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Evaluation of different levels of poultry manure and lime on performance of plantain (*Musa paradisiaca* AAB) in Unwana - Afikpo, Ebonyi state

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Abstract

Field experiment was carried out at the Teaching and Research Farm of Horticulture and Landscape Technology Department in Akanu Ibiam Federal Polytechnic, Unwana, Ebonyi State between September, 2023 and May, 2024 to evaluate the effects of different levels of poultry manure and lime on the performance of plantain (*Musa paradisiaca* AAB) in Unwana-Afikpo, Ebonyi State, Nigeria. The lime levels were 0, 2 and 4 t ha^{-1} whereas, the poultry manure levels used were 0, 10 and 15 t ha^{-1}. The experiment was a Factorial experiment fitted into a Randomized Complete Block Design. The three different levels of lime were imposed on the main plots while the three different levels of poultry manure were imposed on the sub-plots. The entire experiment was replicated four times. Data were collected and analyzed using Analysis of Variance and differences between treatment means were by Fisher's Least Significant Difference. The soil type was clay loam with only 0.15% total Nitrogen and a pH of 5.80. Evaluations for growth parameters of plantain at different stages of growth were made while fruit yield and other yield components of plantain were determined at harvest. The results revealed that lime had no significant effects ($P \leq 0.05$) on most of the parameters measured. Plants treated with 0 t ha^{-1} lime produced the tallest plants, largest leaf, widest pseudostem girth and longest days to harvest than those treated with 2 t ha^{-1} and 4 t ha^{-1} of lime respectively whereas, the greatest number of leaves and suckers, highest number of fruits, heaviest bunch per plant, highest yield per hectare and fruit dry matter yield were obtained from 4 t ha^{-1} lime treated plants. Application of 15 tons of poultry manure ha^{-1} produced significantly ($P \leq 0.05$) taller plants, more number of leaves, leaf area, wider pseudostem girth, lesser days to fruits harvest, higher number of fruits per bunch, heavier bunch, higher yield per hectare and fruit matter yield than 10 tons of poultry manure ha^{-1} and the control (0 ton ha^{-1}). The mean number of fruits per plantain bunch were 25.61, 29.11 and 30.56 fruits for 0, 10 and 15 t ha^{-1} poultry manure rates respectively. And the fruit yield per hectare were 9.17, 10.49, 11.92 tons for 0, 10 and 15 t ha^{-1} poultry manure rates respectively. The combination of 4 t ha^{-1} lime and

15 t ha^{-1} poultry manure treatment was recommended for plantain in order to obtain optimum vegetative growth and yield of the crops in Unwana-Afikpo, Ebonyi State.

Keywords: Lime, Poultry manure, Plantain, Suckers.

Introduction

Plantain (*Musa paradisiaca* AAB) is one of the important staple foods in the tropical and subtropical regions of the world, including high rainfall areas of South Eastern Nigeria (Englberger *et al*., 2006; Jalloh *et al*., 2012). West and Central Africa is a secondary centre of diversification for plantain with more than 100 cultivars and thus has the world's highest diversity (Swennen *et al*., 1995; Blomme *et al*., 2013). In Nigeria and many other parts of Africa, plantain serves as a major staple food. It can be consumed in the unripe, fairly ripe, ripe and over-ripe stages (Oladele and Khokhar, 2011; Kwofie *et al*., 2020). Plantain and banana have been crops of extraordinary significance to human societies. They are at present the fourth most important food crop in the world after rice, wheat and maize in terms of gross value of production, and are widely used as food, beverages, fermentable sugars, medicines, cooked food, flavourings, silage, rope, cordage, shelter, clothing, smoking materials and fragrance (Phillip *et al*., 2009; Blomme *et al*., 2019). In Nigeria, Akinyemi *et al*. (2010) reported that plantain is the third most important starchy staple grown after cassava and yam, with the majority of production being consumed nationally. Plantain production in Nigeria has been estimated to be 1,855,000 metric tonnes and they are produced in large quantities in Edo, Delta, Ogun, Ondo, Oyo, Osun, Rivers, Cross River, Imo, Anambra, Lagos, Kwara, Kogi, Benue, Abia and Enugu States (FAO, 1997; Opeyemi *et al*., 2015). The potential for improving productivity and yield stability is thought to be high and would improve food security. The all year round fruiting habit of plantain placed the crop in a superior position in bridging the hunger gap between crops harvests. Therefore, it contributes significantly to food and income security of people engaged in its production and trade, especially in developing countries (Heslop-Harrison and Schwarzacher, 2007; Temple *et al*., 2007).

The crop requires fertile soil and soil with a pH between 5.5 to 7.0 for optimum performance and nutrient uptake. Plantain is not tolerant to salty soils (Norgrove and Hauser, 2013). Plantains are fast growing and require the frequent addition of nutrients as well as additional irrigation in the dry season. Plantain requires large amounts of mineral nutrients such as nitrogen and potassium to maintain high yields under commercial production (Swennen, 1990; Ndukwe *et al*., 2011). Jinadasa *et al*. (1997) also reported that poultry manure increased soil pH, organic matter content, available phosphorus, exchangeable cations and micro nutrients as well as reduce soil salinity and extractable ions. The soil pH increased progressively with the application and subsequent decomposition of poultry manure (Amanullah, 2007; Aba *et al*., 2011). In Nigeria, plantain production has gone seriously on the decline due to depleted soil nutrients and inadequate and indiscriminate use of soil amendments (Rosati *et al*., 2000). In order to obtain high yields from plantain, there is need to augment the nutrient status of the soil to meet the crop's need and thereby maintaining the fertility of the soil. One of the ways of increasing the nutrient status of soil is by boosting the soil nutrient content either with the use of organic materials such as poultry manure, animal waste and compost or with the use of inorganic fertilizers. However, animal manure is often readily available and may constitute a valuable source of nutrients and organic matter which can improve soil physical conditions (Dauda *et al.,* 2005; Baiyeri *et al*., 2013). Poultry manure is relatively resistant to microbial degradation. It is essential for establishing and maintaining optimum soil physical condition and important for plant growth and yield (Rahman, 2004; Eghball *et al*., 2004).

Lime application neutralizes soil acidity, reduces toxicity levels of aluminium, iron and manganese and improves physiological, chemical and biological properties of soils (Kisinyo *et al*., 2005). Ponette *et al*. (1991) found that lime and phosphorus application to acid soils decrease plant available iron, manganese, zinc and copper, and increase pH, calcium, magnesium and available phosphorus thereby, improve crop performance. Soil acidity is commonly corrected by applying lime. However, liming soil is not a common practice in the traditional subsistence farming system due to lack of awareness of the importance of lime and unavailability of the products at critical period (Effiong *et al*., 2009). Soils in South Western and South Eastern parts of Nigeria where plantains are mostly cultivated are acidic due to the nature of the parent material, heavy leaching and weathering. In addition to acidity, the soils suffer from nutrient deficiency (Akinrinde *et al*., 2005). There is scarcely any information on the rate of poultry manure and lime application on plantain and despite the fact that plantain is a major crop under cultivation in Nigeria. Hence, the need to determine the right rate to apply poultry manure and lime in order to boost growth performance, bunch yield and fruit yield of both crops.

Objectives

The major objective of this study is to evaluate the response of plantain to different rates of poultry manure and lime.

The specific objectives are as follows:

1. To evaluate the influence of poultry manure and lime on the growth and yield of plantain.
2. To estimate the levels of poultry manure and lime needed to obtain optimum growth and yield performance in plantain.

Materials and Methods

Experimental site and field conditions

The field experiment was conducted in the Teaching and Research Farm of the Department of Horticulture and Landscape Technology, Akanu Ibiam Federal Polytechnic, Unwana-Afikpo, Ebonyi State. Unwana is situated between latitude 06^0 05 N and longitude 08^0 03 E with altitude 300m above sea level. Annual average rainfall is between 2,500mm to 3,000mm, distributed between March to October. Temperature range during the cropping season is 27^0C to 30^0C with a relative humidity of 75% (NIMET, 2021).

Experimental materials

The experimental site was manually cleared and then divided into three blocks and each block consisted of three plots which was replicated four times, giving a total of thirty six plots, each measuring 9m x 6m ($54m^2$). The experiment was conducted as a Factorial experiment in Randomized Complete Block Design (RCBD). The treatment comprised of three different levels of both lime and poultry manure which will be as follows 0, 2 and 4t/ha, and 0, 10 and 15t/ha respectively.

Factor A (Main plots) = 3 Lime rates
Factor B (Sub-plots) = 3 Poultry manure rates

Measurements

The vegetative and yield parameters studied were plant height (m), number of leaves, leaf length (cm), leaf width (cm), number of days to 50% flowering, leaf area (cm^2), pseudostem girth (cm) at 6MAP, number of sucker per stool, number of days to harvest, number of fruits, weight of fruits (tons/ha), weight of bunches (kg/ha) and fruit dry matter (kg).

