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Effects of Seasonal Variation and Fertilizer on Yield and Yield Components of Fluted Pumpkin

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Abstract
Fluted pumpkin is one of the popular cut vegetable grown in southern part of Nigeria. However, it is an underutilized indigenous vegetable in Southwestern Nigeria due to limited data on its production and economic importance. This study which was on Effects of Seasonal Variation and Fertilizer on Yield and Yield Components of Fluted Pumpkin(Telfairia occidentalis)was carried out at the Teaching and Research Farm of the Obafemi Awolowo University, Ile-Ife. The study was in two phases. The first phase was under rainfed while the second phase was carried out under irrigation. The physico-chemical properties of the soil in the study area such as pH, electrical conductivity, bulk density, available Phosphorus and exchangeable cations at three different depths (0-10 cm, 10-20 cm and 20-30 cm) were determined using standard procedures. The plots were subjected to three treatments (NPK, Poultry Waste and the Control). The total crop evapotranspiration (ET_c) for Fluted Pumpkin was 138.1 mm/dec under the effective rainfall of 195.7 mm/dec. These values were considered to be normal for the plant growth. The crop coefficient (K_c) of Fluted Pumpkin was 0.7 at the initial stage, the development stage (0.8 – 0.95), the mid-season stage (0.96 - 1.05) and during the late season stage (1.05 - 0.95). The effects of seasonal variation of the plant indicated that the growth parameters were influenced by different manures utilized. The dry matter yield during rainfed was highest on plots treated with poultry waste (119.12 g), followed by control (108 g) and NPK (79.40 g) respectively. The growth parameters examined indicated that for plant height, all the three factors considered (method, treatments and time) are not significantly different ($p > 0.05$) in their effects on the plant height. However, there were significant ($p < 0.05$) difference between the seasonal variables (Rainfed and Irrigation) for both number of leaves and stem girths.The study was able to provide information on the crop water requirement and crop coefficient with effects of seasonal variation on yield components of fluted pumpkin in relation to their growth stage.

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I. Introduction

Fluted Pumpkin (Telfairia occidentalis) is one of the popular cut vegetable grown in southern Nigeria especially in the east. The crop is a perennial climber grown for its leaves and seeds; belongs to the cucurbitaceous family and originates from West Africa. It is found throughout the former forested area from Sierra Leone to Angola and up to Uganda in the east (Nkang et al., 2003). Nwauwa and Omona (2010) observed that fluted pumpkin does best at the lower altitudes and medium to high rainfall and will do well on sandier soil provided fertilizer is applied but has a more robust growth in rich well drained soil. The most common productive method in pumpkin cultivation is traditional faming system which involved mixing crop together with a staple food, particularly yams or less frequently, with other vegetables. Some farmers utilize the stakes provided for yam to support fluted Pumpkin. Of late, pure stands are becoming more common in Nigeria for market gardening especially during the Fadama season. During the dry season, irrigation is required every three days (Schippers, 2000). Among the important indigenous vegetables, the vegetable seems to be widely eaten in Nigeria and cultivated for its edible succulent shoots and leaves as a backyard crop mainly by the Igbo tribe. Telfairia is now being cultivated not only as backyard crop but also as commercial crop during the wet and dry season (Akoroda, 1990).

Fluted pumpkin leaf is of high nutritional, medicinal and industrial values which is rich in protein, fat and; minerals and vitamins. The nutritional value of pumpkin seeds is different from that of its leaves which makes it more important and useful. The fluctuation in climatic parameter affects the growth and production of this vegetable. Fluted Pumpkin is underutilized indigenous vegetable in Southwestern Nigeria due to limited data on its productivity, economic importance and effects of seasonal variation. There is a need to establish effects of seasonal variation and fertilizer on the vegetable However, in both rainfed and irrigated fluted pumpkin cultivation, farm yields and financial returns are governed in the short to medium term by other factors, the quality of soil and the climate. Therefore, there is need to consider these factors and estimate the effect of seasonal variation for fluted pumpkin in our clime. The specific objectives of the study is to establish effects of seasonal variation and fertilizer on yield and yield components of the plant.

