Effect of Decomposed Bee Hive Waste and Pig Manure on Soil Properties, Growth and Yield Performance of Fluted Pumpkin *(Telfairia occidentalis)*

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Abstract: This study investigated the effects of different application rates of decomposed beehive waste and pig manure on the soil properties, growth, and yield of fluted pumpkin (*Telfairia occidentalis*). A randomized complete block design with a 3x3 factorial arrangement was used, with treatments including three rates of beehive waste (0.2, 0.4, 0.6 kg/5m²), three rates of PM (0.5, 1.0, 1.5 kg/5m²), and an untreated control. Initial analysis showed that both amendments had a neutral pH (7.21 for beehive waste, 7.08 for pig manure) compared to the acidic control soil (pH 6.19). Beehive waste exhibited higher levels of organic carbon (1.78%), organic matter (3.17%), nitrogen, phosphorus, and potassium than pig manure. Both organic amendments significantly ($P<0.05$) enhanced all measured growth parameters compared to the untreated control. Pig manure treatments consistently resulted in superior vegetative growth, with the highest application rate (1.5 kg) producing the maximum vine length (302.0 ± 22.0 cm), number of leaves (134.0 ± 13.2), and shoot yield (2.8 ± 0.4 kg/m^2). While pig manure maximized yield quantity, the proximate analysis revealed that fluted pumpkins grown with beehive waste had significantly ($P<0.05$) higher nutritional values including crude protein of 13.19 ± 0.71% for bee hive waste to 9.59 ± 0.71% of pig manure, lipid (5.46 ± 0.49% of beehive waste vs. 3.95 ± 0.05% of PM), and fiber (19.56 ± 0.22% of beehive waste vs. 17.05 ± 0.04% of pig manure). The findings suggest that while pig manure is more effective for maximizing biomass production, beehive waste is a superior amendment for enhancing the nutritional value of fluted pumpkins.

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1. 0 Introduction

Fluted pumpkin (*Telfairia occidentalis* Hook F.) is a West African green leafy vegetable valued for its nutritional, medicinal, and industrial benefits (Mpanga *et al*., 2021; Falodun *et al*., 2023). Predominantly cultivated in southern Nigeria, it is used by numerous ethnic groups and known by various local names, including 'ugu' (Igbo), 'Iroko' (Yoruba), and 'Ukong' (Efik and Urhobo) (Offiong *et al*., 2010; Udoh *et al*., 2025). Its leaves are rich in protein, vitamins, and minerals and can help reduce blood glucose, while its seeds provide edible oil containing essential unsaturated fatty acids like oleic, linoleic, and eicosatetraenoic acids (Bello *et al*., 2011).

Despite its high nutritional content, fluted pumpkin is primarily produced at a subsistence level in southwest Nigeria. Udoh *et al*. (2024) argue that, similar to other non-exportable tropical vegetable crops, the agronomy of fluted pumpkin has been overlooked in Nigeria. Production is further hindered by farmers' reliance on rain-fed agriculture and the region's inadequate soil nutrientr. However, the enterprise could be more successful if farmers bypassed intermediaries and marketed their produce strategically to hotels, restaurants, and hostels.

In tropical climates, the rapid decomposition of organic matter poses a significant challenge to retaining soil nutrients and increasing crop yields. The use of organic manures, such as poultry litter, pig manure, and compost, is an emerging strategy for enhancing yields (Agbede *et al*., 2024; Ijigbade *et al*., 2019). Applying these amendments to the soil has been shown to reduce reliance on agrochemicals by increasing nutrient availability, preventing nutrient leaching, stimulating beneficial microbial activity, and reducing greenhouse gas emissions (Agbede *et al*., 2024; Udounang *et al*., 2022). However, there is insufficient information on the optimal application rates of organic fertilizers to maximize fluted pumpkin productivity. This is a critical knowledge gap, as soil constraints including poor fertility, acidity, and nutrient imbalances—along with inadequate weed control, are responsible for Nigeria's low vegetable yields (Iyagba *et al*., 2013). Therefore, research on the effects of different rates of decomposed beehive waste and pig manure on soil properties and the growth and yield of fluted pumpkin (*Telfairia occidentalis*) will be immensely beneficial for developing sustainable cropping systems.

