YIELD AND YIELD COMPONENTS OF MAIZE (*ZEA MAYS* L.) AS INFLUENCED BY VARIETIES AND NITROGEN LEVELS IN NORTHERN GUINEA SAVANNA ECOLOGICAL ZONE OF NIGERIA.

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ABSTRACT

Experiments were conducted at the Taraba State College of Agriculture Experimental Farm, Jalingo (latitude 6° 30′ and 9° 36′ N; longitude 9° 10′ and 11° 50′E), Nigeria during the 2004 and 2005 cropping seasons whereby two varieties of maize {New Kaduna (W) and Obatanpa (QPMW)} as main plots, and seven nitrogen fertilizer levels (30, 40, 50, 60, 70, 80 and 90 kg N ha^{-1}) as sub plots in a split plot arrangement replicated three times. Soil and Yield parameters measured include soil pH, soil total nitrogen, available phosphorous, exchangeable cations, organic matter,100 grains weight, grains yield, percentage protein and percentage fat. The results indicated that Obatanpa (QPMW) significantly exhibited better yield parameters of 100 grains weight, grains yield, and percentage crude protein than New Kaduna (W), Furthermore, nitrogen levels of 70, 80 and 90 kg N ha^{-1} consistently produced the highest mean values of 100 grains weight, grains yield, and percentage crude protein.

Key words: Maize varieties, nitrogen levels, yield components.

INTRODUCTION

Maize (*Zea mays* L.) originated in Central America and was introduced to West Africa in the early 1500s by the Portuguese traders (Dowswell *et al.*, 1996). Today, maize is one of the most important food crops world-wide. It has the highest average yield per hectare and is third after wheat and rice in area and total production in the world. It is grown in most parts of the world over a wide range of environmental conditions, ranging between 50° latitude north and south of the equator. It also grows from sea level to over 3000 meters above sea level (Dowswell *et al.*, 1996). Maize is a cereal crop grown for food, feed and industrial uses. World production was around 800 million metric tons in 2007, which is just slightly more than rice (approximately 650 million metric tons) or wheat (approximately 600 million tons). The United States produces almost half of the world's harvest (approximately 42.5%). Other top producing countries include China, Brazil, Mexico, Argentina, India and France. In 2007, over 150 million hectares of maize were planted worldwide, with a yield of 4971 kilogram/hectare. Nigeria is the 10th largest producer of maize in the world, and the main producing country in tropical Africa with an annual production in excess of 6 million metric tons (USAID MARKETS, 2010). In Nigeria, area of maize is expanding across the agro-ecological zones. The most notable expansion is occurring in the north, where maize is replacing sorghum and grown under irrigation replacing wheat and vegetables (Ado *et al.*, 1999).

The maintenance of high crop yield under intensive cultivation is possible only through the introduction of high yielding, drought tolerant, early, and extra early maturing varieties and use of fertilizers (IITA, 2006). Nitrogen (N) is the most limiting nutrient in maize production in the Nigerian savanna. Nitrogen fertilizer, water supply, spacing of plants and temperature are the most important factors in obtaining maximum yield of maize (Rowland, 1993). There are scanty information on maize production as regards quality protein maize and nitrogen requirement in Jalingo.The study, therefore, aimed at investigating the response of two maize varieties to specific levels of nitrogen for optimum maize production in Taraba State.

MATERIALS AND METHODS

Field experiments were conducted in two successive cropping seasons (2004 and 2005) at the Taraba State College of Agriculture Experimental Farm Jalingo, which lies between latitude 6° 30′ and 9° 36′ N; longitude 9° 10′ and 11° 50′E (Taraba State Diary, 2003).The treatments consisted of two maize varieties (New Kaduna and Obatanpa) and seven nitrogen rates (30, 40, 50, 60, 70, 80 and 90 kg N ha^{-1}) in a split-plot design replicated three times, with varieties as main treatments and nitrogen rates as sub treatments. There were inter and intra row spacing of 75 cm x 50 cm with two plants per stand. Main plots and replicates were separated by 2 m path ways and 1 m path ways between sub-plots. There was an application of 30 kg P_2O_5 ha^{-1} at sowing using SSP as source of P. Uréa fertilizer was used as source of nitrogen fertilizer and it was applied in two split doses. The first dose of each level of nitrogen fertilizer applied to the crop at four weeks after sowing (WAS) was 40%, while the remaining 60% was applied at booting using band placement method.

The land was harrowed and leveled in order to get a fine tilts. Maize seeds were treated with Apron plus at the rate of one sachet per 3 kg of seeds in order to protect the seeds against soil-borne diseases and sown on the 16th July, 2004 and 2005. The crop was sown on the flat after the plots were marked out. Maize plants were thinned to two plants per stand at 3 WAS. Weeding was done manually at 3,6 and 9 weeks after sowing (WAS).

Data collection

Soil sampling: Soils were randomly sampled by digging three borings of 0-15 cm depth before and after harvest. The soil samples were bulked, air dried and sieved through 2 mm mesh before physico-chemical analysis was carried out in the soil science laboratory of the Department of soil science, Federal University of Technology, Yola.

Particle size analysis: The particle size analysis was carried out using bouyoucons hydrometer method (model No. 4427 ASTM) as described by Black (1965). The textural class of the soil was obtained using marshal's textural triangle (Palmer and Troech, 1977).

Soil pH: The soil pH was measured in soil suspension which was determined using glass electrode digital pH meter (model kent Bil 704548) as described by Black (1965).

