**IMPACT OF COMPOST LEVELS ON SOIL PROPERTIES AND GROWTH PERFORMANCE OF OKRA**

**ABSTRACT**

The organic matter content of soil plays a pivotal role in determining its health, influencing its physical, chemical, and biological properties, in addition to the promotion of plant growth, highlighting the need for this study which investigated the effects of different levels of compost on soil physical and chemical properties, and on plant height and number of leaves of okra. An experimental layout covering an area of 4m x 2m was prepared, and okra seedlings were planted in a Randomized Complete Block Design (RBCD) consisting of six (6) treatments (0g, 200g, 400g, 600g, 800g, and 1000g) of compost. Soil samples were collected before planting (initial soil) and at maturity of crops, and analyzed for physical and chemical properties. Plant data were taken on plant height and number of leaves at 4 Weeks after Planting (WAP), 6WAP, and 8WAP, they were subjected to analysis of variance (ANOVA) at P≤0.05, and means were separated using Duncan multiple range test. Results of the study showed that before the addition of compost to soil samples, soil texture was sandy loam, soil pH was moderately acidic (5.37), moisture content (18.00%) and porosity (40.67%) were moderate. After the addition of different levels of compost, soil texture was loamy, soil pH was neutral (7.29), and soil had a higher moisture content (27.5%) and porosity (60.65%). Also, Organic carbon (4.25%), organic matter (7.37%), and available phosphorus (94.75 mg/kg) were significantly higher in soil mixed with compost compared to the levels of 1.40%, 2.43%, and 28.23 mg/kg, respectively recorded in soil samples before the addition of compost. The study concluded that increasing compost levels significantly improved soil physiochemical properties and okra growth, with 1000g treatment yielding the tallest plants and highest leaf count. These findings underscore the importance of compost application in sustainable agriculture, promoting soil fertility and reducing reliance on synthetic fertilizers.

**Keywords:** Compost, Soil properties, Okra, Growth parameters.

**INTRODUCTION**

The organic matter content of soil plays a pivotal role in determining its health, influencing its physical, chemical, and biological properties, in addition to the promotion of plant growth (Adekiya et al. 2019a). Soil health is fundamental for sustainable agriculture and compost, due to its capacity to enhance soil structure and fertility has emerged as a noteworthy organic soil amendment in this regard (Brady & Weil, 2017).

Compost is a type of organic material/amendment resulting from the controlled aerobic decomposition of organic waste, and it is an important alternative source of organic fertilizers (Miller, 2020). The composition of compost can vary widely depending on the raw materials used and the composting process, but it generally contains a rich mix of organic matter, nutrients, and a diverse microbial community (Rillig et al. 2019). These contents makes compost an essential component of sustainable agriculture, contributing to improved soil health, enhanced nutrient availability, and increased crop productivity (Berruti et al. 2016). Also, compost has been known to improve the physical and chemical properties of the soil (Miller, 2020), minimize nutrient runoff and environmental pollution (Bernal et al. 2018). Compost can suppress soil-borne pathogens by promoting antagonistic microbial populations; this biological control mechanism reduces pathogen activity and improves plant health without the use of synthetic pesticides (Adekiya et al. 2019a).

Compost serves as a source of organic matter and nutrients for the soil; when added to the soil, it enriches the soil with nutrients like nitrogen, phosphorus, and potassium, which are essential for plant growth (Bonanomi et al. 2015), including okra. Compost-amended soils often produce okra pods with better nutritional content and aesthetic quality, as higher nutrient levels in the soil translate to pods with improved taste, texture, and overall marketability (Holland et al. 2018).

Okra (*Abelmoschus esculentus*) is an economically important vegetable crop, it’s a warm-season vegetable native to Africa and widely cultivated in tropical and subtropical regions worldwide (Adekiya et al. 2019b). It belongs to the mallow family and is prized for its edible green pods, which are rich in vitamins, minerals, and dietary fiber understanding its response to compost-amended soils is crucial for optimizing production (Gupta & Sharma, 2017). Okra thrives in well-drained, fertile soil, requires warm temperatures to grow successfully, and it is appreciated not only for its nutritional value but also for its culinary diversity and potential health benefits (Gupta & Sharma, 2017). Due to its nutritional value and adaptability to a range of environmental conditions, okra is an important vegetable crop in many regions, particularly in Africa, Asia, and the Americas (Adekiya et al. 2019b).

