EVALUATION OF TWELVE CASSAVA GENOTYPES IN DERIVED GUINEA SAVANNA AGROECOLOGICAL ZONES OF NIGERIA

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ABSTRACT

Cultivar adaptability trials were conducted for two years in two different locations of derived guinea savanna agroecological zones of Nigeria, Ibadan (07' 22°E, 03' 55°N, temperature 27°C, relative humidity:60-80%, rainfall: 1308 mm), and Ilorin (08' 30°E, 04' 46°N, temperature 28°C, relative humidity 60-80%, rainfall 1050 mm) using 12 cassava genotypes. Data collected included number of tuberous root yield, shoot weight and harvest index. The results showed significant differences ($P < 0.05$) in cassava genotype performance among the environments (Ilorin, 1992/93; Ilorin 1993/94; Ibadan, 1992/93, Ibadan, 1992/93, Ibadan, 1993/94) for number of tuberous roots, shoot weight, fresh tuberous yield and harvest index. Cassava genotypes grown at Ilorin, 1993/94 had the highest mean values for the number of tuberous roots, fresh tuberous root yield, shoot weight and harvest index at 12 months after planting. Genotypic differences were observed across locations and years for tuberous root number, fresh cassava tuberous root yield shoot weight and harvest index. In across locations and years, TMS 30572, TMS 81/01635, TMS 82/00058 and TMS81/00110 had the highest mean values for total tuberous root number, shoot weight, fresh tuberous root yields and harvest index respectively. In Ibadan, TMS 82/00058 and TMS 91934 had the highest values for parameter measured whereas in Ilorin, TMS 30572, TMS 82/00058, TMS 81/01635 and TMS 81/00110 performed better than other genotypes tested. Stability analyses were carried out on fresh tuberous root yield. When all the rank sums were summed for each genotype used as a parameter for stability, the result showed that for tuberous root yield, TMS 82/00942, TMS 82/00058 and TMS 30572 could be the most stable genotypes for the derived guinea savanna ecology. TMS 30572 has been widely adopted in some parts of these areas. TMS 82/00942 and TMS 82/00058 are new genotypes which are promising for distribution to farmers in derived guinea savanna ecology.

1.0 INTRODUCTION

Cassava is an important crop in Africa because of its diverse uses and relatively high productivity under conditions in which many other crops may fail (Cock, 1985; Carter *et al.*, 1992; Dixon *et al.*, 1994). Genotype x Environment Interaction (GEI) is the change in relative performance of cultivars over environment, resulting from the differential response of the genotypes to various edaphic, climatic and biotic factors (Dixon *et al.*, 1994). When G X E Interactions are present, the breeder faces the problem of selecting genotypes for performance, since the interaction reduces the correlation between genotype and phenotype, thus resulting in weak inferences to be made from field data (Ngeve, 1994).

Desert encroachment into the zone is going at a fast rate, causing many rainforest zones to become derived guinea savanna zones (Carter *et al*, 1992). The derived guinea savanna regions are undergoing drastic changes in environmental factors, especially rainfall, which has reduced drastically. The annual rainfall is between 1000 mm and 1500 mm (Carter *et al*, 1992). There is need to screen for cassava cultivars that are high yielding and that can be recommended for the farmers in derived guinea savanna areas. In order to stabilise cassava yields, special emphasis has been placed on the attainment of high-yielding genotypes across differing environments by plant breeders, aimed at wider adaptation (Dixon *et al*, 1994; Otoo *et al*, 1994). Extensive regional testing is generally considered necessary for assessing adaptability lines, and for gaining additional information on the incidence of biotic and abiotic stresses in a given region. Developing cultivars specifically adapted to different ecological conditions would simultaneously enhance the efficiency of breeding programmes and genetic diversity of crops (Dixon *et al*, 1994; Annicchiarico and Mariani, 1996).

The information on yield is necessary for predicting adaptability and yield stability of materials in a target region. Stability analyses developed and mainly applied to other crops (Becker and Leon, 1988; Annicchiarico and Mariani, 1996) can be used for cassava crops. Various statistical methods have been proposed to identify stable genotypes (Breese, 1969; Otoo *et al.*, 1994). Plant breeders look for genotypes which are both high yielding and vary a little over a target region. Thus, the objective of this study is to evaluate twelve IITA improved cassava genotypes for their adaptation to derived guinea savanna ecology.