Soil total nitrogen (N %): The regular macro kjedahl method was used to determine nitrogen in the soil samples as described by Black (1965). The percentage N in the soil was calculated using the following formula:

$$\% N = \frac{a \times n \times 0.014 \times 100}{w}$$

Where a = amount of hydrochloric acid (HCL) used for titration (m/s)

n = Normality of HCL

w = Mass equivalent (g/100 g) of N (g) (constant)

Available phosphorus: The soil available P was determined using the bicarbonate method as described by Olsen *et al.* (1954).

Exchangeable cations:
The soil exchangeable cations were extracted with 1N ammonium acetate solution. The concentration of Na^+ and K^+ were determined using flame photometer. The concentration of Ca^{++} and Mg^{++} were determined by titration with 0.02NEDATA solution as described by age *et al.* (1982).

Organic carbon and organic matter: The organic carbon and organic matter of the soil were determined using the dichromate wet oxidation method as describe by Black (1965).

Weather data collection: Weather data including rainfall, relative humidity, daily temperature and sunshine hours from 2004 to 2005 were collected from the weather station of the General Studies Department, Taraba State College of Agriculture Jalingo.

Weight of 100 maize grains: Weight of 100 maize grains per plot was weighted using a weight scale balance. An average total from the weight of 100 grains of sub-plots was recorded as weight of one hundred grains.

Grains yield: This was computed from the grains yield of sub plots as follows:

$$\text{Grain yield (kg/ha)} = \frac{\text{Grain yield per plot (kg)} \times 10{,}000\ m^2}{\text{Net plot size } (20.25m^2)}$$

Grain protein and oil content: Grain samples were taken from each of the 42 plots and were analyzed for their protein and oil contents in a laboratory usingnear infrared reflectance (NIR) analyzer.

Statistical analysis:
Data generated from all measured parameters where subjected to split plot analysis as described by Gomez and Gomez (1984) using the PROG GLM procedures of the SAS statistical package for windows (SAS, 1999). Mean separations were performed using LSD ranking of the soft ware package.

RESULTS

Soil analysis of the experimental site:
The results of soil analysis indicated that the soil was sandy loam with 61.6% sand, 24.8% silt and 13.6% clay (Table 1). The soil was slightly acidic with a PH of 5.26. The soil also contained low percentage of organic matter (0.07%) (Table 1).

Meteorological data: Meteorological results for the 2004 and 2005 followed similar pattern, with only slight variations (Figures 1-4). Maximum temperatures were experienced in March and minimum in August for the two years (Fig 1). Sunshine hours followed the same pattern with day temperatures (Fig 2); days with more sunshine hours were experienced in March and most cloudy days in August, for both years. The monthly mean rainfall for the 2004 and 2005 cropping seasons were 106.7mm and 107.0mm. For both years no rain was recorded from December to February. Rain generally started in March and ended in November, reaching peaks in August (Fig 3). Result on relative humidity followed similar pattern with rainfall (Fig 4). The driest months were the first two and the last month of the two years. Relative humidity was very high during the month of August when rainfall was at its peaks.

Weight of 100 grains:

Weight of 100 grains as affected by varieties, and nitrogen levels treatments in 2004 and 2005 revealed no significant (P = 0.05) difference in respect of weight of 100 grains. Highest (32.40) weight of 100 grains was produced by Obatanpa in 2005, while least (25.59) weight of 100 grains was produced by New Kaduna in 2004. The application of 70 kg N ha^{-1} produced highest (45.93) weight of 100 grains in 2005 while the least (16.86) weight of 100 grains was produced with the application of 30 kg N ha^{-1} in 2004 (Table 2).

Weight of 100 grains in the combine analysis showed no significant difference (P= 0.05) among the year, varieties and the nitrogen levels. Weight of 100 grains in 2004 and 2005 gave same mean values of 22.13 (Table 2). Variation was observed between the varieties in the combine analysis where Obatanpa produced the highest (31.42) weight of 100 grains over the new kaduna with lowest (25.98) mean value. The application of 70 kg N ha^{-1} produced the highest (45.20) weight of 100 grains and lowest (17.02) mean value was recorded with the application of 30 kg N ha^{-1} (Table 3).

Grain yield:

Grain yield in 2004 in Table 2 indicated no significant (P = 0.05) difference between varieties and nitrogen levels. However, there was significant (P = 0.05) difference between varieties in grain yield in 2005. There was no significant (P = 0.05) difference between nitrogen levels in grain yield in 2005. Obatanpa variety yielded the highest (1984.90) grain yield in 2004 than New Kaduna (1725.90) in 2004. The application of 80 kg N ha-1 produced the highest (1964.40) grain yield in 2005, while the treatment of 30 kg N ha-1 produced the least (1166.70) grain yield in 2004 (Table 2).

Table 3 showed significant difference (P=0.05) between the year on the grains yield. There were no significant difference (P= 0.05) between the varieties and the nitrogen levels for the combine analysis. However there were significant interaction (P= 0.05) between varieties and year. Same mean values of grain yield for 2004 and 2005 were produced. Obatanpa produced highest (1983.34) grain yield over New Kaduna (1740.86). The application of 80 kg N ha^{-1} yielded the highest (1905.31) grain yield while 30 kg N ha^{-1} yielded the lowest (1210.50) grains yield (Table 3).

There was also highly significant difference (P = 0.01) between varieties and year as presented in Table 5. Highest yield value of 1665.77 kgha-1 was produced by interaction of Obatanpa in 2004, while the least (1555.82) grain yield was recorded in the interaction of New kaduna in 2004 (Table 5).

