EVALUATION OF THE EFFECT OF COMPOST APPLICATION AND IRRIGATION ON GROWTH AND YIELD OF UGWU

(*Telfairia Occidentalis*)

BY

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DECLARATION

I hereby declare that this project work is a record of a research work undertaken and written by me. It has not been presented before for any degree or diploma or certificate at any university or institution. Information derived from personal communications, published and unpublished work were duly referenced in the text.

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19/02/2010

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CERTIFICATION

This project entitled "Evaluation of The Effect of Compost Application and Irrigation on Growth and Yield of Ugwu *Telfairia Occidentalis*" by Suleiman. Ismaila Adebayo meets the regulations governing the award of the degree of Bachelor of Engineering (B.ENG.) of the Federal University of Technology, Minna, and it is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

This project is dedicated to Almighty God the author and the finisher of our faith who makes it possible for me to complete the program successfully whose hand lies my future and to my lovely parent Mr and Mrs Suleiman Tijani

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ABSTRACT

The effect of compost application and irrigation on the growth and yield of ugwu was evaluated. Two treatments were used for the experiment these are tap water only for irrigation (treatment one T_1) and the compost manure and tap water for irrigation (treatment two T_2) such parameter as growth measurements, soil analysis, compost characteristics and total irrigation water requirements were conducted during the experiment. The growth measurement indicated that treatment two(T_2) had the highest value for plant height, width of leaves, length of leaves and number of leaves. The soil analysis also shows that treatment two(T_2) had the maximum result. Treatment two (T_2) has the highest concentration of (P and Mg) and lowest concentration of (Zn and Cu) and treatment one (T_1) has the highest concentration of (P and Ca) and lowest concentration of (Zn and Cu). The result of the compost analysis shows that the values of NPK in compost are 3.86%, 34.7ppm, 370.8ppm. The total irrigation water of 728lit was used for the effective operation of the experiment. The result shows that compost manure farming is of higher advantage in terms of nutrient value for the growth and yield of ugwu.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study.

Ugwu, fluted pumpkin or fluted guard with botanical name *Telfairia occidentalis* belong to the member of the family cucurbitaceae is a cotyledonous plant. It is a climbing perennial that produces leafy shoots about is inches (50 cm) long. It is an important leaf and seed vegetable indigenous to south eastern Nigeria. The reason for the popularity and acceptance of the vegetables is that it's seeds, shoos and stems are sought after items of diets and highly nutritious, among the important indigenous vegetable, Ugwu seems to be widely eaten in Nigeria ad leaves as a background drop mainly by the Igbo tribe, with the spread of Igbo's to other part of the country (Akoroda 1998). In the middle belt, which is in the guinea savanna region of Nigeria, Ugwu is now being cultivated not only as backyard crop but also a commercial crop during the wet and dry season.

The leaves and young are edible. The lea has a high nutritional, medical and industrial being rich in protein (29 %), fat (18 %) and minerals and rich vitamins (20 %), and the consumers of the leaf have grown tremendously and healthy over the years, owing to claim that the leaf is a blood boosting vegetable and a delicacy in the preparation of local Nigeria soups. Ugwu leaves are rich in magnesium, iron and fibers (Akwaowo, 2000) and are use as food supplements. Beyond the leaves lies the giant pod with scores of seed that have proved to be rich source of several nutrients required by the body. The seed are used as propagating material, eaten, roasted, boiled or ground to paste as soup thickness. The nutritional value of the fluted pumpkin seeds (53 % fat and 27 % crude proteins). This justifies the wide consumption of fluted

pumpkin. The oil in the seeds is nondrying and is useful in soap making and in cooking, the seed as an excellent pattern of amino acids. 93.7 % which contains higher levels of most essential amino acids (except lysine) than soya bean meal with 94.9 % even the potassium and sodium availability are higher in Ugwu seed (58.8 %) than that of soya bean seed cake (54.9 %) (Esuose 1999). This indicates that Ugwu seed cake may suitable to fortify foods and the seed oil serves as food oil for making margarine. The high oil content makes it a potential source of raw material for the vegetables oil industries in Nigeria. Fluted pumpkin seed serves as good source of zinc make them well sweated for this role as a prostrate protector. These justify apparent increase in its production in Nigeria.

The fruit case and pulp of ugwu which constitute 64% of whole fresh fruit weight which can be used as feedstuff for livestock and the pectin content of the pulp (1.0 %) has been used in the production of marmalade (Egbekan 2000). In the recent time, ugwu as gained medicinal recognition, it has been discovered to be blood purifiers and could therefore be useful in maintenance of good health most especially among poor resource ruralities in developing country, it is sweet, Nutley, flat creamy –colored seed with a chewy texture. Ugwu is use at home and I some cases, ugwu provides an appreciable cash income to small farm families by selling in local market. The new shoot of ugwu can be harvested every three to four weeks.

Irrigation is the artificial application of water to the soil for the purpose of crop production i.e. further stated that irrigation water is applied to supplement the water available from rainfall and contribution of sol moisture from ground water (Michael 2002).Also irrigation is described as the application of water to the soil for the purpose of supplying the moisture essential for development and growth of plants (Eling, 2005). Irrigation is to ensure that enough moisture essential for plant life, provide crop insurance against short duration, drought, cool or dilute

harmful salt in the soil, reduce hazards f soil piping and soften the tillage pans. The necessity of irrigation is when the total amount of rainfall is less than the amount required by the plant as when the amount of rainfall is sufficient but the distribution does not coincide with the schedule of supply required by the plant for their growth.

Compost is well rated organic manure prepared by decomposition of organic matter. Composting is largely a biological process in which micro-organism of both type, Aerobic (require oxygen for deep development) and Anaerobic (function in absence air or free oxygen) Decompose the organic matter are lower down the carbon and nitrogen ration of refuse. The final production of composting is well ratted manure known as compost. It contains relatively higher quantity of major nutrients than that of farm yard manure. Compost is prepared from waste material like vegetable refuse, farm litter such as weeds, sugar cane trash, sewage sludge and animal wastes.

1.2 Objectives

The objective of this project is to:

1. Evaluate the yield of ugwu under the application of compost manure.
2. Study the amount of irrigation water requirement for the effective operation of the scheme when there is less or no rainfall.

1.3 Justification

Over the years, ugwu as been one of the agricultural products under utilization especially in the developing countries like Nigeria. Ugwu is highly nutritious as well as rich in oil and thus the oil can be used for cooking and making soup. Ugwu have excellent nutritional qualities with a fact composition and have rich in mineral content especially zinc, magnesium, iron. The seed of ugwu was found to contain 93% amino acid. This has the higher level of most essential amino acid. The seed are used as propagating material, eaten, roasted, boiled or ground to paste as soup thickness. The potassium and sodium availability are higher in determine the growth and yield of ugwu in response to irrigation and compost application.

1.4 Scope of the Study

The scope of the study is to know a suitable compost and better application of irrigation to the growth and yield of ugwu.

1.5 Limitation

The limitation of the study is the potential of the crop, its cultivation has not gained sufficient scientific recognition, the fertilizer application technology and poor pest control strategy. In order to get expected result from the use of agrochemical, it has to be applied in correct method.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Origin and Geographic Distribution of Ugwu

Fluted pumpkin occurs in the forest zone of West and Central Africa, most frequently in Benin, Nigeria and Cameroon. It is a popular vegetable all over Nigeria. It is rare in Uganda, and absent in the rest of East Africa. It has been suggested that it originated in south-east Nigeria and was distributed by the Igbo's, who have cultivated this crop since time immemorial. It is, however, equally possible that fluted pumpkin was originally wild throughout its current range, but that wild plants have been harvested to local extinction and are now replaced by cultivated forms.

