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THE EFFECT OF N-FERTILIZER APPLICATION ON THE BRIX, POL, FIBRE AND PURITY OF TWO PINEAPPLE CULTIVARS (*ANANAS COMOSUS*)

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ABSTRACT

An experiment was conducted in March, 2004 at Iwuru, about 15 km from the University of Cross River State Akamkpa Campus to determine the effect of N-fertilizer application on the brix, pol, fibre and purity of two pineapple cultivars (*Ananas Comosus*). Nitrogen fertilizer application exerted a significant ($P<0.05$) effect on the brix and pol contents of the pineapple cultivars. There was 9.5% increase in brix content when N-fertilizer rate increased from 100 to 150 and 20.2% drop in brix content and 31.4% drop in pol content when N was further increased from 150 to 200 kg N/ha, in smooth canyenne. The differences between cultivars in terms of brix and pol contents were glaring with queen cultivar producing significantly ($P<0.05$) 10.1 and 14.6% more brix and pol contents respectively more than smooth canyenne given the same treatments.

N-fertilizer especially at high rates reduced juice content and increased fibre content of the fruit later in the season. These results are discussed in relation to pineapple production and fruit quality.

KEYWORDS: N-fertilizer application, brix, pol, fibre and purity of pineapple.

INTRODUCTION

The pineapple (*Ananas Comosus*) is native of Southern Brazil and Paraguay where wild relatives occur. The crop was spread by the Indians up through South and Central America to the West Indies, Spanish introduced it into the Philipines and may have taken it to England in 1660. By 1720, the crop was grown in green houses in England, from where it came 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 from 4.5 to 6.5 (Ubi *et al*, 2005). The crop is propagated by new vegetative growth.

Pineapples have oval to cylindrical shaped compound fruits, 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 N-fertilizer to pineapple has become very important for growth, development, vigor and good fruiting. The possibility of nutrient losses characterized by tropical soils through percolating water, leaching, erosion menase, and crop removal has great influence on the fertilizer rate to apply, the type of fertilizer and the method of application (Morton 1987, Faithful 1998, and Ubi *et al*, 2005.

The objective of this study was to determine the effect of N-fertilizer rates on the brix, pol and purity of pineapple fruits using treatment combinations.

MATERIALS AND METHOD

This experiment was conducted in March, 2004 at Iwuru about 15km from the University of Cross River State, Akamkpa Campus. The experimental site lies between 8°14′N and 8°20′E longitude, 5°14′N and 5°18′E latitude with a rainfall of over 2,000mm in the rainforest vegetation. 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 a randomized complete block design (RCBD) and replicated three times. The main plot size was 3 x 48m, treated with the pineapple cultivars, and sub-plot size 3m x 12m, treated with four N levels, with a sampling area of 2 x 2m. The two propagules used were smooth canyenne and Natal Queen. Suckers which are ratoons from parent stock were planted at a spacing of 50cm between rows and 30cm within rows. Four different levels of N-fertilizer used in form of urea were: 0, 100, 150 and 200kg N/ha. At the beginning of the experiment, the soil was treated with 122.2kg P/ha and 325.0kg K/ha in the forms of triple superphosphate and muriate of potash respectively.

Furadan, was applied to the soil before planting at the rate of 8kg/ha, to control ants and other insects. Equally, ridomil was mixed at the rate of 3.0g per 20 litres of water and was applied to the roots against fungi and nematodes. At 12 months, fruiting was forced at plant maturity by applying calcium carbide solution (30 g to 4 litres of water) which produce acetylene, this was to enhance early fruiting. The experiment lasted in the field for 15 months (450 days), a period sufficient enough to allow the fruits mature and ripe for use in this study. Analysis of juice was carried out 15 months after planting to enable the behaviour of brix, pol and purity in the fruit to be traced. As brix only gives sugar content, the proportion pol to brix multiply by 100 gives the purity of the fruit. Fruits were harvested from the sampling areas, cleaned of trash and toped-off, and weighed. Five fruits each from the sampling area weighing 1kg were put together for the determination of brix, pol, fibre and purity. The fruits were washed and cut into four top to bottom splits. The juice was extracted separately from each split with a motorized fruit crusher and the brix and pol determined respectively. The brix consists of total dissolved substance in the juice and the dissolved substance was determined by a refractometer. About 100ml of the juice was filtered with a 0.5mm mesh-screen and then read-off in a sacharimeter to give the pol, content of the juice.

