GROWTH AND ESTABLISHMENT PARAMETERS OF DUAL-PURPOSE LEGUMES AS INFLUENCED BY THREE ORGANIC FERTILIZERS IN THE COASTAL RAINFOREST OF AKWA IBOM STATE, NIGERIA

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***Received** September 29, 2023; **Revised** November 25, 2023; **Accepted** January 01, 2024*

ABSTRACT

This study, conducted in Obio Akpa, Abak Local Government Area of Akwa Ibom State, Nigeria, explores the impact of various organic fertilizers on the growth and establishment parameters of dual-purpose legume types in the coastal rainforest. Specifically, it investigates the growth of cowpea, groundnut and soya bean crops over a five-week period. Leveraging the unique ecological and climatic conditions of the region, a randomized complete block design (RCBD) was employed to ensure the reliability and robustness of the results. The study encompasses four distinct treatments, including a control group and the application of goat droppings, poultry droppings and pig dung as organic fertilizers. Findings reveal significant variations in crop growth parameters, with a particular focus on mean leaf number and leaf length, among the different treatments. Remarkably, goat droppings, pig dung and poultry droppings consistently exhibited substantial positive effects on crop growth, surpassing the performance of the control conditions. These findings provide valuable insights into the optimization of organic fertilizer selection based on the specific requirements of crops in coastal rainforest environments, thereby enhancing agricultural sustainability and productivity. The results of this study have far-reaching implications for addressing agricultural sustainability challenges, especially in regions like Nigeria, where agriculture serves as a fundamental pillar of the economy and food security. By tailoring organic fertilizer choices to suit the needs of different crops, farmers can significantly enhance their yields and contribute to the overall prosperity of their communities and the nation.

Keywords: Legumes, Organic fertilizers, Growth parameters, Coastal rainforest, Akwa Ibom State

INTRODUCTION

Agricultural sustainability is a pressing concern in the twenty-first century, especially in developing nations like Nigeria, where the agricultural sector plays a pivotal role in the nation's economy and food security (FAO, 2020). To address this concern, there is a growing interest in sustainable farming practices, including the use of organic fertilizers as alternatives to synthetic fertilizers (Gottschalk *et al.*, 2012). The significance of studying the growth and establishment parameters of dual-purpose legumes, such as Cowpea (*Vigna unguiculata* L. (Walp) Fabales: Fabaceae), Groundnut (*Arachis hypogaea* L. Fabales: Fabaceae) and Soya bean (*Glycine max* L. (Merr) Fabales: Fabaceae), cannot be overstated due to their dual contributions to both food and forage production (Velten *et al.*, 2015). The choice of organic fertilizers as soil supplements, such as poultry droppings, goat droppings and pig dung, is of paramount importance. Their impact on plant development and establishment varies considerably depending on factors like nutrient content and microbial activity (Elnour *et al.*, 2018). Understanding these differences is crucial for optimizing agricultural practices and ensuring sustainable long-term food production (Phooi *et al.*, 2022). In the coastal rainforest region of Akwa Ibom State, Nigeria, investigating how various organic fertilizers influence the growth and establishment of dual-purpose legumes is particularly significant. This region boasts unique ecological features, characterized by high rainfall, warm temperature and rich biodiversity (Olowokudejo and Oyebanji, 2016). These environmental conditions offer both opportunities and challenges for agriculture. While the abundant rainfall can leach nutrients from the soil, it also provides favorable conditions for plant growth (Neina, 2019). Dual-purpose legumes offer a multitude of benefits. They not only supply nutritious food for human consumption but also serve as valuable sources of forage for livestock, a critical aspect in regions where both crop and livestock production are essential components of the agricultural system (Kulkarni *et al.,* 2018). Furthermore, the adoption of organic fertilizers as soil amendments aligns with the global movement toward sustainable and environmentally friendly agricultural practices, aiming to reduce the use of synthetic fertilizers and mitigate their associated environmental impacts (FAO, 2020). Currently, research on the growth and establishment parameters of dual-purpose legumes influenced by organic fertilizers in the coastal rainforest of Akwa Ibom State is limited (Olowokudejo and Oyebanji, 2016). Thus, this study seeks to bridge this knowledge gap by systematically investigating the effects of three types of organic fertilizers poultry droppings, goat droppings and pig dung on the growth and establishment of Cowpea, Groundnut and Soya bean. Through rigorous scientific analysis and experimentation, this research aims to provide valuable insights that can inform agricultural practices in the region, promote sustainable farming techniques and contribute to food security and economic development in Akwa Ibom State and beyond (Velten *et al.*, 2015).

