GROWTH PARAMETERS OF MAIZE (*ZEA MAYS* L.) AS INFLUENCED BY VARIETIES AND NITROGEN LEVELS IN JALINGO NORTHERN GUINEA SAVANNA OF NIGERIA.

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ABSTRACT

Field 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 consisting two varieties of maize {New Kaduna (W) and Obatanpa (QPMW)} were allocated to the main plots, and seven nitrogen fertilizer levels (30, 40, 50, 60, 70, 80 and 90 kg N ha^{-1}) as sub plots laid out in a split plot arrangement replicated three times. Parameters measured include crop stand count, plant height, number of leaves per plant, stem diameter, leaf area index, ear diameter, ear length, number of rows per ear and number of grains per ear. The results indicated that Obatanpa (QPMW) significantly exhibited better growth parameters of plant height, stem diameter, ear diameter, number of rows per ear and number of grains per ear than New Kaduna (W). Furthermore, nitrogen levels of 70, 80 and 90 kg N ha^{-1} consistently produced the highest mean values of plant height, number of leaves per plant, stem diameter, leaf area index, ear diameter, ear length, number of rows per ear and number of grains per ear.

Key words: Growth parameters, Maize varieties, nitrogen levels.

INTRODUCTION

Maize (*Zea mays* L.) is a major cereal crop for human nutrition and livestock feed in Nigeria. It is also an important raw material for several agro-based industries. The grain is mainly processed and used in the preparation of several indigenous dishes. Despite its wide spread use across the country, maize consumed in Nigeria is mainly normal maize with low protein content. Unlike in other West African countries such as Ghana, the adoption and cultivation of quality protein maize (QPM) is rather low in Nigeria. Normal maize proteins like other cereal proteins have poor nutritional value for monogastric animals such as humans and pigs, because of reduced content of essential amino acids such as lysine and tryptophan. Cereal protein contains on average about 2% lysine which is less than one half of the concentration recommended for human nutrition by Food and Agricultural Organization (FAO) of the United Nations (Prasanna *et al*., 2001). Hence, normal maize dependent diets can lead to mal nutrition. According to United Nation Development Programme (UNDP), almost one billion people living in developing countries are mal nourished and do not consume enough protein for good health (Future Harvest, 2004). The nutritive value of QPM protein approaches that of protein from milk (NRC, 1988).

The maintenance of high crop yield under intensive cultivation is possible only through the use of fertilizers. 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). The contribution of N to growth and yield of maize is large and readily quantifiable. Nitrogen influences yield largely because of its role in determining the amount of sunshine absorbed by crops and the efficiency of sunshine utilization to biomass. Nitrogen deficiency reduces leaf size, which reduces total crop leaf area and consequently the ability to absorb radiation. Furthermore, the N deficiency reduces the concentration of N in leaves, which reduces their sunshine use efficiency (SUE) or ability to photosynthesize. Nitrogen deficiency also causes premature leaf death because crops are able to sense when leaf N concentration is getting too low to sustain adequate level of SUE. To combat this problem crops sacrifice leaves so that N can be shifted to a smaller number of more efficient leaves. Together, these responses underline the importance of adequate N for maize growth and yield. A typical maize crop contains about 1.5% N, which for a 15 tha^{-1} yield requires absorption of about 450 kg N ha^{-1}, with approximately 275 kg N ha^{-1} residing in the grain. Nitrogen contributes most effectively to yield if provided for the duration of crop growth (Steele, 1984). Owing to the effect of rapid population growth and enormous expansion of industrial and other socio-economic activities, which Jalingo in particular and Taraba State in general has been experiencing in the recent years; has resulted in reduction of cultivatable land area arising from competitive demand for land by the non agricultural sectors of the economy. Maize production and nitrogen requirement in Jalingo has been based on recommendation by the Taraba State Agricultural Development Programme. Detail study on maize and its nitrogen requirement is therefore lacking. It, therefore, becomes necessary to investigate the response of two maize varieties to specific levels of nitrogen.

MATERIALS AND METHODS

Experimental site

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).

