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Full Length Research Paper

Comparative performance of improved white yam (*Dioscorea rotundata*) genotypes in the rainforest belt of South-west Nigeria

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Five *Dioscorea rotundata* genotypes were evaluated alongside a popular cultivar in the locality for yield and yield components and incidence and severity of major diseases of yam in 2005 and 2006 at the Orin Ekiti out-station research farm of the Institute of Agricultural Research and Training (IAR&T), Moor Plantation Ibadan, Nigeria. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Results indicated significant effects of genotype on most of the traits studied. There were significant differences among the yam genotypes for percentage establishment count at 4 weeks after planting (WAP), but there were no significant differences among the yam genotypes at 8 WAP. There were no significant differences among the yam genotypes for crop vigour at 8 and 12 WAP. There were no significant differences among the genotypes for number of stand per plot at harvest. There were significant differences among the genotypes for number of ware tubers harvested per plot and number of seed tubers harvested per plot. The highest number of ware tubers per plot in 2005 and 2006 were recorded for TDr 95/18922. Local genotype; Abi gave the least values for the number of ware tubers per plot. There were significant differences among the yam genotypes for yield of ware tubers (above 1 kg), yield of seed tubers (below 1 kg) and yield of total fresh tubers in 2005 and 2006. The highest yield of ware tubers were recorded for the genotype TDr 89/02157. Also, TDr 89/02157 gave the highest total fresh tuber yield in 2005 and 2006. The least total fresh tuber yield were recorded for the local yam genotype; Abi in 2005 and 2006.

Keywords: *Dioscorea rotundata*, genotypes, rainforest, comparative performance, yield components.

INTRODUCTION

Yam (*Dioscorea spp.*) is widely cultivated in tropical regions. Nigeria produces 16 MT of yam tubers (68% of world yam production), at 10.7 t/ha. This accounts for about 75% of Africa's yam production (Degras, 1993). Yam tubers are usually consumed in the forms of chunks, flour, fufu, and slices resulting from any of the processes of boiling, drying, fermentation, frying, milling, pounding, roasting, and steaming (Achi, 1991; Degras, 1993; Ige and Akintunde, 1981; Iwuoha, 1999). Yams, which supply up to 4956 KJ of energy per kg of tuber, form primarily staple food in Nigeria and account for 50% of daily carbohydrate intake of people in the yam zone of West Africa (Ige and Akintunde, 1981; Okonkwo, 1995).

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Therefore, every effort should be geared towards the improvement of yam. The principal objectives of this should include high and stable yield of marketable tubers as well as plant morphology for reduced labour use in yam-based production systems (IITA, 2009).

The ultimate aim of the plant breeder is the development of and release for production, improved crop varieties. This is achieved when the improved varieties are acceptable to the consumers. Over time, plant breeding programmes mostly focused on high yielding cultivars, but recently, stable and sustainable yields under various environmental conditions have consistently gained importance over only increased yield. The development of cultivars, which are adapted to a wide range of diversified environments, is the ultimate aim of plant breeders in a crop improvement programme (Alghamdi, 2004). Genotype x environment (G X E) inte-

Table 1. Mean values of growth parameters of white yam varieties in Orin Ekiti.

Varieties	% Establishment 4 WAP		% Establishment 8 WAP		Crop vigor 8WAP		Crop vigor 12WAP	
	2005	2006	2005	2006	2005	2006	2005	2006
TDr 89/02157	78.4ab	57.6ab	98.4a	96.1a	4	4	4	5
TDr 95/18988	70.0b	51.1b	94.4a	92.3a	4	4	4	4
TDr/ 95/18922	95.0a	72.6a	96.7a	96.4a	4	4	4	5
TDr 95/19177	55.0bc	67.3b	100.0a	97.4a	4	4	4	3
TDr 98/18949	85.7a	67.3a	100.0a	96.1a	4	4	4	5
ABI (Local)	63.4b	51.1b	96.4a	97.3a	4	4	4	5

Means in the same row with different superscripts differ significantly (P<0.05)
NB: Crop vigor 1= weak 5= very vigorous

ractions is an important issue to agronomists, who transfer a new variety from one environment to another. A variety is considered to be more stable if it has a high mean yield but a low degree of fluctuation in yielding ability when planted over diverse environments (Dhillion et al., 2009; Gurmu et al., 2009). The ranking of the variety depends on the particular environmental conditions in which it is grown. The environment is widely indicated as all non-genetic factors that influence expression of characteristics. According to Basford and Cooper (1998), it should include water, nutrition, temperature, and disease that influence the growth of plants and therefore influence the expression of characteristics.