The increasing demand for sustainable food production practices necessitates research that explores methods to enhance plant growth and soil health without relying on chemical fertilizers, as unsustainable practices in agriculture, such as excessive use of synthetic fertilizers on a farm land, pose significant challenges to soil health and environmental sustainability (Zhang et al. 2018). This study therefore investigated the effects of different levels of compost on soil physical and chemical properties, and on plant height and number of leaves of okra. This study addresses a critical area in sustainable agriculture by investigating the interplay between compost application, and Okra growth. This study bridged knowledge gaps in this specific context, and provided valuable insights for developing eco-friendly strategies to enhance Okra production while promoting soil health.

**MATERIALS AND METHODS**

**Study Area**

The study was conducted at the Department of Crop and Soil Science green house at the Faculty of Agriculture, University of Port Harcourt, Rivers state, Nigeria.

**Experimental Layout and Design**

An experimental layout covering an area of 4m x 2m was prepared, marked using tape and ropes, and used in this study. Randomized Complete Block Design (RBCD) consisting of six (6) treatments (0g, 200g, 400g, 600g, 800g, and 1000g) of compost was adopted. The treatments were replicated three times.

**Planting Materials**

The seeds of local varieties of okra were purchased from Choba Community Market, Port Harcourt Rivers State, Nigeria.

**Soil Sampling**

Soil samples were collected before planting (initial soil) and at maturity of crops, soil samples were collected from each pot at a depth of 0-30cm with the use of a hand trowel. The collected samples were placed in well labelled polythene bags and then transferred to the laboratory for analysis.

**Physical and Chemical Properties of Soil**

***Soil Sample Preparation***

Soil samples were air-dried at room temperature sieved through a 2mm sieve and were analyzed for physico-chemical properties using the following standard procedures.

***Particle Size Analysis***

After dispersion with sodium metaphosphate. Fifty-one grams of air dried soil samples were placed in a baffle cup. The cup was half filled with sodium hexametaphosphate reagent and thoroughly stirred till all sample aggregates were completely broken down. The suspension was transferred into a cylinder and filled with water, while the hydrometer was still in suspension. The amount of sand in the sample was determined by removing the hydrometer, mixing the contents of the cylinder and inverting the cylinder several times. The cylinder was replaced on the work table and the time recorded. The hydrometer was carefully inserted at the end of 20 seconds, and the reading was taken after 40 seconds. The hydrometer was removed and the temperature of the suspension was recorded. The hydrometer reading was corrected by adding 0.3 units for every degree above 200C and subtracting 0.3 units for every degree below20oC. Two units were also subtracted for all hydrometer readings to compensate for the volume of sodium hexametaphosphate added.

The weight of sand in the sample was obtained by subtracting the corrected hydrometer reading from the total weight of the sample. Percentage sand content was calculated by dividing the weight of sand by the weight of the sample and multiplying by 100. To determine clay content in the samples, the sample suspension was shaken again, the hydrometer was inserted and the temperature was taken. The hydrometer reading was taken after 2 hours, the corrected hydrometer reading represents the amount of clay in the sample. Percentage clay content in the sample was obtained by dividing the weight of clay by the weight of the sample and multiplied by 100. Percent silt was thereafter determined by subtracting the sum of the percentage of sand and clay from 100.

***Bulk Density***

Bulk density was determined with core samples using the formulae:

Bulk density =

***Soil Water Retention Characteristics***

Soil water-retention characteristics (SWRC) were measured on undisturbed core samples 5 cm in diameter and 6 cm in height, using the pressure chamber apparatus with ceramic plates. The water content at -10 and -1500 kPa represent the field capacity (FC) and permanent wilting point (PWP), respectively.

