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Effect Ofdifferent Rates of Urea Fertilizer on the Growth and Development of *Zea Mays* in South Eastern Region of Nigeria.

Kelechukwu Chris Egbucha
Michael Okpara University of Agriculture, Umudike

Abstract

This research was designed to study the effect of urea on the growth and development of maize at different rates of application in South Eastern region of Nigeria. Completely randomized block design was employed in the experimental setup, comprising four treatments replicated three times to give a total of 12 plots. Each plot had a total of nine maize stands making a total of 108 plant population. The treatments were applied at the rates of 100kg/ha, 150kg/ha and 200kg/ha three and seven weeks after planting. The control had no treatment application. Plant growth and development was assessed using plant height, number of leaves, leaf area, fresh weight and dry weight of plants. Plant yield was assessed using fresh weight of cobs with husk, fresh weight of cobs without husk and the dry weight of cobs. The data collected from different treatment was subjected to statistical analysis using ANOVA and mean separation was done using LSD at ($p<0.05$).The results were presented using the bar chart diagrams. The results shown by the bar chart with reference to the data collected indicated that urea applied at the rate of 100kg/ha, 150kg/ha and 200kg/ha improved the growth, development and yield of Zea mays L. but to varying degrees. The result revealed that the maximum vegetative growth was recorded from the treatment with the highest urea application (200kg/ha) followed by plots treated with 150kg/ha and 100kg/ha urea. Treatment application at the rate of 200kg/ha also produced highest result in yield of maize. Control had the lowest result at both growth

and development stages. Hence, the study revealed that urea (46% N) had a significant increase ($p<0.05$) on the plant growth, development and yield of maize of plants.

***Keywords**: Growth teosinate, Urea, silking, chlorosis, senescense*

Introduction

Zea mays L. a species in the Zea genus and of the family Graminae (Poaceae), commonly known as the grass family is believed to have originated in Mexico through the domestication of its closest relative teosinnte (*Zea mexicana*) Hossain et.al/.2016). Maize is one of the most extensively studied crop plants in terms of its agronomy, cytology and genetics, as well as its evolutionary history under domestication, possessing 20 somatic chromosomes with a genome size of 2.3 gigabase and more than 32,000 genes (Schnable *et al.,* 2009).The adaptability of maize crop to grow well in various agro ecologies makes it to stand out as a stable cereal of choice in different parts of the world. Globally maize has assumed great importance owing to its multiple end uses as human food and livestock feed and serving as an important component for varied industrial products. About 1016.73 million metric tonnes of maize is produced every year the highest among major staple cereals (FAOSTAT 2013). A major portion of maize produced worldwide is used for animal consumption as it serves as a vital source of proteins and calories to billions of people in developing countries, particularly in Africa, and Asia (Shiferaw *et al.,* 2011). Furthermore, maize is a source of important vitamins and minerals to the human body. Along with rice and wheat, maize provides at least 30 % of the food calories to more than 4.5 billion people in 94 developing countries. Specifically, maize alone is said to provide over 20 % of total calories in human diets in 21 countries and over 30 % in 12 countries that are home to a total of more than 310 million people (Shiferaw *et al.,* 2011). With the rapid growth in population worldwide, forecasts indicate that by the year 2050, the demand for maize in the developing countries will double (Rosegrant *et al.,* 1999; Prasanna 2014).

Nitrogen is an essential element for both fodder quantity and quality as it is a component of protein and

chlorophyll, it is thus essential for photosynthesis, vegetative and reproductive growth and it often determines yield of maize (Igbal *et al*; 2006). The continuous cultivation of crops and the adverse environmental factors make the arable soil deficient in nitrogen along with other plant nutrient (Taize and Zeiger, 2010; Epstein and Bloom, 2004).

Among the various nitrogen fertilizers, urea is widely used in the Agricultural sector. The high nitrogen content per unit material (46%), lower cost, ease of storage, along with solid and liquid formulation options make it a popular choice for farmers (Andrew *et al.*, 2013).Nitrogen deficiency alters the composition of the soil much more than any other mineral nutrient as it is an indispensable elementary constituent of many organic metabolites including nucleic acids and phytochrome, thus nitrogen makes up 1 to 4% of dry matter of plants (Taize and Zeiger, 2010).

