

EVALUATION OF DIFFERENT MANURE SOURCES IN SOIL FERTILITY IMPROVEMENT AND YIELD OF FLUTED PUMPKIN IN AN ULTISOLS OF SOUTHEASTERN NIGERIA

Abstract

Achieving food security for a rapidly growing population in Nigeria will require intensification of food production on existing cropland through improving soil fertility and agronomic practices. Use of chemical fertilizers has been blamed relentlessly for the deterioration of soil and water resources and the environment as a whole. In an attempt to improve the fertility of the soil and crop yield with economically viable, environmental friendly and sound, and socially accepted farm practice, a study was conducted to evaluate sole organo-minerals, inorganic fertilizer and their mixtures on the soil chemical improvement and leaf yield of fluted pumpkin in an ultisol of Southeastern Nigeria. Seven treatments including the control (10 tones/ha of poultry dropping, 10 tones/ha of rice husk, 0.375 tones/ha of NPK fertilizer, 5 tones/ha of poultry dropping +5 tons/ha of rice husk, 5tones/ha of rice husk +0.188 ton/ha of NPK fertilizer, control) were built into a randomized complete block design (RCBD) replicated three times. The results showed that the amendments significantly ($p < 0.05$) improved the soil pH, organic carbon, exchangeable calcium and magnesium within the period of study. The results indicated that the CEC, available phosphorous and base saturation were positively ($p < 0.05$) improved by the soil amendments, while the exchangeable acidity was highly reduced significantly by the application of the amendments. The results revealed also the better performance organic sources over the inorganic in improving most soil chemical properties and the crop leaf yield.

Keywords: organo-mineral, soil amendments, fluted pumpkin, soil properties, leaf yield

Introduction

Telfaria occidentalis is a tropical vine grown in West Africa as a leaf vegetable and for its edible seeds. The young shoots and leaves of the female plant are the main ingredient of a Nigerian soup [1]. The leaves and edible shoots of fluted pumpkin continue to be the primary source of protein, minerals, and vitamins in African countries [2].

In the recent time, fluted pumpkin had gained medicinal recognition. It has been discovered to be blood purifiers [3] and could therefore be useful in the maintenance of good health most especially among poor resource ruralities in developing countries. In Nigeria, the herbal preparation of the plant has been employed in the treatment of anaemia, chronic fatigue and diabetes [4].

However, its supply can fall short of demand, even when grown with irrigation, partly due to low fertility of arable soils.

Low soil fertility is a constraint to crop production in the tropics [5 – 7]. According to Sanchez *et al.* [8], declining soil fertility in smallholder farms is a cause of declining food production. There is a need to increase productivity of crops through improving the soil in which the crop is grown. Unavailability of commercial fertilizers poses a barrier to crop production among smallholder farmers [9 – 10]. This also applies to those growing fluted pumpkin in tropical Africa [11], making identification of alternatives to synthetic fertilizers is important. Organic materials have advantages of being environmental friendly as reported by Yusoff, [12]. Residues from bio-energy processes may constitute a source of fertilizer and nutrient cycling in agriculture. In southeastern Nigeria, rice mills generate large quantities of fresh but partially burned rice-mill wastes daily, and these are either dumped to the detriment of the environment or burned into ashes [6].

Use of turkey litter for growing fluted pumpkin in the low-fertility soils in this region has also been recommended [13].

A treatment is missing

gives expectation !!! In science, this kind of sentence should not be used

5.7

3. Stem girth at 2, 3, 4, 5, and 6 weeks after planting. It was measured from 2 weeks - 6 weeks after planting by using the rope and meter rule. The rope was tied around the vine girth, and then the rope length twined round the stem girth and was placed at a meter rule.
4. Weight of fresh leaves at 6, 8, 10, 12, 14, and 16 weeks after planting. This was determined by weighing the harvested leaves at two weeks intervals and carried out from the 6th week - 16th week after planting. The first harvest was cut after 20 cm distance from the base.

