OPEN ACCESS
Global Journal of Research in Agriculture & Life Sciences
ISSN: 2583-4576 (Online)
Volume 04| Issue 01 | Jan.-Feb. | 2024
Journal homepage: https://gjrpublication.com/gjrals/
Original Research Article

Growth and Tuber Yield of Sweet Potato (*Ipomoea Batatas*) as affected by Vine Style of Planting and Fertilizer Application

*Adeyeye, A.S[1]; Ejim E. P[3]; Etukudo, O.O[2]; Ahmadu, R[4]; Gadu, H.O[1]

[1]Department of Crop Production & Protection, Federal University Wukari, Taraba State, Nigeria
[2]Department of Agronomy, Ahmadu Bello University, Zaria, Kaduna State Nigeria
[3]Research Scientist, Federal University Wukari,Taraba State Nigeria
[4]Research Asistant, Federal University Wukari, Taraba State, Nigeria

DOI: 10.5281/zenodo.10676597 **Submission Date:** 10 Dec. 2023 | **Published Date:** 19 Feb. 2024

***Corresponding author:** Adeyeye, A.S
Department of Crop Production & Protection, Federal University Wukari, Taraba State, Nigeria

Abstract
The study was carried out at the Teaching and Research Farm of Federal University Wukari, Taraba State, Nigeria to evaluate the effect of vine style of planting and fertilizers application on the growth and tuber yield of sweet potato variety. The treatments consisted of white skin variety of sweet potato, two styles of vine planting as (direct style vine planting and one ring style vine planting patterns), two levels of poultry manure (2 and 4t/ha), two levels of cow dung manure (2 and 4t/ha), 400kg/ha NPK 15:15:15and the control (0kg/ha). These were laid out in a Randomized Complete Design (RCD) with three replications. Data were collected on the growth and tuber yield parameters of the crop which includes length of vine, number of leaves, number of vine, leaf area, canopy formation, number of tuber, weight of tuber and size of tuber. Data collected were analyzed using ANOVA and the differences among the treatment means was separated using Least Significant Difference and Duncan Multiple Range Test at 5% level of probability. The results obtained showed that the direct vine planting pattern significantly affected the growth parameters such as length of vine, number of leaves, number of vine, leaf area, canopy formation at 2, 4, 6, 8, 10 and 12 weeks but the ring vine style of planting produced higher weight (3.90kg) and more tuber (4.74). Poultry manure nutrient source at 4t/ha performed significantly best in all the growth and yield parameter taken at all stages of growth. The combined effect of ring style of planting with the application of 4t/ha poultry manure at harvest produced significantly higher weight of tuber (2.81kg) and tuber size (45.56). Hence planting sweet potato using ring style vine planting with poultry application rate of 4t/ha is best for the production of sweet potato.

Keywords: Sweet Potato, fertilizers, poultry manure, vine planting styles, cow dung.

INTRODUCTION
Sweet potato (*Ipomoea batatas (L) Lam)* is an important economic crop cultivated worldwide. The crop is a native of tropical America (central and northern), and it was transported to the Pacific Islands and Asia early in history (Roullier *et al*., 2013). The crop is also known as the morning-glory which belong to a family Convolvulaceae. The tuberous roots of the crop are for human consumption and its vegetative parts for both human consumption and animal feed. It is considered as a poor man's crop because of it low input requirement, use in production and ability of produce under adverse weather and marginal soil condition (Aritaa and Gibson, 2002) Most small-scale farmers in Africa and Asia used sweet potato, both the vegetative and storage roots as source of human food (Wubamechi, 2014) and livestock feed (Yamakawa and Yohimene, 2012). The edible tubers can be eaten boiled, fried or baked and in Nigeria, presently packaged fried sweet potato chips which are common in major cities of Portharcourt, Lagos, Ibadan and Abia (Wubanechi, 2014). Sweet potato vines have crude protein content ranging from 16-29% on dry matter basis which is comparable to leguminous forages (Ankumah *et al*., 2003). Feeding the vines to cows as a supplement to a basal diet of

