

# ON-FARM EVALUATION OF DROUGHT TOLERANT MAIZE VARIETIES AND HYBRIDS IN THE SOUTHERN GUINEA SAVANNA ZONES OF NIGERIA

I. Ogunlade<sup>1</sup>, G. Olaoye<sup>2</sup>, D. Tologbonse<sup>3</sup> and O.E. Ayinde<sup>4</sup>

<sup>1</sup>Department of Agricultural Extension and Rural Development, University of Ilorin, Ilorin, Nigeria.

Correspondence: [iogunlade@unilorin.edu.ng](mailto:iogunlade@unilorin.edu.ng); [iogunlade@yahoo.com](mailto:iogunlade@yahoo.com)

<sup>2</sup>Department of Agronomy, University of Ilorin, P.M.B. 1515, Ilorin, Ilorin, Nigeria.

<sup>3</sup>National Agricultural Extension Research Liaising Services, Ahmadu Bello University, Zaria, Nigeria

<sup>4</sup>Department of Agricultural Economics and Farm Management, University of Ilorin, Ilorin, Nigeria.

## ABSTRACT

Drought is one of the major factors affecting maize production most especially in the Southern Guinea Savanna Zones of Nigeria. Scientists working on maize research have demonstrated the ability of local farmers to double maize yield through drought resistant varieties and agronomic practices. This study was evaluated on farm trial of Drought Tolerant (DT) maize varieties and hybrids in the Southern Guinea Savanna Zones of Nigeria. Mother-baby trial approach was used for the study. The mother-plot consists of eight DT varieties planted at each of the central locations of Bida and Ilorin headquarters of Agricultural Development Project (ADP), of Niger and Kwara States respectively. The farmers fields scattered around each of the central locations made up the baby trials. Socio-economic data were obtained from participating farmers through structured questionnaire.

The results show that four of the DT maize varieties had higher gross margins than the farmers local varieties. The farmers were satisfied with the technology characteristic such ease operation, maturity days, grain yield, and inputs requirements. They preferred the grain size and grain color of DT varieties to the local variety; inadequate supply of fertilizer for production, and unavailability of seed were the major constraints. The paper concluded that four of the DT varieties were better than the farmers local variety. It was recommended that the four hybrid maize varieties with higher gross margin be multiplied and disseminated to farmers in order to boost production during the drought period.

## 1. INTRODUCTION

Climate variability and change pose challenge to researchers and farmers in agricultural business. The researchers would need the scientific methods to finding plausible adaptation strategies for farming business to continue. Also, the farmers need the knowledge and application of these strategies for optimum production. Maize is an important crop in Nigerian crop mix. Farmers grow it both for food and income. Ogunlade, Ojo and Ladele (2008) traced the increasing importance of maize to its demand for food and industrial processes. Maize, which is about 9% protein is a very important raw materials for the food industry. It is used either fresh or dried, and generally preferred for industrial uses. Maize can be processed into grits (brewers grits, coarse and medium grits), corn meal, flour, germbran, offals, oil, food glutton, animal food stock and starch. Principally, maize products are used in the production of baby weaning foods, alcoholic beverages and adhesives (Federal Ministry of Agriculture and Natural Resources, 1993).

The rain forest agro-ecological zone of Nigeria are the major suppliers of maize eating green while the savanna produce the large quantity needed for fod industry. The savanah zone (Derived, Guinea, Sudan and Sahel) is located in the northern part of the country of Nigeria. This region is characterised by short wet season and long dry season. The annual temperatures are high and range from 28°C – 32°C with few scattered trees and grasses, gentle slopes and large farm holdings. Maize is one of the major crops that thrive well in this savanah. Sowunmi and Akintola (2010) reported high variability in the annual maize hectrage and output across different agro-ecological zones of Nigeria. Bency (2000) studied on the influence of climate change on maize production in semi-humid and semi-arid areas of Kenya advocated for the

planting of early maturing cultivars. Ake et. al. 2001 identified Niger state as one of the states that are prone to drought in Nigeria. Amaza, Kwache and Kamara 2008 found early maturity and high green yield of improve maize varieties as the positive perceptions that influence 66.4% adoption by farmers.

