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EFFECT OF N-FERTILIZER RATES ON DRY MATTER YIELD (DMY) AND QUALITY OF PINEAPPLE PROPAGULES (*ANANAS COMOSUS*) IN THE ACID SANDS OF CROSS RIVER

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ABSTRACT

Two experiments were conducted in April, 2002 and 2003 during the wet seasons at Iwuru, near University of Technology, Akamkpa Campus, to investigate the effect of N-fertilizer rates (0,150,300 and 450kg N/ha) on leaf area index (LAI), Dry Matter Yield (DMY) and crude protein concentration of pineapple progagules (*Ananas Comosus*), suckers and crowns.

The result in both years showed that increasing N-fertilizer rates significantly (<0.005) increased LAI in the two propagules throughout the experimental season. On the average, there was a 18.4% unit increase in LAI and a further 23.3% unit increase in LAI when N-fertilizer rates increased from 150 to 300 and 300 to 450kgN/h respectively during the planting season compared with nil N. The protein concentration (g per kg DM), on the average increased by 16.9% and 20.4% when N-fertilizer rates increased from 150 to 300kg N/ha and from 300 to 450kg N/ha respectively, throughout the experimental period. These results are discussed in light of the effect of N-fertilizer rates on growth of pineapple in Cross River State-Nigeria.

KEYWORDS: N-fertilizer rates yield and quality of pineapple.

INTRODUCTION

The origin of pineapple (*Ananas Comosus*) is said to be southern Brazil and Paraguay. It is believed that from there, it was spread by Indians through South and Central America to West Indies. The crop reached England in 1860 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 (*Ubi et al, 2005)*. The crop 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 axil or leaves, crown from the top of the fruits; and ratoons; that come out from the underground portions of the stem. Generally, farmers prefer planting slips and suckers instead of crowns probably due to inadequate information on crowns as a main planting material used in acid sands.

The fruits of pineapple are oval to cylindrical-shaped compound fruit develops from many small fruits fused together. The fruit is both juicy and fleshy with the stem serving as the fibrous core (Sampson 1986). The tough, waxy rind may be dark green, yellow, orange-yellow or reddish when the fruit is ripe for harvest.

The application of fertilizers to pineapple has become very important for increased fruit size and total yield. The possibility of nutrient losses, characteristic of tropical soils, through percolating water, leaching, erosion and crop removal has great influence on the fertilizer rate to apply, the type of fertilizer and the method of application (*Ubi et al. 2005*). Also the frequency and time to apply are considered very important in pineapple production (Morton 1987, Faithful 1998).

The objective of this study was to determine the N-fertilizer rate that will give good DMY and quality of smooth cayenne pineapple cultivar using treatment combinations.

MATERIAL AND METHODS

Two experiments were conducted in April 2002 and 2003 at Iwuru, about 15km from University of Cross River State, Akamkpa Campus during the wet season, on the acid sands derived from basement complex. The experimental site lies between 8°14 and 8°2' E longitude, 5°18N latitude with a rainfall of over 2,000mm in the rainforest vegetation (Olivine, 1986). In terms of land use, the area was previously cropped with cassava followed by a three year fallow in which guinea grass (*Panicum Maximum*) was the dominant fallow species. The site was manually cleared, allowed to dry for some days, then gathered and removed. The trial was planted in a 2 x 4 split –plot in randomized complete block design (RCBD) replicated three times. Main plot size was 3m x 48m and sub-plot size was 3m x 12m, with a sampling area of 2m x 2m. Two propagules of smooth cayenne were used; suckers (rations from) parent stock and crowns derived from the head of each pineapple fruit). Four different levels of nitrogen fertilizer used in form of urea were: 0,150,300 and 450kgN/ha. At the beginning of the planting season, the roots were top dressed with 122.2kg P/ha and 325kg/ha in the form of triple supephusphate and muriate of potash respectively.

A land area was marked out within the sampling area and was used in the determination of the Leaf Area Index =

$$\frac{\text{Leaf Area}}{\text{Land Area}}$$

The leaf area was measured using leaf area meter Li-COR MODEL.

About 200g fresh weight samples were taken from each sub-plot and was oven dried for 72 hours at 65°C to obtain the dry weights, thereafter the DMY was calculated. Dried leaves were milled through a 1mm screen in a high-speed laboratory mill and representative sub-samples stored in envelops under dry room condition for use in the protein analysis. Crude protein concentration (g per kg DM) was determined by the use of microkhajeidal apparatus.

