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Identifying soil properties influencing cassava yield in Akpabuyo Local Government Area of Southern Cross River State – Nigeria

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Abstract

The study is aimed at identifying the most important soil properties influencing cassava yield in Akpabuyo Local Government. In order to gain a proper understanding of the relations between soil variables and the cassava parameters, and also to identify those soil properties contributing significantly to the prediction of cassava yield and its vegetative parameter in the study area, cassava yield parameters (tuber, leaves and stem) were examined and related to 21 soil parameters to statistically examine how soil properties related to yield of cassava. Consequently, bivariate and multiple-regression models were used to carry out the statistical relationship between the aforementioned variables. The results of the models form which discussions on soil parameters contributed to cassava yield were pursued. First, over-parametised model test was conducted, the essence of which is to capture the main dynamic process in the model. From this model, a parsimonious model was achieved via a reduction (selection) process, guided mostly by statistical consideration. Thus, the parsimonious reduction (selection) process made use of the step-wise regression procedure, subjecting each stage of the reduction process to several diagnostic tests before eventually arriving at an interpretable model. The results of the regression analysis show that 14 different soil properties contributed significantly to the prediction of cassava parameters in the study area. To achieve this selection/reduction process, an index of soil variables influencing the yield of cassava was computed. The index is simply the mean percentage contribution of each of the 14 significant variables to the prediction of the tree cassava parameters in the area. In order words, the percentage values representing the levels of explanation of each soil parameter on each of three multiple-regression results are summed up and the total is divided by 3. The mean value obtained is used as an index of each soil property contributing to the prediction of a cassava parameter.

Keywords: Soil properties, Cassava yield, Akpabuyo, Southern Cross River State and Nigeria.

INTRODUCTION

The traditional extensive system of shifting cultivation is gradually breaking down and is being replaced by continuous farming, consequent upon rapid population increase and the attendant problems of food shortage and malnutrition (Aweto, 1981). However, surveys of agricultural practices in tropical and subtropical regions have indicated that multiple cropping is the dominant cropping system in Nigeria. It is therefore noteworthy that during cropping there is lowering of soil fertility and this can be highly observed in continuous cropping because the soil is exposed for long and unprotected from drainage, climatic influences. Growing crops certainly require nutrients but if care is not taken, the soil fertility may be exhausted within a very short period. Obviously, the reduced yields in variable lands in the tropics, which become apparent, even after a year or two of cultivation is caused by a constraints on intensive food crop production such as cassava (Eludoyin, 2008).

Cassava (*Manihot esculenta*) is a major food crop grown in the Southern part of Nigeria. Many studies on agronomy of food crops had been carried out and these include FAO (1999), Aweto et al. (1992), and Nye and Green land (1960). Nevertheless, the need for the development of crop yield prediction model that will specify more clearly the soil properties influencing crop yield has been recognized. For example, the first few attempts at analyzing crop yield in terms of soil properties were made as far back as the beginning of the 20th century by (Odell and Smith, 1941; Odell, 1958; Cooke, 1979). According to (Gbadegesin, 1987), this problem has been tackled in the past by agronomists who related crop yield to individual soil types. The assumption, then, was that the list of the soil types of a region was an adequate statement of soil variation, and that this would express also regional variation in crop yield, crop suitability and treatment requirements.

Studies have demonstrated that variability in yield of crops occurs mainly in relation to specific soil properties. However, the degree of explanation afforded by many of these studies is low, largely because they failed to take into account the complex interactions between the numerous soil variables used in explaining variation in the crop yields (Briggs, 1981). However, more of these studies have actually demonstrated the fact that crop yield could be reliably predicted or estimated using some of these vegetative components except that of Gbadegesin (1987, 1990), which identified soil properties influencing maize production in the savanna belt of South - Western Nigeria, and on suitability assessment of the forest and savanna ecological zones of South - western Nigeria for maize production respectively and that of Odjugo (2007) on gas flaring on the micro climate of yam and cassava production in Ekrohorike and environs, Delta State, Nigeria.