II. Materials And Methods

The study location is on longitude 4.500E and latitude 7.500N, with an elevation of about 281 meters above the mean sea level. The temperature of the location ranges between 14^{o}C to 39^{o}C. There are two distinct seasons in the area, namely, the rainy season which lasts from March to October and the dry season which last for the rest of the year. The temperature is relatively high during the dry season with the mean value of about 30^{o}C. During rainy season, low temperatures are experienced between July and August when the minimum temperature could be as low as 24oC. The design was laid out in a complete randomized design in three replicates. The factors that were considered are poultry waste, inorganic fertilizer and the control. The rainfed experiment was carried out during raining season without any control over the rainfall amount, intensity and duration. The irrigated experiment was carried out during dry season with irrigation scheduling of 6 mm depth at 3 days interval. The organic matter treatment was applied at rate of 117.29g per plant while the N. P. K. 63.07g per plant. The poultry manure was left for two weeks to allow for some decomposition of the manure. Thirty seeds of fluted pumpkin (Telferia occidentalis) were planted.

III. Results And Discussion

The physico-chemical properties of soil considered include; soil moisture content, soilpH, electrical conductivity, bulk density, availablePhosphorus and exchangeable cations.

Soil pH

Table 1 shows some of the physico-chemical properties of soil from the experimental site. The pH (CaCl2) of the soil samples collected at three different depths i.e. 0-10, 10-20, 20-30cm from experimental site ranged between 5.05 and 5.2. This implies that the soil was slightly acidic. From the table, the soil pH decreases with the soil depth. The highest pH of 5.2 was recorded on depth 0-10. According to EHS (2012), most vegetables perform well on pH range of 5.5 and 6.5. Therefore, the soil at the experimental field did not fall within this range. To increase productivity and yield, lime was applied to neutralize the soil acidic content to a required level. Ifthis measure is not addressed there is possibility of root injury to the crop. Low pH values couldresult into lateral root development suppressed the growth and in some cases root tip were killed(Ajiboye and Ogunwale, 2010). Therefore, optimal yield for pumpkin at this location requires theneed to reduce the soil acidity.

Electrical conductivity of the soil

Electrical conductivity is an indication of soil salinity. The results presented in Table 1shows that the highest electrical conductivity of 0.135 mS/cm was observed at soil depth of 10-20 cm, while the lowest electrical conductivity of 0.105 mS/cm was observed at soil depth of 0-10 cm. These results indicated that the soils at the experimental site had lower salinity value. According to FAO standard on salinity tolerance, any value higher than 16 mS/cm is considered high salinity. Vegetables require a salinity that ranged between 0.08 – 6.56 mS/cm for its growth (FAO, 2013). The salinity level of the soil from the results showed that the soil salinity is appropriate for the pumpkin growth at the experimental site. Adeniran et al., (2010) however, argued that the salinity value is an indication that the soils have low potentials for retaining plant nutrients.

Table 1: Physico-chemical properties of the experimental site

Soil depth	pH ($CaCl_2$)	Ec (Ms/cm)	Bulk density g/cm^3	P(ppm)	% sand	% silt	% clay	Exchangeable cations Ca^{2+}	Mg^{2+}	Na^+	K^+
0-10	5.2	0.105	0.78	54.24	75	10	15	47.64	6.14	1.15	0.51
10-20	5.1	0.135	1.02	38.50	75	10	15	47.43	5.98	1.26	0.26
20-30	5.05	0.135	0.92	39.47	77	8	15	47.47	5.84	1.20	0.15

Exchangeable Cations

The exchangeable Calcium (Ca2+) content of the soil at experimental site (Table 4.1) ranged between 47.43 Cmol kg-1 and 47.64 Cmol kg-1, the exchangeable Potassium (K+) varied from 0.15 - 0.51 Cmol kg-1, Mg2+ varied from 5.84 – 6.14 Cmol kg-1 and 1.15 - 1.26 for Na+. The Cation Exchange Capacity was generally low from 0.15 to 47.59 meq/100g of soil material in the top soil and 5.90 to 47.89 meq/100g at the sub-soil, which means that the soils available have low potentials for retaining plant nutrients.

Bulk density of the soil

The bulk density ranged from 0.78 g cm-3 on soil depth 0-10 cm to 1.02 g cm-3 on depth 10-20 cm. the soil is coarse textured and has a mixture of sandy and loamy soils at the top soil. High bulk density is an indicator of low soil porosity and soil compaction. The soil supports root growth and development, effective aeration and water movement through the soil.

