EFFECT OF RAINFALL AND TEMPERATURE DISTRIBUTION AT YEWA NORTH SAVANNAH AND ONIGAMBARI RAINFOREST ZONES OF NIGERIA ON MAIZE YIELD IN MAIZE AND CASSAVA INTERCROP

NDUBUAKU, U. M.; ADEJONWO, K. O.; SOSANYA, O. S. AND FAYINMINU, O. O.
Department of Crop Production, College of Agricultural Sciences, Olabisi Onabanjo University, Ago- Iwoye, Ayetoro Campus

Abstract

This study was carried out in the savannah region of Ayetoro in Yewa North and the rainforest region of Onigambari in Ibadan North to determine the effects of rainfalland temperature distributions on the growth and yield of tropical *Zea mays* resistant variety with yellow flint (TZSR-Y) in the two ecological zones. The meteorological results showed even distributions of rainfall and temperature at Onigambari rainforest zone in 2004 and 2005 while those of Ayetoro savannah vegetation followed an irregular pattern. There was higher vegetative growth of the maize plants in terms of number of leaves, leaf area, stem height, number and length of internodes. The yield values such as the number and weight of grains per hectare were higher in Ayetoro than Onigambari. There were no significant differences in the moisture contents of the grains in both ecological zones.

Keywords; Tropical Zea mays resistant variety with yellow flint (TZSR-Y), Ayetoro savannah, Onigambari rainforest vegetation, temperature and rainfall distribution.

Introduction

Among the major grains produced in Nigeria are maize, rice, cowpea, soybeans, sorghum, and groundnut (Adekunle and Nabinta, 2000). Maize constitutes the greater proportion of these grains because of its ability to thrive under different ecological conditions. FAO (1989) figures showed a consistent increase in production of these crops in Nigeria. Adekunle and Nabinta (2000) also reported sustained increase in maize production. It is the most important staple food in Nigeria. It accounts for about 43% of calorie intake (Nweke, 2004). Studies on maize production in different parts of Nigeria have shown an increasing importance of the crop amidst growing utilisation by food processing industries and livestock feed mills. The crop has thus grown to be local "cash crop" most especially in the southern part of Nigeria where at least 30 % of the cropland has been devoted to maize production under various cropping systems (Ayeni, 1991). Studies have shown that maize farm of 1.2 ha can overcome hunger in the household and the aggregate effect could double food production in Africa (Ogunsumi *et al.*, 2005). According to Ogunsumi *et al.* (2005), about 561397.24 ha of Nigerian land are planted with maize yearly. This constitutes about 61 % of total cultivatable land in Nigeria. Maize cultivation in Nigeria unlike temperate regions is mainly done in intercropping system. Intercropping has long been recognised as a common practice among subsistence farmers in the traditional semi-intensive system of agriculture, due to the flexibility of labour used (Ighalo and Alabi, 2005).

Crop performance in any environment is closely associated with rainfall and temperature distributions. Maize yields had been found to be low in "bad years" when the rains started too late or ceased too early (IITA, 1985). If there were more favourable rainfall distribution and higher solar radiation during the growing season, the sub humid savannah regions of the North and Northwestern Nigeria were better grain producing areas than the south (IITA, 1983). In the tropical savannah climate, rainfall is the principal limiting factor that determines when the growing season begins and ends. It is also the determining factor in some dry, subtropical climates. In the southern Guinea savannah in which Ilorin is situated, the rainy season starts from March and ends in October with two weeks dry spell in July or August. However, the rain stabilizes in most years by May and planting of maize starts thereof and terminates by early August. It was also observed that the optimum date for maize depends on location, tillage and residue management practices used in the production system. (Omisore, 2000). Swanson and Wilhelm (1996) found that maize yield was significantly affected by main effect of date of planting and soil temperature.

Materials and Methods

The maize variety used for the experiment was the improved tropical *Zea mays* resistant variety with yellow flint (TZSR-Y) adapted to the lowland forests and savannah regions. It was intercropped with the commonly grown local cassava variety (Idileru) in the Crop Collection Garden of College of Agriculture, Ayetoro (Yewa North) and Cocoa Research Institute of Nigeria (CRIN) Onigambari (Ibadan North). Ayetoro is located in Yewa North Local Government Area. It represents savannah vegetation with total annual rainfall, which ranges from 300 mm to 600 mm with daily temperature of 21° C to 31° C during the rainy season and 39° C to 45° C during the dry months. Onigambari represents the rainforest vegetation with total annual rainfall ranging from 1250 mm to 1500 mm. At Onigambari, the rainfall normally starts around March and ends in October with short dry spell in August. The temperature ranges from 10° C to 22° C most of the year. The daily rainfall over the months was measured with a rain gauge while the temperature was measured with the minimum - maximum bulb thermometer.

