corm size 31 – 40 cm produced the highest number of surviving shoot (16.34) as Pita 24 under corm size 41 – 50 cm produced the lowest number of surviving shoot (11.05).

Fig. 1: Plantlet Growth in the Macro Chamber

Table 2: Effect of Plantain Variety and Corm Sizes on Corm Proliferation in the Macro Chamber

	Corm weight (g)				Number of proliferated buds				Number of surviving shoot				Number of plantlets			
	corm size				corm size				corm size				corm size			
Variety	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**
Agbagba	488.94	324.31	404.25	405.83	16.00	15.13	14.94	15.36	13.88	13.25	13.50	13.54	3.44	2.13	2.19	2.59
Big Egban	399.19	455.25	356.00	403.48	18.56	18.81	17.63	18.33	15.31	16.38	15.69	15.79	3.19	3.31	2.69	3.06
Mbi Egome	435.56	448.94	419.81	434.77	15.88	15.25	17.31	16.15	13.56	13.25	15.19	14.00	3.50	2.44	3.06	3.00
Obini Lewai	462.75	432.73	395.62	430.37	16.50	18.40	18.77	17.89	14.19	15.87	16.23	15.43	3.13	3.53	3.00	3.22
Pita 14	459.25	321.88	429.88	403.67	13.44	16.38	17.19	15.67	11.56	13.75	14.38	13.23	2.25	2.44	2.06	2.25
Pita 17	486.06	412.69	369.40	422.72	18.44	14.00	17.13	16.52	15.94	12.06	15.40	14.47	3.50	2.44	2.60	2.85
Pita 23	415.63	308.25	389.44	371.11	14.31	13.63	15.06	14.33	11.06	11.94	12.31	11.77	2.19	3.31	2.00	2.50
Pita 24	439.81	330.00	368.20	379.34	14.88	16.88	12.35	14.70	13.50	14.81	11.05	13.12	2.56	2.56	2.50	2.54
Size means	448.40	379.26	391.58		16.00	16.06	16.30		13.63	13.91	14.22		2.97	2.77	2.51	
LSD Variety (V)	ns				ns				ns				ns			
LSD Size (S)	57.48				ns				ns				ns			
LSD V × S	ns				ns				ns				ns			

Effects of Variety and Corm Sizes on Plantlet Growth in the Macro Chamber

The plantain varieties had a significant effect on the height, stem girth and leaf area of the plantlets in the macro chamber whereas the corm sizes had no significant influence on the height of plantlets in the macro chamber. Variety Big Egban produced tallest plantlets (21.40 cm) while Pita 23 produced the significantly shortest plantlets (15.38 cm). On the other hand, corm size 41 – 50 cm produced tallest plantlets (17.65 cm) and size 31 - 40 cm produced the lowest number of plantlets (16.90 cm). Variety Big Egban under corm size of 21 – 30 cm produced the overall tallest plantlets (21.50 cm) whereas variety Pita 24 with corm size, 41 – 50 cm produced the overall shortest plantlets (13.45 cm). Variety Big Egban produced plantlets with the highest mean girth (6.75 cm) (Table 3) and Pita 14 produced the plantlets with the significantly lowest mean girth (4.73 cm). Whereas, the corm size of 21 – 30 cm and 41 – 50 cm produced plantlets with the highest mean girth (5.53 cm) and the size of 31 - 40 cm produced the plantlets with the lowest mean girth (5.19 cm). Variety Big Egban under corm size 31 – 40 cm produced the plantlets with the highest girth (7.50 cm) whereas variety Agbagba under corm size 31 – 40 cm produced the plantlets with the shortest girth (4.25 cm). Variety Big Egban produced plantlets with the highest mean leaf area (78.71 cm^2) (Table 4) and Pita 14 produced the plantlets with the significantly lowest mean leaf area (50.38 cm^2). Similarly, the corm size of 21 – 30 cm produced plantlets with the highest mean leaf area (66.83 cm^2) while the size, 31 - 40 cm produced the plantlets with the lowest mean leaf area (58.21 cm^2). Variety Big Egban under corm size 41 – 50 cm produced the plantlets with the highest leaf area (93.87 cm^2) whereas variety Pita 24 under corm size 41 – 50 cm produced the plantlets with the lowest leaf area (43.04 cm^2).

