



## **Evaluation of Plantain (*Musa spp.*) Varieties for Growth and Yield Characters in Humid Rainforest Zone of Nigeria**

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### **Authors' contributions**

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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### **ABSTRACT**

A field experiment was conducted to evaluate the growth and yield characteristics of plantain varieties in the humid rain forest zone of Nigeria. The research was conducted at the University of Uyo Teaching and Research Farm in Uyo, Akwa Ibom State, Nigeria. The objective of this study was to evaluate the performance of various plantain varieties with a view to identify high yielding genotypes. The planting material used for this study were the following varieties - 4479-1, 7152-2, Agbagba, Akpakpak, Mbiegome and a local cultivar called "Ogoni Red" obtained from the International Institute of Tropical Agriculture (IITA), Onne, River State. Data collected on shoot and bunch yields characters were statistically assessed by analysis of variance. The growth characters showed significant variations among the plantain varieties. Plant height at 32 weeks after planting showed that variety 4479-1 recorded the highest height, 4.09 m while Agbagba and Mbiegome had heights 3.21 m and 3.07 m, respectively. The bunch characteristics measured after harvesting were statistically significant differences ( $P < 0.05$ ) among the varieties. The bunch weight differed significantly ( $P < 0.05$ ) amongst the varieties. The result showed that the yield (bunch weight) for Mbiegome was 10.55 kg, followed by 4479-1 with 10.28 kg., while 7152-2, Ogoni red and Agbagba varieties recorded 07.68 kg, 04.11 kg and 09.5 kg, respectively. In this study, variety Mbiegome outperformed other varieties in terms of yield and yield components apart from the finger thickness and length and is therefore recommended to promotion in Akwa Ibom State.

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## 1. INTRODUCTION

Plantain (*Musa paradisiaca* L.) is a member of the family Musaceae and they are closely related to the common banana. It is a perennial plant with rhizomes below the ground. Plantains are cultivated in across the globe, including the tropics and are consumed majorly as food in different forms [1]. Generally, all plantain landraces have 33 chromosomes ( $2n=3x$ ). These triploid genotypes are completely sterile and develop their fruit by vegetative parthenocarpy. The evolution of *Musa* varieties from their wild species (*M. acuminata*, Colla. and *M. balbisiana*, Colla.), and their dispersal from the Southeast Asian centre of origin to the new secondary centers of diversity [2]. Plantain ranks as the fourth most important food commodity after rice, wheat and maize in developing countries [3]. They are highly nutritious food enriched with vitamins, fiber, potassium and antioxidants [4]. Plantains serve as a booster to immune system and aids digestion. More so, plantains are good sources of essential minerals such as vitamins A, C, and B6. Plantains are consumed in various forms. They could be eaten cooked, baked, steamed or fermented [5]. Plantain is one of the world's most important staple food crops [5], over the centuries, the crop extensively cultivated in over 120 countries [6]. In Nigeria, plantains are consumed as major staples and serve as sources of revenue for small-holder farmers, especially in the humid rainforest agro-ecology of Nigera [7].

Plantain is a perennial monocotyledon crop, it heights ranges between 2 to 9 m [8]. This crop possesses pseudo-stem, which comprises of concentric layers of leaf sheaths rolled into a cylinder of between 20 and 60 cm diameter [9]. Plantain develops a true stem, which is usually a large rhizome underground. This rhizome develops aerial shoots that emanates from the lateral buds, which develop into buds and later suckers [10].

The continuous availability and higher yields of harvestable bunches contributes to the year round food security and income generation to small-holder farmers in Sub-Saharan Africa [11]. In Akwa Ibom State, Nigeria, plantain production is abysmally low despite their increasing demand in the urban markets. The bulk of plantain consumed in the State is supplied from neighboring States. The foremost constraint to

increased production is lack of suitable varieties and unavailability of planting materials. The objective of this study was therefore to evaluate the performance of various plantain varieties with a view to identify high yielding varieties in Uyo, Akwa Ibom State.

## 2. MATERIALS AND METHODS

### 2.1 Experimental Site and Field Layout

The study was conducted at the University of Uyo Teaching and Research Farm in Uyo, Akwa Ibom State, Nigeria during 2020 and 2021 cropping seasons. Uyo is located in the South-south, Nigeria and is situated within the humid tropical rainforest zone. The area lies within latitude  $4^{\circ}33'$  to  $5^{\circ}33'$  North and longitude  $7^{\circ}55'$  to  $8^{\circ}25'$  East of the Greenwich meridian. The mean annual rainfall ranges from 2680.8 to 2700.1 mm with a mean monthly relative humidity of 79.80 % while the mean monthly atmospheric temperature range is 26.88 to  $27.00^{\circ}\text{C}$  [12]. The experimental site has been under continuous cropping for the past seven years with maize, fluted pumpkin, cassava and okra as the main crops. The field experiment was laid out in a randomized complete block design (RCBD) with three replications per treatment. The entire experimental site was 24.0 x 33.5 m. The plot size measured 5 x 5 m, the inter-pot spacing was  $\frac{1}{2}$  m (length) and 5 m (breadth).

