

**EFFECT OF NPK FERTILIZERS AS SOIL AMMENDMENT FOR THE
GROWTH AND DEVELOPMENT OF FLUTED PUMPKIN IN A
DEGRADED ULTISOL**

BY

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DEPARTMENT OF SOIL SCIENCE AND LAND MANAGEMENT

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UNIVERSITY OF BENIN

BENIN CITY

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CERTIFICATION

This to certify that Emmanuel Chukwuemeke OKWUSENDI carried out this project work in the Department of Soil Science, Faculty of Agriculture, University of Benin, Benin City.

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Date: _____

DEDICATION

With profound gratitude to God almighty, my creator and my sufficiency, I gratefully dedicate this research work to Him for gift of life, strength, divine provision, protection and His inspiration towards me throughout the course of this research and for seeing me through my undergraduate study.

ACKNOWLEDGEMENT

My gratitude goes to God my provider and sufficiency who has been my protector throughout my undergraduate study..

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ABSTRACT

The study was carried out at the Experimental Field of the Department of Soil Science and Land Management, Faculty of Agriculture, University of Benin, Benin City (latitude 6.4013754° and 5.6258° North and longitude 5.625880° and 6.40127231 East). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications, four treatment levels with different rates of NPK 20:10:10 (0, 150, 300 and 450kg/ha). Planting was done in October at 0.5m x 0.5m spacing.

The study was carried out to determine the effect of NPK 20:10:10 fertilizers as soil amendment for the growth and development of fluted pumpkin in a degraded ultisol. Experimental trials were conducted and the following growth and yield parameters were collected: Vine length and number of leaves. The experiment was terminated 8 weeks after planting and soil samples were collected for laboratory analysis. Soil physical and chemical properties such as Particle Size Distribution, Textural Classification, Soil Organic Carbon, Total Organic Nitrogen, Available Phosphorus, Exchangeable Bases (Ca, Mg, Na, K), Cation Exchange Capacity and Exchangeable Acidity were determined.

The results showed that the control plot recorded the lowest vine length of 64cm, and other plots treated with different rates of NPK 20:10:10 fertilizer produced higher vine length values than the control plot. The lowest value of leaf was recorded in control plot (97 leaves) while the highest value of number of leaves was recorded in soil treated with 450kg rate of NPK 20:10:10 (230 leaves) followed by plot treated with 300kg rate of NPK 20:10:10 fertilizer. This means that the application of NPK 20:10:10 fertilizer had a significant effect on the yield of *Telfairia occidentalis*. The soil analysis result showed that soil properties were influenced by the application of NPK fertilizer and fluted pumpkin. The Nitrogen, Phosphorus and Potassium content of the soil before planting were 0.9 g/kg, 9.06 mg/kg and 0.25 cmol/kg and after fertilizer application were 0.9 g/kg, 7.09 mg/kg and 0.1 cmol /kg respectively. After fertilizer application the control plot and plots amended with 150, 300, and 450 kg/ha of NPK 20:10:10 had values of 0.63, 0.64, 0.73 and 0.73 g/kg respectively.

Available p was highest at control plot with a value of 3.40 mg/kg¹ while exchangeable k had highest value at plot amended with 150 kg/ha NPK 20:10:10 with a value of 1.60 cmol/kg. The amended soils with NPK 20:10:10 had influence on some soil physical and chemical properties.

CHAPTER ONE

1.0 INTRODUCTION

In the time past, human beings were hunters and gatherers with no knowledge of agriculture thus they were forced to migrate searching for food. The history of agriculture is the story of humankind's development and cultivation of processes for producing food, feed, fiber, fuel and other goods by the systematic raising of plants and animals. The knowledge and skill of learning to care for the soil and growth of plants advanced the development of human society.

Soil fertility has always been a major concern in the history of agriculture.

The inorganic materials generally are relatively "high-analysis" fertilizers with few impurities. In Nigeria, an estimated 30 to 35 million people use fluted pumpkins, including the Efik, Ibibio, Ikwerre, and Urhobo ethnic groups. (Akoroda, 1990). However, the Igbo ethnic group uses it primarily for food sources and traditional medicines. The fluted gourd is a common sight in Igbo folklore, and it is said to have healing properties and was used as a blood tonic to be given to the weak or sick. It is native to Southern Nigeria and was a contributor to the Igbo ethnic group's international food trade.

In our increasing population, a large number of pumpkins are being harvested in millions of tons each year, causing the soil to be depleted of nutrients, lowering the soil's fertility. Planting of vegetables in soil with low fertility level will affect these crops so measures are taken to replenish and increase the fertility level of the soil and a more effective approach is the application of Inorganic fertilizers to the soil. This is because Inorganic fertilizers help to replenish the soil and provide nutrients which are essential and released in the soil and taken up by plants. A study and understanding of the effect of Inorganic fertilizer will help improve our knowledge on soil fertility and increase fluted pumpkin production for a growing population of mankind.