Effects of Variety and Corm Sizes on Sucker Growth in the Chamber

Plant Height (cm)

The plantain varieties produced a significant effect on the height of suckers in the nursery all through the sampling period whereas the corm sizes produced no significant influence on the height of suckers throughout the study period in the nursery (Table 4). Suckers from variety Big Egban consistently had the highest mean height at 4, 8, 12 and 16 weeks after transplanting (WAT) (38.51, 70.61, 106.98, 126.24 and 130.51 cm, respectively) while Pita 23 produced the significantly shortest suckers at all period of data collection (27.68, 50.74, 76.88, 90.71 and 93.79 cm, respectively). Also, suckers from corm size 41 – 50 cm steadily grew tallest on the average at all periods of data collection (31.76, 58.23, 88.23 and 104.11 cm, respectively) while corm size 31 - 40 cm produced the mean shortest suckers in the same period (30.41, 55.76, 84.48 and 99.68

cm, respectively). The interactive effect of the plantain variety and corm sizes produced no significant effect on the height of suckers at all sampling period.

Stem girth (cm)

The plantain varieties produced a significant effect on the girth of suckers in the nursery all through the sampling period whereas the corm sizes produced no significant influence on the girth of suckers throughout the study period in the nursery (Table 5). Suckers from variety Big Egban consistently had the thickest stems at 4, 8, 12 and 16 WAT (8.10, 10.13, 13.50 and 15.21 cm, respectively) while Pita 14 produced the significantly thinnest suckers at all period of data collection (5.68, 7.09, 9.46 and 10.65 cm, respectively). Furthermore, the corm sizes produced no variation on the girth of suckers throughout the study. The interactive effect of the plantain variety and corm sizes produced no significant effect on the height of suckers at all sampling period.

Leaf area (cm^2)

The plantain varieties produced a significant effect on the leaf area of suckers in the nursery throughout the period of experimentation whereas the corm sizes produced no significant influence on the height of suckers in the period in the nursery (Table 6). Variety Big Egban produced suckers with the consistently highest mean leaf area at 4, 8, 12 and 16 WAT (86.59, 98.40, 105.48 and 110.99 cm^2, respectively) while Pita 14 suckers with the lowest leaf area at all period of data collection (44.44, 50.50, 54.13 and 56.96 cm^2, respectively). Moreover, suckers from corm size 21 – 30 cm consistently resulted in suckers.

Correlation Results among the Plantlet Materials in the Macro Chamber

The correlation among the plantlets parameters in the nursery is presented in Table 7. The number of days to first sprouting was not significantly correlated to any of the parameters in the macro chamber except for total number of plantlets that it was significantly but weakly and negatively correlated with ($r = -0.14$; $P \leq 0.05$). The number of surviving shoot had a high, significant and positive correlation with total number of plantlet, plantlet height, plantlet girth ($r = 0.58, 0.68, 0.79$ and 0.5, respectively; $P \leq 0.0001$). The plantlet height had a high and significant correlation with plantlet girth ($r = 0.90$; $P \leq 0.0001$).

`Table 3: Effects of Variety and Corm Sizes on Plantlet Growth in the Macro Chamber

	Plantlet height (cm)				Stem Girth of plantlet (cm)				Leaf area of plantlet (cm^2)			
	corm size				corm size				corm size			
Variety	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**
Agbagba	18.63	16.02	16.56	17.07	5.81	4.25	4.94	5.00	74.78	60.73	51.07	62.19
Big Egban	21.50	21.19	21.50	21.40	6.31	7.50	6.44	6.75	72.34	69.92	93.87	78.71
Mbi Egome	17.38	15.25	17.06	16.56	6.13	4.69	5.06	5.29	77.31	57.56	53.85	62.91
Obini Lewai	18.69	20.20	21.15	20.01	6.06	5.87	7.08	6.34	76.59	85.39	72.09	78.02
Pita 14	13.88	15.06	17.38	15.44	4.19	4.56	5.44	4.73	50.68	30.73	39.78	40.40
Pita 17	17.63	16.88	18.00	17.50	5.75	5.13	5.87	5.58	71.92	55.44	65.00	64.12
Pita 23	16.19	13.88	16.06	15.38	5.00	4.56	5.06	4.87	48.53	60.30	70.53	59.79
Pita 24	16.25	16.69	13.45	15.46	5.00	4.94	4.35	4.76	62.48	45.61	43.04	50.38
Size means	17.52	16.90	17.65		5.53	5.19	5.53		66.83	58.21	61.15	
LSD Variety (V)	2.44				0.73				14.61			
LSD Size (S)	ns				Ns				ns			
LSD V × S	ns				Ns				ns			