Treatments, Experimental design and field layout

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}). The treatments were laid out in a split-plot design, with varieties as main treatments and nitrogen rates as sub treatments and replicated three times. The sub plot size was 5 m x 4 m with inter- and intra-row spacing of 0.75 m x 0.5 m respectively with two plants per stand. 30 kg $P_2 0_5$ ha^{-1} was applied at sowing using SSP as source of P. Urea fertilizer was used as source of nitrogen fertilizer and it was applied in two split doses. Nitrogen fertilizer treatments were applied in two split doses with 40% at four weeks after sowing (WAS), while the remaining 60% was applied at booting using band placement method.

Agronomic practices

The land was harrowed and leveled in order to achieve a fine tilt before sowing the maize seeds on 16th July, 2004 and 2005. Maize seeds were treated with Apron plus at the rate of one satchet per 3 kg of seeds before sowing in order to protect the seeds against soil-borne diseases. 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

Data were collection on the following parameters:

Establishment Count Per Plot: Maize establishment count was taken at 3 WAS from the net plot.

Plant height: plant height was measured from the soil surface to the base of the inner most leaf at 3, 6 and 9 WAS. The average of ten randomly selected plants from the net plot were measured using a meter rule, was recorded.

Number of leaves per plant: Ten plants were randomly selected per plot and third leaf was tagged at 3 WAS. When sensescence progresses the tags were shifted to the 7th leaf at 6 WAS and to the 10th leaf at 9 WAS respectively. The average of the total number of leaves of ten plants was recorded as number of leaves per plant.

Stem diameter: This was done by measuring the middle of ten randomly selected plants at 5, 7 and 9 WAS using vernier calipers in millimeters. The average of ten diameters was used as a stem diameter.

Leaf area index: This was determined by dividing the leaf area per plant by the land area occupied by one plant.

Ear diameter: Ten maize ears were randomly selected per plot and the diameter of each ear was measured using vernier calipers in millimeters. The average of ten ears was used as an ear diameter.

Ear length: Ten maize ears were randomly selected per plot and their lengths were measured using a meter rule.. An average of the ten ears served as the ear length.

Number of row per ear: Ten ears were randomly selected from each plot, the number of rows from each ear was counted and an average number of rows per ear were determined there from.

Number of grains per ear: Ten ears were randomly selected from each plot, the number of grains from each ear was counted an average number of grains per ear were determined

Statistical analysis:

Data collected were subjected to analysis of variance (ANOVA) 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

Plants stand count:

The result of the performance of the two varieties tested during the 2004 and 2005 cropping seasons on establishment count are presented in Table 2. There was no significant difference (P=0.05) on establishment count between the varieties of maize in 2004 and 2005. The effect of nitrogen levels on the establishment count was not significant. New Kaduna variety gave the highest establishment count (48.10) in 2005 and the lowest establishment count was recorded (41.67) in 2005 while 70 kg N ha-^{1} treatment produced the least (41.67) establishment count in 2004 (Table 1). The combined analysis of the two-year results showed no significant (P = 0.05) effects on the establishment count of maize due to varieties and nitrogen influence for 2004 and 2005 cropping seasons.

Plant height at 3, 6 and 9 WAS:

Maize plant height at 3,6 and 9 WAS during 2004 and 2005 cropping seasons as affected by varieties and nitrogen levels are show in Table 1. There were no significant difference (P=0.05) between the maize varieties and nitrogen levels in plant height at 3 WAS in 2004 and 2005. However there were significant difference at P = 0.05 between varieties in plant height at 6 WAS in 2004 and 2005. Similarly there were significant differences (P = 0.05) between the nitrogen levels in plant height at 9 WAS in 2005. Obatanpa recorded the highest (15.60 and 81.33) mean values of plant height at 3 and 6 WAS in 2005. New Kaduna recorded the least (14.44 and 54.35) mean values of plant height at 3 and 6 WAS in 2004. New Kaduna produced the tallest plants (130.81) at 9 WAS in 2004 at 9 WAS while least (93.27) plant height was recorded by Obatanpa at 9 WAS in 2005. The application of 80 kg N ha^{-1} gave the tallest (134.07) plants at 9 WAS in 2004. The least (84.22) plant height was recorded from the application of 60 kg N ha^{-1} at 9 WAS in 2005 (Table 1).