1.1 OBJECTIVES OF STUDY

(1) The objective of the study were to determine the effect of NPK 20:10:10 on the growth and development of fluted pumpkin

(2) The effect of NPK 20:10:10 on same soil properties of the study area

CHAPTER TWO

2.0

LITERATURE REVIEW

The fluted pumpkin belongs to the kingdom plantae, which includes angiosperm, eudicots, rosidae, and tracheophytes. cucurbitales, family cucurbitaceae, genus *telfairia*, specie *t. occidentalis*, scientific name is hook f (Nwanna, 2008). Fluted pumpkin leaves are greenish leafy vegetables that are commonly grown in west african countries, including Ghana, Cameroon, Sierra leone, and of course, Nigeria. *Telfairia occidentalis* is a plant that is grown in West Africa as a leafy vegetable with edible seeds. In recent studies, it was discovered that fluted pumpkin leaves and seeds have anti-cancer, anti-oxidative, and superoxide properties, reducing the chance of a oxidative burst in the human blood (Collins, 2020).

Telfairia occidentalis leaves have chemo-suppressive properties, including chlorophyll, phenolic compounds, saponins, tannins, flavonoids, glycosides, and phytosterols, which all aid in the prevention of cancer (Collins, 2020). Fluted pumpkin leaves contain high amounts of dietary fiber, vitamins, protein, riboflavin, thiamine, manganese, magnesium, iron, potassium, and carotene, all of which play a vital role in overall human health as well as the heart (Giami, 2003). These leaves are also used in certain parts of the world for making herbal medicine intended to enhance the heart's overall function. It also aids in the prevention

and treatment of cardiovascular-related illnesses, such as heart disease and stroke (Collins, 2020).

The fluted pumpkin fruit is large; one study found a 16–105 centimeter (6.3–41.3 inches) in length and an average of 9 cm in diameter. The seed count in larger gourds was found to be around 196 per fruit, typically measuring between 3.4 and 4.9 cm in length, according to the same study. *T. occidentalis* flowers appear in sets of five, with creamy-white and dark red petals, which contrast with the fruit's light green colour when young and yellow when ripe. The fluted gourd is the most abundantly dioecious flowering species, with only a few documented cases of monoecious flowering (Nwanna, 2008).

2.1 Nutritional Content of Fluted Pumpkin:

Considered an “oil seed”, the fluted pumpkin is high in oil (30%). [Shoots](#) of *T. occidentalis* contain high levels of potassium and iron, while seeds are composed of 27% crude proteins and 53% fats (Aiyelaagbe and Kintomo, 2002). The leaves contain a high amount of antioxidants and hepatoprotective and antimicrobial properties (Collins, 2020).

The young shoots and [leaves](#) of the female plant are the main ingredients of a [Nigerian soup](#), ofe egwusi. The large (up to 5 cm), dark-red seed is rich in [fat](#) and [protein](#) and can be eaten whole, ground into [powder](#) for a kind of soup, or made into a [fermented porridge](#) (Nwanna, 2008).

2.2 Cultivation

T. occidentalis is typically grown vertically on trestle-like structures; however, it can be allowed to spread flat on a field. A beneficial outcome of growing the fluted pumpkin flat is the suppression of weeds, especially when intercropped with a tall, upright plant such as maize (Nwanna, 2008). The growing period begins in April or May when seeds are planted; the first leaves and shoots can be harvested after a month and can be collected every 2–4 weeks thereafter. Seeds are planted directly in the soil, typically in groups of three to increase output in a case of a failed germination (Giami, 2003). Fruit is typically harvested between October and December. The seeds are subsequently collected and dried; a portion of them are consumed, while the remainder are stored for the following planting season (Nwanna, 2008). Although dependent upon soil type, the fluted gourd is able to ratoon and subsequently produce many flushes of fruit over long periods (Aiyelaagbe and Kintomo, 2002). It is able to ratoon with the highest degree of success in well-drained soils. It is propagated using the seeds. Its seed is housed in another greater covering or hard shell which protects it from harm. It survives drought and can retain its life in the root even after many years. It is a creeping plant and grows well if staked with bamboo sticks (Nwanna, 2008).

