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Application of Discarded Fish Pond Water on Soils to Assess Growth Rate and Fresh Edible leaves Weight of Fluted Pumpkin (*Telfairia occidentalis*, Hook, F.) in Abraka, Delta State, Nigeria

ENUJEKE, EC; OGBINAKA, EJA

Department of Agronomy, Delta State University, Abraka, Delta State, Nigeria

**Corresponding Author email: enujeke@yahoo.com*
**ORCID: https://orcid.org/0000 0002 3653 1300*
**Tel: +2348063874792*

Co-Author: ejaogbinaka@delsu.edu.ng

ABSTRACT: Many people ignorantly discard fish pond water (FPW) despite its huge potentials to improve soil fertility by enhancing its physicochemical properties as well as increasing crop growth and yield. Consequently, the objective of this paper was to apply discarded fish pond water (FPW) on soils to assess growth rate and fresh edible leaves weight of fluted pumpkin (*Telfairia occidentalis,* Hook, F.) in Abraka, Delta State, Nigeria using appropriate standard procedures. Results obtained showed that fluted pumpkin plants that received FPW significantly increased the germination percentage from 97.0% to 99%, while plants that did not receive FPW (control) had germination percentage of 68.0% to 90.0%. The fresh weight of leaves for increased growth and edible yield of fluted pumpkin also increased from 54.6g/m^2 to 55.2g/m^2 after application of FPW. The outstanding performance of plants that received FPW against their control counterparts could be attributed to additional supply of nutrients to the soil by the FPW.

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Fluted pumpkin (*Telfairia occidentalis*, Hook, F.)is a member of Cucurbitaceae family, grown in West Africa for its leaves and edible seeds (Alegbejo, 2012).It is used primarily in soups and herbal medicines. As a drought tolerant plant noted to have healing properties, it is administered as a blood tonic to the weak or ill (Enujeke and Ojeifo, 2013). Considered an oil seed, the fluted gourd is high in oil (30%), the shoots of the plant contains high level of potassium and iron, while the seeds contain 27%crude proteins and 53% fats (Alegbejo, 2012). The leaves contain calcium, iron, vitamins A, B_2, C_2 and E as well as a high amount of antioxidants with hepato protective and antimicrobial properties (Alegbejo, 2012). The edible seeds can be boiled and eaten whole or fermented and added to ogilli, while flour produced from the seeds can be used for high – protein breads (Enujeke and Ojeifo, 2013). Nigerians

**Corresponding Author email: enujeke@yahoo.com*
**ORCID: https://orcid.org/0000 0002 3653 1300*
**Tel: +2348063874792*

use the shoots and leaves to make soup, stew, egg sauce and vegetable sauce (Enujeke and Ojeifo, 2013). When *T. occidentalis* is prepared for herbal medicine, it is used to treat sudden attack of convulsion, malaria and anaemia; it also plays a vital and protective role in cardiovascular disease control (Opabode and Adeboye, 2025). Telfairia leaf meal possesses biochemical, nutritional and haematological properties, and they are used as protein supplements in broiler starter diets (Fasuyi and Nonyerem, 2007).

Also, pro-osteogenic properties in leaf extract of Violina pumpkin (*Cucurbita moschata*) has been reported from *In-vitro* Human Primary Cell Cultures (Piva *et al.,* 2021) while Kulazynski *et al.,* (2020) reported antioxidant potential of phytochemical in pumpkin varieties of *Cucurbita moschata* and *Cucurbitapepo species*. Yadav *et al.,* (2010) reported that fluted pumpkin possesses both medicinal and biological potentials that are beneficial for livelihood. The increasing relevance and enormous potentials of fluted pumpkin notwithstanding, its production has been limited by declining soil fertility caused by continuous cropping and leaching in many places. Though, organic manure is known to improve fertility, it has offensive odour and is bulky for transport to areas needed, while mineral fertilizers are costly to resource-poor farmers. At present, very little research work has been carried to harness the potentials of fish pond water with respect to improving soil fertility for crop production. Payebo and Ogidi (2020) posited that fish pond serves as a reservoir of water for irrigation of plants because the deposits in the water, including the effluents of fishes have the potential of increasing plants growth. Ojobor and Tobih, (2015), reported that fish pond effluents improve soil physic-chemical properties by nourishing it with rich primary or major nutrients such as nitrogen, phosphorus and potassium which are needed for enhancement of vegetative growth and eventual yield of crops. Haytham *et al.,* (2024) reported that application of fish pond water improves soil fertility by encouraging the proliferation of beneficial organisms whose activities stimulate rooting and development of crops that help to reduce the impacts of climate change. According to Payebo and Ogidi (2020), highest application rate of $15000lha^{-1}$ of fish pond water gave corresponding growth parameters and eventual yield of maize against other rates of application as well as the control plot. Consequently, the objective of this paper was to apply discarded fish pond water (FPW) on soils to assess growth rate and fresh edible leaves weight of fluted pumpkin (*Telfairia occidentalis,* Hook, F.) in Abraka, Delta State, Nigeria.