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About 5g each from the fibre extract from each sampling area was weighed and used for the determination of the fibre content of the fruit, using fibre extraction apparatus, employing the method of AOAC (1990). Juice percent purity was determined by dividing pol

Brix x 100

STATISTICAL ANALYSIS

Data was subjected to analysis of variance (ANOVA) and means compared with Fisher's least significance difference (LSD) at 5% probability level, employing the methods of Wahua (1999).

RESULT

The effect of N-fertilizer rates on brix content of two pineapple cultivars (*Ananas Comosus*) over 15 months is presented in Table 1. The highest brix content was obtained from Natal queen plots treated with 100 kg N/ha where was planted while the lowest was obtained from smooth canyenne plots planted with where no N was applied.

Table 1: Effect of N-fertilizer rates on brix content of two pineapple cultivars (*Ananas Comosus*)

Cultivars	N-fertilizer rates (kg N/ha)				
	0	100	150	200	Means
Smooth canyenne	13.0	16.8	18.4	15.3	15.8
Natal Queen	16.5	20.4	17.2	15.5	17.4
Mean	14.7	18.6	17.8	14.8	

LSD (0.05) between treatment means
Cultivars 1.2

Cultivars x N-fertilizer interaction was significant (P<0.05). Increasing N-fertilizer rate from 100 to 150 kg/ha significantly (P<0.05) increased the brix content of Natal queen pineapple cultivar which dropped at 200kg N/ha. There was a 9.5% increase in brix content when N-rate increased from 100 to 150 and 20.2% drop in brix content when N-fertilizer was further increased from 150 to 200 kg N/ha in smooth canyenne during the planting season. The brix content of Natal queen was highest (20.4) in plots that received 100kg N/ha and this was significantly (P<0.05) higher than all other treatments.

Differences between cultivars was glaring with Natal queen producing the highest brix content (17.4) and this was significantly (P<0.05) higher than those of smooth canyenne when given the same treatments. However, the two cultivars produced their maximum brix content at different N-fertilizer rates. The average brix content of the two cultivars on plots treated with 200kg N/ha was significantly low and ranked the same level with that obtained from plots where no N was applied.

The effect of N-fertilizer rates on the pol, content of two pineapple cultivars over 15 months is presented in Table 2. The highest Pol content 15.6 was obtained from Natal queen cultivar while the lowest 9.5 was obtained from smooth canyenne. Differences between cultivars in terms of pol content was significant (P<0.05), with Natal queen cultivar producing 14.6% increase in pol content more than smooth canyenne when given the same treatment.

The interaction between cultivar x N-fertilizer rate was significant (P<0.05). Increasing N-fertilizer rate from 100 to

Table 2: Effect of N-fertilizer application on the pol content of two pineapple cultivars (*Ananas comosus*)

Cultivars	N-fertilizer rates (kg N/ha)				
	0	100	150	200	Means
Smooth canyenne	9.5	12.6	13.8	10.5	11.6
Natal Queen	12.4	15.6	14.4	10.6	13.3
Mean	10.9	14.1	14.1	10.5	

LSD (0.05) between treatment means
Cultivars 1.2
N-rates 1.3
Cultivar x N-rates 1.4

150 in smooth canyenne gave 9.5% increase in pol content but dropped by 31.4% when it was further increased from 150 to 200kg N/ha. The average effect of the application of 200kg N/ha in terms of the pol content was similar to that of plots with no N treatment, and the effect on the application of 100kg N/ha was equal to that of lot that received 150kg N/ha. The two cultivars produced their highest plots pol content at different N-fertilizer rates. Thus plots that received 150kg N/ha where smooth canyenne was planted had the highest pol content of 13.8 while those that received 100kg N/ha where Natal queen was planted had the highest pol content of 15.6 and there were significantly (P<0.05) higher than all other treatment throughout the study period.

The effect of N-fertilizer rate on the fibre content of two pineapple cultivars over 15 months is presented in Table 3. The highest fibre content (12.8) was obtained from plots treated with 200kg N/ha.

