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# EFFECT OF CLIMATIC FACTORS AND SOIL CHARACTERISTICS ON THE PRODUCTION OF MAIZE VARIETIES IN THE SOUTHERN ZONE OF ADAMAWA STATE, NIGERIA

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## ABSTRACT

The main objective of the study was to determine the effects of climate and soil on the growth and yield of maize varieties in the southern zone of the State. Three different maize varieties were used in this study. The varieties are namely: maize variety 1 (TZE Comp-5), variety 2 (TZSR-W) and variety 3 (Local variety). These varieties were grown at the same time on an experimental farm established at the research farm of the Department of Crop Production Adamawa State College of Agriculture Ganye located in the southern zone of the State. The experiment was conducted for two growing seasons (2009 and 2010) consecutively. Climatic data on mean temperature, rainfall, humidity and sunshine hours were provided by the meteorological services unit of Upper Benue River Basin Development Authority, Yola while data on crop agronomy were generated from field experiment conducted. Data collected were analyzed using mean averages, percentages, Analysis of Variance (ANOVA) and Correlation Analysis. Result from the spatial analysis of maize production in the zone shows that maize varieties have depicted high significant differences at p=0.01 for all the growth and yield parameters measured. Maize variety 1 had the highest grain yield per plot, cob diameter, stem diameter, and the second best performer in terms of 100 grains weight. Variety 2 showed better performance with regards to leaf length, days to 50% flowering, days to 95% maturity as well as the best yielder per cob, while variety 3 showed good performance in terms of plant height, leaf length, cob length and plant stand count respectively. Correlation coefficients of climatic factors with growth and yield parameters of maize varieties in the zone show that there was a significant positive correlation between all maize varieties with temperature, rainfall and humidity but showed negative significant correlation with sunshine hours only.

**KEYWORDS:** Climatic Factors, Soil Characteristics, Maize Varieties, Performance and Yield

## INTRODUCTION

Climate is likely to be highly variable under global warming both in absolute and relative terms. This variability basically would include changes in temperature (rise or fall in temperature) conditions, precipitation (pattern and quantity), solar radiation, relative humidity, wind, cloud cover and shift in seasons thereby making agricultural production to be more vulnerable to these changes in different regions of the world (IPCC,2007).

Worst region to be affected by the adverse effects of climate variability and change is the Sudano-Sahelian zones of West Africa (Mavi, 1985), where according to him the climate of the zone particularly areas at the southern fringes of the Sahara desert (northern Nigeria inclusive), is dramatically changing where food production is expected to drop by 20-50% in extreme climate variability years.

In Nigeria, the manifestation of the impacts of climate variability or its change on the livelihood of people particularly in the northern part has not unfolded until from the early 1960s. Between 1968 and 1973, a sizeable portion of the region suffered a progressive decline in rainfall which culminated in a drought so severe that it damaged soils, crops, vegetations, starved and killed flocks and herds including an unknown number of inhabitants (especially farmers and herdsmen). During this period, production of major grains such as maize, guinea corn and millet in northern Nigeria have fallen drastically. The major reason for the falling trend of food production in the region can be attributed to the increasing change in the variability of climate which has caused increasing frequency of meteorological hazards such as droughts, floods and changes in the onset date of rains, cessation and length of rainy seasons which impacts seriously on food availability and food production systems at both local and regional scales in the region (Oguntoyinbo, 1982; Kowal and Knabe, 1972; Ayoade, 2002).

Over 70 percent of the populations in this part of the country are small farm-holders practicing largely rain-fed types of agriculture, with rainfall patterns in the region highly variable in nature which in turn, play a major role in agricultural production in the region (Mavi, 1985). According to Kowal and Knabe (1972), agricultural systems and practices are intimately dependent on the environment in which crops grow; and the yield of crops is largely determined by the prevailing weather rather than by the state of the soils. Kowal and Knabe (1972) and Nieuwolt (1989) have observed that of all the climatic elements (temperature, humidity, rainfall, sunshine, wind) which influence agriculture, especially in the tropics, availability of water to the crops in the form of moisture from precipitation, is by far the most important.