Percentage crude protein:

Results of percentage crude protein in Table 2 indicated that there were no significant difference ($P = 0.05$) due to varieties in percentage crude protein in 2004 and 2005. On the other hand, there were significant difference ($P = 0.05$) among the nitrogen levels in percentage crude protein in 2004. There were no significance difference ($P = 0.05$) between nitrogen levels on percentage crude protein in 2005. Obatanpa produced the highest (4.43) percentage crude protein in 2004 and lowest (3.95) percentage crude protein was produced by New Kaduna in 2004. The application of 90 kg N ha^{-1} recorded the highest percentage crude protein (5.61%). Least (3.95) percentage crude protein was produced with the treatment of 30 kg N ha^{-1} in 2004.

There were no significant difference ($P=0.05$) between the years and varieties on percentage crude protein. However there were significant difference ($P=0.05$) between the nitrogen treatments on the percentage crude protein in the combine analysis. Similarly there were significant interaction ($P= 0.05$) between the varieties and the nitrogen levels on the percentage crude protein. Percentage crude protein produced in 2004 and 2005 were the same (4.36). Statistically Obatanpa produced highest (4.41) percentage crude protein over New Kaduna (4.17). The application of 90 kg N ha^{-1} produced highest (5.00) percentage crude protein while the application of 40 kg N ha^{-1} recorded the lowest (4.16) percentage crude protein (Table 3).

Table 4 presents the interaction between maize varieties and nitrogen levels in the combine analysis of percentage crude protein. There were significant ($P=0.05$) interaction between varieties and nitrogen levels on percentage crude protein in the combine analysis. When Obatanpa interacted with 90 kg N ha^{-1} highest (5.83) percentage crude protein was produced while lowest (4.15) percentages crude protein was recorded when 50 kg N ha^{-1} with New Kaduna Variety..

Percentage crude fat:

Result showed there were no significant difference ($P =0.05$) between varieties, nitrogen levels and the year on the percentage crude fat in 2004, 2005 and the combine analysis (Tables 2 and 3). Same mean values (7.26) of percentage crude fat were produced in 2004 and 2005 respectively. Combined analysis showed that Obatanpa statistically produced the highest (8.17) means value of percentage crude fat than New Kaduna with 6.88 mean value. With the application of 90 kg N ha^{-1} recorded when 60 kg N ha^{-1} was applied (Table 3).

DISCUSSION

Effect of varieties and Nitrogen levels on grain yield and yield component of maize:

The performance of maize varieties (New Kaduna and Obatanpa) in Jalingo was basically similar in the two seasons (2004 and 2005). However, crop growth and yield were optimally better in 2005 than 2004. This was probably as a result of adequate rainfall distribution in 2005 than in 2004. The total amount of rainfall received in 2005 was more (963.30mm) as against 959.90mm in 2004. Sufficient and even rainfall distribution result in good growth and yield. Schulthess (2007) reported that even rainfall distribution enhances early uniform emergence, good growth, increase yield and improves grains quality of maize. Adegbola *et al.* (1972) similarly reported that it is possible to get good yield with only 460mm-

760mm of rainfall if it is evenly distributed during the cropping season. Growth and yield of maize plant is largely governed by the distribution of rainfall because distributions supersede the intensity or amount of rainfall received over a cropping season (Adegbola *et al.* 1972).

There were some levels of increase among the varieties and the nitrogen levels in 2004 and 2005 cropping seasons in terms of 100 grains weight and yield. In both years and in the combine analysis of the cropping seasons quality protein maize variety Obatanpa produced the highest grain yield, this could be as a result of high level of nitrogen supplied. Nitrogen supply is usually associated with increase in grains yield of maize. These results are consistent with those reported by Griesh and Yokout. (2006), who stated that increasing nitrogen levels from 60 t0 120 kg N ha^{-1} significantly increased plant height, ear length and diameter, number of rows per ear, 100 grains weight, grains yield per hectare in both seasons of the study. Uzo and Paul (1985) also reported similar result in their findings. This also might not be unconnected with the availability of yield parameters such as interception of light and production of photosynthate. Application of nitrogen increase leaf area development resulting in greater radiation interception and consequently high efficiency in the conversion of solar radiation. Aluko and Fisher (1987), reported that the amount of light intercepted and therefore the photosynthate produced by the plant during flowering is the dominant factor determining final number of grains.

The applications of 70 kg N ha^{-1} gave the highest mean values of 100 grain weight in 2005. This might be as a result of relatively adequate supply of nitrogen and optimum rainfall received during cropping seasons. The application of nitrogen fertilizer increased leaf area expansion and thus photosynthetic activity, rooting volume and water use efficiency which all contributed to better crop growth, development and grain yield. This conforms with report of Onken and Wendit (1989), who reported that application of nitrogen under rainfall condition increased water use efficiency (WUE) and grain yield of maize and sorghum.

The interaction of varieties and nitrogen levels on percentage crude protein in the grain showed that varieties performed similarly under different nitrogen levels. However, 90 kg N ha^{-1} gave the highest crude protein in 2004 over other nitrogen levels. This is so provably because it is the highest nitrogen level in the treatments and is expected to supply more nutrients to the yield component and is likely favored by a drier and warmer condition than normal conditions during late vegetative development and grains fill which may have contribution to the higher grain protein composition. This result agrees with the report of Thomision *et al.* (2004) that drier and warmer than normal conditions during late vegetative development and grain fill may contribute to the higher grain protein compositions.