Saturation of the soil samples was achieved by adding water slowly until water was about half way to the top of the soil core and allowed to soak for 24 hours. After saturation, samples were subjected to pressures 0 to -10 kPa using the hanging water column method, and -1500 kPa using the pressure plate apparatus. Excess water drained through the ceramic plate until balance was established between pressure force and water retention force in the samples after 2 days. The gravimetric water content in the samples was measured after oven-drying the soil at 105oC and was converted to volumetric by multiplying the values by the bulk density of each core sample.

***Total Porosity***

Total porosity was calculated with core samples using the core method

Water holding capacity at saturation (0 kpa) tension after 24 hours was calculated using the formula:

Where W.H.C is the water holding capacity, Md is the mass of oven-dried soil and Mw the mass of wet soil.

***Soil pH***

The pH of the soil samples was determined with a glass electrode in a 1:2:5 soil water suspension. Soil pH was determined by mixing eight grams of well homogenized soil in a beaker with 20 mls of distilled water, and stirring thoroughly, the mixture was kept to stand for one minute, after which the pH probe was dipped into the mixture in the beaker, and the reading recorded. Prior to measuring the pH of the soil in the mixture, the pH meter was first standardized by dipping its probe into a buffer solution of pH. The probe was rinsed with distilled water before and after taking each reading.

***Organic Carbon***

Organic carbon was determined by the Walkley and Black Wet oxidation method. The organic matter content of each sample was determined by multiplying % carbon by a factor 1.724. A representative soil sample was ground to pass through a 0.5mm sieve. One gram of the sample was weighed in duplicates and transferred into a 250ml Erlenmeyer flask. Ten milliliters of 1N potassium dichromate was then pipetted into each flask and swirled gently to disperse the soil. This was followed by the addition of 20ml concentrated sulphuric acid (H2SO4), using an automatic pipette. The flask was swirled vigorously for about a minute to mix soil and reagents properly. The beaker was rotated again and allowed to stand on a sheet of asbestos for about 30 minutes. 100ml of distilled water, 4 drops of 0.025M 0-phenanthroline-ferrous complex indicator was added and titrated with 0.5N ferrous sulphate (FeSO4) solution. The solution took on a greenish cast and then turned to dark green as the end point approached. At this point, ferrous sulphate was added drop by drop until the colour changed from blue to red, in reflected light against a white background.

A blank titration was made in the same manner, with soil to standardize the dichromate. The percent total organic carbon in the soil was calculated by using the formula below:

Where Correction factor F = 1.33, Me = Normality of solution xml of solutions used. % Total Organic Matter = % Organic Carbon x 1.729.

***Total Nitrogen***

The total nitrogen content of the soil was determined by the macrokjedahl method. Five grams of air-dried and sieved soil samples were weighed into separate dry 500mlmacro-Kjedahl flasks and 20mls of distilled water was added. The flasks were swirled for a few minutes and allowed to stand for 30minutes. One gram of potassium sulphate mercuric oxide (K2SO4-HgO) mixture catalyst and 10 grams of potassium sulphate (K2SO4) was added, plus 30mls of concentrated sulphuric acid (H2SO4). The flask was heated at low heat on the digestion stand. When the water was removed, and the frothing ceased, the heat was increased until the digest was clear, the mixture was then boiled for about 5 hours. The heating was regulated during the boiling period so that the H2SO4 condensed up to half way up of the flask. The flask was then left to cool and 100ml of water was added slowly. The digest was then transferred into another clean macro-Kjedahl flask. Fifty milliliters of 2% boric acid (H2BO3) indicator solution was added into a 500ml Erlenmeyer flask, which was then placed under the condenser of the distillation apparatus. The 500ml Kjedahl flask was attached to the distillation apparatus and 150ml of 10N sodium hydroxide (NaOH) was poured through the distillation flask by opening the funnel stopcock. Distillation commenced immediately. The condenser was kept cool, allowing sufficient water to run through, while the heat was regulated to reduce frothing and suck-back. The distillate was then collected and the distillation stopped. Ammonium- Nitrogen (NH4-N) in the distillate was determined by titrating with 0.01N hydrochloric acid (HCL). The colour changed at the end point from green to pink. Percent Nitrogen was calculated thus:

Where T = Titre value, M= Molarity of acid (HCL)

***Available Phosphorus***

Available Phosphorus was determined by the Bray No. 1 method. Reagent A was made by mixing 12g of Ammonium molybdate (NH4)6MO7O24 in 250ml distilled water, 0.2908g of potassium antimony tartarate (KSbOC4H4O6) in 100ml distilled water and 5N H2SO4 (prepared by diluting 148ml of concentrated H2SO4 in 100ml distilled water). Reagent B was made by dissolving 1.056g of Ascorbic acid to every 200ml of reagent A.

Standard curve was prepared by pipetting 5ml of 100ppm standard phosphorus stock solution into a 100ml volumetric flask, and the volume made up with distilled water. This solution contains 5ppm (ug P/ml). Then 2, 4, 6, 8,10ml of the diluted solution each was pipetted into 50ml flask, distilled water was then added to bring the volume to 35ml. 8mls of reagent B was added and mixed thoroughly and made up to volume with distilled water, after 30 minutes, the absorbance of the solutions was read on a spectrophotometer at 882nm wavelength, The standard curve was prepared by plotting absorbance against concentration of the solution.

The soil extract for analysis was prepared by weighing three grams of air-dried sieved soil samples into a 250ml plastic beaker and adding 20ml of 0.5N HCL and 460ml of distilled water. The soil suspension was shaken on an orbital shaker. The suspension was filtered using a Whatman No 1 filter paper into a clean 250ml plastic beaker. Five mls of the filtrate was pipetted into a 50ml volumetric flask, distilled water was added to bring the volume to 40mls. Eight milliliters of reagent B was added and mixed thoroughly. After 30minutes, the absorbance of the solution was read on a spectrophotometer at 882 wavelengths. The amount of Phosphorus in the sample was determined by reading from the standard curve previously prepared.

***Exchangeable Cations (Ca, Mg, Na, and K)***

Exchangeable K of the soil sample was extracted with neutral normal ammonium acetate buffered at pH 7 after shaking for 2 hours. Exchangeable Ca and Mg was determined by EDTA complexometric titration while Na was determined by flame photometry. Ten grams of air-dried soil sample was weighed into a conical flask, 100mls of neutral NNH4OAc is added and agitated for 30minutes in a mechanical shaker. The suspension was left to stand overnight, the following day, the suspension was filtered with Whatman filter paper number 42. The leachate was used for the determination of exchangeable bases.

Twenty- five mls of the NH4OAc extract was introduced into a conical flask and made up to 150ml with distilled water. Then 15mls buffer solution, 10 drops of KCN, NH2OH, HCL, K4Fe (CN)6 triethanloamine was added. Few minutes was allowed for the reaction to take place, after which 10 drops of Erichrome Black T (EBT) was added. The solution was titrated with EDTA (Disodium ethylene di-amine tetracetate). At the end point, the colour changed from wine red to purplish blue. The blank was also prepared with distilled water and titrated. Standardization of EDTA using Ca standard and calsein indicator was done, corresponding values of Ca and Mg were calculated thus:

mMoles of Ca + Mg) in 25ml extract =ml of EDTA in EBT titration of sample – ml of EDTA in EDTA titration of blank\* X =X1, Where X= Conc. Of EDTA.

mMoles of Ca in 25ml extract = ml of EDTA in calcein titration of sample – ml of EDTA in calcein titration of blank \* Y= Y1

mMoles of Mg in 25ml exgtract = M moles of (Ca + Mg)

mMoles of Ca = X1-Y1.

mMoles of Ca in 100ml extract =

mMoles of Mg in 100ml extract =

These are present in 20g soil. 100g soil contains

Values obtained were the exchangeable Ca and Mg in 100g soils.