### 1.1 Statement of Problem

Drought constitutes the major factor militating against maize yields in the southern Guinea Savana zone of Nigeria. Byrne *et al.* (1995), noted that since rainfall in much of the drier zone is unpredictable in quantity and distribution, cultivars targeted to such ecologies should perform well under a wide range of moisture conditions. In other words, the use of drought tolerant (DT) maize varieties that are characterized by increased grain production under moisture deficit situation will stabilize maize yields in such ecologies. A corollary is an increase in the land area cultivated to maize in the zone which also will enhance the economic status of the resource poor farmers who grow maize in the ecologies.

Maize scientists at the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, have developed DT maize hybrids and open pollinated varieties (OPVs) which have produced acceptable yields under moisture stress conditions compared to the drought susceptible (DS) counterparts. During the 2007 cropping season, the tolerance of three sets of DT genotypes (20 Hybrids, 12 Late/Intermediate and 16 Early maturing varieties) were determined.

### 1.2 Objective of the Study

The main objective of this study was to determine an on-farm evaluation of drought tolerant maize varieties and hybrids by farmers in the southern guinea savanna zones of Nigeria.

The specific objectives are to:

1. Determine the profitability of DT varieties of maize when compared with the local ones.
2. Examine farmers satisfaction with the characteristics of DT maize varieties compared with the local ones.
3. Investigate the farmers preference for the qualities of the DT.
4. Identify the constraints militating against the optimum benefits of the DT varieties.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

The study was conducted in Niger and Kwara states of Nigeria. These states are located in the North central Nigeria with guinea savana agro-ecology. Niger State lies on latitude 3° 20' East and longitude 11° 03' North. It is bordered to the North by Zamfara State, North-west by Kebbi State, South by Kogi state and South-east by Kwara State. Kaduna and Federal Capital Territory border the state North-east and South-east respectively. Niger state has a population of two million four hundred and twenty one thousand and eighty one people (Population Census, 1991). It has a land area of 74,244 square kilometers covering 8 percent of the total land area of the country. About 85 percent of the land is suitable for arable crops.

Kwara state has a land area of 32,500 km<sup>2</sup> and is situated between latitude 6.5° and 11.5° North of the equator and longitude 2.8° and 7.5° East. It shares a common boundary with Oyo, Osun and Ondo State in the South, Niger and Kebbi state to the North, Kogi State to the East and Kebbi State to the west. This aptly represents a gateway into the Northern, Southern and Western part of Nigeria. These states were selected because of their high production of maize.

### 2.2 On Farm Evaluation Procedure

Mother-Baby trial approach (Snapp, 2002) was used to deploy 8 DT maize varieties to 2 major locations in the guinea savanna agro-ecology zone. Mother trial comprise all the 8 identified DT-varieties planted at each of the head quarters of Agricultural Development Project (ADP) of Niger and Kwara states of Nigeria. Baby trial consist of farmers' fields scattered around each of the ADP's location. Mother trial was planted in 4-row plots, 5m long and 3 replicates/variety.

Each of the Baby trials consist of two (2) DT-varieties + Farmer's variety and/or technology as the control on a 20 x 20m ridge. A farmer represents a replicate and farmer's variety and/or technology in the middle. Establishment of Mother-Baby trials

- Mother trials (1 on-station per state)

-19 Baby trials (i.e. 10 in Niger state and 9 in Kwara state on farmers' fields)

### **2.3 Monitoring of Trial Locations**

Crop performance data were collected from both Mother and Baby trials in conjunction with scientists and participating farmers.

Interactive sessions with participating farmers in each locality both at the Mother trial site and their fields during silking and maturity to identify preferred maize characters/variety (s).

