Effect of Cocoa Pod Ash, NPK Fertilizer and their Combinations on Soil Chemical Properties and Yield of Tomato (*lycopersicon lycopersicum*) on Two Soil Types

Ayeni L.S

University of agriculture, Department of Soil and Land Management, PMB 2240, Abeokuta, Nigeria

E mail: leye_sam@yahoo.com

Abstract

Field experiments were conducted in September 2006 and March 2007 on two soil types loamy sand (Ondo town) and clay soil (Bagbe town) in forest zone, southwest Nigeria to study the effect of cocoa pod ash (0, 5 and 10 t ha^{-1}), NPK 20:10:10 fertilizer (0, 150 and 300 kg ha^{-1}) and cocoa pod ash rates combined with 150 kg ha^{-1} NPK 20:10:10 fertilizer on soil chemical properties, plant nutrient content, growth and fruit yield of tomato. Mean data for 2006 and 2007 were use to compare the treatment means. The treatments were arranged on randomized complete block design and replicated three times. The experiment was repeated in the second year on the same locations. The soil at Ondo was deficient in soil OM, N, P, K, Ca and Mg while Bagbe was fairly adequate for crop production. Cocoa pod ash combined with NPK fertilizer significantly ($p<0.05$) increased soil OM, P, K, Ca, and Mg than single application of cocoa pod ash and NPK 20:10:10. Fertilizer combinations also increased plant N, P and K at the two locations than single application of cocoa pod ash and NPK fertilizer significantly. 10 t ha^{-1} of cocoa pod ash combined with 150 kg ha^{-1} of NPK fertilizer gave the highest fruit yield at the two locations (89 % for Bagbe and 110 % for Ondo). The combined application of cocoa pod ash with reduced level of NPK fertilizer was more effective in increasing soil nutrients and fruit yield of tomato than cocoa pod ash and NPK fertilizer applied individually in loamy sand and clay loam. The trend in the yield showed that loamy sand utilized cocoa pod ash applied alone or combined with NPK fertilizer more than clay loam [New York Science Journal 2010; 3(4):1-11) (ISSN 1554 – 0200)

Key words: integration, soil nutrient, nutrient uptake, yield component

1 Introduction

The aim of a farmer is to improve crop production at minimum cost in order to maximize profit but his major problem is how to maintain soil fertility. Soils in Nigeria are low in organic matter and available nutrients; hence its productivity and sustainability decline over time when subjected to continuous cultivation. In an attempt to correct these deficiencies, sole application of mineral fertilizers and organic manures are widely practiced. Yet, the fertility of the soil has not been able to sustain optimum cop production that can feed the teaming population as a result of their demerits. Mineral fertilizers are scarce, costly and their continuous application acidifies soil while organic manures are bulky, late in nutrient mineralization as well as low nutrient quality. There is need to source for locally available organic materials that are cheap, environmentally feasible that can be combined with mineral fertilizer for optimum crop productivity and soil fertility maintenance.

Cocoa pod is known to be cheap in southwest Nigeria (Egunjobi, 1975). It is advised the husk be burnt to serve as farm sanitation and reduce the incidence of P*hytophtora palmivora*, which is the causal of black pod disease of cocoa.

Burning of cocoa husk also reduced its C/N ratio and therefore enhances its early mineralization (Ayeni, 2008). Cocoa pod ash is rich in K and Ca (Ayeni *et al*, 2008a, Adu-Dapaah *et al*, 1994).

Integrated application of cocoa pod ash with reduced level of NPK fertilizer in tomato production is expected to solve the problems associated with sole use of mineral fertilizers and organic manures by tomato farmers. Combined cocoa pod ash and NPK fertilizer is not known to have been studied for tomato production in Ondo southwest Nigeria where cocoa is widely grown. Ayeni (2008b) found that tomato grown on hydromorphic soil and dry land responded differently to combined application of cocoa pod ash and NPK fertilizer in southwest Nigeria. The objective of this study was to compare the effect of cocoa pod ash, NPK 20:10:10 fertilizer and their combinations on soil chemical properties, plant nutrient uptake and yield of tomato on two soil types in southwest Nigeria.