The major objectives of this research therefore is: To determine the effect of urea on the growth and development of maize at different rates of application.. Establish rate of application for optimum yield and to determine right time of urea application in maize production in the South Eastern region of Nigeria.

MATERIALS AND METHODS

The experiment was carried out at the Federal Ministry of Agriculture and Rural Development garden at Umuahia, Abia State in the rainforest belt of Nigeria, Latitude $05^{0}28^{0}$N and Longitude $07^{0}32^{0}$E. It has average rainfall of 2,200mm and lies 123m above sea level.. Minimum and maximum temperatures are 22.41^{o}C and 30^{0}C respectively with total annual rainfall of 1.245.3mm (National Root Cop Research Institute, meteorological report, 1983).

Soil collection/ analysis

The top soil was collected from the field and samples were analyzed at the soil sample laboratory in National Root Crop Research Institute Umudike for Physico-chemical traits and the result obtained are as follows:: (Sand 88.30, Silt 11.70%, Clay 5.00%, Texture Sandy Loam, p^{H} (H_20)) 4.80%, Mg/kg 37.10, N 5%, Organic Carbon 1.36%, Organic Matter 2.44%, Calcium 12.00%, Magnesium 3.20%, Potassium 0.163%, Sodium 0.365, Exchangeable Acidity 0.32%, ECEC 16.048%).

Design of experiment

The design of the experiment was laid out in a Randomized complete Block Design (RCBD). The estimated land area was 15m x 15m ($225m^2$). Each plot measured 5m x 0.8m with 1m x 0.5m part separating adjacent plots and blocks with a furrow distance 0.39m in between ridge. The experimental site was divided into four blocks, maize plants were planted in three replicates with one control making a total of 12 observations. Each plot had a total of nine (9) maize plant stands making a total of 108plant population. Urea (46% N) was used as the main treatment at different rates of; 100kg/ha, 150kg/ha, and 200kg/ha, application of treatments on maize were done 3 weeks after planting**.**.Seeds of maize variety (Oba super 8) were used for the experiment. The seeds of maize were purchased at the seed center; National Root Crops Research Institute Umudike. Urea (46% N) used in the experiment was purchased from an open market in Ikwuano Local Government Area, Abia State.

Treatment application

Urea (46% N) was applied at the rates of 100kg/ha, 150kg/ha, and 200kg/ha respectively at the

3^{rd} week after planting and readings were taken four consecutive times in an interval of 2 weeks.

DATA COLLECTION

Growth and yield parameters were recorded at different stages of crop growth and development., They include: Plant height, Number of leaves, leaf Area (Cm^2) fresh weight and dry weight of the whole plant, fresh weight of the cobs with husk, fresh weight of the cobs without husk, Dry weight of the cobs.

RESULT

Effect of urea at different rates of application on plant height of maize.

Plant height at 2WAP indicated that treatment application at 200kg/ha and 150kg/ha was about 35.5cm while at 100kg/ha it was about 25cm and control was less than 20cm. At 6WAP, the plant height at 200kg/ha recorded 135cm followed by 150kg/ha (120cm) and at 100khg/ha gives less than 115cm. The control recorded 100cm. At 8WAP, the plant height at 200kg/ha was 87cm

and at 150kg/ha was 89cm, at 100kg/ha recorded 78cm while control was 60cm.