Crop Coefficients and Parameters at each Growth Stage

Values of Crop Coefficient (Kc) for most agricultural crops increase from a minimum value at planting until maximum Kc is reached at about full canopy cover. The Kc tends to decline at a point after a full cover is reached in the crop season. According to FAO (2013), the declination extent primarily depends on the particular crop growth characteristics and the irrigation management adopted during the late season. Figure 1 shows the crop coefficient (Kc) relating water requirements (ETm) to reference evapotranspiration (ETo) for fluted pumpkin. The crop coefficient varies according to the growth stages of the crop. The Kc value of Fluted Pumpkin during rainfed was 0.72 at the initial stage and ranged between 0.72 – 0.74 at the development stage, at the mid-season stage (0.94 - 0.96) and fell during the late season stage to the range of 0.82 - 0.83. However, during irrigation the Kc values were a bit lower than that of rainfed, the value at the initial stage was 0.67 and at the development stage the value ranged between 0.67 – 0.69, at the mid-season stage (0.96 - 0.97) and it also dropped during the late season stage to the range of 0.77 - 0.79 (Figure 1). From Figures 1 water consumption by crops reach their peak during the mid-season stage for both irrigated and rainfed. The crop type has an influence on the duration of the total growing season of the crop. The reduction in the values of Kc could be suggested to be as a result of reduction in evapotranspiration at the late stage of growth. The difference in Kc values during rainfed and irrigation difference could be as a result of some factors affecting Kc like cultural practice, health of plant soil moisture, stages of growth etc. Crop coefficients are normally determined under highly controlled conditions of adequate soil moisture, good plant health, and cultural practicesconditions of adequate soil moisture, good plant health, and cultural practices.

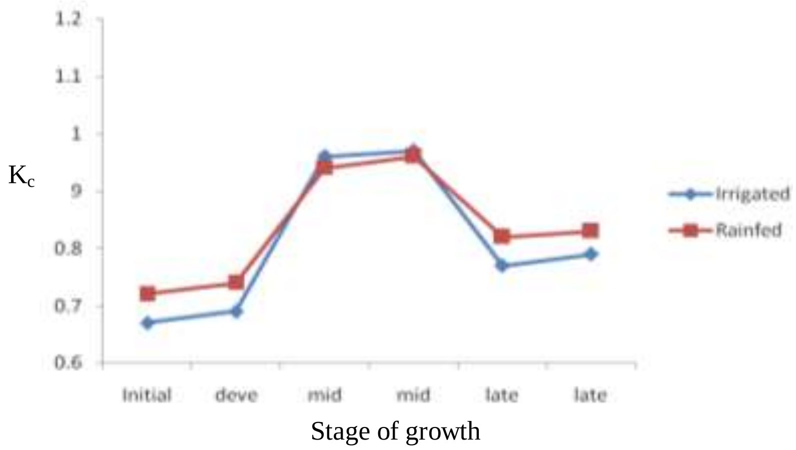

Figure 1: Crop Coefficients (K_c) of Fluted Pumpkin for Rainfed and Irrigated Experiment

Growth parameters

The analysis of plant growth is considered to be a standard approach to the study of plant growth and productivity. Growth and yield are functions of a large number of metabolic processes, which are affected by environmental and genetic factors. The growth parameters considered in this study are: plant height, stem girth, number of leaves and root depth.

Plant height

Figure 2a and 2b show the plant height of the vegetable under the different treatments of NPK, Poultry waste and Control, for rainfed and irrigation experiments respectively. It is observed that Poultry waste incorporation into the soil resulted in highest values of plant height under rainfed when compared with the remaining treatments. From these figures it was observed that the plant height recorded high values under irrigation. This could not be farfetched from the fact that rainfall is not regular as compared to irrigation which was well schedule thereby not allowing the plant to be stressed. The plant height increased on both NPK and

Poultry waste. The rate of growth in the control plot was very slow when compared to the amended soils. According to the work of Ojeniyi *et al.*, (2013) poultry waste improves the biophysical properties of the soil. Therefore, the effect of poultry waste on the growth parameters is as a result of faster release of needed nutrients, especially nitrogen, complemented by the nutrients sustainably released by the poultry waste.The work of Ayeni (2012) and Osunbitan (2013) observed that organic manure supplies major and micro nutrients to the soil which provide favourable conditions for the growth of crops and maintains a good soil organic matter. This observation also support the work of Ndukwe *etal.* (2011) that animal manure is a valuable source of crop nutrients and

