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Yield evaluation of plantain and banana landraces and hybrids in humid agro ecological zone of Nigeria

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Plantain and banana landraces are faced with yield decline due to diseases and pest pressure in the study area. Field studies was conducted with the aim to evaluate and select the best performing cultivar with high bunch yield in farmers production system in the humid agro ecological zone of Nigeria. The studies were carried out during the rainy seasons in humid forest agro ecological zone of Nigeria, known to be centre of plantain and banana diversification. Experimental layout was designed in a randomized complete block (RCBD) with thirty six treatments; each replicated two times. The analysis of variance test of significance showed that bunch yield per producing plant was highly variable and was statistically significant across genotypes tested and within replicates, although some variable measured within replication were not significantly different. A study like this is a necessary step to sustain increased production and a pre requisite for routinely identifying best performing genotypes in plantain and banana growing areas. The hybrids appear to be more suitable for the growing system in the study area as most of the hybrids perform excellently well as compared to the landraces. FHIA 21, SH 3436-9 sv and SH 3640 had the highest bunch yield compared to other hybrids and the landraces. This investigation has determined the best yield performance genotypes and the components of yield in the thirty six genotypes investigated. The best hybrids can be promoted for farmers' adoption in view of the fact that they are best suitable for humid agro ecological zones of Nigeria. This result will be of major impact on plantain production in Nigeria if there is increase in awareness and adoption of these hybrids with consistent high yield performance. Therefore, a further investigation to validate the result over three years or more is required.

Key words: Hybrids, Landraces, humid, agro ecological zones, plantain and banana, yield.

INTRODUCTION

Plantains and bananas, *Musa* sp. are major staple food in developing countries and in Western and Central Africa. About 70 million people are estimated to depend on *Musa* fruits for a large proportion of their daily carbohydrate intake (Swennen and Wilson, 1983). Plantains and bananas represent the world's second largest fruit crop with an annual production of 129,906,098 metric tons (FAOSTAT, 2010). They rank as the fourth most important global food commodity after rice, wheat and maize in terms of gross value of production (INIBAP, 1992). Over the years a myriad of problems tend to militate against the production of this crop especially in the tropics. Some of these problems are weeds. Robinson (Robinson, 1996) mentioned that weeds are a major constraint in the production of this crop for subsistence farmers. In West Africa, weed growth is very prolific and lack of effective weed control is a key factor that reduces yield and this leads to overall yield decline. Currently, most researchers are particularly concerned with identifying management techniques that could reduce weed without paying any attention to the economics of such identified technique. Anderson (1996)

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reported that weeds in plantain can be controlled through mulching, use of herbicides and manually. According to Obiefuna (1989), it is also feasible to control weeds in plantain biologically using Egusi melon (*Colocynthis citrullus*).

Other limiting factor for plantain and banana production is the occurrence of pest and diseases pressure that reduces yield drastically by more than 30 to 50%. Plantain and banana are major sources of food in many regions throughout the world. Total world production of these crops is estimated to be over 76 million metric tonnes out of which, an estimated 12 million metric tonnes are produced in Africa annually. About 70 million people in the African sub-region are estimated to derive more than one quarter of their food energy requirements from plantain. Plantain is very critical in bridging the gap between the demand and supply of the basic carbohydrate staples. In Nigeria, plantain production is becoming a significant economic activity for income generation for both large scale and small holder farmers, especially for those who produce them within their home compounds or gardens. Plantain is one of the Primary Commodities for Investment across the south south zone in Nigeria, and it is known to be centre of plantain and banana diversification. There some yield reduction constraints such as pest and diseases, weed infestation that limits expansion, consequently, several studies have been conducted on plantain and banana production system and management practices that optimize yield. Obiefuna (1989) observed that intercropping plantain with 5000 melon seeds per hectare suppressed weed growth and significantly increased plantain yield. At 2500 melon seeds per hectare, weed control was inadequate and at 10,000 melon seeds per hectare, plantain yield declined due to direct competition with the melon vines. Swennen (1990) found mulching most efficient in weed control because a mulch layer impedes or prevent weed growth. Anderson (1996) recommended mulching as an efficient weed control technique and mentioned several other mulched materials that could be used as hay, manure, grass clippings, sawdust, wood chips, straw, rice hulls, paper and plastic films. Whereas, chemical weed control is known to be expensive and harmful, manual weeding was reported as damaging maize root systems (Thomas et al., 2004). Avarez De La Pena (1978) reported good control of different weed species with the use of Roundup (glyphosate) applied at the rate of 3-5 litres/ha for *Cyperus* or at the rate of 5-7 litres/ha for *Cynodon dactylon* in bananas without injury. Baiyeri et. al, (2004), also conducted a study that produce good results on some yield and phonological traits of Musa species under alley and sole cropping management system in Nigeria. Currently, most researchers' efforts are particularly concerned with identifying plantain and banana cultivar with high yield potential and disease resistant.

