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EFFECTS OF NUTRIENT SOURCES ON THE EARLY GROWTH OF PINEAPPLE PLANTLETS (*Ananas comosus* (L) Merr) IN THE NURSERY

Solomon Olusegun Omotoso[1]
and Ezekiel Akinkunmi Akinrinde[2]

[1]Department of Crop, Soil and Environmental Sciences
Ekiti State University, Ado-Ekiti, Nigeria
[2]Department of Agronomy, University of Ibadan.
Correspondence author: seguntoso@yahoo.com

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A B S T R A C T

Inadequate information on the nutrition of pineapple limits its commercial production in Nigeria. The effects of poultry manure and urea (each at 50 and 100 kg N ha^{-1}), as well as their 1:1 (organo-mineral) combinations at 50, 100, 150 and 200 kg N ha^{-1}, on the early (nursery) growth of pineapple plantlets. Organo-mineral fertilization at 100 kg N ha^{-1} resulted in the highest D-leaf length, number of leaves, root length and leaf area, while the highest biomass production (approx. 304 g, just within the 300-400 g desirable range for transplanting to the field) was achieved at 150 kg N ha^{-1}.

Key words: D-leaf, propagule propagation, nitrogen fertilizer

INTRODUCTION

The pineapple (*Ananas comosus* (L.) Merr), a leading edible member of the family Bromeliaceae, is cultivated between the latitudes approximately 30° N and 34° S (Batholomew and Kadzimin, 1977), predominantly for its fruit, which is consumed fresh or as canned fruit and juice. It dominates the world trade of tropical fruits, accounting for 51% of the world global fruit market (FAO, 2008), and has gained popularity in Nigeria (due to fruit juice importation ban), ranking sixth in the list of producers on a commercial scale and with an extensive cultivation area in the tropics. However, only 5% of this output is exported by producing countries, and as for Nigeria the fruit is not even exported commercially

(FAO, 2010). The pineapple fruit is the only source of bromelain, a proteolytic enzyme commonly used in the pharmaceutical industry and as a meat tenderizing agent (Fougue, 1981).

A major constraint to the expansion of pineapple cultivation in Nigeria is of planting material (Heenkenda, 2003), as the multiplication rate through natural suckering (one or two suckers per plant per year) is too low (Collins, 1960). The mother plants also produce one or two suckers after harvesting at 8-10 months of growth. The inability to get planting material for the establishment of new orchards is, therefore, a major challenge the farmer. Hence, there must be a way to make the propagule grow rapidly at the nursery stage to achieve the appropriate weight desirable for transplanting to the field. This work, therefore, sought to evaluate the effectiveness of different nutrient sources on the early growth of pineapple plantlets in the nursery.

MATERIAL AND METHODS

The study was conducted in the Screen House of Ekiti State University, Ado-Ekiti (latitude 7°40’ N and longitude 5°15’ E) between May 2003 and July 2004. Soil texture was sandy loam and its characterization showed pH 5.8 in water, 0.08 g kg^{-1} N, 2.20 g kg^{-1} organic C, 3.50 mg kg^{-1} available P and 0.38 mg kg^{-1} K.

Applications of poultry manure (PM) (2.3% N, 0.85% P_2O_5, 1.02% K_2O) or urea (45.0% N) (each at 50 or 100 kg N ha^{-1}), and 1:1 combinations of the two (as organo-mineral fertilizer, OMF) at 50, 100, 150 and 200 kg N ha^{-1}, were replicated three times in a randomized complete block design. Six-leaf-stage sweet cayenne pineapple plantlets (pre-germinated pre-nursery with 40-45 g propagules from stumps/stems) were planted at 0.5 x 0.5 m on 2 x 3 m plots, corresponding to 36 plants per plot, which were separated by 1m wide paths. The initial roots of the plantlets were removed at transplanting, while weeding was done manually hand hoeing at two weeks after planting. The length of the D-leaf (cm) (the longest centrally leaf on the pineapple plant) and root length (cm) were measured with a meter rule, and the number of leaves was determined by counting. Leaf surface area (cm^2) was measured using AM-300 (ADC BioScentific, UK) surface area meter. All the data were collected at monthly intervals from 2 months after transplanting (MAT), except for fresh and dry weight, which were measured at 4 and 6 MAT. The collected data were subjected to Analysis of Variance (ANOVA) and the differences between treatment means were separated using Duncan’s Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Pineapple plantlets’ D-leaf length significantly increased with fertilizer application during the growth period (Tab. 1). Thus, urea (at 100 kg N ha^{-1}) increased it by 14% relative to the