2.0 Materials and Method

2.1 Study area

The experiment was conducted at two sites/locations at the Teaching and Research Farm, Rufus Giwa Polytechnic, Owo (latitude 7^0 13 N, longitude 5^0 32 E). The zone's soils are classed as Alfisol Oxic Tropuidalf or Luvisol (Soil Survey Staff, 2014) and are derivative of quartzite, gneiss, and schist. March through July and mid-August through November are the rainy months, each period account for nearly half of the rainfall which averages about 1400 millimeters every year. The average annual air temperature is about 32^0C. The two sites are situated in Nigeria's forest-savanna transition zone.

2.2 Experimental design

The experimental design was a split plot design (3 x 3 factorial) with a randomized full block layout and three replications to test the effects of each treatment combination. The decomposed bee comb (Bee hive waste) was applied at 0.2, 0.4 and 0.6 kg per 5m^2 while the Pig manure (PM) was also applied at 0.5, 1.0 and 1.5kg per 5m^2 (David *et al*., 2019).

2.3 Collection and preparation of bee hives and pig manure

Decomposed Bee hive waste was obtained from the Rufus Giwa Polytechnic, Owo apiary, which was expanded through this project to meet the required demand for the experiment. The Bee hive waste was collected from the beehives during honey harvesting operation and from any pest invaded hives. The Bee hive waste was sundried, grounded and sieved with a 2mm sieve prior to application. The pig manure was obtained from a piggery farmer in Owo, Ondo State and composted for 3 weeks for mineralization.

2.4 Land preparation, incorporation of decomposed bee hive waste and pig manure and planting of fluted pumpkin

Each site was ploughed and harrowed to a depth of 15-30cm. The site was then mapped out to the desired plot size of 5m^2. The decomposed bee comb and pig manure was weighed and distributed uniformly throughout the soil on the plots in accordance with the specified rates (Decomposed Bee hive waste 0.2, 0.4 and 0.6 kg per 5 m^2 and pig manure at 0.5, 1.0 and 1.5kg per 5m^2. Hoe and spade was used to incorporate the treatments uniformly into 10cm depth of the soil 2 weeks before planting the fluted pumpkin. In each of the sites, two fluted pumpkin seeds from purchased pods was planted at 1m x 1m intervals, resulting in a plant population of five per 5m^2. Manual weeding was performed every weeks after planting.

2.5 Analysis of decomposed bee hive waste, pig manure and soil

Routine Analysis was carried out on subsample to determine Pig manure, Bee hive waste and soil PH, Sand, Silt and Clay, Organic Carbon, Organic Matter, N, P, Ca, Mg, K, CEC and EC.

2.5.1 Determination of moisture content

The sample was taken in a pre-weighed container and the initial weight was recorded. The sample was dried in a hot air oven at a temperature of 110 ^{0}C while weighing the sample at regular intervals until a constant weight is achieved. The moisture content of the sample was calculated using the following

$$MC\ (\%) = \frac{W_1 - W_2 \times 100}{W_2}$$

Where, MC is the moisture content, W_1 the original weight and W_2 the constant weight after oven drying.

2.5.2 pH and electrical conductivity

The pH value is a useful tool in the choosing suitable plant species for different Pig manure, Bee hive waste and control soil, as it can predict various chemical activities that will likely occur in a particular sample. The pH value can also be an indicator for a pH adjustment, which will ensure keeping the nutrient availability optimal for the given plant. Pig manure, Bee hive waste and control soil pH was determined (1:2.5 sample, water suspension) using the pH meter.

