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The Analysis of the Agronomic Performance of Different Fertilizer Regimes in Lettuce Production in Techiman Municipality of Ghana

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Abstract
Analysis of the agronomic performance of different fertilizer regimes in Lettuce production was conducted over a period of three months (November to February, 2014) in Valley View University Techiman Campus farm in Brong-Ahafo, Ghana. Eight (8) different treatments of fertilizer regimes were used for the study. These were; Poultry Manure only, Quarry Dust only, NPK only, Poultry Manure and Quarry Dust only, NPK and Quarry Dust only, NPK and Poultry Manure only, NPK, Quarry Dust and Poultry Manure only and no fertilizer as a control. The experimental design used was Randomized Complete Block Design. Eden variety was used in this experiment. Eden variety grown under Poultry Manure recorded the highest height of 15.1cm whilst that grown under NPK only recorded the least height of 13.4cm on the 7th week at a p value of < 0.05 significant difference. Meanwhile, there was no significant difference ($p < 0.05$) in the leaf area and the number of leaves after the various treatments of fertilizer regime from the second to the seventh week after planting.
Keywords: Analysis, Agronomic, Fertilizer regimes, Eden variety

1. Introduction

Lettuce (*Lactuca sativa* L. var. eden) is an annual plant of the aster or sunflower family Asteraceae (Abubakari *et al*., 2011). It is a leafy vegetable which is mainly grown in Techiman at specific periods of the year when the soil have adequate amounts of water. Soils in Techiman lie within the transition zone of Ghana and they are predominantly Ochrosols. These soils are sandy-loam in nature and require soil amendments to support crop growth to maturity (Obeng, 2000). In view of the soil nature, farmers apply lots of inorganic fertilizers mainly, NPK (15-15-15) in order to produce adequate quantities of lettuce for the market. A study conducted by Owusu, 2010 on market potential for lettuce in Kumasi, the second largest city in Ghana indicated that lettuce has high demand in urban areas. According to Owusu and Anifori (2013), consumers are willing to pay for a premium for quality organic fruits and vegetables which include lettuce. However the quality of water for cultivation of lettuce in urban areas in Ghana leaves much to be desired.

The experiment for this study on analyzing the agronomic performance of different fertilizer regimes in lettuce production in Techiman Municipality was conducted at a period when rains were not adequate; hence regular watering of the plants was done for efficient water supply. The study therefore, aimed at analyzing the effects of different organic and inorganic fertilizer regimes on the yield of Lettuce (Vournoukas *et al.,* 2014). Lettuce thrives best on well-drained fertile soils which has high levels of organic matter (Obuobie *et al*., 2006; Drechsel and Keraita 2014). Adequate nutrients and continuous water supply are essential to vigorous growth of leafy vegetables (Bessin *et al*., 2013; Obuobie *et al.*, 2006).

Some growth variables in agronomical studies that was taken into account was the morphological characteristics of plants such as plant height, leaf area and number of leaves (Kristova *et al*., 2008).

A reasonable number of studies have been conducted and empirical data gathered concerning the use of inorganic fertilizers in Lettuce production in Ghana; however, such studies have not been conducted in Techiman and its environs. Leafy vegetables such as Lettuce are not predominantly grown in Brong-Ahafo region of Ghana of which Techiman is no exception. This study combined different fertilizer regimes of organic (poultry manure) and inorganic fertilizer (NPK-15.15.15 & Quarry Dust) to find out Lettuce performance (yield) in the study area. A study conducted in Turkey by Islam *et al*., (2012) revealed that, producing Lettuce with organic manure is profitable. Organic fertilizers, apart from making nutrients available to plants, have added advantages of improving the soil structure, aeration and drainage through soil micro and macro organism activities (Masarirambi *et al*., 2010; Sirajul *et al*.2012). In the study area, poultry manure is abundant especially, at the University farms. Poultry manure in this area is also cheaper and easily accessible by farmers all year round. Therefore, analyzing the agronomic effects of poultry manure, NPK-15.15.15 and quarry dust and their best rates of application in the study area is very essential.