Nevertheless, the importance of crop yield prediction from plant growth parameters cannot be over emphasized because it ensures greater objectivity in the forecasting of crop yield, especially in advance of harvest. In many parts of the world, crop yield forecasts are generally based on farmers' records and these, according to Houseman and Huddleston (1966), Gbadegesin (1987) and Odjugo (2007), are to some degree subject to vicissitude in human judgement. This problem according to Gbadegesin (1987) is even more pronounced in developing countries were farmers' records were they are kept at all, are very unrealizable, The studies above by Gbadegesin (1987; 1990) and Odjugo (2007) however, had a regional and ecological bias as none examined critically variations of soil properties influencing crop yield along the coastal area of Cross River State. It is against these limitations that this study attempts to identify the soil properties influencing Cassava yield in Akpabuyo Local Government Area of Southern Cross River State.

The study area

The study made use of nine cassava farms one hectare in size in the coasted area of Southern Cross River state, Nigeria. The farms were cultivated by the researcher managed uniformly in terms of input by the researchers. Akpabuyo lies between latitude 4° 45' and 5°10'N and longitude 8° 25' E and 8° 40' E of the Greenwich Meridian.

The soils of the sampled farms are all Entisols developed from the deposition of marine organisms and fluvio - deltaic sands of the Awi formation Adeleye and Fayose (1978) in the early cretaceous time (probably apticen).

Soils of Akpabuyo are strongly weathered with coarse to fine sand textures in both the surface and subsurface soils. They are characterized by low contents of organic carbon, total nitrogen, exchangeable bases and high contents of available phosphorus (Buktrade, 1989). Being soils in the humid climate environment, they are highly leached and therefore acidic in reaction (Ogban et al., 2001; Bulktrade, 1989). The soils support most arable (cassava, yam, cocoyam, vegetable among others) crops alongside tree crops such as oil palm, rubber and kolanut. Cropping in the area is intensive, particularly cassava under subsistence cropping system.

The area experienced mean annual rainfall of 4021mm, raining throughout the year with peaks from May to August (1880mm) while the lowest values (240mm) occur from December to February (Ukpong, I995). Moreso, the mean number of rainy days is about 200 (Bulktrade, 1989). In sum the rainfall pattern has two peaks in June and Septembers.

Temperature in the study area is generally high with a diurnal range of 21℃ - 29℃. Relative humidity is also high with most months of the year recording a monthly mean value of 80% except in December and January when values of less than 60% could be recorded.

MATERIALS AND METHODS

The study covered 9 cassava farms each one hectare (Iha) with matured cassava plants, were chosen randomly. At each sampling unit, an area of $10m^2$ was marked out by measuring dimensions of 10m X 10m with a measuring tape. The number of cassava stands within the $10m^2$ area was counted and recorded. All the cassava stands within the marked out area from the ten sampled quadrants (Plots) in each farm were harvested and the fresh tubers bulked together in a sack and then weighed within a manual weighing balance and mean weight in kilogram determined. The leaves were carefully removed from the stems, put in a sack and the fresh leaves weight determined with the aid of a weighing balance. The cassava stems without leaves were tied together with a rope and the fresh stem weight determined with a weighing balance. The weight of each variable measured (fresh tuber weight, leaf weight and stem weight) was calculated from the ten sampling units. The yield of each variable measured was then extrapolated from the average of the sampling units to yield per hectare.

This was repeated for 10 locations (dimension of 10m X 10m) within a hectare for each of the 9 (nine) cassava farms. Thereafter, the mean yield for each cassava farm was evaluated. This was later converted to tones/hectare for each of the farms as given by Daura (1995) as: The same procedure was applied for vegetative parameters identified as contributing significantly to the prediction of cassava yield in the area.