2.2 Description of Ugwu

Perennial, dioeciously herb climbing by coiled, often branched tendrils to a height of more than 20 m; root system ramifying in the top surface of the soil; stem angular, glabrous, becoming fibrous when old. Leaves arranged spirally, pedately compound with 3–5 leaflets; stipules absent; petiole (2–)4–11(–15) cm long; leaflets with petiolules 0.5–3.5 cm long, central one largest, up to 15(–19) cm × 10(–12) cm, lateral ones asymmetrical, usually dentate in the upper two-thirds, sometimes scabrid underneath, 3-veined from near the base. Male inflorescence an auxiliary raceme up to 3(–5.5) cm long, on a peduncle up to 25 cm long, with at base of peduncle one long-pedicellate flower flowering long before the others; female flowers solitary in leaf axils. Flowers 5-merous, cream coloured, pedicel up to 4 cm long, receptacle campanulate, sepals triangular, up to 5 mm long, petals free, oblong, fringed; male flowers with

3 stamens, two 4-locular and one 2-locular, with large reddish connective; female flowers similar to male flowers but with inferior, cylindrical, 3-celled ovary and 3 large, heart-shaped stigmas. Fruit a drooping, ellipsoid berry 40–95 cm × 20–50 cm, weighing up to 6 kg, with 10 prominent ribs, pale green and covered with white bloom wax, fruit pulp yellow, many-seeded. Seeds compressed ovoid, up to 4.5 cm long, black or brown-red. Seedling with hypogeal germination, developing first a taproot and then numerous, spreading auxiliary roots; epicotyls 5–12 cm long; cotyledons planoconvex, fleshy.

2.3 Other Botanical Information of Ugwu

Telfairia belong to subfamily of Cucurbitoideae. It comprises 2 species, of which *Telfairia pedata* and *telfairia occidentalis*.is much cultivated for its seed oil in East Africa. The names *Telfairia pedata* and oyster nut are often used erroneously for *Telfairia occidentalis*.

Cultivars of are distinguished by seed colour, thickness of vine, size of leaf, growing vigour, days to flowering and succulence. In Nigeria the two main cultivars are 'ugu-ala', characterized by succulent, broad leaves, small black seeds, thick stem and slow growth, and 'ugu-elu' which has a high growth rate, large brownish seeds with high viability, and thin stem with small leaves. The large succulent leaves of 'ugu-ala' make this cultivar a commercial vegetable in high demand, while the fast emergence and high growth rate of 'ugu-elu' is preferred by farmers because of quick returns. The seed is often polyembryonic, which is useful for multiplication and in breeding.

T. occidentalis and *T. pedata* are dioeciously (2n = 22) with male and female flowers borne on different plants. Though very rare, monoecious plants can also be found in (Akorode et al.1990).Both species are fast growers and climbers that use trees as support, trailing the trunks

up to a height of over 30 m.g*T.pedata* is hardy and deep- rooting. It is used as an ornamental because of its beautiful foliage. The vine is part there are wide variations in sex ratio but there tends to be more males than female plants (Akoroda 1990a; Akoroda et al. 1990; Emebiri and Nwufo1996). Male plants start flowering earlier (mean of 129 days compared with 150 days after planting for female plants) and over a longer period (59 days versus 17 days for female plants)(Akoroda and Adejoro 1990). There are more than 800 open male flowers to a single opened female flower and male flowers open in the evening till the next morning while female flowers open in the morning till late evening. About 10-15% of a given female population does not flower in the first year of planting and abortion of fruits is high. Plants may set up to six fruits but usually one large and one or two medium sized fruits are eventually carried to maturity. To date, all attempts at finding markers for accurate sexual identification of seeds or seedlings early during growth have not succeeded (Asiegbu 1985; Emebiri and Nwufo 1996).of a rich agro forestry system in the coffee- growing regions of East Africa (World Agroforestry Centre 2004).

2.4 Propagation and Planting of Ugwu

Fluted pumpkin seeds are viviparous (germinating in the fruit). Since seeds are recalcitrant they cannot be stored for more than 3 days once they are extracted from the fruit. The critical seed moisture content below which seeds cannot recover from desiccation is 40–60%. Fluted pumpkin is often grown as a crop in homesteads where it is intercropped with other vegetables and food crops such as cassava, yams and maize, or planted against fences. Commercially it is grown as a sole crop. The conventional method of propagation is by seed, sown directly at a rate of 30,000–70,000 seeds/ha and spaced at 0.3–1 m × 0.3–1 m. Densely spaced stands are best for leaf production, while the wider spacing is best for fruit production

when staked. Depending on the soil type, rainfall and cropping pattern, fluted pumpkin can be planted on the flat, or on ridges or mounds

2.5 Growth and Development of Ugwu

Seed size affects vigour, germination and seedling establishment. The viability varies from 63% for small seed (<11 g), up to 89% for the 22 g). Germination takes about 14 days in natural soil, but only 7 days in a sawdust medium. Vine length one week after emergence is on average 31 cm for large seeds, whereas small size seeds grow into a corresponding vine length of 16 cm. Larger seeds also show better growth potential in terms of number of leaves and number of branches, and show more uniformity in the seedling stand. The vegetative growth pattern of plants is sigmoidal and reaches its peak 6.5 months after planting under selective and periodic pruning of edible young leaves. Male plants flower about 3 months after planting, a month earlier than females ones. Flower opening starts from the base of the inflorescence. Male flowers have a noticeable scent around noon when pollinating insects, mostly bees of the genus *Triton*, visit the flowers. The stigma of female flowers is receptive in the afternoon. Hand pollination seems to be advantageous for fruit set as it resulted in 35% fruit set compared to 15% fruit set in open pollination. Fruit set is evidenced by a rapid growth of the ovary starting within 3 days after pollination. Fruit growth is sigmoidal over 8 weeks; growth is rapid between 1.5–5.5 weeks after successful fruit set. A white, waxy bloom develops on the surface of fruit a week after fruit set and gradually intensifies, but at maturity it becomes less intense. The maturing fruit sometimes suppresses fruits that set later. Female plants produce about 18 single flowers which set fruit, but only 1–4 develop into mature fruits. Out of the female plants of a population, only 35% bear fruits. A large variation occurs between and within plants in the number of seeds per fruit, from 6 seeds per fruit up to 196, with an average of 62 seeds. The seeds are also unequal in size, varying

from 1 g to 68 g. Some seeds exhibit polyembryony. The seed is recalcitrant in nature and thus seed storage is difficult. The time to physiological maturity of the fruit is 9 weeks after fruit set. Identifying the female plants from either seeds or young seedlings has not been successful, but vine size 64 days after planting could be used as a sex indicator, because female plants are more vigorous than the male ones.

2.5.1 Yield of Ugwu

The fresh shoot yield can be as low as 500–1000 kg/ha, but it can also reach 3–10 t/ha. In home gardens in Benin, one plant occupying 3 m of fence produced 2 kg young leaves per m in the rainy season and 500 g in the dry season without irrigation. The seed yield can reach 1.9 t/ha, derived from 3000 fruits.

2.5.2 Harvesting of Ugwu

Leaf harvesting begins one month after emergence and is continued at 3–4-week intervals. The best method of harvesting is by pruning, i.e. by cutting beneath the lowest acceptable leaf. The harvest interval has no effect on the longevity of the crop and, depending on the irrigation facilities, 4–6 harvests or more are expected. In commercial production during the dry season, harvesting time in Nigeria is between November and July with 18 or more harvests. Fruits are harvested 9 weeks after fruit set.