2. Materials and Method

2.1 Location

The experimental field for the study is located in the Valley View University Techiman Campus farm. Techiman, Brong-Ahafo, Ghana.

2.2 Climate

The annual average rainfall for the study area ranges between 1,088mm - 1,197mm. It has a bi-modal pattern of rainfall of which the peak occurs in June to July in every year with relative high humidity (75%) levels throughout the year. The average temperature within this region ranges from 23.9 ^{o}C to 38.0 ^{o}C (Obeng, 2000).

2.3 Experimental Design, Procedure and Data Analysis

A Randomized Complete Block Design was used in this experiment under a shade net to reduce the intensity of Sun rays. The field was partitioned into various blocks and each block assigned to eight (8) different fertilizer treatments with four (4) replications. The fertilizers were applied once, two weeks after transplanting seedlings onto the field. Watering and weeding were done as and when necessary. The various treatments regimes for the assessment is shown in Table 1. Direct field observations and data for each treatment on growth parameters were taken on weekly basis from the second to the seventh week on the experimental field. The data collected were analyzed using the Analysis of Variance (ANOVA) and the least significance difference (LSD) to separate means at 5 % (P value of 0.05) confidence interval.

Table 1**:** Various fertilizer treatment regimes and their rates of application.

Treatments	*Rates of application (per plant /hectare)*
Poultry manure only	75g per plant = 15 tons / hectare
Quarry dust only	300g per plant = 60 tons / hectare
NPK only	25g per plant = 250 kg / hectare
Poultry manure and Quarry dust	40g + 150g per plant
NPK and Quarry dust	11g + 150g per plant
NPK and Poultry manure	11g + 40g per plant
NPK, Quarry dust and Poultry manure	5.5g + 75g + 20g per plant
No Fertilizer as Control	No Fertilizer

3. Results and Discussion

The agronomic features of Lettuce considered in the study included: number of leaves per plant, plant height and leaf area. The observed results after the various treatments are indicated in figures 1, 2 and 3.

3.1 Effects of Fertilizer on the Number of Leaves

There were no significant differences ($p \leq 0.05$) in the number of leaves at the 2nd, 3rd, 4th, 5th and 6th weeks after planting. Maximum number of leaves was recorded at the 7th week after planting. Eden variety grown under quarry dust produced the highest number (15.6) of leaves whereas no fertilizer produced the least number (12.4) of leaves.

The number of leaves of the Eden variety, grown under quarry dust attained its peak at the 7th week after planting (15.6) while the least was produced on the 2nd week of planting (9.0). This indicates that leaves development in Eden variety on the 7th was the best.

The maximum number of leaves of Eden variety grown under poultry manure (13.5) was produced on the 7th week whereas the least number of leaves was produced on the 2nd week (8.6). The number of leaves of Eden variety grown under inorganic fertilizer (NPK 15-15-15) attained it's highest on the 7th week (13.5) whiles the least number of leaves of the same variety was produced on the 2nd week (8.0). The maximum number of leaves (14.1) of Eden variety grown under the combination of quarry dust and poultry manure was produced on the 7th week and least number (7.8) was recorded on the 2nd week.

The highest number of leaves (13.6) of Eden variety grown under NPK and poultry manure was recorded on the 7th week and the least number of leaves (8.9) produced on the 2nd week. Eden variety grown under NPK and quarry dust on the 7th week recorded the maximum number of leaves (13.4) while the least was on the 2nd week with the least number of 9.5. Eden variety grown under NKP, poultry manure and quarry dust recorded the 7th week with the maximum number of 12.6 leaves whereas the least number of leaves (9.0) was observed on the 2nd week. The highest number of leaves (12.4) of Eden variety grown under no fertilizer was recorded on the 7th week whiles the least number of leaves (7.0) was observed on the 2nd week.