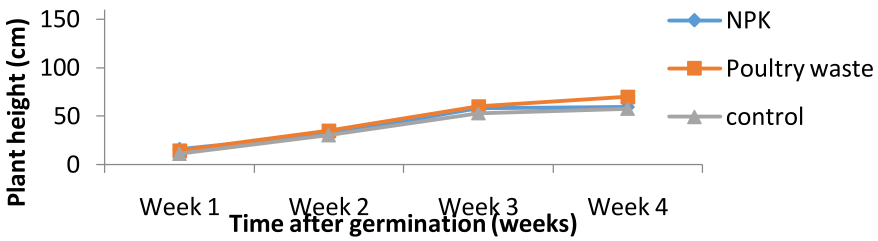

Figure 2a: Plant Height of Fluted Pumpkin under Rainfed Experiment

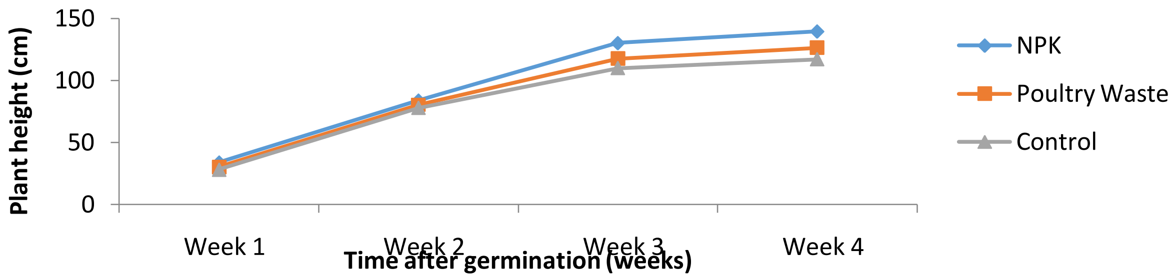

Figure 2b: Plant Height of Fluted Pumpkin under Irrigated Experiment.

organic matter, which can improve the soil biophysical conditions making the soil more productive and sustainable for plant growth. The statisticalanalysis show that for the plant height, all the three factors considered (method, treatments and time) arenot significantly different ($p > 0.05$) in their effects on the plant height. The analysis also shows that there were no significant differences on plant heights during irrigation and rainfed.

Number of leaves

The field experiment suggested that the leaf productions were influenced by different factors. Figure 3a and 3b showed the leaf production on weekly basis for the two planting seasons considered in this experiment. More leaves were produced during irrigation (Figure 3a and 3b) as compared with rainfed. The leaf production was much on soils amended with NPK (Figure 3b). The influence of poultry waste in leave production was not prominent as it was with the plant height. The numbers of leaves increased from 13 to 41 and 18 to 88 during rainfedand irrigated respectively in NPK soil treatment. The result of analysis show that for the number of leaves, all the three factors considered (method, treatments and time) aresignificantly different ($p < 0.05$) in their effects on the number of leaves, but showed some level of significant when the method, treatment and time are related together ($p > 0.09$).However, there were significant difference between the seasonal variables (Rainfed and Irrigation) at ($p<0.05$).

