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Full Length Research Paper

Spatio-tempora variation in cassava (*Manihot* sp.) in forest savannah eco-climatic zone of Nigeria

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Multi-locational trials were conducted in four selected locations with the forest-savannah agro-ecological zone of Nigeria to investigate the spatial variability in the yield of cassava. In an attempt to compare the yield of cassava within the forest-savannah eco-climatic zone of Nigeria, four locations including Ibadan, Abeokuta, Akure and Oshogbo were selected for field trials. Four improved cassava cultivation (TMS 30572, TMS 91934, TMS 50395 and TMS 30555) were grown between 2009 and 2010 in these locations and harvested at 12 months after planting. Results obtained showed that there were significant differences in the yield of cassava in the four selected locations with Ibadan having the highest tuberous root per hectare among the four locations. TMS 30572 had the highest (52,964 t. ha^{-1}) number of tuberous root per hectare among the four varieties of cassava planted. This study revealed that cassava yield decreased with increase in rainfall distribution in the forest-savannah agro-ecological zone of Nigeria.

Key words: Cassava, tuberous root, spartial variability, rainfall distribution.

INTRODUCTION

Forest-Savannah eco-climatic zone of Nigeria covers a total land area of about 115,000 sq. km. The rainfall in the zone can be described as humid to sub-humid tropical with district dry and wet seasons. The dry season runs from early November to end of March, while the wet season is from early April to early November. There are two rainfall peaks (June and September) with a dry spell in August. The annual temperature ranged between 28 to 36°C, relative humidity is high throughout the year and ranged between 60 to 90 percent at 16.00 h. Sunshine hours are directly related to cloud cover, while average daily sunshine hours ranged from 14 h in august and 7.5 h in January.

The wellbeing of large population around the world depends on access, stability and availability of food. This is especially true in the developing world with predominant small land holders and subsistence farmers for whom both on-season and off-season agricultural labour provides the main source of food and income. It has been suggested that larger percentage of African population would be stroked with poverty as short term changes in climate will increase the stress on food production (Ahmed and Hertel, 2009).

Canbas and Olace (2009) used statistical models to highlight the importance of intra-seasonal changes in temperature and precipitation on crop production in southwestern Ontario, Canada and showed that, although precipitation and temperature variability might have impact on average yield, net crop yield will be higher in the future due to a lengthening of the growing season. Cassava (*Manihot utilisima*) is one of the most important root crops in Nigeria. It is affected by different environmental factors (Ngere, 1994). It has been discovered that, improved varieties of cassava would yield an optimum value in any environment (Dixon et al., 1994). Canter et al. (1992) reported that a genotype is adjudged to be stable if at a given location, it has little or no yield variation. This distinction is important because farmers who has to decide the cultivar to adopt is interested in the stability of the cultivars only at her location for a given yield level. The yield potential of the cultivar at any particular location is of importance to the farmer at that location.

Desert encroachment into the rainforest zones is going at a fast rate; thus, many rainforest zones are becoming dry lands, otherwise referred to as forest-savannah zone.

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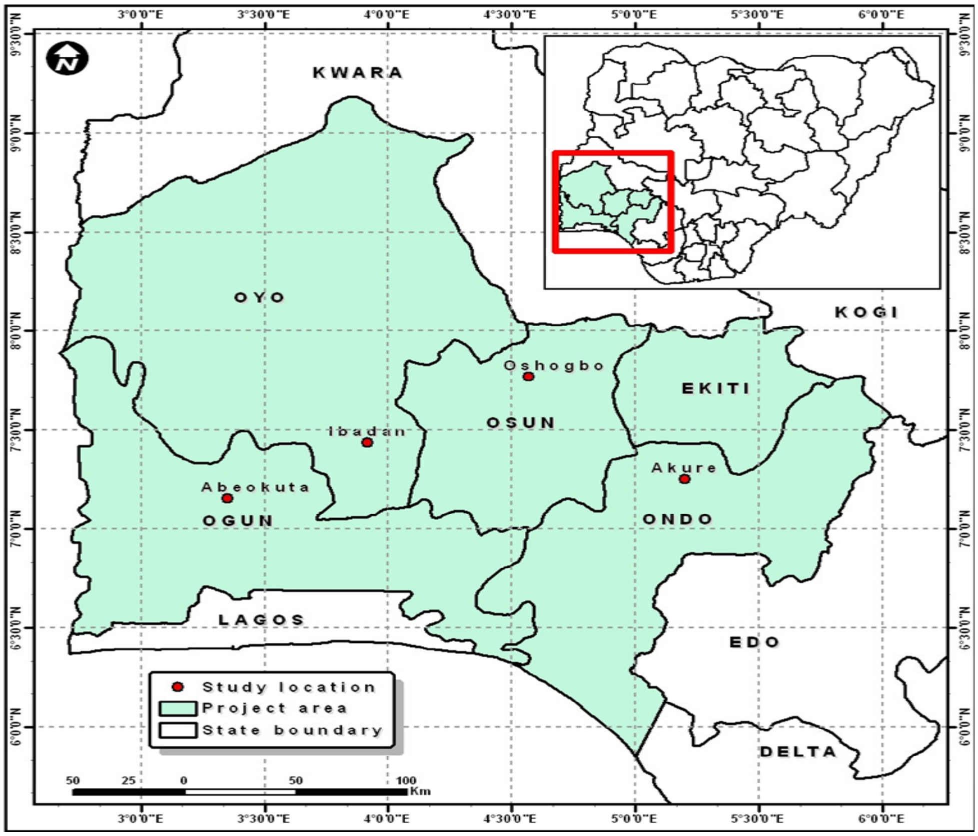

Figure 1. Map of Nigeria showing the four selected study locations.