In Adamawa state, food crops and animal production constitute the bulk of agricultural production. The State is endowed with an extensive amount of agricultural land resources. However, food crop production in the State is relatively poor and much below expectation to meet the food demand of the fast growing population (AADP, 2007). Among the several factors militating against increased food productivity of the lands as presented by the agency, are poor soils, lack of timely and adequate provision of farm inputs as well as global climate variability. These conditions are already having various impact on the state's environment, where in some areas the environment is increasingly becoming drier while in others, it is becoming wetter. This causes great threat and concern to farmers in the state.

The study area is the southern agroecological zone of Adamawa State. It is made up of the 5 southern Local Government Areas (LGAs) of the zone. The LGAs are Mayo-Belwa, Demsa, Jada, Ganye and Toungo LGAs respectively. It is located between latitudes $7^0$ and $9^0$N and between longitudes $11^0$ and $13^0$E. It shares boundary with Taraba State in the south-west and Cameroun Republic along its eastern side (Fig. 1).

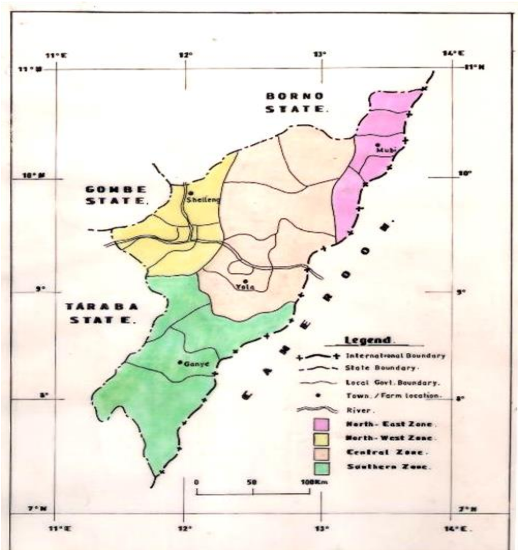


**Figure 1:** Map of the study area showing AE Zones and farm locations

## MATERIALS AND METHODS

### Experimental Farm Design and Treatment

An experimental farm was established at the Teaching and Research farm of the Department of Crop production and Horticulture, College of Agriculture, Ganye, Adamawa State. The treatment consisted of three different maize varieties, two hybrids, namely variety 1 (TZE Comp-5) and variety 2 (TSZR-W), both are regarded as high yielding varieties and variety 3 (unimproved local variety) regarded as low yielding variety. The selection of the maize varieties was based on the fact that they are the most popular varieties and have been used by most farmers in the zone for the past two decades as gathered by the researcher himself which was also confirmed by Sajo and Kadams (2005) and Adamawa State Agricultural Development Programme (AADP,2007). The hybrid varieties 1 and 2 were obtained from AADP Yola, a recognized government agency responsible for the handling of agricultural seeds in the State, while the local variety was obtained from a local farmer in the zone.

An experimental farm with a total size of 45m by 45m was laid out in a Randomized Complete Block Design (RCBD) method. The three maize varieties, replicated three times were planted at same time on the farm with the onset of rain in the zone. All inter and intra rows spacing of the crops were at 75cm and 25cm apart respectively, with plant thinned to one or two per stand two weeks after sowing. Each plot was separated by 2m apart as pathway between plots (Fig 2).

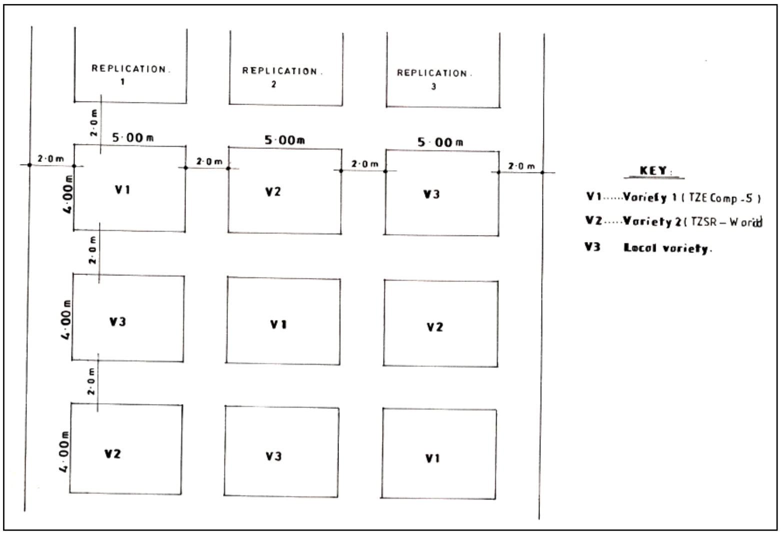


**Figure 2:** Field Layout Design for the experiment involving three varieties of maize (V1, V2 and V3) arranged in a Randomized Complete Block Design (RCBD) replicated three times

Relatively uniform farm management practice was applied on the farm throughout the two growing seasons. Farms were first cleared, ploughed, harrowed and well leveled by tractor in order to get a flat and uniform surface before sowing so as to have easy and uniform seed germination (PROTA, 2005).

