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Identifying Fertilizer Management Strategies to Maximize Soil Nutrient Acquisition by Cocoyam (*Colocasia esculenta*) in a Degraded Ultisol in Agbani, Enugu Area, Southeastern Nigeria

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ABSTRACT

This study was primarily aimed at identifying fertilizer management strategies to maximize soil nutrient acquisition by cocoyam (*Colocasia esculenta*) in a degraded Paleudult in Agbani Enugu area in Southeastern, Nigeria. The experiment was laid out in Randomized Complete Block (RCBD) with four replications and five treatments which comprised of No fertilizer, banding+single dose NPK, banding+split dose NPK, broadcasting+single dose NPK and broadcasting+split dose NPK. Soil analyses were carried out at 90 Days after Planting (DAP) in both years at soil depth of 0-30 cm. The data collected was analysed using analysis of variance (ANOVA) at 5% level of significance. The results of the study showed that fertilizer treated plots had between 10-18% lower values of soil pH when compared with plots not treated with NPK fertilizer and that the methods of fertilizer application used had no influence on soil pH content at 90 DAP. The results showed that banding+split dose NPK treated plots with 0.09% N had between 22-66% higher ($p=0.05$) N content when compared to other plots. The results also showed that fertilizer treated plots had between 76-80% higher organic carbon content when compared with plots not treated with NPK fertilizer and that the use of band placement method of fertilizer application increased soil organic carbon content by up to 20% at 90 DAP, whereas single dose or split dose application methods had no influence on soil organic carbon content. Banding fertilizers increased soil exchangeable K by 50% when compared with broadcasting fertilizer whereas, 25% more soil exchangeable K was found in soils where fertilizer was applied as single dose when compared to plots where split fertilizer application methods were used. The results also showed that the tallest cocoyam plants (45-51 cm) were found in plots treated with banding+split dose NPK for both years. These plants were taller by 46, 24-32, 22-23 and 6-7% than plots treated with no fertilizer, broadcasting+single dose NPK, broadcasting+split dose NPK and banding+single dose NPK treated plots, respectively in both 2013 and 2014 planting seasons. Corm yield of cocoyam followed the same trend. The highest corm yield of cocoyam plants ($19-21 \text{ Mg ha}^{-1}$) were found in plots treated with banding+split dose NPK for both years. These results show that different fertilizer management strategies impact on growth and development of cocoyam and the crop responds quickly to changes in the nutrient availability in the soil during the growing cycle.

Key words: Fertilizer management strategies, soil nutrients, cocoyam, nutrient acquisition, degraded ultisols

INTRODUCTION

Cocoyam is an important starchy, tuberous herbaceous perennial plant (root crop) belonging to the family of group of plants called Araceae (Purseglove, 1975). Cocoyams occur in different varieties but the major and commonly cultivated cultivars are *Colocasia esculenta* (Taro) and *Xanthosoma sagittifolium* (Tannia). There are hundreds of agronomic cultivars of Taro groups grown throughout the world. However, they are distinguished on the basis of their corms, cormels (shoot) characteristics, agronomic characteristics and culinary behaviour. Onwueme (1999) stated that the two groups of cultivated taro are Eddoes type (with small corm and large cormel) and Dasheen type (with large corm and small cormel). *Colocasia* and *Xanthosoma* are cultivated throughout the tropics and subtropics as staple food. It is vegetatively propagated by planting sets of the main corm or rhizome or the small lateral tubers (Purseglove, 1975). Cocoyam ranks third after cassava and yam in terms of total production land area and importance in Nigeria (Onwueme and Singa, 1991). Cocoyam is cultivated for human nutrition, cash crop (for both farmers and traders) and as animal feed (Aguogu *et al.*, 1994). As food for humans, its nutritional value is superior when compared to cassava and yam in terms of digestibility, crude protein content, essential minerals and vitamins, providing Mg, Ca and phosphorus for building up human protoplasm (Falade and Okafor, 2013). Taro (*Colocasia*) is a good source of potassium. The leaves of Taro when cooked is eaten as vegetable. It contains “ β -carotene, iron and folic acid” which protects humans against anaemia (Niba, 2003).

Taro (*Colocasia esculenta*) is both an upland and lowland crop. It is shade tolerant and thrive well in a hydromorphic soil. Taro can fit into intercropping system (Anikwe *et al.*, 2007) partly, because of their large transpiring leaves surfaces. Cocoyam (Taro and Tannia) plants have high requirement for moisture for their production (Onwueme, 1999). Rainfall or irrigation of 1500-2000 mm is required for good production as dry condition results in reduced corm yields.