### 2.2 Treatments of the Experiment

The planting material used for this study were plantain peepers of the following varieties - 4479-1, 7152-2, Agbagba, Akpakpak, Mbiegome and a local variety called "Ogoni Red" obtained from the International Institute of Tropical Agriculture (IITA), Onne, River State.

### 2.3 Agronomic Practices

Land preparation was carried out by manual clearing using cutlass and tillage of the experimental site was carried out using the spade to dig square holes. Planting was done in June 2020. Each sucker was planted within one week after peeling in a square hole size measuring 30 cm (length) and 30 cm (breadth) x 30 cm (deep) dug out using a spade. The planting was done in June during the rainy season. The top soil was first used to fill the hole

followed by the sub soil which were placed near the surface of the hole and made to have good conduct with the soil. The hole was filled with poultry droppings and cow dung rich in nitrogen. The plant spacing 2 x 3 m. This gave a plant population of 1,666 suckers per hectare. Cultural practices carried out included weeding, fertilizer application, desuckering, pest and disease control.

## 2.4 Data Collection and Data Analysis

Growth data were recorded on the following parameters: growth (pseudostem height at shooting, pseudostem girth, leaf length, leaf area, and number of suckers/plant at shooting). The following yield attributes were measured [pseudostem number of hands per bunch, number of fingers per hand, weight at harvest, number of fingers/bunch, bunch length, bunch weight (yield/plant), weight of largest finger, diameter of largest finger and length of largest finger girth]. Data collected on shoot and bunch yield were statistically assessed by analysis of variance (ANOVA).

## 3. RESULTS

### 3.1 Growth Characteristics

The mean values for growth parameters showed significant variations among the plantain varieties as shown in Table 1. The plant height at 32 weeks after planting were significantly ( $P < 0.05$ ) different. Plant height at 32 weeks after planting showed that variety 4479-1 recorded the highest height, 4.09 m while Agbagba and Mbiegome had heights 3.21 m and 3.07 m, respectively. Plant height was least in 7152-2 variety with 2.08 m. There was no significant ( $P < 0.05$ ) difference observed on the number of leaves among the varieties. Variety Mbiegome had the highest

number of leaves (7), followed by 4479-1 and Akpakpa which had 6 leaves respectively while 7152-2 and Ogoni Red both had 4 leaves each. Table 1 also showed that significant ( $P < 0.05$ ) difference was observed among the varieties for leaf length. Variety 4476-1 recorded the highest leaf length (101.6 cm), followed by Mbiegome (88.05 cm) while (64.07 cm) and (48.48 cm) were recorded for Agbagba and 7152-2 varieties, respectively. Table 1 showed that significant ( $P < 0.05$ ) difference was observed on the pseudostem girth among the varieties. A pseudostem girth of 31.69 cm was obtained for cultivar 4479-1 and 26.58 cm for Mbiegome. Varieties Akpakpak recorded 20.33 cm while the least was recorded in 7152-2 with 16.78 cm. Among the varieties, significant ( $P < 0.05$ ) difference was observed on the leaf area. The leaf area obtained for cultivar 4479-1 was 4949.5 cm<sup>2</sup> and 4716.3 cm<sup>2</sup> was recorded for Mbiegome. Varieties Agbagba, Akpakpak and Ogoni Red had 3777.9 cm<sup>2</sup>, 3398.3 cm<sup>2</sup> and 3022.5 cm<sup>2</sup>, respectively. Significant ( $P < 0.05$ ) difference was observed among the varieties on sucker with widest width. The sucker with the widest width was 4497-1 (50.05 cm), followed by (40.75 cm) and (40.50 cm) for Agbagba and Mbiegome varieties, respectively, Both Akpakpak and Ogoni Red had (33.25) cm as the least width.

