Open Science and Technology
Volume 5, Issue 1, 1-9.
E-ISSN :2776-1681
https://opscitech.com/journal
DOI: 10.33292/ost.vol5no1.2025.146

Effect of Soil Ameliorations on Cucumber (*Cucumis sativus* L) Yield and Soil Physico-chemical Properties in an Ultisol of Southeastern Nigeria

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Article Info

Article history:

Received: 25 February 2025
Revised: 28 March 2025
Accepted: 5 April 2025
Published: 8 April 2025

Keywords:

Cucumber,
Fertility,
Growth,
Soil amendment,
Yield.

Abstract

Methods and Aims: Field experiment was conducted at Ndikpa, Umuowa Ibu 1 via National Horticultural Research Institute (NIHORT), Okigwe Sub-Station Imo state, Nigeria in 2021 and 2022 to assess the effects of different soil amelioration on performances of cucumber and soil physico-chemical properties. The treatments were organic fertilizers (goat manure, cow dung, and wood ash) and recommended dose of inorganic fertilizer (250 kg/ha NPK), and control (no soil amendment). The experiment was laid out in a randomized complete block design and replicated thrice. Soil, growth, and yield data were collected and subjected to analysis of variance. Significant means were compared with the least significant difference at 5% probability level.
Result: Results showed that cow dung had the highest organic matter content after harvesting, 2.55 and 2.43 % in 2021 and 2022, while the least organic matter content of 0.71% and 0.65 % was recorded in the control. Wood ash had significantly higher K levels after harvesting, while cow dung had the highest Ca. Goat manure had significantly higher Mg and Na than the other soil amendments. Treatment of NPK had significant fruit yield of 21.12 and 22.54 t/ha in both cropping seasons, respectively. The fruit yield recorded in goat manure was 20.23 and 20.81 t/ha in both cropping seasons, while 19.80 and 17.99 t/ha fruit yield were recorded in the wood ash treatment. The fruit yield obtained from NPK treatment was not significantly different when compared with yields obtained from goat manure and cow dung treatments. The least fruit yield, 5.12 and 6.03 t/ha in 2021 and 2022 was recorded in the control treatment.
Conclusion: Based on the study findings, the application of organic soil ameliorations (cow dung and goat manure) was recommended for higher fruit yields and sound soil conservation practices for sustainable crop production in an ultisol.

To cite this article: Ikeh, A. O., Sampson, H. U., Ukabiala, M. E., Anonaba, N. K., Okamigbo, J. N., Akuwueze, C. G. (2025). Effect of soil ameliorations on cucumber (*Cucumis sativus* L) yield and soil physico-chemical properties in an ultisol of Southeastern Nigeria. *Open Science and Technology, 5*(1), 1-9.

1. Introduction

Cucumber (*Cucumis sativus* L) is a creeping vine fruit vegetable in the plant family of Cucurbitaceae family which includes fluted pumpkin (*Telfairia occidentalis*), pumpkin (*Cucurbita maxima*), egusi-melon (*Colocynthis citrullus*), and squash (*Cucurbita pepo*). This plant produces fruits that can vary from elongated cylindrical forms to almost spherical shapes. This fruit is nutritious and offers many health benefits. It is also important for the economy of many households in both tropical and temperate regions (Ikeh *et al.*, 2012).

Cucumber is fast diffusing into farming systems of southeastern Nigeria's agricultural zone and almost all agricultural zones in Nigeria. The crop was not a major crop in the farming system of southeastern Nigeria where garden egg, pepper, okra, and tomatoes were treated specially as major fruit vegetables. Its cultivation is mostly within urban and para-urban areas where consumers see it as an inexpensive fruit vegetable that can supply essential vitamins and minerals. Poor soil fertility status of ultisol is a major challenge that limits cucumber production in southeastern Nigeria. According to Eifeyida & Remison, (2009), the soil requirement for cucumber cultivation is moderate to high nutrient levels. Planting cucumber in an infertile soil led to poor quality fruits, bitter taste and misshapen fruits. These fruits are usually rejected by consumers, therefore reducing their market value. Soils of southeastern Nigeria receive high amount of rainfall, which contributes to the highly acidic nature of most soils in the region. The most suitable pH range for cucumber production is 6.0 to 6.5. Most of the soils in the rainforest ecology of southeastern Nigeria fall below the stated pH (Ibia and Udoh, 2019).

