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EVALUATION ON THE EFFECTS OF ORGANIC AMENDMENT ON SOIL PRODUCTIVITY OF SELECTED WATERSHEDS IN NNAMDI AZIKIWE UNIVERSITY, AWKA CAMPUS

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ABSTRACT: *This study was carried out to assess the effects of different manure concentrations as an amendment strategy on the soil productivity of the two watersheds in Nnamdi Azikiwe University Awka campus using Telfairia occidentalis as a test crop. Two watersheds in Nnamdi Azikiwe University, Awka were sampled for the study; each watershed consists of head (where the water is flowing from) and tail (the out flow area of water). An area of 600 m^2 (30 m x 20 m) was mapped out in each watershed. Random sampling methods were used in the study. The soil samples were collected separately from both the head and tail of each watershed, using potting polythene bags which were later transported to a screen house where different concentrations of cow dung, poultry manure and then inorganic fertilizer (as standard) were applied to the different soil samples collected from both the upper (head) and lower (tail) of the two watersheds. Each bag containing different manure concentration had two replicates, with a total of 64 bags in all the treatments. Then, fluted pumpkin seed was planted on each bag of the soil and monitored for early seedling growth and other morphometric parameters. The study revealed that cow dung manure performed better in almost all the parameters measured: leaf length, leaf breadth, stem height, stem girth and number of leaves. This better performance of cow dung may be as a result of difference in their C/N ratios as well as difference in nutrient composition.*

KEYWORDS: Watershed, Ecosystem, Soil, Amendment, Pumpkin, Inorganic, Fertilizer, Organic, Manure.

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INTRODUCTION

Watersheds are vital components of our natural landscapes, serving as the lifeblood of ecosystems and a source of freshwater for countless communities. Within these critical areas, a diverse range of vegetation plays a pivotal role in maintaining water quality, providing habitat for wildlife, and offering numerous ecological services. Watersheds, often referred to as drainage basins or catchment areas, are geographical regions where all precipitation, such as rain and snowmelt, drains into a common outlet, typically a river, lake, or ocean. These areas serve as essential ecological hubs and are fundamental to the health and sustainability of ecosystems. Watersheds encompass a wide variety of landscapes, from forests and wetlands to grasslands and urban areas, each characterized by unique vegetation adapted to its specific conditions. Riparian zones, the transitional areas between terrestrial and aquatic ecosystems, are a focal point of watershed vegetation. These zones, lining the banks of rivers, streams, and other water bodies, host a remarkable diversity of plant species. Riparian vegetation, which includes trees, shrubs, and herbaceous plants, is intricately linked to the health of aquatic ecosystems, as it helps to regulate water temperature, reduce sediment runoff, and provide habitat for aquatic life (Gregory *et al*., 2019).

Watershed vegetation faces various challenges, including habitat destruction, invasive species, and climate change. Human activities, such as urbanization and agriculture, can disrupt the natural vegetation of watersheds. Additionally, the introduction of non-native species can outcompete and displace native plants, altering the ecological dynamics of these critical areas (Byun *et al.,* 2018). Conservation efforts are essential to protect and restore watershed vegetation. This includes restoring riparian buffers, controlling invasive species, and promoting responsible land management practices. Such efforts are vital for maintaining the health of watersheds and the ecosystems they support. The loss or alteration of key species can have far-reaching consequences, impacting not only the ecosystem but also the communities and plant species like *Telfairia occidentalis* that rely on these water bodies for sustenance and recreation (Martin *et al*., 2020).

Telfairia occidentalis, often referred to as fluted pumpkin, is a versatile and ecologically significant plant that plays a crucial role in various ecological processes and the sustenance of biodiversity in its native regions. *T. occidentalis* is well-suited as a model organism for ecological surveys due to its adaptability, widespread distribution, and ecological interactions. It thrives in a variety of ecological niches, making it an ideal subject for understanding the ecological dynamics of different habitats. Its ability to grow in both wild and cultivated settings allows researchers to examine the influence of human activities on local ecosystems (Mofunanya *et al.,* 2018).