2.0 MATERIALS AND METHODS

2.1 Experimental Sites

This study used data collected as part of breeding programmes aimed at identifying cassava genotypes that are stable yielding in mangrove swamp forest of Nigeria. Twelve improved IITA genotypes [TMS 30572, TMS 82/00058, TMS 91934, TMS 81/01635, TMS 81/00110, TMS 50395, TMS 82/00942, TMS 82/00661, TMS 30555, TMS 82/00959, TMS 90059 and TMS 4(2) 1425] were grown in two locations, Ibadan (07'22°E, 03' 55° N, temperature 27°C, relative humidity: 60-80%, rainfall: 1308mm), and Ilorin (08' 30° E, 04' 46° N, temperature: 28° C, relative humidity: 60-80% rainfall 1,050 mm) in Nigeria, from 1992 to 1996. The genotypes were grown under rainfed conditions at these locations. These sites were considered to adequately represent the main cassava growing areas of derived guinea savanna zones of Nigeria (Nweke, 1996).

Experimental areas were cleared, ploughed, harrowed and ridged with a tractor. The experimental design used at each location was the randomised complete block designed with four replications. Each plot had 6 rows, 10 m long. Spacing was 1 m between rows and 0.8 m within row. Each plot contained 72 plants. The stem cuttings, each 30 cm long and having at least four nodes, were used as planting material. At 12 months after planting, harvesting was done by hand, stems were cut and tuberous roots uprooted from the soil. The tuberous roots were counted. The plant was separated into tuberous roots and shoots. The fresh weights were determined.

2.2 Statistical Analyses

All analyses were conducted by SAS computer software (SAS Institute, 1996). An analysis of variance (ANOVA) including the factors 'genotype', 'location' and 'year' were performed for number of tuberous roots per hectare and fresh tuberous root yield. Stability assessment of the genotype was carried out using four stability methods, Finlay and Wilkinson (1963); Wrickle (1964); Shulka (1972), and Pinkins and Jinks (1968). All ranks were summed for each genotype and used as a parameter for stability.

3.0 RESULTS AND DISCUSSION

Combined analyses of variance for total number of tuberous roots per hectare, fresh tuberous root yield, shoot weight and harvest index showed significant ($P < 0.01$) mean squares for genotypes, environments and G x E Interaction. The results showed significant differences among the environments (Ilorin, 1992/93; Ilorin, 1993/94; Ibadan, 1992/93 and Ibadan, 1993/94) for number of tuberous roots: shoot weight, fresh tuberous root yield and harvest index (Figure 1). The cassava grown at Ilorin, 1993/94 had the highest mean values for the total number of tuberous roots per hectare, fresh tuberous root yield, shoot weight and harvest index at 12 months after planting. The differences in environmental effects demonstrated that genotypes responded differently to variation in environmental conditions. This justifies specific adaptation as a goal for local breeding programmes. Similar results have been reported on cassava genotypes (Cock, 1985; Akparobi *et al.*, 2002) who reported that environmental factors such as temperature, rainfall, solar radiation and soil conditions have strong influences on the physiological processes of a cassava plant and, ultimately, its yield. Bueno (1986) and Ekanayake *et al.* (1997) reported that environment influenced fresh root yield. There is need to identify these environments and recommend them to cassava growers in derived guinea savanna ecology.

Genotype differences were observed across locations and years for tuberous root number, fresh cassava tuberous root yield, shoot weight and harvest index (Table 1). In across locations and years, TMS 30572, TMS 81/01635, TMS 82/00058 and TMS 81/00110 had the highest mean values for total tuberous root number, shoot weight, fresh tuberous root yields and harvest index respectively (Table 1). In Ibadan, TMS 82/00058 and TMS 91934 had the highest values for parameter measured whereas in Ilorin, TMS 30572, TMS 82/00058, TMS 81/01635 and TMS 81/00110 performed better than other genotypes tested (Tables 2 and 3). These results indicated that genotypic differences occurred in cassava and some genotypes are high yielding across different locations and years. This result is in agreement with the finding of Otoo *et al.*, (1994); Ngeve, (1994); Dixon *et al.*, (1994) and Akparobi *et al.* (2002) who reported genotypic differences among cassava. The results of this work have identified some cassava genotypes for cassava growers in derived guinea savanna ecology such as TMS 30572, TMS 81/01635, TMS 82/00058 and TMS 81/00110.