Maintaining low soil fertility in the highly humid ultisols of southern Nigeria can be achieved through both conventional and non-conventional soil amendments. However, due to the inherently infertile nature of ultisols and their elevated acidity levels, organic materials derived from crop and animal production systems, or through fallow practices, have proven effective in enhancing soil quality. Numerous researchers have explored the importance of organic soil amendments in crop production, highlighting that these materials offer varying concentrations of nutrients. Research by Ikeh *et al.* (2012) shows that using treated poultry and goat manure significantly increased cucumber fruit yield in Uyo, Akwa Ibom State, southern Nigeria. Organic soil amendments release nutrients slowly and steadily but in different amounts. Idem *et al.* (2012) noted that organic manure is not easily leached from the topsoil, making it readily available for crop absorption. Additionally, the application of organic fertilizers in the soil enhances soil physical properties (texture and structure), water retention capacity, helps rehabilitate degraded land, as well as environmentally friendly and ecologically sound, and ensures that crop yields are safer for human consumption.

Ndaeyo *et al.* (2013), Akata *et al.* (2016), & Nwite-Eze (2024) summarize the beneficial effects of organic soil amendments in an ultisol of southern Nigeria. They report that organic manure enhances soil quality by: binding soil particles to form aggregates; improving moisture retention, particularly in sandy and loamy soils; increasing soil aeration; enhancing permeability to water; augmenting the cation exchange capacity; buffering the soil against drastic pH changes when alkaline or acidic materials are applied; and promoting the formation of metal-organic matter complexes, which improves the stable availability of micronutrients throughout the growing season.

Apart from supplying nutrients in slow-release form in the soil, organic fertilizer helps in ameliorating the acidic nature of ultisol of Southeastern Nigeria, due to high aluminum (AL) toxicity. According to Ibia (2005), Akata *et al.* (2016), & Ikeh *et al.* (2023a), acid soil, which results from the leaching of basic cations in high-humidity areas, leaves behind the more resistant Al^{3+} ions that predominately remain. This phenomenon can be utilized to mitigate aluminum toxicity and enhance yields in agricultural practices. Additions of organic residues have been demonstrated to enhance nutrient uptake, leading to improved crop growth and yield (Udoh, 2023). Furthermore, applying organic manure to acidic soils helps to mitigate soil acidity, which in turn results in an increase in soil pH (Akata *et al.*, 2016).

The continuous application of conventional fertilizers in crop production within the humid zone of Imo State, southeastern Nigeria, faces numerous challenges. These include the high cost of inorganic fertilizers, limited accessibility for farmers, and a growing preference for organically produced crops over their inorganic counterparts. Additionally, environmental concerns associated with inorganic fertilizers—such as greenhouse gas emissions, soil toxicity, eutrophication, cadmium uptake, and contamination—have prompted more comprehensive research on sustainable alternative methods for crop production. Despite this, research findings have varied regarding soil fertility and crop yield outcomes. In light of these issues, this research was carried out to assess the impact of soil ameliorations on soil and cucumber yield in high humid ultisol of southeastern Nigeria.

2. Materials and Methods

2.1 Experimental site description

The field experiment was conducted at Ndikpa, Umuowa Ibu1, under the auspices of the National Horticultural Research Institute (NIHORT) at the Okigwe substation in Imo State, Nigeria. This region is geographically positioned between latitudes 5°49'45" N and longitudes 7°21'2" E, offering a unique ecological environment for horticultural studies.

Okigwe experiences a mean annual rainfall that varies significantly, ranging from 100 to 380 mm, which directly influences the local agricultural practices and crop yields. The climate is characterized by a mean relative humidity of 79%, creating a consistently moist atmosphere conducive to plant growth. The temperatures in the area fluctuate between 22.7°C and 34°C, contributing to its classification as a humid tropical rainforest zone.

The region experiences two distinct seasons: a wet season, characterized by heavy rainfall that supports lush vegetation and a dry season, which can impact water availability and crop management strategies. This climatic variation plays a crucial role in determining the types of crops cultivated and the timing of agricultural activities throughout the year.