MATERIALS AND METHOD

Description of experimental site: The research was conducted in the Research Farm of Delta State University, Abraka in 2023 and repeated in 2024.Abraka his between Latitude $6^0 4^0$E and Latitude $5^0 54^0$N. Rainy season in Abraka starts in April and ends in October, while the dry season starts in November and ends in March. Temperature ranges from 25^0 – 31^0C, while annual rainfall ranges from 2000mm to 3000mm per annum (Efe and Aruegodore, 2003).

Land preparation and soil analytical procedure: The land measuring $540m^2$ was clear using cutlass and tillage was done using hoe. Plots measuring 5m x 5m ($25m^2$) were marked out. The net area for the experiment was $375m^2$, while discard areas was $165m^2$.

Surface soils (10 – 15cm) were collected using sampling auger. Representative soil samples were taken from the replicate and then hulled together. The samples were air-dried at room temperature for 5 days and crushed to enable it pass through a 2mm mesh tube. Sub-samples from the bulked soil sample were further ground to pass through 100-mesh sieve to enable organic matter to be ascertained. The remaining samples were analyzed to determine the physic-chemical properties.

Particle size distribution was known using the hydrometer method of Gee and Bauder (1986). The Pyeunican Model MK 2pH meter was used to measure the pH in a 1 : 2 : 5 water suspension ratio. Organic carbon was ascertained using Walkey-Black wet oxidation method suggested by Nelson and Sommer (1982). The Micro-Kjedahl distillation technique described by Bremiuer and Mulvancy (1982) was used to assess the Total nitrogen. Bray No. 1 method of IITA (1979) was used to determine the Available phosphorus. A flame photometer was used to indicate the Exchangeable potassium, while Ammonium acetate saturation method of Raades (1982) was used to know the cation exchange capacity (CEC). The fish pond water was analyzed as directed by IITA manuals (1979).

Seed procurement, planting and application of fish pond water: Healthy seeds collected from matured pumpkin pods purchased from Abraka market were sown 2.5cm deep at a spacing of 1m x 1m on the marked out plots as recommended by Enujeke and Ojeifo (2013). Fish pond water (FPW) was collected from already bailed ponds of Fisheries and Aquaculture Unit of Delta State University, Abraka Research Farm analyzed following the procedure of

Agbogidi *et al.,* (2023) and applied according to the treatments.

Germination percentage: After 2 weeks of sowing the seeds, data on Germination percentage of each treatment was collected by counting using equation 1:

$$\mathrm{GP} = \frac{\text{Germinated seeds}}{\text{Total seeds}} \times \frac{100}{1} \qquad (1)$$

Plant Height: Plant height of the sample population assessed at 4, 8 and 12weeks sowing was determined by using tape rule to measure from the base of the stem to the tip of the growing seedling according to the treatments.

Leaf area: Using a tape rule, length and breadth of the leaf was measured and the answer multiplied by a correction factor of 0.75 following equation 2 (Agbogidi *et al.*,2007;Chukwudi*et al.,* 2021)

$$\mathrm{LA} = \mathrm{L} \times \mathrm{B} \times 0.75 \qquad (2)$$

Data Analysis: Data collected were subjected to analysis of variance and significant means when separated using Duncan Range Test (DMRT) using SAS (2000).

RESULTS AND DISCUSSION

Pre-planting soil and fish pond water analysis: The pre-planting soil and fish pond water analysis is shown in Table 1. The particles size fraction indicated that the soil was sandy loan with percentage sand, silt and clay contents of 86.2, 9.7 and 4.1 respectively. It had a pH of 6.5 which is slightly acidic. The soil had poor facility status with low organic carbon and organic matter contents of 0.53 and 1.14% respectively according to ratings of FMANR (1996) for that ecological zone. Available phosphorus and total nitrogen values were 0.02mgkg^{-1} and 0.20%, respectively characteristic of low fertility soil. The level of calcium (0.02cmolkg^{-1}) was low, while potassium and magnesium values were 0.23 and 1.30cmolkg^{-1}, respectively. The sodium content of the soil was 0.15cmolkg^{-1}, while the exchange acidity was 0.42cmolkg^{-1}.The fish pond was slightly alkaline with pH of 7.1, organic carbon of 2.40% organic matter of 3.84 and available phosphorus of 0.18mgkg^{-1}, which are al higher than the nutrient status of the soil. Equally too, the nutrient status of Total nitrogen (%), calcium, potassium and magnesium in cmolkg^{-1} in fish pond water were higher than those in the soil, with values of 0.34, 0.56, 0.62 and 2.16, respectively.

