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RESEARCH ARTICLE

THE GROWTH AND DEVELOPMENT PATTERNS OF THE RED VARIETY OF GROUNDNUT *(ARACHIS HYPOGAEA L)* CULTIVARS ARE INFLUENCED BY THE APPLICATION OF ORGANIC MANURE

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ABSTRACT

To evaluate the influence of organic manure on the growth and development patterns of red varieties of groundnut (Arachis hypogaea. L). 30 pot samples of a groundnut variety were planted from July to September 2023 using 60 days. Organic manures consisting of poultry droppings and cow dung were applied. Four seeds were planted per pot and were subjected to 4g, 8g and 12g of both organic manures. A control group was also employed for comparison. The growth parameters measured include plant height, number of leaves and plant girth. This measurement was taken at 30, 44 and 58 days after planting. The 8g of poultry manure recorded the highest increase in plant height. For several leaves, 4g exhibited the highest number of leaves when compared to other treatments. For plant girth, poultry manure at 4g and 8g produces the same results. The control group exhibited a slower growth rate in all the parameters measured compared to those treated with poultry manure and cow dung. The absence of supplemental organic manure led to slower vertical growth. The need for the usage of organic manure is essential due to its effectiveness over cow dung and control group.

KEYWORDS

Growth, Groundnut, Organic Manure

Introduction

Peanuts, scientifically known as *Arachis hypogaea L.*, are annual legumes belonging to the *Leguminosae* family. They are considered one of the most valuable oilseed crops and were grown extensively on over 29.62 million hectares worldwide in 2023. (USDA, 2024a). The economic potential of this crop for use in human and animal nutrition is significant. In 2023, peanut grain, oil, and meal production reached 50.46 million metric tons, 6.14 million metric tons, and 7.55 million metric tons, respectively (USDA, 2024b). Peanuts are primarily cultivated in China, India, Nigeria, and the USA, covering the regions of Asia, Africa, and America. Together, these countries produce 63.5% of the world's peanut grain, 75.3% of peanut oil, and 75.8% of peanut meal/cake. (USDA, 2024b, FAO 2023). Peanut-producing regions in developing nations often have fields with low to medium yields, indicating that the soil in these countries lacks essential mineral nutrients for plant growth. (Shi et al., 2020). Asia stands out as the primary region for peanut cultivation globally, with China and India being the major producers in this region, contributing 15.7 and 5.6 metric tons, respectively, in

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2010 (FAOSTAT 2023). The production of peanuts in Africa is second only to that of other regions worldwide. Nigeria, Senegal, and Sudan are the main peanut-producing countries in this area, with production amounts of 2.6 metric tons, 1.2 metric tons, and 0.7 metric tons, respectively. (FAOSTAT 2023). Peanut production differs significantly across regions and countries, with a particular focus on those cultivated in developing nations, which have been historically utilized since the beginning of human civilization (Ibrahim et al., 2021). Groundnuts must be grown extensively in emerging nations as a food and oil crop. For instance, Nigerians have access to around 10 kg of groundnuts per person for home use. In 2021, Ibrahim et al. The average annual consumption of fat and oil per person is less than 5 kg. Based on estimates, the global groundnut production in 2000 was estimated to have been 34 million Mt, of which 15 million Mt were produced in China, 6 million Mt in India, 2 million Mt in Nigeria, 1.5 million Mt in the United States of America, and the remaining Mt mostly in other countries. Raw, boiled, or roasted peanuts are often eaten and are used as a main component in various processed foods, such as peanut butter, sweets, treats, and snack items. (Arya et al., 2016). The application of organic fertilizer and materials results in higher productivity and sustained soil health for extended periods of cultivation. The rising prices of fertilizers and their impact on the environment have created a crisis, prompting the need to find alternative sources. (Ramakrishna et al., 2017). The high oil and protein content make it very energy-rich (Vaghasia and Dobariya 2021). Once extracted, the leftover cake is typically utilized as animal feed, although it is also suitable for human consumption. Since the beginning of human history, groundnuts, particularly those grown in developing nations, have been utilized historically. It has a high-calorie content and is high in protein and oil. Finding different uses for groundnuts in food and confections is crucial. (Satpute et al., 2021). In addition, it is high in calories and high in protein and oil. Roughly 95% of global output comes from developing nations. (Tyoakoso et al., 2019). Essential quality characteristics for the final use of groundnut differ between developed and developing nations. In many developing countries, groundnuts are primarily processed for oil (Muhammad et al., 2021). Groundnuts, particularly those grown in underdeveloped nations, have been utilized historically from the dawn of humankind, despite being a strong source of protein, however, the cake that remains after the oil is extracted is not the same as groundnuts. (Ibrahim et al., 2021).