This area has rainfall that ranges between 1500 to 2900 mm. There is a need to estimate the impact of micro-climatic variability on cassava yield and screen cassava cultivars that are high yielding and that can be recommended for farmers at particular location. The aim of this study was to compare the yield of cassava in some selected locations including Ibadan (7°24` N; 3°33`E), Abeokuta (7°9` N; 3°20` E), Akure (7°15` N; 5°11` E) and Oshogbo (7°46` N; 4°34` E) within the forest-savannah agro-ecological zones of Nigeria. These selected locations have a total annual rainfall of 1279, 1529, 1576 and 1382 mm respectively.

MATERIALS AND METHOD

The research was conducted during the 2010/2011 season at Ibadan (Institute of Agricultural Research and Training research farm), Abeokuta (Federal University of Agriculture Abeokuta research farm), Akure (Federal University of Technology agricultural Research farm) and Oshogbo (Oshun State Agricultural Development Program farm) (Figure 1). The soils of the experimental site in all the selected locations are well-drained tropical ferruginous soil classified as sandy-loam. Four improved IITA cultivars: TMS 30572, TMS 91934, TMS 50395 and TMS 30555 were planted in the four locations.

The experimental sites were cleared, ploughed, harrowed and ridged (tractor-driven). The experimental design used at each location was Randomized Complete Block Design (RCBD) with four replications. Each plot was 10 m long and 1 m apart. Stem cutting of each at 30 m long having at least 4 nodes were used as planting materials. Each plot measured 10 m and 1 m apart. Stem cuttings each of 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. Data collected included number of tuberous roots per hectare and fresh tuberous root yield per hectare. These data were subjected to General Linear Model (GLM) and mean differences were determined by least significant difference (LSD).

RESULTS AND DISCUSSION

Rainfall encountered during the experiment in all the locations were higher than the amount required for the growth and development of cassava. Hence, the plant stood no risk of water stress. The results of the preliminary soil survey in all the selected locations indicated that the experimental sites were sufficient in terms of basic nutrient requirements. Mean pH, organic matter and organic carbon obtained for the sites were 6.7, 1.17 and 0.68%, respectively. Also, the mean exchangeable base Ca, Mg, K, Na and CEC were 1.36, 1.92, 0.10, 90.36 and 3.75 cmol kg^{-1}, respectively. There is no significant different in the growth indices during establishment and vegetative stages. This could be

Table 1. Average total tuberous roots number per hectare and fresh tuberous root yield (mg ha^{-1}) in 2010 and 2011.

Variety	Total tuberous roots number per hectare	Fresh tuberous root yield (mg ha^{-1})
$V_1 * P_1$	52.964	24.5
$V_1 * P_2$	48.847	19.2
$V_1 * P_3$	50.262	22.0
$V_1 * P_4$	47.562	22.4
$V_2 * P_1$	40.332	20.5
$V_2 * P_2$	39.425	18.5
$V_2 * P_3$	40.014	19.8
$V_2 * P_4$	38.813	17.8
$V_3 * P_1$	50.024	18.4
$V_3 * P_2$	40.136	18.0
$V_3 * P_3$	42.256	19.0
$V_3 * P_4$	29.468	17.5
$V_4 * P_1$	32.467	18.5
$V_4 * P_2$	29.674	17.0
$V_4 * P_3$	30.128	17.5
$V_4 * P_4$	22.245	16.0
LSD = $P \leq 0.01$	10124	5.4

V1, TMS 30572; V2, TMS 91934; V3, TMS 50395; V4, TMS 30555; P1, Ibadan; P2, Akure; P3, Abeokuta; P4, Oshogbo.

attributed to similarity in rainfall amount, temperature condition and sunshine hours in the four selected locations, which among other factors accelerated the initial sprouting ability, breaking of bud dormancy, plant vigour and plant establishment (Eke-okoro et al., 1999; Njoku and Muoneke, 2008).

Table 1 shows the results of the average total tuberous roots number per hectare and fresh tuberous root yield. Cultivar differences were observed for the parameters measured thereby reflecting the generic differences between the varieties of cassava used. Analysis of variance (ANOVA) for total number of roots per hectare and fresh tuberous root yield per hectare showed significant difference ($P \leq 0.01$) in the four locations. Cassava planted in Ibadan (P_1) had the highest for tuberous roots number and fresh cassava tuberous root yield followed by those planted in Abeokuta, whereas the lowest were recorded for those grown in Akure. This finding suggests the influence of spatial variability of climatic factors on yield of cassava. This implies that cassava yield will be enhanced by planting in certain locations since the same trend was obtained irrespective of the variety of cassava planted. This is in agreement with Eke-Okoro et al. (1999) and Simwambana et al. (1995) who reported differences in the annual productivity of cassava in Nigeria and India, respectively. The annual differences in rainfall amount in both cropping seasons predisposed the treatments to differential performances in favour of interaction of treatments and weather condition. This suggests that the productivity of cassava was driven by the differences in weather condition of rainfall and sunshine in response to climate change in our environment. The results of this study emphasized that differences in the treatments (agronomic factors) and annual weather conditions were responsible for differences in the growth and productivity of cassava. This study suggests that climatic factor in Ibadan when adequately harnessed will have the best positive influence on the yield of cassava than any of the other three locations selected.

Conclusion

Significant differences were noticed in the yield of the selected varieties of cassava in the four selected locations within the forest-savannah agro-ecological zones of Nigeria. Genotypic differences were also observed in the yield characteristics of the varieties of cassava irrespective of the planting locations. The study further revealed that yield characteristics of cassava decreased with increased rainfall distribution to a certain critical value.

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