2.5.3 Handling after Harvest of Ugwu

After harvest, the succulent leaves remain fresh for just one day. In Nigeria harvested leaves are packed as 'heads' and tied in a jute bag. These are collected from the farm gate. It is possible to store the leaves for 3 days in a jute bag in an airy place but they lose turgidity. Fresh shoots are sold wholesale to traders, mainly women, who retail them in smaller bundles. Large bundles are wrapped with plantain leaves or loosely covered with old jute or kenaf cloth sacks.

and sparingly watered to preserve freshness. Fruits may be stored in open shade for 1–2 months at the most. Most often they are transported by rail from the eastern part of Nigeria to the middle zone of the country. Before the fruits are sold, they are graded according to size (small, medium and large). In the market they are placed in heaps and sold as heaps or singly. Seeds are left in the fruits until they are used for planting or consumption.

2.6 Properties of Ugwu

The moisture content and composition of the leaves show large variations as a function of cultivar, plant age, ecological conditions and cultural practices. The composition of the leaves is comparable to that of other dark green leaf vegetables. The leaf composition per 100 g edible portion is: water 86.4 g, energy 147 kJ (47 kcal), protein 2.9 g, fat 1.8 g, carbohydrate 7.0 g, fibre 1.7 g. The high content of mineral nutrients, especially of Mg, Fe and K, and of carotene and vitamin C make the leaves potentially useful as food supplements. Young leaves contain the ant nutrients cyanide at 60 mg per 100 g dry matter and tannins at 41 mg per 100 g dry matter, but their concentrations are below toxic levels and may not affect the bioavailability of the minerals. Young leaves should be well cooked to remove the potential toxic effects before consumption. The composition of the seed per 100 g edible portion is: water 6.2 g, energy 2280 kJ (543 kcal), protein 20.5 g, fat 45.0 g, carbohydrate 23.5 g, fibre 2.2 g, Ca 84 mg, P 572 mg (Leung, W.-T.W., Busson, F. & Jardin, C., 1968). Other sources recorded a protein content of 28–37% and an oil content of 42–56% of the dry matter. The mineral content of the seed is reported to be high. The seeds are high in essential amino acids (except lysine) and can be compared with soya bean meal with 95% biological fruit pulp has a protein content of about 1.0%. The main constituents of the seed oil are oleic acid (37%), stearic and palmitic acid (both 21%), linoleic acid (15%). Variation between samples, however, is large.

2.7 Use and Importance of Ugwu

Seeds of fluted pumpkin and oyster nut are of great importance to the nutrition and health of the majority of people in West and East Africa where they are eaten raw, boiled or roasted, because of the seed's high content of protein (>25%) and extractable oil (55-60%).The longlasting, non-drying oil from seeds of the two species is of high value for domestic and industrial purposes. The seeds are also in high demand for consumption by nursing mothers because of their lactation-promoting properties. Owing to the high concentration of essential fatty acids, polyunsaturated fatty acids and iodine, oyster nut oil is also used as a breast massage to aid milk flow and for hair treatment to enhance lustre and growth (Bird 2003). The oil also promotes a soft and supple skin (Kürbis, Kiwano & Co. 2003). It is a common practice for pregnant women to have a large store of oyster nut seeds prior to delivery because it is part of the traditional food of breastfeeding mothers and weaned infants in parts of East Africa (World Agroforestry Centre 2004). The cotyledons are also suitable for use in baked confectionery, chocolate products, mixed-fruits snacks and other snack articles in Europe and North America (Kürbis, Kiwano & Co. 2003; http://www.usitawi.org/en/projects/proj15.html). Fermented flour of *Telfairia* cotyledons can be processed into seasonings, marmalade, high-protein infant weaning food mixtures and different local products in West Africa (Giami and Bekrbain 1992; Egbekun et al. 1998). Chewing young shoots of *T. pedata* can cause abortion in the early stages of pregnancy (Pers. Com. H.P. Msanga), but young, succulent leaves and shoots of fluted pumpkin are relished as special delicacies when cooked, alone, or in mixtures with other vegetables and cucurbits seeds, and eaten with different starch dough. Concoction of fresh leaves is a recommended high-value health tonic for impotent men and a cheap and fast remedy for acute anemia. Seed residue after oil extraction is used as animal feeds. Roots have high

concentrations of alkaloids; therefore, extracts are poisonous to humans and animals and are used to kill rats and mice (Longe et al. 1983; Akoroda 1986, 1990a, b; Ihesie 2000; Schippers 2000). Smallholder farmers in East Africa plant the oyster nut on forest verges and earn extra income from the sale of the seeds.

2.8 Nutritional Value of Ugwu

Table 2.8 Nutritional Value of Ugwu

	Parts of Plant	
Nutrient	**Seeds**	**Leaves**
Water (ml)	6.0	86.0
Calories	543.0	47.0
Protein (g)	20.5	2.9
Fat (g)	45.0	1.8
Carbohydrate (g)	23.0	7.0
Fiber (g)	2.2	1.7
Calcium (mg)	84.0	0.0
Phosphorus (mg)	572.0	0.0

Akoroda, M.O. 1999

2.9 Diseases and Pests of Ugwu (Fluted Pumpkin)

White leaf spot disease, caused by Phoma sorghina, reduces the leaf lamina. It also affects the seed. It is controlled by biweekly foliar spraying with Dithane M-45 at a concentration of 500 ppm. Fusarium moniliforme forms a dry powdery mass of mycelia on the fruits. Erwinia aroideae causes soft rot of the leaves with yellowish ooze; it also affects the fruits. A prevalent virus disease is Telfairia mosaic virus (Telfairia mosaic potyvirus) (TeMV), causing

mottling of the leaves and low leaf yield; it also causes chlorosis, stunting and abnormal fruit development. It is transmitted by the aphid Aphis spiraecola and via the seed. Fluted pumpkin is remarkably resistant to root-knot nematodes (Meloidogyne spp.).

Rhizopus stolonifer, Aspergillus Niger, Botryodiplodia theobromae and Erwinia spp. are diseases of fluted pumpkin fruits in storage. Fungi may cause up to 95% loss, bacteria only 5% loss in long-term fruit storage.

A common pest of fluted pumpkins is the grasshopper Zonocerus variegatus which feeds on the foliage and stems. The leaf beetle Copa occidentalis feeds on the leaves, flowers and other plant parts, while Spodoptera caterpillars feed on leaves and bore into fruits. Pachmola (flower beetles) and Nezara spp. (green shield bug) feed on leaves, stem and fruits. Margaronia indica defoliates the plant, white beetle (Baris spp.) feeds on fruits. Sylepta derogata, Aphis gossypii and Aphis spiraecola hinder growth by feeding on stem, foliage and flower buds, and transmit viruses. There are some unidentified predators that feed on the aphids. Thrips of the genus Taeniothrips cause flower abortion.

2.10 Importance of Irrigation

Irrigation is an artificial application of water to the soil. It is usually used to assist in growing crops in dry areas and during periods of inadequate rainfall. Additionally, irrigation also has a few other uses in crop production, which include protecting plants against frost, suppressing weed growing in rice fields and helping in preventing soil consolidation. In contrast, agriculture that relies only on direct rainfall is referred to as rain-fed farming. Irrigation is often studied together with drainage, which is the natural or artificial removal of surface and sub-surface water from a given area.

2.10.1 Types of Irrigation

Various types of irrigation techniques differ in how the water obtained from the source distributed within the field. In general, the goal is to supply the entire field uniformly with wat so that each plant has the amount of water it needs, neither too much nor too little.