Statistical analysis

Statistical analysis of data was based on the procedure outlined by Onuh and Igwemma (2007) for Factorial Experiment in Randomized Complete Block Design (RCBD). Separation of treatment means for significant effects was by the use of Fishers Least Significant Difference (F-LSD) as described by Obi (2012).

Results

Effects of Lime and Poultry Manure on Plant Height (m) of Plantain

The effects of different levels of lime on plant height (m) of plantain (*Musa paradisiaca* AAB) was significant at 4 and 6 Months After Planting (MAP) and non significant at 2 Months After Planting (MAP) ($P \leq 0.05$) as shown in Table 1. Plantain grown on 0ton lime/ha produced the longest mean plant height (0.97m, 1.02m and 1.21m) at 2MAP, 4MAP and 6MAP respectively while plant height were shortest (0.88m. 0.93m and 1.07m) at 2MAP, 2MAP and 6MAP respectively on the plants grown with 2ton lime/ha and they differed significantly. 0ton lime/ha produced plant height that was significantly higher than all other lime treatments. However, the plant height obtained on the 2ton lime/ha and 4ton lime/ha did not differ significant among themselves.

Poultry manure applications had significant effect on the plant height of plantain produced at $P \leq 0.05$ (Table 1). 15ton manure/ha produced the longest plant height at 2MAP (1.02m), 4MAP (1.06m) and 6MAP (1.27m) while the shortest plant height at 2MAP (0.83m), 4MAP (0.86m) and 6MAP (1.00m) respectively were obtained on the 0ton manure/ha and they differed significantly. The plant height recorded on 15ton manure/ha at 2MAP, 4MAP and 6MAP were significantly higher than all other poultry manure applications. However, the plant height (0.99m and 1.16m) obtained at 4MAP and 6MAP respectively on the plants grown with 10ton manure/ha was significantly higher than plant height of plantain produced on 0tan manure/ha at 4MAP and 6MAP, whereas it was statistically the same at 2MAP.

The effects of different levels of lime and poultry manure applications on plantain were significant at 2MAP, 4MAP and 6MAP (Table 1). The longest mean plant height at 2MAP (1.15M), 4MAP (1.15m) and 6MAP (1.35m) were recorded on plants grown with 0tan lime/ha and 15 ton manure/ha while the shortest plant height (0.78, 0.82 and 0.92m) at 2MAP, 4MAP and 6MAP respectively were obtained on plants treated with 2ton lime/ha and 0ton manure /ha and they differed statistically. Plantain plants treated with 0ton lime/ha and 15ton manure/ha recorded plant height that was significantly longer than all other treatment combinations. Although, the plant height obtained on plants treated with 0tan lime/ha and 10ton manure/ha, and 4ton lime/ha and 15ton manure/ha at 4MAP, and 6MAP were significantly longer than plant height produced on 2ton lime/ha and 0ton manure/ha. Plant height produced on plants grown with 0ton lime/ha and 0ton manure/ha, 2ton lime/ha and 10ton manure/ha, 2ton lime/ha and 15ton manure/ha, 4ton lime/ha and 0ton manure/ha, and 4ton lime/ha and 10ton manure/ha did not differ significantly among themselves.

Table 1: Effects of Lime and Poultry Manure on Plant Height (m) of Plantain

Treatments	2MAP	4MAP	4MAP
Lime Rate			
0ton lime/ha	0.97	1.02	1.21
2ton lime/ha	0.88	0.93	1.07
4ton lime/ha	0.91	0.97	1.15
F-LSD $_{0.05}$	NS	0.06	0.08
Poultry Manure Rate			
0ton manure/ha	0.83	0.86	1.00
10ton manure/ha	0.91	0.99	1.16
15ton manure/ha	1.02	1.06	1.27
F-LSD $_{0.05}$	0.09	0.06	0.09
Interactions			
0ton lime x 0ton manure/ha	0.83	0.87	1.05
0ton lime x 10ton manure/ha	0.93	1.03	1.23
0ton lime x 15ton manure/ha	1.15	1.15	1.35
2ton lime x 0ton manure/ha	0.78	0.82	0.92
2ton lime x 10ton manure/ha	0.93	0.97	1.10
2ton lime x 15ton manure/ha	0.93	1.00	1.18
3ton lime x 0ton manure/ha	0.87	0.90	1.04
3ton lime x 10ton manure/ha	0.87	0.97	1.15
3ton lime x 15ton manure/ha	0.98	1.03	1.27
F-LSD $_{0.05}$	0.29	0.21	0.28

Effects of Lime and Poultry Manure on the Number of Leaves Produced per Plant

Table 2 shows that the effects of lime on the number of leaves produced was non-significant at P ≤ 0.05. Although, the highest mean number of leaves were obtained on plants grown with 0ton lime/ha (7.11 leaves), 2ton lime/ha (6.94 leaves) and 4ton lime/ha (10.56 leaves) at 2MAP, 4MAP and 6MAP respectively while the lowest mean number of leaves (6.28, 6.67 and 10.22 leaves) were produced on 2ton lime/ha and 0ton lime/ha at 2MAP, 4MAP, and 6MAP respectively.

Application of poultry manure had significant effect on the number of leaves produced (Table 2). 10ton manure/ha produced the highest number of leaves (6.83 leaves and 7.44 leaves) at 2MAP and 4MAP respectively and at 6MAP, 15ton manure/ha produced the highest number of leaves (11.56 leaves) while, the lowest number of leaves (6.50 leaves) at 2MAP, (5.44 leaves) at 4MAP and (8.89 leaves) at 6MAP were obtained on plants grown on 0ton manure/ha and they were significantly different at 4MAP and 6MAP. However, the number of leaves recorded on 10ton manure/ha at 4MAP and 15ton manure/ha at 6MAP were significantly higher than all other treatments. At 2MAP, 0ton manure/ha, 10ton manure/ha and 15ton manure/ha produced number of leaves that were statistically similar.

Lime and poultry manure applications were significant on the number of leaves produced at P ≤ 0.05 (Table 2). At 2MAP, 0ton lime/ha and 10ton manure/ha produced the highest number of leaves (8.17 leaves) while the lowest number of leaves (5.67 leaves) was obtained on 2ton lime/ha and 15ton manure/ha and at 4MAP, 2ton lime/ha and 15ton manure/ha recorded the highest number of leaves (8.67 leaves) while the lowest number of leaves (5.33 leaves) was produced on 2ton lime/ha and 0ton manure/ha whereas at 6MAP, the highest number of leaves (11.83 leaves) was obtained from plants treated with 0ton lime and 15ton manure/ha while 0ton lime and 0ton manure/ha recorded the lowest number of leaves (8.50leaves) and they were all significantly different. Although, the number of leaves produced on 0ton lime and 0ton manure/ha, 2ton lime and 0ton manure/ha, 2ton lime and 10ton manure/ha, 4ton lime and 0ton manure/ha, and 4ton lime and 15ton manure/ha were statistically the same.

Table 2: Effects of Lime and Poultry Manure on the Number of Leaves Produced per Plant

Treatments	2MAP	4MAP	4MAP
Lime Rate			
0ton lime/ha	7.11	6.67	10.22
2ton lime/ha	6.28	6.94	10.44
4ton lime/ha	6.44	6.67	10.56
F-LSD $_{0.05}$	NS	NS	NS
Poultry Manure Rate			
0ton manure/ha	6.50	5.44	8.89
10ton manure/ha	6.83	7.44	10.78
15ton manure/ha	6.50	7.39	11.56
F-LSD $_{0.05}$	NS	1.10	1.30
Interactions			
0ton lime x 0ton manure/ha	6.33	5.50	8.50
0ton lime x 10ton manure/ha	8.17	7.67	10.33
0ton lime x 15ton manure/ha	6.83	6.83	11.83
2ton lime x 0ton manure/ha	6.67	5.33	9.33
2ton lime x 10ton manure/ha	6.50	6.83	10.33
2ton lime x 15ton manure/ha	5.67	8.67	11.67
3ton lime x 0ton manure/ha	6.50	5.50	8.83
3ton lime x 10ton manure/ha	5.83	7.83	11.67
3ton lime x 15ton manure/ha	7.00	6.67	11.17
F-LSD $_{0.05}$	1.30	1.90	2.60

Effects of Lime and Poultry Manure on Leave length (cm) Produced per Plant

There was non–significant effect of lime application on the leaves length of plantain at P ≤ 0.05 (Table 3). The longest leaves at 2MAP (91.46cm), 4MAP (96.09cm) and 6MAP (103.70cm) were on the plants treated with 0ton lime/ha and the shortest leaves at 2MAP (83.54cm), 4MAP (87.06cm) and 6MAP (94.99cm) on plants treated with 2ton lime/ha. Plants treated with 4ton lime/ha produced the longest leaves than 2ton lime/ha treatment.