The EC of the Pig manure, Bee hive waste and control soil is a basic measure determining the salinity of the samples and thus their ability to transmit electricity in an aqueous solution (Udoh *et al*., 2024). The excess salts in Pig manure, Bee hive waste and control soil have a major harmful physical and chemical impact on the plant nutrient availability. Electrical conductivities (EC) of the Pig manure, Bee hive waste and control soil samples were measured with electric conductivity meter in a paste of 1:5 Pig manure, Bee hive waste and control soil/water (Udoh *et al*., 2024). Both pH and EC need to be measured since a good range for electrical conductivity could be found in an acid Pig manure, Bee hive waste and control soil that was unsuitable for plant growth. The measurement of both pH and EC provides a more complete indication of the chemical nature of the Pig manure, Bee hive waste and control soil. The parameters of EC and pH can be indicators of effects on biological activity where certain microbial mediated processes are affected by shifts in pH or EC (Udoh *et al*., 2024).

2.5.3 Total nitrogen (TN)

Total nitrogen was determined using the Micro-Kjeldahl method which involves three steps: mineralization, distillation and titration. Mineralization aims at changing the solution into minerals. Mineral organic matter and sulphuric acid with Kjeldahl catalyst were poured to the Pig manure, Bee hive waste and control soil sample separately. The solution heated for 2 hours on a 300 ˚C oven until the green colour appeared. Distillation aims at getting vapour condensation. After preparing the distillation flask, 10 ml of sodium hydroxide and 10 ml of sulphuric acid were added into the mineralized solution. By evaporation, the nitrate solution collected in 5 ml of boric acid. Titration aims at getting the amount of Nitrogen. The distillate solution contained excess acid was titrated by sodium hydroxide until pink colour appeared as endpoint. The colour changed from green to pink then yellow. Then, the used volume of sodium hydroxide, to nearest 0.01 ml of concentration, was recorded (Udoh *et al*., 2024).

2.5.4 Cation exchange capacity (CEC)/ effective cation exchange capacity (ECEC)

The cation exchange capacity (CEC) of a Pig manure, Bee hive waste and control soil is a measure of the quantity of negatively charged sites on Pig manure, Bee hive waste and control soil surfaces that can retain positively charged ions (cations) such as calcium (Ca^{2+}), magnesium (Mg^{2+}), and potassium (K^{+}), by electrostatic forces. Cations retained electrostatically are easily exchangeable with cations in the Pig manure, Bee hive waste and control soil solution so a Pig manure, Bee hive waste and control soil with a higher CEC has a greater capacity to maintain adequate quantities of Ca^{2+}, Mg^{2+} and K^{+} than a Pig manure, Bee hive waste and control soil with a low CEC (Udoh *et al*., 2024). However, when CEC is combined with other measures of Pig manure, Bee hive waste and control soil fertility, CEC is a good indicator of Pig manure, Bee hive waste and control soil quality and productivity. Pig manure, Bee hive waste and control soil CEC is normally expressed in one of two numerically equivalent sets of units: meq/100g (milliequivalents of charge per 100g of dry Pig manure, Bee hive waste and control soil) or cmolc/kg (centimoles of charge per kilogram of dry Pig manure, Bee hive waste and control soil) (Udoh *et al*., 2024).

Cation exchange capacity (CEC) of the Pig manure, Bee hive waste and control soil was determined by Summation (TEB + EA) method (Udoh *et al*., 2024).

2.5.6 Organic carbon and organic matter

Calcination method was used to determine the Pig manure, Bee hive waste and control soil organic matter according to method described by Agbed *et al*. (2022). During the laboratory analysis, the crucibles were dried at 105˚C for one hour. Hence, 2g of the Pig manure, Bee hive waste and control soil samples were sieved at 0.5mm, then added into the dried crucible. Then the mass was recorded. The crucible containing Pig manure, Bee hive waste and control soil sample was dried in an oven dryer at 105˚C for three hours, then the mass (M_1) was recorded. This process was repeated but the crucible contained Pig manure, Bee hive waste and control soil sample dried in furnace at 450 ˚C for three hours and its mass (M_2) was recorded (Udoh *et al*., 2024). Finally, Organic Matter was calculated using the following equation: Organic carbon x 1.74 (constant).