One of the key advantages of using *T. occidentalis* in ecological surveys is its role in promoting plant diversity. It is often grown alongside other crops and acts as a nurse crop, providing shade and moisture to other plants. This intercropping technique enhances biodiversity and creates microclimates that support various species, including beneficial insects. Studies have shown that intercropping *T. occidentalis* with other crops can lead to enhanced pest control and improved soil fertility, contributing to sustainable and ecologically balanced farming systems (Mofunanya *et al*., 2018). The aim of this study is to assess the effects of different manure concentrations as an amendment strategy on the soil productivity of the two watersheds, using *Telfairia occidentalis* as a test crop.

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MATERIALS AND METHOD

Study Area Description

The study area was made up of 30 by 20 meters which will give a total of 600 meter square in the watershed upper and lower area. It lies within the humid tropical rainforest belt of Nigeria characterized with trees, evergreen leaves and thick undergrowth. Two climatic seasons exist: the rainy season (March to October) and the dry season (October to March). There was no detailed geological study conducted. However, the information obtained from the field indicated that the underground rock is a sedimentary rock formed through a process of lithification of weathered rock debris, which was transported and deposited by the force of water flow through the stream and dead plant leaves. The site is situated on a sloping slightly hillside with a dominantly loamy soil. There is natural vegetation consisting of grasses and bushes.

Experimental Equipment/Materials

The equipment used include cutlass, peg, line, measuring tape, cow dung, poultry manure, organic fertilizer, soil sample, fluted pumpkin seed, perforated polythene bag and recording sheet.

Experimental Procedure

This work was based on the study of two watersheds in Nnamdi Azikiwe University, Awka. Each watershed consists of head (where the water is flowing from) and tail (the out flow area of water). An area of 600 m^2 (30 m x 20 m) was mapped out in each watershed region with the aid of a measuring tape and pegs; random sampling methods were used in the study. The soil sample were collected separately from both the head and tail of each watershed, using potting polythene bags which were transported to a screen house where different concentrations of cow dung and poultry manure and then inorganic fertilizer (as standard) were applied to the different soil samples collected from both the upper (head) and lower (tail) areas of the two watersheds. Each bag containing different manure concentration had two replicates, with a total of 64 bags in all the treatments. Then fluted pumpkin seed was planted on each bag of the soil and monitored for early seedling growth, and all the physiological parameters were measured on weekly bases for 4 weeks. The manure treatments include:

a. Poultry manure (PM)

b. Cow dung (CD)

c. Mixture of PM and CD

d. NPK fertilizer (Standard)

Measurement of Plant Parameter (Method by Shoupeng *et al.,* 2019)

Leaf Length: To measure leaf length, a measuring tape was used. This was placed along the central vein (midrib) of the leaf from the base (where it attaches to the stem) to the tip (apex). The value will be read and recorded in centimeters.

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Leaf Breadth: To measure leaf breadth, a measuring tape was used. The tape was also placed across the base of the leaf and the readings were recorded accordingly.

Stem Girth: A flexible measuring tape was wrapped around the circumference of the stem; the reading was recorded in centimeters.

Stem Height: To measure the stem height, a measuring tape was used. The measuring tool was placed perpendicular to the central vein (midrib) of the stem, from the base of the root to the tip of the leaf and the reading was recorded in centimeters.

Numbers of Leaves: The number of leaves of each plant was counted and recorded every week for the whole of the four weeks study.

First germination %: $\frac{\text{No germinated}}{\text{No planted}} \times \frac{100}{1}$

Statistical Analysis

Data collected was subjected to two-way analysis of variance (ANOVA) to ascertain the level of significance at 0.05% in order to analyse the effect of the treatments given to *Telfairia occidentalis.* The IBM SPSS computer software version 25 was used for the data analysis.