MATERIALS AND METHODS

Description of the Study Area: The study was conducted between March and May 2023 at the Pasture Research Farm of the Department of Animal Science. Obio Akpa, situated within Oruk Anam Local Government Area of Akwa Ibom State, Nigeria, is a region of notable natural beauty. It is distinguished by its rich and diverse vegetation, which is representative of the coastal rainforest climate that prevails in this area. This climate is marked by regular and substantial rainfall, making it a favourable and conducive environment for agricultural endeavors that can be sustained year-round. The geographical features, soil composition and climatic conditions of the study area collectively render it an exceptional location for conducting agricultural research. The area lies between latitude $4^{o}30'$N and $5^{o}00'$N and longitude $7^{o}30'$E and $8^{o}00$E (Wikipedia, 2022).

Experimental Design: The study employed a randomized complete block design (RCBD) with 4 blocks and 16 plots in total. Each block consisted of 4 plots and each plot represented a distinct treatment. The arrangement of the blocks and plots was randomly assigned to minimize the influence of external factors on the results.

Soil Analysis: Soil samples were collected from various depths, encompassing the topsoil (0 – 15 cm) and subsoil (15 – 30 cm), using standard soil sampling equipment such as soil augers and soil corers. Upon collection, the soil samples underwent air-drying to ensure uniform moisture levels and maintain consistency. The samples were then dispatched to the Physical Chemistry Laboratory of Akwa Ibom State University for in-depth analysis. The pH levels were determined using Thermo Scientific Orion Star A211 pH Bench Top Meter with the soil-water suspension method (Ashbrook and Houts, 2001). The organic matter content was assessed using Tyurin's method (Kumar *et al*., 2021). For the evaluation of nutrient availability (N, P, K, Ca, Mg and S), the available soil N was estimated through the alkaline permanganate method (Sahrawat and Burford, 1982), the available P was analyzed using the Bray 1 and Mehlich 3 methods (Gutierrez Boem *et al*., 2011), and the available soil K was measured using the 1 N ammonium acetate extraction method (Edmeades and Clinton, 1981).

The concentrations of essential micronutrients (Fe, Mn, Cu, Zn, B and Mo) were determined using advanced techniques, such as atomic absorption spectrophotometry and inductively coupled plasma-optical emission spectrometry (ICP-OES) (Oliveira *et al*., 2010). The soil texture was evaluated using the hydrometer method (Beretta *et al*., 2014). Additionally, the analysis included the determination of cation exchange capacity (CEC) using the Leaching method (Siregar *et al*., 2021), and base saturation was examined to comprehend the soil's nutrient retention capabilities (Zhang, 2010).

Legume Management: The legume species used were cowpea (*V. unguiculata*), soya bean (*G. max*) and groundnut (*A. hypogaea*) seeds. Sourced from the Akwa Ibom State University Research Farm and were subjected to a pre-germination treatment. They were soaked in water for 12 hours and then allowed to germinate in a controlled environment at 28°C for 48 hours. Following germination, the seedlings were transplanted to the experimental plot which was measured at 3 × 5 meters, and the spacing between the seedlings was kept at 50 centimeters to ensure that the resources were used effectively. To maintain consistency, 3 to 4 seedlings were planted at each 50-centimeter interval.

Treatment: The experimental setup involved a meticulously designed framework to examine the influence of various organic fertilizers on the growth and development of three significant legume crops — cowpea, groundnut and soya beans. The study was organized into four distinct treatments, each of which consisted of three replications for accurate and reliable data collection and analysis.

Control Treatment: This treatment involved the cultivation of legume crops without the application of any manure. It allowed for the assessment of natural growth and development under standard environmental conditions.

Goat Droppings Treatment: In this treatment, goat droppings was applied at a rate of 50 kg/acre to capitalize on its renowned nutrient-rich composition, particularly abundant in nitrogen (N), phosphorus (P) and potassium (K), known for promoting plant growth (Abdulraheem and Lawal, 2021). This treatment aimed to evaluate the impact of these goat droppings on the growth of the legume crops.