100ppm Na was prepared by dissolving 0.254g dried NaCL in water and diluting to one litre.

100ppm K was prepared by disoldissolving1g dried KCL in water and diluting to one liter of NH4OAc for extraction as in Ca and Mg. 0, 4, 10, 14, and 20ppm standards of Na and K are prepared by pipetting 0, 2, 5, 7, 10ml of 100ppm stock solution of the element into 50ml volumetric flasks and diluting the solutions to 50ml with NH4OAc solution. Also, 10ml of NH4OAc extract was diluted to 50ml with NH4OAc solution. Sodium and Potassium filter were inserted into the flame photometer. The flame photometer was calibrated by setting the meter needle to zero by aspirating 0ppm standards and by setting the meter needle to 100% emission with the highest concentration of standard. The rest of the standards were aspirated one by one and the emission readings recorded. A calibration curve was prepared by plotting emission readings against concentration of standards. The NH4OAc extract (diluted and undiluted) was aspirated in the flame photometer, the concentration of the extract was determined from the meter readings and calibration curve. Corresponding sodium and potassium were calculated thus:

Concentration of Na in the diluted NH4OAc

Amount of Na in the 100ml undiluted extract =

This quantity is present in 20g of soil, 100g contains =

**Plant Parameters**

Plant data were taken on plant height and number of leaves at 4 Weeks after Planting (WAP), 6WAP, and 8WAP.

**Statistical Analysis**

Data collected from the various parameters were subjected to analysis of variance (ANOVA) at P≤0.05, and means were separated using Duncan multiple range test.

**RESULTS**

**Initial Soil and Compost Physiochemical Properties**

Figure 1 shows the results of soil and compost physiochemical properties before planting. pH was moderately acidic (5.37), soil has a sandy loam texture, with a moderate moisture content (18.00%) and porosity (40.67%), while the compost had a neutral pH of 7.29, loamy texture with a higher moisture content (27.5%) and porosity (60.65%). Organic carbon (4.25%), organic matter (7.37%), and available phosphorus (94.75 mg/kg) were significantly higher in compost compared to the levels of 1.40%, 2.43%, and 28.23 mg/kg, respectively recorded in soil.

**Figure 1: Initial Soil and Compost Physiochemical Properties**

**Physical Properties of Soils with Various Compost Levels**

Results of the tested soil physical properties (structure, texture, bulk density, moisture content, and total porosity) under different compost levels are presented on Table 1.

Texture of soils ranged from sandy loam to loamy sand, with 0g having a Sandy loam texture, 200g – 600g had loam texture while 800g - 1000g had a loam to loamy sand texture.

Structure quality ranged from low to high, moisture content ranged from 18.0% - 28.33%, following the order 800g>1000g>200g>600g>400g>0g Porosity of 40.67%. Bulk density ranged from 1.46 g/cm³ to 1.14 g/cm³, following the order 200g has a loam texture, high structure quality, moisture content of 24%, porosity of 55% and bulk density of 1.23 g/cm3, 400g has a loam texture, low structure quality, moisture content of 20.67%, porosity of 46.67 and bulk density of 1.38 g/cm3.

**Table 1: Physical Properties under Compost Levels**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Compost**  **Level** | **Texture** | **Structure Quality** | **Moisture content**  **(%)** | **Porosity**  **(%)** | **Bulk density**  **(g/cm3)** |
| 0g | Sandy loam | Moderate | 18.00a | 40.67a | 1.46d |
| 200g | Loam | High | 24.00c | 55.00d | 1.23b |
| 400g | Loam | Low | 20.67b | 46.67b | 1.38c |
| 600g | Loam | Moderate | 23.00c | 52.33c | 1.34c |
| 800g | Loam - Loamy sand | High | 28.33d | 58.00e | 1.14a |
| 1000g | Loam - Loamy sand | Moderate - High | 28.00d | 56.00de | 1.16a |
| **(P ≤ 0.05)** |  |  |  |  |  |

Means with the same letters were not significantly different at p ≤0.05

**Chemical Properties of Soils across Various Compost Levels**

Results of the tested soil chemical properties: (pH, organic matter, total nitrogen, available phosphorus, sodium, potassium, calcium, magnesium, exchangeable acidity, exchangeable acidity and cation exchangeable capacity) are presented on Table 2.