RESULTS

Table 1: Effect of organic and inorganic manure on the leaf length (cm) of *Telfairia occidentalis* in Watershed Locations 1 and 2

	Water shed 1				Watershed 2			
	Weeks after planting				Weeks after planting			
Treatments	**Wk1**	**Wk2**	**Wk3**	**Wk4**	**Wk1**	**Wk2**	**Wk3**	**Wk4**
0.5KG/PM	5.10	8.00	10.70	12.70	3.43	7.90	9.83	11.43
0.5KG/CD	6.63	8.50	10.73	13.05	8.75	10.53	11.38	12.03
1KG/PM	5.25	8.45	10.10	11.80	3.58	5.60	7.15	7.88
1KG/CD	6.00	11.15	12.68	13.70	5.50	8.13	10.18	12.03
0.5KGPM/0.5KGCD	3.05	7.20	10.03	12.35	4.70	9.10	10.73	12.70
1KGPM/1KGCD	3.25	8.35	10.73	13.28	4.78	9.23	11.53	13.40
0.5KG NPK 15:15:15	4.50	7.60	10.70	13.03	4,45	5.15	7.93	10.70
Control	6.25	8.90	11.08	12.35	8.13	10.28	11.13	12.10
Total	5.00	8.52	10.84	12.78	5.41	8.24	9.98	11.53
P-value	.033	.046	.191	.483	.000	.000	.001	.012

PM = POULTRY MANURE, CD = COW DUNG

Table 1 above shows the effect of the organic and inorganic manure on the leaf length of *Telfairia occidentalis* in Watersheds 1 and 2.

In **Watershed 1**, there was a significant difference in the leaf length among treatments at Weeks 1 and 2 ($p<0.05$) but no significant difference at Weeks 3 and 4 ($p>0.05$).

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In **Watershed 2**, there was a significant difference in the leaf length among treatments at Weeks 1, 2, 3 and 4 ($p<0.05$).

Table 2: Effect of organic and inorganic manure on the leaf breadth (cm) of *Telfairia occidentalis* in Watershed Locations 1 and 2

	Water shed 1 Weeks after planting				Water shed 2 Weeks after planting			
Treatments	**Wk1**	**Wk2**	**Wk3**	**Wk4**	**Wk1**	**Wk2**	**Wk3**	**Wk4**
0.5KG/PM	2.93	4.43	6.25	7.63	2.40	4.55	5.15	5.75
0.5KG/CD	4.63	6.00	6.53	7.25	6.38	6.70	6.93	7.78
1KG/PM	3.58	5.18	6.30	6.98	2.33	3.75	4.45	4.98
1KG/CD	3.13	5.93	6.70	7.48	3.13	5.20	5.58	6.15
0.5KGPM/0.5KGCD	2.30	4.25	5.45	6.15	3.58	5.58	6.15	5.63
1KGPM/1KGCD	1.70	3.78	5.05	6.38	3.10	5.20	5.90	6.93
0.5KG NPK 15:15:15	3.75	4.55	5.85	7.18	3.80	4.20	5.05	6.80
Control	4.00	4.80	5.50	6.28	5.75	6.38	6.78	7.40
Total	3.25	4.86	5.95	6.91	3.81	5.19	5.75	6.43
P-value	.002	.058	.183	.094	.000	.012	.043	.189

PM = POULTRY MANURE, CD = COW DUNG

Table 2 above shows the effect of the organic and inorganic manure on the leaf breadth of *Telfairia occidentalis* in Watersheds 1 and 2.

In **Watershed 1**, there was a significant difference in the leaf breadth among treatments at Week 1 ($p<0.05$) while no significant difference existed at Weeks 2, 3 and 4 ($p>0.05$).

In **Watershed 2**, there was a significant difference in the leaf breadth among treatments at Weeks 1, 2 and 3 ($p<0.05$) excluding Week 4.