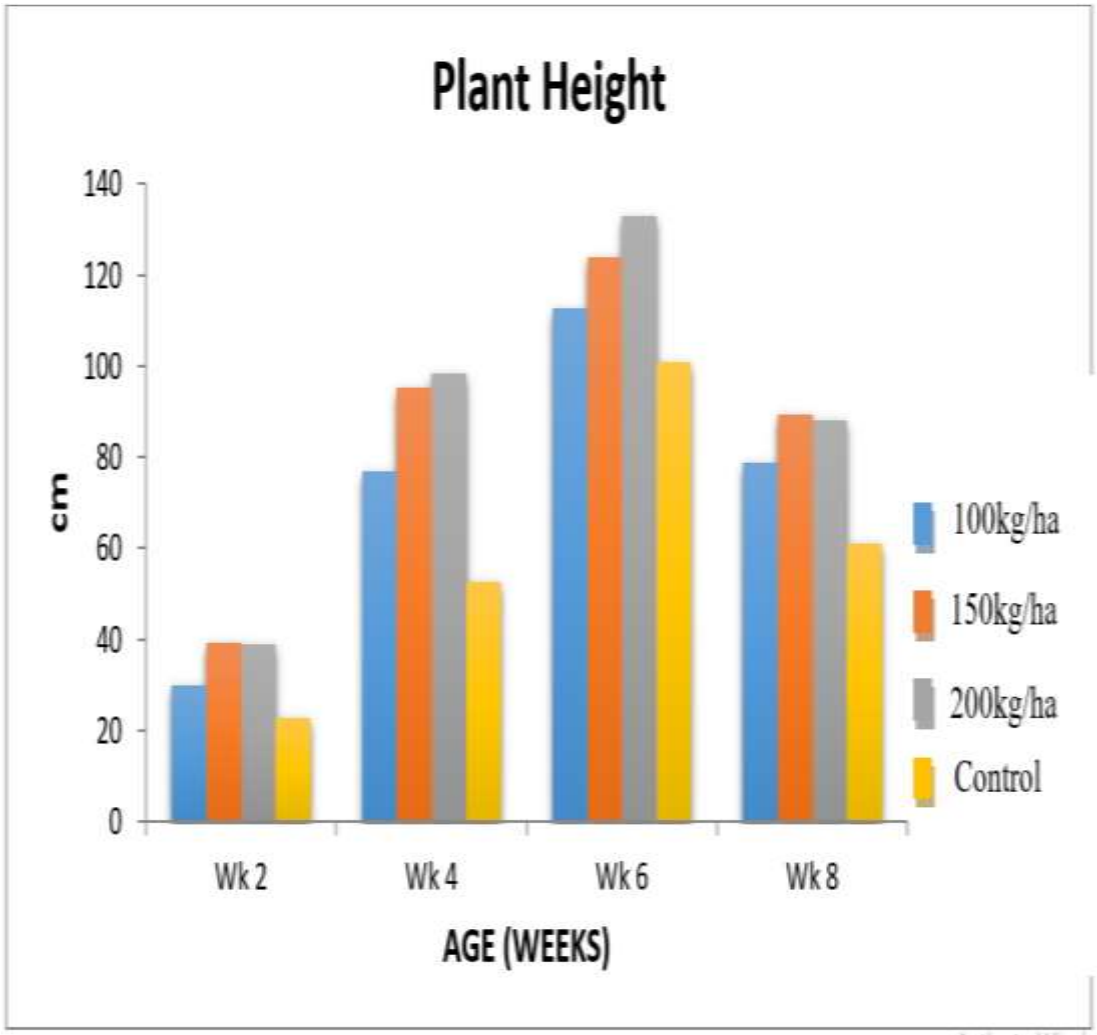

Fig. 1: Effect of urea at different rates of application of maize.

Effect of urea at different rates of application on plant leaf area.

The application of urea at 200kg/ha at 2WAP was 600cm^2, at 4WAP recorded 750cm^2, 6WAP was about 850cm^2 and decreased to 750cm^2 at 8WAP. At 150kg/ha application of urea in 2WAP, the leaf area was about 500cm^2, at 6WAP it was about 750cm^2 and came down to 700cm^2 at 8WAP. Urea application at 100kg/ha recorded 500cm^2 at 2WAP, 650cm^2 at 4WAP, 600cm^2 and 580cm^2 at 6th and 8WAP. The control had 200cm^2 at 2WAP, 500cm^2 at 4WAP and