the forage increases milk yield (Etela *et al*., 2008). Sweet potatoes play critical roles in rural diets during shortage of grain crops such as maize and when drought occurs. Most households produce sweet potato as a food security or famine prevention crop therefore, sweet potatoes are viewed in this instance us a form of insurance in the period of drought or food shortages (Wubanechi, 2014). The yield of sweet potato like other crops is influenced by climatic, biological and soil factors (Udo *et al*., 2005, NRCRL, 2008) and recently, the vine planting pattern (Adeyeye et al, 2023). This can be improved through application of fertilizers either organic or inorganic and good agronomic practices such as new innovation of vine styles of planting. The vine pattern of planting used for a crop such as sweet potato determines to a greater extent is performance in terms of growth and tuber yield (Adeyeye *et al*., 2023). Good vine planting pattern such as folding the vines into rings ensure a crop to have adequate opportunities to grow and produced good canopy coverage and higher tuber yield than the traditional direct vine planting as well as the amount of total dry matter production of a crop, it is believed that planting potatoes cutting in a ring firm will produce higher yield in terms of tuber number and dry matter than traditional direct vine planting method. Fertilizer is one of the most important inputs either as organic or inorganic for increasing the productivity of crops (Ali *et al*., 2009). Inorganic fertilizer when applied to crop usually has a quick-release formula making nutrient rapidly available to plants. Despite the fact that using inorganic fertilizers has been reported to give high yields, the high cost and its long time adverse effect on soil chemical properties are the concern (Akanni *et al*., 2011). This makes the use of organic fertilizer more preferred because of its ability to supply both macro and micro nutrients to the soil (Negassa *et al*., 2001; Tirol-padre *et al*., 2007) improve the physio-chemical properties of the soil, environmentally friendly and cheap for the rural farmers to purchase. Several workers had reported an increased in yield of the crop through application of fertilizers for example, Ankumah *et al*., 2003 reported that when nitrogen fertilizer was applied to low poor-nutrient soil it increases the yield and improve tuber quality of the crop. More researches are needed to evaluate the effects of the vine style of planting and fertilizer application on the growth and tuber yield of sweet potato in this environment. Hence the study was designed to evaluate the effect of fertilizers and vine style of planting on the growth and tuber yield of sweet potato.

MATERIALS AND METHODS

Study Area

This study was conducted at the Teaching and Research Farms located at Federal University Wukari, Taraba State, Nigeria. Wukari is a famous city located formerly in Gongola State of Nigeria Wukari is located at latitude $7^{0}51$ North and longitude $9^{0}47$ East. Wukari is situated at elevation 189 meters above sea level with a mean annual rain fall of 1300mm (Wikipedia, 2016). Its mean annual maximum temperature varies from 30^{o}C (Reuben and Mshella, 2011). The total land mark of Wukari is 4,308km^2 and a population of 241,546 as at 2006 census (Worldatlas, 2015). Wukari lies between Taraba State and Benue State and it is in agricultural based center.

Experimental Materials

The planting materials consisted of white skinned sweet potato variety. The white skin variety was from Donga Local Government Area in Taraba State, Nigeria. Other materials used for the experiment includes; cutlasses, hoes, pegs, ropes, meter rule (100cm and 30cm rule), record book, pen, making tape, 20kg weighing scale and jute bags. Inorganic Fertilizers such as NPK 15:15:15, and Urea were purchased in Wukari Yam Market. Also, Poultry Manure and Cow Dung were collected from the Teaching and Research Farm, Federal University Wukari. The manures were sorted out of stones and other debris; air dried and packed in bags. Soil samples from the experimental site as well as manures were taken to the laboratory for analysis.

Experimental Design and Treatment

The experiment design for the study was a 1 x 2x6 factorial which was arranged in a randomized complete design (RCD) with three replications and the treatments comprises of white skinned sweet potato variety, two different vine planting patterns (direct vine and ring vine planting patterns), Poultry manure rate at 2 and 4t/ha, Cow dung manure at 2 and 4t/ha ,400kg/ha NPK and the control (0kg/ha) The treatments were assigned to each plot in each replication. The bed size of 2mx 2m was used and separated by 1m intra and 2m inter row spacing respectively. The total land used for the experiment was 350m^2 (10m x 35m).

