OPEN ACCESS

Global Journal of Research in Agriculture & Life Sciences
ISSN: 2583-4576 (Online)
Volume 04 | Issue 06 | Nov.-Dec. | 2024
Journal homepage: https://gjrpublication.com/gjrals/

Research Article

Effect of Vine Length and Organic Manures Application on Growth and Yield of Sweet Potatoes (*Ipomoea Batatas* L.) In Makurdi, Nigeria

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DOI: 10.5281/zenodo.14099127 **Submission Date: 20 Sept. 2024 | Published Date: 12 Nov. 2024**

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Abstract

The study was carried out at the Joseph Sarwuan Tarka University teaching and research farm located at (Latitude 7°49N, Altitude 07°52N and Longitude 08°36E). The study objective was evaluating different vine lengths and organic fertilizer types on the growth and yield attributes of sweet potato (Ipomoea batatas L) in Makurdi, Benue State. The experiment was 4 x 3 factorial treatment combinations laid out in a Randomized Complete Block Design (RCBD) replicated thrice. The treatments were sweet potato vines cut at different vine lengths of 20cm, 25cm, 30cm and 40cm and three organic fertilizer types of cow dung, poultry manure and goat manures at the rate of 5 t/ha and control. Data collected was subjected to Analysis of Variance (ANOVA) using GENSTAT statistical software version 17. The study results revealed significant variations among the vine length and organic fertilizer types. The vine length of 40cm had higher number of leaves (140.23), number of branches (5.87), vine length (110.12), leaf area (86.89), tuber weight (237.21), tuber number per plant (4.67), tuber diameter (21.32) and yield (12.56) and application of poultry manure showed superior performance on all the parameters evaluated as compared to other organic manure types and the control. From the result obtained it can be concluded that sweet potato should be planted with a 40cm vine length and the application of poultry manure at 5t/ha for optimum sweet potato yield in Makurdi, Benue State.

***Keywords*:** *vine length, organic manures, growth, yield and sweet potatoes.*

1.0 INTRODUCTION

Sweet potato (*Ipomea batatas*) is one of the most important root and tuber crop and is the 6th most important crop in the world. In 2019, Nigeria was the third highest producer of the crop in the world, producing over four million tonnes (FAOSTAT, 2021). Sweet potato is the most widely grown in different part of the world and an important food crop in tropical and sub-tropical regions of the world, particularly in Asia and Africa (Udeorah, 2021).

It is an important root and tuber crop in Nigeria whose storage roots are used for both animals and human beings and as a source of income. The crop occupies a vital place in the diet regime of people in Nigeria (Owolade *et al.*, 2018). Among the staple food crops yam, cassava and cocoyam, sweet potato is the only crop that contains enough beta-carotene, a precursor for pro-vitamin A (Ilodibia, 2021). The carbohydrate rich root is used as subsidiary food after boiling or baking. In some countries the vine tops are used as vegetables.

Vines form an excellent source of green fodder for cattle. The crop is efficient in the production of carbohydrates, proteins, vitamins and cash income per unit area of land and time (Magagula *et al.*, 2010). The propagation is through vine cutting and thus is the quickest and easiest way to grow piece of runner about 4-6 nodes that is 30cm length (Nwaigwe *et al.*, 2011; Egbe *et al.*, 2012; Idoko *et al.*, 2017). Root number and yield were associated to vine lengths. According to IITA (2011) the use of vine cutting, as a planting material gives a higher multiplication rate than the traditional system. Growth and yield of sweet potato is affected by length of vine. Most farmers plant the crop using the vine cuttings irrespective of the number of nodes and part of vine cutting. One of the essential factors that determine the growth and yield of sweet potato is the availability of nutrients from the soil. To enhance soil fertility and nutrient availability, farmers often use different types of organic manure as a fertilizer. Organic manure provides a diverse range of nutrients and organic matter to the soil, which enhances soil health and promotes soil microorganisms' activity. Organic manure also increases the soil's water-holding capacity, enhances soil structure, and reduces soil erosion. Cattle dung, poultry manure, and goat manure are prevalent types of organic manure that can be used to boost the growth and