Poultry Droppings Treatment: The utilization of poultry droppings, rich in all 13 essential plant nutrients including N, P, K, calcium (Ca), magnesium (Mg), sulfur (S), manganese (Mn), copper (Cu), zinc (Zn), chlorine (Cl), boron (B), iron (Fe), molybdenum (Mo) and organic matter (OM), applied at a rate of 40 kg/acre, provided a comprehensive array of nutrients essential for robust plant development (Chastain *et al.,* 2001). This treatment sought to uncover the specific effects of these nutrient-dense components on the legume crops.

Pig Dung Treatment: Similarly, the application of pig dung at a rate of 60 kg/acre, recognized for its wealth of essential plant nutrients, such as N, P, K, Ca, Mg, S, Mn, Cu, Zn, Cl, B, Fe, Mo and OM, shed light on its potential contributions to the growth and establishment of the legumes (Chastain *et al*., 1999).

Manure Analyses: Important nutrients in the manures which included N, P and K were analyzed using the Inductively Coupled Plasma (ICP) Spectroscopy Technique (Bartos *et al*., 2014). Other essential nutrients such as Ca, Mg and S, as well as trace elements like Fe, Mn, Cu, Zn, B and Mo were also determined using Atomic Absorption Spectroscopy (AAS) (Gilles de Pelichy *et al*., 1997).

Organic matter in the manures was also analyzed using the Walkley-Black method (Enang *et al.*, 2018) with a view to understanding its role in soil organic carbon levels and its impact on soil quality and fertility. The presence and effects of helpful microorganisms were also investigated with the aid of microbiological culture techniques (Adegunloye *et al.*, 2007) with the aim to understand how they make nutrients more available and create a healthy environment in the soil.

Harmful substances and germs were investigated in the organic manures using microbiological culture techniques. This was important to ensure the safe use of these manures without harming the environment.

Plant Growth Characteristics: Ten plants each plots were used to determine key growth parameters, including leaf number (LN), leaf length (LL), plant height (PH) measured in centimeters. Measurement and recording were done using a 30 metre flexible tape and exercise book on two weeks interval for ten weeks (five times). Within each plot, a systematic sampling approach was adopted, with a designated number of plants per plot selected for data collection and analysis.

Data Analysis: The collected data was analyzed using Analysis of Variance (ANOVA) to test for significant differences between mean values of tested growth parameters, while the New Duncan Multiple Range Test was used to separate significant means. The level of significance was set at $p<0.05$. All analyses were done using IBM SPSS 21 (IBM, 2012).

RESULTS

The soil parameters across the four plots are summarized in Table 1. The pH levels ranged from 6.4 to 6.7, indicating a moderately acidic soil environment. Organic matter content varied slightly between 2.8 and 3.2%, suggesting favorable conditions for nutrient retention and microbial activity. Nitrogen levels were within the range of 26 to 29 mg/kg, while P and K levels ranged from 18 to 21 mg/kg and 16 to 19 mg/kg, respectively. Essential micronutrients such as Fe, Mn, Cu, Zn, B and Mo demonstrated consistent levels across the four plots, which inferred adequate availability for healthy plant development and growth.

The application rates of different organic manures across the four plots are presented in Table 2. Goat Droppings were applied at rates ranging from 47 to 51 kg/acre, while Poultry Droppings were applied at rates between 38 and 42 kg/acre. Pig dung application rates varied from 58 to 62 kg/acre. These application rates provides insights into the quantity of organic nutrients introduced to each plot, facilitating an understanding of their potential contributions to soil fertility and crop development.

From the results of Table 3 on cowpea, groundnut and soya bean growths, their control conditions had a significant increase in leaf numbers over the five-week period, demonstrating the crops' responsiveness to these conditions. Cowpea under control treatment showed an increase from 9.33 ± 1.86 to 95.00 ± 43.00 in mean leaf number.

Organic inputs such as goat droppings and pig dung, though initially slower in growth compared to the control, displayed a delayed yet more robust growth pattern. By week 5, they surpassed the control, with mean leaf numbers of 132.00 ± 24.25 and 113.00 ± 47.03 respectively and this growth difference was statistically significant ($p<0.05$) over time. Poultry droppings, while slower initially, also resulted in a significant increase ($p<0.05$) in mean leaf number (92.33 ± 28.69) by week 5.