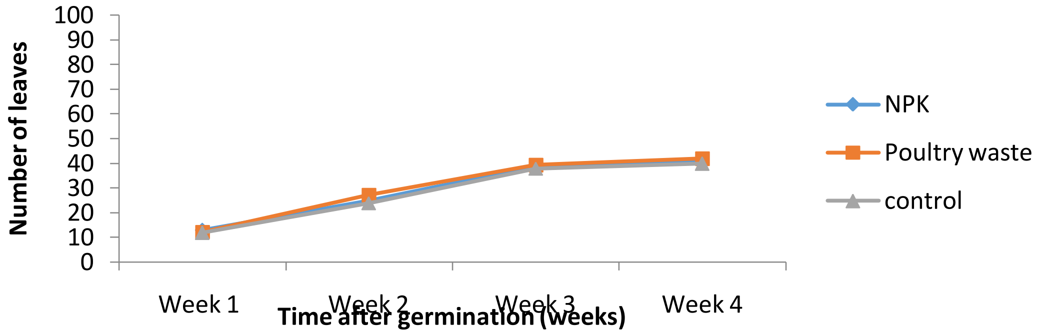

Figure 3a: Number of Leaves Produced under Rainfed Experiment

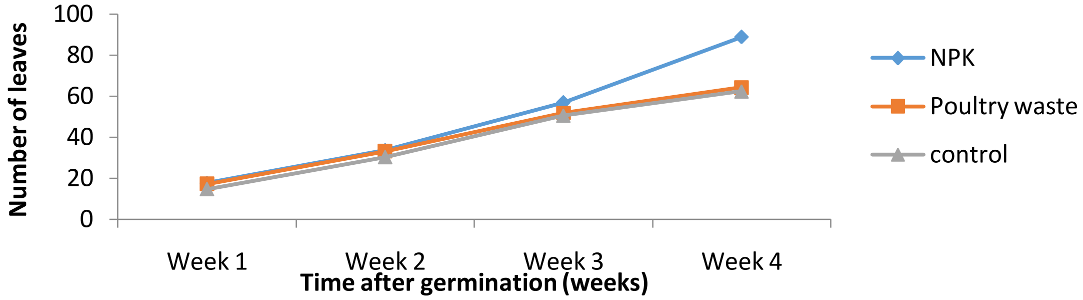

Figure 3b: Number of Leaves Produced under Irrigated Experiment

Stem girth

The plant girths as influenced by application of poultry manure are indicated in Figure 4a and 4b. Though the stem girth during rainfed is more (2 - 6.48 cm) when compared to irrigation (2.5 – 6.08). The number of leaves and stem girth were low in the soil that was not amended. The plots that recorded highest were among the soil amendments although highest values for number of leaves (88) and stem girth (6.48 cm) were attributed to NPK and control respectively. The stem girth of pumpkin produced on the soil amended with poultry waste was higher the remaining treatments as it recorded the high values on both rainfed and irrigation.The result of statistical analysis indicated that there were no significant differences between the stem girths ($p < 0.05$) of the planted pumpkin. The analysis also shows that there were significant differences on the stem girths during irrigation and rainfed season. The inconsistency in the germination of some seeds could be as a result of varying soil and climatic conditions where seeds were gotten from. The growth parameters have the highest values with poultry waste, and this corroborates with the findings of Ewulo *et al.* (2008). The result of analysis of the stem girth on weekly basis indicates that there was significant difference ($p<0.05$) every week.