Table 4: Effects of Variety and Corm Sizes on Sucker Height (cm) in the Chamber

	4 WAT				8 WAT				12 WAT				16 WAT			
	corm size				corm size				corm size				corm size			
Variety	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**
Agbagba	33.53	28.84	29.81	30.73	61.46	52.87	54.66	56.33	93.13	80.11	82.81	85.35	109.89	94.53	97.72	100.71
Big Egban	38.70	38.14	38.70	38.51	70.95	69.92	70.95	70.61	107.50	105.94	107.50	106.98	126.85	125.01	126.85	126.24
Mbi Egome	31.28	27.45	30.71	29.81	57.34	50.33	56.31	54.66	86.88	76.25	85.31	82.81	102.51	89.98	100.67	97.72
Obini Lewai	33.64	36.36	38.08	36.03	61.67	66.66	69.81	66.05	93.44	101.00	105.77	100.07	110.26	119.18	124.81	118.08
Pita 14	24.98	27.11	31.28	27.79	45.79	49.71	57.34	50.95	69.38	75.31	86.88	77.19	81.86	88.87	102.51	91.08
Pita 17	31.73	30.38	32.40	31.50	58.16	55.69	59.40	57.75	88.13	84.38	90.00	87.50	103.99	99.56	106.20	103.25
Pita 23	29.14	24.98	28.91	27.68	53.42	45.79	53.01	50.74	80.94	69.38	80.31	76.88	95.51	81.86	94.77	90.71
Pita 24	29.25	30.04	24.21	27.83	53.63	55.07	44.39	51.03	81.25	83.44	67.25	77.31	95.88	98.46	79.35	91.23
Size means	31.53	30.41	31.76		57.80	55.76	58.23		87.58	84.48	88.23		103.34	99.68	104.11	102.38
LSD Variety (V)	2.64				4.83				7.32				8.6			
LSD Size (S)	ns				ns				ns				ns			
LSD V × S	ns				ns				ns				ns			

Table 5: Effects of Variety and Corm Sizes on Stem Girth (cm) of Sucker in the Chamber

	4 WAT				8 WAT				12 WAT				16 WAT			
	corm size				corm size				corm size				corm size			
Variety	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**
Agbagba	6.98	5.10	5.93	6.00	8.72	6.38	7.41	7.50	11.63	8.50	9.88	10.00	13.09	9.58	11.12	11.26
Big Egban	7.58	9.00	7.73	8.10	9.47	11.25	9.66	10.13	12.63	15.00	12.88	13.50	14.23	16.89	14.51	15.21
Mbi Egome	7.35	5.63	6.08	6.35	9.19	7.03	7.59	7.94	12.25	9.38	10.13	10.59	13.80	10.56	11.41	11.92
Obini Lewai	7.28	7.04	8.49	7.60	9.09	8.80	10.62	9.50	12.13	11.73	14.15	12.67	13.66	13.21	15.94	14.27
Pita 14	5.03	5.48	6.53	5.68	6.28	6.84	8.16	7.09	8.38	9.13	10.88	9.46	9.43	10.27	12.26	10.65
Pita 17	6.90	6.15	7.04	6.70	8.63	7.69	8.80	8.37	11.50	10.25	11.73	11.16	12.96	11.54	13.21	12.57
Pita 23	6.00	5.48	6.08	5.85	7.50	6.84	7.59	7.31	10.00	9.13	10.13	9.75	11.26	10.28	11.42	10.99
Pita 24	6.00	5.93	5.22	5.72	7.50	7.41	6.53	7.15	10.00	9.88	8.70	9.53	11.26	11.12	9.80	10.73
Size means	6.64	6.23	6.64		8.30	7.78	8.30		11.07	10.38	11.06		12.46	11.68	12.46	
LSD Variety (V)	0.55				0.69				0.91				1.03			
LSD Size (S)	ns				ns				ns				ns			
LSD V × S	ns				ns				ns				ns			

Table 6: Effects of Variety and Corm Sizes on Leaf area (cm^2) of Sucker in the Nursery