3 Materials and methods

Experiments were conducted in September 2006 and repeated in March 2007 concurrently at two different locations in Ondo area (Adeyemi College of Education Students Research Farm and Bagbe). Ondo is located in latitude 07^0 05^1N, on longitude 040^0 55^1E and at an elevation of 381.3M above sea level. The mean annual rainfall of 1,575.6mm is distributed over nine to ten months in a bimodal rainfall pattern. Early rain occurs between March to July and late rain occurs between August to October with five months of dry season and a short dry spell in August (August break). The two soils were skeletal, clayey, kaolinitic oxic tropuldalf (Adepetu *et al.*, 1979). The experiments were carried out concurrently in the two locations in September 2006 and repeated in March 2007.

The experiments were laid in a randomized complete block design on a plot size of $5x5m^2$ in each location. Three levels of NPK 20:10:10 fertilizer at 0, 150 and 300 kg ha^{-1} was combined with three levels of cocoa pod ash at 0, 5 and 10 t ha^{-1}. The treatments were: control, 5 t ha^{-1} cocoa pod ash (C5), 10 t ha^{-1} cocoa pod ash (C10), 150 kg ha^{-1} NPK 20:10:10 fertilizer (F150), 300 kg ha NPK 20:10:10 fertilizer (F300), 5 t ha^{-1} cocoa pod ash + 150 kg ha^{-1} NPK fertilizer (C5F150) and 10 t ha^{-1} cocoa pod ash + 150 kg ha^{-1} NPK 20:10:10 fertilizer (C10F150). Treatments were replicated thrice on manually cleared land. Cocoa pod ash collected from cocoa farmers was sun dried and burnt inside a bin. The ash was incorporated into the soil at ridging. New Roma type of tomato was purchased from a local market. Seedlings were transplanted to the field at a spacing of 75 x 60cm to give 56 stands/plot after three weeks in the nurseries. Weeding was carried out thrice manually and staking was done. Harvest of fruits was done weekly from 8 weeks after sowing; number of fruits and fruits weight were determined. Fruit weight was expressed in t ha^{-1} for meaningful comparison.

Soil analysis

The pH of the soil was determined in 1:1 soil/ water and was read with pH meter. Organic matter was determined by dichromate oxidation method. Total N was determined by using distillation technique (Jackson, 1964) Available phosphorus was extracted by Bray -1 – method and the phosphorus in the extractant was determined colorimetrically by the blue colouration method on spectronic 20 at 882nm The absorbance (A) taken was calculated to reflect P in mg kg^{-1}. 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 on Atomic Absorption Spectrophotometer. Soil particle size analysis was done by hydrometer method.

Ash and leaf analysis

The nutrient composition of cocoa husk ash was determined. With the exception of nitrogen (N), the determination of other nutrients was done using wet digestion method based on 25 – 5 – 5 ml of HNO_3 – H_2SO_4 – $HClO_4$ acids (AOAC, 1990). The methods used in soil were also used to analyze P, K, Ca and Mg after the digestion. Total N was determined with Microkjedahl method. Leaf samples randomly collected from tomato plants at 50% flowering were oven dried for 24 hrs at 70^{o}C, milled and analyzed as described by Tel and Hagarty (1984). Nutrients determination was carried out as done in cocoa pod ash.

Growth and yield data

Growth and yield components data such as plant height, leaf area and number of fruits were collected on plant basis. Five plants per plot were selected for this purpose. Leaf area was evaluated using graph paper method. Fruits were harvested from all the remaining plants /plot, counted and weighed. Data on number of fruits was transformed using Ark sine transformation method.

Statistical analysis

The Duncan Multiple Range Test was used to compare the mean data at 5% level.

4 Result and Discussion

Pre - cropping soil analysis indicated that the loamy sand (Ondo) was acidic, deficient in OM, N, K Ca and Mg but marginal in P. The clay loam (Bagbe)) was slightly acidic, adequate in Ca, Mg and P, marginal in OM, N and K (Table1). The low fertility of the experimental soils indicated that the soils need fertilization.