The local seed variety was treated with a chemical (Apron plus DS) at the rate of one sachet per 3kg of seeds before sowing in order to protect the seeds against soil borne diseases. The hybrid seeds were treated with this chemical already and do not need this treatment again. Seeds were sown on the leveled ground after the plot was demarcated and marked out. Sowing of seeds commenced in the zone when the soil moisture and temperature conditions were measured to be suitable for seed germination. Weeding frequency using a hand hoe was maintained at time intervals of 3 and 6 weeks period after sowing (in addition to herbicides applied earlier) in order to maintain weeds free conditions till harvest on the farm. Fertilizer in the form of NPK (20:10:10) was applied twice at equal dozes of 20, 10 and 10kg/plot. The experiments were carried out for two growing seasons (2009 and 2010) consecutively.

**Data collection**

Data on maximum and minimum temperatures, mean daily, monthly and annual rainfall (as well as precipitation effectiveness indices such as onset dates of rain, cessation dates and length of rainy season), relative humidity and sunshine hours were obtained for the period of the two growing season months (May-October) and used in this study. The data were obtained from the meteorological station of Upper Benue River Basin Development Authority (UBRBDA) Yola, located adjacent to the experimental farm.

Soil data was obtained after the collection of soil samples from the experimental farm. Soil sample collection procedure involved digging of holes (to a depth of 0-20cm and 20-40cm) in five different places randomly selected on the experimental farm using soil auger. Soil samples collected were analyzed at the Laboratory of the Department of Soil Science Federal University of Technology Yola, Adamawa state.

Data on crop parameters determining growth and yield were collected on the farm directly from a continuous monitoring and assessment of growth and yield performances of maize varieties for the two growing seasons consecutively. Growth parameters included plant height, stem diameter; leaf length, leaf area and plant stand count, while yield parameters included cob length, cob diameter, days to 50% flowering, days to 95% maturity, one hundred grains weight, and yield per plot. This information was collected from ten randomly selected crops (usually in the middle rows regarded as areas with the least border effects). Measurements were taken every 10 days beginning from three weeks after sowing till maturity stage of the crops.

## RESULTS AND DISCUSSION

**Rainfall**

The movement of the Inter Tropical Discontinuity (ITD) and its associated zones of rainfall during the course of the year is the major factor controlling rainfall in Nigeria. Between November and January, the ITD is in its most southerly position (at about latitude 2-5$^{o}$ N). During this period, the whole of northern Nigeria (Adamawa state inclusive) is under the influence of dry, continental and relatively stable air masses from the north-east (the harmattan). There is hardly any rainfall received between November and February in the State (Table 1).

As the ITD advances northwards, the southern zone of the state starts receiving small amounts of rainfall in the month of March. The small Rainfall amounts received during this period ranged from 10mm in Jada Local Government Area (LGAs) to 50mm in Ganye LGAs both situated in the southern zone of the State. However, Mean annual rainfall in the zone was up to 1600mm.

Mean onset dates for the two growing seasons varied from 10$^{th}$ and 20$^{th}$ April in the zone. Normal cessation dates varied between16$^{th}$ September and 6$^{th}$ November in the zone, while mean lengths of rainy season varied between 120 to 210 days in the zones respectively (Fig. 3).