Materials and Method

Study Area

The location for this Study is Lokoja, Kogi State. Lokoja is a city located in Nigeria with the coordinates of 7° 48'8.352'' N and 6° 44' 0.0348'' E. The elevation of Lokoja is 88.534, the time zone is Africa/Lagos. Local Government Area of Kogi State with an area of 3,180 km2 and a population of approximately 1.4 million people. Lokoja is a settlement site at the confluence of rivers Niger and Benue in Nigeria. The town is well connected and accessible through state and federal highways; the town is situated between a water body and a hill including river Niger and Mount Patti respectively which has streamlined the settlement to a linear one and has a modifying effect on the climate. The residents are involved in farming ranging from Groundnut farming to fish farming. The climate is characterized by wet and dry seasons, and the annual rainfall is between 1016 mm and 1524mm with a mean annual temperature of 27^0C it is a trade centre concerning its agricultural products.

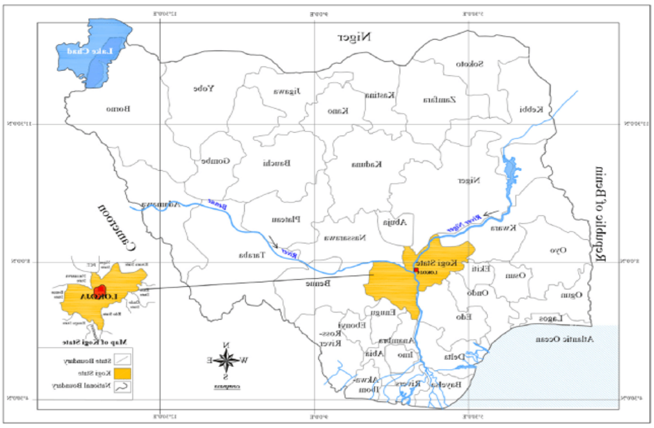

Figure 1; Map of Nigeria showing Kogi state and Lokoja in the National Setting. Source: Kogi State Ministry of Land and Environment, Lokoja. August 2023.

Soil Collection

Garden topsoil was collected from the Botanical Garden, Federal University Lokoja.

Soil Preparation and Pot Filling

The sands and top soils were thoroughly homogenized in the proportion of 1:1, this was used to fill the polythene bags. (Saha et al., 2015).

Seed Collection

Groundnut seeds were collected from the Legume Section, Ministry of Agriculture, Lokoja, Kogi state. A particular variety of groundnut was used for this research. CULTIVAR 1, the seed colour is red from the Ministry of Agriculture, Lokoja, Kogi state.

Figure 2; Groundnut red variety seeds were collected from the Legumes unit Ministry of Agriculture, Lokoja, Kogi state.

Sowing

A groundnut variety (CULTIVAR 1) was grown in the Botanical Garden. They were sown in a polythene bag and holes were bore for free escape of air and excess water 4 seeds were sown per polythene bag.