According to Onwueme (1999), an average temperature of above 21°C is required for normal yield. Highest yield, however, is obtained under full intensity sunlight. Cocoyam does best in soil pH of 5.5-6.5 and tolerates heavy soil. Despite the socioeconomic importance of cocoyam, its production within the tropics and subtropics, for example, Nigeria and Ghana, are beset with challenges such as the alarming rate of soil degradation, lack of improved varieties and most importantly, poor fertilizer management strategies. Soil is a key natural resource and soil quality is the integrated effect of management on most soil properties that determine crop productivity and sustainability. Understanding management effects on near surface properties, in particular, is important given the effect of the soil surface on erosion control, water infiltration and nutrient conservation (Franzluebbers, 2002). Although, fertilizer is needed to maintain soil productivity, it must always be used in conjunction with strict management strategies and practices. Sustainable soil nutrient enhancing strategies involve the wise use and management of inorganic and organic nutrient (fertilizer) sources in ecologically sound production systems (Roberts, 2007).

Despite all of the positive research, results and efforts of extension services, fertilizer management is often misunderstood and done out of tradition, without reflecting newer technical options. This is particularly important in tropical climates where blanket application is often done without recourse to soil tests. Fertilizer application is also one of the most time and energy consuming operations in arable farming and often creates labour or farm power (animal draught or motor) bottlenecks (Anikwe *et al.*, 2007).

Cocoyam, generally has high demand for potassium, calcium, magnesium, iron, phosphorus, nitrogen and other trace elements. The deficiencies of these nutrients, as well as aluminum toxicity

have been reported to limit growth and yield of root crops such as cocoyam. Good fertilizer management strategy provides a framework to achieve cropping system goals, such as increased farmer profitability, enhanced environmental protection and improved sustainability. To achieve these goals, the right fertilizer sources should be used at the right rate, time and in the right place. Properly managed fertilizer strategy supports cropping system that provides economic social and environmental benefits. On the other hand, poorly managed nutrient application can decrease profitability and increase nutrient losses, potentially degrading water and air. Best fertilizer management strategies aim at matching nutrient supply with crop requirements and to minimize nutrient losses from the field depending on soil type, climate, agronomic practices and other factors (Roberts, 2007).

Degraded Ultisols are characterized by low fertility and high acidity which may be caused by over exploitation, erosion or leaching. Farmers in attempt to overcome this challenge adopt the strategy of chemical fertilizer application. Approach of farmers toward chemical fertilizer usage has posed a big threat to soil quality status. Cocoyam is an ecologically unique crop. It is able to grow in ecological conditions (waterlogged soil, shaded environment), which other crops may find difficult or adverse. Most of the constraints in the cocoyam production system can be effectively tackled and possibly solved through reason. However, the adaptation of cocoyam to different farming systems need to be studied in detail (Anikwe *et al.*, 2007).

The main objective of this work is to identify fertilizer management strategies that maximize soil nutrient acquisition by cocoyam in a degraded Ultisol in Southeastern, Nigeria. Specifically the work aims at investigating the effect of broadcasting, banding, single dose and split dose fertilizer application techniques on the growth and yield of cocoyam in a degraded tropical Paleudult.

MATERIALS AND METHODS

Soil characterization: The research was carried out at research farm of Faculty of Agriculture and Natural Resources Management, Enugu State University of Science and Technology, Agbani during 2013 and 2014 farming season. The farm is located in Latitude 6°29'N and Longitude 7°54'E with estimated annual rainfall of about 1700-2060 mm. The soil is of shale parent material classified as Typic Paleudult and has a sandy loam texture (Anikwe *et al.*, 2007).

Field method: The site was slashed and cleared of grasses. A total land area of 11×20.5 m (225.5 m²) was mapped out for the experiment. The experiment was carried out on the same plots in the 2013 and 2014 planting seasons. The field was divided into 4 blocks with each block having 5 experimental units giving a total of 20 plots. The experimental units were demarcated by 1 m alleys and each unit (bed) measured 3 m by 3 m (9 m²). The experimental beds were prepared manually with traditional hoes. The experimental units comprised five fertilizer management practices viz:

- T₁ = No fertilizer
- T₂ = Banding+single dose NPK
- T₃ = Banding+split dose NPK
- T₄ = Broadcasting+single dose NPK
- T₅ = Broadcasting+split dose NPK

The fertilizer used was NPK 15:15:15 fertilizer at 300 kg ha⁻¹ applied singly at 2 weeks after planting or at two equal splits at 2 and 10 weeks after planting in the appropriate plots. The fertilizers were manually broadcasted or banded in groves made 5 cm away from the base of the plant stand in the appropriate plots.