2.3 Inorganic Fertilizers

A fertilizer is any material of natural or synthetic origin that is applied to soil or to plant tissues to supply one or more plant nutrients essential to the growth of plants (Scherer *et al.* 2009). Inorganic fertilizers have been at the epicentre of many scientific sectors during the last fifty years (Smil, 2001). Multiple facets of the world such as food security, population growth and economic development were set on their discovery, or to be precise, their formulation (Cakmak, 2002). While the population grows, demand on increasing food production ascertains the role of plant nutrition and fertilizers (Cakmak, 2002). Inorganic fertilizers heavily rely on synthetic-organic or inorganic compounds, and they can be also abbreviated as mineral fertilizers (Scherer *et al.*, 2009).

2.4 Types of Inorganic Fertilizers

Complete fertilizer which comprises of the 3 primary essential macronutrients of interest, Nitrogen (N) Phosphorus (P) and Potassium (K) :

1. **Nitrogen:** Nitrogen fertilizer constitutes a crucial part of amino acids, proteins, enzymes and nucleic acids (Scherer *et al.*, 2009). Not only is it a structural component, but it also contributes to the protein-nuclei acid synthesis and chloroplast formation, therefore, a common aspect of deficient plants is their low chlorophyll content along with a minimal

protein concentration (Scherer *et al.*, 2009). It is commonly absorbed by plants in the form of NO_3^- or NH_4^+ (Griffin, 2015) and is responsible for higher crop yields.

2. **Phosphorus:** Phosphorus is an element contributing to various nucleic acids and phospholipids, whereas its role in ATP -a vital energy molecule- should not be neglected (Scherer *et al.*, 2009). Furthermore, two significant reactions, phosphorylation and glucose activation are based on P molecules bound to ATP (Scherer *et al.*, 2009). Therefore, a deficiency of P might relate to symptoms of grey dark green colour, while overall growth rates are hindered (Scherer *et al.*, 2009). Phosphorus is in the form of PO₄ in fertilizers and is often absorbed as H_2PO_4^- or HPO_4^{2-} (Griffin, 2015) Further, there exists a significant correlation between N and P when it comes to metabolic reactions, as well as the increase in photosynthesis when leaf-P is abundant (Reich *et al.*, 2010). The same authors state that phosphorus is an irreplaceable nutrient, underlining that only a fraction is uptaken by plants. They end up saying that when it comes to roots, phosphorus seems to be an adversary of mycorrhization.

3. **Potassium:** The third macronutrient of interest, Potassium, is the nutrient that plants do absorb most prominently (Scherer *et al.*, 2009). It is known that K cations are found at great concentrations inside cells, while their role in depolarization of cells is rather important, as they can move in or out of membranes (Scherer *et al.*, 2009). A strong indication of K

deficiency is the respiration of carbohydrates to keep ATP at adequate levels, resulting in low energy status of plants, thus making them susceptible to multiple diseases and attacks (Scherer *et al.*, 2009). The molecular role of K should not be underestimated, as drought stress pathway, water uptake, osmotic adjustment and stomatal regulation are all procedures dictated by K⁺ (Wang *et al.*, 2013). Potassium can increase biotic stress resistance. Most cultivations are indeed susceptible to pathogen attacks and as shown, K deficiency tends to increase this fact; therefore, rather simple appliance of K-rich fertilizers does improve yields (Wang *et al.*, 2013). Most often, potassium is in the form of K₂O in fertilizers, listed as potash, while it is absorbed as K⁺ by plants (Griffin, 2015).

2.5 Advantages of Inorganic Fertilizers

1. **Higher nutrient concentration:** Inorganic fertilizers often have higher concentrations of specific nutrients like nitrogen, phosphorus, and potassium compared to organic fertilizers. This allows for more precise control over nutrient application and can be beneficial in situations where plants have specific nutrient deficiencies. (Hatfield and Prueger, 2015)
2. **Fast-acting:** Inorganic fertilizers are typically water-soluble, which means they dissolve quickly in soil moisture and are readily available to plants for uptake. This fast-acting nature can be advantageous, especially during periods of rapid plant growth or when immediate correction of nutrient deficiencies is needed. (Brady and Weil, 2008)

3. **Precision and control:** Because inorganic fertilizers contain specific nutrient ratios, they allow for precise control over the types and amounts of nutrients applied to plants. This can be advantageous for optimizing plant growth and minimizing nutrient wastage. (Marschner, 2012)

2.6 Disadvantages of Inorganic Fertilizers

1. Excessive use of fertilizers damages the plants and reduces soil fertility.
2. Can pollute the environment/underground water.
3. Scorching.
4. Expensive to produce.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study Area:

The study was carried out in 2023 at the Experimental Field of the Department of Soil Science and Land Management, Faculty of Agriculture, University of Benin, Benin City. The area lies between latitude 6.4013754° and 5.6258° North and longitude 5.625880° and 6.40127231 East. It is in the rainforest ecological zone of Nigeria (Iloba and Ekkrakene, 2008) which is characterized by two distinct seasons: dry (November–March) and wet (April–October) (Molindo and Nwachokor, 2010). It has a mean annual rainfall of 1900 mm and average temperature of 27°C. The topography of the land is a gentle slope, which falls eastwards. The soils in the area are ultisols; which are derived from recent coastal plain sands known as Benin formation (Umweni, 2007). The vegetation of the area includes weeds such as: *Panicum maximum*, *Mimosa pudica*, *Eleusine indica*, *Sida acuta*, *Sporobolus pyramadalis* etc.