Table 1: initial soil analysis

Location	Ondo	Bagbe
pH	5.66	6.07
Soil organic matter	2.32	2.43
Total N	0.11	0.12
P mg kg^{-1}	7.99	9.00
K c mol kg^{-1}	0.30	0.40
Ca c mol kg^{-1}	1.98	2.12
Mg c mol kg^{-1}	1.10	1.22
Soil physical properties (%)		
Sand	87	45
Silt	11	24
Clay	2	33
Textural class	loamy sand	clay loam

Table 2: Nutrient composition of cocoa pod ash (%)

Nutrient	OC	N	C/N	P	K	Ca	Mg
Cocoa pod ash	16.56	1.23	14	1.10	15.52	3.74	2.4

Tables 3 and 4 contain mean soil chemical properties as given by cocoa pod ash, NPK fertilizer and their combinations at Bagbe and Ondo respectively. Relative to control, all the treatments increased soil OM, N, P and K in the two locations. Cocoa pod ash applied singly or combined with NPK 20:10:10 fertilizer significantly increased ($p<0.05$) soil pH while NPK fertilizer had no effect on soil pH at the two locations. Cocoa pod ash applied at 10 t ha^{-1} had highest soil pH at the two locations. Cocoa pod ash combined with NPK fertilize at all rates had higher ($p<0.05$) soil OM, N, P and K than cocoa pod ash and NPK fertilizer applied individually (Tables 3 and 4). Five and 10 t ha^{-1} of cocoa pod ash (C5 and C10) released more Ca to the soil than when combined with NPK 20:10:10 fertilizer. Compared with cocoa pod ash applied alone, cocoa pod ash combined with NPK fertilizer reduced Mg at Bagbe while Mg was increased at Ondo. Soil OM, N, P and K increased as the level of cocoa pod ash and NPK fertilizer increased in the two locations. The low C/N ratio of NPK fertilizer and cocoa pod ash might have enhanced early mineralization of the nutrients present in cocoa pod ash. The increase in soil organic matter, N, P, K Ca and Mg by cocoa pod ash applied individually and cocoa pod ash combined with NPK 20:10:10 fertilizer than 300 kg ha^{-1} NPK 20:10:10 fertilizer might be as a result of the nutrient released by cocoa pod ash.

Tables 5 and 6, show the effect of combined cocoa pod ash and NPK fertilizer on yields of tomato in both locations. At Bagbe (clay loam), relative to control, all the treatments increased the plant height, no of branches, leaf area, number of fruits and fruit yield. The highest level of combinations (C5F150 and C10F150) had the highest growth and yield components (Table5).

Table 3: Effect of combined cocoa pod ash and NPK fertilizer on soil chemical properties at Bagbe (2006 and 2007)

Treatment	pH	OM	N	P	K	Ca	Mg
		-----%--------		mg kg^{-1}	----------c mol kg^{-1} -------		
Control	5.58c	2.20c	0.13c	7.22d	0.46f	2.10b	1.23b
F300	5.56c	2.61bc	0.14c	8.34c	1.00c	2.00b	1.20b

F150	5.58bc	2.10c	0.13c	7.80d	0.66f	2.00b	1.22b
C5	5.69b	2.99b	0.15ab	8.99c	1.46d	4.23a	2.14a
C10	6.09a	3.02b	0.16b	7.92d	1.68c	5.00a	2.62a
C5F150	5.60b	3.40a	0.17a	10.99b	1.94b	4.00a	1.68b
C10F150	6.05a	3.41a	0.17a	12.43a	2.72a	4.55a	2.60a

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

Table 4 Effect of combined cocoa pod ash and NPK fertilizer on soil chemical properties at Ondo 2006 and 2007)

Treatment	pH	OM	N	P	K	Ca	Mg
		-----%--------		mg kg^{-1}	----------c mol kg^{-1} -----------------		
Control	6.46bc	2.42b	0.12b	7.90c	0.37c	1.73b	1.38a
F300	6.40c	2.77a	0.14ab	9.14b	0.67c	1.61b	1.39a
F150	6.44c	2.61b	0.13b	7.93c	0.66c	1.64b	1.30a
C5	6.69b	2.67ab	0.13a	9.35ab	0.98c	4.41a	1.90a
C10	7.26a	2.99a	0.15a	10.18a	1.12b	4.72a	2.10a
C5F150	6.66b	3.20a	0.16a	11.70a	1.90a	4.47a	1.60a
C10F150	7.20a	3.33a	0.17a	12.00a	1.92a	4.70a	2.00a