2.4 Collection of Soil Samples and Laboratory Analysis

A composite soil sample from different representative field location was collected from the experimental site, with soil auger at a depth of 0 – 20 cm for initial soil characteristics. At the harvest, another soil samples were collected from each of the plots to determine the changes that occurred due to treatments application. The soil samples were air-dried and sieved with 2 mm sieve. Soil fractions less than 2 mm from individual samples were then analyzed using the following methods; Particle size distribution of less than 2 mm fine earth fractions was measured by the hydrometer method as described by Gee and Bauder [23]. Soil pH was measured in a 1:2.5 soil:0.1 M KCl suspensions [24]. The soil OC was determined by the Walkley and Black method described by Nelson and Sommers [25]. Total nitrogen was determined by semi-micro kjeldahl digestion method using sulphuric acid and CuSO_4 and Na_2SO_4 catalyst mixture [26]. CEC was determined by the method described by Thomas [27], while exchangeable acidity (EA) was measured using the method of McLean [24]. The available phosphorous was determined by the Bray 11 method [28]. Base saturation was determined by calculation as the percentage ration of total exchangeable bases to effective cation exchange capacity, using the procedure outlined in Tropical Soil Biology and Fertility Manual [29].

2.5 Data Analysis:

Data analysis was performed using GENSTAT 3 7.2 Edition, while the correlation - regression and graph were performed using SPSS stat. 17.0 and MATLAB R2007b. Treatment means were separated and compared using Least Significant Difference (LSD) and all inferences were made at 5% Level of probability

3.0 RESULTS AND DISCUSSION

3.1 Soil Initial Properties and Organic Amendments nutrient composition

3.1.1 Soil properties

The soil physical and chemical properties are reported in Table 1. Generally, the soils are sandy loam with 9% (90 g kg^{-1}) clay, 19% (190 g kg^{-1}) silt and 72% (720 g kg^{-1}) sand contents.

Soil inventory of the high rainfall region of southeastern Nigeria show that the major soil unit consists of deep, coarse textured, well-drained acidic sandy loam, largely derived from coastal plain sand sediments, sandstones and shales. The dominant soil has been classified as kaolinitic utisols belonging to the soil taxonomy of Typic Paleudult [30].

Soil organic carbon concentration was 0.30% whereas the soil total nitrogen was 0.028% and the pH measured in water was 6.0 (Table 1). The analysis indicated that the soil was low in CEC.

3.1.2 Organic Amendments nutrient composition

Soil amendments comprised of rice-mill wastes or rice husk dust (RHD) collected from a rice-mill industry near the study site. Others included poultry litter droppings (PD) and 15N-15P-15K. Chemical analysis of organic materials indicated that PD had the highest N (2.10%) and Ca (14.40%), phosphorous (2.55%) values; RHD had the highest OC value of 33.75% and C:N ratio of 48.21 (Table 2).

you used | $\sim 200 \text{ g m}^{-2}$ in poultry litter
 $\sim 70 \text{ g m}^{-2}$ in rice husk
 $\sim 66 \text{ g m}^{-2}$ in 15N-15P-15K
 is this fair?

Table 1: Physical and chemical properties of the studied soil (0 – 20 cm) depth

Soil properties	Values
Clay (%)	9
Silt (%)	19
Total sand (%)	72
Textural class	Sandy loam
Organic carbon (%)	0.30
Total nitrogen (%)	0.028
pH (H ₂ O)	6.0
Exchangeable bases (cmolkg ⁻¹)	
Sodium (Na ⁺)	0.802
Potassium (K ⁺)	0.420
Calcium (Ca ²⁺)	4.0
Magnesium (Mg ²⁺)	0.4
Cation exchange capacity (CEC) cmolkg ⁻¹	9.60
Exchangeable acidity (EA) cmolkg ⁻¹	1.8
Available phosphorous (mg/kg)	15.86

Table 2: Nutrient compositions (%) in amendments.