$$OC\ (\%) = \frac{M_1 - M_2}{M_2} \times 100$$

Where, M_1 oven dryer at 105˚C for three hours, M_2 is sample dried into furnace at 450 ˚C for three hours and its mass

2.5.7 Available phosphorus (AP)

The available phosphorus was determined using Bray 2 method according to Udoh *et al*. (2024) where a 5g sample of the Pig manure, Bee hive waste and control soil samples was sieved at a 2-mm sieve and then was put in a testing tube. Then 33 ml of the extracting solution Bray 2 was poured in the testing tube containing Pig manure, Bee hive waste and control soil sample and mixed for 5 minutes. The mixture was filtrated using filter paper. Finally, the filtered solution was put in the Atomic Adsorption Spectrometer (AAS) that automatically read the phosphorus content (Udoh *et al*., 2024) the available Phosphorus calculated using the following equation:

$$AP = Reading\ data\ in\ AAS \times 35/5$$

2.5.8 Determination of growth and yield parameters

Five plants from the middle row were tagged to prevent border line effect from which data on growth and yield attributes were obtained. The parameters that were taken includes; the number of leaves/plants, leaf length, leaf area, vine length, vine girth, number of branches/plant and total shoot yield. Data were collected on the various parameters at 2 weeks interval after 4 weeks of planting. Number of leaves were obtained through counting while the vine length and vine girth were measured using a measuring tape and Vernier caliper. The leave length and leaf area were determined through graphical method; by measuring the leaf's length and width on a graph paper. The leaf area was estimated using the equation proposed by Falodun *et al.* (2023) thus:

"LA = 0.9467 + 0.2475LW + 0.9724LWN.
Where,
LA denotes the leaf lamina area;
L denotes the length of central leaflet;
W denotes the maximum width of the central leaflet and
N denotes the number of leaflets in a leaf".

At harvest, a top loading balance was used to record the weight of 12 randomly chosen shoots from each plot to determine the yield.

The plant yield was calculated using the formula; total harvest weight divided by total land area. That is

Yield = Total harvest weight of fluted pumpkin/ Total land area

2.6 Statistical analysis

Genstat (GENSTAT, 2005), a statistical software, was used to carry out an analysis of variance (ANOVA) on the data collected from the experiment. The significant difference means was separated using least significant different (LSD) test and Duncan's multiple range test at p = 0.05 probability level. Count data was transformed using square root transformation.

3.0 Results

3.1 Physico-chemical properties of pig manure and bee hive waste

Tables 3.1 and 3.2 present a comparative analysis of the physical and chemical properties of pig manure, bee hive waste, and a control soil sample. Bee hive waste exhibited the highest moisture content (14.19%), followed by pig manure (11.64%), while the control soil had the lowest (7.14%). Regarding texture, the control sample was predominantly sand (69.80%), significantly ($P<0.05$) higher than that found in pig manure (59.77%) and bee hive waste (54.80%). Silt content was highest in the bee hive waste (34.17%), followed closely by the pig manure (31.11%). Across all samples, clay content was consistently lower than both sand and silt fractions as seen in Table 3.1.

The pH levels of the bee hive waste (7.21) and pig manure (7.08) were categorized as neutral, whereas the control soil sample was slightly acidic (6.19). Notably, the bee hive waste showed superior organic carbon (1.78%) and organic matter (3.17%) concentrations compared to both the pig manure and control samples. Furthermore, concentrations of key nutrients such as Nitrogen (N), Phosphorus (P), and Potassium (K) were significantly ($P<0.05$) higher in the bee hive waste than in the pig manure and the control soil as seen in Table 3.2.