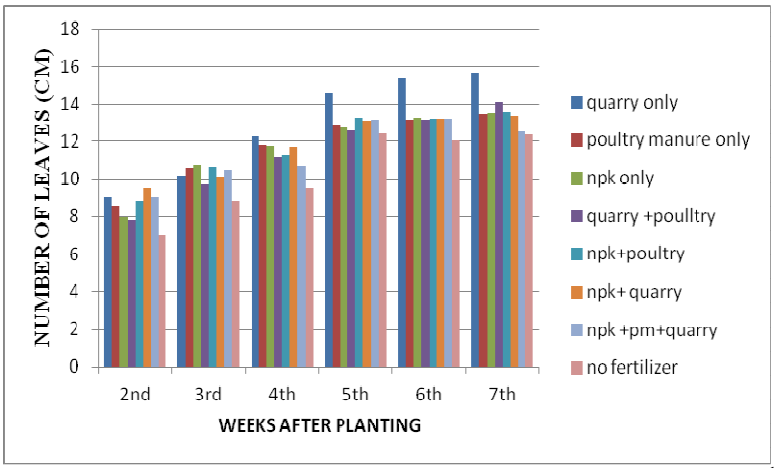

Figure 1: Effects of Fertilizer on the Number of Lettuce Leaves from 2nd to 7th week after planting
(Source: Field data, 2013)

3.2 Effects of Fertilizer on Plant Height

The effects of various fertilizer treatments on plant height as shown in figure 2 produced from 2nd to 7th week after planting showed significant differences ($p \leq 0.05$) in plant height. Maximum height was observed on the 7th week after planting. Eden variety grown under poultry manure only recorded the highest height of 15.1cm whereas Eden variety grown under NKP only produced the least height of 13.4cm.

The height of the Eden variety grown under quarry dust attained its highest height of 14.4cm at the 7th week. The maximum height of Eden variety grown under poultry manure was 15.1cm which occurred on the 7th week. The highest height of Eden variety grown under inorganic fertilizer (NPK 15-15-15) was 13.4 cm at the 7th week. The maximum height of Eden variety grown under the combination of quarry dust and poultry manure was 14.1cm also recorded on the 7th week. The highest height of Eden variety grown under NPK and poultry manure was 14.9cm occurred on the 7th week. Eden variety grown under NPK and quarry dust was produced on the 7th week with the maximum height of 14.6cm. Eden variety grown under NKP, poultry manure and quarry dust gave the maximum height of 13.5cm on the 7th week. The highest height grown under no fertilizer was 14.5cm recorded on the 7th week.

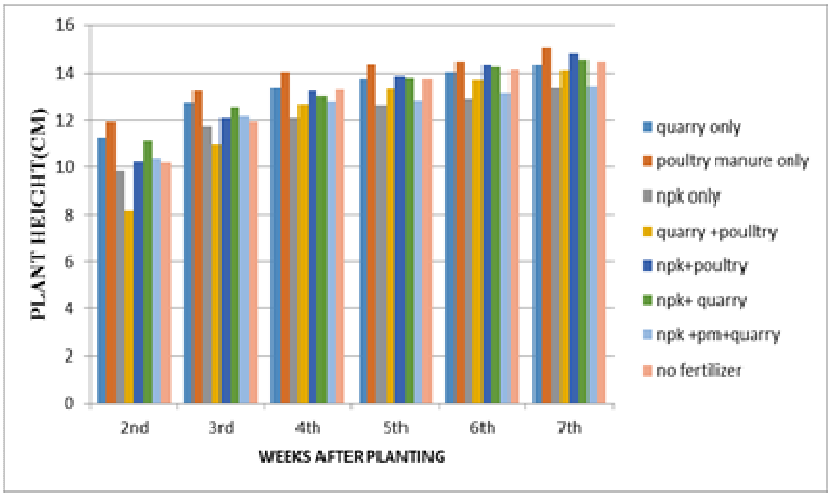

Figure 2: Effects of Fertilizer on Lettuce Height (cm)
(Field data, 2013)

3.3 Effects of Fertilizer on the Leaf Area produced by Lettuce

Figure 3 shows the effects of fertilizer treatments on leaf area of Lettuce from the 2nd to the 7th week of growth. There were no significant differences ($p \leq 0.05$) in the leaf area from the 2nd to the 7th week after planting for all the treatments.