In view of the issues raised above, this study examines the comparative performance of some improved white yam varieties with relation to some agronomic characteristics investigated in one of the yam zones of South west Nigeria.

MATERIALS AND METHODS

The experiment was conducted in the 2005 and 2006 cropping seasons at Orin Ekiti (Lat. 7 83'N, Long. 5 23'E) southwest Nigeria. Orin Ekiti is one of the out-station research farms of the Institute of Agricultural Research and Training (IAR&T), Moor Plantation Ibadan, Nigeria. Orin Ekiti is in the rainforest agro ecological zone of Southwest Nigeria and it falls within the yam zone of West Africa.

Five improved white yam varieties were collected from the International Institute of Tropical Agriculture (IITA), Ibadan Nigeria. In the Institute, there was development of genotypes which were subjected to, first, advanced generation tests and second, the elite genotypes trials. Highly performing genotypes identified from these on-station tests were then finally evaluated in the multilocational yam varieties trials across yam zones of Nigeria. Orin Ekiti was chosen as one of the trial locations. The improved white yam varieties evaluated at Orin Ekiti are TDr 89/02157, TDr 95/18988, TDr 95/18922, TDr 95/19177, and TDr 98/18949. The local variety used as control was Abi; which was the local best among the yam farmers in Orin Ekiti.

The experiment was laid out in a completely randomized block design with three replications of 4 by 5m plot size. The site was ploughed and harrowed, and the plots were laid out according to the design of the experiment. Heaping was done manually at the spacing of 1m apart and planting of 250 g setts was done by the month of April in both the experimentation years. Plots were weeded three times; at 1, 3 and 6 months after planting (MAP) manually during the experimentation period and staking was carried out as required. NPK (15-15-15) fertilizer was applied to all the plots at the rate of 400kg/ha at 2 MAP. Harvesting was done at 9 MAP; the necessary agronomic data on growth and yield were collected. Also, data on disease incidence and severity were collected. The data collected on growth parameters include percentage establishment count at 4 and 8 weeks after planting (WAP) and crop vigour at 8 and 12 WAP. The data collected on yield parameters are number of ware tubers harvested per plot (tubers above 1 kg weight), number of seed tubers harvested per plot (tubers below 1 kg weight), yield of tubers below 1 kg, yield of tubers above 1 kg, total yield of fresh tubers. Data were collected on pests and diseases incidence and severity. The data collected were subjected to statistical analysis for the analysis of variance (ANOVA). Means were compared using Duncan's Multiple Range Test at 0.05 level of probability when F-ratio was significant.

RESULTS AND DISCUSSION

Table 1 shows the mean values of growth parameters of white yam genotypes evaluated at Orin Ekiti in 2005 and 2006. There were significant differences among the yam genotypes for percentage establishment count at 4 weeks after planting (WAP), but there were no significant differences among the yam genotypes at 8 WAP. There were no significant differences among the yam genotypes for crop vigour at 8 and 12 WAP. Improved yam genotype TDr 95/18922 gave the highest percentage establishment count (95 and 72.8 %) at 4 WAP in 2005 and 2006 respectively; its performance was not significantly different from TDr 98/18949. This implies that, among the yam genotypes evaluated, TDr 95/18922 had early sprouting ability. However, at 4 WAP Improved genotype TDr 95/19177 recorded the least values for percentage establishment count in both years; these were lower than the values recorded for the local genotype; Abi.

The means of yield parameters of white yam genotypes evaluated at Orin Ekiti in 2005 and 2006 are presented in Table 2. There were no significant differences among the genotypes for number of stand per plot at harvest. There were significant differences among the genotypes for number of ware tubers harvested per plot and number of seed tubers harvested per plot. The highest number of ware tubers per plot in 2005 and 2006 were recorded for TDr 95/18922. These values were not significantly different from the values recorded for genotype TDr 89/02157 and 98/18949. Local genotype; Abi gave the least values for the number of ware tubers per plot. In 2005 and 2006, among the improved genotypes, TDr 95/19177 gave the highest values for number of seed tubers. The local yam variety; Abi recorded the highest number of seed tubers per plot compared to improved yam genotypes.