The maize grains were planted three in a hole at a distance of 1m x 0.5m while the cassava cuttings were planted one per mound at a spacing of 1m x 1m. Both crops were planted at the same time on both locations. The experiment was replicated three times in each location in a randomised complete block design. Each replicate consisted of a plot size of 10m x 10m. After emergence, the maize plants were thinned down to two per stand. Weeding was done three times manually, at 3, 7, 11 weeks after planting. There was no fertilizer application. The result of the soil test done before planting is shown in Table 1. The plant height and number of leaves were taken at tasselling. The plant height was measured with a meter rule while the number of leaves was merely counted physically. The leaf area was estimated with a leaf area meter.

Table 1: Nutrient status of the soils of Ayetoro and Onigambari (0-30 cm depth)

Location	PH(in H_2O)	%Org. C	Total N	Average P(ppm)	Ca (C mol/kg^1	Mg (C mol/kg^1	K(C mol/kg^1	Na(C mol/kg^1
Ayetoro	6.2	1.27	0.23	3.75	1.32	1.18	0.28	0.33
Onigambari	6.4	1.32	0.45	3.25	2.44	2.26	1.20	0.34
Mean	6.3	1.295	0.34	3.5	1.88	1.72	0.74	0.335

The ear height and days to silking were taken 45 days after planting. The ear height was also measured with a meter rule. The yield parameters such as number of grains per ear, grain weight per ear, number of ears per plant, total grain yield (t / ha), were taken at harvest, 95 days after planting (DAP). The weights were taken at harvest and four weeks later after air-drying. The percentage moisture content was calculated as

$$\%MC = \frac{\text{Harvest weight} - \text{dry weight}}{\text{Harvest weight}} \times \frac{100}{1}$$

Where MC = moisture content

Results and Discussion

The results of the rainfall and temperature distributions in years 2004 and 2005 are given in Figures 1 and 2. In 2004, the rainfall distribution at Ayetoro followed a irregular pattern with two peaks in June and October. There were drier months in 2005 with two peaks in June and October. There were scanty rains between February and May. It picked up in June (45 mm), peaking in October (55 mm) when the rains became heavier again. The temperature pattern also varied with the fluctuations in the rainfall pattern with weather being hotter during the dry periods and cooler during the rainy months. At Onigambari, the rainfall and temperature distributions followed the regular patterns having two peaks in June and October (220 mm and 215 mm respectively). There was a short dry spell in August. The temperature was highest during the dry spell and coolest during the rainy periods.

The growth characteristics of the plants are shown in Table 2. The values for the plant height, ear number per plant, ear height, number of leaves, leaf area, number of internodes, internode length and days to silking were higher in the rainforest vegetation of Onigambari than Ayetoro savannah vegetation. This could be attributed to higher rainfall values and distribution, associated with good soil conditions in Onigambari, which encouraged luxuriant growth of the plants. The unpredicted irregular rainfall and temperature distribution in Ayetoro created a partial water stress and also constituted a setback to vigorous vegetative growth of the plants resulting in reduction in number of leaves, leaf area and expansion and delayed flowering. Limited rainfall and the low water-holding capacity of the savannah soils imposed limitation between the effective length of the growing season and the crop cycle as pointed out in IITA Annual Report (1983). The yield records such as the grain number and weight per plant (tonnes/ hectare), were significantly higher at Ayetoro than Onigambari (Table 3). IITA Annual report (1975 and 1982) pointed out that partial defoliation resulted to increased grain yield probably due to increased source to sink activities. Early stress during the growing season reduced vegetative dry matter production but increased grain number and yield. Stress during flowering also reduced dry matter and grain production through reduction in both grain number and weight. Ngwuta *et al* (2005) reported that any crop yield obtained indicated the genetic and environmental conditions prevalent at the time of production. Thus the genetic constitution of any crop can be exploited fully under enabling environmental conditions. Consequently, the higher grain yield at Ayetoro resulted to higher grain dry weight per hectare (Table 3).

There were no significant differences in the moisture contents of the grains grown in the two ecological zones (Table 4). The moisture content of the grains at storage is very important as it determines the longevity of the grain shelf life. If the moisture content at storage was higher than the critical level at which dormancy of the grains could be broken, germination could result during storage.