Plantain production as a business like every other enterprise is aimed at profit maximization by the farmer. There is therefore need to have a comparative understanding of the economic return on production investment of this crop. The aim of this study therefore, was to evaluate the yield of plantain and banana; their hybrids considering the bunch yield and other yield components.

MATERIALS AND METHODS

Thirty six (36) genotypes of plantain and banana hybrids were field established in two replication in a completely randomized design as previously described by Simmond and Shepherds (1955). Seedlings were planted in a 30cm x 30cm x 30cm hole in the onfarm trial of Kpite, near Onne in high rainfall humid agro ecological region of Rivers State, Nigeria, in July 2010. The coastal Onne site is geographically located at 4°51' N, 7° 03' E at 10 m above sea level (masl) and comprises an Ultisol derived from coastal sediments that is well drained but poor nutrient availability and high extractable phosphorous. This area is regarded as centre of plantain diversification. Data wascollected on 12 agro morphological and phenological traits, and were recorded at flowering and at harvest. Rainfalls pattern over the years have been bi-modal with peaks around May and September and spans from late March of each year to November (Obi and Salako, 1995). The field had been fallowed for five years before the commencement of the study. The vegetation is mainly of south-south and south-east derived – savanna with some relics of rainforest distributed in patches and regular sometimes on daily basis as common known of humid forest ecosystem (Jungerius, 1964). The annual rainfall total is 2,500mm per annum with an average daily temperature range variations between 20 and 35°C; and fluctuating with relatively constant radiation at ~5285 MJ/m^2/year.

Statistical Analysis

Data were subjected to Analysis Of Variance (ANOVA) statistical analysis using Statistical Analysis System (SAS), according to the procedure outlined for randomized complete block design (RCBD) using SAS 9.2 version (2009). SAS Institute Version 9.2. North Caro N.C. Detection of differences among treatment means for significance was done using descriptive statistics as described by Obi (2002).

RESULTS AND DISCUSSION

The analysis of variance for 12 agro morphological traits of yield and yield component (Table 1) were significant within genotype for all the traits measured DFL = = FRC at probability level (P = 0.001), and was significant within replication for days to flowering (DFL), days to harvest (DTH), plant height (PHT), and number of fingers (FIN), at probability level (P = 0.001) and significant for bunch weight and number of hands at probability level (P = 0.05). Consequently, days to fruit filling (DFF), total number of leaves (TNL), height of tallest sucker at flowering (HTSFL), fruit weight (FRWT), fruit length (FRL), and fruit circumference (FRC) were not statistically

Table 1. Mean square from analysis of variance of some yield and yield component of plantain and banana landraces and their hybrids

Source of variation	df	DFL	DFF	DTH	PHTFL	TNL	HTSFL	BWT	HND	FIN	FRWT	FRL	FRC
Gen	35	30762.3***	3884.4***	23107.3***	16280.5***	224.2***	83246.8***	253.0***	23.8***	10690***	0.0***	79.0***	22.3***
Rep	1	27969.1***	836.5	38479.3***	37880.7***	1.5	13.0	94.5*	4.9*	6991.6***	0.0	1.5	2.8
Gen x Rep	35	8114.9***	412.9	8643.9***	2166.5***	79.6***	6701.9***	46.4***	1.6***	690.8***	0.0	19.9***	3.3***
R^2		0.78	0.63	0.74	0.86	0.61	0.86	0.79	0.88	0.88	0.63	0.76	0.71
CV		9.8	13.8	7.3	7.2	22.3	16.7	23.7	9.6	15.1	41.3	14.1	9.6

DFL=days to flowering, DFF=days to fruit filling, DTH-days to harvest, PHTFL=plant height at flowering, TNL=total number of leaves, HTSFL=height of tallest sucker at flowering, BWT-bunch weight, HND=number of hands, FIN=number of fingers, FRWT=fruit weight, FRL=fruit length, FRC=fruit circumference. *, *** significant at P = 0.05, 0.01, 0.001. Values without asterisks are not significant.

significant within replication (Table 1). The interaction between genotype and replication was statistically significant for days to flowering (DFL), days to harvest (DTH), plant height (PHT), total number of leaves (TNL), height of tallest sucker at flowering (HTSFL), bunch weight (BWT), number of hands (HND), number of fingers (FIN), fruit length (FRL), and fruit circumference (FRC) at probability level (P = 0.001), but was not significant for days to fruit filling (DFF) and fruit weight (FRWT). The yield and component of yield of plantain and banana were statistically significant for some traits measured indicating the most important agro morphological variables that accommodate the yield component that contribute to yield potential. This result has revealed the most efficient methodological evidence for evaluating crop performance, and using the most efficient statistical tool to delineate cultivar and varietal selection for the best bet.