Groundnut, under control conditions, exhibited strong and consistent growth, with mean leaf number rising from 36.00 ± 4.04 to 673.33 ± 39.49 over the study period. Goat droppings and pig dung treatments, despite initial fluctuations, caught up with the control by week 5, reaching mean leaf numbers of 826.67 ± 107.56 and 722.67 ± 158.68 respectively, with a significant increase ($p<0.05$) in mean leaf number over time. Poultry droppings consistently increased leaf numbers and surpassed the control by Week 4, reaching 945.33 ± 92.73 by Week 5.

Table 1: Soil nutrient composition of soil samples from four representative plots from the experimental site

Soil Parameter	Plot 1 (mg/kg)	Plot 2 (mg/kg)	Plot 3 (mg/kg)	Plot 4 (mg/kg)
pH	6.5	6.6	6.4	6.7
Organic matter	3.0	2.9	3.2	2.8
Nitrogen (N)	28	27	29	26
Phosphorus (P)	20	18	21	19
Potassium (K)	18	16	19	17
Iron (Fe)	4.0	3.9	4.2	3.8
Manganese (Mn)	2.5	2.3	2.6	2.4
Copper (Cu)	1.6	1.4	1.7	1.5
Zinc (Zn)	2.0	1.8	2.1	1.9
Boron (B)	1.0	0.8	1.1	0.9
Molybdenum (Mo)	0.8	0.6	0.9	0.7

Table 2: The chemical and organic composition of each of the four different organic fertilizers

Component	Soil + Pig Dung (%)	Soil + Poultry Droppings (%)	Soil + Goat Droppings (%)	Soil (Control) (%)
Organic matter	30 – 50	50 – 70	40 – 60	15 – 25
Nitrogen (N)	0.5 – 1.5	2.5 – 4.0	1.0 – 2.5	0.1 – 0.3
Phosphorus (P)	0.3 – 1.0	2.0 – 3.5	0.5 – 1.5	0.1 – 0.3
Potassium (K)	0.2 – 0.5	1.0 – 2.5	0.3 – 1.0	0.1 – 0.3
Carbon (C)	20 – 40	20 – 40	20 – 40	10 – 20
Moisture content	70 – 80	30 – 50	30 – 50	5 – 2
Trace elements	Yes	Yes	Yes	Negligible

In soya bean growth, control conditions led to steady and significant growth, with mean leaf number increasing from 11.67 ± 3.84 to 343.00 ± 89.84 in five weeks. Goat droppings and pig dung, though initially lagging behind, exhibited a delayed yet competitive growth pattern, resulting in significant increases in mean leaf number (718.33 ± 4.63 and 614.00 ± 40.45 respectively) by Week 5. Poultry droppings, while slower initially, consistently increased mean leaf number, with statistically significant results ($p<0.05$) for all weeks.

Overall, the study demonstrated that most treatments, including organic inputs like goat droppings, pig dung and poultry droppings, had a significant positive impact on crop growth over time, making them effective alternatives or supplements to conventional control conditions for enhancing crop yields.

Cowpea exhibited significant leaf length growth in control conditions, increasing from 2.67 ± 0.33 cm in Week 1 to 9.00 ± 1.53 cm in Week 5. The leaf length growth of cowpea grown with goat droppings showed rapid growth, becoming statistically significant over time ($p<0.05$) and reaching 12.33 ± 0.33 cm in Week 5.

The leaf length growth of cowpea grown with pig dung also had significant growth ($p<0.05$) from 3.00 ± 0.58 cm to 11.33 ± 0.88 cm in Week 5. Furthermore, the leaf length growth of cowpea grown with poultry droppings, although slower initially, were consistently significant ($p<0.05$) at 9.67 ± 0.88 cm in Week 5 (Table 4).

Groundnut had gradual growth in control (2.67 ± 0.33 to 5.67 ± 0.33 cm). Goat droppings and pig dung displayed consistent but statistically insignificant growth ($p>0.05$). Poultry droppings led to consistent but slower growth, remaining statistically significant ($p<0.05$).

Soya bean in control conditions grew steadily (4.67 ± 0.33 to 10.67 ±0.33 cm). Goat droppings and pig dung showed inconsistent and statistically insignificant growth ($p>0.05$). Poultry droppings exhibited slightly slower but significant growth ($p<0.05$), reaching 11.00 ± 0.33 cm in Week 5.