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

Table 5: Effect of combined cocoa pod ash and NPK 20:10:10 fertilizer on growth and yield components of tomato at Bagbe (2006 and 2007)

Treatment	plant height	No of branches	Leaf area cm^3	No of fruits/plant	Fruit yield $t\ ha^{-1}$	increase in fruit yield (%)
Control	76e	11.00b	17.23ff	13.10d	18.00d	0
F300	102c	13.00ab	36.00c	20.00c	25.10c	39
F150	70e	11.00b	20.00e	16.30d	19.62d	9
C5	99d	13.00ab	30.00c	29.00b	23.00c	28
C10	111c	13.00ab	45.00b	30.00b	29.80b	66
C5F150	177b	15.00a	49.30a	38.81a	31.18b	73
C10F150	199a	14.00a	49.40a	40.12a	34.00a	89

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

Table 6: Effect of combined cocoa pod ash and NPK 20:10:10 fertilizer on growth and yield components of tomato at Ondo (2006 and 2007)

Treatment	plant Height(cm)	No of branches	Leaf area cm^3	No of fruits/plant	Fruit yield $t\ ha^{-1}$	increase in fruit yield (%)
Control	54c	11.27ab	15.66d	8.11c	11.93c	0
F300	102a	11.15b	28.72b	16.70b	14.00c	74
F150	56c	13.00a	20.32c	9.45c	22.92b	17
C5	68b	13.00a	26.18c	20.00a	22.00b	84
C10	69b	13.16a	32.10b	21.00a	23.00b	93
C5F150	101a	13.00a	36.67b	20.00a	20.12b	69
C10F150	111a	13.00a	42.00a	22.40a	25.12a	110

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

Table 6 shows that C10F150 had highest plant height, leaf area and fruit yield. The percentage increases in fruit yield for Bagbe were in the order C10F150 > C5F150 > C10 > F300 > C5 > F150 > control while the increases in Ondo location (clay loam) were C10F150 > C10 > C5F150 > C5 > F300 > F150 > control. These trends showed that loamy sand utilized cocoa pod ash applied alone and cocoa pod ash combined with NPK fertilizer more than clay loam. This shows that cocoa pod ash is likely to respond to soil types. Loam sand and sandy clay are known to exhibit different physical characteristics such as coarseness, water holding capacity, infiltration rate as well as leaching rate. These factors might have caused differences in soil nutrient availability, plant nutrient uptake and performance of tomato grown in loam sand and sandy clay in this experiment.

Tables 7 and 8, show the nutrient concentration in tomato tissue at Bagbe and Ondo respectively. At Ondo, the plots without treatments had the highest plant height and branches but with lower leaf area, number of fruits per plant and fruit weight. Relative to control, all the treatments increased leaf N, P, K and Ca (Tables 7 and 8). Cocoa pod ash applied individually (C5, C10) compared with combined cocoa pod ash and NPK fertilizer (C5F150, C10F150); the combinations had higher N, P and K with lower Ca and Mg (Tables 7 and 8). C10F150 had highest Mg at Bagbe while C10 had the highest Mg at Ondo. C10 had highest Ca at both locations compared with other treatments.

Table: 7 Effect of combined cocoa pod ash and NPK 20:10:10 fertilizer on nutrient composition of tomato/plant at Bagbe (2006 and 2007)

Treatment	N	P	K	Ca	Mg
	-------------------------%-----------------------------				
Control	2.23b	0.28c	2.27c	0.16d	0.12c
F300	3.45ab	0.47b	5.32b	0.19d	0.11c
F150	2.66b	0.30c	3.97c	0.23c	0.12c
C5	2.98b	0.43b	6.67b	0.47b	0.16b
C10	4.50a	0.45b	7.78a	0.99a	0.14b
C5F150	4.99a	0.54a	8.90a	0.44b	0.19a
C10F150	4.43a	0.56a	9.37a	0.46a	0.19a

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

Table 8: Effect of combined cocoa pod ash and NPK 20:10:10 fertilizer on nutrient composition of tomato/plant at Ondo (2006 and 2007)