Table 1. Effects of nutrient sources on D-leaf and root length of pineapple plantlets

Fertilizer treatments		Months after transplanting				
Fertilizer sources	rate [kg N ha^{-1}]	2	3	4	5	6
D-leaf length [cm]						
Control	0	10.55d*	17.54e	24.38e	29.41f	35.47f
Urea	50	14.49c	20.99c	26.15d	31.54d	38.61de
	100	14.72c	21.71a	27.20bc	33.44bc	40.37c
PM	50	10.69d	18.21d	25.58d	31.98de	38.20de
	100	10.38d	18.56d	27.38bc	33.45bc	39.27d
OMF	50	14.72c	20.89c	26.54cd	32.44cd	38.06e
	100	16.63a	21.41b	31.21a	37.34a	45.67a
	150	16.70a	21.88b	28.99b	34.40b	41.82b
	200	15.64b	20.80c	26.53cd	32.60cd	38.24de
SE±		0.09	0.20	0.30	0.28	0.34
Root length [cm plant^{-1}]						
Control	0	6.33e	6.94e	7.93e	8.71e	9.83f
Urea	50	9.88d	10.76d	11.71cd	12.23d	14.03de
	100	14.31ab	14.93b	15.53ab	17.37b	18.66bc
PM	50	10.36d	10.90d	11.03d	11.83d	12.74e
	100	11.40cd	12.23cd	12.90cd	14.01cd	14.81de
OMF	50	12.16cde	12.80bcd	13.70bc	15.00bc	16.06cd
	100	15.52a	17.62a	17.71a	21.70a	24.17a
	150	14.33ab	15.20b	16.30d	16.91b	18.32bc
	200	13.37abc	14.93b	17.46a	17.67b	17.81c
SE±		0.88	0.80	0.74	0.79	0.83

*Means with the same letter in each column are not significantly different ($p < 0.05$) using DMRT
PM = poultry manure; OMF = organo-mineral fertilizer

control at 6th month of growth. The response to poultry manure was not obvious until 4 months after transplanting (MAT). The application of OMF at 100 kg N ha^{-1} resulted in the longest D-leaf, while higher application rates caused a decrease. It was evident that the full potential of OMF could not be expressed at early growth periods due to the slow release of the elements bound in organic form in the manure. There has been a similar report plant response to PM (Adeleye et al., 2010). Maximum root length (24.17 cm) was obtained the combination in which 100 kg N ha^{-1} was applied in the form of OMF, while the lowest root length (9.83 cm) was in the control (measured 6 months after transplanting) (Tab. 1). Increasing N application rates with urea increased the root length of plantlets throughout the growth period, but 100 kg N ha^{-1} consistently gave highest values.

The number of plantlets' leaves increased with age and fertilizer application (Tab. 2). At 6 MAT, the highest number of leaves (30) was obtained with OMF application at 100 kg N ha^{-1}. This is in agreement with the findings of Olaniyi et al., (2010) for okra. Leaf area per plant was also significantly affected by fertilizer treatment. It is obvious in Table 2 that 100 kg N ha^{-1} from OMF application enhanced pineapple growth most in terms of leaf area (180.00 cm^2) followed by the treatment with 150 kg N ha^{-1} from urea, while the lowest value (73.87 cm^2) was observed in the control plots (measured 6 months after transplanting). This is in agreement with an earlier report (Aladesanwa, 2007) on jute. Leaf area was consistently higher in the plots that received OMF throughout the whole period of growth. Application of PM alone (at 100 kg N ha^{-1}) gave a 57% leaf area than in the control plants at 6 MAT.

Table 2. Effects of nutrient sources on the number and area of pineapple plantlets' leaves

Fertilizer treatments		Months after transplanting				
Fertilizer sources	rate [kg N ha^{-1}]	2	3	4	5	6
Number of leaves per plant						
Control	0	9.50b*	14.73c	15.33c	21.00c	23.67c
Urea	50	10.33ab	15.33b	17.67bc	23.34ab	25.33bc
	100	10.33ab	17.00b	18.31bc	22.67bc	26.31bc
PM	50	10.33ab	16.00bc	17.80bc	20.65d	23.33c
	100	10.00ab	16.00bc	17.32bc	21.32bc	24.32bc
OMF	50	10.33ab	17.00b	17.33bc	21.33bc	24.00c
	100	10.67a	19.31a	21.00a	24.67a	30.00a
	150	10.00ab	17.67b	19.30ab	24.61a	24.67bc
	200	11.00a	16.32bc	17.67bc	22.30bc	27.67ab
SE±		0.30	0.51	0.73	0.90	1.09
Leaf area [cm^2 plant^{-1}]						
Control	0	64.47f	66.40f	67.13g	71.10f	73.87f
Urea	50	111.66d	115.03d	116.56de	117.81d	118.70cd
	100	123.61b	125.13b	132.47b	135.01b	137.84b
PM	50	95.50e	97.80e	101.00f	103.84e	105.67e
	100	97.43e	100.60e	109.10e	113.24d	115.70de
OMF	50	115.53cd	117.47cd	120.03cd	122.03cd	125.70cd
	100	137.60a	153.80a	157.90a	170.01a	180.00a
	150	118.70bcd	119.63bcd	127.96bc	132.16bc	137.96b
	200	116.66bc	122.31cd	124.80bc	126.40bcd	129.40bc
SE±		2.75	2.83	2.77	3.34	3.55