2.10.1.1Surface Irrigation

In surface irrigation systems water moves over and across the land by simple gravity flo in order to wet it and to infiltrate into the soil. Surface irrigation can be subdivided into furrow border strip or basin irrigation. It is often called flood irrigation when the irrigation results i flooding or near flooding of the cultivated land. Historically, this has been the most common method of irrigating agricultural land.

2.10.1.2 Drip Irrigation

Drip irrigation, also known as trickle irrigation, functions as its name suggests. Water is delivered at or near the root zone of plants, drop by drop. This method can be the most water-efficient method of irrigation, if managed properly, since evaporation and runoff are minimized.[citation needed] In modern agriculture, drip irrigation is often combined with plastic mulch, further reducing evaporation, and is also the means of delivery of fertilizer. The process is know as fertigation

Drip irrigation methods range from very high-tech and computerized to low-tech and labor-intensive. But drip irrigation can also be as low-tech as a porous clay vessel sunk into the soil and occasionally filled from a hose or bucket. Subsurface drip irrigation has been used successfully on lawns, but it is more expensive than a more traditional sprinkler system. Surface drip systems are not cost-effective (or aesthetically pleasing) for lawns and golf courses.

2.10.1.3 Sprinkler Irrigation

In sprinkler or overhead irrigation, water is piped to one or more central locations within the field and distributed by overhead high-pressure sprinklers or guns. A system utilizing sprinklers, sprays, or guns mounted overhead on permanently installed risers is often referred to as a solid-set irrigation system. Higher pressure sprinklers that rotate are called rotors and are driven by a ball drive, gear drive, or impact mechanism. Rotors can be designed to rotate in a full or partial circle. Guns are similar to rotors, except that they generally operate at very high pressures of 40 to 130 lbf/in² (275 to 900 kPa) and flows of 50 to 1200 US gal/min (3 to 76 L/s), usually with nozzle diameters in the range of 0.5 to 1.9 inches (10 to 50 mm). Guns are used not only for irrigation, but also for industrial applications such as dust suppression and logging.

Sprinklers may also be mounted on moving platforms connected to the water source by a hose. Automatically moving wheeled systems known as traveling sprinklers may irrigate areas such as small farms, sports fields, parks, pastures, and cemeteries unattended. Most of these utilize a length of polyethylene tubing wound on a steel drum.

2.10.1.4. Sub-Irrigation

Sub irrigation also sometimes called seepage irrigation has been used for many years in field crops in areas with high water tables. It is a method of artificially raising the water table to allow the soil to be moistened from below the plants' root zone. Often those systems are located on permanent grasslands in lowlands or river valleys and combined with drainage infrastructure. A system of pumping stations, canals, weirs and gates allows it to increase or decrease the water level in a network of ditches and thereby control the water table. Sub-irrigation is also used in commercial greenhouse production, usually for potted plants.

2.10.1.5 Localized Irrigation

Localized irrigation is a system where water is distributed under low pressure through a piped network, in a pre-determined pattern, and applied as a small discharge to each plant or adjacent to it. Drip irrigation, spray or micro-sprinkler irrigation and bubbler irrigation belong to this category of irrigation methods.

2.10.1.6 Manual Irrigation Using Buckets or Watering Cans

These systems have low requirements for infrastructure and technical equipment but need high labor inputs. Irrigation using watering cans is to be found for example in peri-urban agriculture around large cities in some African countries.

2.10.1.7 Automatic, Non-electric Irrigation Using Buckets and Ropes

Besides the common manual watering by bucket, an automated, natural version of this also exist. Using plain polyester ropes combined with a prepared ground mixture can be used to water plants from a vessel filled with water. The ground mixture would need to be made depending on the plant itself, yet would mostly consist of black potting soil, vermiculite and perlite. This system would (with certain crops) allow you to save expenses as it does not consume any electricity and only little water (unlike sprinklers, water timers,). However, it may only be used with certain crops (probably mostly larger crops that do not need a humid environment; perhaps e.g. paprika's).

2.10.1.8. Irrigation Using Stones to Catch Water From Humid Air

In countries where at night, humid air sweeps the countryside, stones are used to catch water from the humid air by condensation. This is for example practiced in the vineyards at Lanzarote.

2.10.1.9. Dry Terraces for Irrigation and Water Distribution

In subtropical countries as Mali and Senegal, a special type of terracing (without flood irrigation or intent to flatten farming ground) is used. Here, a 'stairs' is made through the use of ground level differences which helps to decrease water evaporation and also distributes the water to all patches (sort of irrigation).

2.10.2. Sources of Irrigation Water

Sources of irrigation water can be groundwater extracted from springs or by using wells, surface water withdrawn from rivers, lakes or reservoirs or non-conventional sources like treated wastewater, desalinated water or drainage water. A special form of irrigation using surface water is spate irrigation, also called floodwater harvesting. In case of a flood (spate) water is diverted to normally dry river beds (wadi's) using a network of dams, gates and channels and spread over large areas. The moisture stored in the soil will be used thereafter to grow crops. Spate irrigation areas are in particular located in semi-arid or arid, mountainous regions. While floodwater harvesting belongs to the accepted irrigation methods, rainwater harvesting is usually not considered as a form of irrigation. Rainwater harvesting is the collection of runoff water from roofs or unused land and the concentration of this water on cultivated land. Therefore this method is considered as a water concentration method

2.10.3 Problems of Irrigation

1. Competition for surface water rights.
2. Depletion of underground aquifers.
3. Ground subsidence (e.g. New Orleans, Louisiana)
4. Under irrigation gives poor soil salinity control which leads to increased soil salinity with consequent build up of toxic salts on soil surface in areas with high evaporation. This

requires either leaching to remove these salts and a method of drainage to carry the salts away.

5. Over irrigation because of poor distribution uniformity or management wastes water, chemicals, and may lead to water pollution.
6. Deep drainage (from over-irrigation) may result in rising water tables which in some instances will lead to problems of irrigation salinity.
7. Irrigation with saline or high-sodium water may damage soil structure.

2.11 Compost Manure

The compost is prepared from waste of all kind of farm house and cattle shed supplies of organics. Composting is the process of reducing plant and animal refuse to a product that is in a quickly utilizable condition. Good compost manure, sum far in appearance and fertilizing nutrient value as that of farmyard manure, can be produced from waste material of various kinds, viz. cereal straws, crop stubble, cotton stalks, groundnut husk, farm weeds and grasses, leawer, leaf-mould, house refuse wood ashes, litter, urine-soaked earth from cattle sheds and other similar substances.

These raw plant materials are rich in cellulose and other readily decomposable carbohydrates, and have a carbon. Nitrogen ratio of 40:1 or more. It is necessary to compost or partially decompose them to reduce the carbon-nitrogen ratio to about 10:1 or 12:1 to check immobilization of nitrogen.

2.11.1 Method of Compost Preparation

Aerobic and anaerobic methods of decomposition are used to prepare compost from waste organic material. In both cases the farm waste is used as bedding for cattle to absorb a large portion of animal urine.

2.11.1.1 Aerobic Decomposition

In this process the used bedding, the sweepings from cattle sheds and some urine-soaked earth from the stable floor are removed every day, mixed with a little cattle during and 2 or 3 handfuls of wood ashes are deposition on a well drained site to gradually build up a low pipe of 30 to 45cm in height, 5m in width and of any convenient length. The pipe is built up before the start of the rainy season. After the first heavy shower, the welted materials in a 1.2m strip on each side of the long heap are turned with a rake on to a 2.4m wide strip in the middle, raising the height of the heap to nearly in. this process prevent the loss of moisture and ensure a quick start of decomposition. When the heap sinks appreciable in 3-4 weeks, its given a turning and made into a fresh heap, this mixing the outside material with that of inside. After about a month, depending on the incidence of raons, the heap is given a final turning on a cloudy or moderately rainy day, and rebuilt in the vacant part of the original position.