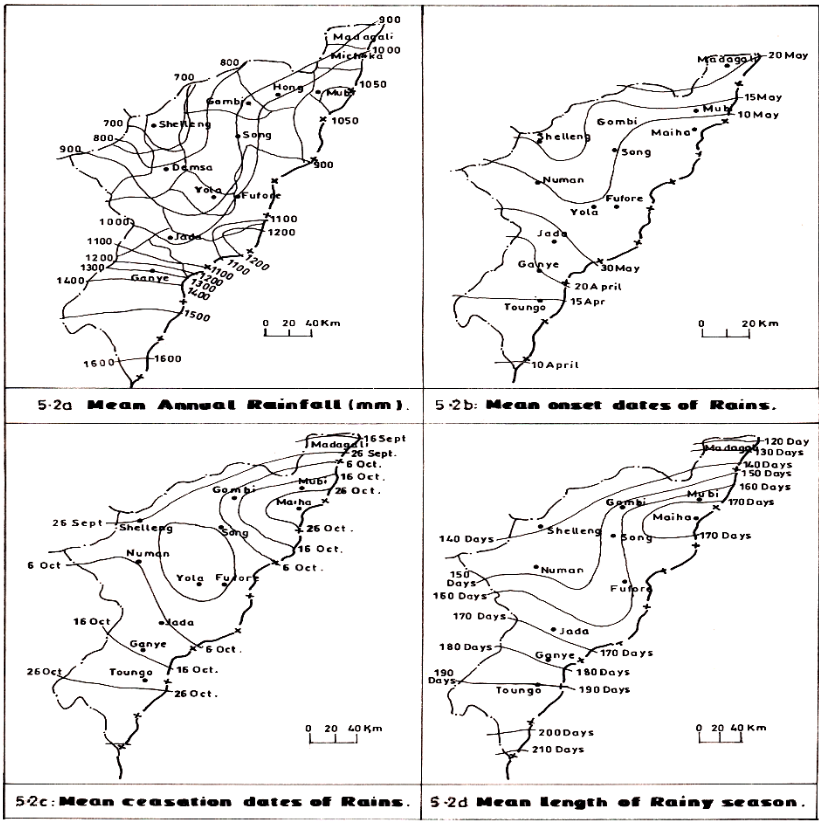


**Figure 3:** Map of the Study Area showing spatial distribution of precipitation indices

The understanding of spatial variations of rainfall characteristics is of paramount importance to maize varieties production in the zone. Information on onset and cessation dates of rains will assist farmers to determine the appropriate time for sowing of crops in the zone. Finally, the knowledge of the spatial variations in rainfall amounts will also provide a useful guide in deciding which maize variety that can be optimally cultivated in the southern zone of the State.

**Temperature**

Air temperature characteristics in the southern zone of the State were generally typical of the West African Savannah climate. Temperatures in this climatic region are high throughout the year because of high radiation income which is relatively evenly distributed throughout the year. However, there was a gradual increase in temperature from January to April in the zone. The seasonal maxima occurred in April. There was a distinct drop in temperature at the onset of rains due to the effect of cloudiness. A slight increase after the cessation of rains

(October-November) was observed before the onset of harmattan in December when temperature dropped further. Maximum temperature reached up to 40$^{O}$C in April while minimum temperature was as low as 18 $^{O}$C between December and January in the zone (Table 1). Mean monthly temperature in the State varied between 26.7 $^{O}$C to 27.8 $^{O}$C in the zone.

**Relative Humidity**

Seasonal variations in relative humidity in the zone are shown in Tables 1. Between January and March, relative humidity was observed to be extremely low (20-30%) in the zone. It started increasing from April and reached the peak (about (80%) in August and September. This was due to the influence of the humid maritime air mass which covered the whole of the zone during this period. Relative humidity started to decline again as from October following the cessation of rains.

**Sunshine hours**

Mean monthly distribution pattern of sunshine hours in the southern zone of the State (Table 1) shows that the period from January to April had mean monthly sunshine hours of over 220. There was a decline in sunshine hours between May and September due to increasing cloudiness all over the zone. The mean duration of this period was about 207 hours. The mean sunshine hours increased again to 255 hours for the period between October and December. The amount of sunshine hours varied between 20.9 to 244.5 hours between the growing seasons in the zone. In relation to maize production, the mean sunshine hours in the zone was adequate throughout the two growing seasons to provide the drying power of the air required by maize and other field crops such as sorghum, millet etc. Similarly, temperature and other climatic parameters discussed above did not pose serious limitation to maize production in zone the during the two growing seasons because they were relatively less variable as observed during the two growing seasons.

**Overview of soil characteristics of the southern zone**

In general, the particle size distribution of soils of the zone reveals that the soil texture of the surface horizons vary from loamy sand to clay with pronounced variation within the zone. Apparently, the varying texture of the soils suggests that the variability of parent materials from which they were developed. More than 50% 0f the soils of the zone have sandy loam textured soils on the surface horizons indicating the highly suitable nature of the soils for crop production particularly with cereals like maize, while the remaining areas can be used for deep rooted crops such as yam and cassava.