3.2 Planting Materials

Pumpkin pods was processed and seeds were allowed to stay at room temperature, Inorganic fertilizer were bought from the market and used for the experiment.

3.3 Cultural Practices

Prior to planting, pumpkin seeds were collected from the fruit, air dried for two days before planting. And was planted using a spacing of 0.5m by 0.5m, 12 blocks measuring 1.5m by

1.5m each in a land at the rate of 16 seed per hole in each block. NPK 20:10:10 was applied at 4th week. Weeding was done bi-weekly. Before harvest, vine length, leaves number, yield per stand and total yield per hectare of pumpkin were taken as parameters for the estimation of yield.

3.4 Experimental Design

This experiment was laid out on a Randomized complete block design (RCBD) with 12 layouts and 3 replicates. This resulted in an average of 16 stands for each block resulting in 48 stands for each treatment level with a plant population of 192 stands.

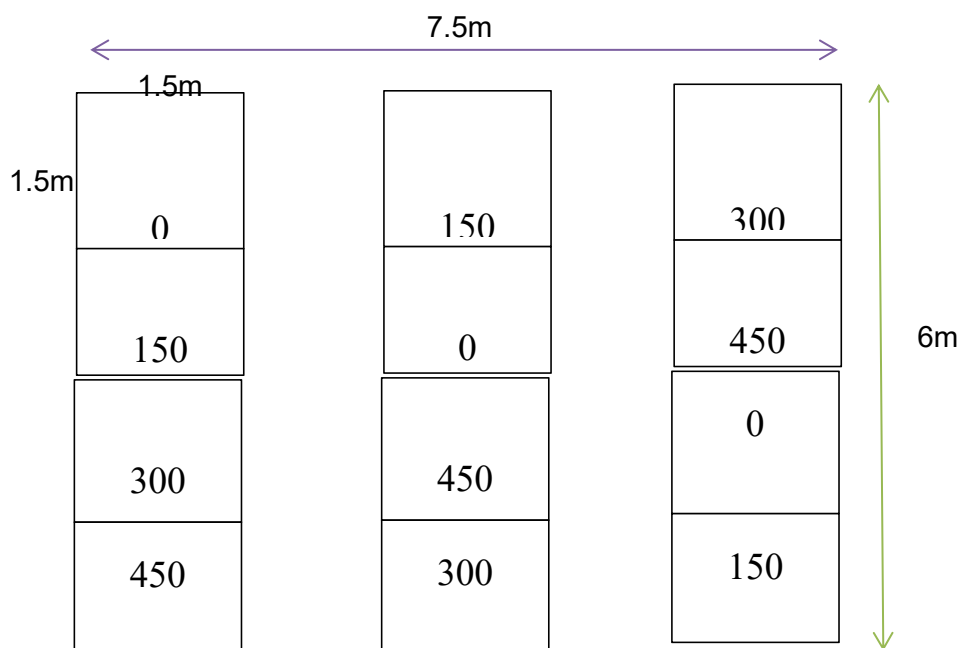


Fig 1: Plot layout of Study Area

3.1.1 Soil Sampling

Composite soil samples were collected with an auger from (0-30cm) soil depth before planting, and some days after fertilizer application, after harvest soil samples were collected from plots where NPK 20:10:10 were applied at 0, 150, 300, and 450 kg/ha. The collected soil samples were air dried, crushed and sieved with 2 mm mesh and stored in labeled polythene bags prior to analysis.

3.2 Laboratory Analysis

Soil samples were analyzed for selected physical and chemical properties using standard procedures.