The cultivar x N-fertilizer interaction was significant (P<0.05). Increasing N-fertilizer rates, consistently increased the fibre content of pineapple fruits in the two cultivars throughout the study period. On the average there was 16.1% increase in fibre content when N-fertilizer was increased from 100 to 150kg N/ha and a further 11.3% increase in fibre content when N-fertilizer was increased from 150 to 200 kg N/ha during the study period. Differences between the cultivars in terms of the fibre content was not significant.

Table 3: Effect of N-fertilizer rates on the percent fibre content of two pineapple cultivars (*Ananas Comosus*)

Cultivars	N-fertilizer rates (kg N/ha)				
	0	100	150	200	Means
Smooth canyenne	8.5	10.1	11.5	12.8	10.7
Natal Queen	8.2	9.8	11.6	12.7	10.5
Mean	8.3	9.9	11.5	12.8	

LSD (0.05) between treatment means
Cultivars N.S
N-rates 1.2
Cultivar x N-rates 1.3

The effect of N-fertilizer rates on the percent purity of two pineapple cultivars over 15 month is presented in Table 4. The highest percent purity, (76) was obtained from Natal queen plots that received 150kg N/ha, while the lowest 65 percent was obtained from smooth canyenne plots where no N was applied. The fruit purity In both cultivars increased with

Table 4: Effect of N-fertilizer rates on the percent purity of two pineapple cultivars (*Ananas Comosus*)

Cultivars	N-fertilizer rates (kg N/ha)				
	0	100	150	200	Means
Smooth canyenne	65	71	75	72	70.7
Natal Queen	67	72	76	71	71.5
Mean	66.5	71.5	75.5	71.5	

LSD (0.05) between treatment means
Cultivars N.S
N-rates 2.5
Cultivar x N-rates 3.2

increase in N-fertilizer from 100 to 150kg N/ha and then dropped with further increase from 150 to 200kg N/ha. The average percent purity obtained in plots treated with 100kg N/ha was equal to that of plots that received 200kg N/ha. Differences between species in terms of purity was not statistically significant.

DISCUSSION

Preliminary work showed that none of the cultivars matured with ripe fruits before 12 months (Sampson, 1986). The brix and pol content in this study was increased by increasing N-fertilizer rate up to 150kg N/ha for smooth canyenne and then dropped at N-fertilizer rate of 200 kg N/ha. This shows that the sugar content of ripe smooth canyenne pineapple is retarded by high rare of N-fertilizer. Equally, N-fertilizer application was found to raise the brix and pol contents of Natal queen cultivar than in plots treated with 100 kg N/ha than in either 150 kg N/ha or 200 kg N/ha. This response of the two cultivars to different levels of N-rates in terms of the brix and pol contents is attributable to the lignification process as the fruit matures. In a similar experiment, Ubi and Omoliko (2004) found that increasing N-fertilizer at high rate significantly increased lignification process and that the effect was greater as the crop matures later in the season.

In the two cultivars, the fibre content increased with a corresponding increase in N-fertilizer rate even in the early stages of the experiment. The positive effect of applied N on the fibre content coupled with its effect in reducing the brix and pol contents at higher rates later in the season led to the high fibre content of fruits from plots with high N-treatment.

At all stages of growth, N is adequately required to keep the crop at its optimum growth stage for fruiting. As the fruit matures, the change from N retarding rather than N increasing growth activities occurred at the same times, such that the effect of N accounts for only about 15% to the fruits maturity. During the period of fruit formation after fertilization, the fruit size may be doubled or trebled. It is a period in which the systematic dynamics in the production of juice (brix, and pol) are greatest.

The rate of post-fruit formation seems likely to be related to the rate of fruit size pre-formation. This period, as observed in this study accounts for about one third of the time a fruit is considered mature to sufficiently produce juice. More investigations may be required before the relationship could be understood a two year study at least needed.

CONCLUSION

The evidence derived from this study showed that high levels of N above 150 kg N/ha is detrimental to quality fruit of pineapple. Fertilization with urea at the rate of 150 kg N/ha for smooth canyenne and 100 kg N/ha for Natal queen would be cost effective with good quality fruits; and grater economic returns to the farmers.

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