Land preparation and planting

The experimental land was cleared and ploughed manually using traditional hoes and cutlasses. Raised bed of 2m high was made manually to a size of 2m x 2m per plot. During the planting time matured cuttings of 30cm in length was planted with 2/3 of its lengths covered with soil to a depth of 4 cm which represent traditional method of planting while the cuttings were also formed into a ring-like structure and buried into the soil as ring style of planting. Supply was done to replace dead vines after one week of planting. Manual hoe weeding of the experimental plot was done at two weeks after planting and as when necessary to keep the field free of weeds during the growth periods of the plants. The organic manure was applied to the soil two weeks before planting. This was done to ensure complete decomposition of organic manure and to allow for total nitrification to avoid the risk of ammonia toxicity. The NPK (15:15:15) and urea fertilizers were applied two (2) weeks after planting.

Data collections

The data for growth parameters was collected from three randomly selected plants per plot at 2, 4, 6, 8, 10 and 12 weeks after planting. The data recorded for the growth parameters are length of vine (cm), number of vine per plant, number of leaves, leaf area (leaf breath x leaf length) and canopy expression.

Length of the Primary Vine: Length of primary vine was determined by measuring the length from the base to the tip of the three tagged primary vine using tape or meter rule and the average was recorded for each of the plots at all the sampling periods.

Number of Vine per Plant: All secondary vines on each of the tagged plants were counted and the average value will be recorded for each of the plots at all the sampling periods.

Number of Leaves per Plant: All leaves on each of the tagged plants were counted and the average value was recorded for each of the plots at all the sampling periods.

Canopy Formation: The canopy formation of the cultivars was measured using a scale of 1 to 5, i.e. poor, fair, good, very good and excellent.

Yield components

Yield data collection was done at harvest when about 80-85% of the leaves turned yellowish in colour and mostly dried. The data recorded at harvest are, number of tubers per plant, weight of tubers (kg) and size of tubers (cm).

Number of tubers per plant: This was recorded by counting the actual number of storage tuber harvested per plot and divided by the total number of plants counted at harvest.

Weight of tuber (kg/plant): Storage tuber of plants in each net plot was dug out at harvest and weighed using a 20kg weighing scale.

Size of tuber (kg/plant): This was done by rolling tape around the harvested tuber.

Statistical analysis

The data recorded was subjected to analysis of variance (ANOVA) using statistical analysis software (statistix version 13). Difference between treatments means was compared using the Least Significant Difference and Duncan Multiple Range Test (DMRT) at 5% level of probability.

RESULTS

Soil analysis was conducted during the study and the results obtained showed that textural class of the soil is loam sandy soil having a pH of 5.75 and Cation exchange capacity of 10.4 (CEC), total exchangeable base of 9.3 (TEB) and total Nitrogen of 0.98 which mean the fertility of the soil is low, hence there a need to apply fertilizers to improve crop yield (Table 1). The effects of vine method of planting on the growth parameters of sweet potato at all sampling periods were significant as shown in (Table 3). The number of leaves was significantly higher for direct vine planting than ring vine planting at all the sampling periods except at 10 and 12 WAP. Furthermore, the length of vine and leaf area recorded indicated no significant differences among the means in the study, moreover the number of vine and canopy formation produces a significant differences and ring vine planting gave the highest mean values when compared to direct vine planting at all sampling period.

Fertilizer applications influence positively the growth and development of the crop as shown in (table 4). Poultry manure rate of 2 and 4t/ha gave the highest number of leaves, followed by 400kg/ha NPK at 2WAP. While at 4WAP the application of 4t/ha poultry manure and 400kg/ha NPK produces the highest number of leaves but statistically similar to other fertilizer treatments used. At 6, 8 10 and 12 WAP, highest significant number of leaves were produced from the plants that received poultry manure at the rate of 4t/ha closely followed by 400kg/ha NPK fertilizers. Although most at times are similar statistically to other treatments. The length of vine recorded in the study indicated that there was a significant difference among the fertilizer treatment applied. Though 4t/ha poultry manure produced higher length of vine at all the sampling stages but are statistically similar with 0kg/ha, 4t/ha cow manure, 2t/ha cow manure and 400kg/ha NPK, respectively (Table 5)

The numbers of vines produced by the plant were significant different among the fertilizer treatments applied in the study. At 2WAP poultry manure rate of 4t/ha and okg/ha produced the highest significant number of vine but not different statistically from 2t/ha poultry manure, 2 and 4t/ha cow dung and 400kg/ha NPK fertilizer. Furthermore at 4, 6 8,10 and 12 WAP poultry manure rate of 4t/ha gave the highest vine number but are similar statistically to other fertilizer treatments used in the study (Table 6). Leave area result obtained shows that fertilizer treatments produced significant differences but the means are statistically similar at all stages of growth measured (Table 7)