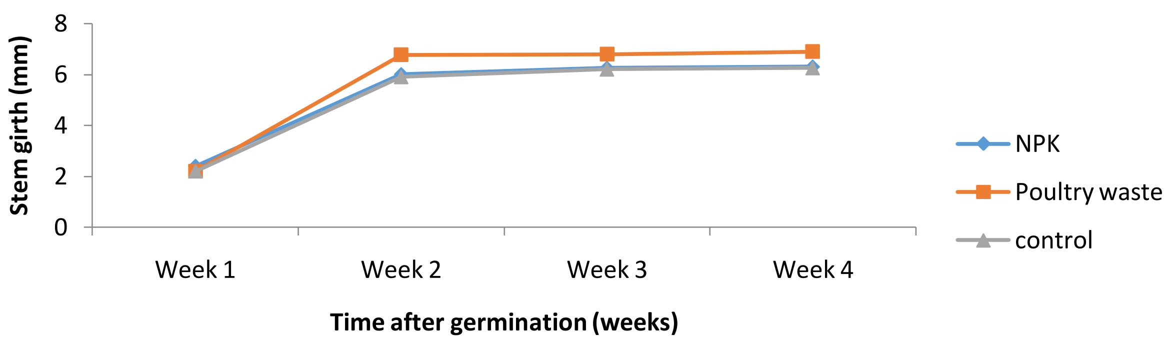

Figure 4a: Stem Girth of Fluted Pumpkin under Rainfed Experiment

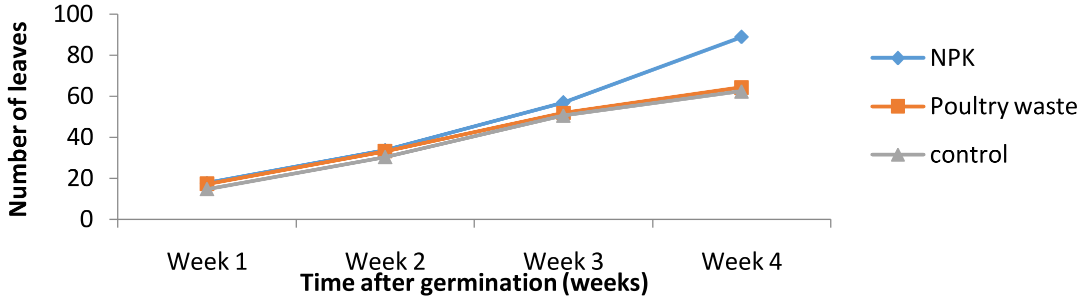

Figure 3b: Number of Leaves Produced under Irrigated Experiment

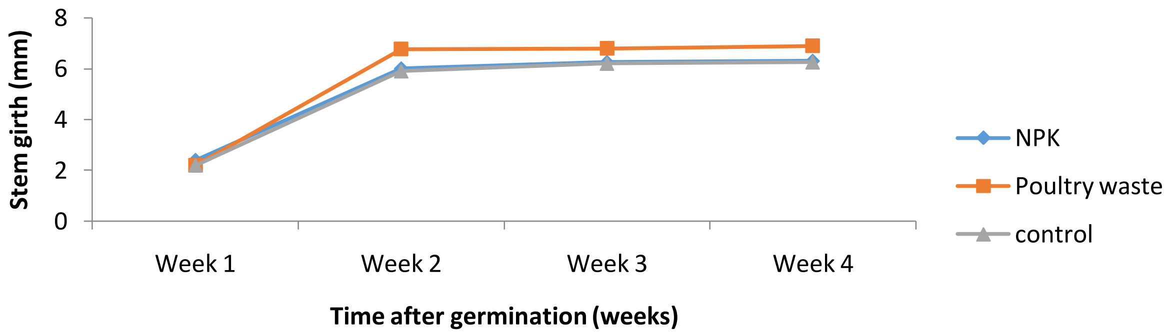

Figure 4a: Stem Girth of Fluted Pumpkin under Rainfed Experiment

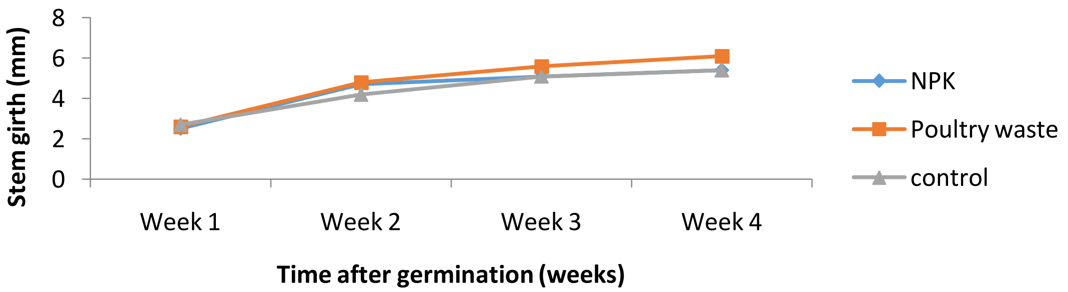

Figure 4b: Stem girth of Fluted Pumpkin under Irrigated Experiment

Yield and Yield Components of Fluted Pumpkin

The yield and yield components of Fluted pumpkin showed that among the amended soil and the control there were difference. The dry matter yield during rainfed was highest on plots treated with poultry waste (119.12 g), followed by control (108 g) and NPK (79.40 g) respectively (Table 2). The amended soil produced similar ear diameter of leaf. The dry matter yield under irrigation showed a significant higher values, 104.86 g for NPK, 131.17 g for poultry waste and 112.56 g for the control. Poultry waste maintained the highest dry matter yield. The performance during irrigation was much better than during rainfed. The irrigated plot maintained the highest yield (697.97 g) under soil amended with NPK as shown on Appendix B3 and closely followed by poultry waste. The soil that was not amended recorded the lowest yield (519.59 g). It can also be deduced that the irrigated soil has the highest yield. This could be as a result of regular water supply. Unagwu (2014) in similar study revealed that soil media amended with organic and inorganic fertilizers consistently produced tallest plants and leaf area throughout the growing period. He also emphasised that many researchers have found the integrated soil nutrition management to be more feasible in maintaining nutrients status and crop production than single application of mineral or organic fertilizers.

Table 2: Dry Matter Yield at 70 ^{0}C for 24 hours

Treatment	Crop weight (g) 1	2	3	Mean	Standard deviation
N.P.K	77.31	95.69	65.27	79.42	15.32
Poultry manure	148.56	92.62	116.18	119.12	28.09
Control	111.65	114.82	98.34	108.27	8.74

IV. Conclusion

The experimental design was complete Randomized design made up of three treatments and three replicates. The treatments were poultry waste, NPK and control. The organic matter treatment applied to amend the soils influenced the pumpkin leave production and yield. The fluted pumpkin recorded a high yield under irrigated experiment; therefore it is recommended that farmers in the southwest Nigeria should embrace irrigation to grow fluted pumpkins in order to have higher yield. The study has been able to provide some basic information on yield, water use and crop coefficients at different crop stages of fluted pumpkin growth with different types of fertilizer (poultry waste, and NPK) under rainfed and irrigation. The study will serve as a guide to practioners as well as government on vegetable production.

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