There were significant differences among the nitrogen levels in 2004 and the combine analysis of the cropping seasons. This might be due to high nitrogen level supplied during silking. This is similar to the report of Padua (2005), who reported that Nitrogen application at silking also increased grains crude protein content up to the application of 100 kg N ha^{-1}. This response showed that nitrogen applied during booting was taken by the plant and accumulated in the grains. The treatment of 70 kg N ha^{-1} gave the highest mean values in 2004, and the combine analysis. This was so because the response of maize to applied nitrogen is dependent on many factors including soil types, crop sequence and supply of residual and mineralized nitrogen. This is in line with the report of Oberle and Keeney (1990), and Lory *et al.* (1995), who stated that crop maize response to applied nitrogen fertilizer is affected by a number of factors.

Percentage crude fat was not significantly influence by nitrogen levels and variety in 2004, 2005 and the combine analysis where by Obatanpa, 40 kg N ha^{-1} and 50 kg N ha^{-1} gave the highest crude fat content respectively. Most studies had shown that increase in nitrogen rates have little or no effect on percentage crude fat. This is in conformity with Thomision *et al.* (2004), who reported that grain oil concentration was not influenced by the timing of nitrogen application and responded to nitrogen rate only in 2001.

CONCLUSION

Results of the experiment proved the efficacy of Quality protein maize (QPM) variety Obatanpa and application of nitrogen levels 70 kg N ha^{-1}, 80 kg N ha^{-1} and 90 kg N ha^{-1} on yield and yield components in Jalingo. It is therefore, recommended that further works that will include more varieties of Quality protein maize (QPM) and nitrogen levels be tried in order to identify the optimum varieties for higher protein content and nitrogen level for optimum maize production in Jalingo and other ecological zones of the state.

REFERENCES

Ado, S.G.; Abubakar, I.U. and Mani, H. (1999). Prospects of Extra Early maize varieties in the Nigeria savannah zones. In: *Valencia, J.A.; Falaki, A.M. and Ado, S.G.(Eds) Sustainable maize production in Nigeria: the challenge in the coming millennium, proceedings of National Maize workshop*, pp.96-107.

Adegbola, A.A.; Are, I.A.; Ashaye, T.I. and Komolafe, M.F. (1972). Agricultural science for West African schools and colleges. *Oxford University press*, pp. 106-109.

Aluko, G.A. and Fisher, C.S. (1987). The effects of changes of Assimilation supply around flowering on grain sink size and yield of maize (*Zea mays* L.) cultivated on tropical and temperate adaptation. *Australian Journal of Agricultural Research* 28:153-161.

Black, C.A. (1965). Methods of soil analysis; *Agronomy Journal* No. 9 part 2 American Society of Agronomy. Madison Winscosin, USA.

Dowswell C.R., R.L. Paliwal and R.P. Cantrell. (1996). Maize in Third World. West View Press, Inc. Colorado,USA.

Gomez, K.A. and Gomez, A.A. , (1984) *Statistical procedures for Agricultural Research*; 2nd ed. John Willey and Sons: pp 306 – 308.

Griesh, M.H. and Yokout, G.M. (2006). Effects of plant population density and nitrogen fertilization on yield and yield component of some white and yellow maize hybrids under drip irrigation system in sandy soil. Plant Nutrition, 92:810-811.

International Institute for Tropical Agriculture (IITA) (2006). Annual report for 2006, Ibadan, Nigeria.

Lory, J.A.; Rosselle, M.P. and Randall, G.W. (1995). A classification system for factors affecting crop response to nitrogen fertilization. *Agronomy Journal*, 87: 869-876.

Oberle, S.I. and Keeney, D.R. (1990). Soil type, precipitation and fertilizer effects on corn yields. Journal of Production Agriculture 3:522-527. Olsen, S.R.; Cole, C.V.; Watanabe, F.S. and Dean, I.A. (1954). Estimation of Available P in the in the soil by extraction with NaHCO, USDA: 939.

Olsen, S.R.; Cole, C.V.; Watanabe, E.S. and Dean, I.A. (1954). Estimation of available P in the soil by extraction with NaHCO, USDA: 939.

Onken, A.B. and Wendit, C.W. (1989). Soil fertility management and water relationships.In: Soil, crop and water management systems for rain fed agriculture in the sudano-sahelian zone. Proceedings of an international Workshop, 11-16 January 1987, ICRISAT Sahelian Center, Niamey, Niger, pp. 99-105.

Padua, A.D. (2005). The effects of nitrogen side dressing at the booting and silking stages on agronomy traits of maize hybrids commercially released at different areas. *Scientia Agricola*, 1-13.

Page, A.I.; Miller, P.H. and Keeney, D.R. (1982). Methods of soil analysis part 2: chemical and micro biological properties 2nd edition, ASA, in Madison Wisconsin, USA.

Palmer, R.G. and Troech, F.R. (1977). Introductory soil science laboratory manual. 2nd edition *Iowa State University press*. Ames Iowa, USA.

Rowland, J.R.J. (1993). Dry land farming in Africa. 3rd edition, Macmillan press, pp 80-100

Schulthess, J.R. (2007). Sweet Corn production: *Department of Horticultural Science, North Carolina Cooperation Extension Service*. North Carolina State University USA. Pp 1-8.

Statistical Analysis System (1999). SAS/Stat users guide for personal computers version 8. North Carolina, USA, *Statistical Analysis System Institute*. 378pp.

Taraba State diary (2003). Ministry of information, Jalingo. Taraba State, Nigeria

Thomison, P.R.; Bishop, B.L.; Young, J.R.; Geyer, A.B. and Lentz, E. (2004). Nitrogen fertilization effects on grain yield, protein and oil of corn hybrids with enhanced grains quality traits. *Crop Management*, 1-7.

USAID MARKETS (2010). Package of practices for maize production. Prepared by USAID MARKETS, p1-23.