Table 3: Effect of organic and inorganic manure on the stem height (cm) of *Telfairia occidentalis* in Watershed Locations 1 and 2

	Water shed 1 Weeks after planting				Water shed 2 Weeks after planting			
Treatments	**Wk1**	**Wk2**	**Wk3**	**Wk4**	**Wk1**	**Wk2**	**Wk3**	**Wk4**
0.5KG/PM	12.40	27.10	88.10	132.20	7.85	26.95	67.08	103.40
0.5KG/CD	15.50	44.28	92.85	134.68	29.75	79.28	100.20	132.60
1KG/PM	11.40	32.98	69.40	118.35	6.03	34.13	55.08	81.88
1KG/CD	14.00	44.33	74.08	119.30	15.00	44.48	91.63	134.45
0.5KGPM/0.5KGCD	5.48	22.25	98.23	157.88	14.20	53.50	97.20	153.48
1KGPM/1KGCD	4.68	24.50	106.45	174.73	12.80	51.78	80.08	119.73
0.5KG NPK 15:15:15	8.00	30.50	88.45	159.85	7.80	18.63	44.45	81.50
Control	16.00	35.45	98.50	170.88	24.25	61.08	94.73	129.30
Total	10.93	32.67	89.51	145.98	14.71	46.23	78.80	117.04
P-value	.083	.366	.714	.553	.000	.000	.031	.141

PM = POULTRY MANURE, CD = COW DUNG

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Table 3 above shows the effect of the organic and inorganic manure on the stem height of *Telfairia occidentalis* in Watersheds 1 and 2.

In **Watershed 1**, there was a significant difference in the stem height among treatments at Week 1 ($p<0.05$) while no significant difference existed at Weeks 2, 3 and 4 ($p>0.05$).

In **Watershed 2**, there was a significant difference in the stem height among treatments at Weeks 1, 2 and 3 ($p<0.05$) excluding Week 4 ($p>0.05$).

Table 4: Effect of organic and inorganic manure on the stem girth (cm) of *Telfairia occidentalis* in Watershed Locations 1 and 2

Treatments	Watershed 1 Weeks after planting				Watershed 2 Weeks after planting			
	Wk1	**Wk2**	**Wk3**	**Wk4**	**Wk1**	**Wk2**	**Wk3**	**Wk4**
0.5KG/PM	1.78	2.13	2.30	2.48	1.78	2.20	2.35	2.55
0.5KG/CD	2.13	2.63	2.80	3.05	2.45	2.80	2.98	3.15
1KG/PM	2.23	2.38	2.55	2.75	1.65	1.90	2.08	2.28
1KG/CD	1.80	2.23	2.38	2.55	2.50	2.98	3.00	3.20
0.5KGPM/0.5KGCD	1.58	1.95	2.15	2.30	2.40	2.73	2.90	3.05
1KGPM/1KGCD	1.75	2.08	2.25	2.50	1.98	2.30	2.50	2.73
0.5KGNPK 15:15:15	1.75	2.20	2.33	2.50	2.50	2.75	2.90	3.03
Control	2.20	2.53	2.73	2.90	2.25	2.58	2.78	3.03
Total	1.90	2.26	2.43	2.63	2.75	2.62	2.68	2.88
P-value	.142	.104	.098	.042	.604	.400	.179	.227

PM = POULTRY MANURE, CD = COW DUNG

Table 4 above shows the effect of organic and inorganic manure on the stem girth of *Telfairia occidentalis* in Watersheds 1 and 2.

In **Watershed 1**, there was a significant difference in the stem girth among treatments at Week 4 ($p<0.05$) while no significant difference existed at Weeks 1, 2 and 3 ($p>0.05$).

In **Watershed 2**, there was a significant difference in the stem girth among treatments at Weeks 1, 2, 3 and 4 ($p>0.05$).