3.2.1 Particle Size Distribution

This was determined using the Hydrometer method of Bouyocuos (1951) as modified by Day (1965). 51g of the soil sample was weighed into a soil shaking bottle, 100 ml calgon was added and the mixture was stirred using a stirring rod, dispersed using a dispersing machine for 5 minutes and transferred into a 1000 ml measuring cylinder, made up to mark with distilled water and the soil particles were set in motion using a plunger. The first hydrometer (H_1) and temperature (T_1) readings were taken after 40 seconds while the second hydrometer (H_2) and temperature (T_2) readings were taken after 2 hours using the standard soil hydrometer with Bouyoucos scale in g/L and thermometer respectively. The first reading was used to calculate the percentage of clay and silt in the soil while the second reading was used to calculate the percentage of clay in the soil, according to the formula below:

$$\% \text{ (Clay+ Silt)} = \frac{H_1 + 0.36 (T_1 - 20)}{W} \times 100$$

$$\% \text{ Clay} = \frac{H_2 + 0.36 (T_2 - 20)}{W} \times 100$$

$$\% \text{ Sand} = 100\% - \% (\text{Clay} + \text{Silt})$$

$$\% \text{ Silt} = \% (\text{silt} + \text{clay}) - \text{clay}$$

Where;

H₁ = first hydrometer reading

T₁ = first temperature reading

H₂ = second hydrometer reading

T₂ = second temperature reading

w = weight of soil sample used

3.2.2 Textural Classification

Textural classification was determined using the textural triangle (soil survey staff, 2013).

3.2.3 Soil pH

The pH of the air dried soil was determined using a glass electrode pH meter ratio 1:2 and (21 g soil to 20 ml distilled water) according to method of Mclean, (1965).

10 g of air dried soil was weighed into 100 ml beaker, 20 ml of distilled water was added and the mixture was stirred intermittently for 30 minutes with a stirring rod. The pH meter was standardized with buffer pH 4.0 and 7.0, before the pH of the soil was taken. The reading was taken by dipping the electrode into the liquid part the mixture and the reading recorded.

3.2.4 Soil Organic Carbon (OC)

The soil organic carbon (OC) content was determined by the wet oxidation method of walkley and Black (1934). 1 g of soil was weighed into a conical flask. 10 ml 0.167 M K₂Cr₂O₇ was added and the conical flask was swirled. 20 ml of concentrated H₂SO₄ was added and swirled for 1 minute and the mixture was allowed to cool for 30 minutes after

which 100 ml distilled water was added and swirled and allowed to cool. 3 drops of ferroin complex indicator was added. The mixture was swirled and titrated against 0.5 N $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ to a brownish red end point (T). Blank was prepared and titrated (B) following this procedure without soil.

$$\% \text{ OC} = \frac{(B-T)N \times 0.3F}{w}$$

Where;

N = normality of acid used

B = blank titre value

T = sample titre value

F = correction factor

w = weight of soil

3.2.5 Total Organic Nitrogen (TON)

Total nitrogen was determined by dividing the values of organic carbon by 20 (Ibitoye, 2008).

3.2.6. Available Phosphorus Determination

The available phosphorus in the soil samples was determined using Bray and Kurtz (1945) 1 g soil sample that passed through 2 mm sieve was weighed into a shaking bottle in duplicate. 35 ml of Bray solution was added into the shaking bottle and suspension was shaken for 1 minute. The suspension was then filtered through whatman 42 filter paper. The phosphorus content of the filtrate was determined using vanado-molyhdate blue procedure of Riley and Murphy (1962). The phosphorus content of aliquot was extrapolated from a standard curve prepared alongside the samples.

3.2.7 Exchangeable Base (Ca, Mg, Na, K)

Determination of calcium and magnesium were determined volumetrically by the EDTA titration procedure described by black (1967). 10g of air dried soil was weighed into shaking bottle. 100 ml of 1N ammonium acetate solution of pH 7 was added with 100 ml measuring cylinder to extract the exchangeable bases. The bottle was covered tightly and shaken for 1 hour on reciprocal shaker thereafter; the soil suspension was filtered through whatman No 42 filter paper into 100 ml volumetric flask and residue washed into three 10 ml aliquots of 1N ammonium acetate of pH 7 solutions. 25ml aliquot of the filtrate was withdrawn with pipette into 250 ml conical flask, 20 ml of concentrated ammonia solution was added followed by 6 drops of eriochrome black T indicator, the content of the flask was titrated with 0.01 M of disodium salt of ethylene diamine tetraacetic acid (EDTA) solution and the colour change was sky blue colour as end point.

Potassium and Sodium were determined from the filtrate by flame photometry as described by black (1965).

3.2.8 Cation Exchange Capacity (CEC)

The cation exchange capacity was determined by direct summation methods where CEC was calculated by summation of Ca + Mg + Na and K (Udo *et al.*, 2009).