Poultry manure applications did not significantly affect the leave length produced (Table 3). Although the longest leaves at 2MAP (89.41cm), 4MAP (95.41cm) and 6MAP (104.26cm) were recorded on plants treated with 15ton manure/ha while the shortest leaves at 2MAP (83.46cm), 4MAP (87.11cm) and 6MAP (95.02cm) were obtained on plants that received 0ton manure/ha. 10ton manure/ha produced leaves longer than plants grown on 0ton manure/ha.

Application of lime and poultry manure had significant effect on the leave length produced (Table 3). Plants which received 0ton lime/ha and 15ton manure/ha produced the longest leaves at 2MAP (97.72cm), 4MAP (103.28cm) and 6MAP

(111.83cm) while the shortest leaves at 2MAP (79.72cm), 4MAP (83.28cm) and 6MAP (92.06cm) were obtained on plants treated with 2ton lime/ha and 0ton manure/ha and they differed significantly except at 4MAP. 0ton lime/ha and 15ton manure/ha produced leaves that were significantly longer than all other treatments. However, the leave length obtained on plants treated with 0ton lime and 0ton manure/ha, 0ton lime and 10ton manure/ha, 2ton lime and 10ton manure/ha, 2ton lime and 15ton manure/ha, 4ton lime and 0ton manure/ha, and 4ton lime and 10ton manure/ha did not differ significantly among themselves.

Table 3: Effects of Lime and Poultry Manure on Leave Length (cm) Produced per Plant

Treatments	2MAP	4MAP	4MAP
Lime Rate			
0ton lime/ha	91.46	96.09	103.70
2ton lime/ha	83.54	87.06	94.99
4ton lime/ha	84.71	93.06	100.84
F-LSD $_{0.05}$	NS	NS	NS
Poultry Manure Rate			
0ton manure/ha	83.46	87.11	95.02
10ton manure/ha	86.74	93.69	100.24
15ton manure/ha	89.41	95.41	104.26
F-LSD $_{0.05}$	NS	NS	NS
Interactions			
0ton lime x 0ton manure/ha	85.83	89.22	96.95
0ton lime x 10ton manure/ha	90.83	95.78	102.33
0ton lime x 15ton manure/ha	97.72	103.28	111.83
2ton lime x 0ton manure/ha	79.72	83.28	92.06
2ton lime x 10ton manure/ha	86.89	88.67	96.34
2ton lime x 15ton manure/ha	84.00	89.22	96.56
3ton lime x 0ton manure/ha	84.83	88.84	96.06
3ton lime x 10ton manure/ha	82.50	96.61	102.06
3ton lime x 15ton manure/ha	86.50	93.72	104.39
F-LSD $_{0.05}$	11.98	NS	14.73

Effects of Lime and Poultry Manure on Leave Width (cm) Produced per Plant

Lime did not significantly affect the leave width of plantain produced at P ≤ 0.05 (Table 4). The highest leave width at 2MAP (38.87cm), 4MAP (41.02cm) and 6MAP (45.56cm) were recorded on plants grown with 0ton lime/ha while the least leave width at 2MAP (33.94cm), 4MAP (37.66cm) and 6MAP (40.52cm) were obtained on plants treated with 2ton lime/ha. Plants treated with 4ton lime/ha produced leave width leave width that were wider than those of 2ton lime/ha treatment.

Poultry manure had significant effect on the leave width produced (Table 4). The highest leave width (37.89, 42.05 and 45.43cm) at 2MAP, 4MAP and 6MAP respectively were produced on plants grown with 15ton manure/ha while the lowest leave width (33.28, 36.04 and 40.06cm) at 2MAP, 4MAP and 6MAP respectively were obtained on 0ton manure/ha and they differed significantly. Plants manured with 10ton manure/ha produced leave width (37.06 and 40.63cm) at 2MAP and 4MAP respectively that was significantly wider than leave width (33.28 and 36.04cm) at 2MAP and 4MAP respectively obtained on 0tan manure/ha treated plants.

Lime and poultry manure significantly affected leave width of plantain (Table 4). Plants that were treated with 0ton lime/ha and 15ton manure/ha produced the highest leave width (44.89, 47.17 and 50.83cm) at 2MAP, 4MAP and 6MAP respectively while plants treated with 2ton lime/ha and 0ton manure/ha recorded the least leave width (31.83, 34,72 and 37.61cm) at 2MAP, 4MAP and 6MAP respectively and they were significantly different. 0ton lime/ha and 15 manure/ha produced leave width that was significantly wider than all other treatments. However, the leave width recorded on plants treated with 0ton lime and 0ton manure/ha, 2ton lime and 15ton manure/ha, and 4ton lime and 15ton manure/ha were statistically similar.

Table 4: Effects of Lime and Poultry Manure on Leave Width (cm) Produced per Plant

Treatments	2MAP	4MAP	4MAP
Lime rate			
0ton lime/ha	38.87	41.02	45.56
2ton lime/ha	33.94	37.66	40.52
4ton lime/ha	35.41	40.04	43.58
F-LSD $_{0.05}$	NS	NS	NS
Poultry Manure Rate			
0ton manure/ha	33.28	36.04	40.06
10ton manure/ha	37.06	40.63	44.17
15ton manure/ha	37.89	42.05	45.43
F-LSD $_{0.05}$	2.71	3.12	4.36
Interactions			
0ton lime x 0ton manure/ha	33.44	35.45	41.17
0ton lime x 10ton manure/ha	38.28	40.44	44.67
0ton lime x 15ton manure/ha	44.89	47.17	50.85
2ton lime x 0ton manure/ha	31.83	34.72	37.61
2ton lime x 10ton manure/ha	37.61	40.94	43.06
2ton lime x 15ton manure/ha	32.39	37.33	40.89
3ton lime x 0ton manure/ha	34.56	37.95	41.39
3ton lime x 10ton manure/ha	35.28	40.50	44.79
3ton lime x 15ton manure/ha	36.39	41.66	44.56
F-LSD $_{0.05}$	4.69	5.40	7.56

Effects of Lime and Poultry Manure on the Pseudostem Girth (cm) per Plant at 6MAP

Lime was non-significant on the pseudostem girth of plantain at $P \leq 0.05$ (Table 5). The highest pseudostem girth (31cm) was obtained on the plants treated with 0ton lime/ha while the lowest pseudostem girth (29.81cm) was recorded on the plants treated with 2ton lime/ha. However, 4ton lime/ha treated plants produced pseudostem girth that was wider than those of 2ton lime/ha.

There was significant effect of poultry manure on pseudostem girth at 6MAP (Table 5). Plants grown with 15ton manure/ha produced the highest pseudostem girth (32.58cm) while the lowest pseudostem girth (28.08cm) was obtained on 0ton manure/ha and they differed significantly. Plants grown on 15ton manure/ha produced pseudostem girth significantly wider than all other treatments. Although, 10ton manure/ha treated plants produced pseudostem girth (31cm) that was significantly wider than pseudostem girth (28.08cm) obtained on 0ton manure/ha.

Lime and poultry manure had significant effect on pseudostem girth of plantain (Table 5). 0ton lime and 15ton manure/ha produced the highest pseudostem girth (33.33cm) at 6MAP while 0ton lime and 0ton manure/ha recorded the lowest pseudostem girth (27.92cm) and they differed significantly. Pseudostem girth produced on 0ton lime and 15ton manure/ha, 2ton lime and 15ton manure/ha, and 4ton lime and 15ton manure/ha were statistically wider than pseudostem girth obtained on 0ton lime and 0ton manure/ha, 2ton lime and 0ton manure/ha, 4ton lime and 0ton manure/ha, and 2ton lime and 10ton manure.

