VEGETATIVE GROWTH OF MAIZE (*Zea mays* L.) AS AFFECTED BY SPACING AND RATES OF NITROGEN FERTILIZER IN MUBI, ADAMAWA STATE.

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ABSTRACT
Field experiments were conducted in 2005 and 2006 rainy seasons at the school farm of Government Secondary School Mubi to assess the effects of spacing and nitrogen rates on the growth of maize (Zea mays L.*). The experiment was laid out in a split-plot design replicated three times with four spacing (75 cm x 25 cm, 90 cm x 25 cm, 90 cm x 30 cm and 90 cm x 45 cm) assigned to main plots and four nitrogen rates (25, 50, 75, 100 kg Nha*$^{-1}$*) to sub-plots. Parameters such as emergence, establishment, plant height, stem diameter, number of leaves per plant, days to 50% tasselling and 50% silking were measured. Growth parameters such as emergence and plant establishment were not affected by spacing and nitrogen fertilizer. However, plant height, stem diameter, number of leaves per plant, days to 50% tasselling and silking were significantly affected by spacing and rates of nitrogen fertilizer applied (P = 0.05). Based on the findings of the study, a spacing of 90 cm x 30 cm and fertilizer rate of 75 kg N/ha is considered promising for efficient vegetative growth of maize in Mubi.*

Key words: Vegetative growth, spacing, fertilizer rates

INTRODUCTION
Maize is a large, annual, monocious grass that belongs to the family Gramineae, the most successful family of flowering plants. Barden *et al.*, (1987) reported that variation in height (0.5 – 7.5m), number of leaves (4-44), number and shape of ears, flowering, kernel characteristics, and maturity (50-330 days) is common. The physiology of maize makes it possible for the crop to adapt to a wide range of climatic and soil conditions. In Northern Nigeria, maize is mostly grown under rain fed condition with a very small hectarage produced under irrigation. Maize is the most commonly accepted staple food crop in most parts of Northern Nigeria (lliyasu and Abakura, 2009). The crop has now outweighed rice and wheat on worldwide production. Wikipedia (2006) reported that worldwide production was over 600 million tons in 2003, just slightly more than rice and wheat. Maize in highly nutritious and contains a lot of nutrients. Martins *et al.*, (1979) reported that maize contains carbohydrates 72.1%, water 13.5%, Protein 10%, Oil 4%, potassium 0.4%, phosphorus 0.43% magnesium 0.16% and sulphur 0.27%. The endosperm contains about 35% oil, 20% Protein and 10% ash. Maize can be taken as food and also processed into products such as breakfast breads, alcohol and spirits, corn syrup and sugar, corn meal and flour as well as feed for livestock (Barden *et al*. 1987). Rowland (1996) reported that maize requires an ample supply of plant nutrient particularly nitrogen and soil reaction between pH 5.5 -8.0 for best production. Growth of maize is best on fertile, well drained loan soils, on poor soils, vegetative growth may use most the available nutrients at the expense of grain production later in the season. In view of the rapidly expanding population in Nigeria, and the general acceptability of maize as a popular staple food among small holder farmers, there is the need to increase production through adequate spacing and timely applications of correct doses of fertilizer to ensure efficient growth of the maize plant. Therefore, the objectives of the study were to investigate the most appropriate spacing and nitrogen

fertilizer rates that will ensure healthy growth of the maize plant which has a direct influence on yield.

MATERIALS AND METHODS

Field trials were conducted during the cropping seasons of 2005 and 2006 at the school farm of the Government Secondary School Mubi. Mubi lies within latitude $10^{0}08^{11}$N and 10^{0}30N and longitude $13^{0}10^{''}$E and $13^{0}25^{''}$E (Obiefuna *et al.* 1997). Mubi has an annual rainfall range of 700 mm – 1000 mm commencing in early may with a peak in the month of August, and terminate in late October (ADADP, 2004). The experimental site was previously cropped to cowpea and soyabeans and the soil was sandy – loan with good drainage. The treatments consisted of four spacings (75 cm x 25 cm, 90 cm x 25 cm, 90 cm x 30 cm and 90 cm x 45 cm) and four levels of nitrogen fertilizer (25, 50, 75 and 100 kg N/ha). Spacing was assigned to the main plot and nitrogen fertilizer to sub-plot treatment. The experiment was laid out in a split plot design replicated three times. The experimental field was $700m^2$ which consisted of 48 plots with each net sub-plot measuring 3m x 4m ($12m^2$). The maize cultivar used for the trial was the local open pollinated maize widely used by farmers in Mubi area of Adamawa State. The seed was obtained from a farmer in Madanya Village. The cultivar is medium in height, matures between 90 – 110 days, has white kernel and is high yielding. Sowing was done on 1^{st} july 2005 and 2006 using pre-marked rope at four levels of spacing. Fertilizer was applied at 21 and 42 days after sowing by side placement using a compound fertilizer NPK 15:15:15. Hand weeding was carried out at 20, 40 and 60 days after sowing. Data collected was subjected to statistical analysis appropriate to split-plot design using the method described by Gomez and Gomez (1984) and differences between means was accessed using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