Table 5: Effect of organic and inorganic manure on the number of leaves per plant of *Telfairia occidentalis* in Watershed Locations 1 and 2

	Water shed 1 Weeks after planting				Water shed 2 Weeks after planting			
Treatments	**Wk1**	**Wk2**	**Wk3**	**Wk4**	**Wk1**	**Wk2**	**Wk3**	**Wk4**
0.5KG/PM	4.75	8.50	16.75	31.00	3.50	8.25	19.00	29.00
0.5KG/CD	4.50	9.25	17.50	26.00	5.75	6.75	16.25	23.25
1KG/PM	4.25	9.50	15.00	22.00	4.00	8.00	9.00	16.25
1KG/CD	4.25	8.25	17.75	27.25	6.25	11.00	20.75	29.50
0.5KGPM/0.5KGCD	2.75	6.75	17.75	27.75	5.00	9.50	15.75	25.00

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1KGPM/1KGCD	4.75	9.75	15.25	23.50	4.00	8.25	18.00	27.25
0.5KG NPK 15:15:15	4.25	7.75	18.75	24.25	3.75	6.00	11.25	16.25
Control	5.25	9.00	17.50	28.50	6.25	11.00	17.00	23.50
Total	4.34	8.59	17.03	26.28	4.81	8.59	15.88	23.75
P-value	.648	.667	.746	.831	.111	.163	.074	.099

PM = POULTRY MANURE, CD = COW DUNG

Table 5 above shows the effect of the organic and inorganic manure on the number of leaves per plant of *Telfairia occidentalis* in Watersheds 1 and 2.

In **Watershed 1**, there was no significant difference in the numbers of leaves among treatments at significant differences at Weeks 1, 2, 3 and 4 ($p>0.05$).

In **Watershed 2**, there was no significant difference in the number of leaves among treatments at Weeks 1, 2, 3 and 4 ($p>0.05$).

Table 6 below reveals that there was no significant ($F = 1.776$, $p = 0.219$) difference in the germination percentage of *Telfairia occidentalis* as a result of the different treatments.

Table 6: Germination percentage of *Telfairia occidentalis* given the different treatments

TREATMENTS	GERMINATION PERCENTAGE
0.5KG/PM	62.50±17.68
0.5KG/CD	100.00±0.00
1KG/PM	62.50±17.68
1KG/CD	87.50±17.68
0.5KGPM/0.5KGCD	62.50±17.68
1KGPM/1KGCD	87.50±17.68
0.5KG NPK 15:15:15	62.50±17.68
Control	62.50±17.68
P-value	**0.219**
F	**1.776**

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DISCUSSION

In productivity study, the results of the study revealed that the application of the organic manure improved the germinability of the *Telfairia occidentalis* seeds. Most of the nutrients in the soil were below the critical level (Adeoye & Agboola, 1985), making it necessary for the application of soil amendment in the form of organic manure. This organic manure has significant effects on leaf length, leaf breadth, stem height, stem girth and number of leaves of *Telfairia occidentalis*. This also supports the report of Schipper (2000) and Awodum (2007) that application of organic manure significantly influenced the growth and yield of fluted pumpkin. The organic based soil amendment with cow dung and poultry manure demonstrated higher effectiveness in the improvement of the soil. This finding agrees with Agbede (2018) which revealed that soil amendment could be utilized to enhance higher crop production.

From Table 1, which shows the leaf length performance in both Watersheds 1 and 2, at Weeks 1 and 2 of both watersheds, cow dung has the highest mean values. At Weeks 3 and 4, cow dung also has the highest mean values in Watershed 1 while the combination of 1 kg each of both PM and CD has the highest mean values in Watershed 2. Table 2 shows the performance of leaf breadth in the both watersheds. At Weeks 1, 2 and 3, cow dung has the highest mean values, while at Week 4, poultry manure has the highest mean value in Watershed 1, and cow dung also has the highest mean value in Watershed 2. Table 3 shows the performance of stem height in both watersheds. At Weeks 1 and 2, cow dung has the highest mean values while at Weeks 3 and 4, the combination of both PM and CD has the highest mean values in both watersheds. From Table 4, which shows the stem girth performance in the study of both watersheds, at Weeks 1, 2, 3 and 4, cow dung has the highest mean values in both watersheds.