The correlation analysis between yield and yield components and some agro morphological traits: Table 2 showed: days to flowering (DFL), was significantly positively correlated with days to fruit filling (DFL), days to harvest (DTH), fruit weight (FRWT), fruit length (FRL), and fruit circumference (FRC), but negatively collated with the total number of leaves (TNL), height of tallest sucker at flowering (HTSFL), bunch weight (BWT) at probability level (P = 0.01). Days to fruit filling was significantly positively correlated with total number of leaves (TNL), height of tallest sucker at flowering (HTSFL) and significantly negatively correlated with plant height (PHT) and fruit length (FRL) at probability level (P = 0.01), days to harvest was negatively significantly correlated with total number of leaves (TNL), bunch weight (BWT), fruit weight (FRWT), fruit length (FRL) and fruit circumference (FRC) at probability level (P = 0.01). Plant height was significantly positively correlated with height of tallest sucker at flowering (HTSFL), bunch weight (BWT), number of hands (HND), number of fingers (FIN) and fruit circumference at probability level (P = 0.01). The total number of leaves was significantly positively correlated with height of tallest sucker at flowering (HTSFL), bunch weight (BWT) fruit weight (FRWT), fruit length (FRL) and fruit circumference (FRC) at probability level (P = 0.01). Height of tallest sucker at flowering (HTSFL) was significantly positively correlated with number of fingers (FIN), fruit length (FRL) and fruit circumference (FRC) at probability level (P = 0.01). Bunch weight was significantly positively correlated with the major components of yield that includes number of hands (HND), number of fingers (FIN), fruit weight (FRWT), fruit length (FRL) and fruit circumference (FRC) at probability level (P = 0.01), and the number of hands (HND) was significantly correlated with total number of fingers (FIN) at probability level (P = 0.01) but variable such as fruit weight (FRWT), fruit length (FRL) and fruit circumference (FRC) were not significant. Total number of fingers was significantly but negatively correlated with fruit weight (FRWT) and fruit length (FRL) at probability level (P = 0.01), and fruit was not significant. Fruit weight (FRWT) was significantly positively correlated with fruit length (FRL) and fruit circumference (FRC) at probability level (P = 0.01), while fruit length (FRL) was significantly positively correlated with fruit circumference (FRC). It is revealed from this result that the major variables contributing to yield were biologically related and the contributions of such correlated and related variables influence positively the performance of the other, hence, the variables that indicated negative correlation will definitely reduce the performance of the other and this largely depends on their attributes to the performance of the particular traits measured. For

Table 2. Correlation coefficient of some yield and yield components of plantain and banana genotypes and their hybrids

	DFL	DFF	DTH	PHTFL	TNL	HTSFL	BWT	HND	FIN	FRWT	FRL	FRC
DFL	-	-0.363**	0.926**	o.103	-0.536 **	-0.388**	-0.204**	0.049	0.020	-0.380**	-0.0314**	-0.249**
DFF			0.014	-0.153**	0.148**	0.428**	0.010	-0.110*	0.046	0.047	-0.215**	0.047
DTH				0.049	-0.515**	-0.244	-0.215**	0.008	0.040	-0.388**	-0.423**	-0.441**
PHTFL					0.090	0.334**	0.213**	0.295**	0.247**	-0.065	0.067	0.273**
TNL						0.254**	0.275**	-0.008	0.036	0.305**	0.371**	0.430**
HTSFL							0.003	0.038	0.149**	-0.031	-0.191**	0.214**
BWT								0.585**	0.628**	0.320**	0.502**	0.547**
HND									0.871**	-0.108	-0.071	-0.031
FIN										-0.190**	-0.157**	-0.093
FRWT											0.567**	0.536**
FRL												0.693**
FRC												-

DFL=days to flowering, DFF=days to fruit filling, DTH-days to harvest, PHTFL=plant height at flowering, TNL=total number of leaves, HTSFL=height of tallest sucker at flowering, BWT-bunch weight, HND=number of hands, FIN=number of fingers, FRWT=fruit weight, FRL=fruit length, FRC=fruit circumference. *, ** Significant at P = 0.05, 0.01. Values without asterisks are not significant.