There were significant (P=0.05) interaction between varieties and nitrogen levels in plant height at 9 WAS in the combined analysis. Obatanpa interacted with 50 kg N ha^{-1} and produced the tallest (117.67) plants at 6 WAS. The lowest (98.73) mean value of plant height was recorded when New Kaduna interacted with 60 kg N ha^{-1} (Table 2).

Number of leaves per plant at 3, 6 and 9 WAS:

There were no significant difference (P = 0.05) between the maize varieties and nitrogen levels in number of leaves per plant at 3 and 6 WAS in 2004 and 2005 respectively. However there were significant difference (P= 0.05) between the varieties on the number of leaves per plant at 9 WAS in 2004. Similarly there were highly significant difference (P =0.01) between varieties in terms of number of leaves per plant at 9 WAS in 2005 (Table 3). At 9 WAS New kaduna produced the highest (10.69) number of leaves per plant in 2004 while Obatanpa produced the least (6.71) number of leaves per plant in 2005. Highest (10.72) number of leaves per plant were recorded with the application of 80 kg N ha^{-1} at 9 WAS in 2004. Least (6.50) number of leaves per plant were recorded with the application of 90 kg N ha^{-1} at 9 WAS in 2005 (Table 3). Similarly, there was highly significant difference (P = 0.01) between the varieties in the combine analysis on the number of leaves per plant at 9 WAS. However, there was no significant difference (P = 0.05) between the nitrogen levels in the number of leaves per plant at 9 WAS.

Stem diameter at 5, 7 and 9 WAS:

Results of the Stem diameter showed no significant (P= 0.05) difference between varieties and nitrogen levels at 5 WAS in 2004 and 2005.On the other hand there was significant difference (P= 0.05) between varieties in stem diameter of maize at 7 WAS in 2004. There were no significant difference (P= 0.05) between nitrogen levels in stem diameter at 7 WAS in 2004 and 2005. Similarly there were no significant difference (P= 0.05) between varieties and nitrogen levels in stem diameter at 9 WAS in 2004 and 2005 and the combined means. Highest (7.41) stem diameter was produced by New Kaduna in 2004 at 9 WAS while Obatanpa produced the least (7.13) stem diameter in 2004 at 9 WAS. The application of 90 kg N ha^{-1} produced the highest (7.90) stem diameter at 9 WAS in 2004 while application of 80 kg N ha^{-1} recorded the least (6.27) stem diameter at 9 WAS in 2004 (Table 3). The quality protein maize variety Obatanpa produced the highest (9.85) stem diameter than New Kaduna with lowest (7.35) stem diameter at 9 WAS. Application of 80 kg N ha^{-1} statistically produced the highest (7.53) mean value in the combine analysis at 9 WAS, while 60 kg N ha^{-1} treatment produced the least (7.00) mean value (Table 3).

Leaf area index:

Leaf area index in 2004, 2005 and the combine means as affected by maize varieties and nitrogen levels are shown in Table 4. There were no significant (P= 0.05) difference between the varieties and nitrogen levels on the leaf area index of maize in 2004, 2005 and the combine means. New Kaduna produced the highest (4. 29) leaf area index in the combine means. Similarly application of 70 kg N ha^{-1} gave the highest (4.54) leaf area index in the combine means and the least (3.60) leaf area index was recorded with the application of 50 kg N ha^{-1} in 2004 (Table 4).

Ear diameter:

Result of ear diameter showed no significant difference (P=0.05) between varieties and nitrogen levels in ear diameter at 2004, 2005 and their combine means respectively. Highest ear diameter (12.93) was recorded by New Kaduna in the combine means while the least (12.58) ear diameter was produced by Obatanpa. The application of 90 kg N ha^{-1} gave the highest ear diameter (13.33), while the least (12.03) was recorded with the application of 30 kg N ha^{-1} in the combine means (Table 4).