Experimental Design

A randomized complete block design (RCBD) was employed for the field experiment with poultry droppings manure and cow dung manure consisting of four levels. Without poultry droppings (B0), using poultry droppings 4t/ha (B1), 8t/ha (B2) and 12t/ha (B3). Also, without cow manure (V0), using cow dung 4t/ha (V1), 8t/ha (V2) and 12t/ha (V3). The treatment was repeated 3 times so that there were 30 experimental units. (Saha et al., 2015).

Figure 3; Randomized complete block design (RCBD) for the field experiment

Materials

The materials and tools used in this study include a Shovel or Spade, Rake, Hoe, Trowel, Ruler or Measuring Tape Hose or Watering Can, Tape Measure or Ruler, Veiner Calipers, Notebook and Pen.

Land Preparation and Plot Establishment

The selected study area has undergone land preparation, including ploughing and levelling, to create uniform plots. Each plot was well-spaced to avoid any interference between neighbouring plants. Regular weeding of unwanted plants to avoid competition with groundnut samples.

Organic Manure Application

The organic manures, including poultry droppings and Cow dung, were applied to the respective treatment plots at 4t/ha, 8t/ha and 12t/ha. (Gadade et al., 2018)

Data Collection

Data on various growth parameters was collected throughout the crop's growth stages. These parameters include plant height, number of leaves and plant girth. Measurements were taken using appropriate instruments and methods. They were collected at 30, 44, and 58 DAP (Days after planting).

Data Analysis

The collected data was subjected to statistical analysis using appropriate software. Analysis of variance (ANOVA) and mean separation tests were performed to assess the significant differences among treatments and groundnut varieties

Results

The results obtained from the study on the growth parameters of *Arachis hypogaea l* under the influence of different organic manures- poultry droppings manure and cow dung manure. The study spans over 60 days, with measurements taken on plant height, number of leaves and plant girth. The data obtained has been tabulated for easy interpretation and analysis. The plant height is measured with the aid of a meter rule while the plant girth is measured using a Vernier caliper. The number of leaves was counted manually.

Plant Height

The plant height measurements (cm) were taken at 30, 44 and 58 days after planting for each treatment group. The results show diverse growth tendencies in response to different treatments and types of organic manures. Table 1 shows the effect of poultry droppings and cow dung on the plant height of *Arachis hypogaea. L* at different growth periods. This shows that the 4g treatment of poultry manure exhibited rapid initial growth at 30-44 DAP but declined at 58 DAPS. While the 8g treatment demonstrated sustained growth over the entire period recording the highest growth in the whole treatment. The control group exhibited a relatively slower growth rate in plant height compared to the groups treated with poultry manure and cow dung.

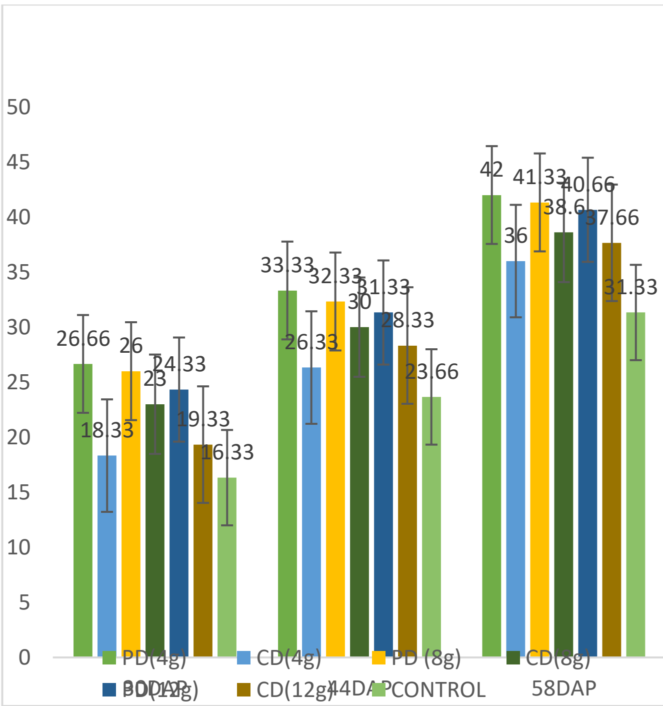

Figure 4; experimental study on the growth parameters (Plant Height) of *Arachis hypogaea* over 30, 44 and 58 days of treatment

Table 1: Effect of poultry droppings and cow dung on the plant height of *Arachis hypogaea. L* at different growth periods.