The canopy expression of the plant in (table 8) shows that application of poultry manure rate of 4t/ha produced the best canopy spread or expression in all the growth stages but statistically not different from the results of other fertilizer treatments used. 4t/ha poultry manure gave significantly higher canopy expression, which are statistically similar to 2t/ha cow manure, 2t/ha poultry manure, 4t/ha cow manure, 400kg/ha NPK and 0kg/ha respectively.

The result obtained on the yield of the crop at harvest indicated that the number of tubers and the weight of tubers are significantly higher in plants planted using ring method which may suggest production of more tubers arising from more growing points of the potato vines buried in the soil. The size of the tuber harvested was higher in the direct method of planting but not significantly different from the ring method of planting (Table 9). Application of 4t/ha poultry manure (PM) produced significantly higher number of tubers in the study but the result is similar statistically to those obtained through the application of 4t/ha cow dung (CM) and 400kg/ha NPK. Tuber weight recorded also followed the same trend as in the number of tubers where poultry manure rate of 4t/ha gave the highest tuber weight which are also similar to 4t/ha cow dung and 400kg/ha NPK respectively (Table 10). Furthermore, the size of tuber obtained showed that poultry manure application rate of 4t/ha and cow dung rate of 4t/ha had significant higher tuber size when compared to other fertilizer treatments used (Tale 10). The interactive effect of vine planting method and fertilizer application showed that number of tuber, weight of tuber and size of tuber was also influenced positively by treatment combination of direct planting + 4t/ha CM, ring planting + 4t/ha PM and ring planting + 0kg/ha and ring planting + 400kg/ha NPK respectively (Table 11).

TABLES

Table 1: The Soil Chemical and Physical Analysis of the Teaching and Research Farm, Federal University, Wukari

Properties	Values
pH (H_2O)	5.75
Organic carbon (%)	1.36
Organic matter (%)	2.35
Total N (%)	0.98
Available P (MgL^{-1})	0.52
Exchangeable K (mol/kg)	1.6
Exchangeable Na (mol/kg)	2.1
Exchangeable Ca (mol/kg)	3.8
Exchangeable Mg (mol/kg)	1.8
Exchangeable Acidity (mol/kg)	1.10
TEB	9.3
CEC	10.4
Base Saturation (%)	89.4
Sand (g/kg)	76.80
Clay (g/kg)	15.20
Silt (g/kg)	8.0
Textural Class	Sandy soil

Soil analysis was conducted during the research and the above result were obtained. The textural class of the soil is sandy soil with a pH of 5.75 and cation exchange capacity of 10.4 (CEC), total exchangeable base of 9.3 (TEB) and other characteristics of the soil was seen above.

Table 2: Nutrient Compositions of the Organic fertilizers used in the Study

Treatments	pH	%C	%N	P	K	Ca	Mg	Na
Poultry manure	7.50	8.50	5.74	1.79	0.38	2.62	1.76	0.02
Cow dung	7.90	8.90	5.60	0.56	3.57	3.10	1.34	0.02

Table 3: Effects of vine planting methods on the growth parameters of sweet potato at all sampling stages.

Vine Style planting	Weeks After planting (WAP)	Number of leaves	Length of vine	Number of vine	Leave area	Canopy Formation
Direct	2WAP	96.41a	83.57a	3.96b	80.77a	53.33a
Ring		71.89b	75.67a	4.67a	80.57a	57.33a
Mean		11.72	8.60	0.58	5.95	4.46
Direct	4WAP	166.06a	127.57a	4.35b	73.14a	61.26b
Ring		134.83a	124.09a	5.76a	70.85a	81.44a
Mean		18.75	11.85	0.54	4.40	11.69
Direct	6WAP	247.89a	182.90a	7.50b	88.59a	92.28b
Ring		189.76b	173.96a	8.74a	83.96a	100.32a
Mean		26.67	16.94	0.81	5.03	6.07