### **2.4 Instrument for Data Collection**

The primary data was collected using the data sheet jointly designed by International Maize and Wheat Improvement Center (CIMMYT) and International Institute of Tropical Agriculture (IITA) for measuring the impact of drought tolerant maize and research in Africa.

### **2.5 Measurement of Variables**

The types and quantity of inputs used and outputs from both control and treatment plots were obtained. Also, the market prices of inputs and outputs were determined. Farmers satisfaction with the technology characteristics was measured by placing seven items of technology characteristics against four point likert- type scale of satisfaction. Farmers preferences were based on their ratings of grain size, grain color, grain texture, food quality and suitability for food. Farmers were asked to list the production constraint that would likely militate against optimum benefits of the DT varieties.

### **2.6 Data Analysis**

Data was analysed using SPSS package for social sciences. Gross margin, ranking, frequency and percentages were used to analyse the data.

## **3. RESULTS AND DISCUSSION**

Eight DT varieties were grown on farmers field along with their local varieties. All treatments give a positive return to investment. However, treatments 5, 3, 7 and 6 ranked higher than the control in return to investment with Gross margin of 640 Naira, 437.8 Naira, 370.8 Naira and 296.8 Naira compare with control that gives a gross Margin of 258 Naira. Among the treatment, treatment five gave the highest gain with a Gross Margin of 640 Naira. Treatments 1, 2, 4 and 8 gives lower Gross Margin than the control varieties. It is surprising that early maturing varieties did not give better return to investment. This may be due to delay in planting these varieties. Timeliness in planting is a prerequisite for optimum performance of these varieties. This finding is contrary to Amaza, Kwache and Kamara 2008.

Table 2 shows Farmer's level of satisfaction with technology characteristics was measured based on seven items. All farmers were satisfied with the ease of use, 89.5% of the respondents were satisfied with the grain yield, 84.2% show satisfaction with input requirement of the DT maize varieties, 68.4% were satisfied with DT varieties resistance to biotic and abiotic stresses. About 52.6% gave the indication that DT varieties had adapted to the ecology.

**Table 1: Farmers analysis of Cost and Return from DT maize varieties and control.**

	Control (farmers practice)	1	2	3	4	5	6	7	8
Total Revenue	848.00	1092.00	1129.00	1698.80	1249.48	1866.00	1483.00	1592.00	1185.00
Variable cost									
Seeds	40.5	34.5	33.0	42.0	42.0	40.5	40.5	42.0	40.5
Fertilizer	623.56	270.90	260.50	679.00	646.64	585.69	585.70	639.80	579.78
Labour	530	600	600	540	550	560	560	540	560
Total variable cost	1106.00	905.40	893.50	1261.00	1238.00	1225.00	1186.19	1221.80	1180.27
Gross margin	258.00	187.00	236.00	437.80	10.90	640.00	296.81	370.80	4.73
Ranking		6 <sup>th</sup>	5 <sup>th</sup>	2 <sup>nd</sup>	7 <sup>th</sup>	1 <sup>st</sup>	4 <sup>th</sup>	3 <sup>rd</sup>	8 <sup>th</sup>

Key: 1= ZEA DILO BC4C3F2, 2= EVDTIY2000STRQPM, 3=TZ4TSR-WSGY-SYN, 4 = Pool-18-SRIAK94DMRSRY/AK94DMRESRY, 5 =DT-SR-WWF2, 6 =TZE/WDTSTRC4, 7= TZB-SR, 8= EVDT Y2000STRCO.