Treatment	Plant Height (cm)	Days after planting (DAP)		
		30 DAP	44 DAP	58 DAP
PD	4g	a21.67±1.89	27.90±1.97	34.20±3.29
	8g	b20.27±2.15	26.50±4.88	35.70±1.57
	12g	a19.83±1.06	25.90±1.90	30.90±2.19
CD	4g	b13.17±1.04	22.10±2.12	30.23±1.31
	8g	a19.03±2.93	26.87±2.74	34.13±3.75
	12g	14.90±3.29	26.87±2.74	33.73±2.22
Control		**15.93±2.70**	**23.27±2.08**	**31.97±2.18**

Values are mean± S.D, n=3, different letters superscript along the same column indicates the mean difference is significant at the p<0.05 level

Note: PD = Poultry droppings (2g, 4g and 8g)

CD = Cow dung (2g, 4g and 8g)

Number of Leaves

This presents the number of leaves recorded on different days for each treatment group. This parameter is crucial in assessing the nutrient status and determining the adequacy of current fertilization practices. The 4g treatment of poultry manure exhibited the highest increase in the number of leaves while the 8g of cow dung showed the highest increase. Thus, it is evident that the poultry manure (at 4g treatment) provides the highest number of leaves compared to the cow dung. The control group shows the lowest number of leaves in the whole treatment.

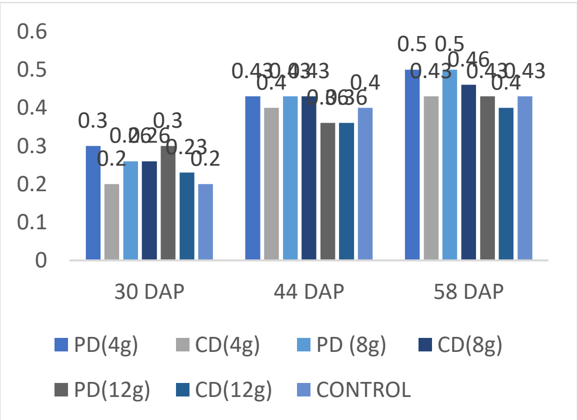

Figure 5; experimental study on the growth parameters (Number of Leaves) of *Arachis hypogaea* over 30, 44 and 58 days of treatment

Table 2: Effect of poultry droppings and cow dung on the number of leaves *of Arachis hypogaea. L* at different growth periods.

Treatment	Number of leaves (cm)	Days after planting (DAP)		
		30 DAP	44 DAP	58 DAP
PD	4g	a26.67±1.52	33.33±0.58	42.00±1.73
	8g	a26.00±3.00	32.33±3.51	41.33±2.31
	12g	24.33±1.53	31.33±3.21	40.00±4.58
CD	4g	18.33±1.15	26.33±0.58	36.00±1.31
	8g	23.00±5.00	30.00±6.00	38.67±5.77
	12g	19.33±5.03	28.33±4.73	37.67±4.93
Control		**b6.93±1.53**	**23.67±2.08**	**31.33±2.31**

Values are mean± S.D, n=3, different letters superscript along the same column indicates the mean difference is significant at the p<0.05 level

Note: PD = Poultry droppings (2g, 4g and 8g)

CD = Cow dungs (2g, 4g and 8g)

Plant Girth

This prevents the plant girth measurements taken on various days for each treatment group. This parameter is essential in assessing the girth and overall structural development of the plants. The 12g treatment of poultry manure demonstrated an initial increase in girth alongside the 4g but later declined at 44 and 58 DAP. The 4g and 8g treatment exhibited the highest increase in plant girth at 58 DAPS. The control group shows the same performance as the cow dung at the 4g treatment.