**Table 1:** Average Climatic Condition in Ganye (southern Zone) for 2009-2010 seasons

| Months | T. Max. (°C.) | T. Min. (°C.) | T.Mean (°C.) | R.H (%) | Rainfall (MM) | Evap.(mm) | S/Shine (hrs) |
|---|---|---|---|---|---|---|---|
| Jan | 30.4 | 16.4 | 23.4 | 58.3 | 0 | 256.5 | 221.8 |
| Feb. | 24.3 | 18.3 | 21.3 | 54.4 | 0 | 281.6 | 244.5 |
| Mar | 36.3 | 25.3 | 30.8 | 52.8 | 0 | 321.9 | 184.8 |
| April | 34.8 | 23.9 | 29.4 | 49.6 | 57.0 | 269.0 | 168.1 |
| May | 34.6 | 22.4 | 28.5 | 45.5 | 86.0 | 196.0 | 149.6 |
| Jun | 30.2 | 21.2 | 25.7 | 40.3 | 203.3 | 129.0 | 130.1 |
| Jul | 29.4 | 20.9 | 25.2 | 84.6 | 248.8 | 125.8 | 115.1 |
| Aug. | 28.7 | 20.9 | 24.8 | 84.9 | 324.5 | 121.4 | 99.8 |
| Sept | 29.2 | 21.3 | 25.3 | 82.3 | 129.1 | 102.4 | 83.2 |
| Oct | 31.8 | 21.3 | 26.6 | 71.6 | 83.9 | 147.7 | 62.8 |
| Nov. | 32.5 | 15.7 | 24.1 | 49.8 | 45.5 | 213.4 | 41.2 |
| Dec. | 30.3 | 16.1 | 23.2 | 39.5 | 5.0 | 249.0 | 20.9 |

**Source:** Field Survey, 2010.

Soil reaction (pH) measured in waterfall varied from strongly to slightly acidic in nature with few soils of the zone that are neutral to alkaline in reaction. The low pH values indicate that soil acidity can be a problem on most soils of the zone if proper management is not done. However, salinity hazard is not likely to occur in the zone. Soil acidity can affect the natural distribution of plants. The adverse effect is usually the deficiency of essential plant nutrients (e.g. Ca, Mg and P). This may be common in the zone because of high rainfall, high enough to leach appreciable amounts of exchangeable bases from the surface layers of soils.

Organic matter contents of the soil of the zone varied from low to moderate on most of the soils, although, there can be wide variations within the zone. Because of the relative low organic matter content of soils in the zone, the soils are likely to respond to nitrogenous fertilizers. In addition to N fertilizers, crop rotations involving legumes can be adopted as an alternative with a view to maintaining the soils productivity on a sustainable basis in the zone.

Exchangeable cations especially Ca and Mg and base saturation both varied significantly from low to moderate. Deficiency of such essential elements associated with high acidity limits growth, cause lodging and structurally weakens a crop and makes it prone to fungus attack (FMOA&RD, 2002). Soils of these types are likely to develop acidity if they are not properly managed.

Generally, the soils of the zone have been classified into low, moderate and high fertility categories (FDALR, 1985). Out of the total soil categories of the zone, 51.9% is made up of low fertility soils, 35.7% has moderate fertility while 12.4% has high fertility. Therefore, majority of the soils of the zone is covered by soils of low fertility but, with pockets of higher fertility soils.

Despite variations in soil types and fertility levels in the zone, problems of soil fertility maintenance are similar in many parts of the zone. The important elements in soil fertility maintenance worthy to note here are the organic matter and mineral nutrient contents which decline with cropping. The traditional method of improving such soil fertility in the zone is in most cases through bush fallowing. However, investigations by researchers have shown that the use of bush fallow systems in maintaining soil fertility has failed in many parts of the zone more especially in urban areas because of continuing rapid population growth. This failure has led to increasing concern about the future of using fallow for soil fertility maintenance.