Field studies

Nine representative soil profiles were dug and described. After, horizon delineation, the profiles were described according to the provision of the Soil Survey Staff (2006). Profiles were dug to the depth of 150cm or 200cm except when a water table is struck or an impenetrable layer is encountered. Soil samples taken from the different horizons were stored in polyethylene bags and transported to the laboratory for processing and analysis.

Laboratory analysis

The soil samples were air-dried grinded and sieved through a 2mm sieve. Particle size was determined by the hydrometer method (Juo, 1979). Soils reaction (pH) was determined in 1:2 soil/water ratio by use of glass electrode pH metre. Organic carbon was determined by the Walkley and Black (1934) method and the value obtained was multiplied by 1.73. While total nitrogen was by the Kjeldal digestion defined methods. Available phosphorus was determined by the Bray No. 1 method. Exchangeable cations were extracted within NH_4OAc (pH 7), Calcium (Ca) value and Magnesium (Mg) were determined by the EDTA titration method while potassium (K) and Sodium (Na) were determined with a flame photometer (Black *et al.,* 1973). Exchangeable acidity (H^+ and Al^{3++}) were determined by leaching the soils with 1M KCl and titrating aliquots with 0.01M NaOH. Soil CEC was determined by the summation method (Chapman, 1965). Bulk density by the core method (Blake, 1973); total porosity values computed from those of bulk density using the assumed particle density value of 2.65g/cm^3. All the soil properties were determined for both the surface and subsurface soils.

RESULTS AND DISCUSSION

The range, mean, standard deviation and coefficient of variation in the soil properties and cassava parameters are shown in Tables 1 and 2 respectively. To investigate the nature of the relationships between the variables of interest (soil properties and cassava parameters), a simple bivariate correlation analysis was carried out. The result for the top and subsoils are as shown in Table 3 and 4.

The negative and significant relationships between bulk density (0.62) and moisture content (0.81) in the soils of the study area indicate that increase cassava tuberisation leads to a corresponding decrease in bulk density and moisture contents in soils of the study area. However, the negative correlation of bulk density to tuber yield indicates that the more compacted the soil becomes, the lower the tuber yield of cassava. Similar result was obtained by Gbadegesin (1986) who worked on soils of savanna belt of South-Western Nigeria using maize parameters (leaves, leaf area, number of cobs and stem height). Moreso, the negative correlation of moisture content to cassava tuber also suggest that decrease in moisture content could enhance cassava tuber yield, as high moisture content would have adverse effect on tuberisation.

The positive and significant correlation between soil pH and the tuber yield suggests the increase of cassava tuber with decrease in soil pH. Implications of the relationships are that at low pH values, gave high tuber yield, occasioned by low mineralization. Albeit pH have been reported to influence nutrient availability and biochemical transformation in soils (Udo et al., 1993). Besides organic matter, exchangeable K, effective CEC (exception of base saturation, Ca:Mg, Mg:K and C:N ratios) positive and significantly correlate with tuber yield, as an increase in these parameters exert a proportional increase in tuber-yield while the reverse is the case for base saturation, Ca:Mg, Mg:K and C:N ratios whose results negatively though significantly correlated with the crop yield. A number of studies have reported similar result, see for instance studies by Gbadegesin (1986) and Odjugo (2007) similar results relating cassava tuber in savanna belt of south-western Nigeria and some oil producing communities in Delta State and its environs

It is important to note that the positive and significant correlation between soil pH, total nitrogen, carbon-nitrogen ratio, effective CEC, exchangeable acidity to cassava leaves-yield imply increase of these parameters with attendant increase in the leaves yield in the area under study. These findings also agreed with the results obtained by Gbadegesin (1986) on vegetative parameters of maize grains in the savanna region of south-western Nigeria. Others, base saturation, Ca:Mg ratio, Mg"K and C:N ratios negatively though significantly correlated with the aforementioned variables which contri-

Table 1. Summary results showing variation in physico-chemical characteristics of soils sampled along transects in Akpabuyo Local Government Area, Cross River State.