STATISTICAL ANALYSIS

Data were subjected to analysis of variance (ANOVA) and means compared with Fisher's Least Significant Difference at 5% probability level, using the method out lined by Wahau (1993).

RESULTS

The rainfall and temperature data presented in Table 1 show that the monthly rainfall and temperature from April were sufficient to support crop growth and development (*Ubi et al. 2005*)

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Table 1: Average rainfall values from 2001 to 2004

Month	2002/2003 Rainfall (mm)	2003/2004 Rainfall (mm)	Average Temperature
January	5.1	4.3	32.2
February	7.9	8.1	36.5
March	51.8	52.0	38.1
April	68.5	69.1	53.2
May	78.6	81.0	42
June	113.2	115.6	38.5
July	96.6	101.4	36.2
August	71.4	86.2	34.3
September	70.1	66.0	33.0
October	48.6	52.3	31.1
November	31.2	42.6	29.4
December	23.1	30.4	32.0
Mean	55.5	59.1	30.0

Source: Meteorological station, College of Education, Cross River University of Technology, Akamkpa.

Table 2: Effect of N-fertilizer rates on leaf area index (LAI) of pineapple suckers and crown over two years.

Propagules	Nitrogen	Fertilizer		Rates (kg N/ha)	Mean
	0	150	300	450	
		2002			
Suckers	6.3	8.2	10.3	14.0	9.7
Crowns	7.2	9.1	11.1	14.8	0.5
Mean	**6.7**	**8.6**	**10.7**	**14.4**	
		2003			
Suckers	6.1	8.6	10.0	13.2	9.4
Crowns	7.4	9.7	12.1	14.6	8.4
Mean	**6.7**	**9.1**	**11.0**	**13.9**	

LSD (<0.05) between treatment means

	2002	2003
Nitrogen	1.5	1.4
Propagules	Ns	Ns
Nitrogen x propagules	1.6	1.6

Table 3: Effect of N-fertilizer rates on the total DMY of suckers and crowns of pineapple over two years

Propagules	Nitrogen Fertilizer			Rates (kg N/ha)	Mean
	0	150	300	450	
			2002		
Suckers	3.6	4.8	7.8	9.6	6.5
Crowns	3.2	6.5	13.1	26.8	12.4
Mean	**3.4**	**6.6**	**10.4**	**18.2**	
			2003		
Suckers	3.3	4.6	7.2	8.9	6.0
Crowns	3.1	6.8	13.4	27.3	15.1
Mean	**3.2**	**5.7**	**10.3**	**18.2**	

LSD (<0.05) between treatment means

	2002	2003
Nitrogen	1.5	1.6
Propagules	2.1	2.1
Nitrogen x propagules	2.6	2.6

Table 4: Effect of N-fertilizer rates on crude protein concentration (G Per DM) of two pineapple propagules over two years.

Propagules	Nitrogen	Fertilizer		Rates (kg N/ha)	Mean
	0	150	300	450	
		2002			
Suckers	63	74	92	142	85
Crowns	64	73	93	143	85.7
Mean	**63.5**	**73.5**	**92.5**	**142.5**	
		2003			
Suckers	62	74	93	140	84.7
Crowns	63	75	94	142	86.0
Mean	**62.5**	**74.5**	**93.5**	**141.0**	

LSD (<0.05) between treatment means

	2002	2003
Nitrogen	85	84
Propagules	Ns	Ns
Nitrogen x propagules	91	93

LEAF AREA INDEX (LAI)

Table 2 shows that increasing N-fertilizer rates significantly (P<0.05) increased LAI of both pineapple suckers and crowns. There was on the average a 19.6% and 25.6% unit increases in LAI when N-fertilizer rate increased from 150 to 300kg N/ha and from 300 to 450kg N/ha respectively during the 2002 planting season.

Equally, In 2003 planting season, there was on the average, a 17.3% and 20.9% unit increases when N-fertilizer rate increased from 150 to 300kg/ha and from 300 to 450kg N/ha respectively, compared with plots without N application. These increases as a result of every addition of 150kg N/ha were consistent throughout the experimental period. Comparing suckers and crowns in terms of LAI using all possible treatment combinations did not show any effect throughout the study period. But the two propagules produced their highest LAI where 450kg N/ha was applied. The interactions effects of suckers x N-fertilizer rates and crowns x N-fertilizer rates in terms of LAI were significant. Highest LAI (14.8) was produced by crowns where 450kg N/ha was applied while the lowest occurred in the plots where N was not applied.