The compost becomes ready for use in 4 months. The method is better suited for composting in the rainy season. The proportion of raw materials considered suitable for compost making in 400,56,60, and 6 parts by weight of mixed farm residues and cattle-shed wastes, urine-soaked earth, fresh cattle during and wood ashes.

In Tamil nadu 90kg of partially fermented during as then suspension with 22.5kg bone meal/tone day material is composted. If urine-soaked earth and cattle during are not available, the raw organic materials can still be composted, provided more than one-third of the residues is soft and finely broken, viz. fallen leaves, leaf mould, kitchen wastes, grass clipping, green and succulent weeds, plant trimmings and chopped straw of wheat, barley and soft cereal. The use of ordinary soil wood ashes or line is, however, essential.

2.11.1.2 Anaerobic Decomposition

In the processes the mix farm residues are, collect in pits of convenient size e.g. 4.5m x 1.5m x 1m. Each day's collection is spread in a thin layer, sprinkle with a mixture of fresh cow-during (4.5kg), ashes (140-170g) and water (18-22 liters) and compacted. The pit is filled till the raw material stands 38-46cm above its edge and is than plastered with 2.5cm layer of a mixture of mind and cow dung. The plastered pit also prevents the fly nuisance. The compacted moist material becomes composted in 4-5 months without any attention. The well made compost contains 0.8 to 1% N and has all the good properties of farmyard manure. It can be used in the sample way is the farmyard manure. The anaerobic process is particularly suited for use by gardeners in or new cities and towns

2.11.1.3 Town Compost

In recent years large-scale composting of town refuse and right soil in properly constructed trenches away from human habitation has been taken up successfully by the manicipaties of many large and small cities. Trenches 1 to 1.2m wide 75cm deep and of convenient length are filled with successive layers of night soil, town refuse and earth, in the order the compost gets ready in 3 months.

2.11.1.4 Sewage and Sludge

Sewage: It is used water and substances that are produced by human beings and factories and collected through sewers or special pipes. This is a ban on the dumping of such raw or untreated sewage at rivers, sea treated with chemicals to clean. It, can be dumped into the rivers or sea or used to make manure. Wherever available, the farmers especially the vegetable growers use it as manure in the outskirts of big cities.

Sludge: If is the thick soft wet and mud or solid matter or substance that accumulates at the base of the sewage storage tank. The industrial or humane waste that has been treated is termed as industrial or chemical sludge and is used as sewage-sludge as fertilizer or manure on farmland. (Hand book of agriculture, Indian council of agricultural research New Delbi pg 429-432)

2.12 Previous Work on Ugwu

Growth, herbage and seed yield and quality of *telfairia occidentalis* as influenced by cassava peel compost and mineral fertilizer. This experiment was conducted in department of plant science, Obafemi Awolowo University, Ile-Ife Nigeria.

The use of both mineral fertilizer and organic manure has been found to be a sustainable technology for crop production and integration of mineral fertilizer with crop residue compost could further increase crop yield. This assertion was tested in Nigeria by nourishing *telfairia occidentalis* with cassava compost (CPC) with or without mineral fertilizer. The treatment tested were 0, 45 and 60kg N from NPK 45 and 60kg N from CPC,45kg N from NPK and 60kg N CPC, 30kg N from NPK+ 30kg N from CPC. Brought about significant improvement in growth, shoot fruit yield as well as shoot and seed quality of *telfairria occidentalis*. This treatment produced herbage yield, shoot protein, N, P and K mineral element that are similar to what was obtained with application of 60kg N from NPK alone or joint application of 15 kg N from NPK +45kg N from CPC. There result support the concept of synergy between compost and mineral fertilizer and provide further stimulate to employ blends instead of sile application of compost or mineral fertilizers for crop production.

In an experiment conducted in department of Chemistry University of Benin, Benin city, Nigeria. On a nutritional assessment of *telfairia occidentalis* seed.

The nutritional assessment of the seed of *telfairia occidentalis* was conducted. The objective was to provide the consumer of the seed and nutritional with information on the of nutrients potentials of the seed. The result of the study showed that the seed contained essential nutrients in significant amount that can supplement other food. The level of crude protein(3.47%) crude fat (31.38%) moisture (10.98%),ash (2.02%), carbohydrate (50.08%), fiber (2.12%), calcium (28µg/g), phosphorus (2100µg/g), iron (69µg/g), sodium (1080µg/g) potassium (1280µg/g), vitamin A (890Iu) and vitamin C (0.7µg/g) detected in the seed were compared with nutritional composition of some common plant pod in Nigeria, the result showed that the seed of *telfania occidentialis* is high in carbohydrate, fat and phosphorus. The seed also contained levels of vitamin A, which can supplement other dietary sources.

In another experiment conducted in department of food science and technology, faulty of agriculture. University of Khartoum, Khartoum north, 13314 shambat, Sudan on "a nutritional evaluation and physiochemical properties of *Telfania occidentials* seed flour.

CHAPTER THREE

3.0 MATERIAL AND METHODS

3.1 Location and Experiment Conditions

The experiment was conducted in the formal school of agric and agricultural technology complex, located at the Bosso campus of the Federal University of Technology Minna Niger State. Located on latitude 9^0, 39' 40"N and at longitude 6^0, 31' 26"N in the middle belt zone of Nigeria, in the northern guinea savannah region.

3.2 Planting Procedure

The Ugwu seeds *Telfairia occidentalis* were planted on the 2nd of October 2009. They were planted in 10 containers (15cm deep and 20cm diameter). Each container was filled with soil (sandy loam) collected from the same site.

The soil was filtered to obtain uniformity and the entire 10 container were filled with the soil up to about 13cm from the base of each container, after which they were than placed on a ground surface. Prior to planting the Ugwu seed, Owe Ugwu seed where then planted in each container at a depth about 4cm. Compost were apply after the two weeks after the emergence of the plant.

3.3 Treatments

To fulfil the objective of this experiment, the 10 container were arranged in two platforms, each platform bearing 5 containers. Treatments carried out on each platform are explained as follows.

3.3.1 Treatment One

The crops were supplied with water (tap water) for irrigation and at an irrigation interval of one day with 1000cm of water per irrigation time.

3.3.2 Treatment Two

The crops were supplied with compost manure and water (tap water) for irrigation at an irrigation interval of one day with $100cm^3$ of water for irrigation time.

3.4 Analysis and Measurements

In the cause of this experiment the following parameters where measured or analyzed for. They include:

i. Plant measurement

ii. Soil analysis

iii. Compost characteristics

iv. Irrigation water requirement

3.4.1 Plant Measurement

The plant measurement conducted during the experiment which includes:

3.4.1.1 Plant Height

Plant heights measured in cm were taken from the base of a stand to the collar of the last leaf with a meter rule. This was done at 1 week interval.

3.4.1.2 Leaf Number

The number of leaves from base to the leaf node of each plant was counted and the average of the five plants was recorded. This was done at interval of one week.

3.4.1.3 Leaf Length

The length of the leaves was measured from the petiole to the leaf apex. The average was then taken as the leaf length for each plant stand. This was done at interval of one week.