Table 3.1: Physical properties of pig manure, bee hive waste and control soil sample

Soil Properties	Composition Values		
	Soil	Bee hive waste	Pig manure
Moisture content (%)	7.14	14.19	11.64
Soil Texture			
Sand (%)	69.80	54.80	59.77
Clay (%)	20.20	11.03	09.12
Silt (%)	10.0	34.17	31.11

Table 3.2: Chemical properties of pig manure, bee hive waste and control soil sample

Soil Properties	Composition Values		
	Soil	Bee hive waste	Pig manure
Ph	6.19	7.21	7.08
Organic Carbon (%)	0.17	1.78	0.78
Organic matter (%)	0.30	3.17	1.36
Nitrogen (%)	0.09	0.96	0.13
Phosphorus (%)	8.20	11.41	9.62
Effective Cation Exchange Capacity			
Potassium (K^+) (Cmol/g)	0.28	0.88	0.64
Calcium (Ca^{2+}) (Cmol/g)	2.80	4.84	3.33
Magnesium (Mg^{2+}) (Cmol/g)	2.90	3.90	3.90
Sodium (Na^+) (Cmol/g)	0.22	0.62	0.41

3.2 Effect of different rates of decomposed beehives waste and pig manure on growth and yield performance of fluted pumpkin (*Telfairia occidentalis*)

The effect of different rates of decomposed bee hives and pig manure on growth and yield performance of fluted pumpkin is presented in Table 3.3 respectively. Pig manure generally outperformed the decomposed beehives in terms of vine length across all applied rates. The maximum vine length (302.0 ± 22.0 cm) was achieved using the highest application rate of pig manure (1.5 kg). Successively lower rates (1.0 kg and 0.5 kg) resulted in shorter vine lengths (275.8 ± 113.0 cm and 249.5 ± 92.1 cm, respectively). All pig manure treatments yielded significantly longer vines than the control group (218.2 ± 30.0 cm). The highest rate of beehives applied (0.6 kg) produced a maximum vine length of 265.5 ± 65.1 cm. Lower rates (0.4 kg and 0.2 kg) resulted in 252.2 ± 31.4 cm and 209.7 ± 76.1 cm, respectively. The vine lengths produced by all beehive treatments were consistently lower than those produced by the corresponding pig manure treatments. The provided data indicates that pig manure treatments consistently yielded a higher average number of fluted pumpkin leaves (ranging from 98.0 to 134.0) compared to beehive waste treatments (ranging from 95.7 to 96.7) across tested weights of 0.2 kg, 0.4 kg, and 0.6 kg. While all specific treatment averages were numerically greater than the control value of 91.7 leaves, the text concludes that the beehive waste results were significantly lower than the control, and that the number of leaves increased as the treatment weight increased for pig manure.

The vine girth and leaf area of the fluted pumpkin treated with pig manure and Bee hives also increase with increase concentration, whereas the leaf area recorded for pig manure at concentrations 1.5kg, 1.0kg and 0.5kg were 433.4±101.3 cm^2, 397.7±44.2 cm^2 and 360.0±81.2 cm^2 respectively while for Bee hives waste at concentrations 0.2kg, 0.4kg and 0.6kg, the leaf area was recorded as 335.2±38.1 cm^2, 355.9±38.5 cm^2, and 398.8±91.1 cm^2 respectively. Meanwhile the control is significantly ($P<0.0$) lower than the treatments ($P< 0.05$). The vine girth recorded for pig manure at concentrations 1.5kg, 1.0kg and 0.5kg being 3.9±0.3, 3.6±0.5 and 3.0±0.4 respectively were significantly ($P<0.05$) higher than that of Bee hives at concentrations 0.6kg, 0.4kg and 0.2kg being 3.2±0.2, 3.1±0.3 and 2.9±0.2 respectively. The highest shoot yield of fluted pumpkin was obtained at treatment with 1.5kg of pig manure (2.8±0.4 kg/m^2) while bee hives gave lower yield of 1.8±0.4 kg/m^2 and they differed significantly ($P<0.05$). The shoot yield also increase as the concentration increased and higher than that of the control (untreated soil) as seen in Tables 3.3.

