RESIDUAL EFFECT OF COCOA POD ASH, POULTRY MANURE AND NPK 20:10:10 FERTILIZER ON SOIL NUTRIENTS, NUTRIENT UPTAKE AND YIELD OF MAIZE (*Zea mays*)

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ABSTRACT

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Pot experiment to determine effect of cocoa pod ash (0, 5 and 10 t ha^{-1}), poultry manure (0. 5 and 10 t ha^{-1}) and NPK 20:10:10 fertilizer (0, 200 and 400 kg ha^{-1}) on soil, plant nutrients properties and maize yield in southwest Nigeria in 2005 and repeated in 2006 without new treatments. The treatments were control, 5 t ha^{-1} poultry manure (P5), 10 t ha^{-1} poultry manure (P10), 5 t ha^{-1} cocoa pod ash (C5), 10 t ha^{-1} cocoa pod ash (C10), 200 kg ha^{-1} NPK 20:10:10 fertilizer (F200) and 400 Kg ha^{-1} NPK 20:10:10 fertilizer (F400). Among the treatments, P10 had highest soil OM, N, Ca, P and Fe, C5 and C10 most increased K, while F400 had highest Cu, Zn and Mn. On residual basis, P10 had highest OM, Ca, Mg, P and Fe. Among the treatments, P10 had highest plant P, Ca, Cu and Mn. F400 had highest plant N and Fe. On residual basis, all the treatments had higher N and Zn except (F400) than control. Only P10 had higher P than control. In 2005, compared with control, all the treatments significantly increased ($p<0.05$) plant height, grain yield (except C10 and P5) and root dry matter (except P5). On residual basis only P10 significantly increased grain, stover and root yields. Increases in grain yield were P10 > F400 > C5 > F200 > P5 on immediate basis and P10>C10>F400>P5>F200>C5 on residual basis. The cumulative yield increases were P10 (61.97g), F400 (51.07g), C5 (47.55g), F200 (45.54g), C10 (44.65g), P5 (41.96g) and control (39.15g). Poultry manure had the best effect on soil and plant nutrients as well as yield components.

Keywords: residual effect, nutrient uptake, maize yield

INTRODUCTION

It is the goal of most farmers in Nigeria to produce sustainable high crop yield. However, decrease in soil fertility after few years of cropping is a major limitation. The need to improve soil fertility and crop production to support the rapidly growing population has led to a renew interest in the use of organic sources of nutrients and mineral fertilizers for soil fertility maintenance. The use of mineral fertilizer is hindered by its scarcity, high cost, nutrient imbalance and soil acidity. In addition, the continuous use of mineral fertilizers adversely affects soil chemical and physical properties, causing nutrient imbalance, increase soil bulk density and causing low water infiltration rate (Ojeniyi, 1995, Nottidge *et al*., 2005). Thus, the needs to investigate alternative sources of nutrients that will be less damaging to the soil become imperative.

In southwestern Nigeria, huge quantity of poultry wastes (manure) is generated and also constitute environmental hazard (Adediran *et al*., 2003). Recently, studies also showed that poultry manure increased soil organic matter and nutrient status (Adeniyan and Ojeniyi, 2006). However, the huge amount of poultry manure required for field crop production and its handling problems limits its use to distant farmers.

There is also a renewed interest in the use of burnt organic residues from plants as sources of phosphate and potash fertilizers (Ojeniyi, 1995, Ayeni, 2008, Ayeni *et al.*, 2008). These materials are often considered less likely to have detrimental effect on soil physicochemical properties compared with mineral fertilizers. The use of plant residues are also limited by large quantity required to meet crop nutritional needs due to their low nutrient content and time lag to mineralize.

In Nigeria, cocoa farmers are handicapped as to the best way to dispose the huge amount of cocoa pod husks that serve as inhabitant for some destructive pathogens such as *Phytophtora palmivora* in their cocoa farms. About 800, 000 tonnes of cocoa pod husks are annually generated in Nigeria and often wasted (Egunjobi, 1975). It is advised the husk be burnt into ash as a method of sanitation and for the control of black pod disease of cocoa.

There is need to compare the effectiveness of the three sources of fertilizer (mineral fertilizer, animal and plant residues) on soil fertility and productivity. Hence, the objective of this study was to compare the immediate and residual effects of cocoa pod ash, poultry manure and NPK 20:10:10 fertilizer on soil chemical properties, nutrient uptake and yield of maize in southwest Nigeria.