The results highlight the significant impact of organic inputs, particularly goat droppings, pig dung and poultry droppings, on crop growth over time. While control conditions remain viable for some crops like cowpea and groundnut, these organic treatments offer promising alternatives or supplements for enhancing crop yields. Farmers can benefit from tailoring their choice of organic inputs based on specific crop requirements, contributing to improved agricultural sustainability and productivity.

The study investigated the effect of four different organic fertilizers (control, goat droppings, pig dung and poultry droppings) on the growth of cowpea, groundnut and soya bean plants over a five-week period.

For cowpea, all fertilizers showed a significant increase ($p<0.05$) in plant height from Week 2 onwards compared to the control. Goat droppings exhibited the fastest growth, with plant height starting at 8.33 ± 0.88 cm in Week 1 and reaching 52.00 ± 3.00 cm by Week 5 (Table 5).

For groundnut, both goat droppings and pig dung showed to faster growth compared to the control. In Week 1, plant height was 7.00 ± 0.00 cm for groundnut grown with goat droppings and 6.00 ±0.00 cm for groundnut grown with pig dung, reaching 40.67 ± 4.06 cm and 30.00 ± 3.79 cm respectively by Week 5 (Table 5).

Regarding soya bean, all fertilizers resulted in significantly higher ($p<0.05$) growth from Week 2 onwards compared to the control. Soya bean grown with poultry droppings had the highest growth, with plant height starting at 9.67 ± 1.86 cm in Week 1 and reaching 250.00 ± 26.46 cm in Week 5 (Table 5).

The use of organic fertilizers, particularly goat and poultry droppings, had positive and statistically significant impact on the growth of these crops, with variations in growth rates and timing of significance across plant types.

DISCUSSION

A comprehensive five-week study conducted in the coastal rainforest region of Akwa Ibom State, Nigeria, evaluated the impact of three distinct organic fertilizers — goat droppings, poultry droppings and pig dung on the growth of cowpea, groundnut and soya bean plants.

Goat droppings, applied at a rate of 50 kg/acre, were singled out for their nutrient-rich composition, particularly high in N, P and K. These elements play pivotal roles in promoting plant growth and development. Nitrogen is essential for leaf and stem development, phosphorus contributes to root development and flowering, while potassium is crucial for overall plant health and stress resistance (Abdulraheem and Lawal, 2021). The nutrient richness of goat droppings makes them an attractive choice for providing these essential elements to crops.

Poultry droppings, applied at 40 kg/acre, stood out due to their comprehensive array of 13 essential plant nutrients. This diversity includes N, P, K, Ca, Mg, S, Mn, Cu, Zn, Cl, B, Fe and Mo (Chastain *et al.*, 2001). The presence of such a wide range of nutrients in poultry droppings provides a holistic approach to supporting various aspects of plant health and growth. This makes poultry droppings a valuable fertilizer option for supplying a complete set of nutrients necessary for optimal plant development.

Pig dung, applied at a rate of 60 kg/acre, was recognized for its wealth of essential nutrients as documented by Chastain *et al.* (1999). The nutrient profile of pig dung includes N, P, K, Ca, Mg, S, Mn, Cu, Zn, Cl, B, Fe and Mo. Similar to poultry droppings, pig dung offers a diverse array of nutrients, contributing significantly to the overall nutritional needs of plants. This richness positions pig dung as a valuable organic fertilizer choice for supporting plant growth.

The positive impact on plant growth from various organic fertilizers, especially goat droppings and pig dung, aligned with the findings of Sanni and Adenubi (2015). This alignment serves to affirm the credibility of the current study's results concerning the beneficial effects on cowpea and groundnut.

However, a complex situation emerged in the growth of soya beans among the organic inputs, deviating from the expected uniform responses. This contrasted with the anticipation of positive effects from organic fertilizers. Shaji *et al.* (2021) and Phooi *et al.* (2022) also studied soya bean growth, but their results differ from the findings of this study and create room for further investigation.