Direct	8WAP	376.04a	295.81a	11.15b	102.45a	120.01b
Ring		278.59b	267.94a	13.00a	101.99a	128.33a
Mean		40.13	26.19	1.30	5.33	7.31
Direct	10WAP	529.70a	416.06a	17.02b	137.16a	146.91ab
Ring		444.26a	410.13a	19.30a	132.57a	149.78a
Mean		58.51	37.46	1.81	5.81	7.91
Direct		748.04a	609.59a	26.00a	163.04a	179.94a
Ring	12WAP	616.59a	601.87a	22.76a	154.51a	170.17a
Mean		79.41	52.07	2.23	6.35	7.91

Values with different letters along the columns are significantly different using DMRT at 5% probability level. WAP = Weeks after planting, Direct = Direct vine method of planting, Ring = Ring vine method.

Table 4: Effects of fertilizer treatments on the Number of leaves of sweet potato at all sampling stages

Fertilizer treatments	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
0kg/ha	64.72b	136.33ab	200.72ab	230.94b	482.89ab	637.83ab
2t/ha PM	94.33a	145.17a	230.22a	312.94ab	450.83ab	624.50ab
4t/ha PM	114.33a	158.11a	228.56a	342.44a	515.06a	739.17a
400kg/ha NPK	84.33ab	155.11a	208.67ab	345.83a	507.28a	737.28a
2t/ha CM	68.56b	137.50ab	208.44ab	302.28ab	483.39ab	652.67ab
4t/ha CM	78.94ab	150.44a	216.33ab	329.44a	482.44ab	692.44ab
Mean	14.01	22.96	32.66	49.15	71.66	97.26

Values with different letters along the columns are significantly different using DMRT at 5% probability level. PM = poultry manure, CM = Cow manure, NPK = Nitrogen, Phosphorous, Potassium.

Table 5: Effects of fertilizer treatments on the Length of vine of sweet potato at all sampling stages

Fertilizer treatment	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
0kg/ha	85.06a	122.00ab	187.56ab	296.89a	434.28a	634.00a
2t/ha PM	52.94b	104.83b	141.22b	234.94ab	342.22ab	502.78ab
4t/ha PM	104.06a	141.67a	211.78a	317.28a	497.94a	691.94a
400kg/ha NPK	76.50ab	122.22ab	156.06b	274.17ab	400.44a	597.17ab
2t/ha CM	77.78ab	126.17ab	187.61ab	282.78ab	415.61a	607.61a
4t/ha CM	81.39ab	127.11ab	186.06ab	285.22ab	417.06a	600.89a
Mean	10.54	14.52	20.75	32.07	45.88	64.81

Values with different letters along the columns are significantly different using DMRT at 5% probability level. PM = poultry manure, CM = Cow manure, NPK = Nitrogen, Phosphorous, Potassium.

Table 6: Effects of fertilizer treatments on the Number of vine of sweet potato at all sampling stages

Fertilizer treatment	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
0kg/ha	5.39a	5.83a	8.33ab	12.33a	18.28a	25.44a
2t/ha PM	4.00ab	4.72ab	7.00ab	10.28ab	15.22ab	21.83ab
4t/ha PM	5.22a	6.06a	9.00a	13.28a	19.72a	26.06a
400kg/ha NPK	3.83ab	5.50a	8.00ab	11.83ab	17.50ab	24.06ab
2t/ha CM	4.00ab	5.89a	8.33ab	12.94a	20.78a	25.61a
4t/ha CM	3.44ab	5.33a	7.56ab	11.78ab	17.44ab	23.28ab
Mean	0.71	0.66	0.99	1.59	2.21	2.72

Values with different letters along the columns are significantly different using DMRT at 5% probability level. PM = poultry manure, CM = Cow manure, NPK = Nitrogen, Phosphorous, Potassium.

Table 7: Effects of fertilizer treatments on Leaves area of sweet potato at all sampling stages

Fertilizer treatment	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
0kg/ha	88.25a	69.51ab	87.25a	101.52a	131.24ab	153.82ab
2t/ha PM	84.64a	80.48a	90.25a	114.52a	144.12a	166.84a
4t/ha PM	82.30a	72.51a	82.42a	96.69ab	125.29ab	147.68ab
400kg/ha NPK	82.49a	73.98a	89.36a	102.36a	140.17a	163.84a
2t/ha CM	69.15ab	68.78ab	83.64a	104.14a	143.46a	171.78a
4t/ha CM	77.22ab	66.70ab	84.70a	94.08ab	124.91ab	148.68ab

Mean	6.76	5.38	6.16	6.53	7.11	7.78

Values with different letters along the columns are significantly different using DMRT at 5% probability level. PM = poultry manure, CM = Cow manure, NPK = Nitrogen, Phosphorous, Potassium.