Uzo, A.M. and Paul, I.G.V. (1985). Developments in plant and soil sciences management of nitrogen and phosphorus fertilizers in sun-saharan Africa. *Martinus nijhoff publshers*. pp. 117-121

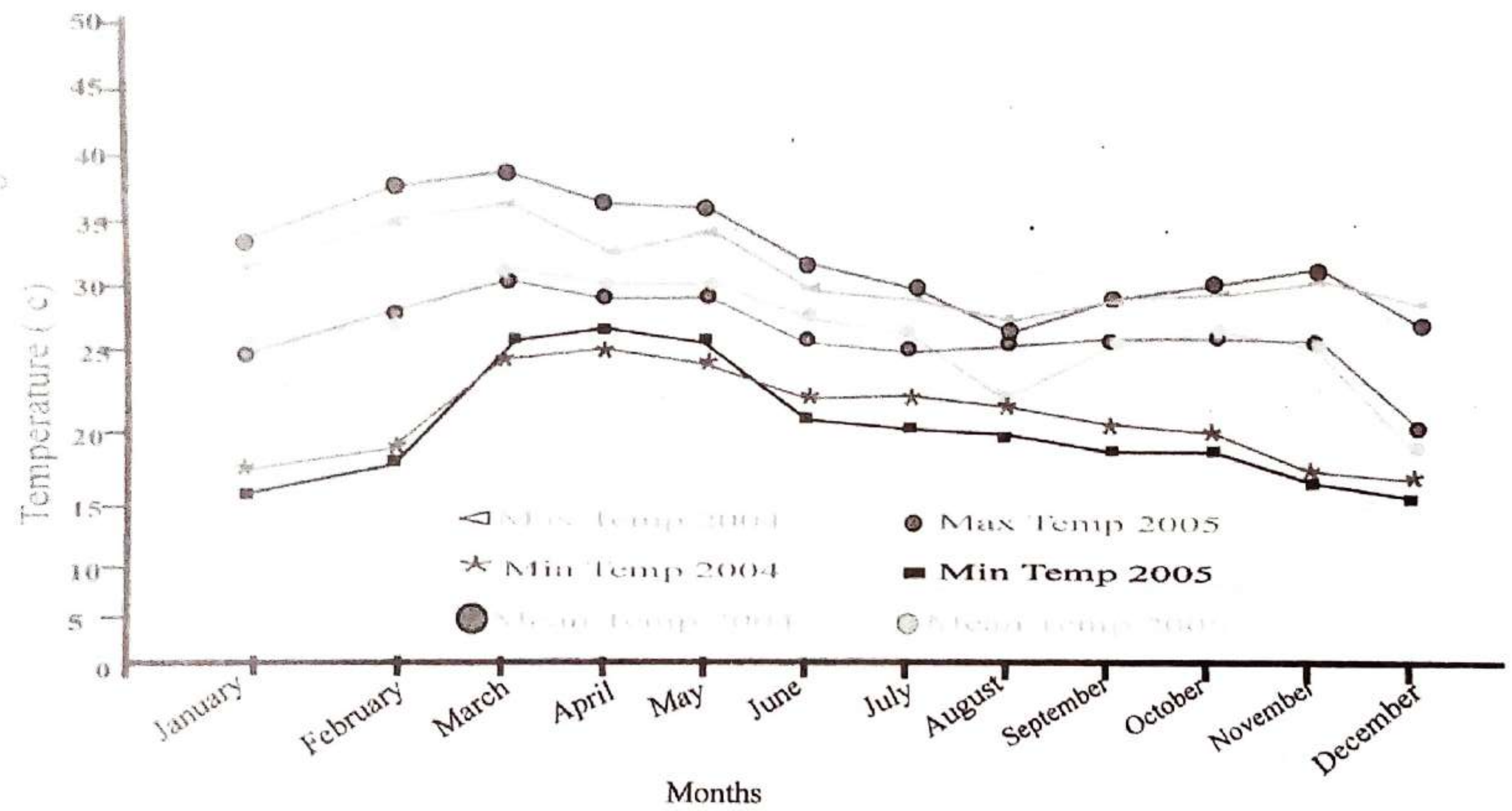

Fig. 1: Maximum, minimum and mean Temperatures in Jalingo for 2004 and 2005

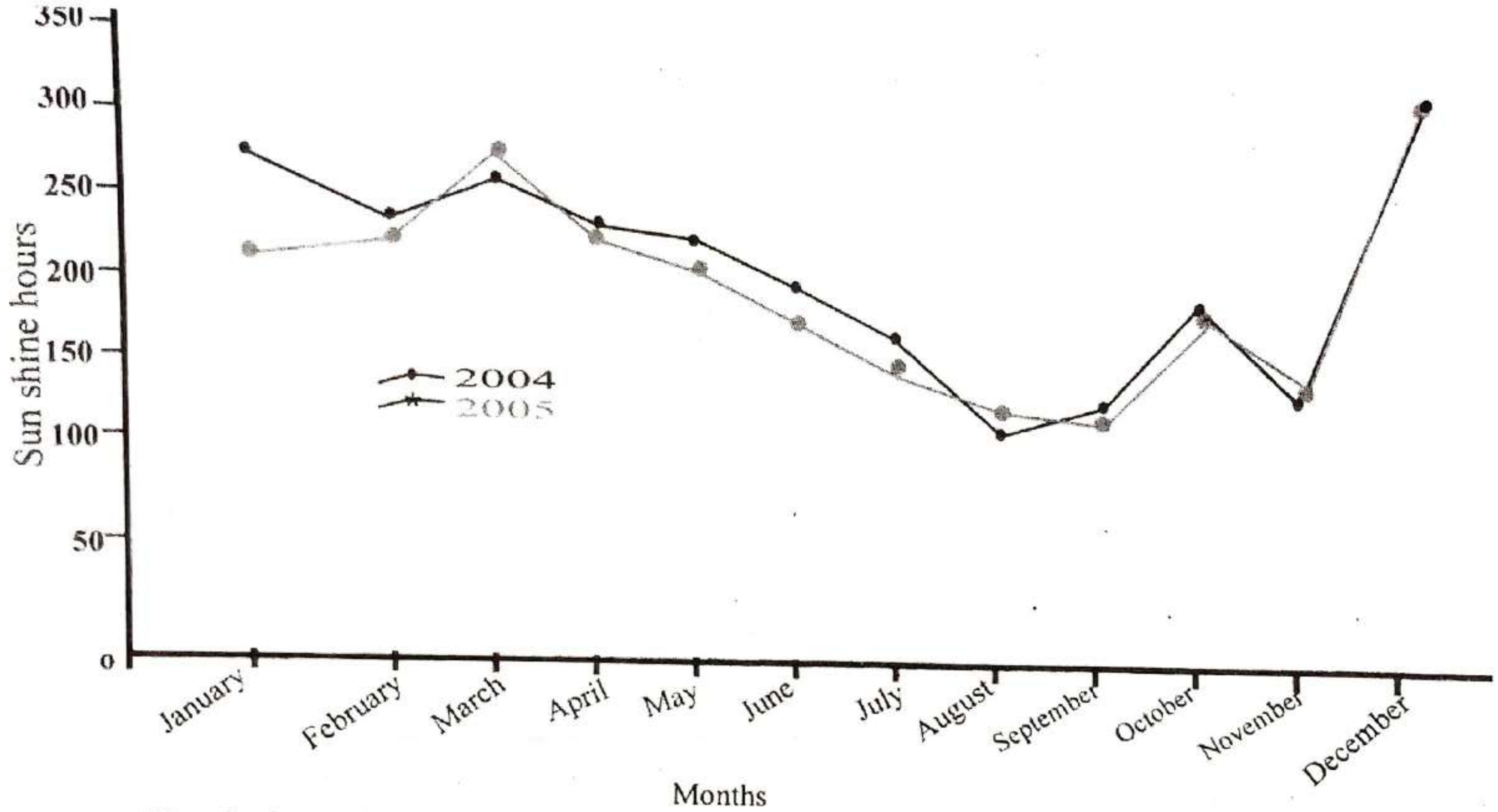

Fig. 2: Sunshine hours in Jalingo during the 2004 and 2005 cropping seasons

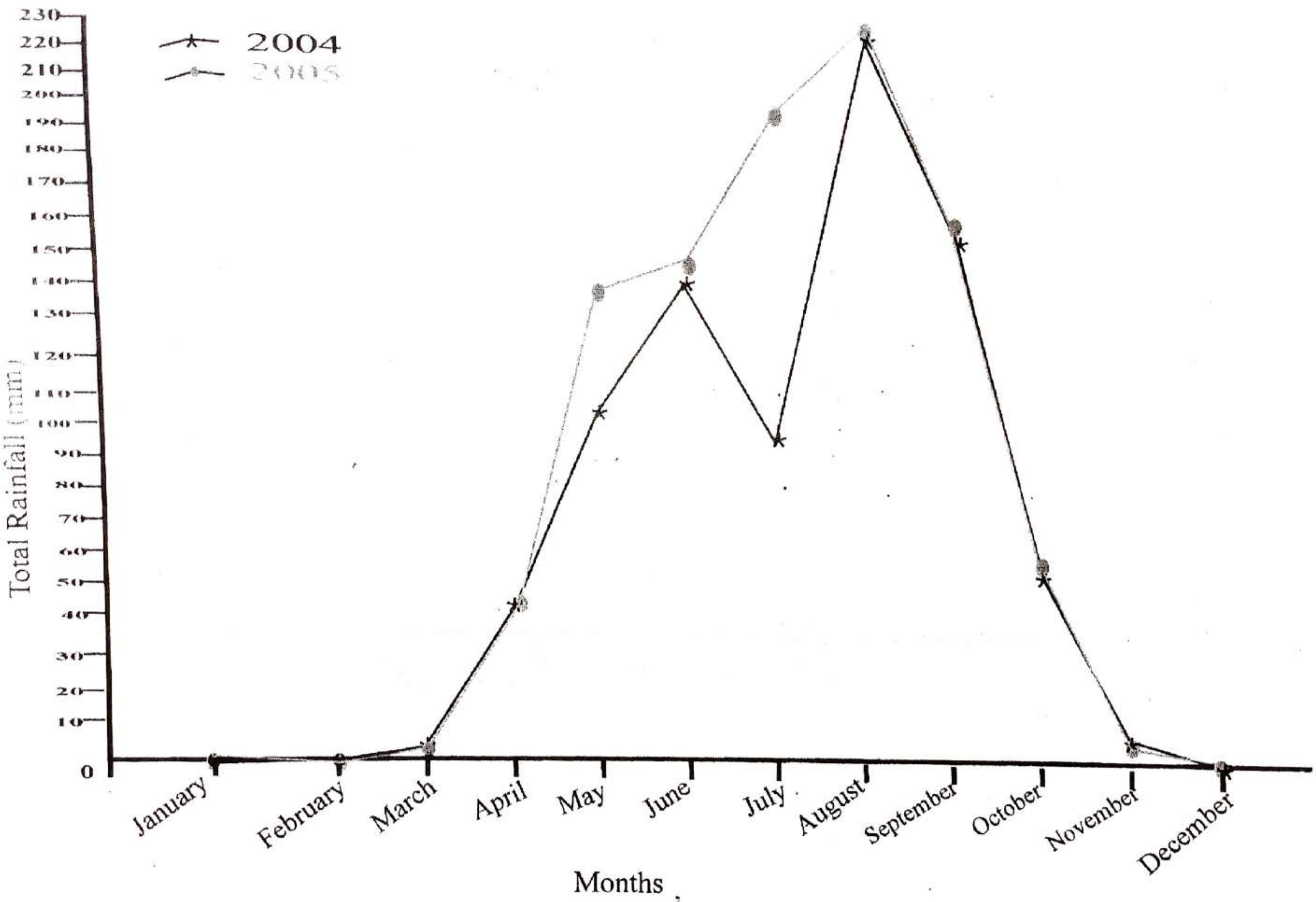

Fig. 3: Total Rainfall in Jalingo during the 2004 and 2005 cropping seasons