example, the bunch weight was significantly positively correlated with all the yield components. This study has confirmed the previous studies that total number of hands, number of fingers, fruit weight, fruit length and fruit circumference are the major contributing factors to yield. Days to flowering, days to fruit filling and days to harvest are also phenological determinants of yield including plant height at flowering which is almost the time for plant to use all the growth traits to manufacture their food especially during photosynthesis. Also, the height of the tallest sucker at flowering determines the fast rationing of this plant to become a mother plant after first circle harvest. The results of the mean procedures showed that there were differences in yield between the genotypes, genotype by replication and within replication. It is evident in this study that the hybrids recorded the highest bunch yield (kg) than the landraces (Table 3). Among the plantain and banana hybrids, FHIA 21 has the highest bunch yield (26.03kg), SH 3436-9 has the bunch yield (25.98kg), followed by SH 3640 (23.45kg), FHIA 23 (22.17kg), and FHIA 1 (21.28kg) respectively. The yields in the landraces were lower compared to that of the hybrids. Some of the landraces (Agbagba) weighed 10. 40kg, while (UNN DB), weighed 10.06 kg, and another landrace (Saba), recorded the highest (17.10kg) among the landraces in this study (Table 3). Adoption of high yielding varieties of plantain and banana is a better option for farmers that produce plantain and banana as a venture for income generation and profit making and for home consumption. In plantain and banana, the weight (yield in kg) of a bunch is determined by the total number of hands and fingers produced per bunch, therefore, the weight in kilograms is a function of the total number of hands and fingers produced per bunch as the bunches with higher number of hands and fingers increases the weight. IITA (1981) reported a yield increase of about 400% of a well managed plantain plot over that of unmanaged plot, therefore, management of plantain and banana field is a prerequisite for increase in yield. This results have confirmed the previous report of (Dzomeku et al., 2006, 2007a, b) that indicate the potential of this hybrid 'FHIA 21' and in Africa, testing of hybrids and new cultivar is still ongoing and although some results are available (Dzomeku et al., 2006, 2007a, b). This result will be of major impact on plantain production in Nigeria if there is increase in awareness and adoption of these hybrids.

The statistical model explained the coefficient of determination (R2) that fits the yield and component of yield at different regression level. Among the trait measured (Table 3), three important yield component including fruit weight (FRWT) had the highest coefficient of variation (41.3%), bunch weight (BWT) had coefficient of variation (23.7%) and total number of leaves

Table 3. Descriptive statistics of plantain and banana landraces and hybrids

Genotypes	Grouping	No. of observation	Yield (kg)	Standard deviation	Standard error	Variance	Coefficient of variation
1112-1	hybrid	7	10.14	2.25	0.85	5.06	22.18
1378	hybrid	10	13.62	3.03	0.96	9.19	22.25
15108-6	hybrid	10	20.07	5.34	1.69	28.51	26.60
1658-4	hybrid	8	16.49	2.52	0.89	12.50	15.28
2637-49	hybrid	9	5.13	2.65	0.88	7.03	51.63
2796-5	hybrid	10	14.02	3.67	1.16	13.49	26.20
5295-1	hybrid	10	9.26	5.91	1.87	34.96	63.85
548-4	hybrid	9	11.28	3.51	1.17	12.32	31.12
548-9	hybrid	9	11.08	5.9	1.90	35.90	35.11
5511-2	hybrid	9	12.22	3.81	1.24	14.51	31.16
612-74	hybrid	10	9.06	1.14	0.36	1.29	12.54
6930-1	hybrid	10	7.43	2.70	0.85	7.30	36.37
7002-1	hybrid	3	10.87	2.48	1.43	6.17	22.86
7152-2	hybrid	6	8.47	3.26	1.33	10.04	38.52
Agbagba	landrace	9	10.40	4.01	1.34	16.05	38.52
Blueggoe	landrace	10	15.42	2.49	0.79	6.24	16.19
Cardaba	landrace	10	16.66	2.83	0.89	8.01	16.99
EMB 402	hybrid	9	7.60	3.69	1.23	13.60	48.51
EMB 403	hybrid	9	6.29	2.60	0.87	6.77	41.39
EMB 602	hybrid	6	9.18	1.35	0.55	1.82	14.69
FHIA 1	hybrid	10	21.28	2.84	0.89	8.06	13.34
FHIA 2	hybrid	9	16.87	3.73	1.24	13.90	22.10
FHIA 21	hybrid	8	26.03	6.34	2.24	2.20	39.59
FHIA 22	hybrid	6	18.85	5.63	2.31	31.94	29.99
FHIA 23	hybrid	9	22.17	9.63	3.21	92.78	43.45
FHIA 3	hybrid	10	18.95	5.10	1.61	26.06	26.94
Fouganou	landrace	9	16.22	4.80	1.60	23.09	29.62
K M 5	landrace	10	6.91	2.49	0.79	6.19	36.03
Obinol'Lewai	landrace	9	8.44	0.98	0.33	0.97	11.63
Pelipiter	landrace	10	15.34	1.92	0.61	3.70	12.55
Pisang cylan	landrace	9	18.33	5.66	1.89	32.08	30.86
SH 3436-9 sv	hybrid	8	25.98	2.48	0.88	22.70	9.55
SH 3640	hybrid	10	23.45	3.21	1.02	10.33	13.71
Saba	landrace	10	17.10	2.37	0.75	5.63	13.89
UNN DB	landrace	10	10.06	1.76	0.56	3.09	17.48
Valery	landrace	9	8.61	2.83	0.95	8.05	32.94