Table 5: Effects of Lime and Poultry Manure on the Pseudostem Girth (cm) per Plant at 6MAP

Treatments	6MAP
Lime Rate	
0ton lime/ha	31.00
2ton lime/ha	29.81
4ton lime/ha	30.86
F-LSD $_{0.05}$	NS
Poultry Manure Rate	
0ton manure/ha	28.08
10ton manure/ha	31.00
15ton manure/ha	32.58
F-LSD $_{0.05}$	2.18
Interactions	
0ton lime x 0ton manure/ha	27.92
0ton lime x 10ton manure/ha	31.75
0ton lime x 15ton manure/ha	33.33
2ton lime x 0ton manure/ha	28.08
2ton lime x 10ton manure/ha	29.42
2ton lime x 15ton manure/ha	31.92
3ton lime x 0ton manure/ha	28.25
3ton lime x 10ton manure/ha	31.83
3ton lime x 15ton manure/ha	32.50
F-LSD $_{0.05}$	3.78

Effects of Lime and Poultry Manure on Leaf Area (cm^2) Produced/Plant

The effects of different levels of lime on leaf area (cm^2) of plantain was significant at $P \leq 0.05$ (Table 6). Plants treated with 0ton of lime/ha produced the highest mean leaf area (52310.23cm^2, 55832.88cm^2 and 68864.82cm^2) at 2MAP, 4MAP and 6MAP respectively while the lowest mean leaf area (42558.65cm^2, 47760.36cm^2, 55922.45cm^2) at 2MAP, 4MAP and 6MAP respectively were obtained on plants treated with 2ton of lime/ha and they differed significantly. 0ton of lime/ha treated plants produced mean leaf area that was significantly higher than all other lime treatments. However, plants treated with 4ton of lime/ha recorded mean leaf area that was statistically higher than plants treated with 2ton of lime/ha.

Poultry manure treatments had significant ($P \leq 0.05$) effect on the leaf area of plantain (Table 6). The highest mean leaf area (51896.88cm^2) at 2MAP, (56954.56cm^2) at 4MAP and (69344.60cm^2) at 6MAP were obtained from plants treated with 15ton of manure/ha while plants treated with 0ton of manure/ha recorded the least mean leaf area at 2MAP (39905.07cm^2), 4MAP (45677.39cm^2), and 6MAP (55144.03cm^2)

and they differed significantly. Plants treated with 15ton of manure/ha produced mean leaf area significantly higher than the other poultry manure treatments. Although, plants manured with 10ton of manure/ha recorded mean leaf area that was significantly higher than 0ton of manure/ha treated plants.

Lime and poultry manure applications were significant ($P \leq 0.05$) on the leaf area of plantain at 2MAP, 4MAP and 6MAP (Table 6). The highest mean leaf area at 2MAP (21444.84cm^2), 4MAP (21766.16cm^2) and 6MAP (27550.46cm^2) were produced on plants treated with 0ton of lime and 15ton of manure/ha while the lowest mean leaf area at 2MAP (11686.41cm^2), 4MAP (13944.58cm^2) and 6MAP (16679.83cm^2) was obtained on plants treated with 2ton of lime and 0ton of manure/ha and they differed significantly. Plants treated with 0ton of lime and 15ton of manure/ha produced mean leaf area that was statistically higher than all other treatment combinations.

Table 6: Effects of Lime and Poultry Manure on Leaf Area (cm^2) of Plantain Produced per Plant

Treatments	2MAP	4MAP	4MAP
Lime Rate			
0ton lime/ha	52310.23	55832.88	68864.82
2ton lime/ha	42558.65	47760.36	55922.45
4ton lime/ha	43830.68	51709.98	64296.04
F-LSD $_{0.05}$	53.50	70.44	62.57
Poultry Manure Rate			
0ton manure/ha	39905.07	45677.39	55144.03
10ton manure/ha	46897.61	52671.27	64594.68
15ton manure/ha	51896.88	56954.56	69344.60
F-LSD $_{0.05}$	18.73	26.64	37.06
Interactions			
0ton lime x 0ton manure/ha	13910.48	15283.56	19228.88
0ton lime x 10ton manure/ha	16954.91	18783.16	22085.48
0ton lime x 15ton manure/ha	21444.84	21766.16	27550.46
2ton lime x 0ton manure/ha	11686.41	13944.58	16679.83
2ton lime x 10ton manure/ha	15869.83	17695.47	20136.87
2ton lime x 15ton manure/ha	15002.41	16120.31	19105.75
3ton lime x 0ton manure/ha	14308.18	16449.25	19235.32
3ton lime x 10ton manure/ha	14072.87	16192.64	22372.33
3ton lime x 15ton manure/ha	15449.63	19068.09	22688.39
F-LSD $_{0.05}$	56.19	79.87	111.36

Effects of Lime and Poultry Manure on Plantain Height at Flowering

The effects of lime and poultry manure application on plantain (*Musa paradisiaca* AAB) height (m) at flowering per plant is shown in Table 7. Lime application had no significant ($P \leq 0.05$) effect on the mean plant height of plantain at flowering per plant. The mean values at flowering were 2.22, 2.16 and 2.25m for 0, 2 and 4 t ha^{-1} lime application rates respectively. Application of 4 t.ha^{-1} lime rate produced the tallest plant of 2.25m while the shortest plant 2.16m was obtained from 2 t ha^{-1} lime application rate, however, they were statistically ($P \leq 0.05$) similar.

Application of 15 $t.ha^{-1}$ poultry manure rate produced the tallest plant at flowering and was significantly ($P \leq 0.05$) different from 0 t ha^{-1} poultry manure application rate. Also, at flowering, the plant that received 15 t ha^{-1} poultry manure rate produced the tallest plant 2.27m and this was statistically ($P \leq 0.05$) similar to 2.22m obtained from 10 t ha^{-1} poultry manure application rate, while the least plant height value of 2.14m was recorded from 0 t ha^{-1} poultry manure application rate (Table 7).

The interaction of different rates of lime and poultry manure application had significant ($P \leq 0.05$) effects on plant height at flowering. Interaction of 0 t ha^{-1} lime and 15 t ha^{-1} poultry manure application rate produced the tallest plant of 2.35m which was significantly ($P \leq 0.05$) taller than 2.15, 2.15, 2.15 and 2.13m obtained from the interactions of 0 t ha^{-1} lime and 0 t ha^{-1} manure, 2 t ha^{-1} lime and 0 t ha^{-1} manure, 2 t ha^{-1} lime and 10 t ha^{-1} manure, and 4 t ha^{-1} lime and 0 t ha^{-1} poultry manure application rates respectively but was statistically ($P \leq 0.05$) similar to all other values (Table 7). However, the interaction of 4 t ha^{-1} lime and 0 t ha^{-1} poultry manure application rate gave the least plant height at flowering per plant with a value of 2.13m which was statistically ($P \leq 0.05$) the same to all others except that of 0 t ha^{-1} lime and 15 t ha^{-1} poultry manure, and 4 t ha^{-1} lime and 10 t ha^{-1} poultry manure application rates which produced mean values of 2.35 and 2.33m respectively.

Table 7: Effects of Different Levels of Lime and Poultry Manure on Plant Height at Flowering

Treatments	Plant Height (m) at Flowering
Lime Rate	
0ton lime/ha	2.22
2ton lime/ha	2.16
4ton lime/ha	2.25
F-LSD $_{0.05}$	NS
Poultry Manure Rate	
0ton manure/ha	2.14
10ton manure/ha	2.22
15ton manure/ha	2.27
F-LSD $_{0.05}$	0.12
Interactions	
0ton lime x 0ton manure/ha	2.15
0ton lime x 10ton manure/ha	2.17
0ton lime x 15ton manure/ha	2.35
2ton lime x 0ton manure/ha	2.15
2ton lime x 10ton manure/ha	2.15
2ton lime x 15ton manure/ha	2.17
3ton lime x 0ton manure/ha	2.13
3ton lime x 10ton manure/ha	2.33
3ton lime x 15ton manure/ha	2.30
F-LSD $_{0.05}$	0.19

Effects of Different Levels of Lime and Poultry Manure on Number of Plantain Suckers at Flowering

The results (Table 8) indicated that application of lime and poultry manure did not exhibit significant ($P \leq 0.05$) effects on the number of suckers at flowering. The mean values for the different lime rates were 4.33, 4.06 and 4.39 suckers for 0, 2 and 4 t ha^{-1} application rates respectively. Application of 4 t ha^{-1} lime rate produced the highest number of suckers per plant of 4.39 suckers while the least value of 4.06 suckers was obtained from plants treated with 2 t ha^{-1} lime application rate. These were statistically (P ≤ 0.05) the same.

Poultry manure application did not significantly (P ≤ 0.05) affect the number of suckers produced at flowering. The mean sucker numbers were 4.06, 4.44 and 4.28 suckers for 0, 10 and 15 t ha^{-1} poultry manure application rates respectively (Table 8). The application of 10 t ha^{-1} poultry manure rate gave the highest mean number of suckers at flowering per plant of 4.44 suckers which was statistically (P ≤ 0.05) similar to 4.06 and 4.28 suckers obtained from 0 and 15 t ha^{-1} poultry manure application rates respectively.

Interaction of lime and poultry manure application had no significant (P ≤ 0.05) effect on the number of suckers produced at flowering. The number of suckers produced ranged from 3.83 to 4.83 suckers per plant. The interaction of 4 t ha^{-1} lime and 10 t ha^{-1} poultry manure application rate gave the highest mean number of suckers per plant of 4.83 suckers which was statistically (P ≤ 0.05) similar to all other values obtained (Table 8).