The test crop was a variety of cocoyam (*Colocasia esculenta* Schott, [cultivar: *ede oguta*]) obtained from the National Root Crops Research Institute, Umudike, Abia State, Nigeria. The choice of the variety stems from the fact that it is one of the most popular varieties grown around the zone. Cocoyam setts weighing 25-30 g were planted at one sett per hole at 5 cm depth using 50 cm apart intra-inter row spacing. A total of 35 setts were planted in each plot making a plant population of 40,000 plants ha⁻¹. Lost stands were replaced. Weeding was done once (at 21 Days After Planting (DAP)), with subsequent rouging.

Determination of soil and plant parameters: Soil samples collected from 4 points in each plot at 90 DAP was analyzed in the laboratory for total nitrogen (N), available phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sodium (Na), pH, SOC and Cation Exchange Capacity (CEC). Total N was determined by the macro Kjeldahl method (Bremner, 1982). Available P was determined using Bray II method as outlined in Olsen and Sommers (1982). The SOC was analyzed by the Walkley/Black procedure (Nelson and Sommers, 1982). Soil pH in KCl was measured by the glass electrode pH meter (McLean, 1982). The exchangeable cations and CEC were determined by the method described by Thomas (1982). Particle size distribution was determined by hydrometer method (Gee and Or, 2002). Dry bulk density was determined by the core method (Grossman and Reinsch, 2002).

Meter rule was used to measure plant height from the base level to the tip of the last formed leaf at 90 DAP. Five plants were selected at random in each plot and measured, which was averaged to give plant height per plant at 90 DAP. In determining the number of leaves, five plants were also randomly selected from each plot. Their number of leaves were averaged to determine number of leaves per plant. Five plants per plot were harvested to get the fresh corm weight at 210 DAP. The fresh corms were weighed in a scale and the average taken to give the corm weight per plant. Also, the leaf area index was determined at 90 DAP according to the method of Watson (1958).

Data analysis: The data collected from the experiments were analyzed using Analysis of Variance (ANOVA) for randomized complete block design using Fisher's least significant different at $p = 0.05$ according to the procedures outlined by Steel and Torrie (1980) and detection between treatment means as described by Obi (1986).

RESULTS AND DISCUSSION

The pre-planting analyses of soil properties in both years are presented in the Table 1. The result indicated that the textural class of the study site is loamy sand. Percentage organic carbon (1.68%), organic matter (2.09%) and nitrogen (0.126%) are higher in 2013 planting season compared 2014 planting season (1.08, 1.86 and 0.056%), respectively. As expected, this indicated that the soil had higher values for soil nutrient in 2013 at the start of the experiment when compared to 2014 planting season. The soil pH in water ranged from 5.4-6.0 in both years indicating slight acidity according to the rating by Landon (1991). The pre-planting exchangeable cations content of the soil in 2014 (Mg²⁺ 1.20, K⁺ 0.06, Na⁺ 0.09, Al⁺ 0.27 and CEC 8.4 cmol kg⁻¹) were lower when compared

Table 1: Initial soil properties of the study sites collected at 0-30 cm depth

Pre-planting analysis	2013	2014
Clay (%)	8.00	8.00
Silt (%)	7.00	7.00
Sand (%)	85.00	85.00
pH (H ₂ O)	5.40	6.00
pH (KCl)	4.50	5.80
Organic carbon (%)	1.08	1.08
Organic matter (%)	1.86	1.86
N (%)	0.056	0.056
Na ⁺ (cmol kg ⁻¹)	0.09	0.15
K (cmol kg ⁻¹)	0.06	0.10
Ca (cmol kg ⁻¹)	4.20	4.30
Mg (cmol kg ⁻¹)	1.20	2.20
CEC (cmol kg ⁻¹)	8.40	23.70
Al (cmol kg ⁻¹)	0.27	0.40
Ex. acidity (cmol kg ⁻¹)	0.60	
Available P (cmol kg ⁻¹)	15.64	18.88
Bulk density (Mg m ⁻³)	1.46	1.52
Total porosity (%)	44.00	42.00
Hydraulic conductivity (k cm ³ h ⁻¹)	21.72	30.30