Table 8: Effects of fertilizer treatments on the Canopy formation of sweet potato at all sampling stages.

Fertilizer treatment	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
0kg/ha	51.00ab	62.11ab	94.69a	124.50ab	152.44a	176.72a
2t/ha PM	53.72ab	59.75b	94.33ab	114.06b	139.11ab	161.17ab
4t/ha PM	62.83a	75.11ab	100.67a	140.17a	154.22a	187.61a
400kg/ha NPK	51.44ab	97.94a	89.33ab	128.67ab	149.83a	176.78a
2t/ha CM	60.00a	67.61ab	93.89ab	117.11b	149.83a	178.00a
4t/ha CM	53.50ab	65.56ab	104.89a	123.22ab	146.61ab	170.06ab
Mean	5.46	14.32	7.43	8.95	9.69	9.70

Values with different letters along the columns are significantly different using DMRT at 5% probability level. PM = poultry manure, CM = Cow manure, NPK = Nitrogen, Phosphorous, Potassium.

Table 9: Effect of vine planting method on yield parameters of sweet potato at harvest

Planting method	No of tuber	Weight of tuber	Size of tuber
Direct	3.96ab	2.00b	35.17a
Ring	4.74a	3.90a	33.20a
Mean	0.39	0.32	1.74

Values with different letters along the columns are significantly different using DMRT at 5% probability level. Direct = Direct vine method of planting, Ring = Ring vine method of planting.

Table 10: Effect of fertilizer treatments on yield parameters of sweet potato at harvest

Fertilizer treatment	No of tuber	Weight of tuber	Size of tuber
0kg/ha	2.56a	1.26b	34.83b
4t/ha PM	4.56a	2.64a	59.94a
2t/ha PM	2.39c	1.39b	28.17c
4t/ha CM	4.05ab	2.01ab	55.67a
2t/ha CM	3.17bc	1.54b	34.00b
400kg/ha NPK	4.39ab	1.86ab	32.50bc
Mean	0.68	0.55	3.02

Values with different letters along the columns are significantly different using DMRT at 5% probability level. PM = poultry manure, CM = Cow manure, NPK = Nitrogen, Phosphorous, Potassium.

Table 11: The Interactive effect of Vine planting methods and fertilizer treatments on yield parameters of sweet potato

Fertilizer treatment	No of tuber	Weight of tuber	Size of tuber
Direct + 0kg/ha	4.33abc	1.83ab	33.22cd
Direct + 4t/ha PM	4.78a	2.49ab	42.00ab
Direct + 2t/ha PM	2.56cd	1.78ab	36.56bc
Direct + 4t/ha CM	5.22a	2.48ab	34.33bc
Direct + 2t/ha CM	2.67bcd	1.58ab	30.67cd
Direct + 400kg/ha NPK	4.22abc	1.83ab	34.22bc
Ring + 0kg/ha	4.78a	2.69a	36.44bc
Ring + 4t/ha PM	3.89abcd	2.81a	45.56a
Ring + 2t/ha PM	3.67abcd	0.99b	31.44cd
Ring + 4t/ha CM	3.33abcd	1.52ab	29.33cd
Ring + 2t/ha CM	2.22d	1.51ab	25.67d
Ring + 400kg/ha NPK	4.56ab	1.89ab	30.78cd
Mean	0.97	0.78	4.26

Values with different letters along the columns are significantly different using DMRT at 5% probability level. Direct = Direct vine method of planting, Ring = Ring vine method of planting, PM = poultry manure, CM = Cow manure, NPK = Nitrogen, Phosphorous, Potassium.