	4 WAT				8 WAT				12 WAT				16 WAT			
	corm size				corm size				corm size				corm size			
Variety	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**	**21-30 cm**	**31 - 40 cm**	**41 - 50 cm**	**Means**
Agbagba	82.26	66.81	56.18	68.42	93.48	75.93	63.84	77.75	100.21	81.38	68.43	83.34	105.45	85.63	72.01	87.70
Big Egban	79.58	76.92	103.26	86.59	90.43	87.41	117.36	98.40	96.94	93.70	125.79	105.48	102.00	98.59	132.37	110.99
Mbi Egome	85.04	63.32	59.24	69.20	96.65	71.96	67.33	78.65	103.58	77.13	72.16	84.29	108.99	81.16	75.92	88.69
Obini Lewai	84.26	93.93	79.32	85.84	95.76	106.74	90.14	97.55	102.63	114.42	96.62	104.56	108.00	120.41	101.65	110.02
Pita 14	55.74	33.81	43.76	44.44	63.34	38.43	49.73	50.50	67.91	41.18	53.30	54.13	71.46	43.33	56.08	56.96
Pita 17	79.13	60.99	71.50	70.54	89.91	69.31	81.26	80.16	96.39	74.29	87.11	85.93	101.40	78.16	91.65	90.40
Pita 23	53.38	66.34	77.59	65.77	60.66	75.39	88.16	74.74	65.03	80.81	94.51	80.12	68.43	85.02	99.44	84.30
Pita 24	68.74	50.18	47.34	55.42	63.08	78.40	91.69	77.72	83.74	61.13	57.66	67.51	88.10	64.31	60.68	71.03
Size means	73.52	64.04	67.27		81.66	75.45	81.19		89.55	78.01	81.95		94.23	82.08	86.23	
LSD Variety (V)	16.07				18.26				19.58				20.62			
LSD Size (S)	ns				ns				ns				ns			
LSD V × S	ns				ns				ns				ns			

Table 7: Correlation Coefficients among the Plantlet Parameters in the Macro Chamber

	Number of days to first sprouting	Corm weight	Number of proliferated buds	Number of surviving shoots	Total number of plantlets	Plantlet height	Plantlet girth
Corm weight	0.02ns						
Number of proliferated buds	-0.09ns	0.17**					
Number of surviving shoots	-0.07ns	0.17**	0.98***				
Total number of plantlets	-0.14*	0.21***	0.61***	0.58***			
Plantlet height	0.06ns	0.11*	0.83***	0.78***	0.61***		
Plantlet girth	0.07ns	0.09ns	0.72***	0.69***	0.53***	0.90***	
Plantlet leaf area	-0.05ns	0.09ns	0.56***	0.54***	0.49***	0.65***	0.59***

DISCUSSION OF RESULTS

In terms of seedlings production, several methods of banana propagation have been identified. However, the high costs and sophisticated skills associated with some of the technology have limited their adoption. There is therefore a need for a more affordable and simple technique (Lopez, 1994). Results of this research have proven that macro propagation can be adopted as an alternative to the other methods since it costs less and is simpler to implement and can be used by farmers at field level with simple structures to produce seedlings of their own choice (Faturoti *et al*., 2002).

Time taken to sprout varied significantly among the varieties, indicating that these varieties have different inherent sprouting tendencies and therefore multiplication rates. Multiplication rates among the plantain varieties with different corm sizes indicated that variety Obini Lewai had the highest multiplication whereas variety Big Egban had the lowest multiplication rate. Furthermore, corm size 21-30 cm resulted in the highest rate of proliferation. These results agree with Hirimburegama and Gamage (1997) who reported that multiplication rates depends on the variety as well as the maturity of the corm being utilized. The current

research confirms that varieties Big Egban, Mbi Egome and Obini Lewai had more plantlets than other varieties as had been earlier reported by Baiyeri and Aba (2005).

Results of this study indicated that the time necessary to observe the bud induction from corms depends on their. Larger corms respond more rapidly to bud induction because of the importance of nutritive reserves in tissue and a lesser susceptibility to stress occurring during the process of sucker preparation before planting in macro chamber. In relation to the physiological state of corms, the time to induce buds seems variety-specific. Therefore, young corms produce buds more rapidly. The significant effect of the variety on duration for initiating buds was also reported by Bayeri and Aba (2005). They reported variable multiplication rates between cultivars. This implies that genomic complement i.e. the special characteristic of a given cultivar which makes it different from the other was more important in producing significant difference on proliferation.

The plantain varieties were also found to influence the growth of the plantlets in the macro chamber in terms of the plantlet height, girth and leaf area although the corm sizes had no significant effect on the performance of the plantlets. This implies that the varieties have a major impact on the eventual growth of the plantlets. Irrespective of the variety, the highest growth performance was obtained with the smallest corm size. These may be adduced to the corms containing active axillary buds which could be activated after having destroyed the apical meristem by double cross incision. Similar observations have already been reported (Koné, 2013; Dzomeku *et al*., 2014).