Ear length:

Result of ear length indicated that there were highly significant difference (P= 0.01) between varieties in

2004 and the combine means. However there were no significant difference (P=0.05) between nitrogen levels in 2004, 2005 and the combine means. Longest (12.36) ear length was produced in by New Kaduna. The shortest (11.69) ear length was produced by New Obatanpa in the combine means. The application of 70 kg N ha^{-1} produced the longest (12.62) ear length while the application of 30 kg N ha^{-1} recorded the lowest (11.49) mean value of ear length (Table 4)

Number rows per ear:

Statistical analysis indicated that Obatanpa was the highest (12.83) on number of rows per ear whereas New Kaduna was the least (12.67) on number of rows per ear. The application of 90 kg N ha^{-1} produced highest (13.57) number of rows per ear while the lowest (12.48) was recorded from 60 kg N ha^{-1} treatment (Table 4).

Number of grains per ear:

Number of grains per ear as affected by varieties and nitrogen is shown in Table 4. There were no significant difference (P= 0.05) between the varieties and nitrogen levels on the number of grains per ear. Highest number of grains per ear was recorded in 2005 (259.30) than 2004 (155.08) in the combine analysis. Obatanpa variety produced highest (216.03) number of grains per ear than the New Kaduna (206.28). With the application of 90 kg N ha^{-1} highest (231.13) number of grains per ear was produced. The applications of 60 kg N ha-1 gave least (198.39) number of grains were produced (Table 4).

DISCUSSION

Effect of varieties and nitrogen levels on growth and yield of maize Parameters:

There were variatal variations in plant height at 3, 6 and 9WAS in both years of study. However, significant differences were observed in the nitrogen levels at 9WAS in 2005 cropping season. Although Obatanpa produced the tallest plants in 2004, 2005 and the combine years in which 60 kg N ha^{-1} produced the shortest plants in both years, while at 9WAS 80 kg N ha^{-1} recorded the highest plant height in 2004. The significant difference observed in nitrogen levels at 9WAS was probably due to optimum level of nitrogen supply. This is in line with the report of El- Douby *et al.* (2000), who reported that increasing nitrogen level up to 140 kg N ha^{-1} increased plant height. This is also in line with the report of Griesh and Yokout (2006).

The significant difference between the varieties in the number of leaves observed at 9 WAS, in 2004, 2005 and the combine analysis is probably as a result of genetic differences between the varieties in the expression of this trait. The New Kaduna produced the highest number of leaves than that of the Obatanpa. On the other hand, 30 kg N ha^{-1} which was the least in the treatment would have been expected to give the least number of leaves due to less supply of nutrient or 90 kg N ha^{-1} to produce the highest number of leaves due to high supply of nutrient. This result is in line with the report of Subedi and Ma (2005) that there was no effect on nitrogen treatment on the number of leaves in maize.

There were variations between varieties in stem diameter due to varietals treatments in 2004 at 7 WAS. There were no variations due to nitrogen levels at 5, 7 and 9 WAS on stem diameter in 2004, 2005 and at 5, 7 and 9

WAS and the combine analysis of the cropping seasons. This indicated that there were no nitrogen levels and crop interaction through out the plant growth period in 2004, 2005 and the combine analysis at 5, 7 and 9 WAS which might have had effect on the stem diameter. New Kaduna variety gave the highest values at 5, 7 and 9WAS in 2004 while in 2005 Obatanpa had the highest value in 2004. Similarly in 2005, 80 kg N ha^- level gave the highest mean value. This result is similar to the report of El-Douby *et al.* (2000), who reported that increasing nitrogen level up to 140 kg N ha^{-1} increased most of the character of maize under study.