There were significant differences among the yam genotypes for yield of ware tubers (above 1 kg), yield of seed tubers (below 1 kg) and yield of total fresh tubers in 2005 and 2006. The highest yield of ware tubers 10.54 and 17.41 t/ha in 2005 and 2006 respectively were recorded for the genotype TDr 89/02157. These values were not significantly different from the values obtained for TDr 95/18922 and 98/18949 in 2005 and 2006. In presenting the results of weight of ware tubers in percentage basis, TDr 95/18922 gave the highest weight of ware tubers 83.7 and 86.5% of total fresh tubers in 2005 and 2006 respectively. This is closely followed by TDr 98/18949 that recorded 81.6 and 85.9% and TDr 89/02157 which recorded 79.8 and 83.6% in 2005 and 2006 respectively. Among the improved yam genotypes, the least yield values 6.31 and 12.47 t/ha (61.2 and 61.8%) in 2005 and 2006 respectively for ware tubers were recorded for the genotype TDr 95/19177. However, in general, the local yam genotype; Abi gave the lowest ware tuber yield; 3.65 and 7.31 t/ha (35.4 and 46.3%) in 2005 and 2006 respectively.

The highest yield for seed tubers; 6.67 and 8.51 t/ha (64.6 and 53.7%) in 2005 and 2006 respectively were recorded for the local genotype; Abi. Among the improved genotypes, TDr 95/19177 gave the highest values 4.0 and 7.7 t/ha (38.8 and 38.2%) 2005 and 2006 respectively. TDr 89/02157 gave the highest total fresh tuber yield (13.21 and 20.83 t/ha) in 2005 and 2006 respectively. The least total fresh tuber yield (10.32 and 15.82 t/ha) were recorded for the local yam genotype; Abi in 2005 and 2006 respectively.

Both the improved and local yam genotypes recorded low scores for incidence and severity against major diseases of yam (Tables 4, 5 and 6). It has been suggested that, the identification of host resistance as the most reliable method for managing viral diseases (Thottappilly, 1992), as well as the high cost of acquiring agrochemicals and the increasing concern to minimize its use have increased the interest in varietal resistance to anthracnose and virus diseases of yam (Odu *et al.,* 2004; Onyeka et al., 2006). Generally, performances of yam genotypes varied from one location to another, but the consistently low levels of leaf spot, anthracnose and virus disease symptoms on the yam varieties evaluated in 2005 and 2006 at Orin Ekiti suggest relatively stable resistance to the diseases. This also agrees with Egesi et al. (2007) who found that the genotype component for virus resistance was most important. This finding lends credence to the earlier assertion of Thottappilly (1992) that host plant resistance is the most effective means of controlling virus diseases of yams. The same yam genotypes observed to be resistant to leaf spot were equally resistant to the anthracnose and virus diseases. These have good implications for multiple disease resistance breeding as the different genes controlling these traits could be pyramided into a single genotype.

The implications of these findings could be summarized as thus: The difference in the yield performance of the genotypes in the two cropping seasons was attributed to the level of adaptability of the genotypes to different prevailing biotic and abiotic factors. There is a strong indication that selecting genotypes based on mean yield of one cropping season alone would be inappropriate. Improved genotypes performed better than the local genotype showing that the improved genotypes were relatively stabled in their yield performance in Orin Ekiti; the representative of high rainforest agro-ecological zone of south west Nigeria. This is expected because hybrids have been known to perform better than their unimproved counterparts. According to Obi (1991), hybrids are products of two or more parents of good agronomic characteristics and in most cases should perform better than either of their parents. The ability of some genotypes, especially TDr 95/19177 to consistently seed tubers profusely in 2005 and 2006 indicates their potential value to commercial seed production. This characteristics would ensure availability of planting materials and would reduce cost of materials for field production on per hectare bases as suggested by Okoli and Akoroda (1995) and Orkwor and Asadu (1998). In addition, low set multiplication ratio of yam and dormancy impede breeding and selection programmes. For example, it will take several generations and seasons to obtain enough planting

Table 2. Mean values of yield parameters of white yam varieties in Orin Ekiti.