Soil pH ranged from 5.26 (200g) to 6.11 (1000g), pH followed the order 1000g>600g>800g>400g>0g>200g, this trend shows increased soil pH with higher compost levels. Organic carbon (OC) ranged from 1.01% (200g) to 1.53% (1000g), organic carbon followed the order 1000g>600g>800g>400g>0g>200g. Organic matter (OM) values ranged from 1.75% (200g) to 2.54% (1000g), following the order 1000g>600 g>800g>400g>0 g>200g, indicating a positive relationship between compost levels and soil organic content. Total nitrogen (TN) ranged from 0.15% (0g and 200g), peaking at 0.24% (800g), following the order 800g>1000g>400g>600g>200=0g, showing increased nitrogen availability at higher compost levels. Available phosphorus (Ava P) showed a range of 31.66 mg/kg at both 0g and 200g to 59.60 mg/kg at 600g, following the order 600g>400g>800g>1000g>200g=0g. These increases in Ava P highlight compost's role in enhancing phosphorus availability.

Potassium (K⁺), values ranged from 0.13 Cmol/kg to 0.41 Cmol/kg, following the order 1000g>800g>600g>400g>200g>0g. Sodium (Na⁺) ranged from 0.28 Cmol/kg (0g) to 0.74 Cmol/kg (1000g), following the order 1000g>800g>600g>400g>200g>0g. Calcium (Ca²⁺) ranged from 3.32 Cmol/kg at 200g to 7.32 Cmol/kg at 1000g, following the order 1000g>400g>600g>800g>0g>200g. Magnesium (Mg²⁺) ranged from 0.85 Cmol/kg at 800g to 1.68 Cmol/kg at 400g. Exchangeable acidity, ranged from 1.08 Cmol/kg at 600g to 1.36 Cmol/kg at 800. CEC ranged from 4.05 Cmol/kg (200g) to 9.22 Cmol/kg (1000g), following the order 1000g>400g>600g>800g>0g>200 g.

**Table 2: Chemical Properties across Various Compost Levels**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Compost Level** | **pH** | **%** | | | **m/kg** | **Cmol/kg** | | | | | |
| **OC** | **OM** | **TN** | **Ava P.** | **K+** | **Na+** | **Ca2+** | **Mg2+** | **Exch**  **acidity** | **CEC** |
| **0g** | 5.72bc | 1.25b | 2.14b | 0.15a | 31.66a | 0.13a | 0.28a | 3.55a | 0.26a | 1.14a | 4.20a |
| **200g** | 5.26a | 1.01a | 1.75a | 0.15a | 31.66a | 0.18b | 0.39b | 3.32a | 0.28a | 1.09a | 4.05a |
| **400g** | 5.44ab | 1.34bc | 2.24c | 0.22bc | 45.60d | 0.27c | 0.45c | 6.88c | 1.68a | 1.24b | 9.13d |
| **600g** | 5.83cd | 1.47d | 2.39d | 0.16a | 59.60e | 0.29c | 0.54d | 5.90b | 6.52a | 1.08a | 8.37c |
| **800g** | 5.67bc | 1.43cd | 2.32d | 0.24c | 42.85c | 0.37d | 0.66e | 5.83b | 0.85a | 1.36c | 7.57b |
| **1000g** | 6.11d | 1.53d | 2.54f | 0.22b | 38.97b | 0.41e | 0.74f | 7.32d | 0.87a | 1.13a | 9.22d |
| **(P ≤ 0.05)** |  |  |  |  |  |  |  |  |  |  |  |

Means with the same letters were not significantly different at p ≤0.05

**Plant Parameters of Various Compost Levels at 4 WAP, 6 WAP, 8 WAP**

From the Table 3, the data for plant height and number of leaves at 4, 6, and 8 weeks after planting (WAP) indicate a significant positive effect of increasing compost levels on both parameters, with statistically significant differences observed between treatments.