The fresh tuberous root yield was used in the stability analyses (Table 4). The mean yields of fresh tuberous root yield, stability parameters and the rank sums of the genotypes in the two locations are shown in Table 4. According to Westcott (1986), in assessing stability, simple comparing regression slopes was not enough, overall yield level of a genotype also had to be taken into account. The mean yields from 23 to 34 Mg/ha among the genotypes were recorded across environments. TMS 82/00058 out-yielded all other genotypes evaluated (Table 4). Finlay and Wilkinson's b-value rated TMS 82/0058, TMS/00942 and TMS 30572 as stable for fresh tuberous root yield. The Perkins and Jink's (1968) ß parameter gave similar rankings as Finlay and Wilkinson's b-value. The procedure judged TMS82/00058, TMS 81/00110 and TMS 30572 to be stable (Table 4).

The stability 'ecovalence' proposed by Wrinkle (1964) was also computed for fresh tuberous root yield. Four genotypes (TMS 82/00058, TMS 82/00942, TMS 50395 and TMS 30572) were judged to be stable because a genotype with a large ecovalence valued indicated low stability (Table 4). The stability variances proposed by Shulka (1972) were also computed for fresh tuberous root yield. TMS 82/00942, TMS 50395 and TMS 30572 were rated to be stable, since their stability variances were not significantly different from the within-environment variance (Table 4).

The rank sums for mean fresh tuberous root yields per hectare and various combinations of stability parameters indicated that TMS 82/00942, TMS 82/00058 and TMS 30572 were judged to satisfy the criteria for high yield and stability based on their rank sums (Table 4). Hence, this study shows that high yielding genotypes may necessarily be yield stable and stable genotypes may be high yielding.

This result suggests that for determining yield stability in cassava, statistical methods could be an aid in selecting stable and superior genotypes, and also in identifying genotypes which might be used as parents in future cassava breeding programmes for derived guinea savanna ecology. Other workers (Kang and Miller, 1984; Bacusmo *et al*, 1988; Ngeve, 1994) have compared stability methods to determine their usefulness for their particular applications. They found some of the methods highly correlated, judging similar genotypes as stable.

When all the rank sums were summed for each genotype and used as a parameter for stability, the result showed that for fresh tuberous root yield, TMS 82/00942, TMS 82/00058 and TMS 30572 could be the most stable genotypes for the derived guinea savanna ecology.

ACKNOWLEDGEMENTS

This study was funded by the core budget of IITA (International Institute of Tropical Agriculture). Author acknowledges the assistance of Dixon, A. G. O. and Ekanayake, I. J. during the data collection.

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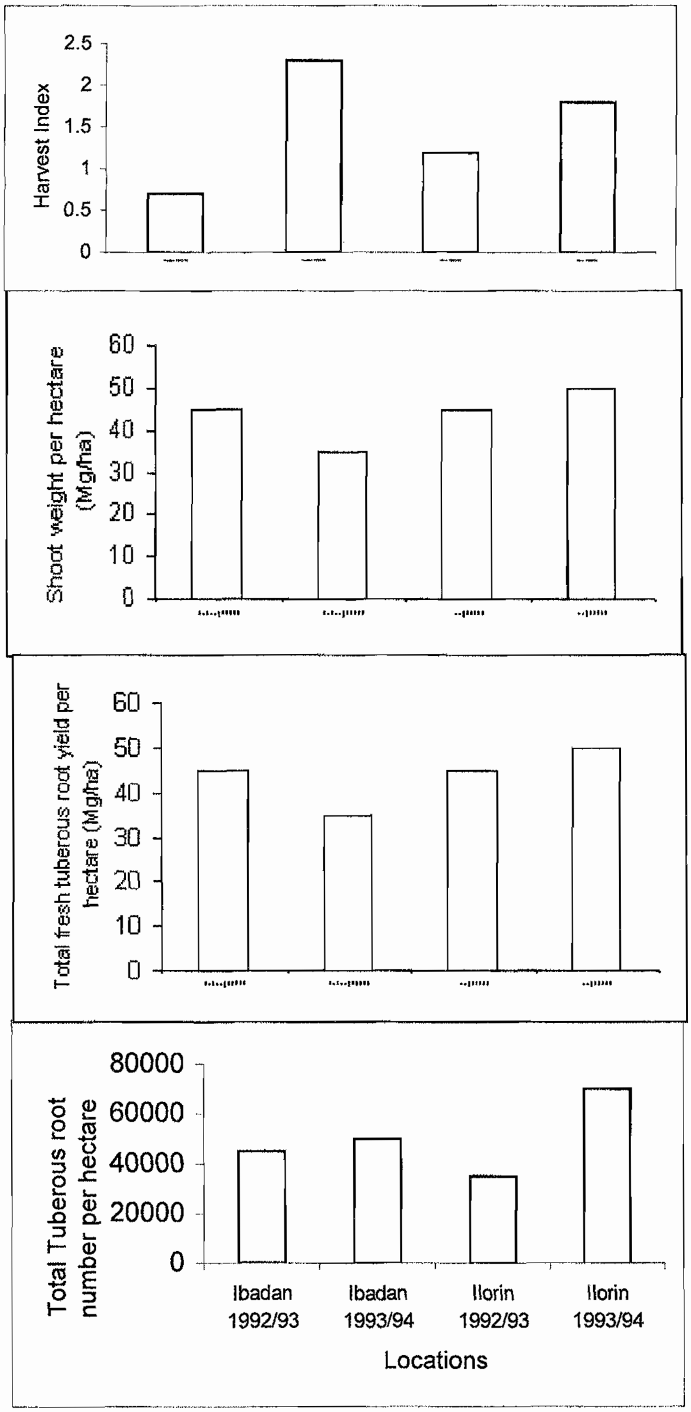