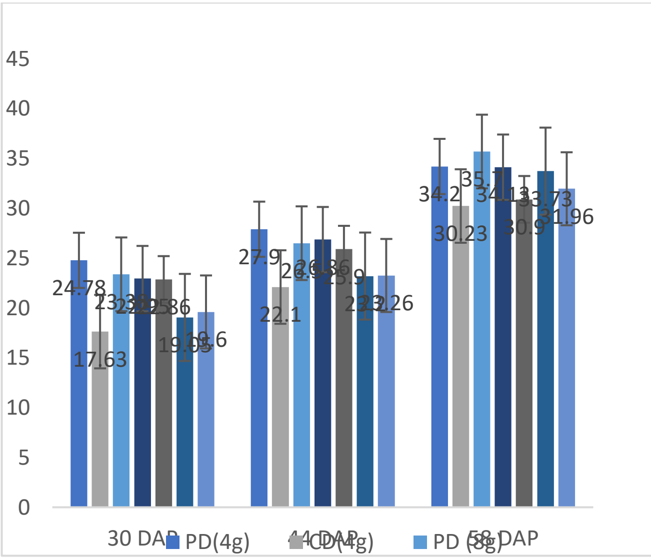

Figure 6; experimental study on the growth parameters (Plant Girth) of *Arachis hypogaea* over 30, 44 and 58 days of treatment.

Table 3: Effect of poultry droppings and cow dung on the plant girth of *Arachis hypogaea. L* at different growth periods.

Treatment	Plant Girth (cm)	Days after planting (DAP)		
		30 DAP	44 DAP	58 DAP
PD	4g	0.30±0.10	0.43±0.06	0.50±0.00
	8g	0.27±0.06	0.43±0.12	0.50±0.00
	12g	0.30±0.10	0.37±0.06	0.43± 0.06
CD	4g	0.20±0.00	0.40±0.00	0.43±0.06
	8g	0.27±0.06	0.43±0.06	0.47±0.06
	12g	0.23±0.06	0.37±0.06	0.40±0.00
Control		**0.20±0.00**	**0.40±0.00**	**0.43±0.06**

Values are mean± S.D, n=3, different letters superscript along the same column indicates the mean difference is significant at the p<0.05 level

Note: PD = Poultry droppings (2g, 4g and 8g)

CD = Cow dungs (2g, 4g and 8g)