Plant height, ranged from 15cm (0g) to 32.27cm (1000g) at 4 WAP, following the order 1000g>800g>600g>400g>200g>0g. At 6 WAP, plant heights ranged from 27.7cm (0g) to 52.23cm (1000g), following the order 1000g>800g>600g>400g>200g>0g. By 8 WAP, heights ranged from 37.33cm (0g) to 85.43 (1000g), following the order 1000g>800g>600g>400g>200g>0g. These results illustrate that higher compost levels significantly promoted plant growth, with the tallest plants consistently observed in the 1000g treatment.

Number of leaves, values ranged from 4.67 leaves (0g) to 7.33 leaves (1000g) at 4 WAP following the order 1000g>800g>600g>400g>200g>0g. At 6 WAP, values ranged from 5.33 leaves (0g) to 8.0 leaves (800g and 1000g), following the order 1000g and 800g>600g>400g>200g>0g. By 8 WAP, leaf numbers ranged from 6.33 leaves at 0g to 9.0 leaves at 1000g, following the order 1000g>800g>600g>400g>200g>0g.

**Table 3: Plant Parameters of Various Compost Levels at 4 WAP, 6 WAP, 8 WAP**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Compost Level** | **Plant Height** | | | **No. of Leaves** | | |
|  | **4WAP** | **6WAP** | **8WAP** | **4WAP** | **6WAP** | **8WAP** |
| **0g** | 15a | 27.70a | 37.33a | 4.67a | 5.33a | 6.33a |
| **200g** | 18.67b | 35.60b | 46.17b | 5.33ab | 6.33ab | 6.67ab |
| **400g** | 22.53c | 38.90c | 56.43c | 5.67abc | 6.67abc | 7.33ab |
| **600 g** | 25.1d | 43.5d | 65.67d | 6.67bcd | 7.0bc | 7.67bc |
| **800 g** | 28.47e | 47.33e | 73.23e | 7.0cd | 8.0c | 8.67cd |
| **1000 g** | 32.27f | 52.23f | 85.43f | 7.33d | 8.0c | 9.0d |
| **P ≤ 0.05** |  |  |  |  |  |  |

Means with the same letters were not significantly different at p ≤0.05

**DISCUSSION**

The findings show the initial physiochemical and biological characteristics of both soil and compost, providing essential insights into their baseline status before the application of amendments. These results play a crucial role in understanding how different levels of compost influence soil health, microbial activity, and plant responses.

The initial soil analysis (figure 1) revealed a moderately acidic pH, which aligns with typical observations in tropical regions where high precipitation leads to the leaching of basic cations and natural soil acidification (Smith & Brown, 2019). In contrast, the compost had a neutral, making it a suitable amendment for balancing acidic soils and promoting plant growth. Previous studies have highlighted that neutral to slightly alkaline pH in compost supports nutrient availability and microbial activity, contributing to improved plant performance (Miller, 2020).

The compost contained significantly higher levels of organic carbon and organic matter compared to the initial soil. This observation shows the compost's potential to enrich soil organic content, which is known to enhance soil fertility and provide a reservoir of nutrients for plant uptake (Brady & Weil, 2017). Compost demonstrated significantly higher moisture content compared to soil. This is indicative of compost's enhanced water retention ability, which is critical for sustaining plant growth, especially in dry conditions (Adekiya et al. 2019a). Similarly, the porosity of compost was much higher than that of soil, suggesting that compost application could improve soil aeration and promote root development. This aligns with findings that compost-amended soils often exhibit better physical properties, contributing to improved plant health and root architecture (Tisdale et al. 2021).

Soil physical and chemical properties are key indicators of soil quality and directly impact plant growth, nutrient availability, and soil microbial activity. The application of compost significantly modifies these properties, affecting soil structure, texture, porosity, moisture content, bulk density, pH, and nutrient composition (Gul et al. 2015).