Table 1: Pre-planting soil and fish pond water analysis

Parameter	Soil	Fish pond water
Particles size fractions (%)		
Sand	86.2	
Silt	9.7	
Clay	4.1	
Textural class	Sandy loam	
pH (H_2O)	6.5	7.1
Organic carbon (%)	0.63	2.40
Organic matter (%)	1.14	3.84
Available phosphorus (mgkg^{-1})	0.02	0.18
Exchangeable acidity (cmolkg^{-1})	0.42	
Total Nitrogen (%)	0.20	0.34
Calcium (cmolkg^{-1})	0.02	0.56
Sodium (cmolkg^{-1})	0.15	
Potassium (cmolkg^{-1})	0.23	0.62
Magnesium (cmolkg^{-1})	1.30	2.16

Legend: % = Percentage, mgkg^{-1} = milligram per kilogram, cmolkg^{-1} = centimole per kilogram

Germination percentage (%) and plant height of fluted pumpkin as affected by fish pond water: The germination percentage of *T. occidentalis* as affected by five different rates of fish pond water is shown in Table 2. Fish pond water significantly affected the germination percentage of the crop. Plants that received 24000 lha^{-1} of fish pond water had the highest germination percentage of 97.0% in 2023 and 99% in 2024, followed by plants that received 18000 lha^{-1}which had 94.0% in 2023 and 96.0% in 2024. Plants that did not receive FPW (control) had the lowest germination percentage of 68.0% in 2023 and 90.0% in 2024. The outstanding performance of plants that received FPW against their control counterparts could be attributed to additional supply of nutrients to the soil by the FPW..

Table 2: Effects of five different rates of fish pond water on Germination percentage and plant height of fluted pumpkin

Parameter	Germination percentage (%)			2023 Plant height (cm) Weeks after sowing				2024 Plant height (cm) Weeks after sowing			
	2023	2024	Mean	4	8	12	Mean	4	8	12	Mean
Rate of FPW lha^{-1}											
0	68.0_{e}	72.0_{e}	70.0_{e}	54.0_{e}	88.0_{e}	124.0_{e}	88.7	62.0_{e}	92.0_{e}	124.0_{e}	92.7
6000	82.0_{d}	85.0_{d}	83.5_{d}	86.0_{d}	102.0_{d}	148.0_{d}	112.0	106.0_{d}	130.0_{d}	162.0_{d}	132.7
12000	90.0_{c}	93.0_{c}	91.5_{c}	104.0_{c}	130.0_{c}	170.0_{c}	134.7	132.0_{c}	160.0_{c}	188.0_{c}	160.0
18000	94.0_{b}	96.0_{b}	95.0_{b}	126.0_{b}	154.0_{b}	210.0_{b}	163.3	154.0_{b}	182.0_{b}	214.0_{b}	183.0
24000	97.0_{a}	99.0_{a}	98.0_{a}	148.0_{a}	176.0_{a}	242.0_{a}	188.7	180.0_{a}	202.0_{a}	266.0_{a}	216.0
Mean	86.2	89.0		103.6	130.0	178.8		126.8	153.2	190.8	

Means with similar letters under the same column are not significantly different ($p \leq 0.05$) under Duncan Multiple Range Test (DMRT)

Table 3: Effects of five different rates of fish pond water on leaf area (cm^2) and fresh weight of leaves (g/m^2) of fluted pumpkin

	Leaf area 2023 Weeks after sowing				Leaf area 2024				Fresh weight of edible leaves 2023 Weeks after sowing				Fresh weight of edible leaves 2024			
Parameter	12	14	16	Mean	12	14	16	Mean	12	14	16	Mean	12	14	16	Mean
Rate of FPW lha^{-1}																
0	49.5_{e}	72.0_{e}	89.3_{e}	70.3_{e}	54.0_{e}	78.0_{e}	94.5_{e}	75.5_{e}	34.2_{e}	36.6_{e}	38.8_{e}	36.5_{e}	34.8_{e}	37.2_{e}	39.4_{e}	37.1_{e}
6000	63.0_{d}	87.8_{d}	102.0_{d}	84.3_{d}	72.0_{d}	94.5_{d}	105.0_{d}	90.5_{d}	38.2_{d}	40.8_{d}	43.2_{d}	40.7_{d}	38.8_{d}	41.2_{d}	44.0_{d}	41.3_{d}
12000	84.0_{c}	96.0_{c}	108.0_{c}	96.0_{c}	89.3_{c}	108.0_{c}	114.8_{c}	104.0_{c}	42.8_{c}	45.0_{c}	48.0_{c}	45.3_{c}	43.2_{c}	45.4_{c}	48.6_{c}	48.7_{c}
18000	108.0_{b}	112.5_{b}	121.5_{b}	114.0_{b}	114.8_{b}	121.5_{b}	128.3_{b}	121.5_{b}	46.2_{b}	48.8_{b}	51.4_{b}	48.8_{b}	46.4_{b}	50.2_{b}	51.8_{b}	49.5_{b}
24000	116.0_{a}	120.0_{a}	127.5_{a}	121.2_{a}	123.8_{a}	128.3_{a}	140.3_{a}	130.8_{a}	48.8_{a}	51.8_{a}	54.6_{a}	51.7_{a}	50.4_{a}	51.8_{a}	55.2_{a}	52.5_{a}
Mean	84.1	197.7	109.7		90.8	106.1	116.6		42.0	44.6	47.2		42.7	45.2	47.4	