The performance of maize (*Zea mays* L.) in Mubi was generally satisfactory in the two cropping seasons (2005 and 2006). However, the growth was better in 2006 than 2005. This was attributable to sufficient rainfall distribution in 2006, even though the total amount of rainfall received in 2005 was more (1,111.3mm) as against 981.6mm in 2006 (Appendix I). Vegetative growth in terms of plant emergence and plant establishment was not significantly influenced by spacing (p = 0.05). There was also no significant interaction between spacing and fertilizer levels used in respect to plant emergence and establishment in both 2005 and 2006 (Table 1). This was because nitrogen fertilizer was not applied at the time of sowing. This suggests that when conditions for germination are right, seed will germinate and emerge from the soil even if the nutrient status of the soil is poor. Plant height was significantly influenced by spacing in both 2005 and 2006. Plants that were spaced 90 cm x 30 cm produced tallest plant (187.9 cm) in 2005 while in 2006 a spacing of 90 cm and 25 cm produced the tallest plant (168.6 cm) Table 1. Closely spaced maize plants tend to compete for growth factors thus accounting for increase in height of plants. Similar finding was reported by Nadir, (1984), Rowland, (1993) and Youdeowei *et al*., (1999). Widely spaced plants (90 cm x 45 cm) produced shorter plants (75.4 cm in 2005 and 144.4 cm in 2006) Table 1. Reduction in competition for growth factors resulted in shorter plants, similar to the results reported by Hay and Walker, (1992). In case of fertilizer treatment, there was no significant influence on plants at 4 weeks after sowing, however, at 8 weeks after sowing, the influence of fertilizer treatment was significant (p = 0.05). Plants that received 25 kg N/ha produced taller plants (183.3 and 157.0 cm) in 2005 and 2006 cropping seasons respectively (Table 1). This shows that it is not the amount of fertilizer applied that matters to the plant but how much of the fertilizer applied is available for plant uptake similar to the result reported by Kamara *et al.* (2009). Maize plants spaced 90 cm x 30 cm produced plants with thicker stem diameter (4.5cm). Plants with thicker stems are less susceptible to lodging as reported by Hay and Walker (1992). The vegetative growth in terms of number of leaves per plant was also significantly influenced by nitrogen fertilization. The highest number of leaves per plant was 12.0 on plots that received 75 kg N/ha in 2005. However, in 2006, the situation changed were plants that received 100 kg N/ha produced the highest number of leaves per plants. This finding is supported by Raemaekers (2001) who observed that nitrogen fertilization will allow a quick start of vegetative growth and supply nutritional needs during active plant growth. (Table 1).

Table 1 Means of plant emergence, establishment, plant height, stem diameter and number of leaves per plant of maize in 2005 and 2006 cropping season in Mubi

TREATMENT	Emergence (%)		Establishment (%)		Plant height (cm)				Stem diameter (cm)				Number of leaves/plant			
	2005	2006	2005	2006	2005		2006		2005		2006		2005		2006	
A - SPACING					4	8	4	8	4	8	4	8	4	8	4	8
75X25CM	93.8a	98.0a	90.1a	98.0a	78.1a	117.7a	24.1ab	166.9b	2.2a	4.3a	4.1a	6.1a	6.7a	12.1ab	6.5a	12.0a
90x25cm	84.6a	81.2a	80.1a	80.2a	74.1ab	114.3a	23.1b	168.6ab	2.3a	4.4a	5.0a	6.2a	6.9a	11.7b	7.1a	11.9a
90x30cm	85.8a	90.3a	85.0a	85.0a	70.8b	187.9ab	26.1a	152.6b	2.4a	4.3a	4.5a	6.5a	6.7a	11.9b	6.0a	12.0a
90x45cm	98.9a	90.3a	93.1a	90.3a	70.8b	75.4bc	23.1b	144.4a	2.2a	4.2a	4.5a	6.0a	6.4a	12.2a	7.1a	12.0a
B - FERTILIZER																
25kgN/ha	80.0a	81.0a	83.1a	80.4a	74.9a	183.3a	24.3a	157.0a	2.4a	4.3a	4.6a	6.2a	6.4a	12.0ab	7.0a	12.0a
50kgN/ha	89.2a	88.6a	87.6a	86.4a	71.8a	107.3b	24.7a	155.5a	2.2a	4.2a	4.8b	6.2a	6.7a	11.8b	6.0a	11.8a
75kgN/ha	80.3a	85.0a	80.5a	86.6a	72.8a	109.4b	23.5a	153.0a	2.3a	4.5a	4.4a	6.0a	6.8a	12.3a	7.0a	11.8a
100kgN/ha	87.1a	81.0a	80.1a	83.7a	73.6a	109.3b	25.2a	153.2a	2.3a	4.2a	4.7a	6.3a	6.9a	11.8b	7.0a	12.2a
C - INTERACTION																
A X B	NS	NS	NS	NS	NS	*	*	*	NS	NS	*	NS	NS	*	NS	NS