MATERIALS AND METHODS

The research and training farm of Adeyemi College of Education, Ondo in southwestern Nigeria was used for the conduct of the experiment. Ondo is located in latitude 07^0 05^{1}N, on longitude 040^0 55^{1}E and at an elevation of 381.3M above sea level. It is in the tropical rain forest zone. The soil belongs to Ondo series (Egbeda fasc) and is classified as Alfisol (Oxic tropuldalf) (Harpstead, 1974).

Soil Analysis

The collected soil samples were bulked, air-dried and sieved through 2mm sieved mesh. Part of the soil samples was used for routine soil analysis and the remaining sample for pot experiment. The pH of the soil was determined in 2:1 $CaCl_2$ / soil suspension using a glass electrode pH meter. Organic matter was determined by dichromate oxidation method. Total N was determined by the Kjedahl method. Available phosphorus was extracted by Bray-1- method and the P in the extractant was determined by colorimeter. Exchangeable bases (Ca, K and Mg) were extracted with 1N ammonium acetate at pH 7.0. Potassium was read using flame photometer while Ca and Mg were determined by AAS. The micronutrients (Fe, Cu, Zn and Mn) were determined by extracting them with 0.1N HCl and the extracts were measured on Perkin Elmer 20 atomic absorption spectrophotometer (AAS) (Association of Analytical Chemists, 1990).

Organic Materials Analysis

Cocoa husks were sun dried and burnt into ash inside a bin. Partial burning of plant residue is a simulation of what the farmers use in southwest Nigeria. Fresh poultry litter from layers was collected, air-dried and ground into fine particles. The poultry manure and cocoa husk ash used were passed through 2mm mesh.

The nutrient composition of powdered poultry manure and cocoa husk ash were also determined after ashing in the muffle furnace. Total N was determined by Kjedahl method. For other nutrients, ground samples were subjected to wet digestion using 25 – 5 – 5 ml of HNO_3 – H_2SO_4 – $HClO_4$ acids (Association of Analytical Chemists, 1990). The filtrate was used for nutrients determination as done in routine soil analysis. Total P was determined by colorimeter, K by flame photometer and Ca, Mg, Fe, Cu, Zn and Mn by AAS.

Pot Experiment

Immediate Effect

Ten kilogram of air-dried soil sample from Adeyemi College of Education research farm site was used per pot. The treatments consisted of three levels of cocoa pod ash at 0, 25 and 50 g to represent 0, 5 and 10 t ha^{-1}, poultry manure at 0, 25 and 50 g to represent 0, 5 and 10 t ha^{-1} while NPK 20:10:10 fertilizer consisted of 0, 1 and 2g to represent 0, 200 and 400 kg ha^{-1} respectively. The treatments were replicated three times.

Hand trowel was used to mix both cocoa pod ash and poultry manure with soil constituents. The soil samples were copiously watered. Maize (SUWAN-1-SR) was used as test crop. Two maize seeds were planted/pot in March 2005 two weeks after the organic materials were incorporated into the soil samples.

At 45 days after planting, above soil portion of one maize/ pot was harvested, washed with clean water, bagged in brown envelops and labeled accordingly. The plant tissues were oven dried at 65 ^oC till constant weight was obtained. The ground samples were ground with a Willey mill to pass through 0.5mm sieve. The ground samples were digested with nitric – perchloric acid mixtures (Association of Analytical Chemists**,** 1990) as was done in organic materials analysis. Total N was determined by Mickrockjedahl procedure, P was determined Bray – 1 - method. Potassium was determined by flame photometer while Ca and Mg were determined by AAS. The micronutrients (Fe, Cu, Zn and Mn) were also determined by atomic absorption spectrophotometer.

At cob harvest, the remaining maize plant per pot was uprooted and cut from the base to separate the shoot from the root. The root and shoot part of each sampled plants were washed with clean water, bagged in brown envelopes and labeled accordingly for dry matter determination. The samples were dried in the oven at 65^0 C until constant weight was recorded. The stover and root yields were weighed. Plant height was measured per plant. Maize cobs were harvested after three months of planting, sun dried to reduce the moisture content to about 12% and shelled. Maize grains/ plant were weighed with weighing balance.