The region has two main seasons: the wet season and the dry season. The wet season starts between March and April and lasts until October, featuring heavy rainfall and a brief pause in August known as the "August Break." The dry season follows, beginning in November and extending through February, sometimes into late March, characterized by lower humidity and minimal rainfall. The experimental site has a history of crop cultivation, including maize (*Zea mays*), okra (*Abelmoschus esculentus*), and egusi-melon (*Colocynthis citrullus*).

2.2. Soil chemical and physical properties

Composite soil samples were collected with the aid of soil augar, before planting and at harvest at soil depth of 30 cm. The soil samples were collected in polythene bags, labeled air dried, crushed, and sieved through a 2.0 mm-mesh, for physico-chemical analysis: Soil pH: Soil pH was determined in water 1:2 (soil: water ratio) using a pH meter with a glass electrode (Bates, 1954), total nitrogen in the soil was determined by micro-Kjeldahl digestion and distillation method (Ibia & Udo, 2009). The organic matter content of the soil was determined by the dichromate wet oxidation method of Walkley & Black (1934). Available P in the soil was determined by Bray-1 method (Bray & Kurtz, 1945). Exchangeable Cations: Exchangeable cations were extracted with neutral NH4 OAC. Calcium and magnesium were determined in the extract by EDTA titration (Jackson, 1962), while potassium and sodium were determined using flame photometer.

2.3 Treatments and experimental design

The experimental treatments were goat manure, cow dung, wood ash, inorganic fertilizer (NPK) and control (no soil amendment). The experiment was laid out in a randomized complete block design, replicated thrice. Each replicate measured 34 m x 5 m (m2). Each plot size was 5 m x 5 m. The total number of plots in each replication was four (4) while the entire number of plots was fifteen (15). The inter-block and plot spacing was 1.5 m and 1 m, respectively. All plots were constructed into seedbeds and organic soil fertilizers were incorporated in the soil during land preparation while inorganic fertilizer (250 kg/ha NPK-15:15:15) was applied on a treatment basis at two (2) weeks after planting (WAP).

2.4 Agronomic practices

Land Preparation

The experimental site was carefully cleared by hand with machetes, and the vegetative debris was raked and stacked along the alleys without burning. After delineating the area, a 5m x 5m seedbed was constructed using a spade.

Planting

The cucumber variety, known as the market more cultivar, was widely cultivated in Okigwe, Imo State, Nigeria. It was planted during the second week of May 2021 and 2022 cropping seasons. Three seeds were sown per hole with a spacing of 75 cm x 75 cm and were later thinned to one plant per stand three weeks after planting.

Weeding

Weeding was done manually at 3 and 9 weeks after planting with the aid of a native weeding hoe. The predominate weed species observed during weeding were: *Amaranthus spp., Axonopus compressus, Ageratum conyzoides, Centrosome, Sida acuta*, and *Mimosa tenuiflora.*

Pest and disease control
The crops were sprayed with *landacyahalothrin* as "Karate" (insecticide) at the rate of 2 litres at 3 and 6 weeks after sowing. Fungi diseases were controlled by benomyl (benlate) at 1.5kg/ha, the spraying was done fortnightly from 4 to eight weeks after sowing (WAS).

Harvesting
Harvesting of the cucumber fruits commenced at seven WAS when the fruits had turned deep green. Harvesting was done by land-picking of the matured fruits weekly.

Data Collection
The parameters related to the growth, yield, and yield components of cucumbers were assessed as follows:
i) Vine Length (cm): The length of the cucumber vine was measured from the base, where it emerges from the soil to the tip of the vine.
ii) Number of Fruits per Plant: This was determined by counting the fruits on each plant within the designated net plot for each treatment.
iii) Fruit Length (cm): The length of the fruit was measured from the proximal end to the distal end.
iv) Circumference of the Fruit (cm): The circumference of the cucumber was measured using a flexible measuring tape. It was wrapped around both the widest and thinnest parts of the cucumber. Each measurement was taken multiple times to ensure accuracy, and the average of these measurements was recorded as the fruit circumference.
v) Fruit Yield (tonnes per hectare): Fruit yield was measured using a top-loading weighing balance (model unspecified) in kilograms per hectare, which was subsequently converted to tonnes per hectare.

2.5 Data analysis

Data on soil characteristics, plant growth, crop yield, and yield components were analyzed using analysis of variance (ANOVA). To compare significant means, the least significant difference (LSD) method was applied at a 5% probability level, ensuring that the differences observed were statistically reliable.