3.4.1.4 Leaf Width

The leaf width was determined by measuring the width of 3 leaves on each plant and then taken the average. This was done at interval of one week.

3.4.2 Soil Analysis

The soil chemical properties were conducted from the soil during the experiment which include: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Sodium (Na), Copper (Cu), Zinc (Zn), PH, Soil texture, Organic carbon (OC), Organic matter (OM), Sodium absorption ratio (SAR).

3.4.2.1 Determination of Soil pH

Apparatus

Glass electrode, pH meter, paper portion caps, stirring rod, washing bottle, weighing balance.

Reagents

0.01m calcium chloride ($Cacl_2$), distilled water, standard buffer solutions (4.7 and 9.2).

Procedure

1mg of air-dried 2mm sieved soil was weighed in diploes into paper portion cups. Into are. 25ml distilled water was added and 25ml of 0.01m $Cacl_2$ added into the other. They were then stirred for 1min and left for 15mins and then stirred again for 1min and after 15mins standing, the PH was read on the pH water by insert the electrode into the soil suspension. The PH meter usage was standardized with buffer solution of PH 4.7 and 4.9.

3.4.2.2 Determination of total nitrogen in Soil (Micro Kjeldalil Method)

Apparatus

Distillation apparatus, distillation flasks, measuring cylinder, pipette, burette, tripod stand, digestion flask, volumetric flask, weighing balance.

Reagents

Potassium sulphate (K_2SO_4), Sclemium (Sc), 0.01N Sulphuric acid (H_2SO_4), 10N Sodium hydroxide (NaOH), 2% Boric acid (HBO_3) Indicator solution, Brimocresal green and Methyl red indicators ethanol.

Procedure

0.2g of air-dried, 0.5min sieved soil was weighed into a digestion flask and few drops of distilled water added and allowed to stand for 30 mins, 5 of catalysts mixture (K_2SO_4 plus selenium powder) was added together with 15-20ml of concentrated H_2SO_4.

The digestion flask was then heated for about 2hrs until when the digestion was clear. After cooling the flask, a little distilled water was added and the content washed into a 100ml

mark, 10ml of the digest was then broken into a distillation flask, 10ml of 2% HBO_3 was taken into a flask and placed under the condenser of the distillation apparatus 10ml of 10N NaOH was added to the 10ml digest in the distillation flask and the distillation process carried out until the distillate reaches 35ml mark of the HBO_3 flask. Then distillate was then treated with 0.01N H_2SO_4. A blank was run without soil or water sample. The percentage of nitrogen content in soil was calculated.

3.4.2.3 Determination of Available Phosphorus in Soil (Bray -1 Method)

Apparatus

Centrifuge, mechanical shaker, centrifuge tubes, measuring cylinder, volumetric flasks, pipette, spectrophotometer, test tubes, weighing balance.

Reagents

In ammonium fluoride (NH_4Fl), 0.5N Hydrochloric acid (HCl), Ammonium molybdate [$(NH_4)_6\ NO_7\ O_{24}\ 4H_2O$), stanners chloride ($SnCl_2\ 2H_2O$)].

Procedure

1g of air-dried 2mm sieved soil was weighed into a centrifuge tube and 1ml of the extracting solution (NH_4fl plus HCl) added. It was shaken for 1mm in a mechanical shaker and then centrifuged at 2,000 r.p.m for 15mins 2ml of the clear supernatant was then taken into a test tube, 5ml of distilled water and 2ml of $(NH_4)_6\ MO_7\ O_{24}\ 4H_2O$) were added and mixed properly. 1ml of $SnCl_2\ 2H_2O$ solution as added and mixed thoroughly again after 5mins but not later than 20mins, absorbance was read on the spectrophometer at 660mm wavelength.

3.4.2.4 Determination of Organic Carbon and Organic Matter in Soil (Walkley and Black West Oxidation method)

Apparatus

Burettes, pipettes, flasks, measuring cylinder.

Reagents

Potassium dichromate ($K_2Cr_2O_7$), concentrated sulphuric acid (H_2SO_4), phosphoric acid (H_3PO_4), ferrous ammonium sulphate ($Fe(NH_4)_2\ SO_4$), O-phenauthroline ferrous complex, distilled water, sodium fluoride (NaFl).

Procedure

1g of air-dried, 0.5mm sieved was weighed into a flask and 10ml of $K_2Cr_2O_7$ was added and swirling down gently to disperse the soil. 20ml concentrated H_2SO_4 was added and the flask swirled gently to mix the soil and reagents. After left standing for 30mins 200ml of distilled water was added followed by 10ml of H_3PO_4 and about 1gm of Naf. 3 to 4 drops of the O-phenanthotine indicator was wadded and titration done with ($Fe(NH_4)_2\ SO_4$). A blank was prepared following the same steps in without the soil.

The organic carbon value obtained from above procedure was then multiplied by a factor of 1.72 to obtain the organic matter content.

3.4.2.5 DETERMINATION OF SOIL TEXTURE

Apparatus

Mechanical stirrer, thermometer hydrometer, measuring cylinder, stirring rod, stop watch.

Reagents

Sodium hexametaphosphate (calgon) Na $(PO_3)_6$, distilled water, sodium carbonate ($NaCo_3$).

Procedure

50g of air-dry, 2mm sieved soil was weighed into a flask and 100ml of solution of calgon and sodium carbonate was added and allowed to stand for 30mins. Stirring was done with the mechanical stirrer for 15mins after which the suspension was transferred into the measuring cylinder and distilled water added to 1000ml mark. The stirring rod was used to bring back all the particles into suspension and at 40 secs. after stopping the stirring, the hydrometer reading was taken and the temperature of the suspension also taken. The cylinder was then left on a stable surface undisturbed and after two hours the hydrometer and temperature readings of the suspension were taken. A blank was prepared without the soil and its hydrometer and temperature readings also taken at 40secs and 2 hours.

The percentage of the sand, silt and clay particles got from the above determination was then plotted on the textural triangle and the name of the texture read-off.

3.4.2.6 Determination of Exchangeable Cations (Na^1, mg^{2+}, Ca^{2+}, K^1)

Apparatus

Volumetric flask, whatman fitter paper, suction pump, Buchner funnel, weighing balance, flame photometer, atomic absorption spectrophotometer.

Reagents

Ammonium acetate (NH_4OAC), Na standard (0, 2,4,6,8 and 10 mgl^{-1}).

Procedure

10g of air-dried, 2mm sieved soil was weighed into a volumetric flask and 40ml of NH_4OAC was added it was covered and left to standard overnight. The suspension was then leached with more NH_4OAC to a mark of 100ml using the suction pump fitted with a Büchner funnel ironed with filter paper. The flame photometer was standardized in (PPM) after which the flame photometer and Mg and Ca were determined on an atomic absorption.

3.4.2.7 Determination of Zn and Cu in Soil

Apparatus

Perkin-Elmer model 403 atomic absorption spectrometer, operation instrument in setting up the instrument for analyzing specific element.

Reagents

Zn standards – 0.5, 1, 2 and 3 ppm Zn in aqueous solution

Cu standards – 2, 10, 15 and 20 ppm Cu in aqueous solution

Procedure

In determination of Zn and Cu no dilution is needed. The instrument was set up according to the instrumentations provided for the PE4-3 atomic absorption spectrometer and the concentration readout was standardize by using the standard solution of the element tasted. The concentration of the element in sample solution was readied.

3.4.2.8 Determination of Sodium Absorption Ratio (SAR)

3.4.2.9 SAR was determined from this formula $SAR = \frac{NA}{\sqrt{\frac{(Ca + Mg)}{2}}}$

3.4.3 Compost Characteristics

3.4.3.1 Preparation of Compost

The compost was prepared from different farm waste materials which include grasses, leaves, cow dung, wood ash and urine from cow sheds.