6WAP at 8WAP decreased to 350cm^2

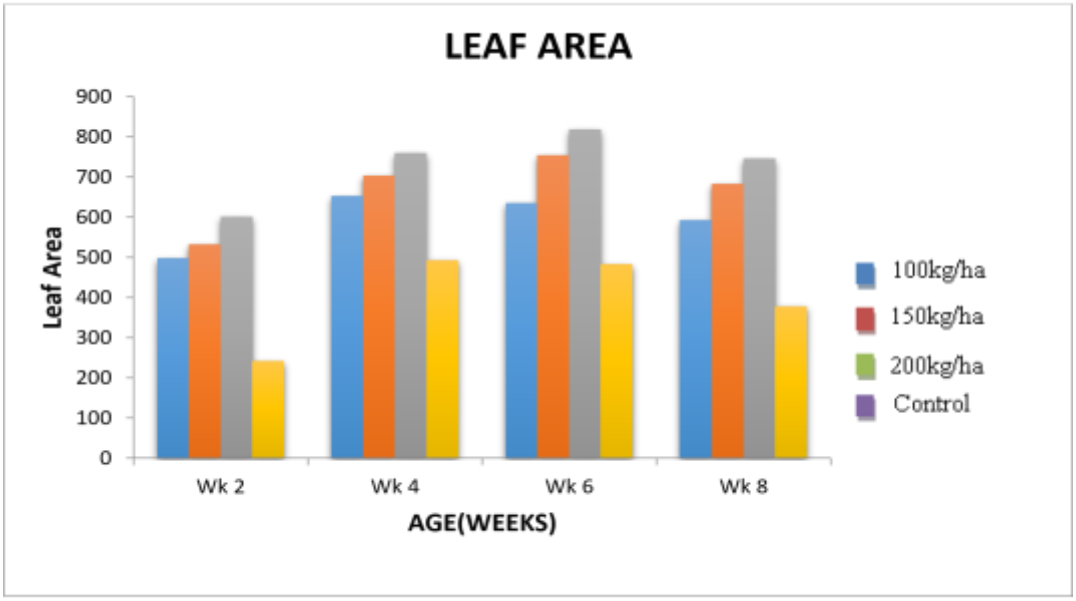

Fig. 2. Effect of urea at different rates of application of maize grown on the field.

Effect of urea at different rates of application on number of leaves

At 2WAP, all the treatments except the control had 10 leaves while at 4WAP, the application of urea at 100kg/ha recorded 18 leaves far and above all the other treatment application, this was followed by 150kg/ha and 200kg/ha (12 leaves respectively) and the control with 10 leaves. At 6WAP, all the treatment had 12 leaves each. There was a further decrease on the number of leaves at 8WAP in all the treatments.

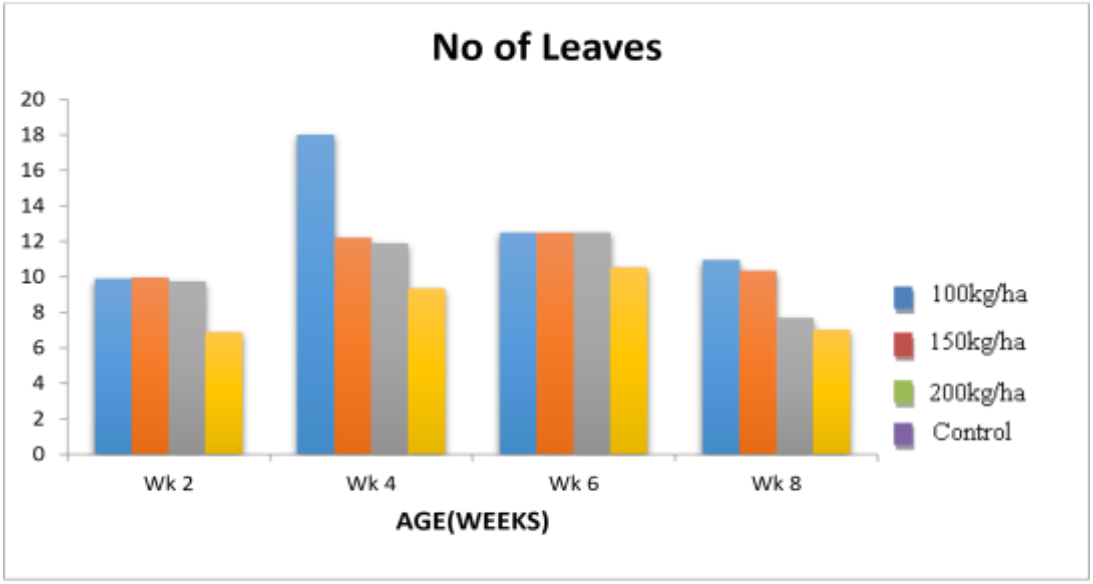

Fig. 3. Effect of urea at different rates of application on number of leaves of maize.