Table 2: Growth characteristics of TZSR-Y maize variety grown at Ayetoro and Onigambari

Location/replicate	Plant samples	Morphological characteristics							
		Leaf number	Leaf area (cm^2)	Internode number	Internode length (cm)	Stem height (cm)	Number of ears per plant	Ear height (cm)	Days to silk
Ayetoro									
Rep 1	1	15	85.6	12	10	120	1	110	45
	2	14	88.7	14	09	126	2	101	48
	3	14	92.3	13	10	130	2	113	50
Mean		14.33	88.87	13	9.67	125.33	1.67	108	47.67
Rep 2	4	13	75.7	14	09	126	1	114	50
	5	12	88.3	12	10	120	1	101	46
	6	11	91.3	10	11	110	2	96	52
Mean		12	85.1	12	10	118.67	1.33	103.67	49.33
Rep 3	7	14	79.6	11	11	121	1	94	51
	8	12	89.3	14	10	140	2	85	53
	9	11	87.4	13	09	117	1	120	45
Mean		12.33	85.43	12.67	10	126	1.33	99.67	49.67

	LSD (P=0.05) of means	ns	8.62	ns	ns	12.58	ns	6.44	ns
Oni-gambari									
Rep 1	1	20	95.6	15	13	195	2	135	55
	2	19	104.5	15	12	180	1	120	50
	3	21	89.7	14	12	168	1	115	56
Mean		20	96.6	14.67	12.33	181	1.33	123.33	53.67
Rep 2	4	18	125.3	16	11	176	2	117	52
	5	21	114.6	14	13	182	2	121	53
	6	18	118.3	15	13	195	2	128	55
Mean		19	119.4	15	12.33	184.33	2	122	53.33
Rep 3	7	19	99.7	16	11	176	1	111	56
	8	17	92.4	13	14	182	2	120	55
	9	18	87.7	14	13	182	2	119	54
Mean		18	93.27	14.33	12.67	180	1.67	116.67	55
	LSD (P=0.05) of means	ns	8.45	ns	ns	6.68	ns	8.44	ns

Table 3: Yield of TZSR-Y maize variety grown at Ayetoro and Onigambari

Location	Cob length (cm)	Number of grains/ ear	Grain weight per ear (g)	Grain yield (tonnes/ha)
Ayetoro	12.8	375	105	6.25
Onigambari	13.4	325	96	5.92
Mean	13.1	350	100.5	6.085
S.E	0.012	5.05	0.35	0.025

Table 4: Grain weights and percentage moisture content of TZSR-Y maize variety grown at Ayetoro and Onigambari

Location	Harvest weight per ear (g)	Harvest dry weight per ear (g)	Percentage (%) moisture content at storage
Ayetoro	114.40	105	9.40
Onigambari	105.50	96	9.50
Mean	109.95	100.5	9.45
S.E	0.60	0.35	0.0025

References

Adekunle, O.A and Nabinta, R. T. (2000). Indigenous storage structures of cereals. By women Farmers in Kaltungo Area of Gombe State, Nigeria. *Journal of Rural Economics and Development* 14(1) :47-54.

Ayeni, A. O. (1991). Maize production in Nigeria. Problems and Prospects. *Journal of Food and Agriculture* 2: 123-129.

FAO (1989). FAO1988-1989 Production Year Book. Statistical Series. 142(85) : 159-172.

Ighalo, S. O and Alabi, R. A. (2005).Relative economic advantage of maize – okra intercrop in humid rain forest zone of Nigeria. *Proceedings of the 39th Conference of the Agricultural Society of Nigeria, Benin*, 2005, pp 158-161.

IITA (1975). *IITA Annual Report*, 1975, pp. 154-169.

IITA (1982). *IITAAnnual Report*, 1982, pp. 26-55.

IITA (1983). *IITA Research Highlights*, 1983, pp. 34-37.

IITA (1985). *IITA Annual Report and Highlights*, 1985, pp75-81.

Ngwuta, A. A., Obi, I. U., Ajala, S. O. and Ene-Obong, E. E. (2005). Yield stability test for cultivated open pollinaqted maize (Zea mays I.) genotypes grown in Southeastern Nigeria. *Proceedings of the 39th Conference of the Agricultural Society of Nigeria, Benin City*, 2005, pp 217-220.

Nweke, F. (2004). New challenges in the cassava transformation in Nigeria and Ghana.EPTD Discussion Paper No. 118. Environment and Production Technology Division. International Food Policy Research Institute, 2033 K Street, N.W. Washington, D. C, 2006, U. S. A.

Ogunsumi, L. O., Ewola, S. O. and Daramola, A. G. (2005). Socio-economic impact assessment of maize production technology. Farmers' Welfare in South west Nigeria. *Journal of Central European Agriculture*, 6(1): 15-26.

Omisore, J. K. (2000). Effect of sowing date on maize production. Proceedings of the 38th annual Conference of the Agricultural Society of Nigeria (ASN), pp. 94 – 97.

Swamson, S. P. and Wilhelm, W. W. (1996). Planting date and residue rate. Effects on growth partitioning and yield of corn. Agron. J. 88: 205-210.

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