There were difference between varieties in both 2004 and 2005 and the combine analysis with regards to ear diameter, although not significant. Similarly there were no significant difference between the varieties and the nitrogen treatment and the year in both cropping seasons and the combine analysis on ear diameter. When 70 kg N ha^{-1} interacted with Obatanpa largest ear diameter was produced in 2004. This is in line with the findings of Griesh and Yokout (2006). They stated that increasing nitrogen levels from 60 to 120 ha^{-1} significantly increased plant height, ear height, ear length and ear diameter yield per plant and per hectare.

Longest ear lengths were recorded in New Kaduna in both 2004 and the combine analysis and the nitrogen levels of 50 kg N ha^{-1} and 70 kg N ha^{-1} respectively. This might not be unconnected with adequate nitrogen supply, varietal difference and optimum rainfall recorded in the years of study. Yield components in terms of ear length were significantly influenced by maize varieties. High yield and yield components can be achieved from high yielding variety. Increase in nitrogen supply can increase yield and yield components of maize. Similarly sufficient and even rainfall distribution can result in good growth and yield of maize. This is in line with the report of Sallah *et al.* (1998) who reported that response to fertilizer is however variable depending on amount and distribution of moisture, soil fertility and variety. This also conforms to the work of Carlos *et al.* (2002), who reported an increased of both ear length and ear diameter from 0-85kg N ha^{-1} and no effects above this rate. Sechulthess (2007), also reported that even rainfall distribution ènhances early uniform emergence, good growth, increase yield and improves grain quality of Maize.

There were no significant differences observed among the varieties and the nitrogen levels in 2004 and 2005 cropping seasons in terms of number of rows per ear, and number of grains per ear. However in the combine analysis of the cropping seasons there were significant differences between the varieties in terms of number of grain per ear in which Obatanpa produced the highest (274.22) number of grain per ear. 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 to 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. Also Uzo and Paul (1985) 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 grain rows produced in 2004, 2005 and the combine analysis of the cropping seasons ranged from 11. 73 to 13.57. This result is consistent with the report of Bengal *et al.* (1997), who measured values of grain rows ranging from 12.0 to 14.7 in a field study conducted under similar experimental conditions.

CONCLUSION

From the experiment, it can be concluded that Obatanpa variety has the ability to respond to nitrogen levels better than the New Kaduna variety in Jalingo. Also 70 kg N ha^{-1}, 80 kg N ha^{-1} and 90 kg N ha^{-1} nitrogen levels performed better than other Nitrogen levels in the experiment. It is therefore, recommended that the Obatanpa maize variety should be adopted by the farmers engaged in maize production in Jalingo since it performed better than the new kaduna on most of the growth parameters and also for its high protein content. However since there were significant difference observed among 70 kg N ha^{-1} 80 kg N ha^{-1} and 90 kg N ha^{-1} among the growth and yield components in the experiment further nitrogen levels should be tried in order to identify the optimum nitrogen level for optimum maize production in Jalingo.

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Table 1: Effects of variety and nitrogen levels on stand count and plant height of two varieties of maize grown at Jalingo in 2004 and 2005 taken at different weeks after sowing.

Treatments	Stand count			Plant height (cm)								
				3			6			9		
Year	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean
A. varieties												
New Kaduna (W)	41.95	48.10	45.02	14.44	14.79	14.61	54.35	66.38	60.36	130.81	94.4	112.63
Obatanpa (QPMW)	44.38	47.71	46.05	15.41	15.60	15.50	56.21	81.83	69.02	128.00	93.27	110.63
Mean	43.17	47.91	45.54	14.93	15.19	15.06	55.28	74.11	64.69	129.41	93.86	111.63
SE	3.03	1.57	2.42	1.50	1.41	0.28	5.33	6.23	5.85	6.94	6.80	6.94
CV %	11.93	5.67	9.04	17.12	15.74	16.44	16.40	14.56	15.40	9.12	12.55	10.56
LSD (0.05)	3.28	1.75	1.81	1.63	1.52	1.09	5.77	6.87	4.37	7.61	7.50	5.17
B. Nitrogen level ($kgha^{-1}$)												
30	43.00	48.69	45.83	14.87	14.67	14.77	53.70	75.75	64.73	126.07	89.80	107.93
40	44.50	48.67	46.58	15.88	16.35	16.12	54.03	72.63	63.33	131.28	89.18	114.73
50	46.50	48.17	47.33	14.03	14.33	14.13	54.58	70.60	62.59	130.07	90.12	110.09
60	45.83	48.00	46.92	13.72	14.07	13.89	53.28	70.73	62.01	122.68	84.22	103.45
70	41.67	47.83	44.75	15.38	15.73	15.56	58.97	77.28	68.13	132.70	102.47	117.58
80	42.00	46.83	44.42	15.63	15.95	15.79	57.17	73.25	65.21	134.07	99.98	117.03
90	38.67	47.17	42.92	14.93	15.25	15.09	55.22	78.50	66.86	128.95	99.22	110.58
SE	3.03	1.57	2.42	1.50	1.38	0.28	5.33	6.23	5.85	6.94	6.80	6.94
LSD (0.05)	6.4	3.23	3.38	3.06	2.85	2.03	10.80	12.85	11.82	14.06	14.03	9.68
C. AxB	ns	Ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*