Effect of urea different rates of application on the fresh and dry weight of maize.

The fresh and dry weight of the maize shown that urea application at 200kg/ha had 156.6g and 36.6g respectively, while at 150kg/ha, it was 119.8g and 25.8g respectively, at 100kg/ha recorded 93.4g and 19.8g.The control had the least at 44.4g for fresh weight and 11.4g for dry weight.

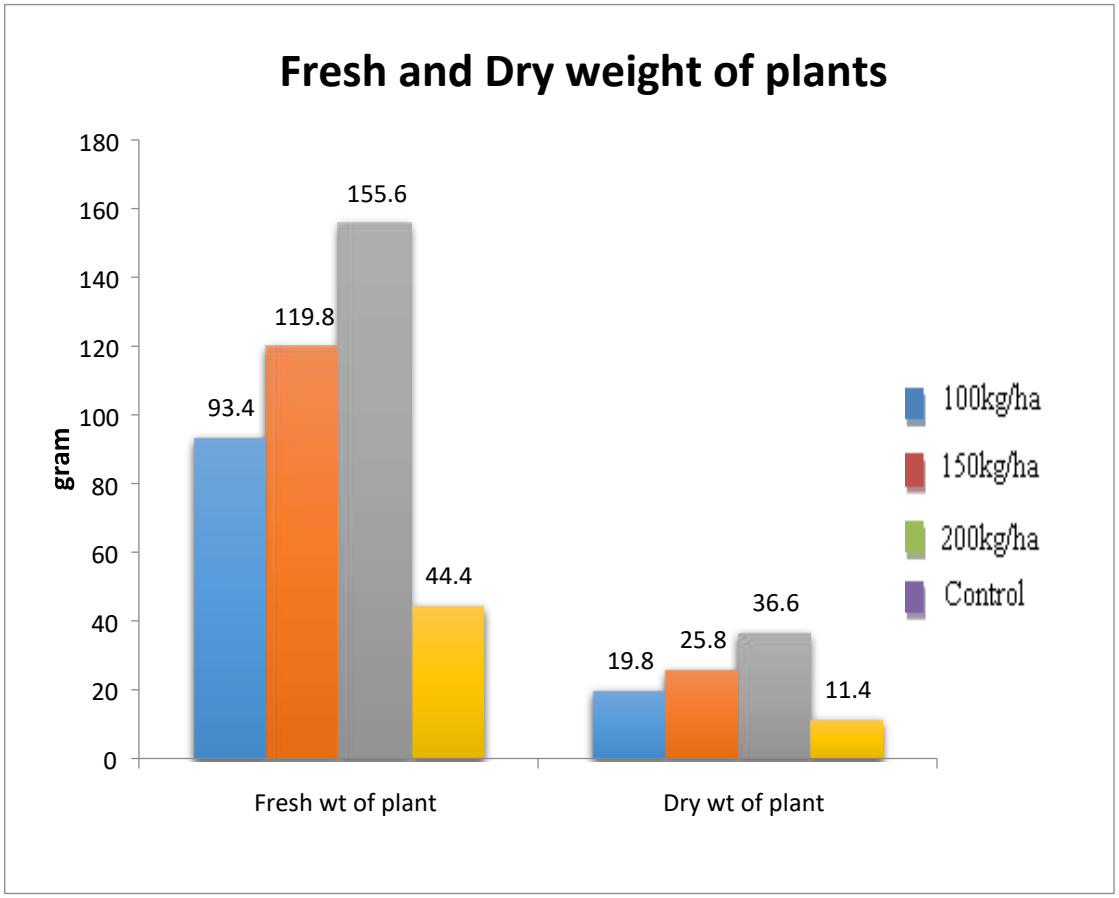

Fig. 4. Effect of urea on the fresh and dry weight of maize grown on the field.