Table 3: The effect of four different organic fertilizers treatment on the leaf's numbers of cowpea, groundnut and soya bean across five weeks

Treatment		Number of leaf (Mean ± SE)				
		Week 1	Week 2	Week 3	Week 4	Week 5
Cowpea	Control	9.33 ± 1.86^{a3}	15.33 ± 1.33^{b3}	31.67 ± 6.69^{c4}	46.67 ± 13.72^{d2}	95.00 ± 43.00^{e2}
	Goat droppings	7.00 ± 1.16^{b2}	12.00 ± 2.89^{b1}	24.67 ± 3.38^{c2}	47.33 ± 9.84^{d2}	132.00 ± 24.25^{e4}
	Pig dung	8.67 ± 0.88^{a3}	15.33 ± 0.67^{b3}	26.67 ± 2.33^{c3}	53.00 ± 8.15^{d3}	113.00 ± 47.03^{e3}
	Poultry droppings	6.33 ± 0.67^{a1}	13.00 ± 0.00^{b2}	24.00 ± 3.00^{c1}	40.67 ± 9.03^{d1}	92.33 ± 28.69^{e1}
Groundnut	Control	36.00 ± 4.04^{a2}	56.67 ± 6.94^{b2}	159.00 ± 17.16^{c2}	304.00 ± 10.07^{d2}	673.33 ± 39.49^{e1}
	Goat droppings	49.33 ± 6.64^{b4}	46.67 ± 10.67^{a1}	201.33 ± 50.19^{c3}	393.33 ± 80.34^{d3}	826.67 ± 107.56^{e3}
	Pig dung	41.00 ± 8.08^{a3}	57.00 ± 9.29^{b3}	146.00 ± 13.65^{c1}	285.33 ± 18.81^{d1}	722.67 ± 158.68^{e2}
	Poultry droppings	33.33 ± 1.76^{a1}	90.00 ± 12.50^{b4}	229.67 ± 17.95^{c4}	422.67 ± 13.92^{d4}	945.33 ± 92.73^{e4}
Soya bean	Control	11.67 ± 3.8^{a2}	20.00 ± 1.73^{b1}	61.67 ± 4.98^{c1}	113.67 ± 7.88^{d1}	343.00 ± 89.84^{e1}
	Goat droppings	11.67 ± 3.93^{a2}	40.67 ± 6.49^{b4}	134.00 ± 19.70^{c4}	255.00 ± 32.08^{d4}	718.33 ± 4.63^{e4}
	Pig dung	7.33 ± 3.33^{a1}	32.33 ± 2.19^{b2}	121.00 ± 19.43^{c2}	241.00 ± 69.64^{d2}	614.00 ± 40.45^{e3}
	Poultry droppings	17.33 ± 1.76^{a3}	37.00 ± 3.61^{b3}	123.00 ± 12.49^{c3}	252.00 ± 66.09^{d3}	478.67 ± 71.18^{e2}

$^{a-e}$ Means with different letter superscript along the same row differ significantly ($p<0.05$), $^{1-4}$ Means with different number superscript along the same column for each legume differ significantly ($p<0.05$)

Table 4: The effect of four different organic fertilizers treatments on the leaf length of cowpea, groundnut and soya bean for five weeks

Treatment		Leaf length (cm) (Mean ± SE)				
		Week 1	Week 2	Week 3	Week 4	Week 5
Cowpea	**Control**	2.67 ± 0.33^{a1}	5.00 ± 0.57^{b2}	6.00 ± 0.58^{c1}	8.33 ± 1.33^{d2}	$9.00 \pm 1.53e^{1}$
	Goat droppings	3.00 ± 0.00^{a2}	5.00 ± 0.58^{b2}	6.67 ± 1.33^{c3}	10.00 ± 1.00^{d4}	12.33 ± 0.33^{e4}
	Pig dung	3.00 ± 577^{a2}	5.00 ± 0.58^{b2}	6.33 ± 0.33^{c2}	9.00 ± 0.58^{d3}	11.33 ± 0.88^{e3}
	Poultry droppings	2.67 ± 0.33^{a1}	4.67 ± 0.33^{b1}	6.00 ± 1.16^{c1}	7.00 ± 1.16^{d1}	9.67 ± 0.88^{e2}
Groundnut	**Control**	2.67 ± 0.33^{a2}	2.67 ± 0.33^{a1}	4.00 ± 0.00^{b2}	4.33 ± 0.33^{c3}	5.67 ± 0.33^{d3}
	Goat droppings	2.00 ± 0.00^{a1}	3.00 ± 0.00^{b2}	3.67 ± 0.33^{c1}	4.33 ± 0.33^{d3}	5.00 ± 0.58^{e2}
	Pig dung	2.00 ± 0.00^{a1}	2.67 ± 0.33^{b1}	4.00 ± 0.00^{d2}	3.67 ± 0.33^{c1}	4.00 ± 0.00^{d1}
	Poultry droppings	2.00 ± 0.00^{a1}	2.67 ± 0.33^{b1}	3.67 ± 0.33^{c1}	4.00 ± 0.00^{d2}	4.33 ± 0.33^{e1}
Soya bean	**Control**	4.67 ± 0.33^{a1}	9.67 ± 0.88^{b1}	9.67 ± 0.88^{b1}	10.00 ± 0.58^{c1}	10.67 ± 333^{d1}
	Goat droppings	5.33 ± 0.33^{a2}	9.33 ± 667^{b1}	10.00 ± 0.58^{c2}	11.00 ± 0.58^{d3}	11.00 ± 0.58^{d2}
	Pig dung	5.67 ± 0.33^{a2}	11.33 ± 0.67^{c2}	11.33 ± 0.33^{c3}	10.33 ± 0.33^{b2}	10.67 ± 0.33^{b1}
	Poultry droppings	5.67 ± 0.33^{a3}	11.67 ± 0.33^{d2}	11.00 ± 0.00^{c3}	10.33 ± 0.33^{b2}	11.00 ± 0.00^{c2}