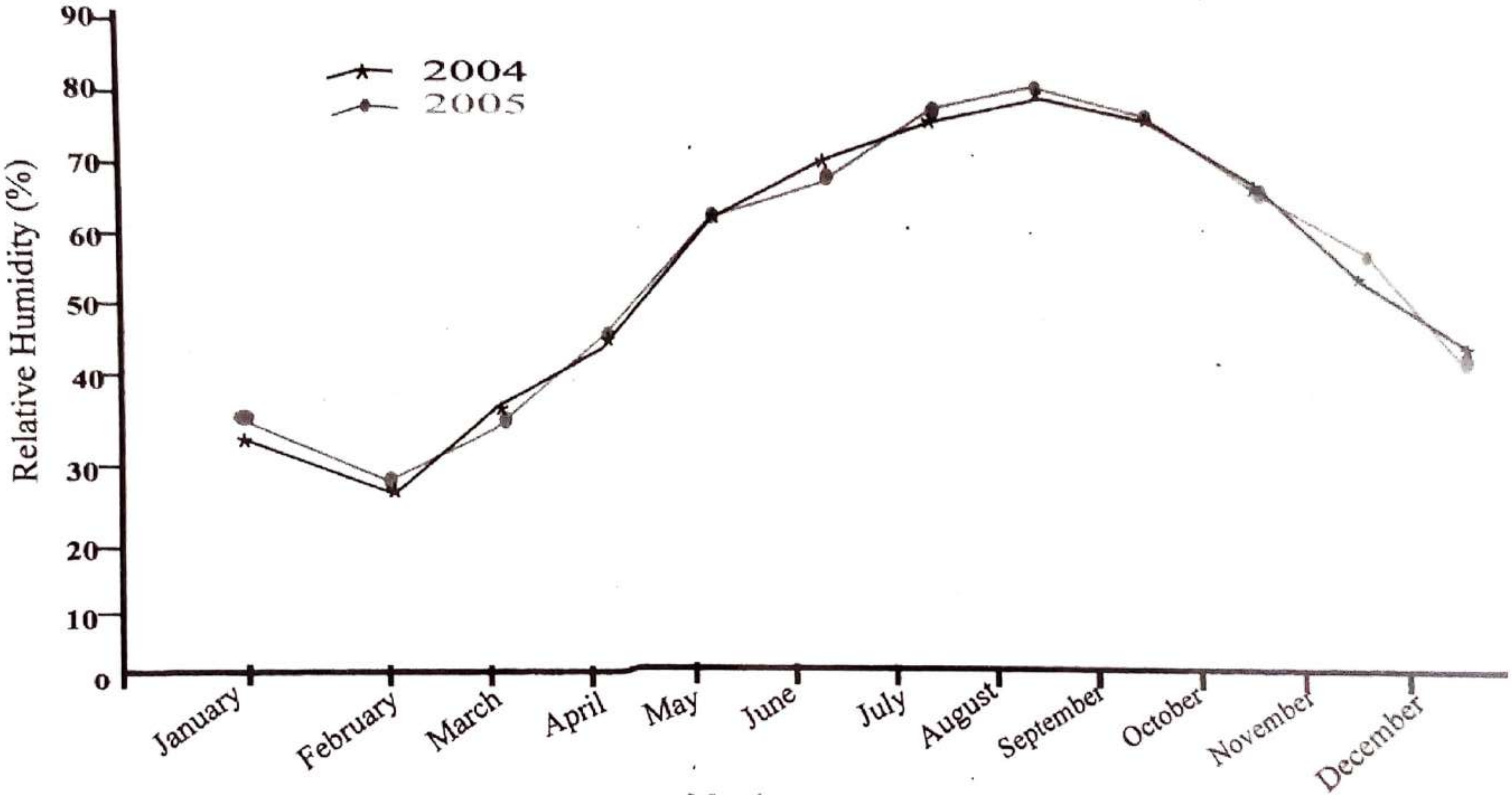

Fig. 4: Relative humidity in Jalingo during the 2004 and 2005 cropping seasons

Table 1: Physical and chemical characteristics of soils of the experimental site

	Soil characteristics	Values
A.	Mechanical Analysis (0-15 cm)	
	Clay %	13.6
	Sand %	61.6
	Silt %	24.8
	Textural class	Sandy loam
B.	Chemical Analysis	
	Soil pH	5.26
	EC (mm hos/cm)	0.36
	Organic carbon (OC) %	0.57
	Organic matter %	0.98
	Total N %	0.07
	Exchangeable potassium	0.54 cmol (+)/kg
	Available calcium phosphorous (ppm)	0.94
	Exchangeable calcium (100 g)	3.36 cmol (+)kg
	Exchangeable magnesium (100 g)	2.47 cmol (=)/kg
	Exchangeable sodium	0.25 cmol (+)/kg
	Exchangeable hydrogen ion (H^+)	0.50 cmol (+)/kg
	Exchangeable Aluminium ion (Al^{3+})	0.70 cmol (+)/kg
	Effective cation exchange capacity (ECEC)	7.82 cmol (+)/kg

Table 2: Effects of variety and nitrogen levels on the weight of 100 grains (g), grains yield (kg/ha), percentage crude protein and percentage crude fat of two varieties of maize grown at Jalingo in 2004 and 2005.