3. Results

The results of physico-chemical properties of the soil before planting show that the experimental soil was acidic with pH values of 5.50 in both cropping seasons (Table 1). The soil particle size analysis indicated that the soil was sandy loam with organic matter content of 1.95 and 1.88 % in 2021 and 2022 cropping seasons, respectively. The result of total nitrogen of the soil was low with an average N content of 0.07 %, in 2021 and 2022 cropping seasons, respectively. Table 2 shows different nutrient concentrations of the organic manure used for the two-year studies.

Table 1. Some physico-chemical characteristics of the soil (30 cm) of the experimental site before planting.

Years	sand	silt	clay	Organic matter	Total N	Available P	Ca	K	Mg	pH
			%			(mg/kg)		(cmol/kg)		
2021	83.00	7.00	10.00	1.95	0.07	5.50	2.30	0.11	1.40	5.50
2022	85.50	6.20	4.50	1.87	28.1	23.3	2.40	0.15	1.33	5.50

Table 2. Chemical analysis of organic soil amendments

Mineral elements (%)	Organic soil amendments					
	Cow dung		Goat manure		Wood ash	
	2021	2022	2021	2022	2021	2022
Nitrogen	1.36	1.42	1.40	1.39	0.01	0.01
Phosphorus	0.15	0.12	2.08	2.02	2.11	1.95
Potassium	0.68	0.57	0.62	0.59	2.45	2.12
Calcium	1.52	1.66	1.39	1.40	2.18	2.01
Magnesium	0.50	0.32	1.78	1.82	2.10	2.05
Sodium	0.09	0.08	0.11	0.09	0.20	0.19

Table 3 shows the physico-chemical properties of the experimental soil after planting. The treatment of wood ash had significantly higher soil pH values at harvest; 8.90 and 8.80 in both cropping seasons. Control treatment had soil pH of 5.30 and 5.15 in 2021 and 2022 planting seasons, respectively while the least soil pH; 5.10 and 5.20 was recorded in the treatment of inorganic fertilizer (NPK) in both cropping seasons.

Table 3. Soil chemical properties as influenced by soil amendments.

Treatment	Soil pH	Organic matter (%)	Total N (%)	Avail P (mg/kg)	K (cmol/kg)	Ca (cmol/kg)	Mg (cmol/kg)	Na (cmol/kg)
2021								
Goat manure	6.70b	2.55a	0.11ab	50.11b	1.16c	2.33b	1.81a	0.19a
Cow dung	6.60b	2.57a	0.12ab	53.33b	1.45b	2.60a	1.26b	0.10c
Wood ash	8.90a	2.25ab	0.07b	60.44a	3.40a	2.33b	1.60a	0.17b
NPK	5.10c	1.72b	0.15a	61.33a	1.10c	1.40c	1.11b	0.09c
Control	5.30c	0.71c	0.06b	20.81c	0.61d	1.12d	0.33c	0.03d
LSD(p<0.05)	***0.61***	***0.59***	***0.05***	***3.59***	***0.12***	***0.14***	***0.24***	***0.02***
2022								
Goat manure	6.70b	2.43a	0.10b	53.16b	1.18c	2.26a	1.85a	0.17a
Cow dung	6.65b	2.50a	0.13ab	54.13b	1.49b	2.67a	1.28ab	0.11a
Wood ash	8.80a	2.26a	0.08b	60.80a	3.55a	2.40a	1.56a	0.15a
NPK	5.20c	1.81b	0.17a	61.01a	1.13c	1.18b	1.09b	0.10a
Control	5.15c	0.65c	0.09b	20.03c	0.60d	1.01b	0.35c	0.03b
LSD(p<0.05)	***1.33***	***0.37***	***0.07***	***3.44***	***0.16***	***0.51***	***0.31***	***0.08***

The treatment of cow dung showed high organic matter content at harvest; 2.55 and 2.43 % in 2021 and 2022 cropping seasons, respectively. Soil amendment treatment had the least organic matter content of 0.71 and 0.65 %, respectively.

The application of soil amendment improved the percentage of total nitrogen content of the soil. The highest total N was recorded in NPK treatment. While the least total nitrogen was recorded in no soil amendment treatment.