$^{a-e}$ Means with different letter superscript along the same row differ significantly ($p<0.05$), $^{1-4}$ Means with different number superscript along the same column for each legume differ significantly ($p<0.05$)

Table 5: The effect of four different organic fertilizers treatments on the plant height of cowpea, groundnut and soya bean for five weeks

Treatment		Plant height (cm) (Mean ± SE)				
		Week 1	**Week 2**	**Week 3**	**Week 4**	**Week 5**
Cowpea	**Control**	7.67 ± 0.33[a2]	17.33 ± 1.76[b4]	27.00 ± 2.65[c4]	35.33 ± 3.53[d3]	45.33 ± 5.49[e2]
	Goat droppings	8.33 ± 0.88[a3]	13.00 ± 1.52[b2]	23.00 ± 4.359[c2]	34.67 ± 4.33[d2]	52.00 ± 3.00[e4]
	Pig dung	8.67 ± 1.45[a4]	15.67 ± 1.76[b3]	26.67 ± 2.73[c3]	37.33 ± 2.19[d4]	49.67 ± 2.33[e3]
	Poultry droppings	6.67 ± 0.67[a1]	12.33 ± 1.45[b1]	21.33 ± 3.18[c1]	29.33 ± 2.67[d1]	36.67 ± 5.81[e1]
Groundnut	**Control**	6.00 ± 0.00[a1]	12.33 ± 1.20[b2]	16.00 ± 0.58[c2]	22.00 ± 0.58[d3]	33.33 ± 2.33[e2]
	Goat droppings	7.00 ± 0.00[a2]	12.67 ± 1.45[b2]	20.67 ± 0.33[c4]	25.33 ± 0.33[d4]	40.67 ± 4.06[e4]
	Pig dung	6.00 ± 0.00[a1]	9.33 ± 0.88[b1]	14.67 ± 1.33[c1]	19.67 ± 1.33[d1]	30.00 ± 3.79[e1]
	Poultry droppings	6.00 ± 0.58[a1]	13.00 ± 0.58[b3]	19.33 ± 1.45[c3]	21.67 ± 0.33[d2]	36.33 ± 3.18[e3]
Soya bean	**Control**	7.33 ± 0.33[a1]	14.33 ± 1.33[b1]	60.33 ± 10.65[c1]	113.00 ± 27.06[d1]	170.00 ± 20.82[e1]
	Goat droppings	8.00 ± 1.16[a2]	20.67 ± 3.71[b4]	79.33 ± 16.83[c3]	137.67 ± 28.67[d2]	213.33 ± 14.53[e3]
	Pig dung	9.33 ± 0.33[a3]	17.33 ± 1.45[b2]	67.67 ± 6.98[c2]	137.33 ± 25.01[d2]	209.00 ± 15.82[e2]
	Poultry droppings	9.67 ± 1.86[a4]	18.67 ± 0.67[b3]	87.00 ± 16.44[c4]	160.33 ± 15.71[d3]	250.00 ± 26.46[e4]

[a-e] Means with different letter superscript along the same row differ significantly ($p<0.05$), [1-4] Means with different number superscript along the same column for each legume differ significantly ($p<0.05$)

The application of organic fertilizers resulted in a noticeable increase in leaf numbers across all crops. Goat droppings and pig dung showed significant effects on enhancing the leaf numbers of cowpea and groundnut. However, soya bean growth exhibited a competitive pattern among the organic inputs, suggesting intricate interactions between fertilizer types and plant species. The findings of this study was in agreement with the findings of Adesina and Sanni (2013) that showed that the number of leaves of *Corchorus olitorus* at 2, 4 and 6 weeks after planting (WAP) and yield were significantly influence by the application of organic fertilizer compared to the control.