3.2.9 Exchangeable acidity (EA)

Exchangeable acidity was determined by extracting soils with 1 M KCl as reported by Juo (1979). 5 g of soil was weighed into a soil shaking bottle, 100 ml 1 M KCl was added, shaken for 1 hour and filtered using whatmann No. 1 filter paper. 10 ml of the filtrate was measured into a conical flask, 5 drops of phenolphthalein were added and made up to 40 ml

mark. The extractant was titrated against 0.01 M NaOH to a permanent pink endpoint and the

EA was calculated using the formula below;

$$EA = \frac{T \times M \times V_1 \times 100}{V_2 \times W}$$

Where,

T = titre value

M = molarity of acid used (0.01 M)

V₁ = volume of extractant (10 ml) used for titration

V₂ = final volume of extract used for titration (40 ml)

W = weight of soil

3.2.10 Effective Cation Exchange Capacity (ECEC)

The ECEC was calculated by the summation of exchangeable bases and exchangeable acidity.

3.2.11 Base Saturation

Percentage base saturation was determined by the equation given below:

$$\% \text{ Base Saturation} = \frac{\text{Total exchangeable basic cation}}{\text{ECEC} \times 100}$$

3.5 Data Collection

Vine Length (cm): The vine length of pumpkin plants from base to tip were measured at harvest, using a tape and the means were determined and recorded.

Number of Leaves and Yield: The number of leaves of pumpkin plants before harvest were counted and mean was determined and recorded.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Effect of NPK 20:10:10 fertilizer on Yield, leave number, and vine length of *Telfairia Occidentalis*

Vine Length (cm):- The control plots recorded the lowest vine length value of 64cm for fluted pumpkin. Other treatments treated with different rates of NPK 20:10:10 fertilizer produced higher vine length values than the control plot (Table 1). This agrees with findings of (Olowoake and Ojo) who observed an increase in growth parameters with applied fertilizer types.

Number of Leaf:- According to (Table 1), the lowest value of number of leaf was recorded in control plot (97 leaves), while the highest value of Number of leaf was recorded in soil treated with 450 kg rate of NPK 20:10:10 fertilizer (230 leaves) followed by plot treated with 300 kg rate of NPK 20:10:10 fertilizer. Hence the application of NPK 20:10:10 fertilizer influences the number of leaves of *Telfairia occidentalis*. This agrees with the findings of (Jahn *et al.*, 2004) who reported a significant increase in the number of leaf of *Telfairia occidentalis* with increase in applied fertilizer. NPK 20:10:10 fertilizers also significantly influences the growth of *Telfairia occidentalis*, this is because almost all vegetables require N for proper shoot growth and P for proper root development and soils rich in organic carbon and organic matter.

Table 1: Effect of NPK 20:10:10 Fertilizers on Yield, leave number, and vine length of

Telfairia occidentalis

TREATMENTS	VINE LENGTH (cm)	NUMBERS OF LEAVES
NPK 20:10:10 (kg)/ha		(tha)
Control	64 cm	97
150 kg	87.8 cm	140
300 kg	88.5 cm	162
450 kg	92 cm	230

4.2 Effect of NPK 20.10.10 on same soil properties

4.2.1 Particle Size Distribution

The particle size distribution shows the percentage of sand, silt, clay of the soil, the result showed that the soil was predominantly sandy, with sand occurring in the highest amount when compared to the other soil separates (Table 2). The sandy nature of the soil remained unchanged irrespective of the amount of Fertilizer and crop applied to the soil. The sand, silt, and clay had values of 8.39.00, 35.60 and 12.10 g/kg before planting and 845.20, 40.00, 114.8 g/kg after fertilizer application respectively. The sand, silt and clay had values of 758.00, 40.00, 200, at control plot. At 450 kg/ha rate of NPK 20:10:10 fertilizer application the sand, silt, and clay had values of 248.00, 40.00 and 162.0 g/kg respectively. The sandy nature of the soil could be due to the parent material from which the soils are derived from. The values obtained for sand, silt, clay, and the textural classification found by this study disagrees with the findings of (Airueghan *et al.*, 2018) who reported sand and loamy textural class at a depth of 15-30cm, and 30-60cm.

Table 2: Results of some physical and chemical properties of soils before planting and after fertilizer application.

