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PRELIMINARY TRIAL OF FERTILIZER TYPES ON PINEAPPLE (*ANANAS COSMOSUS*) GROWN IN COASTAL ACID SANDS OF CROSS RIVER STATE, NIGERIA.

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ABSTRACT

Two experiments on Pineapple (*Ananas cosmosus)* were conducted at coastal plain, acid sands of Calabar, Cross River State, Nigeria, to assess the effect of two types of fertilizers, N. P. K Mg fertilizer mixture and 12:12:17:2 compound fertilizer – applied at four levels each, and the method and time of their application on growth and dry matter (DM) yield of smooth cayenne pineapple cultivar. The results showed that the application of 84g per plant of 12: 12: 17: 2 compound fertilizer increased the growth and DM yield of smooth cayennne pineapple cultivar more than all other rates of the compound fertilizer and was significantly ($P < 0.05$) higher than values obtained from N. P. K. Mg fertilizer mixture, given the same rates. The average effect of applying these two fertilizers by surface application two times increased crop growth and DM yield and values were significantly ($P < 0.05$) higher than those of 'placement application and times', while split application at 2 months and 5 months old was significantly higher than the other two treatments. The implications of these results are discussed in light of pineapple growth and development.

KEYWORDS: Acid sands, fertilizer types, Ananas Cosmosus, yield.

INTRODUCTION

Pineapple (*Ananas Cosmosus)* is native to Southern Brazil and Paraguay from where it was spread by Indians through South and Central America to West Indies. The pineapple reached England in 1660 from where it moved to West Africa in the early 18th century. (Sampson, 1986)

The crop is drought-tolerant, and well adapted to the tropical acid sands with pH ranging between 4.5 to 6.5. Pineapple is propagated by new vegetative growth. There are four general types of planting materials: slips – that arise from the stalk below the fruit: suckers: that originate at the axils or leaves; crowns – that grow from the top of the fruits; and ratoons: that come out from the under-ground portions of the stems. Although 'slips' and 'suckers' are preferred, crowns are the main planting materials used in acid sands. The oval to cylindrical – shaped, compound fruit develops from many small fruits fused together. It is both juicy and fleshy with the stem serving as the fibrous core, (Samson,1986). The tough. waxy rind may be dark green, yellow, orange-yellow or reddish when the fruit is ripe.

The fertilization treatment is essential to pineapple for increased fruit size and total yield. The possibility of nutrient losses characteristic of tropical soils, through percolating water, leaching and erosion have great influence on the fertilizer – rate to apply, the type of fertilizer and the method of application. Also, the frequency and time to apply are considered very important in pineapple production, Morton, (1987) and Faithful, (1998). In South-East Asia, monthly application of 7g to 42g of 12.12:17:2 compound fertilizer per plant has been recommended; Beven and Gray (1966).

The objective of this study is to determine the fertilizer requirement, methods, frequency and time of application on smooth cayenne pineapple cultivar using treatment combinations.

MATERIALS AND METHODS

The experiments were laid out at Iwuru, near Calabar, Nigeria on April 10th 2001, using commonly grown and productive suckers of smooth cayenne cultivar. The soil type was acid sands of pH between 5.5 – 6.0 (Omoti, 1986). In this study, suckers of smooth cayenne cultivar were used due to yearly fruiting compared with crowns (Sampson, 1986). The trial was in a 2x2 split plot in a Randomized Complete Blocks Design (RCBD) replicated four times. Plot size was 2x48m. The experimental site was cleared, packed and removed in a four-year fallow land of *centrosema pubescenes*, as dominant specie.