Residual Effect

The pot experiment was repeated in 2006. For the repeated experiment, the soil samples were sieved in order to remove the root fragments and debris of the first crop and carefully placed in pots in order to minimize soil loss. The soil samples were copiously watered and pulverized before two maize seeds were planted/ pot in April 2006. No treatment was applied in order to determine the residual effect of the earlier applied treatments.

The final soil nutrient analysis was carried out at the end of the experiment as done in the initial soil analysis. The nutrients determined were organic matter, N, P, K, Ca, Mg, Cu, Zn, Fe and Mn.

Statistical Analysis

Means were separated using Duncan's Multiple Range Tests at 0.5 level of probability when F – ratio was significant **(**Statistical Analysis Institute, 2000)

RESULT

The chemical characteristics of the soil used for the experiment showed that the soil had pH 5.56, Organic matter (OM) 13.1 g kg^{-1}, total N 0.6 g kg^{-1}, and available P 4.88 mg kg^{-1}. The exchangeable Ca, K and Mg were 2.32, 0.16 and 0.20 c mol kg^{-1} respectively. Copper (Cu), Fe, Mn and Zn had 2.44, 0.41, 4.20 and 3.30 g kg^{-1} respectively. The soil was slightly acidic and low in organic matter, total percent N and available P. The available S was adequate for maize production in southwestern Nigeria. The exchangeable cations K and Mg values were low while Ca was adequate. The percentage nutrient composition of the poultry manure used for the experiment were (%): (21.70) organic carbon, (3.7) N, (6) C/N ratio, (2.72) P, (2.91) K, (2.80) Ca, (0.80) Mg, (0.45) Zn, (0.10) Cu, (2.66) Fe and (1.48) Mn. Cocoa pod ash had 12.56, 1.23, 14, 0.31, 1.01 and 12.52% for organic carbon, total N, C/N ratio and total P respectively. Exchangeable K, Ca and Mg were 12.52, 3.74 and 1.00% respectively while Zn, Cu, Fe and Mn had 0.13, 0.33, 1.22 and 1.23% respectively.

Table 1. Effect of cocoa pod ash, poultry manure and NPK 20:10:10 fertilizer on soil chemical properties in 2005 pot experiment

Treatment	OM	N	P	K	Ca	Mg	Fe	Cu	Zn	Mn
	%	%	c mol kg^{-1}	c mol kg^{-1}	c mol kg^{-1}	mg kg^{-1}	mg kg^{-1}	mg kg^{-1}	mg kg^{-1}	mg kg^{-1}
C0	2.74c	0.13b	12.32a	0.25b	2.11c	0.99a	0.47a	0.14a	3.88a	28.09a
C5	2.92a	0.15a	8.38b	0.24b	2.89b	0.75b	0.43a	0.13b	2.58a	23.37b
C10	2.82b	0.14ab	8.31b	0.30a	3.11a	0.72b	0.40a	0.12a	1.94b	18.69c
P5	2.78b	0.13b	10.54	0.25ab	2.91b	0.82a	0.40b	0.13b	2.27b	20.44c
P10	3.14a	0.16a	13.74a	0.25b	3.14a	0.89a	0.53a	0.12b	2.61b	23.91c
F200	3.00a	0.15b	10.02a	0.28a	2.02b	0.86b	0.46a	0.13b	3.46a	25.46b
F400	2.58c	0.14ab	10.45a	0.26a	1.20c	0.93a	0.33b	0.18a	4.00a	27.80a

Means with the same letters are not significantly different according to Duncan Multiple Range Test at 5% level

Tables 1 and 2 show he effect of cocoa pod ash, poultry manure and NPK fertilizer applied individually on soil chemical properties after maize harvest in 2005 and 2006. In 2005, result showed that cocoa pod ash significantly ($p<0.05$) increased soil organic matter, N, K and Ca relative to control (Table 1). In 2006, there were significant increases ($p < 0.05$) in soil organic matter, N, P, K, Ca, Fe and Zn (Table 2). In 2005 only K and Ca increased with increase level of cocoa pod ash while organic matter N, P, Fe and Zn increased with increase level of cocoa pod ash in 2006. However, cocoa pod ash at 5 and 10 t ha^{-1} reduced soil Mg, Cu and Mn in 2005 and the decreases still reflected on Cu and Mn in 2006.