**Table 2: Farmers' level of satisfaction with the technology characteristics.**

Technology characteristics	Satisfactory	Not satisfactory	No comment	Still observing
Ease of use (planting, germination etc)	19 (100%)	-	-	-
Inputs requirements (e.g labour, fertilizer etc)	16 (84.2%)	3 (15.8)	-	-
Grain yield	17 (89.5%)	2 (10.5%)	-	-
Resistance to biotic (e.g. drought, pest etc) and abiotic stresses	13 (68.4%)	2 (10.5%)	4 (21.1%)	-
Maturity days	19 (100%)	-	-	-
Ecological adaptation	10 (52.6%)	-	3 (15.8%)	6 (31.6%)
Other technology characteristics (please specify)	4 (21%)	1 (5.2%)	2 (10.5%)	5 (26.3%)

Table 3 shows that farmer's preference for DT varieties was based on grain size (94.7%), grain colour (89.5%), food quality (73.7%) and grain texture (63.2%).

**Table 3: Farmers' Preference for DT Maize varieties.**

Index of preference	Preferred	Not preferred	No comment	Still observing
Grain size	18 (94.7%)	1 (5.3%)	-	-
Grain color	17 (89.5%)	2 (10.5%)	-	-
Grain texture	12 (63.2%)	-	1 (5.3%)	-
Food quality	14 (73.7%)	-	-	-
Other farmers' preferences (please specify)				

Table 4 identified the following constraints to optimum benefit from adaptation of DT Maize Varieties. These are availability and access to fertilizer, observation and adherence to the planting dates, availability of funds for timely farm operations and availability of seeds as planting materials.

**Table 4: Constraints to optimum benefit from adaptation of DT Maize Varieties.**

Constraints	%
Fertilizer	50
Planting date	25
Fund	20
Availability of seed	15

## **4. CONCLUSION AND RECOMMENDATIONS**

### **4.1 Conclusion**

It is evident from this study that farmers found late and intermediate maturing varieties suitable for the drought period. All the characteristics of the technology were of interest to the farmers.

### **4.2 Recommendations**

Based on the afore mentioned facts, it is recommended that :

1. Seeds of DT-SR-WWF2, TZ4TSR-WSGY-SYN, TZB-SR and TZE/WDTSTRC4, to be multiplied for distribution to farmers.
2. Farmers should be trained on seed management of DT maize variety in order to have a sustainable production.
3. Farmers should be organized to cooperatives for recognition by the government agency handling inputs and access to full procurement of the same.
4. The early maturing varieties need to be properly monitored for full adherence to the planting dates for optimum production.
5. There is the need for farmers education on the early maturing varieties as this may solve the problem posed by long dry seasons.

## **5. ACKNOWLEDGEMENT**

The authors wish to acknowledge the support received from Maize improvement programme, International Institute of Tropical Agriculture (IITA), Ibadan in conducting this research and University of Ilorin providing fund for full participation in SASAE 2010 conference in South Africa.

## **REFERENCES**

- Amaza, P., Kwache, A. and A. Kamara 2008. Farmers perception, profitability and factors influencing the adoption of improved maize variety in the guinea savannas of Nigeria. A paper presented at the International Research Conference on food security, Natural Resource Management and Rural Development held at University of Hohenheim between October 7- 9.
- Ake I.E., Noli N., Gbuyiro, S. Ikehua, F. and Ogunbo 2001 Meteorological early warning system for drought preparedness and drought management in Nigeria Meteorology services, Lagos Nigeria.
- Bency, M.M. 2000. The influence of climate change on Maize production in semi-humid and semi-arid areas of Kenya. *Journal of Arid environment* 46(4): 333-334.
- Ogunlade, I., Ojo D.A. and A.A. Ladele 2008. Capacity Of Agro-Input Dealers In Advisory Service Delivery to Maize Farmers in Kwara State, Nigeria. A paper presented at Pan Africa Workshop on Service Delivery to Small Holder Farmers organized by Inter Region Economic Network, Kenya between 18th to 21st 2008 at Safari Park Hotel.
- Sowunmi, F.A. and Akintola J.O. 2010. Effect of climatic variability on Maize production in Nigeria. *Research Journal of Environment and Earth Science* 2(1): 19-30.