ns=not significantly different at p=0.05

Table 2: Interactions between nitrogen levels and two varieties of maize on plant height at 9 WAS for combined analysis at Jalingo.

Varieties	Plant height (cm) at 9 WAS	
	V1	V2
Nitrogen levels ($kgha^{-1}$)		
30		
40	112.03	103.83
50	117.50	111.97
60	102.52	117.67
70	98.73	108.17
80	111.35	115.82
90	122.13	111.92
Mean	116.12	105.05
LSD (0.05)	111.48	110.63
	3.64	

V1 = New Kaduna (W) maize variety 1, V2 = Obatanpa (QPMW) maize variety 2, WAS = weeks after sowing

	No of leaves per plant									Stem diameter (cm)								
	3			6			9			5			7			9		
Year	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean
A. varieties																		
New Kaduna (W)	5.68	5.72	5.70	8.81	9.01	8.91	10.69	7.28	8.98	4.01	3.62	4.73	5.82	5.74	4.88	7.41	7.28	7.35
Obatanpa (QPMW)	5.68	5.72	5.70	8.86	9.09	8.97	10.12	6.71	8.43	3.90	3.86	4.68	5.51	5.81	7.15	7.13	7.16	9.85
Mean	5.68	5.72	5.70	8.84	9.05	8.94	10.41	7.00	8.70	3.96	3.74	4.71	5.67	5.77	7.37	7.27	7.22	7.25
SE	0.29	0.24	0.03	0.66	0.25	0.49	0.50	0.33	0.42	0.36	0.42	0.39	0.36	19.02	13.45	0.31	0.42	0.38
CV %	8.75	7.21	8.01	12.60	4.71	9.43	8.07	8.12	8.24	15.65	19.54	14.21	10.57	19.54	10.59	7.17	10.33	8.88
LSD (0.05)	0.23	0.26	0.20	0.71	0.27	0.37	0.54	0.36	0.32	0.37	0.46	0.29	0.35	0.74s	10.03	0.33	0.48	0.28
B. Nitrogen level (kgha^{-1})																		
30	5.52	5.62	5.58	8.40	9.0	8.72	10.03	.32	8.68	3.82	3.92	4.62	5.32	5.87	4.84	7.07	7.25	7.16
40	5.77	6.05	5.91	8.82	8.9	8.88	10.37	7.28	8.83	3.75	3.83	4.63	5.43	5.83	4.79	7.10	7.05	7.09
50	5.70	5.73	5.72	8.78	8.80	8.79	10.30	7.38	8.84	3.80	3.90	4.98	6.05	5.47	4.63	7.32	7.17	7.24
60	5.37	5.37	5.37	8.76	9.07	8.91	10.43	6.75	8.60	3.65	3.47	4.43	5.40	5.55	4.60	7.20	6.80	7.00
70	5.78	5.73	5.76	9.18	9.38	8.81	10.57	7.05	9.28	4.08	3.55	4.69	5.83	4.78	5.43	7.07	7.33	7.20
80	6.00	5.87	5.93	9.00	8.97	8.98	10.72	6.68	8.70	4.48	3.73	4.82	5.90	5.98	5.23	6.27	7.80	7.53
90	5.62	5.68	5.65	8.92	9.15	8.46	10.42	6.50	9.03	4.08	3.78	4.76	5.73	5.93	5.01	7.90	7.10	7.50
SE	0.29	0.24	0.03	0.66	0.25	0.49	0.50	0.33	0.42	0.36	0.42	0.39	0.35	0.44	13.45	0.31	0.43	0.38
LSD (0.05)	0.59	0.49	0.38	1.33	0.51	0.69	1.00	0.68	0.59	0.74	0.74	0.55	0.72	0.73	18.77	0.62	0.63	0.53
C. AxB	ns	ns	Ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Table 3: Effects of variety and nitrogen levels on the number of leaves per plant at 3, 6 and 9 WAS and stem diameter at 5, 7 and 9 WAS of two varieties of maize grown at Jalingo in 2004 and 2005 taken at different weeks after sowing.