Property	Amendments	
	Poultry litter droppings	Rice husk dust
Organic carbon	16.52	33.75
Nitrogen	2.10	0.70
Phosphorous	2.55	0.49
Calcium	14.40	0.36
Potassium	0.48	0.11
Magnesium	1.20	0.38
Sodium	0.34	0.22
C:N ratio	7.87	48.21

3.2 Effects of Organic Manure Sources on the Soil pH, Organic Carbon and Total Nitrogen

The results (Table 3) showed that the soil amendments significantly ($p < 0.05$) improved the soil pH, with the highest pH value obtained from plots treated with 5 tons of poultry dropping and 5 tons of rice husk. The increase in soil pH could be due to higher K, Mg and Ca contents in poultry dropping applied in T₂. This was followed by plots amended with rice husk and NPK fertilizer. The results showed a range value of 4.5 – 6.5. Generally, all the treated plots did improve the pH significantly ($p < 0.05$) higher relative to the control.

The results indicate that organically amended plots and plots amended with integrated nutrients improved the pH better than the NPK. This work was in line with the work of Huang and Lin, [18]; Zhang and Fang, [19] who stated that combined application of organic and inorganic fertilizers has agronomic benefits, including improved soil fertility and yield.

Table 3 indicated a statistical ($p < 0.05$) improvement on the soil organic carbon due to the amendment application. The result shows that the best improvement on the soil organic carbon was recorded in plots amended with rice husk. This was followed by PD + RH treated plots, while the least improvement was obtained from plots without any amendment. The soil organic carbon values varied from 0.29 – 0.72 %. The low OC in NPK treated plots may be explained by application of a single heavy dose of soluble fertilizers being inefficient in low-activity clay soils that require organic matter to impart appropriate physicochemical and biological properties [31]. In another Ultisol, elsewhere in southeastern Nigeria, Obi and Ofoduru [32] reported that mineral fertilizers (N–P–K, urea, and ammonium sulfate) reduced soil organic matter level and quality. The results obtained here indicate that the low organic matter status of the typically low-fertility Ultisols needs to be compensated with combined application of two organic materials.

no. It was not the organic amendment, but the content of Ca, Mg... in it. If you use lime it will be more effective than organic materials.

check

in husk or dry material? what if you use wet material?

and you decided use the same amounts of each one 10t/ha!!!

? higher organic C and lower N/P/K ratio

complementary use of organic and inorganic fertilizers has been reported to be a sound soil fertility management strategy for crop production [14].

Table 5: Effects of manure sources on the soil cation exchange capacity, exchangeable acidity, available phosphorous and base saturation (0 – 20 cm) soil depth

Soil Amendments	Soil Properties			
	CEC (cmol/kg)	Exch. EA (cmol/kg)	Avail. P (mg/kg)	BS (%)
NPK	12.4	2.87	37.1	47.6
PD	15.9	2.33	57.7	63.6
RH	11.6	2.00	19.1	58.1
PD+RH	12.1	1.80	30.5	77.1
RH+NPK	9.9	3.00	31.8	81.4
CT	7.6	3.60	13.1	52.9
LSD_(0.05)	2.779	0.853	11.49	10.45

NPK = nitrogen, phosphorous, potassium; PD = poultry droppings; RH = rice husk; CT = control; CEC = cation exchange capacity; Exch. EA = exchangeable acidity; Avail. P = available phosphorous; BS = base saturation

3.5 Effects of organo-mineral and inorganic fertilizer on vine length (cm) at various weeks after planting (WAP).

The results of the vine length (Table 6) showed that the soil amendments significantly ($p < 0.05$) improved the vine length of the *telfairia* in all the weeks studied, except on the 4th week after planting. The result (Table 6) showed at 2 weeks after planting, poultry dropping + rice husk produced the longest mean vine length of 19.17cm, followed by NPK fertilizer which had 16.75cm, while control had the shortest mean vine length of 12.83 cm. The result on the 3 WAP showed that poultry dropping at 10 t/ha gave the highest mean significant ($P < 0.05$) value of vine length. This was followed by poultry dropping + rice husk at 5 t/ha each. At 5 and 6 weeks after planting, poultry dropping produced the longest significant ($P < 0.05$) vine length, while the control produced the shortest vine length.