CEC: Cation exchange capacity, N: Nitrogen, K: Potassium, Ca: Calcium, Mg: Magnesium

with values obtained in 2013 (Mg²⁺ 2.20, K⁺ 0.10, Na⁺ 0.15, Al⁺ 0.40 and CEC 23.20 cmol kg⁻¹). The bulk density slightly increased from 1.46 in 2013 to 1.52 Mg m⁻³ in 2014 whereas the total porosity also declined from 44-42% in 2014. Water transmissivity measured as saturated hydraulic conductivity increased from 21.72 in 2013 to 30.30 k cm³ h⁻¹ 2014. Anikwe *et al.* (2005) indicated that cocoyams like other root crops are heavy feeders and their root system explore large area of soil for nutrients used in normal production. This may sometimes lead to soil nutrients depletion through plant nutrient uptake.

In Table 2, the results indicated significant treatment differences in soil pH in both years. In 2013, the soil pH values recorded were 5.1, 4.7, 4.8, 4.3 and 4.4 for plots treated with No fertilizer, banding+single dose NPK, banding+split dose NPK, broadcasting+single dose NPK and broadcasting+split dose NPK, respectively while in 2014 the soil pH values were 5.3, 4.6, 4.7, 4.2 and 4.3 in plots treated with No fertilizer, banding+single dose NPK, banding+split dose NPK, broadcasting+single dose NPK and broadcasting+split dose NPK, respectively. These results showed that fertilizer treated plots had between 10-18% lower values of soil pH when compared with plots not treated with NPK fertilizer. Intensive agriculture can speed up soil acidification through increased leaching, addition of fertilizers and removal of harvested crops. The major fertilizer nutrient N is the main nutrient that influences soil pH. Nitrogen (N) when not properly absorbed by plants normally undergoes series of reactions in the soil which may lead to formation of acid anhydride such as NO₃⁻. This, when combined with H⁺ forms a strong acid in the soil. This fact can be visualized in the plots treated with broadcasting+single dose NPK (4.3 and 4.4) and broadcasting+split dose NPK (4.2 and 4.3). The lower pH values may be attributed to residual N that was not utilized by the plants. The methods of fertilizer application had no influence on soil pH content at 90 DAP.

The results in Table 2 also indicated that there were significant differences in soil percent total N content amongst the treatments (p=0.05) during the two planting seasons. The total percent N for the study sites were 0.03 and 0.04% during 2013 and 2014 planting seasons, respectively for control plots (No fertilizer treatment). Similarly, banding+single dose NPK treated plots had 0.07 and 0.06% N, banding+split dose NPK treated plots had 0.09 and 0.06% N, broadcasting+single dose treated plots had 0.04 and 0.05% N whereas, broadcasting+split dose treated plots had

Table 2: Effect of fertilizer management practices on soil pH, nitrogen and organic carbon at 90 days after planting

Treatments	pH (H ₂ O)		N (%)		OC (%)	
	2013	2014	2013	2014	2013	2014
No fertilizer	5.10	5.30	0.03	0.04	0.43	0.52
Banding+single dose NPK	4.70	4.60	0.07	0.06	1.75	2.50
Banding+split dose NPK	4.80	4.70	0.09	0.06	1.84	2.60
Broadcasting+single dose NPK	4.30	4.20	0.04	0.05	1.48	2.30
Broadcasting+split dose NPK	4.40	4.30	0.05	0.04	1.23	1.90
F-LSD (p = 0.05)	0.09	0.08	0.01	0.01	0.15	0.70

OC: Organic carbon, N: Nitrogen

0.05 and 0.04% N in 2013 and 2014 planting seasons, respectively. These results showed that banding+split dose NPK treated plots had significantly higher post-harvest N content when compared to other plots. Moreover, post harvest total N in all the treated plots were higher than that found in untreated plots. According to Young and Aldag (1982), N in any form has a positive charge and therefore is attracted and held by a negative charged soil and soil organic matter (SOM). This simply implies that some N that were not absorbed by plant does not move downward in the soil rather are subjected to other changes within the soil systems.