Parameter	Sample type	Akpabuyo Soils				Maximum Permissible limit
		Range	Mean	SD	CV (%)	
A) Physical Parameters:						
(i) Sand (g/kg)	S	785.4-915.6	885.6	37.9	43.0	NL
	SS	718.4-898.4	819.8	49.8	60.4	NL
(ii) Silt (g/kg)	S	18.8-88.7	46.3	19.6	423.3	NL
	SS	38.8-117.8	63.5	19.9	313.4	NL
(iii) Clay (g/kg)	S	44.4-195.8	75.4	45.6	604.8	NL
	SS	63.8-183.8	116.8	34.1	292.0	NL
(iv) Textural Class	S	s, ls, sl	-	-	-	-
	SS	sl, ls, s	-	-	-	-
(v) Pore Space (%)	S	10.0-13.0	118.0	12.0	1021.0	NL
	SS	10.0-17.0	142.0	19.0	1338.0	NL
(vi) Moisture Contents (g/kg)	S	509.4-622.6	555.1	45.5	82.0	NL
	SS	358.5-622.6	465.2	71.3	153.2	NL
B) Chemical Parameters:						
(i) pH (H_2O)	S	5.0-5.8	5.3	0.24	4.52	5.1-6.5
	SS	5.0-5.8	5.2	0.18	3.46	
(ii) EC (dSm^{-1})	S	0.030-0.088	0.054	0.021	38.98	2-4dSm^{-1+}
	SS	0.011-0.078	0.023	0.014	59.96	
(iii) Org. M (g/kg)	S	94.9-200.7	129.5	18.8	237.0	2.0^{++}
	SS	88.1-182.3	96.1	15.6	205.2	
(iv) Total N (g/kg)	S	0.05-1.1	0.8	0.2	237.5	0.2%$^{++}$
	SS	0.1-0.9	0.5	0.2	363.7	
(v) Avail P ($mgkg^{-1}$)	S	10-63	28	18.08	64.57	2.0$mgkg^{-1+++}$
	SS	4-80	41	18	44	
Exchangeable Bases ($cmol/kg^{-1}$):						
(vi) Ca	S	1.40-3.40	2.44	0.73	30.05	10-20$cmol/kg^{-1+++}$
	SS	1.00-4.00	2.33	0.80	34.37	
(vii) Mg	S	0.50-2.00	1.15	0.43	37.72	3-8$cmol/kg^{-1+++}$
	SS	0.40-1.80	1.08	0.32	29.86	
(viii) K	S	0.06-0.27	0.14	0.07	53.03	0.6-1.2$cmol/kg^{-1+++}$
	SS	0.04-0.23	0.10	0.06	55.74	
(ix) Na	S	0.04-0.07	0.06	0.11	18.63	0.7-1.2$cmol/kg^{-1+++}$
	SS	0.03-0.08	0.05	0.02	31.29	
Exchange Acidity ($cmol/kg^{-1}$):						
(x) Al^{3+}	S	1.05-2.81	1.69	0.53	31.41	4.1$cmol/kg^{-1+++}$
	SS	0.60-2.85	1.65	0.59	36.03	
(xi) H	S	0.30-3.20	1.14	0.88	77.19	2.1-4$cmol/kg^{-1+++}$
	SS	0.45-1.90	1.14	0.42	36.84	
(xii) ECEC ($cmol/kg^{-1}$):	S	4.54-9.03	6.41	1.52	23.68	-
	SS	3.98-9.11	6.33	1.26	19.85	
(xiii) Base Saturation (%)	S	39-75	59	12.61	21.37	10$cmol/kg^{-1+++}$
	SS	36-74	55	10.32	18.76	
						60-80%$^{+++}$
C) Fertility Indices:						
(i) Ca:Mg Ratio	S	1.50-2.86	2.25	0.48	21.16	3:1-5:1**
	SS	1.25-2.86	2.15	0.37	17.14	
(ii) Mg:K Ratio	S	2.61-22.22	10.20	6.77	66.36	1:2**
	SS	1.74-28.00	13.94	6.87	49.28	