Table 3.3: Effect of different rates of decomposed beehives waste and pig manure on growth and yield performance of fluted pumpkin *(Telfairia occidentalis)*

Treatment	No of Leaves	Leaf Area (Cm^2)	Vine Length (Cm)	Vine Girth	No of Branches	Total shoot yield (kg/m^2)
Pig Manure						
PM 0.5kg	98.0±12.5^a	360.0±81.2^c	249.5±92.1^a	3.0±0.4^c	12.3±3.5^b	1.9±0.2^d
PM 1.0kg	114.7±68.6^c	397.7±44.2^d	275.8±113.0^b	3.6±0.5^b	14.7±5.5^a	2.5±0.3^c
PM 1.5kg	134.0±13.2^b	433.4±101.3^a	302.0±22.0^c	3.9±0.3^d	17.3±3.2^c	2.8±0.4^a
Control	91.7±4.9^d	307.6±33.2^b	218.2±30.0^d	2.6±0.4^a	11.7±4.0^d	1.2±0.0^b
Bee Hives						
BW 0.2kg	95.7±19.1^c	335.2±38.1^b	209.7±76.1^b	2.9±0.2^b	11.7±3.5^c	1.5±0.2^d
BW 0.4kg	95.7±13.4^d	355.9±38.5^a	252.2±31.4^c	3.1±0.3^d	11.3±2.1^a	1.7±0.3^c
BW 0.6kg	96.7±21.6^b	398.8±91.1^c	265.5±65.1^a	3.2±0.2^b	12.7±4.2^d	1.8±0.4^b
Control	91.7±4.9^a	307.6±33.2^d	218.2±30.0^d	2.6±0.4^c	11.7±4.0^b	1.2±0.0^a

Each value represent mean ± standard deviation. Mean with the same superscript across rows are not significantly different ($P< 0.05$)

3.3 Nutritional composition of fluted pumpkin (*Telfairia occidentalis*) planted with bee hive waste and pig manure

Table 3.4 presents the proximate values for fluted pumpkin grown using two different fertilizers: bee hive waste and pig manure. The results indicate that the fluted pumpkin cultivated with bee hive waste possessed significantly higher nutritional values ($P<0.05$) compared to that grown with pig manure. Fluted pumpkin fertilized with bee hive waste recorded higher percentages of ash (5.35±0.62%), lipid (5.46±0.49%), fiber (19.56±0.22%), and protein (13.19±0.71%). It had a moisture content of 16.67±1.77% and a carbohydrate content of 40.77±0.04%. Fluted pumpkin fertilized with pig manure recorded generally lower values across these metrics: ash (5.13±0.14%), lipid (3.95±0.05%), fiber (17.05±0.04%), and protein (9.59±0.71%). This group had a higher moisture (17.03±1.40%) and carbohydrate content (47.25±0.05%).

Table 3.4: Proximate values of fluted pumpkin (*Telfairia occidentalis*) planted with bee hives and pig manure

Nutrient Compositions	Proximate Values (%)	
	Pumpkin + Bee hive waste	Pumpkin + Pig Manure
Ash Content	5.35±0.62^{a}	5.13±0.14^{b}
Moisture Content	16.67±1.77^{b}	17.03±1.40^{a}
Crude Lipids Content	5.46±0.49^{b}	3.95±0.05^{a}
Crude Fiber Content	19.56±0.22^{a}	17.05±0.04^{b}
Crude Protein	13.19±0.71^{b}	9.59±0.71^{a}
Carbohydrate Content	40.77±0.04^{a}	47.25±0.05^{b}

Each value represent mean ± standard deviation. Mean with the same superscript across rows are not significantly different ($P < 0.05$)