Table 8: Effects of Different Levels of Lime and Poultry Manure on Number of Suckers at Flowering

Treatments	Number of Suckers at Flowering
Lime Rate	
0ton lime/ha	4.33
2ton lime/ha	4.06
4ton lime/ha	4.39
F-LSD $_{0.05}$	NS
Poultry Manure Rate	
0ton manure/ha	4.06
10ton manure/ha	4.44
15ton manure/ha	4.28
F-LSD $_{0.05}$	NS
Interactions	
0ton lime x 0ton manure/ha	4.00
0ton lime x 10ton manure/ha	4.67
0ton lime x 15ton manure/ha	4.33
2ton lime x 0ton manure/ha	4.17
2ton lime x 10ton manure/ha	3.83
2ton lime x 15ton manure/ha	4.17
3ton lime x 0ton manure/ha	4.00
3ton lime x 10ton manure/ha	4.83
3ton lime x 15ton manure/ha	4.33
F-LSD $_{0.05}$	NS

Effects of Different Levels of Lime and Poultry Manure on Number of Plantain (*Musa paradisiaca* AAB) Fruits per Bunch

The results (Table 9) revealed the effects of different rates of lime and poultry manure application on the number of plantain fruits per bunch. Application of lime did not significantly (P ≤ 0.05) influenced the number of plantain fruits per bunch. The mean number of fruits per bunch were 27.78, 27.83 and 29.67 fruits for 0, 2 and 4 tons ha^{-1} lime application rates respectively and these were statistically (P ≤ 0.05) the same.

Application of 15 tons ha^{-1} poultry manure rate gave the highest mean number of fruits per bunch significantly ($P \leq 0.05$) different from 0 ton ha^{-1} a poultry manure application rate. The mean values for different poultry manure rates were 25.61, 29.11 and 30.56 fruits for 0, 10 and 15 tons ha^{-1} application rates respectively (Table 9). Application of 10 tons ha^{-1} poultry manure produced 29.11 fruits per bunch significantly ($P \leq 0.05$) higher than 25.61 fruits obtained from 0 tons ha^{-1} poultry manure application rate but statistically ($P \leq 0.05$) similar to 30.56 fruits produced from 15 tons ha^{-1} poultry manure application rate.

The interaction of different lime rates and poultry manure application rates had significant ($P \leq 0.05$) effect on the number of plantain fruits per bunch (Table 9). Interaction of 4 t ha^{-1} lime and 15 t ha^{-1} poultry manure application rate produced the highest number of plantain fruits per bunch value of 33.00 fruits while the least value of 25.83 fruits was obtained from the interaction of 4 t ha^{-1} lime and 0 t ha^{-1} poultry manure application rate and they differed significantly ($P \leq 0.05$) among themselves. Interaction of 4 t ha^{-1} lime and 15 t ha^{-1} poultry manure, 4 t ha^{-1} lime and 10 t ha^{-1} poultry manure, and 2 t ha^{-1} lime and 15 t ha^{-1} poultry manure application rates produced 33.00, 30.17 and 29.67 fruits respectively that were statistically ($P \leq 0.05$) similar but statistically different from all other treatment interactions.

Table 9: Effects of Different Levels of Lime and Poultry Manure on Number of Plantain (*Musa paradisiaca* AAB) Fruits per Bunch

Treatments	Number of plantain fruits per bunch
Lime Rate	
0ton lime/ha	27.78
2ton lime/ha	27.83
4ton lime/ha	29.67
F-LSD $_{0.05}$	NS
Poultry Manure Rate	
0ton manure/ha	25.61
10ton manure/ha	29.11
15ton manure/ha	30.56
F-LSD $_{0.05}$	2.93
Interactions	
0ton lime x 0ton manure/ha	25.00
0ton lime x 10ton manure/ha	29.33
0ton lime x 15ton manure/ha	29.00
2ton lime x 0ton manure/ha	26.00
2ton lime x 10ton manure/ha	27.83
2ton lime x 15ton manure/ha	29.67
3ton lime x 0ton manure/ha	25.83
3ton lime x 10ton manure/ha	30.17
3ton lime x 15ton manure/ha	33.00
F-LSD $_{0.05}$	4.35

Effects of Different Levels of Lime and Poultry Manure on Number of Days from Flowering to Harvest of Plantain (*Musa paradisiaca* AAB) Bunch

The effect of different rates of lime and poultry manure application on number of days from flowering to harvest of plantain is shown in Table 10. Application of lime did not significantly ($P \leq 0.05$) influenced the number of days from flowering to harvest of plantain fruits per bunch.

The mean number of days to harvest of plantain were 63.78, 63.33 and 62.33 days for 0, 2 and 4 t ha^{-1} lime application rates respectively and these were statistically ($P \leq 0.05$) the same.

Application of poultry manure had significant ($P \leq 0.05$) effect on the number of days to harvest of plantain fruits per bunch (Table 10). The control (0 t ha^{-1} poultry manure) significantly ($P \leq 0.05$) prolonged number of days from flowering to harvest than 15 t ha^{-1} poultry manure application rate. Application of 10 and 15 t ha^{-1} poultry manure rates gave mean number of days to harvest per plant value of 62.33 days and 60.61 days respectively which were statistically ($P \leq 0.05$) similar. The shortest days (60.61 days) to fruits maturity was obtained from plants treated with 15 t ha^{-1} poultry manure application rate while the longest days (66.50 days) to fruits maturity was recorded from the control. The mean values were 66.50, 62.33 and 60.61 days for 0, 10 and 15 t ha^{-1} poultry manure application rates respectively and they differed statistically ($P \leq 0.05$).

The result revealed that the interaction of lime and poultry manure had no significant ($P \leq 0.05$) effects on the number of days to harvest per plantain fruits. The mean number of days from flowering to bunch harvest ranged from 60.33 to 68.17 days. However, the longest days (67.67 days) to harvest was recorded from the interaction of 2 t ha^{-1} lime and 0 t ha^{-1} poultry manure application rate while the least value of 60.33 days was obtained from plants treated with 4 t ha^{-1} lime and 15 t ha^{-1} poultry manure application rate and they were statistically ($P \leq 0.05$) the same.

Table 10: Effects of Different Levels of Lime and Poultry Manure on Number of Days from Flowering to Harvest of Plantain (*Musa paradisiaca* AAB) Bunch

Treatments	Number of Days to Harvest
Lime Rate	
0ton lime/ha	63.78
2ton lime/ha	63.33
4ton lime/ha	62.33
F-LSD $_{0.05}$	NS
Poultry Manure Rate	
0ton manure/ha	66.50
10ton manure/ha	62.33
15ton manure/ha	60.61
F-LSD $_{0.05}$	4.19
Interactions	
0ton lime x 0ton manure/ha	68.17
0ton lime x 10ton manure/ha	62.17
0ton lime x 15ton manure/ha	61.00
2ton lime x 0ton manure/ha	67.67
2ton lime x 10ton manure/ha	61.83
2ton lime x 15ton manure/ha	60.50
3ton lime x 0ton manure/ha	63.67
3ton lime x 10ton manure/ha	63.00
3ton lime x 15ton manure/ha	60.33
F-LSD $_{0.05}$	NS

Effects of Different Levels of Lime and Poultry Manure on Plantain (*Musa paradisiaca* AAB) Bunch Weight (kg) per Plant

Figure 1 indicates the effect of lime and poultry manure application on plantain (*Musa paradisiaca* AAB) bunch weight (kg) per plant. Lime application had no significant ($P \leq 0.05$) effect on the bunch weight produced per plant. Application of 0, 2 and 4 t ha^{-1} lime rates gave mean bunch weight per plant value of 6.27, 6.21 and 6.69kg respectively and these were not significantly ($P \leq 0.05$) different.

Application of 15 t ha^{-1} poultry manure rate produced the heaviest mean plantain bunch and it was significantly ($P \leq 0.05$) different from 0 and 10 t ha^{-1} poultry manure rates. The mean bunch weight of 6.52kg obtained from 10 t ha^{-1} poultry manure application rate was statistically higher than 5.50kg bunch weight produced from 0 t ha^{-1} poultry manure rate. The mean values for the different poultry manure rates were 5.50, 6.52 and 7.16kg for 0, 10 and 15 t ha^{-1} application rates respectively (Figure 2).

The interaction of lime and poultry manure application had significant ($P \leq 0.05$) effect on the plantain bunch weight per plant. Interaction of 4 t ha^{-1} lime and 15 t ha^{-1} poultry manure application rate produced the heaviest mean plantain bunch per plant of 7.78kg while the least mean value of 5.47kg was obtained from the interaction of 2 t ha^{-1} lime and 0 t ha^{-1} poultry manure, and 4 t ha^{-1} lime and 0 t ha^{-1} poultry manure application rates and they differed significantly ($P \leq 0.05$) among themselves (Figure 3).