Eden variety grown under NPK attained the highest leaf area of 80.2cm^2 whereas Eden variety grown under quarry dust produced the least leaf area of 73.0cm^2. The leaf area of the Eden variety grown under quarry dust attained its peak at the 7th week after planting (73.0 cm^2) whiles the least leaf area was produced on the 2nd week of planting (48.5cm^2).

The maximum leaf area of Eden variety grown under poultry manure was 79.8 cm^2 on the 7th week whilst the least leaf area recorded on the 2nd week was 52.8 cm^2.

The leaf area of Eden variety grown under inorganic fertilizer (NPK 15-15-15) attained its peak on the 7th week (80.2 cm^2) while the least leaf area of 50.80cm^2 was recorded on the 2nd week.

The maximum leaf area of 78.8 cm^2 was observed for the combination of quarry dust and poultry manure on the 7th week whilst 48.0cm^2 was observed on the 2nd week.

The NPK and poultry manure treatment recorded the highest leaf area of 75.8cm^2 on the 7th week and 43.8cm^2 was the least recorded on the 2nd week.

Eden variety grown under NPK and quarry dust recorded maximum leaf area of 76.2cm^2 whiles the least leaf area of 47.2cm^2 was produced on the 2nd week. Eden variety grown under NPK, poultry manure and quarry dust recorded a maximum leaf area of 76.5cm^2 on the 7th week with the least leaf area of 51.0cm^2 recorded on the 2nd week.

The highest leaf area of 77.5cm^2 of Eden variety grown under no fertilizer was observed on the 7th week whilst the least leaf area of 44.5cm^2 was recorded on the 2nd week.

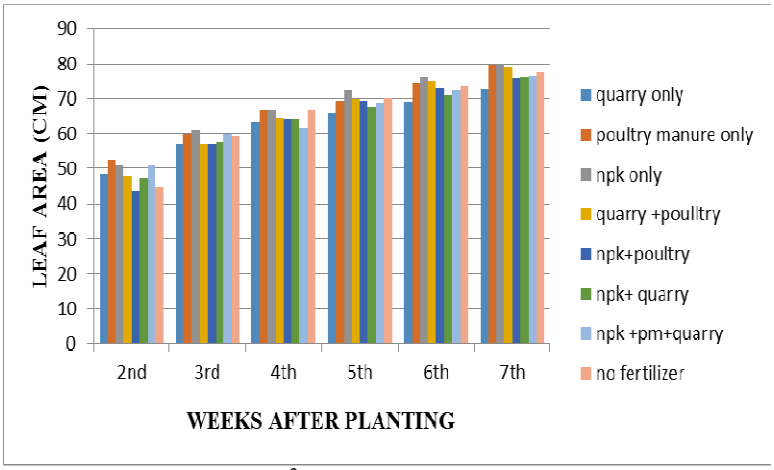

Figure 3: Effects of Fertilizer on Leaf Area (cm^2)

(Field Data 2013)

4 Conclusion

The results from the study showed that fertilizer application statistically, had significant effect ($P < 0.05$) on the height of the lettuce from the 2nd week after transplanting to the field. Poultry manure treatment recorded the highest of 15.1cm on the 7th week after transplanting. There was no significant effect ($P < 0.05$) of the fertilizer on the number of leaves and leaf area from the 2nd to the 7th week after transplanting. From the results, lettuce can be grown using 3 tonnes of poultry manure per hectare for higher yield in Techiman Municipality. The best fertilizer treatment recommended for growing lettuce in Techiman Municipality based on the study is poultry manure only, however the other treatments with organic fertilizer component such poultry manure with NPK is also recommended for improving the nature and properties of soil for lettuce cultivation in the study area.

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