Table 2. Effect of cocoa pod ash, poultry manure and NPK 20:10:10 fertilizer on soil chemical properties in 2006 (one year after treatments application)

Treatment	OM	N	P	K	Ca	Mg	Fe	Cu	Zn	Mn
	%		mg kg^{-1}		c mol kg^{-1}			mg kg^{-1}		
C0	1.79c	0.09c	6.76c	0.14b	1.81c	1.48a	1.58b	0.98a	1.56b	18.47a
C5	2.12b	0.11b	8.09b	0.26a	2.04a	1.18b	1.57b	0.78a	3.09a	15.28b
C10	2.43a	0.12a	8.49a	0.23a	2.00b	1.01b	1.70a	0.20b	3.23a	13.64c
P5	2.06b	0.11b	8.36a	0.21a	1.98b	1.16a	1.64b	0.78a	3.09a	14.33b
P10	2.54a	0.12a	8.69a	0.22a	2.06a	1.28a	1.97a	0.20b	3.23a	16.62a
F200	2.11a	0.11a	8.33a	0.20a	1.81a	1.23b	1.61a	0.69a	2.84a	18.64a
F400	1.38b	0.08c	5.19c	0.08b	1.27a	0.97b	1.86a	0.43a	1.61c	18.66a

Means with the same letters are not significantly different according to Duncan Multiple Range Test at 5% level

The poultry manure applied at 5 and 10 t ha^{-1} increased soil organic matter, N, P, Ca, Mg Fe and Zn in 2005 (Table 1). The soil organic matter, N, P, Ca, Mg and Fe increased with level of poultry manure. The poultry manure application reduced soil Cu, Zn and Mn in 2005 and still reduced Cu and Mn in 2006.

Relative to control, the NPK fertilizer at 100, 200 and 400 kg ha^{-1} increased soil organic matter, N, P, K, Mg, Fe, Cu (except F400), Zn and Mn especially at 200 kg ha^{-1}.

In 2005, relative to control, single application of cocoa pod ash, poultry manure and NPK 20:10:10significantly increased soil OM, (N except P5), Ca (except F400) and Mg. Treatment P10 had the highest soil OM, N, P, Ca, Mg and Fe. Treatment C10 had highest K while treatment F400 had highest Cu and Zn. In 2006 relative to control, all the treatments significantly increased ($p<0.05$) soil OM, N, K and P (except F200)

The nutrient concentration in maize tissue as affected by cocoa pod ash, poultry manure and NPK fertilizer and their corresponding residual effect after one year of treatments application are shown in Tables 3 and 4. In 2005 relative to control, cocoa pod ash applied at 5 and 10 t ha^{-1} significantly increased ($p < 0.05$) plant N, K, Ca and Zn (Table 3). Potassium and Zn increased in maize tissue as the rate of cocoa pod ash increased. In 2006, cocoa pod ash increased N, P, Mg (C5), and Cu and Fe concentration in maize tissue (Table 4).

Table 3. Effect of cocoa pod ash, poultry manure and NPK 20:10:10 fertilizer on soil nutrient concentration

Treatment	N	P	K	Ca	Mg	Zn	Cu	Fe	Mn
	%				mg kg-1				
C0	2.58b	0.42a	3.20c	0.29c	0.17a	27.45a	4.72a	24.62a	28.88a
C5	2.99a	0.45a	3.74b	0.43a	0.16a	31.40b	4.68b	22.08b	23.97c
C10	2.95a	0.44a	3.90a	0.32b	0.16a	44.96a	3.67c	17.96c	25.65b
P5	3.46a	0.13b	1.43a	0.19b	0.11b	30.76b	3.51b	19.58b	13.09b
P10	3.53a	0.47a	1.45a	0.21a	0.15a	38.31a	5.39a	20.08a	23.68c
F200	2.92b	0.44b	3.62b	0.39a	0.17a	33.68b	4.83a	22.94b	26.93a
F400	3.44a	0.47a	3.45c	0.30a	0.17a	21.71d	4.00c	27.80a	23.53b

Means with the same letters are not significantly different according to Duncan Multiple Range Test at 5% level