Effect of urea at different rates of application on yield parameters of maize. The fresh weight of cobs with husk and fresh weight of cobs without husk of the maize shown that urea application at the 200kg/ha had 319.2g and 211.8g, at 150kg/ha had 267.6g and 166.8g, while at 100kg/ha had 196.8g and 137.4g respectively. The control recorded 86.4g and 49.4g.

At 200kg/ha, urea application gave the highest value 131.4g for dry weight of cobs when

compared with other treatment applications.

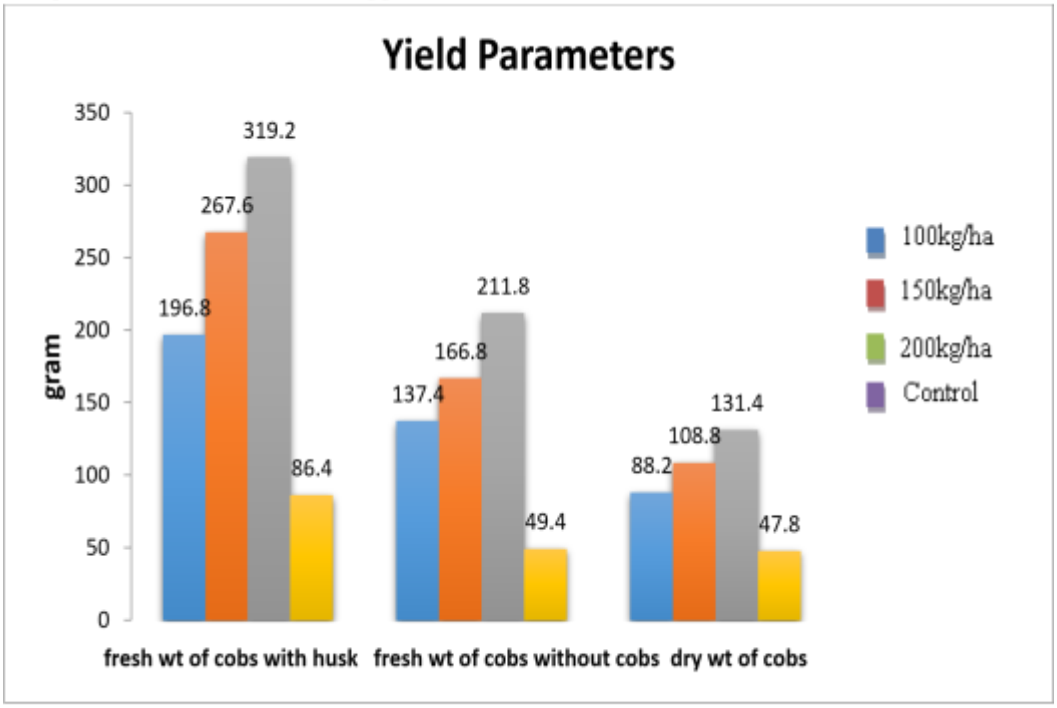

Fig. 5. Effect of urea at different rates of application of maize.

DISCUSSION

The result of soil analysis indicates that the soil texture is sandy loam and it is suitable for the growth of maize as proposed by Norman and Pearson (1995). However, the nitrogen content of the soil was 5% which is low. This may possibly be as a result of the continuous cultivation of crops and adverse environmental factors which make the arable soil deficient of nitrogen along with other nutrients (Taize and Zeiger, 2010, Epstein and Bloom, 2004). Therefore, it is expected that the application of Urea (46% N) will augment the percentage required for proper growth, development and yield performance of crops.

The rate of urea application showed a significant variation in respect to plant height and number of leaves. The result showed that the maximum vegetative growth was recorded from the treatment with the highest urea application (200kg/ha) at 6WAP which was at the time of tassel initiation with a decline at 8th week. This may be attributed to the reduction in the increasing levels of nitrogen days to silking as reported by Shah *et al* (1981). Similarly, Halemani *et al.*, 1976 reported that nitrogen levels had reduced the days to silking.