From the results (Table 2) it was observed that compost application did not improve soil texture and structure quality, as soil texture shifted from a sandy loam at 0g compost to a loam and loamy sand texture at higher compost levels. Improved texture and structural quality enhance water retention, root penetration, and soil stability, supporting findings that compost amendments enhance soil aggregation and reduce compaction (Miller, 2020). Soils with higher compost levels displayed high structure quality, likely due to increased organic matter that binds soil particles into more stable aggregates (Tisdale et al. 2021). The rise in moisture content and porosity with compost addition is consistent with studies indicating that compost’s high organic matter content can improve soil’s ability to retain water and create pore spaces conducive to root growth (Adekiya et al. 2019a). Low bulk density at higher compost levels is typical in compost-amended soils and is attributed to the addition of organic matter that lightens the soil structure and reduces compaction, benefiting root proliferation and soil health (Miller, 2020).

Compost has a buffering effect on soil pH, which can create a more suitable environment for nutrient uptake and microbial activity, benefiting overall soil fertility (Nweke & Egun, 2021). This shift toward a neutral pH at higher compost levels (800 g and 1000 g) is known to facilitate nutrient availability, particularly phosphorus, potassium, and calcium, as well as decrease exchangeable acidity (Siqueira et al. 2020). Studies have shown that organic amendments, including compost, provide carbon sources for soil microorganisms, which improve soil organic matter content and nutrient mineralization (Panettieri *et al*., 2015). The increase in total nitrogen reflects the role of compost in supplementing nitrogen and enhancing soil fertility, supporting plant growth (Zhang et al. 2018). CEC values ranged from 4.20 Cmol/kg - 9.22 Cmol/kg at 1000 g compost level, highlighting the compost’s role in enhancing soil fertility by increasing its ability to retain essential nutrients (Nweke & Egun, 2021). This increase is consistent with studies suggesting that composted organic matter provides exchangeable sites that improve soil’s nutrient-holding ability, enhancing plant growth and yield (Gul et al. 2015).

From the results (Table 3), it was observed that the use of compost significantly impacted the growth of okra plants, as reflected in plant height and the number of leaves over time. These findings indicate that organic amendments can enhance plant growth, likely through improvements in soil nutrient availability, microbial activity, and overall soil health, as observed in other studies (Adekiya et al. 2019b; Nweke et al. 2021). The progressive increase in plant height, especially at 800 g and 1000 g compost levels, reflects the role of compost in boosting essential nutrients like nitrogen and phosphorus that are critical for stem elongation and overall plant vigor (Gupta & Sharma, 2015).

Compost not only supplies essential nutrients directly but also improves soil structure and water retention, which are essential for sustaining plant growth under various environmental conditions (Gul et al. 2017). Increased height at the highest compost levels (1000 g) is indicative of an optimal nutrient environment that supports rapid growth during early developmental stages, in line with findings that organic inputs lead to taller, healthier plants (Nweke et al, 2021). Leaf count differences at 4, 6, and 8 weeks after planting were significant, with higher compost levels showing an advantage. Enhanced leaf development is beneficial, as it increases the photosynthetic surface area, which ultimately supports greater biomass accumulation (Adekiya et al. 2019b). The increase in leaf count observed in this study confirms the efficacy of compost as an organic input that improves plant morphology and facilitates greater photosynthetic capacity, leading to better growth and yield outcomes in okra (Gupta & Sharma, 2015).

**CONCLUSION**

The beneficial effects of compost on okra growth demonstrate its value as a sustainable alternative to chemical fertilizers. Regular incorporation of compost in soil management practices can maintain soil fertility while reducing dependence on synthetic inputs. Adding compost to soil improves soil health and okra growth; compost improved the soil's physical and chemical properties, such as water retention and nutrient content, creating better conditions for plants to thrive. As a result, okra plants grew taller and had more leaves, showing that compost is an effective, eco-friendly way to boost crop growth and support healthier soils.

**Disclaimer (Artificial intelligence)**

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Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Details of the AI usage are given below:

1.

2.

3.

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