Discussion

The result of the research indicated that vine planting method had significant effect on the growth of the plant and that direct planting of vine produced longer primary vine and had higher number of leaves and leave area than the ring method of vine planting. Furthermore, direct method of planting of sweet potato produced large amount of foliage (leaves), which gave the plant a good canopy spread at the early growth stages. This may be due to the early sprouting and production of leaves and new vine. This is in line with the work of Ignatus, M.C, (2018) that says that new innovation of vine style of planting increases the number of nodes in the soil that bring about rapid and profuse growth of the plant. The ring vine planting method produces higher tuber number and weight while direct vine planting produced sweet potato with higher tuber size than ring vine method. These differences could be attributed to the fact that ring vine produced about 5 to 12 nodes which are buried in the soil that resulted into more number of tubers per plant. This showed that vine planting method play an important role in many morphological and physiological processes that occurs in the plant which translates into the kind of yield obtained (Adeyeye et al, 2023).

The effect of poultry manure on the growth of sweet potato was superior to other treatments applied in the study. Result however indicated that the application of fertilizers improved the number of sweet potato leaves in the study and most times are better than non fertilized plants. Poultry manure rate of 4t/ha gave the highest significant number of leaves, length of vine, number of vine, leave area and canopy expression at all the growing stages measured the results are similar in most cases to the one obtained from application of NPK at 400kg/ha. This may be due to the ability of poultry manure to adequately supply the plants with required nutrients as at when needed which in turn enhances the metabolic and physiological processes in the plant. The manure also provides plant with both major and minor nutrients elements needed for the growth and developments of the plant. This supported the work of Akande, et al. 2020 on pepper.

The result obtained on the yield of the crop at harvest indicated that the number of tubers and the weight of tubers are significantly higher in plants planted using ring method which may suggest production of more tubers arising from more growing points of the potato vines buried in the soil. The size of the tuber harvested was higher in the direct method of planting but not significantly different from the ring method of planting. Application of 4t/ha poultry manure (PM) produced significantly higher number of tubers in the study but the result is similar statistically to those obtained through the application of 4t/ha cow dung (CM) and 400kg/ha NPK. Tuber weight recorded also followed the same trend as in the number of tubers where poultry manure rate of 4t/ha gave the highest tuber weight which are also similar to 4t/ha cow dung and 400kg/ha NPK respectively. Furthermore, the size of tuber obtained showed that poultry manure application rate of 4t/ha and cow dung rate of 4t/ha had significant higher tuber size when compared to other fertilizer treatments used. This observation may be due to the adequate nutrients available to the plants from the soil which gives room for metabolic activities to go on well. The application of organic manure also contains appreciable quantities of magnesium might have helped in chlorophyll synthesis which in turn increased the rate of photosynthesis thereby increased fruit number and yield of crop, Esan, et al 2021.

The number of tuber, weight of tuber and size of tuber was also influenced positively by treatment combination of direct planting + 4t/ha CM, ring planting + 4t/ha PM and ring planting + 0kg/ha and ring planting + 400kg/ha NPK respectively. For optimum sweet potato production therefore, combination of 4t/ha PM or 0kg/ha with ring method of planting is recommended for adoption by both large and small scale farmers to improve sweet potato production.

Conclusion

Direct planting method of sweet potato is a traditional practice which needs to be transformed to a more and highly profitable ring planting method for optimum production of sweet potato crop. According to the results of this study, ring method did not significantly affect sweet potato growth, but significantly influenced the yield of the crop. In addition, sweet potato yield and its components were significantly affected by poultry manure and NPK fertilizer, hence producing a positive net return in sweet potato production.

References

1. Adeyeye, A.S, Ogu, M.C, Etukudo, O.O, Ishaku, M.A, Gadu, H.O, Olalekan, K.K (2023) New innovation of vine planting pattern effect on growth and tuber yield of sweet potato (Ipomea batatas. L) varieties. Global Journal of Research in Agriculture and Life Sciences vol 3: 6 Pp 13-21.
2. Akande, G.M, Olaiya, P.A, Iyagin, F.O (2020) Hot pepper (Capsicum annum,L) production using different organic manure and inorganic fertilizer in Akure, Nigeria. Journal of medicinal plants studies, 8(2) Pp 49 - 53
3. Akanni, I.D., Ojeniyi, S.O. and Awodum, M.A. (2011). Soil properties, growth and nutrient content of maize, pepper and Amaranthus as influenced by organic and organomineral fertilizer. *J. Agric and Techn.* 11, 1074-1078