Table 5 shows the number of leaves per treatment in both watersheds. At Weeks 1, 2 and 3 in Watershed 1, the combination of PM and CD has the highest mean values, while at Week 4, poultry manure shows the highest mean values. In Watershed 2, cow dung manure has the highest mean values at Weeks 1, 2, 3 and 4.

The study revealed that cow dung manure performed best in almost all the parameters measured: leaf length, leaf breadth, stem height, stem girth and number of leaves. This better performance of cow dung may be as a result of difference in their C/N ratios as well as difference in nutrient composition. The carbon nitrogen ratio on cow dung is known to either cause immobilization of nutrients at a high level or mineralization at a low rate (Franzluebbers & Aishad, 1996; Elcio, 2010). The ability of cow dung to perform better than poultry manure and inorganic fertilizer in the study is contrary to the report of Hussein (1994) who reported that poultry manure is superior to other sources of organic manure. However, the inability of poultry manure to perform better than others in this study could be associated with age of the animals and mode of preparation of the manure.

Also, the combination of both poultry manure and cow dung manure performed better at some weeks. This significant increase in leaf length, leaf breadth, stem height, stem girth and number of leaves observed with applied organic manure as compared with the control might be due to the increase in N-contents of the applied organic manure. This is in agreement with Olowoake and Ojo (2014) who observed an increase in growth parameters with organic manure use (of applied manure types) which might be due to the effective use of applied manure by the plants.

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The significant influence of organic manure on the growth and yield of *Telfairia occidentalis* showed that organic manure and inorganic fertilizer can be used for soil amendment to promote the yield of crops. This improvement in growth parameters with application of organic manure also confirms the finding of Aminifard *et al*. (2010) and Agbo *et al*. (2012) who also observed significant increase in growth and yield of *T. Occidentalis* and other vegetables with applied organic manures. Organic manure apart from releasing nutrients to the soil has also been shown to improve other soil chemical and physical properties which enhance crop growth and development (Hussein, 1994). The low fertility status of the soil treated with NPK (15 : 15 : 15) might be due to early nutrient mineralization, thereby making the nutrients rarely available for plant use and partly due to nutrient leaching. Hence, the application of inorganic fertilizer does not always improve soil organic matter, which is a storehouse for nutrients.

Evidently, vegetative growth of manure treated plants performed overwhelmingly better than control due to high availability of organic matter and nutrients in the soil for plant utilization. In addition, the lower significance values obtained in control (no manure) could be attributed to low nutrient availability observed in the soil. This observation agrees with the finding of Moyin-Jesu and Atoyosoye (2002) and Ogbonna (2008) that soil with low nutrients responded better to organic or inorganic fertilizer application.

CONCLUSION

All the treatments used were found to increase the germination and growth parameters of *T. occidentalis* significantly. However, organic manures serve as a good source of soil amendment for the improvement of soil properties which also leads to growth, improvement and fluted pumpkin yield. Cow dung manure treatment was more effective than any other treatment in terms of growth of *Telfairia occidentalis*, followed by the combination of PM and CD manure, which also performed better than inorganic manure and control. The combined manure improves soil fertility and enhances the growth of *T. occidentalis*. This growth of the experimental fluted pumpkin responded differently to each of the different applications of organic manure.

RECOMMENDATION

From the result of this study, cow dung manure and also the combined effect of the organic manure (PM and CD) improved the growth of fluted pumpkin. These are recommended to farmers in this study area for a more profitable production of fluted pumpkin. This is even more important now that organic farming is being highly emphasized. These manures will be very advantageous when used because they are readily available, less costly and environmentally friendly.

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