Experimental Treatments

Two types of fertilizers - N. P. K Mg fertilizer mixture as sulphate of ammonia (21%N), single super phosphate (18% P_2O_5) Sulphate of potash (60% K_2O), magnesium sulphate (18% mg) on the one hand, and 12: 12: 17: 2 compound fertilizer, on the other, applied at four levels each, were the main treatments. Method and frequency of application of the two fertilizers were the split plot treatments. The details of the treatments are as follows:

Main treatment

Fertilizer mixture, symbolized (N. P. K. Mg 1 – 4)

28g N. P, KMg mixture containing 1.18gN, 1.01g P_2O_5 3.36 K_2O and 2.02gMg (N. P. K. Mg – ^{1})

56g N. P. K Mg mixture containing 2.3gN, 2.02g P_2O_5 6.72g K_2O and 4.04g Mg (N. P. K. Mg – ^{2})

84g N. P. KMg mixture containing 3.53gN, 3.03g P_2O_5 10.08g K_2O and 6.06Mg. (N. P. K. Mg – ^{3})

114g N. P. KMg mixture (control) containing 4.08gN, 4.11g P_2O_5, 13.71g K_2O and 8.24g Mg (N. P. K. Mg - ^{4})

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Compound Fertilizer: symbolized (CF 1 - 4)

26g 12: 12: 17: 2 (CF –1)

56g 12: 12: 17: 2 (CF – 2)

84g 12: 12: 17: 2 (CF – 3)

114g 12: 12: 17: 2 (CF – 4)

Sub – plot Treatments
Surface application once
Surface application two times
Surface application three times

Placement application once
Placement application two times
Placement application three times

Depth of placement was 2.5cm. The application of fertilizer treatment was carried out when the suckers were six weeks, 3 months and six months old.

The second experiment consisted of determining the best time to apply fertilizer to pineapple in the same study location. The treatments were applied as follows:

A = 114g N. P. K. Mg fertilizer mixture applied to pineapple in two equal doses at planting and 5 months old.
B = 1149 of N. P. K. Mg fertilizer mixture equal doses at one and 5 months old.
C = 114g NPK Mg fertilizer mixture applied in equal doses at 2 and 5 months old.

The design was completely randomized block replicated four times

Planting and chemical treatment.
The smooth cayenne cultivar was used for this study has leaves with little or no spines.
Fruits are cylindrical with high sugar and acid content, and well adapted in the tropical environment (Sampson, 1986).
Planting was done by the use of suckers that originate at the axil from the stalk. Spacing was 30cm within rows and 50cm between rows

Furadan (against ants and other insects) was applied to each drug hole prior to planting at an application rate of 8kg/ha. Ridomil, mixed at the rate of 3.0g per 20 litres of water was used to soak the roots against nematodes and fungi before planting.

Growth Parameters
Ten suckers per plot were sampled for the determination of growth parameters: height, leaf area and number of leaves.

The heights of three plants, randomly selected within each plot, were measured. Measurement was in situ and from the base to leaf blade tip, while sampling was done along the diagonals of each plot. The youngest but fully developed leaf was selected from each of the ten plants. The length from the base of the ligule to the leaf tip and the width at the mid-point along the length of the blade were measured. Leaf area (LA) was measured using leaf area meter (L1 – COR model). The ten leaves were weighed for fresh weight, then oven dried at a temperature of 60°C for 48 hours for leaf dry weight, after which the dry matter yield was determined. The total numbers of leaves produced in the ten selected plants were counted to give the average number of leaves per plant

Statistical Analysis
Data were subjected to analysis of variance (ANOVA) and means compared with Fisher's Least Significant Difference (LSD) at 5% level.