The result of available phosphorus concentration as influenced by soil amendment also differed significantly in both cropping seasons. Treatments of NPK and kitchen wood ash had higher available P of above 60 mg/kg compared to the other treatments. The available P level in cow dung was 50.11 and 54.13 mg/kg in 2021 and 2022 cropping seasons, respectively. The least available P content of 20.81 and 20.03 mg/kg was recorded in the control treatment.

K concentration at harvest were significantly different when compared among the treatments. The highest K concentration was recorded in the treatment of wood ash; 3.40 and 3.55 cmo/kg in 2021 and 2022 cropping seasons, respectively. The K value recorded in the treatment of cow dung was 1.45 and 1.49 cmol/kg in 2021 and 2022. The least K content at harvest; 0.60 and 0.61 cmol/kg in 2021 and 2022, respectively was recorded in the control (no soil amendment). Calcium concentration as influenced by soil amendment differed significantly ($p<0.05$). Treatment of cow dung had higher calcium content at harvest; 2.60 and 2.67 cmol/kg in both cropping seasons. The treatment of kitchen ash had 2.33 and 2.40 cmol/kg calcium left at harvest. The least calcium concentration at harvest; 1.12 and 1.01 cmol/kg in 2021 and 2022 cropping seasons, respectively was recorded in no soil amendment treatment.

The concentration of Mg across the treatments varied significantly different ($p<0.05$) with the treatment of goat manure having the highest magnesium content; 1.81 and 1.85 cmol/kg in both cropping seasons, respectively. Treatment of wood ash had 1.60 and 1.56 cmol/kg Mg content in 2021 and 2022 cropping seasons.

Sodium concentration at harvest as influenced by soil amendments varied significant difference ($p<0.05$) among the treatments (Table 3). Treatment of goat manure had 0.19 and 0.17 cmol/kg sodium content at harvest while the treatment of wood ash had 0.17 and 0.15cmol/kg in both cropping seasons. The least sodium content at harvest; 0.03 cmol/kg for both cropping seasons, was recorded in the control treatment.

The number of cucumbers leaves per plant differed significantly among the soil amendment treatments (Table 4). The result of the number of leaves per plant varied significant difference ($p<0.05$) among the treatment in both cropping seasons. The treatment of cow dung that significantly higher number of leaves per plant at 3 weeks after planting (WAP); 5.53 and 5.79 in 2021 and 2022 cropping seasons, respectively. At 6 and 9 WAP, treatment of NPK had significantly higher number of leaves per plant; 20.99 and 62.56 in 2021 while in 2022 cropping season, the number of leaves per plant recorded were 21.72 and 64.70, respectively. The least number of leaves per plant; 19.45 and 20.12 at 9WAP, was recorded in no soil amended treatment.

Table 4. Number of leaves per plant as influenced by different soil amendments.

Soil Amendments	2021			2022		
	weeks after planting			weeks after planting		
	3	6	9	3	6	9
Goat manure	5.30a	15.93b	57.31ab	5.71a	18.51ab	45.71b
Cow dung	5.53a	12.73c	56.40ab	5.79a	17.11ab	46.81b
Wood ash	5.21a	11.45c	49.70b	5.37a	13.41bc	42.93b
NPK	4.41ab	20.99a	62.56a	4.05b	21.72a	64.70a
Control	2.23b	5.21d	19.45c	3.12b	7.12c	20.12c
LSD(p<0.05)	***1.01***	***2.18***	***3.50***	***1.11***	***2.13***	***3.31***

The vine length of cucumber under different soil amendment treatments varied significant difference ($p<0.05$) in both cropping seasons (Table 5). Significant longer vine was recorded in the treatment of cow dung at 3 WAP while treatment of NPK took over at 6 and 9 WAP. At 9 WAP, treatment of NPK had significantly longer vine of 136.12 and 137.41 cm in both cropping seasons against 125.80 and 130.22 cm, respectively recorded in cow dung. The shortest vine; 66.75 and 69.47 cm, respectively was recorded in no soil amendment treatment.

Table 5. Vine length (cm) of cucumber as influenced by different soil amendments.