The vegetative height of plants at 6WAP was the peak and this increase may be attributed to the better availability of nitrogen and its enhancing effect on vegetative development that results to increase in mutual shading and internodal extension as reported by Tobert *et al.,* (2001). Control had the lowest result in all the weeks which confirmed Epstein and Bloom (2004) report that crops grown on soils deficient of nitrogen exhibit very distinctive N-deficiency symptoms such as poor growth and causes disorder in physiological/biochemical characteristics of plants.

There were no significant differences ($p > 0.05$) among the treatments on the number of leaves at the 2nd week after urea application but when compared with the control, there were significant differences ($p<0.05$). At the 4th week after application, urea at 100kg/ha stimulated the proliferation of leaves and the number of leaves was significantly different when compared with other treatments as well as the control. At 6th week, there were also significant difference

($p<0.05$) when compared with the control, but among the treatments there were no significant differences ($p>0.05$) and same to the treatments at 8weeks after urea application.

This increase may also be ascribed to the availability of nitrogen which often increases plant growth and plant height, resulting in more nodes and internodes and subsequently more production of leaves at the early stage of plants. This is in conformity with, Okajina *et al* (1983), Sawi (1993) who reported that nitrogen significantly increased the number of leaves and suggested that the increased number of leaves maybe as a result of increased number of nodes. Treatment application at the rate of 200kg/ha gave the best result on the leaf area in all the weeks, followed by plots treated with 150kg/ha, 100kg/ha rate. Control had the lowest result in all the weeks. This is in support of the research done by Robson and Deacon (1978), Gastal and Saugier (1986). They discovered that urea application increased the leaf area of plants and canopies to greater extent than leaf and canopy photosynthesis. Also, Taize and Zeiger (2010) reported that crops deficient of nitrogen results to leaf senescence, chlorosis and necrosis. The results obtained from the fresh weight and dry weight of maize plants revealed that urea applied at the rate of 200kg/ha gave the best performance when compared with other treatment application (150kg/ha, 100kg/ha) as well as the control. This result is similar to that reported by Sultana *et al.,* (2005), Khan *et al.,* (1996), and Kumar *et*

al., (2001) who discovered that high rate of urea increases fresh and dry weight of plants.

The yield components (fresh weight of cobs with husk, fresh weight of cobs without husk and dry weight of cobs) at the rate of 200kg/ha urea gave the highest result. The present result are in agreement with the findings of several workers who reported similar reports for a variety of plants. Agba and Long (2005) found that nitrogen produced the best corn yield of 2.43 and 2.96 tons/ha using 210kg/ha urea. Khan *et al.*, (2005) while working with sugar cane discovered that 200N kg/ha, 120 P_2O_5 kg/ha and 150 K_2O were suitable fertilizer for obtaining higher cane and sugar yield. Similarly, Heeb *et al.*, (2005) recorded an impact of nitrogen fertilizers on yield, taste, and nutritional quality of tomatoes, while Smolders *et al.*, (2007) reported that with increasing nitrogen levels both biomass and onion yield were increased.

5.2 CONCLUSION AND RECOMMENDATION

The study revealed that urea (46% N) applied at the rates of 100kg/ha, 150kg/ha, and 200kg/ha improved the growth, development and yield performance of *Zea mays* seedlings, but to varying degrees.

The treatment with 200kg/ha was found to be the best, compared to other treatments used. It has been observed that urea is a good source of nitrogen and at the rate of 200kg/ha, is responsible for proper growth, development and high yield of plants, and should be applied at the vegetative stage (3weeks) and reproductive stage (7week) using maize as a case study. Therefore, I recommended that urea (46 % N) be utilized by farmers in maize cultivation for maximum yield at the rate of 200kg/ha. Also, I recommended that a comparative study be done using urea and other N-fertilizers to verify with certainty that there is no interaction of elements in the growth of plants with urea as the only source of nitrogen.

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