*Explanation: see Table 1
PM = poultry manure; OMF = organo-mineral fertilizer; MAT – months after transplanting

Table 3. Effects of nutrient sources on mean biomass yield (g/plant) of plantlets at 4 and 6 months after transplanting (MAT)

Fertilizer sources	Treatment [kg N ha^{-1}]	Fresh weight [g/plant] MAT		Dry weight [g/plant] MAT	
		4	6	4	6
Control	0	111.56e*	175.77d	97.40d	103.40e
Urea	50	126.13de	188.10cd	103.03d	106.10e
	100	179.13b	252.90b	152.10b	160.83c
PM	50	143.43cd	205.10c	125.53	112.56de
	100	152.86c	238.53b	126.57c	122.50de
OMF	50	205.60a	288.67a	186.80a	195.60b
	100	216.93a	297.30a	175.07a	211.26a
	150	222.07a	304.30a	192.00a	212.30a
	200	143.44cd	238.60b	117.33d	132.51d
SE±		6.59	7.10	6.50	7.03

*Explanation: see Table 1
PM = poultry manure, OMF = organo-mineral fertilizer, MAT – months after transplanting

Total fresh and dry weights of pineapple plantlets (Tab. 3) at 4 and 6 MAT increased significantly with the various fertilizer treatments. OMF at 150 kg N ha^{-1} gave the highest plant dry weight (212.30 g/plant), which was not significantly different from that achieved at 100 kg N ha^{-1}. The lowest value (103.40 g/plant) was recorded for the control treatment (measured 6 months after transplanting). About 160.80 g DM $plant^{-1}$ was obtained with the addition of 100 kg N ha^{-1} from urea, while 122.5 g DM $plant^{-1}$ was obtained at 100 kg N ha^{-1} from PM. Urea gave a 56% and PM an 18% increase over the control. The same trend was observed for fresh weight. Application of OMF at 150 kg N ha^{-1} gave the highest plant fresh weight (304.30 g/plant), which was not significantly different from the combination in which 100 kg N ha^{-1} was applied. The lowest value of plantlet fresh weight (175.77 g/plant) was obtained in the control plots (measured 6 months after transplanting).

CONCLUSION

Application of the organo-mineral fertilizer (OMF) to supply the plants with 100 kg N ha^{-1} resulted in the best performance of pineapple plantlets in terms of D-leaf length, number of leaves, root length and leaf area. Fresh biomass as an index of growth in pineapple was the highest at 150 kg N ha^{-1}, which produced plantlets weighing over 300 g − a desirable size for transplanting to the field.

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WPŁYW ŹRÓDEŁ SKŁADNIKÓW ODŻYWCZYCH NA POCZĄTKOWY WZROST SADZONEK ANANASA W SZKÓŁCE

Solomon Olusegun Omotoso i Ezekiel Akinkunmi Akinrinde

S T R E S Z C Z E N I E

Niewystarczające informacje o odżywianiu roślin ananasa ograniczają jego produkcję na skalę handlową. Oceniano wpływ nawozu z odchodów drobiu oraz mocznika (każdy w dawce 50 i 100 kg N ha^{-1}), jak również ich kombinacje 1:1 (organiczno-mineralne) w dawkach 50, 100, 150 i 200 kg N ha^{-1}, na początkowy wzrost (w szkółce) sadzonek ananasa. Nawożenie organiczno-mineralne w dawce 100 kg N ha^{-1} dało największą długość liścia D, liczbę liści, długość korzeni i powierzchnię liści, natomiast najwyższą produkcję biomasy (ok. 304 g, czyli już w zakresie 300-400 g odpowiednim do posadzania w polu) osiągnięto stosując dawkę 150 kg N ha^{-1}.

Słowa kluczowe: liść D, rozmnażanie przez propagule, nawóz azotowy