3.6 Effects of organo-mineral and inorganic fertilizer on number of leaves at various weeks after planting (WAP)

The results in Table 7 showed that there were significant difference among the treatments on the number of leaves at 2, 3, 4, 5, and 6 WAP. The result (Table 7) indicates that at 2 WAP, PD + RH treated plots did significantly increase the number of leaves (8.00). This was followed by plots treated with PD (7.75), while the controlled plots gave the least (3.83) number of leaves.

In 4, 5 and 6WAP, poultry dropping produced the highest significant ($P < 0.05$) mean number of leaves followed by plots amended with NPK in the 5th and 6th WAP, while the control had the smallest mean number of leaves.

Table 6: Effects of manure sources on the mean vine length per plant (cm)

Amendments	2WAP	3WAP	4WAP	5WAP	6WAP
NPK	16.75	22.92	46.8	74.8	92.1
PD	16.67	27.67	54.7	85.3	99.2

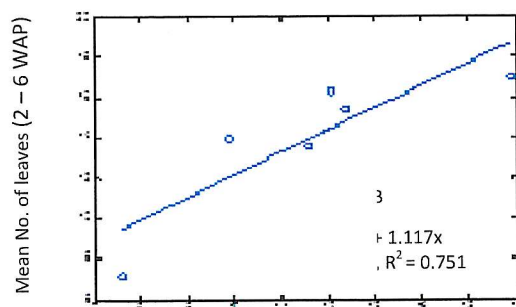
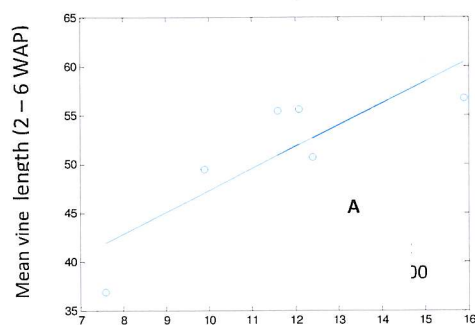


Figure1A: Relationship between CEC and Vine length 2 to 6WAP

Figure1B: Relationship between CEC and No. of leaves 2 to 6WAP

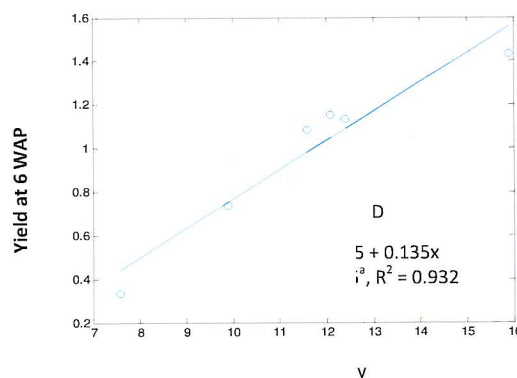
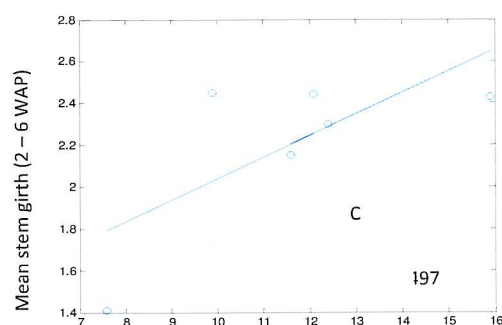


Figure1C: Relationship between CEC and stem girth 2 to 6WAP

Figure 1D: Relationship between CEC and mean yield at 6WAP

Figures 1E to 1H showed the relationship between cation exchange capacity (CEC) and fluted pumpkin leaf yield at harvest. It was obtained that between the 8 – 14 weeks after planting (WAP), CEC correlated positively with the leaf yield of fluted pumpkin. However, higher correlations were observed at week 12 and 10 ($r = 0.976^*$ and $r = 0.902^*$), respectively, compared to leaf yield correlation recorded at week 8 ($r = 0.881^*$).