Means with the same letters in the same column are not significantly different using Duncan's Multiple Range Test
NS = Not significant * significant (P =0.05) 4= 4WAS (weeks after sowing) 8= 8WAS (weeks after sowing)

Table 2 Means of days to 50% taselling and silking of maize in 2005 and 2006 in Mubi.

TREATMENTS		Days to 50% tasseling		Days to 50% silking	
A -	SPACING	2005	2006	2005	2006
	75x25cm	60.3b	60.3ab	66.4b	67.6a
	90x25cm	60.8b	59.3b	65.8b	67.3a
	90x30cm	60.1b	59.2b	65.6b	66.6a
	90x45cm	62.5a	60.4a	67.4a	67.9a
B -	FERTILIZER				
	25kgN/ha	61.1a	61.0a	67.5a	67.9a
	50kgN/ha	60.0ab	59.7b	65.4b	66.4a
	75kgN/ha	59.9b	59.6b	65.4b	67.9a
	100kgN/ha	59.9b	59.5b	66.9ab	67.9a
C -	INTERACTION A X B	NS	NS	NS	NS

Means with the same letters in the same column are not significantly different using Duncan's Multiple Range Test.
NS = Not significant * significant (P =0.05)

However, Days to 50% Tasselling and Silking were influenced by spacing. Results of the study also revealed that taselling was earlier in plants that received higher doses of nitrogen fertilizer (75 and 100 kg N/ha). The low dose of 25 kg N/ha exhibited longest days to taselling, thus nitrogen fertilizer has significantly influenced taselling in maize plant (Table 2). The rates of nitrogen fertilizer also had a significant influence on silking in both 2005 and 2006. 25kg Nlha produced maize plants that task 68 days to produce silk (Table 2), this is contrary to popular opinion on reported by Reamaekers (2001), Rowland (1993) and Kochlar (1986) that high nitrogen level in the soil encourage luxuriant vegetative growth thus delaying maturity, this study revealed that low level of nitrogen fertilizer in the soil delays taselling and silking thereby delaying maturity. NEDC (1999) submitted that the period of maximum uptake of nitrogen by the maize plants is two weeks to taselling, it is therefore, convenient to conclude that delay in taselling and silking is as a result of inadequate nitrogen supply two weeks to tasselling and silking because the nutrient in the soil has been exhansted and maturity was delayed in an attempt by the plant to get additional nutrients.

CONCLUSION AND RECOMMENDATION

Appropriate spacing and timely application of the required doses of nitrogen fertilizer encourages a luxuriant vegetative growth of the maize plant which also determines the drymatter production and yield of the maize plant. Based on the findings of the study, spacing of 90 cm X 30 cm and a nitrogen rate of 75 kg N/ha was found to be more promising for efficient growth of the maize plant in Mubi.