In the pots treated with poultry manure in 2005 (Table3), the concentration of N, P, K, Ca, Mg, Cu, Zn (C10) and Mn in maize tissue increased compared with control. Poultry manure reduced Fe concentration. In 2006, poultry manure (Table 4) tended to increase N, P,

Table 4. Effect of NPK fertilizer on maize nutrient concentration in2006

Treatment	N	P	K	Ca	Mg	Zn	Cu	Fe	Mn
					%				
control	0.39b	0.15a	1.41a	0.19a	0.15b	28.56a	4.34a	17.39b	18.55a
C5	0.51a	0.13b	1.44a	0.19a	0.21a	32.80a	4.18a	19.80a	11.87b
C10	0.52a	0.12b	1.45a	0.17b	0.16b	35.48a	3.27b	127.54b	10.34b
P5	0.46a	0.13b	1.43a	0.19b	0.11b	30.76b	3.51b	19.58b	13.09b
P10	0.53a	0.17a	1.45a	0.21a	0.15a	38.31a	5.39a	20.08a	9.68c
F200	0.49a	0.14a	1.43a	0.18a	0.11a	32.03a	4.04a	17.56a	13.66b
F400	0.34a	0.15a	1.36a	0.17a	0.12a	19.69b	3.56a	18.00a	22.50a

Means with the same letters are not significantly different according to Duncan Multiple Range Test at 5% level

K, Ca, Mg, Cu, Zn, Fe and Mn in the maize tissue. NPK fertilizer significantly increased N, P, K, Mg and Fe in F200 and F400 compared with control. F400 reduced Cu and Mn concentration in maize tissue in 2005. In 2006, compared with control, there were no significant differences in all the nutrients except F400, which significantly increased Mn.

Relative to control, all the treatments significantly increased ($p<0.05$) plant N, P, K and Zn in 2005. Treatment F400 had highest N and Fe, Treatment P10 had highest plant P, Ca, and Cu, treatment C10 had highest C10 had highest K and Zn while the control had highest Mn. In 2006, relative to control, all the treatments significantly increased ($p<0.05$) N (except) F400. Treatment P10 had highest plant N, P, Ca, Zn, Cu and Zn. Treatment C10 had highest K while F400 had highest Mn.

Means with the same letters are not significantly different according to Duncan Multiple Range Test at 5% level of significant.

Table 5. Effect of cocoa pod ash on growth and yield component of maize in 2005 experiment

Cocoa pod ash (t ha^{-1})	Plant height (cm)	Grain yield	Stover yield	Dry matter (Root)	Increase in grain yield (%)
			(g)		
Control	131.33b	26.89b	40.84b	15.41b	0
C5	134.96b	34.15a	48.70a	19.41a	27
C10	145.20a	27.19b	43.29b	16.94b	1
P5	130.40a	27.40b	42.21b	15.21b	2
P10	144.77a	38.52a	59.95a	18.05a	43
F200	156.56a	31.98a	46.57a	16.56ab	19
F400	160.00a	34.51a	52.05b	18.00a	28

Growth and Yield Component of Maize in Pot Experiment

Tables 5 and 6 present data on the effect of cocoa pod ash, poultry manure and NPK fertilizer on growth and yield components of maize immediately after the harvest of maize in 2005 and 2006, respectively. Plant height increased as the level of cocoa pod ash increased, even one year after treatments application. The cocoa pod ash applied at 5 t ha^{-1} gave the highest grain yield, stover and dry root matter. Grain yield and stover increased at all level of poultry manure increased between 0 and 10 t ha^{-1}. Poultry manure also increased plant height.

Table 6. Effect off cocoa pod ash on growth and yield components of maize in 2006 pot experiment (one year after application)

Cocoa pod ash (t ha^{-1})	Plant Height (cm)	Grain Yield	Stover Yield	Dry Matter (Root)	Increase in Grain yield (%)
			(g)		
Control	33.71b	12.26a	25.17a	8.71a	0
C5	60.18a	13.40a	22.78b	7.78b	9
C10	88.04b	17.46.b	24.36b	8.66b	42
P5	62.59a	14.56a	17.40b	6.01c	19
P10	62.48a	23.45a	31.23a	10.68a	91
F200	58.92a	13.56c	20.75a	7.47a	11
F400	54.67 a	16.56a	23.32a	7.74a	35

NPK fertilizer applied at 200 and 400 kg ha^{-1}, significantly increased height, grain, stove and root dry matter. One year later, grain yield also increased with the level of NPK fertilizer.