Table 1. Continue

(iii) C:N Ratio	S	17-25	22	2.78	12.64	25*
	SS	12-25	18	3.92	21.75	

Notes:
S = Surface soils; SS = Subsurface soils; S_1 = Sand; Ls = Loamy sand; sl = Sandy loam + = Miller and Donahue (1995); ++ = FPDD (1990); +++ = Holland *et al.* (1989)
ECEC = Effective cation exchange capacity; * = Paul and Clark (1989); ** = Landon (1991);
EC = Electrical conductivity; NL = No limit

Table 2. Variability of cassava parameters in the study area.

Cassava Parameters	Range	X	S.D	CV %
Tuber-yield	200 – 2706	9.60	6.32	65.83
Leaves-yield	0.80 – 318	1.6	0.56	34.36
Stem-yield	100 – 1502	6.01	4.06	67.55

Table 3. Results of the correlation analysis relating cassava yield and physico-chemical properties of surface soils along transect one (Akpabuyo).

Soil Properties	Cassava parameters		
	Tuber	**Leaves**	**Stems**
Sand	0.10	0.04	0.35
Silt	0.51**	0.15	0.62
Clay	-0.22	-0.05	-0.31
Bulk Density	-0.52*	-0.47	-0.72**
Pore space	0.64*	0.64 *	0.85*
Moisture content	-0.81	-0.57**	-0.63*
pH	-0.50*	0.05	0.08
EC	-0.45	-0.66*	-0.47
Organic Matter	0.72*	0.66	0.01
Total Nitrogen	0.39	0.21	-0.07
Avial. P	-0.11	0.06	0.12
Ca	-0.18	0.66*	-0.21
Mg	0.20	0.21	0.01
K	0.56**	-0.04	0.10
Na	0.04	-0.28	-0.11
Exch. Acidity	0.63*	0.16	0.10
ECEC	-0.66*	0.30	0.06
BS	-0.51*	-0.23	-0.62*
C:Mg	-0.71*	-0.17	-0.16
Mg:K	0.61*	0.29	0.07
C:N	0.53*	0.05	-0.58

BD = Bulk density; PS = Pore space; MC = Moisture content; OM = Organic matter; TN= Total Nitrogen; AP = Available phosphorus; ECEC= Effective cation exchange capacity; BS = Base saturation; C:N = Carbon-nitrogen ratio; Ca:Mg = Calcium-Magnesium ratio;' Mg:K = Magnesium-Potassium ratio; significant at 5% level **=significant at 10% level.

Table 4. Results of the correlation analysis relating cassava yield and physico-chemical properties of surface soils along transect one (Akpabuyo).

Soil Properties	Cassava parameters		
	Tuber	Leaves	Stems
Sand	0.33	0.37	0.37
Silt	-0.05	-0.17	-0.62*
Clay	-0.11	-0.14	-0.08
Bulk Density	-0.02	0.08	-0.72**
Pore space	-0.07	-0.23	0.85**
Moisture content	-0.81*	-0.41	-0.56**
pH	-0.18	-0.03	0.12
EC	-0.16	-0.06	0.24
Organic Matter	0.72**	-0.23	-0.44
Total Nitrogen	-0.37	-0.28	-0.16
Avial. P	0.15	0.10	0.03
Ca	0.13	-0.66*	0.17
Mg	0.09	0.07	-0.86***
K	0.56**	0.40	0.41
Na	0.46	0.25	0.34
Exch. Acidity	-0.17	0.63*	0.26
ECEC	0.35	-0.61*	0.38
BS	0.02	0.11	0.03
C:Mg	-0.59**	-0.64*	-0.64*
Mg:K	0.14	-0.08	-0.08
C:N	0.29	0.18	0.34

BD = Bulk density; PS = Pore space; MC = Moisture content; OM = Organic matter; TN= Total Nitrogen; AP = Available phosphorus; ECEC= Effective cation exchange capacity; BS = Base saturation; C:N = Carbon-nitrogen ratio; Ca:Mg = Calcium-Magnesium ratio;' Mg:K = Magnesium-Potassium ratio; significant at 5% level **=significant at 10% level; *** = significant at 1% level.

buted to leaves yield of cassava.