	SAND →	SILT gkg ⁻¹	CLAY ←	TC	pH	OC →	TON ←	AV.P (mg/kg)	K	Ca	Mg	Na	CEC ←	EA	ECEC	BS %
						gkg ⁻¹			cmol/kg ⁻¹							
Before planting.	839.00	35.60	121.00	LS	4.93	7.78	0.39	9.06	0.25	0.50	0.40	0.21	1.36	0.24	1.59	85.54
AFA	845.20	40.00	114.8	LS	5.32	18.50	0.90	7.09	0.10	0.60	0.95	0.001	1.65	1.60	3.25	50.77
After Harvesting																
O	758	40	200	LS	4.26	12.5	0.63	3.40	1.21	0.51	2.20	0.04	1.78	0.1	1.88	94.68
150	768	40	192	LS	4.20	12,7	0.64	2.82	1.60	0.76	3.67	0.03	6.06	0.2	6.26	96.80
300	788	40	172	LS	4.27	14.6	0.73	2.82	1.42	0.32	1.41	0.03	3.18	0.2	3.38	94.08
450	248	40	162	LS	3.84	14.5	0.73	2.83	1.00	0.57	2.07	0.05	3.68	0.2	3.89	94,86

Where: TC = Textural Class, LS = Loamy Sand, SL = Sandy Loan, TC = Total Carbon, OC = Organic Carbon, TON = Total Organic Nitrogen,

AV.P = Available Phosphorus, CEC = Cation Exchange Capacity, EA = Exchangeable Acidity, ECEC = Effective Cation Exchange Capacity, BS

= Base Saturation AFA= After Fertilizer Application.

4.3 pH

The pH of the soil before planting was observed to be very strongly acidic (4.93) while after fertilizer application the pH was observed to have improved as it became strongly acidic (5.2) while the pH after the harvest of fluted pumpkin was very strongly acidic (4.26, 4.20, 4.27) in the control plot and plots amended with 150 and 300 kg/ha of NPK 20:10:10. While the plot amended with 450 kg/ha of NPK 20:10:10 was extremely acidic. The pH of the plot which was generally acidic may not be unconnected with the high rainfall and parent material of the study area, which encourages leaching of basic cations, leaving sesquioxides that contributes to soil acidity (Juo *et al* 1995).

4.4 Total Organic Carbon (OC)

Total Organic Carbon (OC) was low (7.78 g/kg) in the soil before planting and became high (18.50 g/kg) after fertilizer application. However, the OC was moderate in control (12.50 g/kg⁻¹) and in soil amended with 150 kg/ha of NPK 20:20:20 (13.70 g/kg), while in the plot amended with 300 and 450 kg of NPK 20:10:10 per hectare had OC values of (14.60 and 14.50 g/kg) respectively. The high OC values recorded in this study after fertilizer application and harvest is similar to the findings of (Ehigiator *et al.*, 2016). Who observed that NPK 15:15:15 application increased the TOC content of the soil under cowpea and groundnut intercrop.

4.5 Total Organic Nitrogen (TON)

The TON of the soil before planting was observed to have values of 0.39 and 0.90 g/kg respectively. While the TON after harvest of fluted pumpkin were 0.63, 0.64, 0.73 and 0.73 g/kg⁻¹ in the control plot and plots amended with 150, 300, 450 kg/ha of NPK 20:10:10 plots respectively. The higher TON observed in the plots amended with NPK 20:10:10 when compared to the values obtained before planting is in line with the findings of Nottidge,

(2015), who reported that plots treated with NPK fertilizer had higher total nitrogen than plots that were not amended with NPK fertilizers.

4.6 Available Phosphorus (P)

The results showed that available P was moderate before planting and after fertilizer application when compared with the ratings of Chude *et al.* (2011) the available p obtained in the control plot had value of 3.49 mg/kg and could be said to be low when compared to the critical value of 3.7 reported by Chude *et al.* (2011). The available P at the plot amended with 150, 300, and 450 kg/ha NPK 20:10:10 had values of (2.82, 2.82, 2.83 mg/kg) respectively and could be said to be very low when compared with <3.00 mg/kg reported by Chude *et al.* (2011). The low available p after fertilizer application obtained in this study could be due to Phosphorus sorption as reported by Orhue *et al.* (2021), who reported high P fixation in soils of coastal plain sand.

4.7 Exchangeable Potassium (K)

Exchangeable k content of the soil before the planting and after fertilizer application had values of 0.1 and 0.25 cmol/kg⁻¹, while the exchangeable K after the harvest of fluted pumpkin were 1.21, 1.60, 1.42, and 1.00 cmol/kg⁻¹ in the control plot and plots amended with 150, 300, and 450kg/ha of NPK 20:10:10 respectively. The higher exchangeable K in fertilized plots than that obtained before planting is similar to the findings of Nottidge, (2015), who also reported that plots treated with NPK fertilizer had higher exchangeable K than plots that were not amended with NPK.