Figure 1: *Effect of locations and years on total tuberous root number per hectare, shoot weight per hectare, harvest index and total fresh tuberous root yield For 12 cassava genotypes from 1992 to 1994*

Table 1: Effect of location and years on total tuberous root number per hectare, shoot weight, fresh tuberous root yield per hectare and harvest index for 12 cassava genotypes from 1992 to 1994.

Genotypes	*Total Tuberous Root number Per hectare*	*Shoot weight (Mg/ha)*	*Fresh tuberous root yield (Mg/ha)*	*Harvest index*
TMS 30572	582250a	35b-e	29a-c	0.8b
TMS 91938	55875ab	40a-e	32a	0.8b
TMS 81/01635	55750ab	46a	31a	1.2b
TMS 50395	50469a-c	43a-d	33a	1.1b
TMS 82/00661	52719a-c	37a-e	33a	1.6ab
TMS 82/00058	56688a	45ab	34a	1.95ab
TMS 81/00110	46500c-d	44a-c	27a-c	2.6a
TMS 82/00942	47225b-d	39a-e	32a	2.0ab
TMS 4(2)1425	36813e	30e	24bc	0.9b
TMS 30555	39813e	43a-d	28a-c	1.6ab
TMS 82/00959	33844e	31de	23c	1.6ab
TMS 90059	35000e	33c-e	23c	0.9b

The genotype(s) in a column with the same alphabet letter(s) are not significantly different at 5% level of probability

Table 2: Effect of locations (Ibadan) on total tuberous root number per hectare, shoot weight, fresh tuberous root yield per hectare and harvest index for 12 cassava genotypes from 1992 to 1994.

Genotypes	*Total Tuberous root number per hectare*	*Shoot weight (Mg/ha)*	*Fresh tuberous root yield (Mg/ha)*	*Harvest index*
TMS 30572	54375ab	41a-c	22a-d	1.0b
TMS 91934	52750a-c	40a-c	27a	0.9b
TMS 81/01635	54125ab	46ab	24a-c	0.9b
TMS 50395	43625b-e	40a-c	25a-c	1.5ab
TMS 82/00661	49813a-d	38a-c	27a	1.1ab
TMS 82/00058	58563a	48a	26ab	2.6a
TMS 81/00110	41125c-f	45a-c	21a-d	1.5ab
TMS 82/00942	45063b-e	36a-c	21a-d	1.7ab
TMS4(2)1425	4250e-f	26c	21a-d	0.9b
TMS 30555	42625b-f	45a-c	18cd	2.2ab
TMS 82/00959	30750f	35a-c	15d	1.6ab
TMS 90059	37875d-f	28bc	18b-d	0.7b

The genotype(s) in a column with the same alphabet letter(s) are not significantly different at 5% level of probability