The differences seen in the suckers performance after transplanting is mainly due to the plantain varieties since they were grown at the same physiological stage and under similar conditions. Over the period of study, macro propagated suckers were not significantly different from each other with regards to the corm size from which they were derived from. This means that suckers can adjust to field conditions optimally but performance will be dependent upon the variety being considered (Tenkouano *et al*., 2006). The initial spindle growth of suckers regenerated through macro propagation can be attributed to the fact that corms are a nutrient reserve which could support growth for some time prior to foliage development (Blomme *et al*., 2000; Bayeri and Aba, 2005). Hence the size of the corms from which they were obtained from may have affected their early performance.

The observed differences in response to macro propagation by different cultivars with regards to the growth may be due to genotypic differences. Ploidy level has been earlier noted to influence the size of different plant parts of *Musa* species (Tripathi *et al.,* 2007). Generally,

as ploidy level increases, the magnitude of plant parameters tends to increase e.g. tetraploid has high values for leaf area, plant height, corm fresh weight, root traits, and growth rates (Vandenhout *et al*., 1995). The significant effect of the genotype on growth performance of suckers has earlier been reported by Bayeri and Aba (2005). The height of plantlets, girth as well as the leaf area were significantly influenced by the plantain varieties and revealing that the genotypes used in this study may have been at different ploidy levels.

Rating for the vigour of the plantlets provides an avenue to select plantlets with early growth and high chances of survival in field conditions. The significant effect of the corm sizes on the plant vigour at 12 WAT might be pointing at the probability that the physiological maturity of corms for plantlet production will influence the eventual growth and survival of the plantlets. This is further proven with the observed differing ratings for the different varieties evaluated. However, at 16 WAT, it was observed that the varieties influenced the vigour rating thereby indicating that some varieties will be more appropriate for plantlet production than the others. The observed significant effect of plantain variety on plant survival could be attributed to the varying genetic composition of the varieties. The genetic make-up of varieties have been earlier identified to play a fundamental role in sucker initiation and eventual survival with those with higher Ploidy levels producing higher survival rates than those with lower Ploidy levels (Mshani *et al.,* 2010). This could explain the lower survival rates witnessed in Pita 14 and Pita 23 and higher survival rates in Big Egban and Obini Lewai.

Correlation studies reveals that there are strong positive relationships between various parameters which were evaluated indicating that some parameters that correlates significantly and highly with other parameters can be used as criteria for plantlet multiplication. The number of proliferated bud was highly and significantly correlated with number of surviving shoots revealing that highly prolific varieties will invariably produce higher number of plantlets. Also, the leaf area of the plantlet was significantly correlated to all the other parameters except for the number of days to first sprouting and corm weight. This agrees with the reports of Bloom *et al.* (2000) that the pseudo stems of plantain are made up of leaf sheathes and hence influences the growth of the plant thereby reflecting shoot growth and thus influencing plantlet vigour.

CONCLUSION AND RECOMMENDATIONS

Plantain is an important food crop in SSA and it contributes significantly to the diet of Nigerians. Unfortunately, in spite of its importance yields are still very low. This is largely due to the lack of enough high quality seedlings owing to the inability of seedling production methods to meet the high demand for seedlings. Macro-propagation however provides a cheap, simple and a relatively rapid technique for multiplication. In this study, varieties exhibited differential performance for the studied parameters, denoting that genetic variability among them can influence their suitability for macro-propagation.

This study revealed that the evaluated corm sizes produced no significant effect on the studied parameters except for number of days to sprouting and sucker vigour at 12 WAP revealing that the state of physiological maturity of the corms is important in determining the earliness of sprouting in the macro-propagation chamber. In view of this, it was revealed that the younger corms (21 – 30 and 31 – 40 cm) sprouted early perhaps because they are still in an active growth stage. However, the interaction between the genotypes and the corm sizes produced no significant variation on any of the studied parameters, denoting that the reproductive ability of the plantain varieties is not dependent on the physiological stage of the corms.

In the macro-propagation chamber, some of the parameters that were highly correlated with each other and therefore revealing that they could be used in determining highly prolific varieties suitable for the technique. These parameters which include number of number of proliferated buds, total number of plantlet produced and plantlet height may serve as bench result for other researchers to base their studies upon. Furthermore, with regards to the highly prolific varieties including Obini Lewai, Big Egban and Pita 17; this trial may be repeated for at least one more year in order to validate the results.

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