RESULTS AND DISCUSSION

The effect of various fertilizer treatments on plant height, leaf number, leaf area (LA) and DM yield of smooth cayenne pineapple cultivar is presented in Table 1. Highest height 56.6cm was obtained from plots that received 84g of 12: 12: 17: 2 (CF-3) and this was significantly ($P < 0.05$) higher than those of other compound fertilizer doses, and those of fertilizer mixture. In both fertilizer treatments, plant height increases ran closely with increase in the rate of fertilizer application from 28g to 84g per plant. Levels above 84g significantly ($P < 0.05$) suppressed height. The lowest plant height, 44.1cm was obtained from N. P. K. Mg-1 plots that received 28g per plant. The application of fertilizer mixture at 114g per plant produced similar results as 12: 12: 17: 2 at 114g per plant. The application of 84g of 12: 12:17: 2 compound fertilizers increased the growth and development of smooth cayenne pineapple cultivar more than the rate 114g. Plant heights of 46.5cm obtained from N P K Mg-4 and 54.3cm obtained from CF –4 showed that the application of both fertilizers at rates above 84g per plants depressed plant growth. These findings suggest that better results can be achieved with lower rates of fertilizer in pineapple production. This further indicates that at this rate of application, nutrient losses from several sources would be economically minimized and the plant will utilize the applied fertilizer more efficiently for growth (Splitstosser 1977 Yamaguchi 1983). From this study the optimum fertilizer requirements for the test pineapple would not be more than 84g per plant. The general effect of fertilizer mixture 12:12:17:2 rather than fertilizer N. P. K. Mg in promoting pineapple growth and development was very glaring, as evidenced in the DM yield and growth attributes measured.

The highest number of leaf blades, 24.7 was obtained from plots that received 114g per plant, with CF–4 and this was significantly ($P < 0.05$) higher than other values obtained from all other treatments. The 12: 12: 17: 2 CF–1 at 28g per plant produced comparable results as N. P.K. Mg-2, at 56g per plant. Number of leaf blades per plant increased with increase

Table 1:Plant height (cm), leaf number, leaf area (LA) and DM yield (t/ha) as influenced by fertilizer treatments.

Parameters	N:P:K Mg-1	N:P:K Mg-2	N:P:K Mg-3	N:P:K Mg-4	CF-1	CF-2	CF-3	CF-4	LSD (P 0.05)
Plant ht (cm)	44.1	45.3	47.7	46.5	46.5	55.2	56.6	54.3	1.2
Leaf number	18.2	19.1	20.0	20.1	19.3	22.5	20.2	24.7	0.8
Leaf area (LA)	102.5	110.5	115.2	117.8	105.1	115.6	121.3	125.6	2.5
DMyield (t/ha)	4.3	4.6	5.1	6.4	4.6	5.8	8.8	6.9	0.3

Note: DM = dry matter; LSD (0.05) = least significantly difference at 5% probability level; t/ha = tones per hectare; N.P.K = nitrogen, phosphorous, potassium.

Table 2: Average effect of method and frequency of applying two fertilizers, on plant height (cm), leaf number, leaf area (LA) and DM yield (t/ha)

Method and frequency of fertilizer application	Plant height (cm)	Leaf Number	Leaf area (LA)	DM yield (t/ha)
Surface application				
A	88.0	27.4	129.4	7.8
B	60.2	30.0	131.6	9.2
C	54.1	25.2	127.3	6.5
Placement				
A	56.0	26.4	127.2	6.4
E	52.3	24.0	123.0	5.1
F	48.3	22.0	120.5	4.0
LSD (P < 0.05)	2.2	1.2	2.1	0.8

Note: DM = Dry Mater

Table 3:Effect of time of application of fertilizer on mean plant height (cm), leaf number, leaf Area (LA) and Dm yield (kg/ha)

Treatments	Plant ht. (cm)	Leaf Number	Leaf Area	Dm yield (t/ha)
A	64.0	26.2	136.2	8.4
B	68.2	28.4	141.6	7.8
C	75.4	31.5	148.5	9.5
LSD (P < 0.05)	3.8	2.2	4.7	0.6

NB: A = treatment application once:
B = Treatment application two times
C = Treatment application three times

in the two fertilizer rates (in the two fertilizers) except that in N. P. K. Mg fertilizer mixture, number of leaf blades at N. P. K. Mg-3 (84g/plant) was similar to that of N.P.K Mg-4 (114g/plant). (Table 1).

The leaf area was highly influenced by the rate of fertilizer applied. Thus, the highest leaf area (125.6) was obtained from 12: 12:17: 2 (C-4) where 114g per plant was applied and this was significantly (P< 0.05) higher than those of all other treatments during the study period. The N.P.K.Mg-3 at 84g per plant produced similar result with CF–2 at 56g per plant.