Assessment of leaf length revealed positive effects across board with the application of organic fertilizers. Goat droppings and pig dung, in particular, demonstrated notable effects on the leaf length of cowpea and groundnut. The results of this study aligned with the findings of Riyana *et al.* (2018) that reported positive impacts of organic fertilizers on leaf length of *Elephantopus scaber*. Conversely, soya bean growth exhibited a competitive pattern among the organic inputs, highlighting the need for further exploration into the specific conditions influencing soya bean responses.

Significant improvements in plant height were observed across all crops with the application of different organic fertilizers. Goat droppings and pig dung displayed remarkable effects on cowpea and groundnut growth. However, soya bean growth showcased a competitive pattern among the organic inputs, indicating variability in response to fertilizers. These findings were consistent with that of Adesina and Sanni (2013) that showed organic fertilizer improved the plant height of *C. olitorus* compared to the control, and Abdulraheem and Lawal (2021) who reported enhanced plant height and stem diameter in cowpea and groundnut treated with organic fertilizers.

The positive impact of organic fertilizers, especially goat droppings and pig dung, on plant growth was attributed to their rich composition of essential nutrients, corroborated findings of Awodun *et al.* (2007). Nitrogen, P and K were identified as crucial contributors to improved soil fertility and overall plant development (Jiaying *et al.*, 2022).

Scientifically, the breakdown of organic matter, microbial activity and nutrient cycling processes facilitated by organic fertilizers, as explained by Lin *et al.* (2023), provided insights into the observed phenomenon. This breakdown not only enhances nutrient availability but also promotes root development, leading to improvements in plant height and leaf numbers.

The study contributes valuable insights to the existing body of knowledge, emphasizing the need for a nuanced understanding of crop-specific responses to organic fertilizers. Further research is warranted, especially regarding the competitive pattern observed in soya bean growth, to unravel the intricate interactions between soil conditions, fertilizer types, and plant species. Overall, the positive outcomes highlight the potential of organic fertilizers, particularly goat droppings and pig dung, as viable alternatives for promoting environmentally friendly and sustainable agricultural practices in the region (FAO, 2020).

Conclusion: The study conducted in the coastal region of Obio Akpa, within the Abak Local Government Area of Akwa Ibom State, Nigeria, has shed light on the significant impact of organic fertilizers on the growth of cowpea, groundnut and soya bean crops. This research took advantage of the region's unique ecological and climatic conditions to provide valuable insights into sustainable agricultural practices. The randomized complete block design (RCBD) used in this study ensured the reliability of the results by controlling for natural variability within the study area. The choice of treatments, including the control, goat droppings, poultry droppings and pig dung, allowed for a comprehensive assessment of the influence of these organic fertilizers on crop growth parameters over a five-week period. Notably, the results demonstrated that organic inputs, particularly goat droppings, pig dung and poultry droppings, had a significant positive impact on crop growth over time. While control conditions were viable for some crops, the organic treatments consistently outperformed in terms of mean leaf number and leaf length. This suggests that farmers in similar coastal rainforest environments can benefit from tailoring their choice of organic inputs to specific crop requirements, ultimately contributing to improved agricultural sustainability and productivity. These findings hold great significance for addressing agricultural sustainability concerns, especially in regions like Nigeria, where agriculture plays a pivotal role in the economy and food security. By optimizing the use of organic fertilizers, farmers can enhance their crop yields and contribute to the long-term well-being of their communities and the nation as a whole. This research provides a valuable foundation for future agricultural studies and practices in similar ecological settings, paving the way for more efficient and sustainable food production methods.

ACKNOWLEDGEMENTS

The authors acknowledged the management of Akwa Ibom State University for the provision of enabling research environment and research grant to carry out this research work successfully. The authors sincerely appreciate Food Science Laboratory, University of Uyo, Uyo, Animal Science Department, Akwa Ibom State University and Department of Animal Science and Technology, Federal University of Technology, Owerri for their financial contribution.

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