Soil Amendments	2021			2022		
	weeks After planting			weeks After planting		
	3	6	9	3	6	9
Goat manure	19.33a	51.12ab	124.91ab	18.94a	53.99ab	128.16ab
Cow dung	19.28a	50.23ab	125.80ab	20.17a	54.67ab	130.22ab
Wood ash	17.97a	48.45b	109.44b	18.81a	46.85b	110.40b
NPK	13.79b	56.50a	136.12a	14.44b	66.32a	137.41a
Control	10.20c	21.78c	66.75c	11.12c	20.91c	69.47c
LSD(p<0.05)	***2.45***	***3.13***	***5.18***	***2.23***	***4.02***	***4.51***

The effect of soil amendments on yield and yield components of cucumber is presented in Table 6. The number of cucumber fruits per plant as influenced by soil amendments varied significantly different ($p<0.05$) in both cropping seasons. Treatments that received soil amendments produced significant higher number of fruits per plant compared to no soil amendment. Treatment of NPK had 6.91 and 6.59 fruits per plant in 2021 and 2022 cropping seasons, respectively while treatment that received cow dung had 6.71 and 6.58 fruits in 2021 and 2022, respectively. Control treatment had the least number of fruits per plant; 1.96 and 2.01 in 2021 and 2022 cropping seasons, respectively.

Table 6. Yield and yield components of cucumber different soil amendments

Soil Amendments	2021				2022			
	Number of fruits per plant	Fruit Length (cm)	Fruit Circumference (cm)	Fruit yield (t/ha)	Number of fruits per plant	Fruit Length (cm)	Fruit Circumference (cm)	Fruit yield(t/ha)
Goat manure	6.33a	28.23a	20.22a	20.23a	6.45a	28.55ab	20.31a	20.81a
Cow dung	6.71a	28.18a	20.45a	19.45a	6.58a	27.13ab	21.34a	19.40a
Wood ash	5.66a	26.96a	20.33a	19.80a	5.81a	25.69b	20.01a	17.99a
NPK	6.91a	29.88a	21.12a	22.24a	6.59a	30.12a	22.33a	22.54a
Control	1.96b	18.33b	15.01b	5.12b	2.01b	18.19c	16.11b	6.03b
LSD(p<0.05)	***2.11***	***3.14***	***2.20***	***3.43***	***2.12***	***2.98***	***3.51***	***3.58***

Cucumber fruit length under different soil ameliorations varies statistically significant difference in both cropping seasons. The soil ameliorated treatments had longer fruit than the control (no soil amendment). Among the soil amendment treatments, the treatment of NPK had 29.88 and 30.12 cm in both cropping seasons while 28.23 and 28.55 cm fruit length was recorded in goat manure treatment. The shortest fruit: 18.33 and 18.19 cm, was recorded in the control treatment.

Fruit circumference as influenced by soil amendments also maintained a similar pattern as in fruit length with treatment of NPK having the largest significant fruit circumference; 21.12 and 22.33 cm while the control had the least fruit circumference; 15.01 and 16.11 cm in 2021 and 2022 cropping seasons, respectively. The result showed no significant difference when the fruit circumference of all the soil-amended treatments was compared in both cropping seasons.

Cucumber fruit yield under different soil treated with fertilizers differed significantly in both cropping seasons. Treatment of NPK had a significant fruit yield of 21.12 and 22.54 t/ha in cropping seasons, respectively. The yield obtained from NPK treatment was not significantly different when compared to the yields obtained from goat manure and cow dung treatments (Table 6). The least fruit yield of 5.12 and 6.03 t/ha was recorded in the control treatment in both

4. Discussion

The low fertility of the soil recorded in the experimental site before planting was as a result of exhaustive use of the land for a pro-longed period with little or no proper soil management and conservation practices. Therefore, the result of soil analysis before planting justified that the soil would require an amendment before it could support the productivity of cucumber.

Comparing the organic soil amendments, the treatment of wood ash had higher soil pH value which tends to reduce the acidity of the ultisol as well as potassium and available P while the treatment of cow dung had higher total nitrogen, organic matter, and calcium. The treatment of goat manure application had significantly higher Mg and Na. This observation agrees with Ikeh *et al.* (2023a) who reported significantly higher soil organic carbon, exchangeable bases, and pH with treatments of organic fertilizer in cassava grown in an ultisol of southern Nigeria. According to Essien (2015) higher soil organic carbon during growth phase and at harvest in cucumber grown under different organic fertilizer sources. According to Ndaeyo *et al.* (2013), organic matter has beneficial effects on the physical properties of soil such as water infiltration, and soil biological properties which contribute to increase crop yields.