ns=not significantly different at p=0.05, WAS = weeks after sowing

Table 4: Effects of variety and nitrogen levels on the leaf area index, ear diameter, ear length (cm), no. of rows per ear and no. of grains per ear of two varieties of maize grown at Jalingo in 2004 and 2005.

Treatment	Leaf area index (cm)			Ear diameter (cm)			Ear length per ear			No. of rows per ear			No. of grains per ear		
Year	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean
A. varieties															
New Kaduna (W)	4.37	4.20	4.29	12.58	13.28	12.93	13.98	10.75	12.36	12.88	12.46	12.67	168.15	244.40	206.28
Obatanpa (QPMW)	4.29	4.01	4.15	12.13	13.03	12.58	12.51	10.86	11.69	12.81	12.35	12.83	157.84	274.22	216.03
Mean	4.33	4.11	4.22	12.36	13.15	12.76	13.25	10.81	12.03	12.85	12.66	12.75	163.00	257.31	211.16
SE	1.10	0.90	1.02	0.49	1.52	1.14	0.60	0.69	0.66	0.81	0.44	0.66	24.41	25.12	24.99
CV %	13.84	19.07	21.53	6.66	1.69	15.25	7.67	11.00	9.19	10.66	6.05	8.70	25.46	16.76	20.12
LSD (0.05)	4.51	0.97	0.76	0.52	1.67	0.85	0.55	0.76	0.49	0.87	0.49	0.49	26.43	27.68	18.64
B. Nitrogen level ($kgha^{-1}$)															
30	3.60	4.20	3.90	12.20	12.45	12.03	12.78	10.20	11.49	12.43	12.60	12.56	158.95	255.00	206.98
40	4.31	4.09	4.20	12.58	12.99	12.78	13.57	10.68	12.13	12.10	13.00	12.55	174.37	264.78	219.58
50	3.96	3.67	3.82	12.35	12.42	12.38	14.15	10.53	12.34	13.13	12.42	12.78	169.18	240.78	204.97
60	4.03	3.77	3.90	11.90	12.43	12.17	12.60	11.03	11.82	12.52	12.45	12.48	142.27	254.52	198.39
70	4.48	4.60	4.54	12.33	13.48	12.91	13.37	11.87	12.62	12.55	12.75	12.65	136.00	282.37	209.18
80	3.99	4.11	4.05	12.78	12.58	12.68	13.18	10.58	11.88	13.02	12.30	12.66	174.10	241.63	207.87
90	4.51	4.00	4.26	12.32	12.75	13.33	13.08	10.75	11.91	14.15	12.98	13.57	186.12	276.13	231.13
SE	1.10	0.90	1.02	0.48	1.52	1.14	0.59	0.69	0.66	0.79	0.44	0.66	23.96	25.09	24.09
LSD (0.05)	8.43	1.86	1.43	0.98	3.13	1.60	1.21	1.42	0.91	1.63	0.91	0.91	49.45	51.79	34.88
C. AxB	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

ns=not significantly different at p=0.05