Treatment	N	P	K	Ca	Mg
	------------------------%------------------------------				
Control	1.46d	0.12c	2.60c	0.10c	0.12d
F300	2.24c	0.44a	4.00b	0.12a	0.13d
F150	2.00c	0.31b	3.22b	0.10c	0.10d
C5	2.43b	0.39b	4.00b	0.98b	0.50a
C10	2.99b	0.39b	4.61b	1.12a	0.42b
C5F150	3.47a	0.47a	6.72a	1.00a	0.43b
C10F150	3.62a	0.23c	7.88a	1.00a	0.22c

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

The low fertility status of the soil from textural classes especially Ondo location (loam sand) was expected to benefit from the treatments applied. Analysis of cocoa pod ash indicates that cocoa pod ash comprised N, P, K, Ca, and Mg. This is in line with the work of Odedina *et al*., (2003), Ayeni *et al*., (2008b) and Adu-Dapaah *et al*., (1994), that cocoa pod ash contains plant nutrients. The presence of OC in cocoa pod ash is an indication of incomplete combustion. This is a simulation of what the farmers used in Nigeria. The increases in organic matter, N, P, K and Ca contents in the soils treated with cocoa pod ash and its combinations with NPK fertilizer were expected to produce positive response by the tomato plants. The low C/N ratio and the liming effects might have aided microbial activities and increase in N and P mineralization (Ayeni *et al.*, 2008b). Tomato was expected to perform better in Bagbe soil than Ondo as a result of its higher soil fertility status. The increases in pH of the plots treated with cocoa pod ash and its combinations show the liming effect of cocoa pod ash. Cocoa pod ash obliterated the acidic effect of NPK fertilizer by increasing the pH of the soil treated with combined cocoa pod ash and NPK fertilizer over NPK fertilizer applied alone Ayeni (2008b) noted that cocoa pod ash contained higher cations especially K and Ca than other nutrients present in it. Tomato is known to be sensitive to soil acidity. Obi and Akinsola (1995) found that liming of Iwo series also increased soil pH and tomato yield. Increased in soil pH and Ca due to application of ash should have also increased uptake of other nutrients, including micronutrients The soil treated with cocoa pod ash and its combinations with NPK fertilizer supplied more N, P and K than cocoa pod ash and NPK fertilizer applied individually confirms the findings by Ayeni *et al*., (2008a) that integrated application of cocoa pod ash and NPK fertilizer were more beneficial to soil fertility improvement than their sole application.

The least leaf N, P and K found in the tomato planted in the control agreed with the observation that cocoa pod ash supplied N, P and K to the soil. Also, the relatively low leaf N, P and K recorded for tomato grown in soils without treatments compared with the soils amended with combined cocoa pod ash and NPK fertilizer could be attributed to the fact that the control had the least SOM, N, P and K. The better performance of the combined cocoa pod ash and NPK fertilizer than their sole application might be as a result of their higher nutrient values. This is supported by the finding of Olaniyan and Ayodele (1980) that N, P and K strongly influenced the growth and yield of tomato. Nitrogen and P are indispensable for better performance of tomato (Hooper, 1970). The fertilizer combinations produced increased leaf K, Ca and Mg when compared with 300 kg $^{-1}$ NPK 20:10:10 fertilizer in the two locations. This might be as a result of dilution effect as per K (Oladokun, 1986) and low or absence of Ca and Mg in NPK 20:10:10 fertilizer formulation used in these experiments. The tomato plants treated with cocoa pod ash and its combinations had K higher than NPK fertilizer rates and tended to produce higher tomato yields. This shows that adequate supply of K to tomato plant will enhance the quality and high yield of tomato as noted by Adams *et al*., (1978).

5 Conclusion

Combined cocoa pod ash and NPK 20:10:10 fertilizer increased soil and plant N, P, K Ca and Mg uptake by tomato plants. This led to significant growth and fruit yield of tomato. The combined application of cocoa pod ash with reduced level of NPK fertilizer was more effective in increasing tomato fruit yield than cocoa pod ash and NPK fertilizer applied individually. Integration of cocoa pod ash and NPK fertilizer had positive effect on soil fertility. According to this experiment, the amount of K present in cocoa pod ash can be used to supplement mineral fertilizer such as muriate of potash which is scarce and mostly unavailable for farmers in southwest Nigeria where cocoa pod ash is in abundance. It is also concluded that cocoa pod ash and its combinations with NPK 20::10:10 fertilizer responds differently to soil types in making nutrients derive from the ash available to crop. Field experiments are needed to be carried out to compare the effect of cocoa pod ash with muriate of potash on tomato production for proper recommendation as this work did not study this.