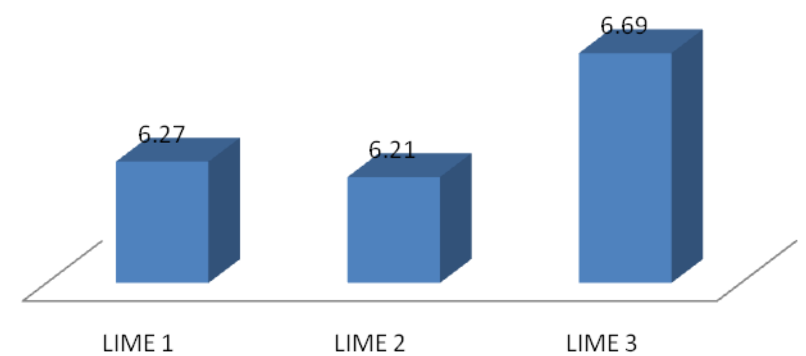

Figure 1: Plantain (*Musa paradisiaca* AAB) Bunch Weight (kg) per Plant treated with different levels of lime.

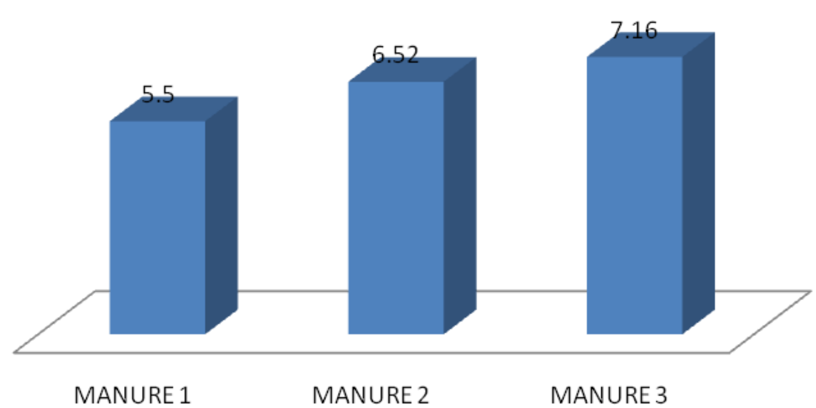

Figure 2: Plantain (*Musa paradisiaca* AAB) Bunch Weight (kg) per Plant treated with different levels of poultry manure.

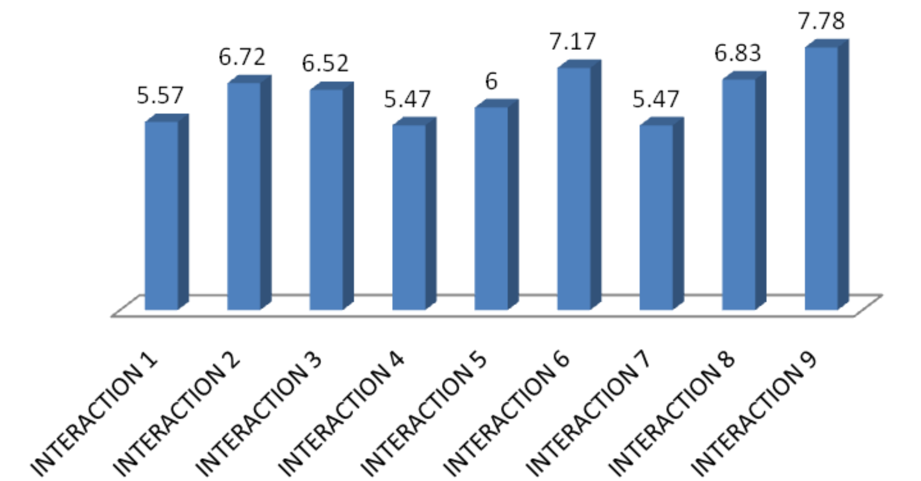

Figure 3: Plantain (*Musa paradisiaca* AAB) Bunch Weight (kg) per Plant treated with different levels of lime and poultry manure.

Effects of Different Levels of Lime and Poultry Manure on Plantain (*Musa paradisiaca* AAB) yield (tons) per Hectare

The results (Figure 4) showed the effects of different lime and poultry manure application on plantain (*Musa paradisiaca* AAB) yield per hectare. Application of lime had no significant ($P \leq 0.05$) effects on plantain yield per hectare. The mean plantain fruits yield per hectare were 10.17, 10.35 and 11.06 tons for 0, 2 and 4 t ha^{-1} lime application rates respectively and these were statistically ($P \leq 0.05$) similar.

Poultry manure application had significant ($P \leq 0.05$) effects on plantain yield per hectare. Application of 15 t ha^{-1} poultry manure rate produced the highest mean plantain yield of 11.92 tons per hectare significantly ($P \leq 0.05$) different from 9.17 tons per hectare obtained from the control (0 t ha^{-1} poultry manure application). Application of 10 t ha^{-1} poultry manure rate recorded higher plantain yield of 10.49 tons per hectare which was statistically ($P \leq 0.05$) similar to 9.17 tons per hectare obtained from 0 t ha^{-1} poultry manure application rate. The mean plantain yield values per hectare for the different poultry manure rates were 9.17, 10.49 and 11.92 tons for 0, 10 and 15 t ha^{-1} application rates respectively (Figure 5).

Interaction of lime and poultry manure application had no significant ($P \leq 0.05$) effects on plantain yield per hectare. Interaction of 4 t ha^{-1} lime and 15 t ha^{-1} poultry manure application rate gave the highest mean plantain yield of 12.95 tons per hectare which was statistically ($P \leq 0.05$) similar to all other interactions. But the smallest mean plantain yield value of 9.11 tons per hectare was recorded from 2 t ha^{-1} lime and 0 t ha^{-1} poultry manure, 2 t ha^{-1} lime and 10 t ha^{-1} poultry manure and 4 t ha^{-1} lime and 0 t ha^{-1} poultry manure application rates (Figure 6).

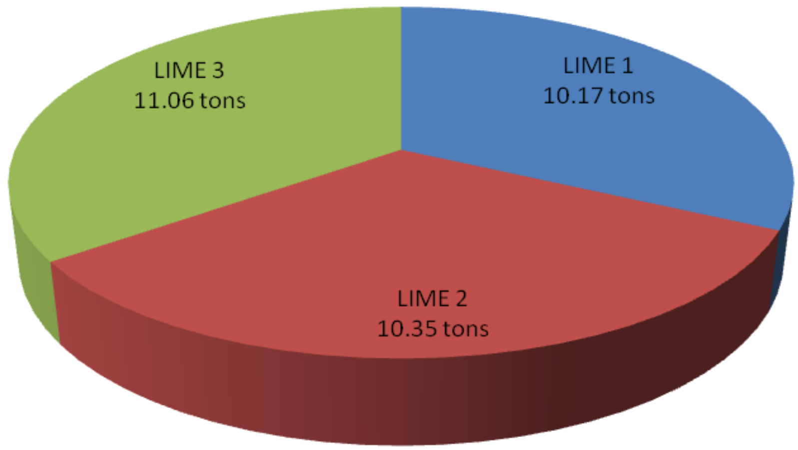

Figure 4: Plantain (*Musa paradisiaca* AAB) yield (tons) per Hectare treated with different levels of lime.

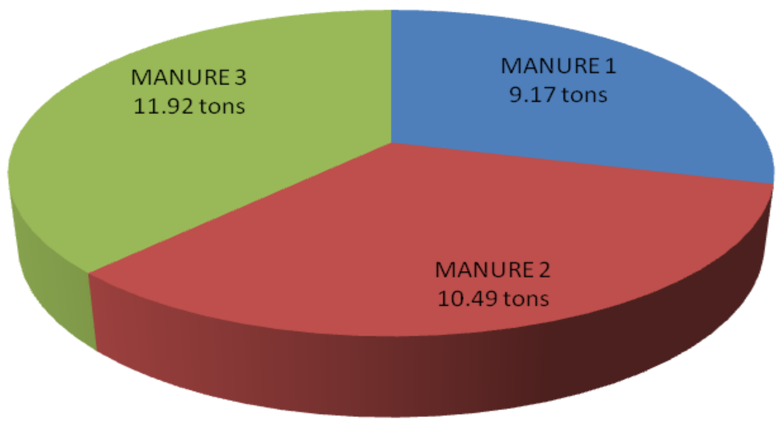

Figure 5: Plantain (*Musa paradisiaca* AAB) yield (tons) per Hectare treated with different levels of poultry manure.