Treatment	Weight of 100 grains (g)		Grains yield (kg/ha)		% crude protein		% crude fat	
	2004	2005	2004	2005	2004	2005	2004	2005
A. varieties								
New Kaduna (W)	25.59	26.38	1725.90	1755.81	3.95	4.38	6.59	7.18
Obatanpa (QPMW)	30.44	32.40	1984.90	1981.77	4.43	4.40	8.97	7.38
Mean	28.01	29.39	1855.40	1868.79	4.19	4.39	7.78	7.28
SE	15.08	3.26	115.08	163.32	0.54	0.02	4.30	0.64
CV %	20.32	21.25	16.25	22.71	22.25	0.61	9.78	15.09
LSD (0.05)	16.63	3.60	248.31	183.49	0.59	0.02	2.40	0.70
B. Nitrogen level (kgha^{-1})								
30	16.86	17.18	1166.70	1254.30	3.95	4.38	6.88	6.92
40	16.88	18.68	1222.20	1322.60	3.96	4.37	6.89	7.60
50	17.31	19.31	1323.50	1328.00	3.96	4.38	6.89	7.60
60	22.53	25.93	1633.20	1698.80	3.96	4.40	5.88	6.25
70	44.47	45.93	1854.30	1799.72	3.96	4.40	6.89	7.53
80	39.65	37.40	1846.21	1964.40	3.96	4.40	6.90	7.53
90	39.66	37.53	1846.20	1922.12	5.61	4.38	7.12	7.53
SE	15.07	3.26	115.08	163.32	0.54	0.02	4.30	0.63
LSD (0.05)	31.11	6.74	464.55	353.27	1.11	0.03	4.49	1.31
C. AxB	Ns	ns	ns	ns	*	ns	ns	ns

ns =not significantly different at p=0.05, * = significantly different at p = 0.05

Table 3: Combined analysis on the Effects of variety, nitrogen levels and the year on weight of 100 grains (g), grains yield (kg/ha), percentage crude protein and percentage crude fat of two varieties of maize grown at Jalingo in 2004 and 2005.

Treatment	Weight of 100 grains (g)	Grain yield ($kgha^{-1}$)	% crude protein	% crude fat
2004	22.34	1668.80	4.36	7.26
2005	22.34	1668.80	4.36	7.26
Mean	22.34	1668.80	4.36	7.26
SE	11.11	201.63	0.39	3.13
LSD (0.05)	2.48	166.4	0.0084	0.48
A. Varieties				
New Kaduna (W)	25.98	1740.86	4.17	6.88
Obatanpa (QPMW)	31.42	1983.34	4.41	8.17
Mean	28.70	1862.10	4.29	7.53
SE	11.11	201.63	0.39	3.13
CV %	19.07	22.24	05.38	7.71
LSD (0.05)	8.29	150.37	0.29	2.34
B. Nitrogen level ($kgha^{-1}$)				
30	17.02	1210.50	4.17	6.90
40	17.78	1272.40	4.16	7.24
50	18.31	1325.75	4.7	7.24
60	24.23	1666.00	4.18	6.06
70	45.20	1827.01	4.18	7.21
80	41.53	1905.31	4.17	7.21
90	41.60	1884.16	5.00	10.83
SE	11.11	201.63	0.39	3.13
LSD (0.05)	15.51	281.36	0:54	4.37
C. Interactions				
VxY	ns	*	ns	ns
VxT	ns	ns	*	ns
VxTxY	ns	ns	ns	ns

ns =not significantly different at p=0.05, * = significantly different at p = 0.05, V = variety, T = Treatment (fertilizer levels), Y = year

Table 4: Interactions between nitrogen levels and two varieties of maize on the % crude protein for 2004 and % crude protein combined analysis in Jalingo.

	% crude protein in 2004		Combined means of % crude protein	
Varieties	V1	V2	V1	V2
Nitrogen levels ($kgha^{-1}$)				
30	3.96	3.94	4.17	4.17
40	3.97	3.95	4.17	4.16
50	3.94	3.95	4.15	4.18
60	3.95	3.97	4.18	4.18
70	3.96	3.97	4.18	4.19
80	3.94	3.96	4.17	4.18
90	3.96	7.26	4.17	5.83
Mean	3.95	4.43	4.17	4.41
LSD (0.05)	0.29		0.21	

V1 = New Kaduna (W) maize variety 1, V2 = Obatanpa (QPMW) maize variety 2

Table 5: Interactions between year and two varieties of maize on grain yield for combined analysis in Jalingo.

	Grain yield ($kgha^{-1}$)	
Varieties	V1	V2
Year		
2004	1555.82	1665.77
2005	1565.80	1655.77
Mean	1560.81	1660.77
LSD (0.05)	0.21	

V1 = New Kaduna (W) maize variety 1, V2 = Obatanpa (QPMW) maize variety 2