Author

Dr. Ayeni, Leye Samuel (Ph.D. Soil Science)

University of Agriculture, PMB 2240, Abeokuta, Ogun State, Nigeria

E-mail: leye_sam@yaho.com

6 Reference

1 Egunjobi, O.A. 1975. Possible Utilization of Discovered Cocoa Pod Husks Fertilizer and Nematicide Proc. International Cocoa Research Conf. Ibadan. Sept. 1 – 9. Pp 541 – 547.

2 Ayeni L.S., Adetunji.M T., Ojeniyi, S.O., Ewulo, B.S. and Adeyemo, A. J. 2008a. Comparative and Cumulative Effect of Cocoa Pod Husk Ash and Poultry Manure on Soil Nutrient Contents and Yield of Tomato. American – Eurasian Journal of Sust. Agric. 2(1): 9- 97.

3 Adu-Dapaah H.K., Combina J. and Asare, E.O. 1994. Effect of Cocoa Pod Ash on Maize Growth. Journal of Agric. Sc. Cambridge 132:31-33

4 Ayeni, L.S.2008a. Integration of Cocoa Pod Ash, Poultry Manure and NPK 20:10:10 for Soil Fertility Management. Continental Journal of Agronomy, Akure, Nigeria. 2: 25-30.

7 A.O.A. C. 1990. Official Method of Analysis. Association of Official Analytical Chemist Washington, D.C.

8 Tel. D.A. and Hagarty, M. 1984. Soil and Plant Analysis. IITA. Ibadan/ University of Guelph, Ontario, Canada 277Pp.

9 Odedina S.A., Odedina J.N., Ayeni S., Arowojolu S.A., Adeyeye S.D. and Ojeniyi S.O. 2003. Effect of Types Of Ash On Soil Fertility Nutrient Availability and Yield of Tomato And Pepper. Nigeria Journal of Soil Science.13: 66-67.

10 Ayeni L.S, Adetunji,M.T and Ojeniyi, S.O 2008b. Comparative Nutrient Release from Cocoa Pod Ash, Poultry Manure, NPK 20:10:10 and their Combinations - Incubation Study. Nigerian Soil Science, 18: 23 - 26

11 Ayeni, L. S. 2008b. integrated application of cocoa pod ash and NPK fertilizer on soil chemical properties and yield off tomato. American – Eurasian Journal of sustainable Agriculture, 2(3). 333 - 3337

12 Obi, O. and Ekpegirin, J. 2001. Effect of Wastes and Soil Ph on Growth and Grain Yield of Crops. African Soils. 23 -27

13 Olaniyan A. and Ayodele O.J. 1993. Effect of P on fruit seed of tomato . Report NIHORT, Ibadan, Nigeria. Pp 36 – 39.

14 Hooper, L.P. 1970. The Basis of Fertilizer Recordation Process. Proceeding of Fertilizer Society. No118. Fertilizer for Maximum Yield Pp250.

15 Adams. P., Davies, J.M. and Winsor, G.W. 1978. Effects of Nitrogen, Phosphorus and Magnesium on the quality and chemical composition of tomatoes grown in peat. Journal of Horticultural Science, 53: 115 – 122.

16 Ayeni L.S, Adetunji, M. T. and Ojeniyi, S.O 2009. Integrated Application of NPK fertilizer, Cocoa Pod Ash and Poultry Manure: Effect of Maize Performance, Plant and Soil Nutrient Content. International Journal of Pure and Applied Science, 2 (2) :34 – 40.

17 Carter, M.R. 1993. Soil Sampling and Method of Analysis. Canadian Society of Soil Science, Lewis Publishers. Pp823.

18 Ojeniyi S.O., Oso O.P and Arotolu A.A. 2002. Response of Vegetables to Wood Ash Fertilizer. Proceeding of 35th Annual Conference of Agricultural Society of Nigeria. PP33-39

19Oladokun, M.O.1986. Percentage Composition of Cocoa Husk, CRIN Annual Report. Ibadan, Nigeria.

submission date 11/12/2009

http://www.sciencepub.net Marslandpress@gmail.com