**Table 2:** Generalized ratings for soil fertility class in the zone

| | | | | |
|---|---|---|---|---|
| **Nitrogen (Total N)** | | | | |
| Low | < 1.5g kg$^{-1}$ | | | |
| Medium | 1.5-2.0g kg$^{-1}$ | | | |
| High | > 2.0g kg$^{-1}$ | | | |
| **Phosphorus** | **(Bray-1-P)** | **(Bray-2-P)** | | |
| Low | < 8mg kg-1 | < 15mg kg-1 | | |
| Medium | 8-20mg kg-1 | 15-25mg kg-1 | | |
| High | > 20mg kg-1 | > 25mg kg-1 | | |
| **Potassium (Exch. K)** | | | | |
| Low | < 20mol/kg-1 | | | |
| Medium | 0.20-0.40mol/kg-1 | | | |
| High | > 0.40mol/kg-1 | | | |
| **Organic Matter (OM)** | | | | |
| Low | < 20g kg$^{-1}$ | | | |
| Medium | 20-30g kg$^{-1}$ | | | |
| High | > 30g kg$^{-1}$ | | | |
| **Exchangeable Cations (Meq/100g soil)** | | | | |
| | Exch. Ca | Exch. Mg | Exch. K | Exch. Na |
| Very High | > 20 | > 8 | >1.0-2.0 | >2.0 |
| High | 10-20 | 3-8 | 0.6-1.0 | 0.7-2.0 |
| Moderate | 5-10 | 1-3 | 0.3-0.6 | 0.3-0.7 |
| Low | 2-5 | 0.3-1.0 | 0.2-0.3 | 0.1-0.3 |
| Very Low | < 2 | < 0.3 | < 0.2 | <0.1 |
| **Percentage Base Saturation (%)** | | | | |
| Very Low | 0-20% | | | |
| Low | 20-40% | | | |
| Moderate | 40-60% | | | |
| High | 60-80% | | | |
| Very High | 80-100% | | | |
| **Soil Reaction (pH)** | | | | |
| Strongly acid | 5.1-6.0 | | | |
| Moderately acid | 5.6-6.0 | | | |
| Slightly acid | 6.1-6.5 | | | |
| Slightly acid to Neutral | 6.6-7.3 | | | |
| Slightly alkaline | 7.4-7.8 | | | |
| Moderately alkaline | 7.9-8.4 | | | |
| Strongly alkaline | 8.5-9.0 | | | |

**Source:** Field Survey, 2010.

Despite this, the use of fertilizers for the maintenance of soil fertility is limited. Farmers often are unable to use agrochemicals because of sudden price increase, supply shortages and changes in the Nigeria's credit policies which are mostly detrimental to the small-farm holders.

**Relationships between climatic factors and growth and yield of maize varieties in the zone**

Mean values from the analysis of variance showing performances of growth and yield parameters of maize varieties in the zone for the two growing seasons are presented in Table 3 below.

From the Table, maize varieties generally showed highly significant performances (note: performance in this context explain levels of development in growth and yield of maize varieties) in most of the growth and yield parameters measured during both growing seasons. Highlights of the results showed that maize variety 1 (TZE-Comp 5) was the highest performed variety in terms of growth parameters such as stem diameter, plant stand count, cob length and cob diameter; and also in yield parameters such as days to 50% flowering, days to 95% maturity, 100 grains weight and grain yield per plot at significant differences of p=0.01. Maize variety 2 (TZSR-W) was the second best variety which performed better than variety 3 in terms of stem diameter, plant stand count, days to 50% flowering, cob diameter, days to 95% maturity, 100 grains weight and grain yield per plot. Mean values for all these parameters showed significant difference at p=0.01 confidence level, while variety 3 (local variety) performed highly significant at (p=0.01) only in plant height, leaf length and number of leaves per plant. The remaining parameters showed significant difference at (p=0.05) probability level (Table 3).

Mean values of correlation coefficients between climatic factors and yield of maize varieties in the zone of the State for the two growing seasons are presented in Table 4 below. It could be observed from the table that maize yield showed a significant negative correlation at p=0.01 with rainfall, temperature and humidity, but however, showed positive significant correlation at p=0.05 with sunshine hours only during the $1^{st}$ and $2^{nd}$ periods of observations.