4.0 Discussion

Applying manure to plants generally has a positive effect on their growth and yield by providing essential nutrients, improving soil structure, and increasing water retention capacity, leading to larger plant size, higher biomass production, and greater crop yields. In this particular study, plants that were treated with bee hive and pig manures had better growth and yield. From this study, it appears that the bee hives and pig manure retained higher moisture content than the control soil. These suggest that both bee hives and pig manure has the ability to increase soil moisture content. The improvement in soil moisture content could also be attributed to increase in organic matter content as a result of bee hives and pig manure application. Organic manure is usually applied at higher rates, relative to inorganic fertilizers. Organic manure, thereby improves soil fertility by activating soil microbial biomass. In this study, beehive waste led to higher concentrations of organic carbon (1.78%), organic matter (3.17%), Nitrogen (N), Phosphorus (P), and Potassium (K) in the soil compared to pig manure and control samples. The concentration of exchangeable cations Ca^{2+}, K^{+} and Mg^{2} were adequate for fluted pumpkin (*Telfairia occidentalis*) production (Akinrinde and Obigbesan, 2019).

Adesodun *et al*. (2020) had found that application of manure to soil increased the organic matter, N and P and aggregate stability. The higher physical properties in bee hives and pig manure in this study is responsible for the higher growth and yield than that of the control soil. It is ascertained that improved nutrient contents in bee hives and pig manure led to increased uptake of N, P, K, Ca and Mg by fluted pumpkin in this study. Although both bee hives and Pig manure had positive effects on growth and yield of fluted pumpkin, but Pig manure had higher growth and yield than the bee hives and this could be attributed to the fact that pig manure contained essential nutrient elements associated with high photosynthetic activities and thus promotes roots and vegetative growth (Mpanga *et al*., 2021). All the treatments had a greater number of leaves than the control soil, this could also be the reason they had higher significant growth and yield rate. The highest shoot yield was obtained using 1.5 kg of pig manure (2.8 kg/m^{2}), which was significantly higher than the best beehive waste treatment (1.8 kg/m^{2}).

According to Dauda *et al*. (2021), who worked on melon, increase in the number of leaves means plants are more able to receive greater amount of radiation which in turn increases the photosynthetic rate of the plant, resulting into greater quantity of fruits. The low yield of fluted pumpkin from the control soil was as a result of low nutrient uptake by the plants which agrees with the findings of Akanbi *et al*. (2021) where similar reports were also obtained.

In this study, fluted pumpkin fertilized with bee hive waste recorded higher percentages of ash (5.35±0.62%), lipid (5.46±0.49%), fiber (19.56±0.22%), and protein (13.19±0.71%). It had a moisture content of 16.67±1.77% and a carbohydrate content of 40.77±0.04%. However, the highest crude protein content recorded in fluted pumpkin treated with bee hives might be because organic materials are more readily available in bee hives since manures have to be slowly decomposed and organic nutrients mineralized.

Also, fluted pumpkin fertilized with pig manure recorded generally lower values across these metrics: ash (5.13±0.14%), lipid (3.95±0.05%), fiber (17.05±0.04%), and protein (9.59±0.71%). This group had a higher moisture (17.03±1.40%) and carbohydrate content (47.25±0.05%). Nutrients contained in manure are released more slowly and are stored for a longer time in the soil ensuring longer residual effects, improved root development and higher crop yield. This was also observed by Aluko and Oyedele (2020), who reported that slow decomposition of organic material releases the nutrients over a long time during the crop growth period and also improves soil properties. A crucial finding was that while pig manure led to a larger harvest, the fluted pumpkins grown with beehive waste had significantly higher nutritional values across several key metrics (P<0.05). A crucial finding was that while pig manure led to a larger harvest, the fluted pumpkins grown with beehive waste had significantly higher nutritional values across several key metrics (P<0.05).

4.1 Conclusion

The study found that organic manures significantly boost fluted pumpkin growth, yield, and nutrition, with pig manure leading to the best physical growth (leaf/vine size) and bee hive waste yielding the most nutritious leaves. Both are excellent, affordable choices for farmers seeking higher quality produce and improved soil health and fertility.

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