Compared with control, the increases in grain yield were in the order P10 > F400> C5> F200>P5 (Table 5) on immediate basis. On residual basis (2006), the increases in grain yield were in the order P10>C10>F400>P5>F200>C5. The cumulative yield increases were in the order P10 (61.97g), F400 (51.07g), C5 (47.55g), F200 (45.54g), C10 (44.65g), P5 (41.96g) and control (39.15g).

DISCUSSION

Based on the established critical level of 3% for organic matter, 0.15% for total N, 10 mg kg^{-1} for available P , 0.20 c mol kg^{-1} for K, 0.23 c mol kg^{-1} for exchangeable Ca and 0.26 c mol kg^{-1} for exchangeable Mg; the soil is low in OM, deficient in N, P, K and Mg and adequate in Ca and Mg (Adebusuyi, 1985, Sobulo and Osiname, 1987, and Agboola and Corey, 1977). The low soil OM, N, P and K status and its acidic nature are expected to benefit from application of the organic materials (cocoa pod ash and poultry manure) and NPK 20:10:10 fertilizer.

In the present study, the poultry manure used had higher percent N, P and Mg compared to cocoa pod ash, while cocoa pod ash had higher K and Ca, especially K. The poultry manure also had lower C/N ratio (6 for poultry manure and 14 for cocoa pod ash). This might have enhanced faster decomposition of poultry manure especially when combined with NPK 20:10:10 fertilizer (Titiloye, 1982), and thereby enhanced more and quick release of N and P, which are respectively more needed for maize performance.

Maize requires N and P in its early stage and any shortage especially at this early stage may reduce root growth, nutrient uptake and affects the crop for the rest of its life cycle. The lower N and P recorded in the control than single application of cocoa pod ash, poultry manure, NPK fertilizer and their combinations showed the ability of the fertilizer materials in supplying N and P to the soil. This might have contributed to the higher yields in these treatments than the control that was deficient in N and P. Bijay-Singh,*et al*., (1997) and Kayode and Agboola, 1983 reported that soil N and P availability during maize seedlings development are important for vegetative, root growth and grain.

This pot experiment showed that, addition of cocoa pod ash to poultry manure increased soil OC, N, K, Ca and Zn. This indicates that the organic materials supplied organic matter and the cations. The increases in soil and plant nutrients content adduced to cocoa pod ash and poultry manure in this research is consistent with the finding that the materials are composed of macro and micronutrients and organic carbon. The nutrients released by the materials were made available for maize uptake. Studies by Odedina *et al*., 2003, Moyin Jesu 2004, and Ajayi *et al*., 2007a and 2007b also showed that cocoa pod ash increased soil OM, N, P, K, Ca and Mg. Also, the finding that poultry manure increased soil nutrient concentration in maize tissue in this work, could be related to the earlier observations that, poultry manure increased soil nutrients and uptake of tomato and maize (Adediran and Ojeniyi, 2005 Adediran *et al*., 2003).

The increased availability of and uptake of Ca, Mg and micronutrients as a result of application of NPK 20: 10:10 fertilizer can be associated with increased soil organic matter. The soil organic matter is known to form chelate with micronutrients and it is also a source of cations due to the presence of exchange sites on organic colloid. The increased presence of Ca could also be due to Ca content of phosphate fertilizer, which might have been used in formulation of NPK 20:10:10 fertilizer. The increased availability of micronutrients Fe, Cu, Zn and Mn are also attributable to reduced soil pH associated with the use of NPK fertilizer.

The micronutrient cations are most soluble and available under acid conditions. In very acid soils, there is a relative abundance of Fe, Mn, Zn and Cu (Brady and Weil, 1999).

CONCLUSION

Cocoa pod ash, poultry manure and NPK fertilizer are sources of plant nutrition. Application of cocoa pod ash by 5 ha^{-1} tended to reduce soil available P, micronutrients and maize growth and yield components in the first year and had slight residual effect in the second year. Poultry manure increased major soil and maize yields as its level increased on both immediate and residual basis. NPK fertilizer had high yields in first year with little residual effect one year later. 10 t ha^{-1} of poultry manure is recommended. Where poultry manure is not available 5 t ha^{-1} cocoa pod ash is recommended on annual basis.

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