The results presented in Table 2 also showed significant differences (p=0.05) in percentage soil organic carbon (SOC) content in both 2013 and 2014 planting seasons. These results show percentage soil organic carbon in 2013 (0.43, 1.75, 1.84, 1.48 and 1.23%) and 2014 (0.52, 2.50, 2.60, 2.30 and 1.90%) for plots treated with No fertilizer, banding+single dose NPK, banding+split dose NPK, broadcasting+single dose NPK and banding+split dose NPK, respectively. These results showed that fertilizer treated plots had between 76-80% higher organic carbon content when compared with plots not treated with NPK fertilizer. The lower organic carbon content found in untreated plots may be because more nitrogen was available in fertilizer treated plots for microorganisms that degrade organic materials leading to faster decomposition rates and release of oxide solids. This is a positive productivity indicator (Anikwe, 2006). The results also showed that the use of band placement method of fertilizer application increased soil organic carbon content by up to 20% at 90 DAP whereas single dose or split dose application methods had no influence on soil organic carbon content.

Exchangeable K⁺ of the soil at 90 DAP was as well significantly influenced by the different fertilizer management strategies as presented in Table 3. In 2013, values of exchangeable K⁺ were found to be 0.09, 0.07, 0.13, 0.07 and 0.13 cmol kg⁻¹ for plots treated with No fertilizer, banding+single dose NPK, banding+split dose NPK, broadcasting+single dose NPK and broadcasting+split dose NPK, respectively. Soil exchangeable K⁺ values in 2014 followed the same trend with plots treated with no fertilizer (0.08 cmol kg⁻¹), banding+single dose NPK (0.10 cmol kg⁻¹), banding+split dose NPK (0.15 cmol kg⁻¹), broadcasting+single dose NPK (0.09 cmol kg⁻¹) and broadcasting+split dose NPK treated plots (0.15 cmol kg⁻¹). Results showed that at 90 DAP fertilizer treated plots had 50% more exchangeable K⁺ when compared to No fertilizer plots. Similarly, banding fertilizers increased soil post harvest exchangeable K by 50% when compared with broadcasting fertilizer whereas 25% more post harvest soil exchangeable K was found in soils where fertilizer was applied as single dose when compared to plots where split fertilizer application methods were used.

The values of soil Mg content for 2013 and 2014 are also presented in Table 3. These values ranged from 2.00-2.65 cmol kg⁻¹ Mg in 2013 for all plots and 2.05-2.21 cmol kg⁻¹ in 2014 for all plots. However, no significant treatment difference in magnesium content was found between the

Table 3: Effect of fertilizer management practices on soil potassium, sodium, magnesium and calcium at 90 days after planting

Treatments	K (cmol kg ⁻¹)		Mg (cmol kg ⁻¹)		Available P (cmol kg ⁻¹)		Ca (cmol kg ⁻¹)	
	2013	2014	2013	2014	2013	2014	2013	2014
No fertilizer	0.09	0.08	2.33	2.12	3.75	3.82	3.40	3.22
Banding+single dose NPK	0.07	0.10	2.35	2.21	7.56	7.20	3.61	3.14
Banding+split dose NPK	0.13	0.15	2.65	1.96	5.60	7.00	3.42	3.35
Broadcasting+single dose NPK	0.07	0.09	2.43	2.18	3.88	4.82	3.55	3.28
Broadcasting+split dose NPK	0.13	0.15	2.00	2.05	3.79	4.14	3.60	3.40
F-LSD (p = 0.05)	0.21	0.33	Ns	Ns	0.21	0.33	Ns	Ns

treatments in both planting seasons at 90 DAP. Similarly, the values of soil calcium content for 2013 and 2014 in Table 3 ranged from 3.40-3.60 cmol kg⁻¹ Ca in 2013 for all plots and 3.14-3.40 cmol kg⁻¹ in 2014 for all plots but no significant treatment difference in calcium content was found between the treatments in both planting seasons at 90 DAP.

The results of the work also showed significant differences in available P as presented in Table 3. In 2013 the values of soil available P at 90 DAP were 3.75, 7.56, 5.60, 3.88 and 3.79 cmol kg⁻¹ in plots treated with no fertilizer, banding+single dose NPK, banding+split dose NPK, broadcasting+single dose NPK and broadcasting+split dose NPK, respectively. In 2014, the values of 3.82, 7.20, 7.00, 4.82 and 4.14 cmol kg⁻¹ were found in plots treated with no fertilizer, banding+single dose NPK, banding+split dose NPK, broadcasting+single dose NPK and broadcasting+split dose NPK, respectively. Results showed that plots where NPK fertilizer was banded had 50% more soil available phosphorus when compared to the control plots and plots where NPK fertilizer was broadcasted. No significant treatment differences in soil available P content was found between the control plots and plots that received NPK fertilizer by broadcasting either as single dose or by split dose application methods. Strategies for P management from the organic soil focuses on lowering P fertilization rate based on improved test calibration and P fertilizer placement and banding P fertilizer is of great benefit (Randall and Hoeft, 1988). Also at low fertilization rates, the efficiency of P uptake by the target crop is greater for banding than broadcast application, especially on soils with high P fixation (Sanchez *et al.*, 1990).