4.8 Exchangeable Bases (Ca, Mg, Na)

The exchangeable bases (Ca, Mg, Na) before planting and after fertilizer application had values of 0.50, 0.40, 0.21 and 0.60, 0.95, 0.00 cmol/kg respectively. The exchangeable bases varied in plots amended with NPK 20:10:10 fertilizer. The exchangeable bases was inconsistence with increase in application of NPK 20:10:10 this disagrees with the findings of

Ehigiator *et al.* (2015) who reported that fertilizer application had effect on exchangeable bases and the effect was consistent with the rate of application. However, Ca and Mg had highest value of 0.76 and 3.67cmol/kg in plot amended with 150 kg/ha of fertilizer respectively and could be said to be adequate and high respectively. While highest value of Na (0.05 cmol/kg) was obtained in plot amended with 450 kg/ha NPK 20:10:10

CHAPTER FIVE

5.0 CONCLUSION

The highest leaf yield of fluted pumpkin was recorded in the plot amended with 450kg of NPK 20:10:10 fertilizers and statistics showed that the result was significantly different from control and plots amended with other treatment levels. This means that the application of NPK 20:10:10 fertilizer had a significant effect on the yield of *Telfairia occidentalis*.

REFERENCES

- Aiyelaagbe, I.O.O, and Kintomo, A.A (2002). "Nitrogen Response of Fluted Pumpkin (*Telfairia occidentalis* Hook. F) Grown Sole or Intercropped with Banana." *Nutrient Cycling in Agroecosystems* 64: 231-35.
- Akoroda M.O (1993). Seed desiccation and recalcitrance in *Telfairia occidentalis* Seed *Sci. Technol.* 14: 327-332.
- Brady, N. C., & Weil, R. R. (2008). *The nature and properties of soils* (14th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.)
- Cakmak, I. (2002). Plant nutrition research: Priorities to meet human needs for food in sustainable ways plant and soil, 247,3-24.<https://doi.org/10.1023/A:1021194511492>
- Collins, N, (2020). 10 Nigerian Foods that Boost the Immune System. www.google.com. accessed June 14th, 2023.
- Giami, S. Y (2003). "Effect of Germination on Bread-Making Properties of Wheat-Fluted Pumpkin (*Telfairia occidentalis*) Seed Four Blends." *Plant Foods for Human Nutrition* 58: 1-9.
- Griffin, B. (2015, November). Turfgrass Fertility: Understanding Fertilizer Labels, Macronutrients and Micronutrients. UGA Cnonerative Eyrencion Circular 1058. <https://secure.caes.uga.edu/extension/publications/files/pdf/C%201058-21.PDF>
- Hatfield, J. L., & Prueger, J. H. (2015). Temperature extremes: Effect on plant growth and development. *Weather and Climate Extremes*, 10, 4-10.)
- Iloba, T. and Ekrakene, M. (2008). One death, many insects' species yet one insect's generation. T Ekrakene, BN Iloba 8 (1), 27-39
- Jahn, G. C., Almazan, L. P., Paria, J. (2004). Effects of Nitrogen fertilizer on the intrinsic rate of the rusty plum aphid. *Environmental Entomology*, 34 (4): 938-943.
- Marschner, H. (2012). *Marschner's mineral nutrition of higher plants* (3rd ed.). London: Academic Press.)
- Molindo and Nwachokor,(2010). Assessment of Tillage/zero Tillage Farming Systems in Ultisols of Benin City, Nigeria. 6(6):987-992
- Nwanna, E. E., (2008). "Antioxidant and Hepatoprotective Properties of *Telfairia occidentalis* Leaf (Fluted Pumpkin)." *Thesis and Dissertations (Biochemistry)*: n. pag 6-12
- Olowoake, A.A and J.A. Ojo, 2014. Effect of fertilizer types on the growth and yield of *Amaranthus caudatus* in Ilorin, Southern Guinea, Savanna /one of Nigeria. *Adv.Agric.*, Vol. 2014
- Reich, P.B., Oleksyn, J ., Wright, I.J ., Niklas, K.J .,Hedin, L., & Elser, J .J. (2010). Evidence of a general 2/3-power law of scaling leaf nitrogen to onosonorus amond ma or dant

- crouos ancbiomes. Proceedings of the Royal Society B:Biological Sciences 277,877-883.
- Scherer, H. W., Mengel, K., Kluge, G., & Severin, K. (2009). Fertilizers, 1. General. In Wiley VCH Verlag GmbH & Co. KGaA (Ed.), Ullmann's Encyclopedia Industrial Chemistry (p. a10_323.pub3).
- Smil, V. (2001). Enriching the Earth: Fritz Haber, Carl Bosch, and the transformation of world food production. The MIT Press.
- Umweni, (2007).Soil mapping, classification and morphological characteristics of the University of Benin land *NJSS 31 (2) 2021, 32-40*
- Wang, M., Zheng, Q., Shen, Q., & Guo, S. (2013).The Critical Role of Potassium in Plant Stress Response. U MS, 147370-7390. <https://doi.org/10.3390/jms14047370>