The significant and negative correlation between silt, bulk density and moisture content in the study area indicates that increase in stem yield leads to a decrease in the parameters examined. Pore space positively and highly significantly correlated with the stem yield, as increase in pore space increases with an increasing stem yield. However, studies by Nnamani (2002), Odjugo (2003) further confirmed these results.

The multiple-regression model

According to Gbadegesin (1986), one of the shortcomings of the model discussed above in identifying the important soil parameters influencing the yield of cassava is that only isolated relationships between the soil properties and the crop parameters are depicted. This unfortunately does not make it easy to isolate the important soil parameters influencing the crop's yield. Thus, in order to gain a proper understanding of the relationships between soil variables and the cassava parameters, and also to identify those soil properties contributing significantly to the prediction of cassava yield and its vegetative parameters in the study area, cassava yield parameters (tuber, leaves and stem) were examined and related to about 21 soil parameters to statistically examine how soil properties relate to yield of cassava under investigation (see tables 3 – 4). Conse-

Table 5. Multiple regression results with cassava tuber yield as independent variable.

Independent variables	Regression coefficient	Standard error of coefficient	Level of explanation (%)	Significance level
Organic matter	20.62	49.71	70	0.05
Moisture content	-3.13	1.58	0.7	0.01
pH	145.02	246.52	30	0.05
Bulk density	-62.68	56.19	5.0	0.05
ECEC	16.49	13.45	3.5	0.05
BS	-0.56	0.67	1.0	0.05
Ca:M	-31.86	1.52	1.8	0.05
C:N	-2.93	3.30	0.7	0.05
Intercept value	92.61			
Multiple R^2	0.54			

Table 6. Multiple regression results with cassava leaves-yield as independent variable.

Independent variables	Regression coefficient	Standard error of coefficient	Level of explanation (%)	Significance level
Organic matter	55.56	21.17	60	0.01
pH	4.01	43.62	6.6	0.05
Total nitrogen	33.26	59.02	14.2	0.05
Exch. Acidity	0.59	0.53	2.4	0.05
Silt	-1.679	1.53	6.7	0.05
Pore space	3.84	1.78	6.0	0.05
Mg:K	-1.90	2.26	1.0	0.05
C:N	0.096	0.136	1.2	0.05
Intercept value	-16.58			
Multiple R^2	0.50			

quently, bivariate and multiple-regression models were used to carry out the statistical relationship between the aforementioned variables in the study area.

The results of the models from which discussions on soil parameters contributed to cassava yield were pursued. First, over-parametized model test was conducted, the essence of which is to capture the main dynamic process in the model. From this model, a parsimonious model was achieved via a reduction (selection) process, guided mostly by statistical consideration as presented in Tables 5 – 7. The object of parsimony is intuitively appealing as it essentially seeks to maximize the goodness of fit of the model with a minimum number of explanatory variables. Thus, the parsimonious reduction (selection) process made use of the step-wise regression procedure, subjecting each stage of the reduction process to several diagnostic tests before eventually arriving at an interpretable model.

The results of the regression analyses show that 14 different soil properties contributed significantly to the prediction of cassava parameters in the study area. However, given the fact that the product of this type of exercise could be further used to develop a cassava-soil property model and in rating the soils of the area for cassava production, the use of as many as 14 soil variables would make the development of such model liable to a large margin of error and make the rating cumbersome. Therefore, there is need to adopt a method of selecting fewer of the soil properties influencing cassava yield in the study area.