The negative relationship at (p=0.01) between yield of maize varieties with rainfall, temperature and humidity signifies that these periods of observation are beginning of rainy season and represents the sowing period in the zone of the State which also shows that rainfall and relative humidity were still insufficient. Adequate rainfall is needed therefore during this period to give enough soil moisture for the crop growth. Shortage of rainfall at these stages of plant growth can cause retardation in growth, hence low yield. However, significant negative correlation at p=0.05 was observed between sunshine hours and yield of maize varieties for most periods of observation. This was because of the fact that rainfall was frequent and often high which provided heavy and thick cloud cover in the zone thereby reducing the amount of solar radiation reaching the earth-atmosphere systems. The implication of this was that insufficient sunshine hours which characterized this zone during the both growing seasons have caused retardations in maize growth and development processes compared to other zones in the State where sunshine hours are high.

Generally, it is evident from Table 4 that significant positive varietal correlation existed between plant height (0.57), leaf length (0.57), number of leaves per plant (0.88), plant stand count (0.87), cob length (0.69), cob diameter (0.71), yield per plot (0.73), days to 50% flowering (0.75) and days to 95% maturity (0.85) with temperature, rainfall and humidity. Positive significant correlation was also observed between yield per plot (0.62), cob length (0.62) and grains weight per cob (0.94) with temperature and sunshine hours in the zone (Table 4).

## CONCLUSION

Of all the climatic factors which influence the pattern and productivity of rainfed agriculture in Nigeria and by extension tropical regions, availability of water to crops is by far the most important. The amount, incidence, variations and reliability of rainfall have far reaching influences on agricultural production and in determining the differences in cropping patterns in various parts of the region (Kowal and Kassam, 1983; Jagtap, *et al* 1993; Amissah-Athur, 1997).

One of the major sources of risk in agricultural production is climatic variability. This can be manifested in the form of yield variation. Yield risk can be affected by fluctuations in rainfall, temperatures, humidity and solar radiation. In addition pest and diseases incidences, which may be partly induced by climatic events, can accentuate it. All other factors which cannot be predicted with certainty but which affects crop growth processes also can contribute to yield risk.

Thus, farmers in the zone are presently confronted with phenomena of intensification of land use and reduced fallow periods, because of increasing population and the degradation of soils' physical and chemical properties in intensified cereal-based cropping systems, all of these within a declining and vulnerable rainfall regime.

**Table 3:** Mean variations of growth and yield parameters of maize varieties of Ganye farm Location (southern zone)

| Source | dF | PH | SD | LL | NL | PSC | Days to 50% flow | CL | CD | Days to 95% mat | 100 grains weight | Grain yield per plot (Kg/ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Var. 1 | 2 | 18.2 | 15.3** | 19.4* | 8.04* | 58.7** | 58.3** | 49.2** | 22.4** | 62.1** | 54.2** | 826.81** |
| Var. 2 | 3 | 23.5** | 13.7** | 19.5** | 6.9** | 56.3** | 48.4** | 32.8** | 28.1** | 55.3** | 48.2** | 781.86** |
| Var. 3 | 3 | 25.4** | 8.5** | 21.5** | 9.08** | 55.2* | 44.3** | 33.6* | 19.3** | 44.3** | 40.1 | 720.31* |
| $V_1$xWAS | 4 | 90.3** | 28.2** | 24.8** | 92.9** | 7.9** | 33.7** | 87.8** | 29.4** | 82.1** | 65.5** | 747.87** |
| $V_2$xWAS | 6 | 16.4* | 99.3** | 90.3** | 58.8* | 10.4* | 18.8** | 95.8* | 87.8** | 36.9** | 40.5** | 186.81* |
| $V_3$xWAS | 9 | 28.9** | 19.5 | 14.02** | 21.5** | 87.8** | 18.5** | 31.3 | 12.2** | 19.9** | 18.6 | 280.68** |
| Error | 58 | 1681.8 | 7.9 | 3.49 | 10.5 | 3.9 | 14.7 | 58.9 | 223.1 | 102.3 | 19.8 | 822.13 |

**Source:** Field Survey, 2010

* Significant at (p = 0.05)

* *Significant at (p = 0.01)

**Note:** PH = plant height, SD = Stem diameter, LL = Leaf length, NL = Number of leaves per plant, PSC = Plant stand count, CL = Cob length, CD = Cob diameter, Var. = Variety, $V_1$ x WAS = Variety 1 x weeks after sowing,