Procedure

The waste materials were collected. The grasses and leaves was cut into smaller particles, and cow dung, wood ash and urine from cow sheds was added and mixed it together and the mixed material are parked into a black polytene bag and tied (air tied) to prevent last of moisture and decomposition to occur at faster rate. The polytene bag was put inside bucket and it was covered and put inside sun, and the compost becomes ready for use in 4 weeks.

3.4.3.2 Nutrient Present in Compost

The nutrient presents in compost were conducted from the compost during the experiment and the major nutrients include Nitrogen, Phosphorus and Potassium.

Nitrogen

Apparatus

Conical flask, pipette, burette, Kjeidlahi distillation apparatus, digestion block.

Reagents

Sulphuric acid, boric acid, sodium hydroxide 40% solution, hydrochloric acid. mixed indicator.

Procedure

1g of the grinned sample was weighed into a digestion tube, and 10ml of sulphuric acid was added with digestion tablet as catalyst, the tube was heated at the temperature 360-370^{0}C at an incline angle until frothing subsided and then boiled till the solution was clear. The digested sample was dissolve with distilled water in a 100ml volumetric flask making up to the mark. 5ml of the dissolved digested sample was transferred to distillation apparatus, and 10ml of boric acid was added to 2 drops of mixed indicator which turn brown. This was heated and the distilled ammonia was collected 10mo boric acid indicator solution. The distilled ammonia was collected on completion of distillation and the receiver removed the colour changes from colourless solution to blue green. Titration of distillation was done by titrating the distillate with standard acid solution (0.1 NHCL).

The percentage of nitrogen was calculated as follow.

% Nitrogen = 0.01 x titre value x conc. of acid x 10^{2}/weight of sample (100-moisture content)/100.

Phosphorus and Potassium

The sample was digested on ashes. In element analysis, the organic matter in the plant has to be burned, having the nutrient in inorganic forms. The potassium and phosphorus may be simple extracted from the fissure without necessarily destroying the organic matter by using dry as Hong method.

Procedure

The sample was ashed at 550^0C. The ash was boiled with 10ml standard flask. It was made up to the mark with deionised water. The mineral was determined from the resulting solution using atoming absorption spectrometer (Pye umcan spg Cambridge, UK).

3.5 Irrigation Requirement (IR)

Irrigation requirement refer to the total amount of water that is applied through irrigation.

It is express as

$$IR = \sum_{I=1}^{n} d/E_a$$

Where

IR = Irrigation requirement

d = Net amount of water to be applied at each irrigation.

E_a = Water application efficiency.

But

$$E_a = W_s/W_f \times 100$$

W_s = Water stored in the root zone of crops during irrigation.

W_f = Water delivered to the field.

$W_f = qt$

q = Quantity of water use

t = Time of irrigation.

Plate. 3.1 Arrangement of Ugwu plant

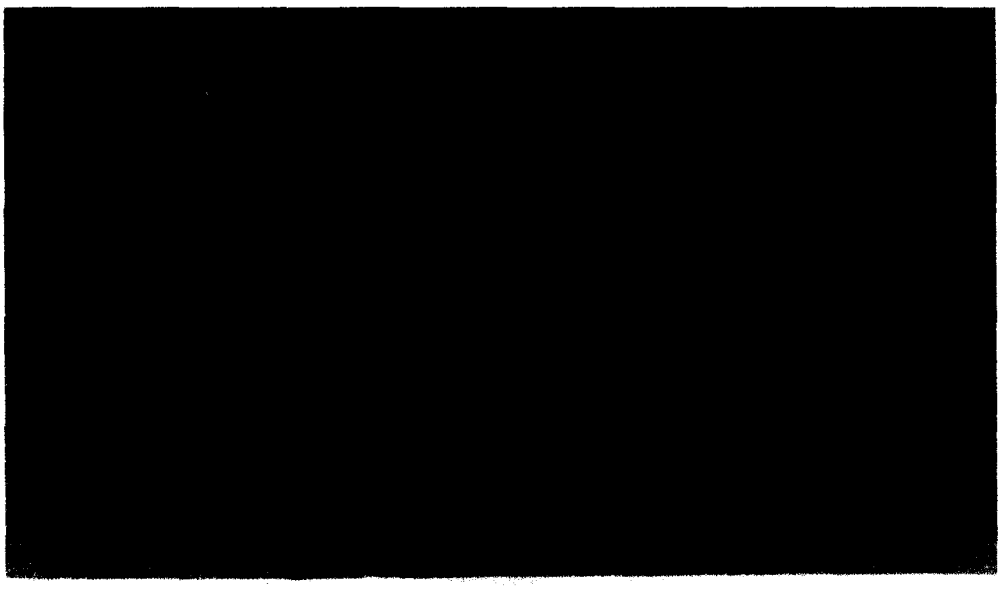

Plate 3.2 Decomposition of Compost

CHAPTER FOUR

4.0 RESULT AND DISCUSSIONS

4.1 Plant Measurements

The following plant measurements were carried out during ten week of the experiment. They include.

4.1.1 Plant Height

The initial value was obtained after the second week of planting before application of compost and the final value were obtained fro the first week after application of compost to the eight week of the experiment. The plant height (in cm) was obtained by taken measurement from the base of the stem to the top of the longest fully emerged leaf. Result were collected for eight weeks and recorded. Table 4.1 shows the result obtained and standard deviation for weekly plant measurement.

TABLE 4.1 Mean Plant Heights and Standard Deviation

Initial measurement before compost application is 15cm

Final measurement after compost application

DATE	WEEK	TREATMENTS (CM	
		T_1	T_2
23/10/09	ONE	25 ±0.1	28 ±1.17
30/10/09	TWO	43 ±0.17	51 ±2.13
6/11/09	THREE	56.5 ±019	60 ±2.51
13/11/09	FOUR	60 ±0.24	67 ±2.80
20/11/09	FIVE	63 ±0.25	67.8 ±2.83
27/11/09	SIX	67.5 ±0.27	70.2 ±2.93
4/12/09	SEVEN	69 ±0.28	85 ±3.55
11/12/09	EIGHT	71 ±0.29	92 ±3.84

From table 4.1 the highest values were obtained from the plant with compost manure.

The values from this treatment range from 28cm at the first week to 92cm at the eight week. The irrigation water treatment recorded a mean of 25cm in the first week and 71cm in the eight week. The higher value in compost treatment may be due to the higher nutrient preserved in the compost.

4.1.2 Leaf Length

The length of the leaves of each treatment was measured on weekly basis. This was done by measuring the length of the three of four different leaves and find the average. The results are presented in table 4.2

TABLE 4.2 Mean Leaf Heights and Standard Deviation (CM)

DATE	WEEK	TREATMENTS (CM)	
		T_1	T_2
23/10/09	ONE	6.9 ±0.16	7.1 ±1.16
30/10/09	TWO	8 ±0.19	9.3 ±0.12
6/11/09	THREE	9.1 ±0.21	12 ±0.27
13/11/09	FOUR	11.5 ±0.27	14.8 ±0.33
20/11/09	FIVE	12.3 ±0.29	15.4 ±0.35
27/11/09	SIX	14 ±0.32	16.6 ±0.37
4/12/09	SEVEN	15.1 ±0.35	18.3 ±0.41
11/12/09	EIGHT	16.5 ±0.38	19.8 ±0.45

The table 4.2 shows that the compost manure treatment (T_2) produced longest leaves than the irrigation water treatment (T_1).