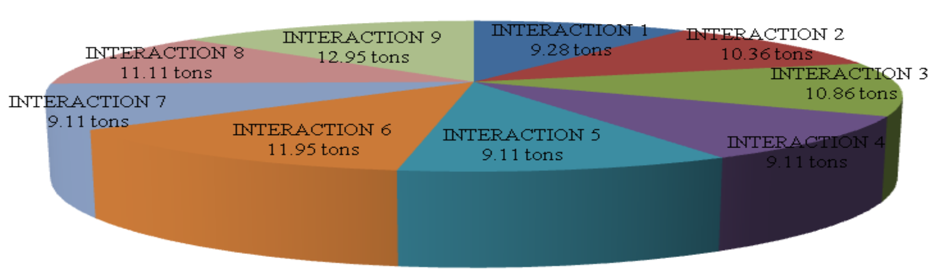

Figure 6: Plantain (*Musa paradisiaca* AAB) yield (tons) per Hectare treated with different levels of lime and poultry manure.

Effects of Different Levels of Lime and Poultry Manure on Plantain (*Musa paradisiaca* AAB) Fruit Dry Matter Yield (kg) per Plant

The effects of lime and poultry manure application on plantain (*Musa paradisiaca* AAB) fruit dry matter yield per plant is shown in Table 11. Lime application did not significantly ($P \leq 0.05$) influenced plantain fruit dry matter yield per plant. The mean fruit dry matter yield per plant were 3.13, 3.10 and 3.34kg for 0, 2 and 4 t ha^{-1} lime application rates respectively, and they were statistically ($P \leq 0.05$) the same.

Application of 15 t ha^{-1} poultry manure rate gave the heaviest mean fruit dry matter yield per plant value of 3.57kg and it was significantly ($P \leq 0.05$) different from plants treated with 0 t ha^{-1} poultry manure application rate which gave 2.75kg per plant. Application of 10 and 0 t ha^{-1} poultry manure rates produced mean plantain dry matter yield per plant value of 3.26 and 2.75kg respectively which were not significantly ($P \leq 0.05$) different.

The interaction of 4 t ha^{-1} lime and 15 t ha^{-1} poultry manure application rate gave the heaviest mean plantain dry matter yield of 3.88kg significantly ($P \leq 0.05$) different from the interaction of 2 t ha^{-1} lime and 0 t ha^{-1} poultry manure, and 4 t ha^{-1} lime and 0 t ha^{-1} poultry manure application rates but statistically ($P \leq 0.05$) similar to all other interactions. The plantain fruit dry matter yield ranged from 2.73 to 3.88kg per plant. The least value of 2.73kg per plant obtained from the interaction of 2 t ha^{-1} lime and 0 t ha^{-1} poultry manure application rate was statistically ($P = 0.05$) similar to all other interactions except 4 t ha^{-1} lime and 15 t ha^{-1} poultry manure application rate which produced the heaviest dry matter yield of 3.88kg per plant (Table 11).

Table 11: Effects of Different Levels of Lime and Poultry Manure on Plantain (*Musa paradisiaca* AAB) Dry Matter Yield per Plant

Treatments	Dry Matter Yield (kg) per Plant
Lime Rate	
0ton lime/ha	3.13
2ton lime/ha	3.10
4ton lime/ha	3.34
F-LSD $_{0.05}$	NS
Poultry Manure Rate	
0ton manure/ha	2.75
10ton manure/ha	3.26
15ton manure/ha	3.57
F-LSD $_{0.05}$	0.54
Interactions	
0ton lime x 0ton manure/ha	2.78
0ton lime x 10ton manure/ha	3.36
0ton lime x 15ton manure/ha	3.26
2ton lime x 0ton manure/ha	2.73
2ton lime x 10ton manure/ha	3.00
2ton lime x 15ton manure/ha	3.38
3ton lime x 0ton manure/ha	2.73
3ton lime x 10ton manure/ha	3.42
3ton lime x 15ton manure/ha	3.88
F-LSD $_{0.05}$	1.76

Discussion

The results from the field trial showed that lime had no significant ($P \leq 0.05$) effect on the number of leaves, leaf length, leaf width, pseudostem girth at 6 MAP, number of suckers, number of plantain hands and fruits per bunch whereas, the plant height and leaf area of plantain were significantly affected. The tallest plant, the longest leaf, widest leaf, widest pseudostem girth and largest leaf area were obtained on plants treated with 0 ton ha^{-1} lime. This may be attributed to the fact that South Eastern part of Nigeria soils are acidic due to heavy leaching and weathering which support acid soils loving plants. This may be attributed to the report by Swennen (1990) who stated that for optimum growth and fruit yield, plantain and banana require high amount of nutrients which are often supplied only in part by the soil. Whereas, plants treated with of 4 tons ha^{-1} lime gave greatest number of suckers, greatest fingers per bunch, heaviest bunch, and highest fruit yield per hectare and dry matter yield. This may be that the application of lime contributes in releasing some amount of fixed phosphorus to be available for the crop. This is in conformity with the report by Ponette *et al*. (1991) who found that lime and phosphorus application to acid soils decrease plant available iron, manganese, zinc and copper, and increase pH, calcium, magnesium and available phosphorus thereby, improve crop performance. Lime application neutralizes soil acidity, reduces toxicity levels of aluminum, iron and manganese and improves physiological, chemical and biological properties of soils (Kisinyo *et al*., 2005). Plants treated with 2 t ha^{-1} lime had the shortest plant, the lowest number of leaves, smallest leaf, smallest pseudostem girth and lowest leaf area of plantain.

Application of lime and poultry manure had significant ($P \leq 0.05$) effects on the plant height, number of leaves, leaf length, leaf width, pseudostem girth and leaf area of plantain. The tallest plant, the longest leaf, widest leaf, widest pseudostem girth and largest leaf area at 2, 4 and 6 MAP were recorded on plants treated with 0 t ha^{-1} lime and 15 t ha^{-1} poultry manure application rate whereas the highest number of leaves at 4 and 6 MAP were obtained from plants treated with 2 t ha^{-1} lime and 15 t ha^{-1} poultry manure application rate. Interaction of 2 t ha^{-1} lime and 0 t ha^{-1} poultry manure treated plants produced the shortest plant height, the lowest leaf length, leaf width and leaf area at 2, 4 and 6 MAP and also gave the least bunch weight, fruits yield per hectare and fruit dry matter yield while plants grown on 0 t ha^{-1} lime and 0 t ha^{-1} poultry manure had the lowest number of leaves, least pseudostem girth and number of fruits per bunch.

The analyzed results of the field trial showed that poultry manure had significant ($P \leq 0.05$) effects on the plant height, number of leaves, leaf width, pseudostem girth, leaf area and number of plantain fruits per bunch. The tallest plant, the longest leaf, widest leaf, widest pseudostem girth and largest leaf area at 2, 4 and 6 MAP were obtained from plants treated with 15 t ha^{-1} poultry manure application rate. Also, the application of 15 t ha^{-1} poultry manure rate gave the highest values of yield and yield component measured. This may suggest that poultry manure decomposed and added some nutrients to the soil in the form available for plant utilization, growth and yield. This observation agreed with the report by Baiyeri *et al.* (2013) who found that animal manure constitute a valuable source of nutrients and organic matter which can improve soil physical conditions and Eghball *et al*. (2004) who reported that increasing organic matter content of the soil improves soil biophysical characteristics and makes it more sustainably productive due to its long lasting residual effects on crop yield and soil properties. Furthermore, the results also agreed with Amanullah (2007) and Aba *et al*. (2011) who noted that soil pH increases progressively with the application and subsequent decomposition of poultry manure. They also observed that poultry manure is a good source of humus, the organic matter component with the most stability and nutrient availability for plants utilization, growth, suckering and over all performances. Plants grown on 0 t ha^{-1} poultry manure consistently produced the least values in all the parameters measured at 2, 4 and 6 MAP. This is in conformity with the observations by Rosati *et al*. (2000) who reported that plantain production in Nigeria has gone seriously on the decline due to depleted soil nutrients and inadequate and indiscriminate use of soil amendments and Ndukwe *et al*. (2011) reported that plantain requires large amount of mineral nutrients such as nitrogen and potassium to maintain high yield under commercial production and without which, the plants will suffer and the overall performance will be low.

Summary and Conclusion

The results of this study showed that 0 t ha^{-1} lime produced the highest vegetative growth of plantain whereas the optimum yield of plantain was obtained from 4 t ha^{-1} lime treatment. Least values of plant height, number of leaves, leaf length, leaf width, pseudostem girth and leaf area were obtained on plants treated with 2 t ha^{-1} lime. Plants manured with 15 t ha^{-1} poultry manure also produced the highest vegetative growth, yield and yield component of plantain while 0 t ha^{-1} poultry manure application rate gave the least values in all the parameters measured. The combination of 0 t ha^{-1} lime and 15 t ha^{-1} poultry manure application rate produced the maximum vegetative growth of plantain and it is more profitable to grow plantain at the interaction of 4 t ha^{-1} lime and 15 t ha^{-1} poultry manure application than any other treatment interactions.