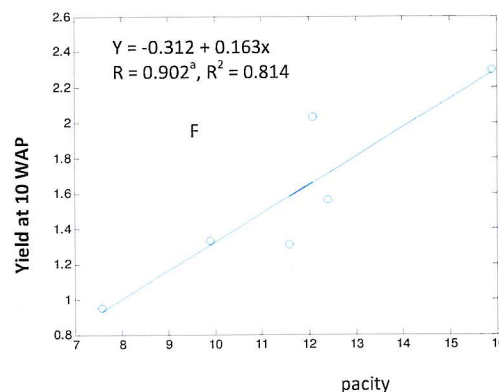
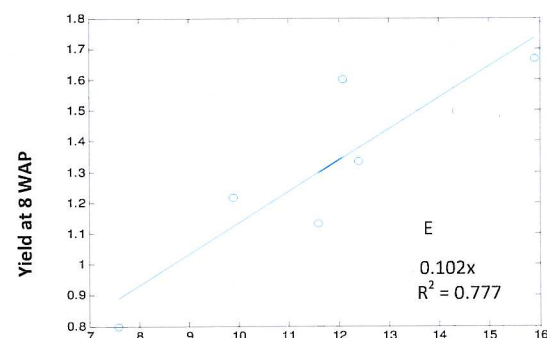


Figure1E: Relationship between CEC and mean yield at 8WAP

Figure1F: Relationship between CEC and mean yield at 10 WAP

For me it is debatable whether these relationships make sense. If the amendments affected equally CEC and vine length, it is clear to me that there is a positive linear relationship between these two variables. In my opinion these figures do not add anything to work.

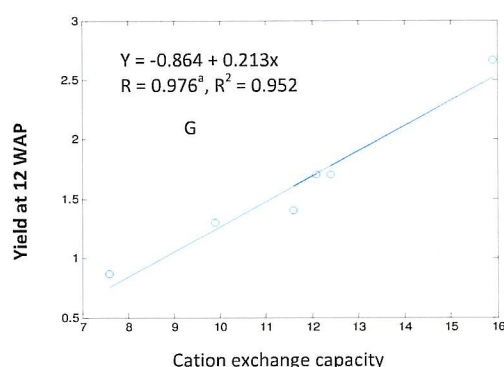


Figure 1G: Relationship between CEC and mean yield at 12 WAP

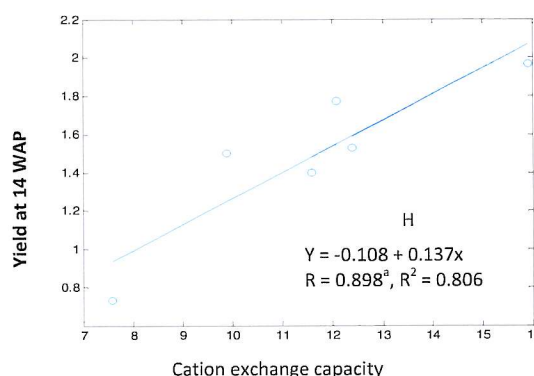


Figure 1H: Relationship between CEC and mean yield at 14 WAP

Figures 2A to 2C showed the relationship between pH and fluted pumpkin vine length, number of leaves and stem girth between 2 – 6 weeks after planting. The correction results showed that all the three parameters positively correlated with soil pH within the period. However, stem girth did correlate better among the three parameters. Figures 2D to 2H showed the relationship between the soil pH and fluted pumpkin leaf yield between 6 – 14 WAP. It was recorded that at 14 weeks after planting (WAP), soil pH correlated positively higher with the leaf yield of fluted pumpkin ($r = 0.864$) compared to other weeks of harvest. However, the least correlations effect were observed at week 12 ($r = 0.515^*$). Generally, there were stronger correlations between the plant parameters and cation exchange capacity compared to their relationship with soil pH within the period of study. This means that fluted pumpkin respond more to changes in cation exchange capacity of the soil than pH.