TOTAL DRY MATTER YIELD (DMY)

The effect of N-fertilizer rates on the Total DMY of pineapple suckers and crowns is presented in Table 3. This shows that there were 36.5% and 42.9% unit increase in DMY on the average when N-fertilizer rates increased from 150 to 300kg N/ha and from 300 to 450kg N/ha respectively during the 2002 study period. In 2003, the corresponding increases were 44.7% and 43.1%.

The sucker x N-fertilizer rates interaction effect was significant (P< 0.05) Highest sucker DMY (9.6 t/ha) was obtained from plots treated with 450 kg N/ha while the lowest (3.6 t/ha) occurred in plots where no N was applied. Equally, crown x N-fertilizer rates interaction effect in terms of DMY was significant (<0.05). The total DMY (26.8t/ha) was highest where 450kg N/ha was applied while the lowest 3.2t/ha) was obtained from plots with no N-fertilizer treatment.

Using crowns as propagules, the total DMY produced was almost doubled for every addition of 150kg N/ha throughout the study period.

The differences between the propagules in terms of DMY were significant (P<0.05), but each propagule produced the highest DMY in plots treated with 450kg N/ha compared with plots with no N-fertilizer. DMY produced by crowns (12.4 t/ha) doubled that of suckers in the first planting season and was even higher (15.1 t/ha) in the second planting season (Table 3).

CRUDE PROTEIN CONCENTRATION

The mean effects of N-fertilizer rates on the protein concentration (g kg DM) of pineapple suckers and crowns of smooth cayenne are presented in Table 4.

The protein concentration in both suckers and crowns increased consistently with increase in N-fertilizer rates. There was 20.5% and 35.0% unit increases in protein concentration (g per kg DM) when N-fertilizer rates increased from 150 to 300kg N/ha and from 300 to 450kg N/ha respectively, during the 2002 planting season.

During the 2003 planting season, the protein concentration (g per kg DM) increased by 20.3% and 35.7% on the average when N-fertilizer rates were increased from 150 to 300kg N/ha and from 300 to 450kg N/ha respectively, compared with where N was not applied. The interaction effect between the propagules x N-fertilizer rates were significant (P<0.05) in both years.

Comparing, the 150kg N/ha with the 450kg N/ha, the crude protein concentration (g per kg DM) of plots treated with 450kg N/ha was more than double that of plots treated with 150kg N/ha (Table 4).

Differences between the suckers and crowns in terms of crude protein concentration (g per kg DM) was not statistically significant. However, each of the propagules produced the highest crude protein concentration in plots treated with 450kg N/ha compared with plot where N was not applied.

DISCUSSION

The positive effect of applied nitrogen on Leaf Area Index (LAI), DM) Yield and crude protein concentration (g per kg DM) reported in this study is in agreement with other results (Sampson, 1986, Leitch and Sahi 1999, Ubi and Omaliko, 2004; Ubi and Iqwe 2005, Ubi, 2006).

In all treatment combination, LAI, DM Yield and crude protein concentration ran closely with increase in the rate of N-fertilizer treatment from 150kg N/ha to 450kg N/ha. In a similar study, Ubi *et al* (2005) reported that the highest number of leaf blades 24.7 was obtained from the application of 114g per plant of compound fertilizer 12:112:17:2. Their report is in agreement with the result of this study in which the highest LAI and DMY were obtained from the highest 450kg N/ha compared with plots without N-application. This report suggests that better results can be achieved with urea at high rates of 450kg N/ha in increasing growth and development of smooth cayenne pineapple. These findings suggest that the optimum N-rate required for the test pineapple would not be less than 450kg N/ha, when urea is used.

Evidently, crowns have faster rate of leaf turn-over than suckers, and infact more leaves per hill than suckers. Thus, the thicker and heavier leaves of crowns might have accounted for the higher DMY of crowns than suckers.

CONCLUSION

The finding from this study showed that LAI, DM and protein concentration of smooth cayenne pineapple cultivar were significantly increased with increase in N-fertilizer rates. However, the magnitude of response was more in 450kg N/ha than with all other N-rates. This implies that urea fertilizer with 45% N at high rate of 450kg N/ha will be most suitable, considering the possibility of nutrient losses characteristics through water percolation, leaching and crop removal in the acid sands of Cross River State, Nigeria.

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