4.1.3 Width of Leaves

The width of the leaves of each treatment was measured on weekly basis. This was done by measuring the width of 3 leaves on each plant and then takes the average. The result are presented in table 4.3.

TABLE 4.3 Mean Widths and Standard Deviation of Leaves (CM)

DATE	WEEK	TREATMENTS (CM)	
		T_1	T_2
23/10/09	ONE	3 ±0.15	4 ±1.16
30/10/09	TWO	4.5 ±0.23	5.3 ±0.21
6/11/09	THREE	6 ±0.30	7 ±0.28
13/11/09	FOUR	6.8 ±0.34	8.8 ±0.35
20/11/09	FIVE	7.4 ±0.37	9.2 ±0.37
27/11/09	SIX	8.3 ±0.42	9.7 ±0.39
4/12/09	SEVEN	9.2 ±0.48	10.5 ±0.42
11/12/09	EIGHT	10 ±0.50	12 ±0.48

The table 4.3 showed that the compost manure treatment (T_2) produce broadest leaves width than the irrigation treatment (T_1).

4.1.4 Number of Leaves

The numbers of leaves which emerge from the plants were counted on weekly basis and the average of the five plants was recorded. The mean of the total number of leaves obtained are tabulated as show in table 4.4.

TABLE 4.4 Mean Numbers of Leaves

DATE	WEEK	TREATMENTS (CM)	
		T_1	T_2
23/10/09	ONE	4	4
30/10/09	TWO	6	6
6/11/09	THREE	7	8
13/11/09	FOUR	8	9
20/11/09	FIVE	8	11
27/11/09	SIX	9	13
4/12/09	SEVEN	11	14
11/12/09	EIGHT	12	15

The table 4.4 showed that the compost manure treatment (T_2) produced the highest number of leaves than the irrigation treatment (T_1).

4.2 Soil Analysis

The soil was analyzed and the following result were obtained from the soil after the treatment were concluded

4.2.1 Soil Particle Density

PARTICLE DENSITY	VALUE (%)	
	T_1	T_2
Sand	65.68	56.96
Silt	8.12	26.20
Clay	8.0	35.04
Texture class	Scl	Sc

4.2.2 Soil Chemical Properties

The following result was obtained from the soil after the treatments were concluded. The nutritional values obtained are tabulated as shown in table 4.6.

TABLE 4.6 Nutrient Element Content of Soil

NUTRIENT ELEMENT	VALUE %	
	T_1	T_2
Nitrogen (N) %		
Phosphorus (P) (ppm)	7.25	9.20
Copper (Cu) ppm	0.10	0.10
Zinc (Zn) ppm	0.05	0.06
Sodium (Na) cmol/kg	0.26	0.35
Potassium (K) cmol/kg	1.44	1.59
Calcium (Ca) cmol/kg	1.90	3.06
Magnesium (Mg) cmol/kg	1.78	8.16
Organic carbon (OC) %	0.99	1.52
Organic matter (OM) %	1.71	2.62
PH in H_2O	6.97	6.82
$CaCl_2$	6.16	6.18
Sodium absorption ratio SAR	0.19	0.15

Table 4.6 showed that the compost manure treatment (T_2) produced the highest nutritional element in soil than that of tap water treatment.

Compost manure treatment has the highest concentration of 9.20 ppm (P) and 8.16 cmol kg^{-1} (Mg) and lowest concentration of 0.06 ppm (Zn) and 0.10ppm (Cu). tap water treatment has the highest concentration of 7.26 ppm (P) and 1.90 cmol kg^{-1} (Ca) and the lowest concentration

of 0.05 ppm (Zn) and 0.10 ppm (Cu). Same concentration of 0.10 ppm (Cu) was occurred in both treatments. The PH value of the soil in water was higher in tap water treatment (6.97) and the PH value of the soil in $CaCl_2$ was higher in compost manure treatment (6.18).

4.3 Result of the Nutrient Present in Compost

The following results were obtained from compost use for the experiment. The nutritional values obtained in compost were presented in table 4.7.

4.7 Nutritional Value Present in Compost

NUTRIENT ELEMENT	VALUE
Nitrogen (N) %	3.86
Phosphorus (P) ppm	34.7
Potassium (K) ppm	370.8

4.4 Irrigation Water Requirement

At the end of the experiment the total irrigation water requirement was calculate. It is express as

$IR = £ \quad d/£_a$

$n=1$

d = Net amount of water to be applied at each irrigation

$£_a$ = water application efficiency.

But $£_a$ Ws/Wf x 100

Ws = water stored in the root zone of crops during irrigation

Wf = water delivered to the field.

Therefore volume of water delivered to the container is 1 litre

$1/1000 = 0.001m^3$

$Wf = 0.001m^3$ $wf = 0.0.001m^3$

Assuming the run off in the container is $4 \times 10^{-5}m^3$

Water store in the root zone (Ws) is $4 \times 10^{-5}m^3$ less than the water delivered to the container

$0.001 - 4 \times 10^{-5}$

$= 9.6 \times 10^{-4} m^3$

Hence $£_a = \frac{9.6X10^{-4}}{0.001} X\ 100$

$£_a = 0.96 \times 100$

$£_a = 96\%$

Irrigation requirement = IR = $d/£_a$

Net amount of water to be applied at each irrigation (d) 1 litre of water is delivered to a container and 10 containers ware used

∴ Net amount of water (d) = 1 litre x 10 = 10 litres

$IR = d / £_a$ but d = 10 litre $£_a$ = 96% = 0.96

$IR = \frac{10}{0.96}$

$IR = 10.4L / day$

∴ 10.4 litres of water were use per irrigation per day

But 70 days are use for the experiment

∴ Total irrigation water requirement (IR_T)

$IR_T = 10.4L/day \times 70 days$

$IR_T = 728$ litres.

∴ 728 litres of water was used for the effective operation of the experiment

4.5 Discussion

The results obtained from the plant height, length of the leaves, width of leaves and number of leaves indicated that the compost manure treatments produced the best results. Results of the soil analysis also showed that the maximum result was obtained from the compost manure treatment. Compost manure treatment had the highest concentration of N.P.K, and it is known that N.P.K was the importance nutrient present in fertilizer. That is why Nitrogen (N). phosphorus (P) and potassium (K) are the three major nutrients found in compost manure, which has a beneficial effect of crops. While some element in small concentration such as Na, Mg, Ca O.C, O.M, Zn, and Cu are essential nutrient for plants growth

The result obtained from the pH of the soil in water shows that the water treatment produced the higher pH value whole the compost manure treatment produced the higher pH value from the result obtained from the pH of the soil in $CaCl_2$.

Total irrigation water of 728 litres was used for the effective operation of the experiment.

CHAPTER FIVE

5.0 Conclusion and Recommendation

5.1 Conclusion

The application of compost manure to ugwu, have a significant advantage over the use of water for irrigation on ugwu. The result of the growth parameters showed that plant treatment with compost manure was higher than the ones treated with tap water. Similar results were obtained from the soil analysis with compost manure treatment up front with the highest nutritional value. The suitability of compost manure application and tap water for irrigation in ugwu plant can therefore not be disputed, as the result of the experiment conducted, in this project has reveal that ugwu plant grow better when compost manure is been applied and more water for irrigation when their is less or no rainfall.

5.2 Recommendation

The application of compost manure and tap water for irrigation should be encourage in Nigeria as developed country, so that the waste material and waste organic material should be used for compost and water for irrigation must be available at any time. So as to increase productivity in agriculture.

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