Comparing the fruit yields recorded in the study, the result showed no significant difference ($p<0.05$) when the yield from inorganic fertilizer (NPK) was compared to the yield obtained from cow dung and goat manure. This result revealed that organic soil amendment, if properly used, can provide adequate soil fertility for maximum crop yield. The lesser fruit yield recorded in wood ash treatment when compared with the fruit yield obtained from inorganic fertilizer treatment could be due to low nitrogen content in wood ash compared to the nitrogen level in NPK fertilizer. From this result, it could be concluded that the application of organic soil amendments, especially cow dung and goat manure could promote high leaf production and longer vines, thereby promoting photosynthetic efficiency which translates to increased fruit yields. Ikeh *et al.* (2012) reported an increase in the vegetative traits of cucumber with the application of poultry and goat manure. The positive observation of effect of organic fertilizers on the improvement of fertility in the rainforest ecology of Nigeria has been reported by Udoh (2023) in okra. Ritonga *et al.* (2024) reported significant improvement in cucumber yield with an application of organic fertilizer of cast got (cassava derivatives manure) in Indonesia. On the other hand, Eifediyi & Remison (2009) and Nwite-Eze (2024) reported a significant increase in the growth and yield of cucumber in southern Nigeria with the application of inorganic fertilizer rates.

Despite the low nitrogen content of wood ash, the treatment equally produced appreciable fruit yield when compared to fruit yield recorded in no soil amendment treatment. The improvement in yield under wood ash treatment could be that the ash was able to neutralize the acidity level of the soil, which promotes efficient absorption of soil nutrients.

Some studies have indicated that wood ash can promote better plant growth and yield when compared to commercial lime. The findings confirm that wood ash enhances plant growth responses more effectively than limestone, primarily due to the additional nutrients present in wood ash. Previous research by Ekokeren *et al.* (2021) and Akpan *et al.* (2024) has indicated that wood ash functions similarly to liming materials, which contribute to the reduction of soil acidity. This suggests that wood ash not only provides essential nutrients but also plays a critical role in improving soil pH, thus fostering better crop yield. Ikeh *et al.* (2023b) reported that the application of oil palm bunch ash significantly enhances egusi-melon yield. This increase in yield may be attributed to the acidic nature of the experimental soil, which likely hindered the availability of nutrient elements to the crops; this issue was addressed by the liming potential of animal manures and wood ash. The findings of the study indicate that the treatment with wood ash resulted in a higher soil pH value.

5. Conclusion

The experimental findings indicated that organic soil amendments can significantly enhance cucumber yields in the ultisol of southeastern Nigeria. The application of cow dung, goat manure, and wood ash positively affected the soil fertility of the study site, leading to increases in organic matter content, soil pH, and exchangeable bases in a sustainable manner. While soil amendment with NPK did improve fruit yield, the difference in yield compared to that obtained from cow dung and goat manure treatments was not statistically significant. Therefore, the study recommends the use of organic soil amendments to achieve higher cucumber yields and to promote sustainable management of ultisol.

6. References

Akpan, E. A., Essien, O. A., Akata, O. R. & Opeolu, E. M. (2024). Effect of oil palm bunch ash and harvesting intervals on okra (Abelmoschus esculentus L.) cultivars in Obio Akpa, Akwa Ibom State, Nigeria. *Nigerian Journal of Agriculture, Food and Environment*, 20 (1), 21 – 30.

Akata, O. R., Uko, A. E., Nwagwu, F. A., Ndaeyo, N. U., Ikeh, A. O. & Esang, D. M. (2016). Weed dynamics, growth and yield of cassava (*Manihot esculenta* Crantz) as influenced by organic fertilizer sources and rates in an ultisol. *Journal of Basic and Applied Research International*, 18 (2), 68-76.

Bates, R. G. (1954). *Electrometric pH Determination.* New York: John Wiley and Son Inc., pp. 50-52.

Bray, R. H. & Kurtz L. T (1954). Determination of total organic and available forms of phosphorus soils. *Soil Science Journal,* 34, 45-49.

Eifediyi, E. K., & Remison, S. U. (2009). The effects of inorganic fertilizers on yield of two varieties of cucumber (*Cucumis sativus* L.). *Report and Opinion*, 1(5), 74-80.