4. Akinrinde, E.A. (2006). Phosphorus fertilization effect on dry matter production and biomass partitioning in sweet potato (Ipomoea batatas) grown on acidic loamy sand Allisol *Journal of Food Agricultural Environment* 4(4): 99-104
5. Alex, B. (2015). Growth, yield and quality factors of sweet potato (Ipoemo batatus (1) Lam) as affected by seedbed type and fertilizer application Department of Crop and Soil Sciences Kwame Nkrumah University of Science and Technology, Kumani.
6. Ali, M.R., Costa, D.J., Abedi, M.J., Sayed, M.A., and Basak, N.C. (2009). Effect of fertilizer and variety on the yield of sweet potato.
7. Ankumah, R.O., Khan, V., Mwamba, K. and Kpomblekou, A.K. (2003). The influence of source and timing of nitrogen fertilizers on yield and nitrogen use efficiency of four sweet potato cultivars. *Agriculture, Ecosystems and Environment*. 100: 201–207.
8. Aritua, V, Gibson, R, Vetten, J (2005) Serological Analysis of Sweet Potato affected by sweet potato viruses diseases in East Africa: White flies and White fly borne viruses in the Tropic. CIAT, PUB (341):83 – 88
9. Chataika, T, Mckenzie, J.A, Swart, E, and Cleophas, M.L (2010) Access to education in Africa: responding to the United Nations Convention on the right of persons with Disability. Disability & Society vol 27 (3) 385 – 398
10. Etela, L, Oji, U.L., Kalio, G.A. and Tona, G.O. (2008). Studies on sweet potato forage and dried brewers grains as supplements to green panic for Bunaji cows. *Tropical Grasslands*, 42: 245-251.
11. Esan, V.I, Omilani, O.O, Okediga, I (2021) Effect of organic and inorganic fertilizers on sweet potato production in Iwo, Nigeria. African journal of plant science vol15(5) Pp 131-137
12. Ignatus, M.C (2018) Growth and tuber yield of sweet potato (Ipomoea batatas. L) as affected by vine planting pattern in North East Zone of Nigeria. A project submitted for the award of degree of bachelor of Agriculture, Department of Crop Production and Protection, Federal University Wukari, Taraba State, Nigeria.
13. Nedunchezhiyan, M. and Ray, R.C. (2010). Sweet potato growth, development production and utilization: overview, In: Ray RC, Tomlins KI (Eds) Sweet potato: *Post Harvest Aspects in Food, Nova Science Publishers Inc*., New York, pp 1-26.
14. Negassa, W., Negisho, K., Friesen, D.K. Ransom J. and Yadessa, A. (2001). Determination of optimum farmyard manure and NP fertilizers for maize on farmer's field. Seventh Eastern and Southern Africa Regional Maize Conference 11th-15th, February. pp: 387-393.
15. Onwueme, I.C., (1978). The tropical tuber crops. Yam, Cassava, Sweet potato and Cocoyams. New York: John Wiley & Sons.
16. Roullier, C., Kambouo, R., Paofa, J., McKey, D. and Lebot, V. (2013). On the origin of sweet potato (*Ipomoea batatas* (L.) Lam.) genetic diversity in New Guinea, a secondary centre of diversity. *Heredity*. 110:594–604.
17. Tirol-padre, A., Ladha, J.K. Regmi, A.P. Bhandari, A.L. and Lnubushi, K. (2007). Organic amendment affect soil parameters in two long-term rice-wheat experiments. *Soil Science Society of America Journal*, 71(2): 442-452**.**
18. Wubanechi, S. (2014). Effect Of Planting Density On Growth And Yield Of Sweet Potato [Ipomoea batatas (L.) Lam] Varieties In Habru District, Northern Ethiopia.www.worldartss.com/../Where-Is-Wilcuri
19. Yamakawa, O. and Yoshimeto, M. (2002). Sweet potato as food material with physiological functions. *Acta Horticulture*. 583: 179-185.

CITATION
Adeyeye A.S, Ejim E. P, Etukudo O.O, Ahmadu R & Gadu H.O. (2024). Growth and Tuber Yield of Sweet Potato (Ipomoea Batatas) as affected by Vine Style of Planting and Fertilizer Application. In Global Journal of Research in Agriculture & Life Sciences (Vol. 4, Number 1, pp. 26–33). https://doi.org/10.5281/zenodo.10676597