Furthermore, to achieve this selection/reduction process, an index of soil variables influencing the yield of cassava was computed. The index is simply the mean percentage contribution of each of the 14 significant variables to the prediction of the three cassava parameters in the area. In other words, the percentage values representing the levels of explanation of each soil parameter on each of three multiple-regression results are summed up and the total is divided by 3. The mean value obtained is used as an index of each soil property contributing to cassava yield prediction. Where a soil property does not make any significant contribution to the prediction of a cassava parameter, it is scored zero. Table 8 shows the 14 soil properties as well as their average contributions.

Table 8 revealed that soil organic matter contributes significantly to the prediction of all the parameters used in the study. It is not surprising then that it has the highest cassava prediction index of 62.7%, which is more than five times the index of the next most important parameter, pH (12.2%) and twelve times plus or more the index of the third most important parameter, pore space (5.0%). None of the 11 soil properties has an index greater than 4.3%; infact, nine have indices less than 2.3%. The results of the

Table 7. Multiple regression results with cassava stem-yield as independent variable.

Independent variables	Regression coefficient	Standard error of coefficient	Level of explanation (%)	Significance
Organic matter	0.22	0.10	58	0.05
Moisture content	-0.75	0.72	2.0	0.01
Bulk density	-40.93	25.62	7.7	0.01
Exch. K	-0.59	0.34	3.7	0.05
Total nitrogen	-50	0.24	0.8	0.01
Exch. Acidity	-1.85	0.97	1.0	0.01
Pore space	1.91	0.95	5.0	0.01
Intercept value	-194.13			
Multiple R^2	0.87			

Table 8. Index of soil properties contribution (%) to the yield of cassava.

Soil variables	% Contribution per cassava parameter			Cassava prediction index %
	CTY	LOC	CST	
Organic matter	70	60	58	62.7
Moisture content	0.5	-	2.0	0.9
pH	30	6.6	-	12.2
Bulk density	5.0	-	7.7	4.2
Exchangeable K	-	-	3.7	1.2
ECEC	3.5	-	-	1.1
BS	1.0	-	-	0.3
Total nitrogen	-	14.2	0.8	5.0
Exch. Acidity	-	2.4	1.0	1.1
Silt	-	6.7	-	2.2
Pore space	-	6.0	5.0	3.6
Ca:M	5.5	-	-	1.8
Mg:K	-	1.0	-	0.3
C:N	0.8	1.2	-	0.7

Note: - indicates zero sum
CTY = cassava tuber yield; LOC = cassava leaves yield and CST = cassava stem yield

exercise thus revealed the importance of soil organic matter and pore space in cassava production in the southern ecological zone of Southern Cross River State, Nigeria.

Furthermore, that organic matter came out as the strongest soil property influencing cassava production in this ecological zone was perhaps to be expected given the Kaolinitic nature of the clay content of the soils, it is the store-house of most of the mineral elements determining the nutrient status of the soils. It also has ameliorative effects on soil physical properties, especially structure and consistency. Previous works on tropical soils by (Ann, 1977; Aweto, 1992; Areola *et al.,* 1982 Gbadegesin, 1986; Abiogba, 2011; Gbadegesin and Abua, 2011) have also stressed the importance of this soil property in improving the fertility status of the soils. Thus, in order to enhance cassava productivity in this ecological zone, an intervention is needed for appropriate soil management strategy to boost cassava production in the study area.

CONCLUSION

The main conclusion arising from this study can be summarized thus:

1. A method of identifying the crucial soil properties influencing cassava yield has been predicted. The index derived is very simple and easy to compute as it is based on the average contribution of each soil property to the crop prediction.
2. The method has the potential of reducing the numerous interacting soil variables to a few significant ones which explain most of the variation in crop yield. This is so as just very few soil properties could be used to develop a more reliable crop-yield-soil properties model.

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