### 3.2 Bunch Characteristics

Table 2 shows the bunch characteristics measured after harvesting. It revealed statistically significant differences ( $P < 0.05$ ) among the varieties. Table 2 showed that Mbiegome had 8 hands, the highest among the six varieties. 4479-1 and Agbagba had 7 hands each, Ogoni Red had 5 while 7152-2 and Akpakpak had the least number of hands, 4 each in a bunch. The result showed that there

**Table 1. Shoot characteristics at 32 weeks after planting**

Varieties	PH (m)	NL (cm)	PG (cm)	LL (cm)	LA (cm <sup>2</sup> )	SWW (cm)
4479-1	4.09	6	31.69	101.6	4949.5	51.05
7152.2	2.08	4	16.79	48.48	1981.0	36.25
Mbiegome	3.07	7	26.58	88.05	4716.3	40.05
Agbagba	3.21	5	23.11	64.07	3777.9	40.75
Akpakpak	2.64	6	20.33	91.35	3398.3	33.25
Ogoni Red	2.49	4	17.46	68.80	3022.5	33.25
LSD ( $P < 0.05$ )	0.16	NS	3.81	8.19	18.3	4.57

NS - Not significant, PH – plant height (cm), NL – number of leaves, PG – pseudostem girth (cm), LL – leaf length (cm), LA – leaf area (cm<sup>2</sup>) and SWW – sucker with widest width

**Table 2. Bunch characteristic and yield of six varieties of plantain at harvest**

Varieties	NH	NFH	NFB	BL (cm)	BW (kg)	MFL (cm)	WSF (kg)	WLF (kg)	DLF (cm)	LLF	BW (kg)
4479-1	7	18	99	51.0	10.28	14.5	0.32	1.00	12	15	10.28
7152.2	4	05	20	46.0	07.68	18.0	0.20	0.12	10	09	07.68
Mbeigome	8	15	17	86.0	10.55	12.0	0.40	0.12	14	18	10.55
Agbagba	7	05	76	47.5	08.44	21.0	0.10	0.19	15	23	08.40
Akpapak	4	14	57	38.0	03.60	10.0	0.85	0.01	07	07	03.60
Ogoni Red	5	05	21	40.0	04.11	24.0	0.47	0.22	10	29	04.11
LSD (P < 0.05)	1.11	3.41	6.23	4.51	2.36	2.11	NS	NS	3.67	6.13	3.89

NS = Not significant, NH = number of hands in a bunch, NFH = Number of fingers in a hand, NFB = Number of fingers in a bunch, BL = Bunch length at harvest, BW = Bunch weight at harvest, MFL = Mean fingers length, WSF = Weight of smallest finger, WLF = Weight of largest finger, DLF = Diameter of largest finger, LLF = Length of largest finger, bunch weight

\* Length on the concave side was measured as the length the length is more on the convex side

was significant ( $P < 0.05$ ) difference recorded on the number of fingers among the varieties. Mbiegome and Akpapak had 15 and 14 fingers per bunch, respectively while Agbagba and Ogoni Red varieties each had 05 fingers in a hand. 117 fingers per bunch were recorded in Mbiegome as the highest of all the varieties. This was followed by 99 and 76 fingers in a bunch for 4479-1 and Agbagba varieties, respectively. 7152-2 had 20, the least number of fingers in a bunch.

Table 2 showed that there was significant ( $P < 0.05$ ) difference among the varieties on bunch length at harvest and mean finger length. Meiegome with 86 cm had the longest bunch length. This was followed by 4479-1 with 51 cm. Agbagba, 7152-2 and Ogoni Red varieties had 47.5, 46 and 40 cm, bunch length at harvest, respectively. The result showed a mean finger length of 24, 21 and 18 cm for Ogoni Red, Agbagba and 7152-2 varieties, respectively. The lowest mean finger length was recorded for Akpapak, which had 10 cm. The length of the concave side was measured since the length was more on the convex side of the plantain finger.

Table 2 showed that there was no significant ( $P < 0.05$ ) difference among the varieties for the weight of the smallest and largest fingers. The weight of the smallest finger recorded was highest in Akpapak (0.85 cm), followed by (0.47 cm) in Ogoni Red, the least weight was recorded in Agbagba, which had (0.1 cm). The weight of the largest finger recorded was highest in 4479-1, which was (1.00 kg). This was followed by (0.22 kg) in Ogoni Red. The least weight was recorded in Akpapak (0.01 kg). Significant ( $P < 0.05$ ) difference was observed the varieties on

the diameter and the length of largest fingers. The largest finger diameter of 15 cm was recorded by Agbagba followed by Mbiegome and 4479-1 with 14 and 12 cm, respectively. The least diameter of 07 cm was obtained from Akpapak variety. Ogoni Red had the longest finger with 29 cm followed by Agbagba 23 cm and Mbiegome 18 cm. 7152-2 variety recorded 09 cm while Akpapak had the least length (07 cm). The bunch weight differed significantly ( $P < 0.05$ ) amongst the varieties. The result showed that the yield (bunch weight) for Mbiegome was 10.55 kg, followed by 4479-1 with 10.28 kg. Bunch weight for 7152-2, Ogoni Red and Agbagba varieties were 07.68 kg, 04.11 kg and 09.50 kg, respectively. The least bunch weight of 03.60 kg was recorded for Akpapak variety.