Varieties	Number of stand per plot at harvest		Number of ware tubers harvested per plot		Number of seed tubers harvested per plot		Yield of ware tubers above 1kg (t/ha)		Yield of seed yams below 1kg (t/ha)		Total fresh tuber yield (t/ha)	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
TDr 89/02157	19.67a	19.21a	16.67a	17.52a	3.67c	4.52d	10.54a	17.41a	2.67c	3.42d	13.21a	20.83a
TDr 95/18988	19.67a	18.45a	14.00b	14.21b	5.00b	6.21c	8.05b	14.00b	4.00b	5.4 1c	12.05b	19.41a
TDr/ 95/18922	19.33a	19.28a	16.00a	16.56a	3.00cd	3.56d	10.24a	16.24a	2.00d	2.54d	12.24ab	18.78b
TDr 95/19177	20.00a	19.47a	12.20bc	12.41c	6.00ab	8.41b	6.31bc	12.47c	4.00b	7.71b	10.31b	20.18a
TDr 98/18949	20.00a	19.21a	16.33a	16.45a	3.33c	3.45d	10.31a	16.24a	2.33c	2.65d	12.64a	18.89ab
ABI (Local)	19.67a	19.45a	13.67b	10.21d	7.67a	10.21a	3.65d	7.31d	6.67a	8.51a	10.32c	15.82c

Means in the same row with different superscripts differ significantly ($P<0.05$)

Table 3. Incidence and severity of anthracnose disease on white yam varieties in Orin Ekiti

Varieties	Incidence of anthracnose 2 MAP (%/plot)		Incidence of anthracnose 4 MAP (%/plot)		Incidence of anthracnose 6 MAP (%/plot)		Severity of anthracnose 2 MAP		Severity of anthracnose 4 MAP		Severity of anthracnose 6 MAP	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
TDr 89/02157	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr 95/18988	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr/ 95/18922	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr 95/19177	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr 98/18949	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
ABI (Local)	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1

NB: Severity 1 = No Symptom 5 = Very severe

Table 4. Incidence and severity of leaf spot disease on white yam varieties in Orin Ekiti

Varieties	Incidence of leaf spot 2MAP (%/plot)		Incidence of leaf spot 4 MAP (%/plot)		Incidence of leaf spot 6MAP (%/plot)		Severity of leaf spot 2 MAP		Severity of leaf spot 4 MAP		Severity of leaf spot 6 MAP	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
TDr 89/02157	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr 95/18988	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr/ 95/18922	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr 95/19177	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr 98/18949	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
ABI (Local)	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1

NB: Severity 1 = No Symptom 5 = Very severe

Table 5. Incidence and severity of leaf blight disease on white yam varieties in Orin Ekiti

Varieties	Incidence of leaf spot 2 MAP (%/plot)		Incidence of leaf spot 4 MAP (%/plot)		Incidence of leaf spot 6 MAP (%/plot)		Severity of leaf spot 2 MAP		Severity of leaf spot 4 MAP		Severity of leaf spot 6 MAP	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
TDr 89/02157	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr 95/18988	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr/ 95/18922	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr 95/19177	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr 98/18949	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
ABI (Local)	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1

NB: Severity 1 = No Symptom 5 = Very severe

Table 6. Incidence and severity of virus disease on white yam varieties in Orin Ekiti

Varieties	Incidence of virus 2 MAP (%/) plot)		Incidence of virus 4 MAP (%/plot)		Incidence of virus 6 MAP (%/plot)		Severity of virus 2 MAP		Severity of virus 4 MAP		Severity of virus 6 MAP	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
TDr 89/02157	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr 95/18988	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr/ 95/18922	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr 95/19177	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
TDr 98/18949	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1
ABI (Local)	0.00	0.00	0.00	0.00	0.00	0.00	1	1	1	1	1	1

NB: Severity 1 = No Symptom 5 = Very severe

materials to evaluate a few clones of yam (Okoli and Akoroda, 1995).

Based on this reported two-year evaluation, among the improved yam genotypes, TDr 89/02157, 95/18922 and 98/18949 consistently gave highest ware tubers yield and total fresh tubers yield. Performances of these genotypes evaluated in 2005 and 2006 at Orin Ekiti suggest relatively stable yield performance and resistance to the diseases. Generally, farmers would prefer to use a high yielding genotype that performs consistently across different years and environments (Kang et al., 1991; Kang, 1993).

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