Essien, I. E. (2015) Effect of organic fertilizer on soil micro-organisms, growth, yield and nutritional contents of cucumber (*Cucumis Sativus L*) in Uyo, Akwa Ibom State Nigeria. Unpublished M.Sc. Dissertation of Department of Soil and Land Resource Management, University of Uyo, Akwa Ibom State Nigeria.

Etokeren, U.E., Ikeh, A. O., & Essien, I.E. (2021). Evaluation of liming potentials of organic soil amendments on cowpea yield in Uyo, Southeastern Nigeria. *Journal of Research and Development*, 1(1), 89-96.

Ritonga, M, F. R., Walida, H., Mustamu, N. E., & Septyani, I. A. P. (2024). The effect of casgot fertilizer on the growth of cucumber plants. *International Journal of Science, Technology & Management*, *5*(4), 840-845. https://doi.org/10.46729/ijstm.v5i4.1142

Ibia, T.O. (2005). Forms and content of iron and aluminum in inland flood plain of South- Eastern Nigeria. *Agronomie Africaine Journal*, 17(3), 211-218.

Ibia, T.O., & Udo, E.J. (2009). *Guide to Fertilizer Use for Crop in Akwa Ibom State, Nigeria*. Sibon Books Limited, Lagos, Nigeria, p.28.

Idem, N. U. A., Ikeh, A. O. Asikpo, N. S. & Udoh, E. I. (2012). Effect of organic and inorganic fertilizer on growth and yield of fluted pumpkin (*Telfaria Occidentalis,* Hook.F) in Uyo, Akwa Ibom State. *Nigeria Journal of Agriculture and Social Research*, 12(2), 74-84.

Ikeh, A. O., Udoh, E. I., Uduak, G. I., Udounnang, P. I., & Etokeren, U. E. (2012). Response of cucumber (*Cumcumis sativus* L.) to different rates of goat and poultry manure on an Ultisol. *Journal of Agriculture and Social Research*, 12 (12), 132-139.

Ikeh, A.O., Etokeren, U.E., Essien, I.E., Udo, E.A., Ukut, A.N., and Nwanne, A.J. (2017). Effects of crop residue ash application on soil, cowpea yield and economic return to management in Uyo, Niger Delta Region of Nigeria. *Journal of Forestry, Environment and Sustainable Development*, 3(1),154-165.

Ikeh, A, O., Ndaeyo, N.U & Ikeh, C.E. (2023a). Effects of integrated fertilization on soil sustainability and cassava (*Manihotesculenta* Crantz) yield in an ultisol. *Journal of Current Opinion in Crop Science*, 4(2): 89-102. https://doi.org/10.62773/jcocs.v4i2.197

Ikeh, A. O., Orji, J. O., Sampson, H. U., & Akata, O. R. (2023b). Effect of oil palm bunch refuse ash in sustainable production of egusi-melon (*Colocynthis citrullus*) in an ultisol. *Asian Journal Agricultural and Horticultural Research* 10 (3) pp. 138-148. DOI: https://doi.org/10.9734/AJAHR/2023/v10i324

Jackson, M.L. (1964). *Soil Chemical Analysis Advanced Course*. Prentice Hall, New York, USA.

Ndaeyo, N. U., Ikeh, A. O., Nkeme, K. K., Akpan E. A., and Udoh E. I. (2013). Growth and foliar yield of waterleaf (*Talinum traingulare* Jacq) to complementary application of organic and inorganic fertilizer in an *Ultisol*. *American Journal of Experimental Agriculture,* 3(2), 324-335.

Nwite-Eze. O. (2024). Effects of organic and inorganic fertilizer on the growth and yield of cucumber (*Cucmis Sativus L*) in Dadin Kowa North East Nigeria. *Nigerian Journal of Horticultural Science*, 27(2), 23-27.

Udoh, E. I. (2023). Effect of fertilization on economic production of okra (*Abelmoschus esculentus* (L) Moench) in Uyo, Southeastern Nigeria. *Journal of Current Opinion in Crop Science*, *4*(3), 112-118.

Walkey, A. & Black, I. A. (1934). rganic Carbon. In: C. A. Black (ed). *Method of Soil Analysis, Part 2*, American Society of Agronomy 9, pp. 1372-1376.