The highest DM yield (8.8t/ha) obtained at 84g per plant was significantly (P< 0.05) higher than those of other treatments, while the lowest of 4.3t/ha was obtained from the plots that received 28g per plant. (N. P. K. Mg-1). The DM yield obtained from CF – 2 treatment plot where 56g per plant was applied showed higher significance than the value obtained from N. P. K. Mg-3 where 84g per plant was applied.

The differential increases in plant growth, development and DM yield due to surface application two times, compared with other treatments suggest that better results of application allow sufficient time for the fertilizer to be used by the crop for growth as earlier reported by Maxwell and Betty (1987), Morton, (1987), Gerbers & Swiaders (1981) and Leith and Sali (1999). In a similar experiment also, Wilman and Pearse (1984), Wilman and Fisher, (1996) and Rezvani and Williams (1998) noted that an increase in interval between crop harvests allowed a larger positive effect of applied fertilizer to develop in respect of crop growth and development.

The results of method and frequency of application of fertilizer on plant height, leaf number, leaf area (LA) and DM yield (t/ha) are presented in Table 2. The highest plant height (88.0cm) was obtained from plots "A" with surface application one times, and this was significantly (P< 0.05) higher than those of other treatments. Surface application two times gave 60.0cm and was significantly higher than 56.0cm obtained from placement application once "A". The result from surface application of "C" (three times) (54.1cm plant height) was significantly higher than the values from both placement applications of "E" and "F"

Equally, highest number of leaf blades (30.0) was obtained from surface application of "B" (two times) compared to 26.4 obtained from placement application once. The value of number of leaf blades obtained from surface application of "C" (three times) (25.2) was significantly higher (PLO.05) than the values, 24.0 and 22.0, obtained from placement application two times and placement application three times, respectively. The least number of leaf blades (22.0) was obtained from placement application three times. (Table 2)

The highest LA (131.6) was from surface application two times (B_2, while the lowest (120.5) was obtained from placement application three times. The LA values obtained on the average by surface application were significantly (P< 0.05) higher than LA values obtained from placement application method and times.

The surface application two times gave the highest DM yield of 9.2 t ha^{-1}, while the lowest value of 4.0 y ha^{-1} was obtained from placement application three times. Except surface application two times, the DM yield (7.8 t ha^{-1}) obtained from surface application once, was significantly (P< 0.05) higher than the values obtained from other placement application method and times, (Table 2). The DM yield obtained from the surface application three times was similar to that of placement application once (Table 2).

Second Experiment

The effect of time of application of fertilizer on plant height, leaf number, leaf area and DM yield of smooth cayenne pineapple cultivar is presented in Table 3.

Highest plant height (75.4cm) was obtained from plots that received equal doses of fertilizer application at 2 and 5 months old; while the lowest (64.0cm) was obtained from plots applied with two equal doses of fertilizer at one and 5 months old. Similar treatment result was obtained for the number of leaf blades (Table 3). Highest total DM yield (9.5t/ha) was obtained from plot C (where fertilizer application was in equal doses at 2 and 5 months old) while the lowest (7.8t/ha) was obtained from plots B (where the fertilizer was applied in equal doses at one and 5 months old) and their differences were significant (P < 0.05).

CONCLUSION

The results of this study showed that the pineapple cultivar yields were significantly increased with increases in fertilizer rates. However, the magnitude of response in terms of growth, development and yield was more with 12:12:17:2 compound fertilizer than with NPK Mg fertilizer mixture, thus implying that compound fertilizer might be more cost effective to the farmer. The study further revealed that optimum growth, development and dry matter yield was obtained from surface application 2 times – at planting and 5 months later. As such,

this period might be considered the best time to apply fertilizer to smooth cayenne pineapple cultivar in the coastal plain, acid sands of Calabar, Nigeria.

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