**Table 4:** Mean correlation coefficients of climatic factors with growth and yield parameters of maize varieties of Ganye farm location (southern zone)

| Time | PH | SD | LL | No. of leaves | PLSTC | Days to 50% flowering | Days to 95% maturity | Cob. Len | Cob. Diam | 100 grain weight | Grain yield per plot(Kg/ha | RF | $T^0C$ | Hum | SS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | -0.61** | -0.60** | -0.48** | -0.87** | -0.63** | 0.12 | 0.13 | 0.13 | -0.16* | -0.15* | -0.05* | -0.40** | -24.7** | 41.3 | -205.5* |
| 2 | -0.03** | -0.32** | -0.63** | -0.44** | -0.43** | 0.78* | -0.34 | 0.20 | 0.20 | 0.10 | 0.28 | -0.26** | -22.6** | 41.2 | -199.9* |
| 3 | 0.10 | 0.58 | 0.63* | 0.47 | -0.46 | 0.84* | 0.14 | 0.15 | 0.18 | 0.10 | 0.26 | 4.40 | 32.1 | 47.5 | 200.8 |
| 4 | 0.26 | 0.10 | 0.32 | 0.93* | 0.10 | 0.78* | 0.57* | 0.22 | 0.28 | 0.18 | 0.28 | 56.7 | 30.7 | 58.2 | 165.6 |
| 5 | -0.11 | -0.03 | 0.58* | -0.30 | -0.29 | -0.09 | 0.76* | 0.51 | 0.28 | 0.19 | 0.28 | 146.6 | 29.8 | 72.2 | 148.1 |
| 6 | 0.16 | 0.13 | 0.10 | 0.29 | -0.30 | 0.48 | 0.61* | 0.35 | 0.40 | -0.31 | -0.22 | 163.1 | 27.0 | 93.5 | 129.6 |
| 7 | 0.73* | -0.35 | -0.03 | 0.23 | 0.32 | 0.63* | -0.19 | 0.22 | 0.62* | 0.09 | -0.07 | 228.0 | 26.5 | 88.2 | 109.9 |
| 8 | 0.81* | 0.12 | 0.13 | 0.19 | 0.55* | 0.63* | 0.08 | -0.59* | -0.62 | 0.39 | 0.49 | 254.5 | 26.3 | 97.5 | 98.4 |
| 9 | 0.78* | 0.57* | -0.34 | 0.28 | -0.19 | 0.32 | 0.03 | 0.38 | 0.62* | 0.32 | 0.45 | 199.6 | 26.6 | 76.8 | 79.4 |
| 10 | -0.09 | 0.76* | 0.14 | -0.32 | 0.32 | 0.58* | 0.03 | 0.14 | 0.85* | 0.62* | 0.94* | 200.0 | 28.0 | 94.4 | 66.2 |
| 11 | 0.47 | 0.78* | 0.57* | 0.03 | 0.28 | 0.10 | 0.18 | 0.23 | 0.26 | 0.57* | 0.23 | 24.1 | 25.6 | 58.3 | 42.6 |
| 12 | 0.60* | -0.09 | 0.76* | 0.47 | 0.17 | -0.03 | 0.64* | 0.23 | 0.48 | 0.23 | 0.36 | 19.6 | 24.5 | 44.3 | 24.1 |

**Source:** Field survey, 2010

**Note:***=Significant at p=0.05, **= significant at p=0.01, OBS=observation periods, PH=plant height, SD=Stem diameter, LL= Leaf length, NL=Number of leaves per plant, PSC= Plant stand count, CL= Cob length, CD= Cob diameter, RF= rainfall, T=Temperature, Hum= Humidity and SS= sunshine.

Therefore, sound and adequate soil management and cropping systems such as agroforestry which can serve as a reliable protective soil erosion control measure should be adopted by farmers in the zone. However, forests have to be established and properly managed to check soil erosion. Minimizing tillage operations will also help in stabilizing the Physico-chemical properties of the soils, thus, sustaining its productivity and continued cultivation. Similarly, the introduction of viable crop rotation practices which keeps the soils covered all year round should be adopted by farmers in the zone. Crop rotation practices which help produce an early ground cover without necessarily depleting the soils of its nutrients is certainly more useful in controlling run-off and erosion than those which takes longer periods for a full canopy cover to develop. Crop rotation with the inclusion of legumes will also go a long way in sustaining the fertility of the soils. Finally, a judicious and balanced fertilization (compound fertilizers) is to be adopted where necessary, with a view to avoiding the development of deficiency of individual nutrients, including micronutrients of the soils. In addition, organic manure is to be followed in order to sustain the productivity of the soils on a long-term basis.

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