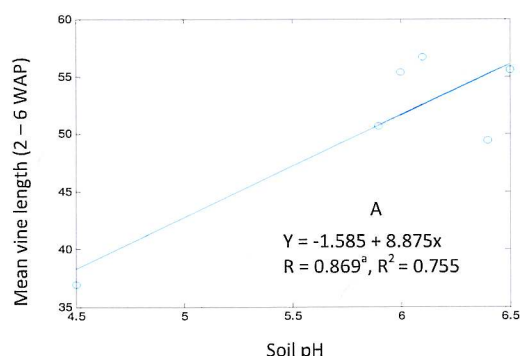


Figure 2A: Relationship between soil pH and vine length 2 – 6 WAP

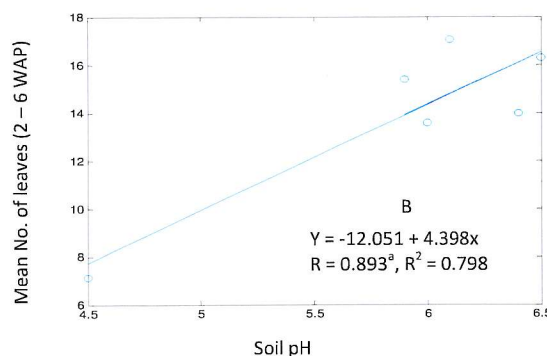
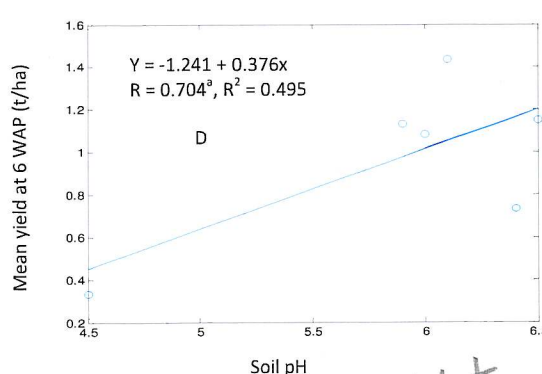
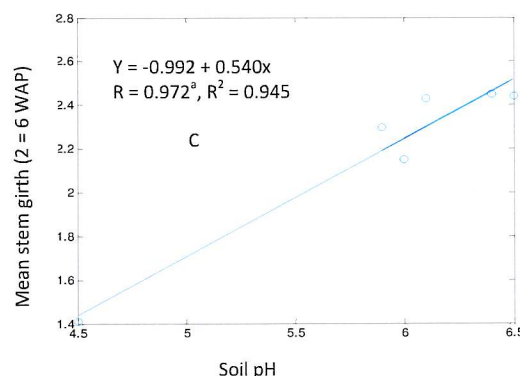


Figure 2B: Relationship between soil pH and No. of leaves 2 – 6 WAP



It treatment affect more CEC and pH
variables than pH, the differences of from 1 and 2
are expected.