(TNL), had CV (22.3%).

Conclusion

With the rising population pressure in the urban areas and devastating effect of pest and diseases attack on the local cultivar, thereby reducing plantain and banana yield and consequently makes the demands and prize of these crops to be high. These crops is an important staple food for rural and urban people consumption, therefore, to obtain higher bunch yield of these crop in the humid agro ecological center of plantain and banana diversification, the use of improved cultivar as planting materials is a prerequisite to sustain higher yield. The improved cultivar from this study hence adjudged the best as compared to the landraces and therefore stands the best crop production option.

REFERENCES

Anderson PW (1996). Weed Science Principles and Applications. 3rd Edition. West Publishing Company.

Minneapolis 1st Paul, New York. p. 685.
Avarez De La Pana FI (1978). Herbicides in banana plantains. Proceedings of the Mediterranean Herbicide Symposium. Madrid, Spain. 2: 263- 270.
Baiyeri KP, Tenkouano A, Mba BN, Mbagwu JSK (2004). Phenological and yield evaluation of Musa genotypes under alley and sole cropping systems in Southeastern Nigeria. Tropical and Subtropical Agroecosystem, 4(3): 137-144.
Dzomeku BD, Armo-Annor D, Adjei-Gwen K, Nkakwa A, Akyeampong E, Banning IS (2006). Evaluation of four Musa hybrids in Ghana. Trop. Sc., 43:176–179.
Dzomeku BM, Bam RK, Adu-kwarteng E, Darkey SK, Ankomah AA (2007a). Agronomic and physico-chemical evaluation of FHIA 21 in Ghana. Int. J. Agric. Res., 2:92–96.
Dzomeku BM, Darkey SK, Bam RK, Ankomah AA (2007b). Sensory evaluation of four FHIA tetraploid hybrids for kaakle (a local dish) in Ghana. J. Plant Sc., 2:640–643.
FAOSTAT (2010). Food and Agricultural Organisation of the United Nations. pp. 28-30.
IITA (1981), International Institute of Tropical Agriculture. Annual Report for 1980. Ibadan Nigeria. pp. 44-48.
INIBAP (1992). International network for the improvement of banana and plantain. Annual Report. 1992. Montpellier. France. p. 48.
Jungerius PD (1964). The soils of eastern Nigeria. Publication Service Géologique de Luxemburg, 14: 185-196.
Obi IU (2002). Statistical methods of detecting differences between treatment means and research methodology issues in laboratory and field experiments. AP Express Publishers Ltd., Nsukka, Nigeria.
Obi ME, Salako FK (1995). Rainfall parameters influencing erosivity in Southeastern Nigeria. CATENA, 24: 275-328.
Obiefuna JC (1989). Biological weed control in plantains (*Musa AAB*) with Egusi-melon (*Colocynthis citrullus*). Biological Agriculture and Horticulture, 6: 221-227.
Robinson JC (1996). Bananas and plantains. CAB International, UK. p. 238.
SAS (2009). SAS Institute Version 9.2. North Caro N.C.
Swennen R (1990). Plantain cultivation under West African conditions. A Reference Manual IITA Ibadan, Nigeria, pp.1-18.
Swennen R, Wilson GF (1983). Response of plantain to mulch and fertilizer. Int. Inst. Trop. Agric. Annual Rep. IITA Ibadan, Nigeria p.187.
Thomas WE, Burke IC, Wilout JW (2004). Weed management in glyphosate-resistant maize with glyphosate and halosulfuron. Weed Technology, 18(4): 1049-1057.