Results presented in Table 4 showed significant differences (p=0.05) in plant height of cocoyam as influenced by the different fertilizer management strategies. These results showed that the tallest cocoyam plants (45-51 cm) were found in plots treated with banding+split dose NPK for both years. These plants were taller by 46, 24-32, 22-23 and 6-7% than plots treated with No fertilizer, broadcasting+single dose NPK, broadcasting+split dose NPK and banding+single dose NPK treated plots respectively in both 2013 and 2014 planting seasons.

These results also showed that the highest number of cocoyam plant leaves (12-13) were found in plots treated with banding+split dose NPK for both years. The number of leaves in these plots were higher by 33-38, 25, 25 and 8-15% in plots treated with No fertilizer, broadcasting+single dose NPK, broadcasting+split dose NPK and banding+single dose NPK treated plots, respectively in both 2013 and 2014 planting seasons.

The highest leaf area index of cocoyam plants (28-29) were found in plots treated with banding+split dose NPK for both years. The long lyrique (LAI) of these plants were higher by 75, 34, 24 and 18% than plots treated with no fertilizer, broadcasting+single dose NPK, broadcasting+split dose NPK and banding+single dose NPK treated plots, respectively in both 2013 and 2014 planting seasons.

Corm yield of cocoyam followed the same trend. The highest corm yield of cocoyam plants (19-21 Mg ha⁻¹) were found in plots treated with banding+split dose NPK for both years. The corm

Table 4: Effect of fertilizer management practices on some plant growth and yield parameters

Treatments	Plant height (cm/plant) (90 DAP)		No. of leaves/plant at 90 DAP		Leaf area index at 90 DAP		Corm yield (Mg ha ⁻¹) at 210 DAP	
	2013	2014	2013	2014	2013	2014	2013	2014
No fertilizer	24.1	27.2	8.0	8.0	7.1	7.8	9.8	9.4
Banding+single dose NPK	42.3	46.6	11.0	11.0	23.3	24.2	14.6	15.3
Banding+split dose NPK	44.9	50.6	12.0	13.4	28.4	29.0	19.4	21.3
Broadcasting+single dose NPK	33.7	34.5	9.0	9.0	18.8	18.0	11.4	11.7
Broadcasting+split dose NPK	35.0	38.7	9.0	9.0	21.5	20.1	14.8	15.8
F-LSD (p = 0.05)	12.0	12.2	1.8	1.2	2.3	2.1	3.7	3.2

DAP: Days after planting

yield of these plants were higher by 50-56, 41-45, 24-26 and 25-28% than plots treated with no fertilizer, broadcasting+single dose NPK, broadcasting+split dose NPK and banding+single dose NPK treated plots, respectively in both 2013 and 2014 planting seasons.

These results show that different fertilizer management strategies impact on growth and development of cocoyam and the crop responds quickly to changes in the nutrient availability in the soil during the growing cycle.

CONCLUSION

Agriculture faces the daunting challenge of meeting food, forage and fibre needs in a manner that is both environmentally and economically sustainable while striving to increase productivity with more efficient use of resources. Fertilizer is an integral part of this quest and adoption of the research based best management practices (BMPs), such as split fertilizer application rewards farmers and consumers.

The results of this study showed that the different fertilizer management practices adopted impacted on soil properties as well as crop development. These results showed that plots where NPK was banded and applied as split dose provided a better edaphic condition for crop development when compared with plots no fertilizer, broadcasting+single dose NPK, broadcasting+split dose NPK and banding+single dose NPK treated plots, respectively. This resulted in higher cocoyam growth and corm yield in plots where NPK was banded and applied as split dose. The results show that by more specifically synchronizing fertilizer supply with a plant's ability to utilize nutrients, split application played important role in making nutrients available at the right time and right place. Banding and split application helped minimize volatilization, leaching or denitrification of N in the soil. It is, therefore, recommended that banding+split dose NPK be adopted in the experimental area and other areas of similar edaphoclimatic conditions for maximum nutrient uptake and utilization of soil nutrients and optimum yield of cocoyam.

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