384 Figure2C: Relationship between soil pH and stem girth 2 – 6 WA
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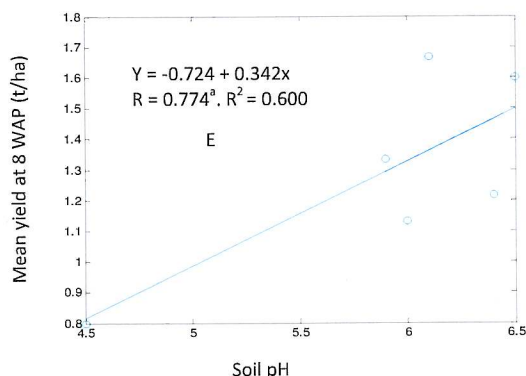
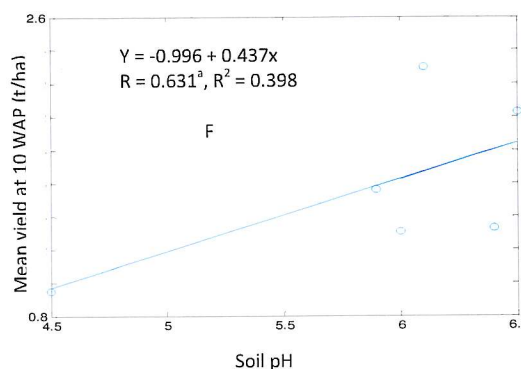


Figure2D: Relationship between soil pH and mean yield at 6 WAP



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387 Figure2E: Relationship between soil pH and mean yield at 8 WAP
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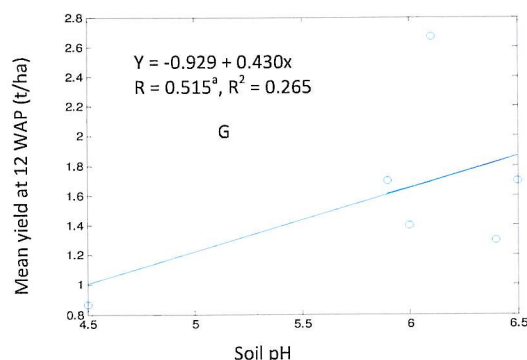
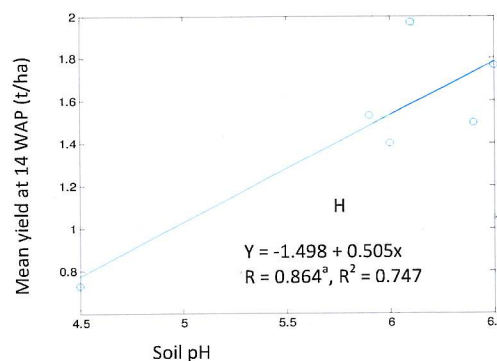


Figure2F: Relationship between soil pH and mean yield at 10 WAP



389

390 Figure2G: Relationship between soil pH and mean yield at 12 WAP
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Figure2H: Relationship between soil pH and mean yield at 14 WAP

392 4.0 CONCLUSION

393 This study was carried as to evaluate the effects of soil amendment (10 tons/ha of poultry dropping, 10
394 tons/ha of rice husk, 0.375 kg of NPK fertilizer, 5 tons/ha of poultry dropping + 5 tons/ha of rice husk, 5
395 tons/ha of rice husk + 188 kg/ha NPK fertilizer), on selected soil chemical properties, growth and leaf yield
396 of *Telfaira occidentalis* in an ultisol of Ishiagu.

397 The results obtained from the study showed that soil chemical properties were significantly improved by
398 the application of Organo-mineral and Inorganic fertilizer. It is therefore concluded that Organo-mineral
399 application could enhance vegetative growth and development of fluted pumpkin. It was noted that
400 integrated nutrient management as the combination of Organic and Inorganic manures or integration of
401 two organic sources as poultry dropping and rice husk dust can be better approaches in quick restoration
402 of degraded soils and vegetable crop yield in southeastern Nigeria.

403 Generally, there were stronger correlations between the plant parameters and cation exchange capacity
404 compared to their relationship with soil pH within the period of study. This means that fluted pumpkin
405 respond more to changes in cation exchange capacity of the soil than pH.

406 References

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Conclusion.

This is not a
Remove.