Discussion

Groundnut productivity on marginal land can be increased by using organic manures which can increase the availability of nutrients and the microbial population which has implications for increasing plant growth. (Santos-Espinoza et al., 2021). Soil health is the foundation of productive farming practices. Fertile soil provides essential nutrients to plants (Kime, 2012). According to this research study, based on the above observations, it is evident that the type and dosage of fertilizer have a conspicuous effect on the plant height of *Arachis hypogea. L.* Soil analysis determines the nutrients available, physical, and chemical and soil properties (Arangote et al., 2019). The 4g treatment of poultry manure exhibited a rapid initial growth at 30-44 DAP but declined at 58 DAPS, while the 8g treatment demonstrated sustained growth before a more gradual increase was observed superseding the 4g treatment and having the highest record of growth in the whole treatment. Thus, the *Arachis hypogea. L* tends to show significant and remarkable growth in the plant height under poultry manure than cow dung manure as shown in Figure 4. The control group exhibited a relatively slower growth rate in plant height compared to the groups treated with poultry manure and cow dung. (Ibrahim et al., 2021). This proposes that the absence of supplemental organic manure led to slower vertical growth. Sudheer (2013). The 12g treatment of poultry manure displayed a fixed and consistent growth throughout the entire experimental period. This treatment recorded the lowest growth in the poultry manure treatments. This is in line with the work of Ahmadi et al., (2012) who proposed that poultry droppings are more concentrated in nutrients and have a higher concentration of nitrogen, phosphorous and potassium. However, Pal and Kar (2014) argued that cow dung instead contains more microorganisms that are beneficial to the soil. It also helps the soil maintain a healthy pH level therefore enhancing a notable increase in the plant height. Poultry Manure at 4g treatment displayed a consistent increase in the number of leaves recording the highest growth in the entire treatment between 30 and 58 DAPS as shown in Figure 5. The 8g treatment of poultry manure exhibited a similar growth pattern following the 4g treatments. The 12g treatment of poultry manure demonstrated the lowest number of leaves when compared to the other poultry manure treatment throughout the experimental treatment. Cow dung (8g) treatment exhibited the highest number of leaves at 30-58 DAP recording 4g to be a decreased number of leaves (Based on cow dung treatment). The control group shows the lowest number of leaves in the whole treatment. Thus, it is evident that the poultry manure (at 4g treatment) provides remarkable growth when compared to the cow dung. This theory is consistent with the works of Ahmadi (2012) who compared 4g treatment with 2g, 6g, 8g, 10g and 12g treatments and found out that 4g was the most effective of them all. The same pattern was also observed in plant Girth in Figure 6. The 4g treatment of poultry manure increased the number of leaves when compared to another treatment group. Gupta (2013). This does not correspond to the work of (Kumar et al., 2012). Moreover, the comparison revealed a highly significant difference among groups with a p-value of 0.05) provided by the ANOVA test as shown in tables 2, 3 and 4 respectively to plant height, number of leaves and plant girth. He found out that cow manure was more effective at 4g of organic manure for increasing the number of leaves than poultry manure as it has a more balanced nutrient profile that is better suited for promoting leaf growth. The plant girth measurements reveal significant growth patterns across the different treatment groups. (Satpute et al., 2021). The 12g treatment of poultry manure demonstrated an initial increase in girth alongside the 4g but later declined at 44 and 58 DAP. The 4g and 8g of the poultry manure treatment exhibited the highest increase in plant girth at 58 DAPS. The poultry manure treatment showed a significant increase in plant girth than the cow manure treatment. (Gupta et al., 2013) Supported this theory. This did not go in line with the work of (Behera et al., 2013) as they proposed the use of organic cow manure over poultry droppings for an increase in plant girth. The result has shown that groundnut tends to exhibit remarkable growth in the plant height and notable growth in the number of leaves with poultry manure and as such Poultry manure has proven more effective than cow dung. Both poultry droppings and Cow dung show a significant growth than the control group. The control group shows the same performance as the cow dung at the 4g treatment. Soil organic matter (cow dung and poultry droppings) is on-site biological decomposition that affects the soil structure and porosity, water infiltration rate, moisture, diversity and biological activity of soil organisms and nutrient availability. Soil texture influences soil fertility and the way air and water move through the soil (Macie, 2013). The enormous amount of manure produced poses a great danger and needs to be managed properly to lessen its negative effects on the environment. The health of people and animals as well as the land, surface water, and groundwater may be at risk from untreated manure. (Kiss et al., 2023)

Conclusion

The result of this project has shown that from the above study, groundnut tends to exhibit remarkable growth in the plant height under 8g of poultry manure. They show notable growth in the number of leaves under 4g of poultry manure. Poultry manure has proven more effective than cow dung. Both poultry droppings and Cow dung show a significant growth than the control group. For plant girth, poultry manure at 4g and 8g produces similar results, therefore either of the two-treatment levels can be employed in ensuring significant growth in groundnut. The control group exhibited a relatively slower growth rate in plant height, number of leaves and plant girth compared to the groups treated with poultry manure. This proposes that the absence of supplemental organic manure led to slower vertical growth.

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