#### 4. DISCUSSION

In this study, considerable variations were recorded among the varieties in terms growth and yield parameters (Table 1 and Table 2). This could be attributed to the inherent genetic variability of these varieties. The result showed that plant height at varied significantly among the varieties studied as variety 4479-1 had the highest plant height at 32 weeks, 4.09 m, followed by Agbagba and Mbiegome. This could be attributed to the genetic constitution of these varieties. This is consistent with the findings of Orluchukwu and Ogburia [2], who reported that Agbagba variety is a triploid. This means that cell size increases with increase in ploidy, triploid have longer stems and are more robust than the diploids. It was observed that the varieties with the highest number of leaves at 32 WAP, recorded the largest pseudostem girth, leaf length, leaf area and sucker with the widest

width. This showed that this variety is a triploid plantain, according to Stover and Simmonds [13]. Triploids have a genetic constitution that makes plants bigger in size generally than diploids [2]. The results of yield components on the cultivars show that 4479-1 had the highest number of hands and fingers per bunch. Number of hands per bunch showed that the variety Mbiegome produced the highest number of hands (8), followed closely by 4479-1 and Agbagba which recorded seven (7) number of hands per bunch. These varieties Akpakpak and 7152-2 produced the least number of hands per bunch (4). A similar result was obtained by Orluchukwu and Ogburia [2] who reported the range of 4.96 to 6.53 for number of hands per bunch but varies partially with the findings of Hoque et al. [14] who reported the range of 5.83 to 8.33 for hands per bunch.

This result showed that variety Agbagba, although produced one of the highest number of hands per bunch ranked 3<sup>rd</sup> in bunch weight. This could be attributed to the size of its fruits which tend to decrease progressively from the basal to the distal end [2]. The maximum number of fingers per bunch was recorded in 4479-1 (99) which was distantly followed by Agbagba (76) and The lowest was recorded in Ogoni Red (21). This result varies from the findings of Orluchukwu and Ogburia [2], who reported the range of 33.88 to 68.36 for number of fingers per bunch. The result showed that Akpakpak recorded the second highest number of leaves yet it had the lowest yield. This implies that genetic constitution could be a more critical factor in determining the yield potential of a given variety. Results from this study, it was also established that, the varieties with longer finger were the shorter ones. This is an important attribute because the market preference for plantain is mainly for long and slender fingers [15]. Bunch weight at harvest showed that variety Mbiegome recorded (10.55 kg) closely followed by variety 4479-1 (10.28 kg). The result differed with the findings of Hoque et al. [14] who reported bunch weight in the range of (09.45) kg to (18.23 kg). Also, the result of this study showed that Agbagba recorded a bunch weight of 08.44 kg which is superior performance compared to the bunch weight of same variety recorded by Orluchukwu and Ogburia [2], who reported a bunch weight of 04.33 kg. This is an indication of its superior adaptability capacity Njuguna et al. [4]. According to Njuguna et al. [4]

bunch weight is dependent on some factors which include genetic factor as well as plant nutrition and other agronomic practices.

According to Njuguna et al. [4], one of the major factor that responsible for bunch size is the ability of a variety to adapt to a particular agro ecological zone. There are varieties which are more tolerant to hot or cold condition than others and this determines their performance in different zones. Number of fingers is a major factor when marketing plantain as retailers usually sell bananas per finger basis thus the more the fingers per bunch the higher the returns. Even for those traders who sell per bunch weight, the more the fingers the higher the weight of the bunch. This is consistent with the findings of Batte et al. [16] that finger length, girth and number are positively associated with the bunch weight. Variety Mbiegome would therefore be accounted as the most preferred by marketers owing to its positive attributes since it outperformed other varieties in all parameters considered apart from the finger thickness and length. Consumers tend to prefer plantain varieties with thick and long fingers. Thus, from this study, variety Mbiegome is selected for preferable for cultivation in Uyo on the grounds on of its superior traits compared to other varieties, including the local variety (Ogoni red).

## 5. CONCLUSION

Based on the above results, it can be concluded Mbiegome performed better in terms of yield and yield components while the cultivar Ogoni red (local variety) is the least promising. Further trials should, however, be carried out in other Agro-ecological zones to determine whether the results obtained at Uyo would be sustained. Mbiegome, the best promising variety should be subjected to further tests like disease, pest, drought tolerance and consumer acceptability.

## ETHICAL APPROVAL

As per international standard or university standard written ethical Approval has been collected and preserved by the author (s).

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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