Means with similar alphabets under the same column are not significantly different($p \leq 0.05$) using Duncan Multiple Range Test (DMRT)

Table 4: Effects of fish pond water on chemical properties of soil after harvest of fluted pumpkin

Rate of application (lha^{-1})	pH (H_2O)	Organic matter (gkg^{-1})	Total N (gkg^{-1})	Ca	Mg ($cmolkg^{-1}$)	K
0	6.8_{a}	0.66_{c}	0.04_{e}	0.06_{e}	1.38_{e}	0.26_{e}
6000	6.6_{a}	0.72_{d}	0.08_{d}	0.20_{d}	1.42_{d}	0.32_{d}
12000	6.4_{a}	0.78_{c}	0.12_{c}	0.28_{c}	1.48_{c}	0.40_{c}
18000	6.2_{a}	0.86_{b}	0.16_{b}	0.34_{b}	1.54_{b}	0.46_{b}
24000	6.0_{a}	0.94_{a}	0.22_{a}	0.46_{a}	1.68_{a}	0.52_{a}

Means with identical alphabets under the same column as not significantly ($p \leq 0.05$) using Duncan Multiple Range Test (DMRT).

This is consistent with the findings of Haytham *et al.,* (2024) who reported that FPW promotes rooting and development of crops due to improved soil fertility made possible by the activities of beneficial organisms. It is also similar to the findings of Enujeke *et al.,* (2013) who reported that the applied liquid organic fertilizer added nutrients in a faster-acting form to benefiting crops than their control counterpart which did not received the applied organic fertilizer. It is also synonymous to the findings of Ojobor and Egbuchua (2020) who attributed the increased growth and productivity of rice to the nutrients released by Abattoir Wastewater used to fertilize the crop

Similar trend was observed in plant height and other growth parameters of *T. occidentalis*, including leaf area and weight of edible yield where the order of superiority with respect to the level of fish pond water received in lha^{-1} was 24000 > 18000 > 12000 > 6000 > 0. The outstanding performance of plants that received FPW application rate of $24000Lha^{-1}$ suggests that it was the most appropriate level which contained the quantity of nutrients required for increased growth and edible yield of *T. occidentalis* in the study area. This is considered with the findings of Mehedi *et al.,* (2011), which reported that the highest rate of manure gave a corresponding highest growth parameter, and seed yield of tomato. It is also synonymous with the findings of Enujeke (2014); Payebo and Ogidi (2020), which reported that highest application rate of 15000 lha^{-1} of FPW gave corresponding highest growth parameters and eventual yield of maize. *Effects of fish pond water on chemical properties of soil:* The effects of fish pond water on chemical properties of soil is shown in Table 4. The results indicate that nutrient present in the soil after harvest of fluted pumpkin were those obtained from fish pond water and those existing previously in the soil which absorbed by the test crop through the activities of beneficial organisms

This is similar to the findings of Haytham *et al.,* (2024) which reported that the application of fish pond water improves soil fertility by promoting the proliferation of beneficial organisms that stimulate rooting and development of crops which help to reduce the impacts of climate change. It is also consistent with the findings of Ojobor, and Tobih, (2015) who reported that fish pond water effluents improve soil physic-chemical properties by nourishing it with rich primary or major nutrients such as nitrogen, phosphorus and potassium which are needed to promote vegetative growth and eventual yield of crops

Conclusion: The present study accessed the growth rate and fresh edible leaves weight of *T. occidentalis* as affected by application of discarded FPW. As a remarkable contribution to knowledge, it has shown the appropriate level required to boost soil nutrients status as well as increase growth and yield of the test crop in the study area.

Declaration of interest: The authors declare that no known conflict of interest or personal relationships that could have influence the work reported in this paper.

Declaration of Data Availability: Data are available upon request from the corresponding author or first author.

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