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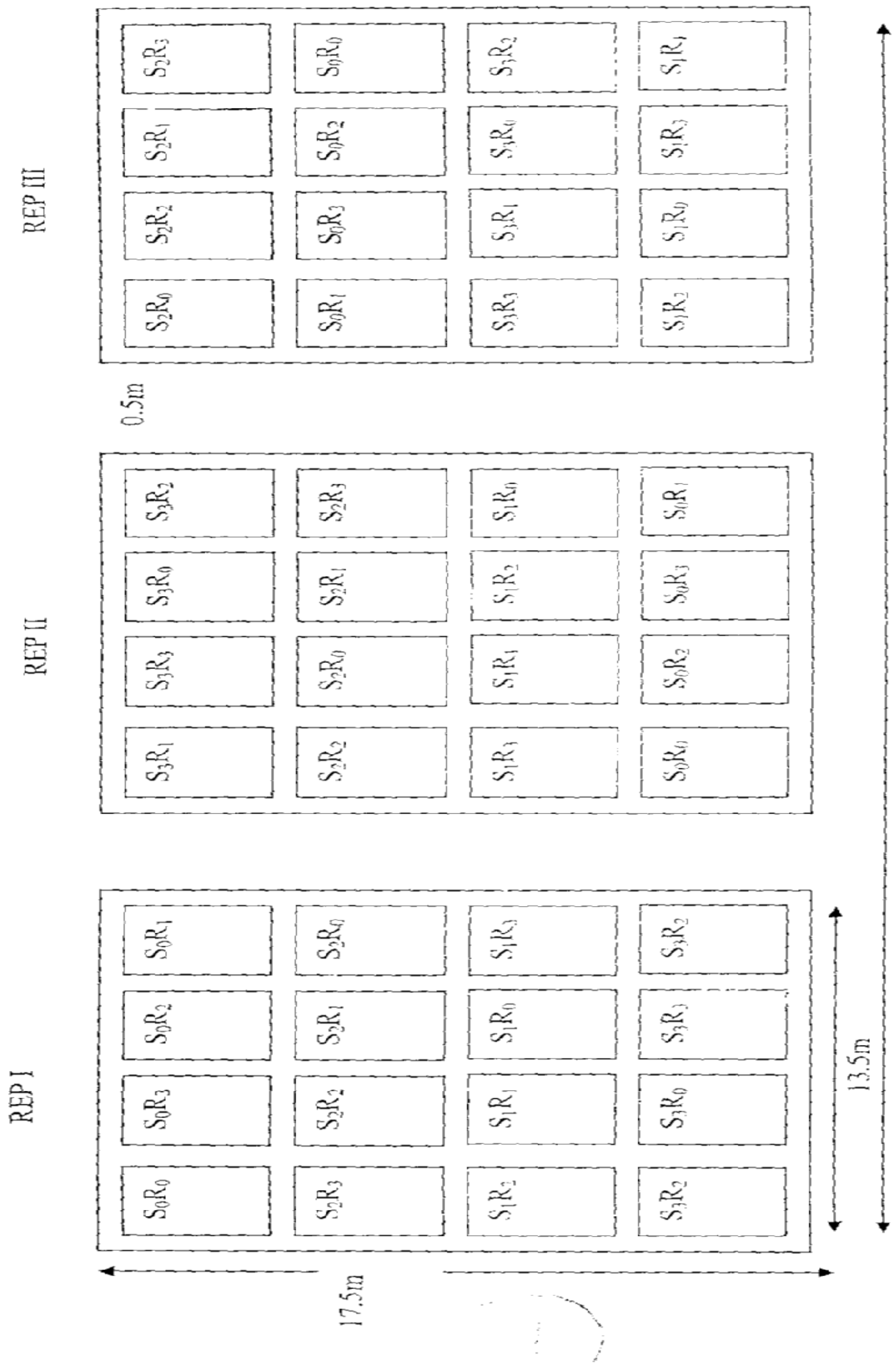
Appendix I: Meteorological data of Mubi during the 2005 and 2006 cropping seasons

Month	Rainfall (mm)		Temperature (0°C)		Relative Humidity (%)		Wind Speed (km ha^{-1})		Sunshine (Hrs)		Evaporation Rate (ml)	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
January	00.0	00.0	24.17	24.00	87.01	89.00	2.74	1.01	2.25	7.38	7.1	4.24
February	00.0	00.0	24.10	24.50	88.18	89.00	6.88	0.67	7.98	7.16	8.0	3.97
March	00.0	48.5	26.40	26.00	88.74	89.00	6.58	0.57	5.92	5.06	5.9	4.45
April	47.2	2.5	29.30	27.00	87.42	89.00	1.75	0.52	3.64	5.75	10.8	4.36
May	75.3	92.7	28.80	28.00	89.90	89.00	2.32	1.27	4.78	4.52	8.54	5.86
June	154.7	95.6	26.80	26.00	90.01	90.00	1.15	3.60	5.26	7.22	6.78	4.94
July	207.0	229.6	24.02	24.00	89.00	90.00	4.83	2.20	4.73	3.50	6.09	5.30
August	329.0	216.0	24.06	24.00	89.00	90.00	11.12	4.30	3.27	2.60	4.16	5.40
September	254.7	244.0	24.02	23.00	89.00	89.00	8.27	4.80	4.73	3.20	5.12	4.20
October	41.9	52.5	24.86	23.00	89.00	89.00	0.76	1.24	7.18	7.01	1.89	5.30
November	00.0	00.0	23.74	NA	88.20	NA	2.56	NA	5.64	NA	2.89	NA
December	00.0	00.0	23.72	NA	88.20	NA	0.86	NA	8.09	NA	3.40	NA
Total	1,111.3	981.6	303.90	249.5	1064.60	893	49.85	20.18	66.47	53.4	70.67	48.02
Means	158.61	122.7	25.33	24.95	88.72	89.3	4.12	2.018	5.33	5.34	5.88	4.802

NA = Not Available

Source: Geography Department, Adamawa State University, Mubi



Appendix 2: **FIELD LAYOUT** Main treatment - Spacing (S) sub-plot treatment - Fertilizer (R)