Having noted the importance of plantain to the people of Nigeria and standing on the position of these plants genetic resources in cushioning food, income and job security of those agrarian communities of the country, it becomes imperative to create more awareness on the effects of liming and manuring *Musa paradisiaca* AAB in Unwana-Afikpo. However, plantain cultivation in Nigeria especially in Unwana-Afikpo, Ebonyi State will go a long way in improving the economy and food security of both the farmers and the country.

Recommendations

Based on the results of the study so far;

1. 4 t ha^{-1} lime is recommended for optimum growth and yield performance of plantain.
2. 15 t ha^{-1} poultry manure is recommended for maximum growth and performance of plantain.
3. For more efficient use of available land and resources, further research should be carried out to determine the best way and period to intercrop plantain and other crops like watermelon, melon, cucumber, etc. in South Eastern Nigeria.

References

Aba, S. C., Baiyeri, P. K. and Tenkouano, A. (2011). Impact of poultry manure on growth behaviour, black sigatoka disease response and yield attributes of two plantain (*Musa spp*. AAB) genotypes. *Tropicultura 28(1):20-27.*

Amanullah, M. M. (2007). Nutrient release pattern during composting poultry manure. *Research Journal of Agriculture and Biological Sciences. 3(4):306-308.*

Akinrinde, E. O., Bello, O. S., Ayegboyin, K. O. and Iroh, L. (2005). Added benefits of combined organic and mineral phosphate fertilizers applied to maize and melon. *Journal of Food Agric Environ. 3:75-80.*

Akinyemi, S. O. S., Aiyelaagbe, I. O. O. and Akyeampong, E. (2010). Plantain *(Musa spp.*) cultivation in Nigeria: a review of its production, marketing and research in the last two decades. In T. Dubois, S. Hauser, C. Staver, D. Coyne (eds.) Proceedings of an International conference on banana and plantain in Africa harnessing International partnerships to increase research impact. *Acta Horticulturae. 879:211-218.*

Baiyeri, K. P., Ndukwe, O. O. and Tenkouano, A. (2013). Manure placement method influenced growth, phenology and bunch yield of three Musa genotypes in a humid zone of Southern Nigeria.

Communications in Biometry and Crop Science. 8(1):1-9.

Blomme, G., Ploetz, R., Jones, D., DeLanghe, E., Price, N., Gold, C. Geering, A., Viljoen, A., Karamuna, E. and Buddenhagen, I. (2013). A historical overview of the appearance and spread of *Musa* pests and pathogens on the African continent: high lighting the importance of clean *Musa* planting materials and quarantine measures. *Annals of Applied Biology. 162(1):4-26.*

Blomme, G., Ocimati, W., Nabuuma, D., Sivirhauma, C., Davey, M., Buah, S., Van den Bergh, I., Vutseme, L., Bahati, L. and Ekesa, B. (2019). Pro-vitamin A carotenoid content of 48 plantain (*Musa* AAB genome) cultivars sourced from Eastern Democratic Republic of Congo. *Journal of the Science of Food and Agriculture, 100*:634-647. https://doi.org/10.1002/jsfa.10058.

Dauda, S. N., Aliyu, L. and Chiezey, U. F. (2005). Effect of variety, seeding age and poultry manure on growth and yield of garden egg *(Solamun gilo* L.*) Nigeria Academic Forum. 9:88-95.*

Effiong, G. S., Ibia, T.O., Ogban, P. I. and Inyang, N. D. (2009). Evaluation of locally-sourced liming materials for acid soils in Akwa Ibom State, Southeastern Nigeria. *American-Eurasian Journal of Agronomy. 2(3):144-151.*

Eghball, B., Ginting, D. and Gilley, J. E. (2004). Residual effects of manure and compost applications on corn production and soil properties. *Agronomy Journal. 96(2):442-447.*

Englberger, L., Willis, B. H., Blades, B., Duffrey, L., Daniells, J. W. and Coyne, T. (2006). Carotenoid content and flesh colour of selected banana cultivars growing in Australia. *Food and Nutrition Bulletin. 27(4):281-291.*

Food and Agricultural Organization of the United Nations FAO (1997). *FAO production statistics and the information Network on post-harvest operations (INPHO)*. P 198.

Heslop-Harrison, J. S. and Schwarzacher, T. (2007). Domestication, genomics and the future for banana. *Annals of Botany. 100 (5):1073-1084.*

Jalloh, A., Roy-Macauley, H. and Sereme, P. (2012). Major agroecosytems of West and Central Africa: brief description, species richness, management, environmental limitations and concerns. *Agriculture, Ecosystems and Environments. 157:5-16.*

Jinadasa, K. B., Milham, C. A., Hawkins, C. A., Cornish, P. A., Williams, C. J., Kaldo, C. J. and Conroy, J. (1997). Survey of cadmium levels in vegetables and soils of greater Sydney. *Australia Journal of Environmental Quality. 26:924-933.*

Kisinyo, P. P., Othieno, C. O., Okalebo, J. R., Kipsat, M. J., Serem, A. K. and Obiero, D. O. (2005). Effects of lime and phosphorus application on early growth of Leucaena in acid soils. *African Crop Science Conference Proceedings. 7:1233-1236.*

Kwofie, M. K., Sarpong, M. A., Anima, F., Bukari, N. and Adeboye, O. (2020). The use of ripe plantain (*Musa spp*.) and peppercorns for beverage processing as a pro-vitamin A carotenoid and nutrition catalyst. *Food and Nutrition Sciences, 11*:1096-1106.

Ndukwe, O. O., Muoneke, C. O. and Baiyeri, K. P. (2011). Effect of time of poultry manure application and cultivar on the growth, yield and fruit quality of plantains *(Musa spp.* AAB). *Tropical and subtropical Agroecosystems. 14:261-270.*

Nigeria Meteorological Agency (NIMET) (2021). Annual meteorological report for Owerri.

Norgrove, L. and Hauser, S. (2013). Black leaf streak disease and plantain fruit characteristics as affected by tree density and biomass management in a tropical agroforestry system. *Agroforestry systems. 87:349-354.*

Obi, I. U. (2012). *Statistical Methods of Detecting Differences Beteen Treatment Means and Research Methodology Issues on Laboratory and Field Experiments (Second Edition)*. Optimal International Limited, Enugu. Xi + 131pp.

Oladele, E. and Khokhar, S. (2011). Effect of domestic cooking on the polyphenolic content and antioxidant capacity of plantain *(Musa paradisiaca* AAB). *World Journal of Dairy and Food Sciences. 6:189-194.*

Onuh, M. O. and Igwemma, A. A. (2007). *Applied Statistical Techniques for Business and Basic Sciences*. Skilmark Media, Owerri. Pp. 341.

Opeyemi, T. O., Ayodele, A. F. and Christopher, J. O. (2015). Effects of organic and inorganic soil amendments on growth performance of plantain *(Musa paradisiaca* L.). *African Journal of Agricultural Research. 10 (3):154-160.*

Phillip, B., Shittu, A. M., Aiyelaagbe, I. O. O. and Adedoku, T. (2009). Economic potentials of plantain and fluted pumpkin intercropping as a poverty reduction strategy in South Western Nigeria. *World Journal of Agricultural Sciences. 5(5):525-534.*

Ponette, O., Belkacen, S. and Nys, C. (1996). Ion dynamics in acid forest soils as affected by addition of calcium fertilizers. *Geoderma. 71:53-76.*

Rahman, S. A. (2004). The place of organic manure in sustaining agricultural development in Nigeria. Paper presented at Science Technology and Society National Workshop in Lafia, Nasarawa State. 11th July, 2004.

Rasheed, A. (2003). Plantain production as a business. *HORT-Magazine. 1 (11):11-12.*

Rosati, A. Day, R. R. and Dejong, T. M. (2000). Distribution of leaf mass per unit area and leaf nitrogen concentration determines partitioning of leaf nitrogen within tree canopies. *Tree Phys. 20:271-276.*

Swennen, R. (1990). Plantain cultivation under West Africa conditions: A reference manual. International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. P. 24.

Swennen, R. Vuylsteke, D. and Ortiz, R. (1995). Phenotypic diversity and patterns of variation in West and Central African plantains *(Musa spp*. AAB group *Musaceae*). *Economic Botany. 49 (3): 320-327.*

Temple, L., Kwa, M., Fogain, R. and Pefoura, A. M. (2007). Participatory determinants of innovation and their impact on plantain production systems in Cameroon. *International Journal of Agricultural Sustainability. 4(3):233-243.*

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