yields of sweet potato. Cow dung is a common and widely used organic fertilizer in many regions of the world. Yang *et al.* (2020) reported positive effects of cattle dung on sweet potato growth and yields. Poultry manures are another type of manure that is commonly used for sweet potato cultivation because of its richness in nitrogen, phosphorus, and potassium, which are important nutrients required for plant growth and development. Goat manure is a valuable source of organic fertilizer mainly used for vegetable crops in many parts of the world. Goat manure is rich in organic matter, nitrogen, phosphorus, and potassium, which are essential nutrients for plant growth and development. Sharaunga *et al.* (2019) recorded that the use of goat manure can significantly improve sweet potato yields. The study reported that sweet potato yields increased by up to 64% with the application of goat manure. Goat manure enhanced soil fertility, nutrient availability, and soil moisture retention, which resulted in increased sweet potato growth and yields. Despite its growing importance and the tremendous potentials as food, animal feed, and source of raw material, sweet potato is still not widely cultivated. The use of animal waste as a fertilizer has the potential to improve the yield and nutritional quality of sweet potato and could offer a sustainable alternative to synthetic fertilizers. Therefore, the study evaluated the effect of different vine lengths and organic fertilizer types on the growth and yield attributes of sweet potato (Ipomoea batatas L) in Makurdi, Benue State.

2.0 MATERIALS AND METHODS

2.1 Experimental Location

A field experiment was carried out during the growing Season of the year 2023 at the Teaching and Research Farm of the Joseph Sarwuan Tarka University, Makurdi (Latitude 07° 40”-70° 50” N, Longitude 08° 45”-08° 50” Elevation 98m) in Benue state located at the southern Guinea savanna of Nigeria.

2.2 Experimental Treatment and Design

The experiment was 4 x 3 factorial treatment combinations laid out in a Randomized Complete Block Design (RCBD) replicated thrice. The treatments were sweet potato vines cut at different vine lengths of 20cm, 25cm, 30cm and 40cm and three organic fertilizer types of cow dung, poultry manure and goat manures at the rate of 5 t/ha and control.

2.3 Source of Planting Materials

Sweet Potatoes vine and different Organic manures was collected from the Teaching and Research Farm of the Joseph Sarwuan Tarka University, Makurdi. The manures (Cow dung, Poultry and Goat) were incorporated and mix thoroughly with the top soil of the heaps per plot one week before planting. The sweet potato vines were cut into different lengths of 20cm, 30cm and 40cm. A spacing of 0.3m x 1m was used for the intra row and inter row spacing respective

2.4 Weeding

Manual hand weeding with hoes method was done at three (3), six (6) and nine (9) weeks after planting (WAP).

2.5 Data Collection

The following growth data was collected; Number of Leaves, Number of Branches, Vine length and Leaf Area at 2, 4, 6, 8, 10 and 12 weeks after planting (WAP). The yield data collected at harvest included, Number of Roots, Root Diameter (cm^2), Root Length (cm) and Root Weight (t/ha)

2.6 Data Analysis

All data collected from the study were subjected to Analysis of variance (ANOVA) using GENSTAT statistical package and treatments means were separated using Fishers Least Significant Difference (F-LSD) at 5% level of probability.

3.0 RESULTS AND DISCUSSION

Results in table 1 indicated that vine length significantly increased with increased in vine lengths and the application of different organic nutrients. Notably, vines treated with poultry manure exhibited the greatest growth, achieving a maximum length of 114.01 cm by week 12, compared to control treatments which only reached 20.11 cm. Differences in the genetic, morphological, and biochemical traits that influence the biomass accumulation among various vegetative parts vine length may be the cause of the notable differences between the different vine length used in terms of plant height Uddin (2009). The results highlight the importance of nutrient management in enhancing potato vine development, suggesting that organic amendments, particularly poultry manure, could optimize yield potential in similar agro-ecological zones. These findings contribute to the understanding of best practices for potato cultivation in Nigeria, potentially improving agricultural productivity and sustainability.

Table 1: Effect of different vine length and inorganic nutrients on vine length of potato grown in Makurdi, Nigeria

	Vine Length (cm)					
Vine length (V)	**2**	**4**	**6**	**8**	**10**	**12 WAP**
20	28.22	32.12	48.23	60.23	82.22	95.23
25	27.34	30.12	42.23	59.12	73.21	91.23
30	40.89	50.22	63.32	72.12	97.21	101.56
40	48.12	54.22	65.23	79.23	100.12	110.12
F-LSD (0.05)	2.02	2.21	2.89	2.98	3.00	2.12
Nutrient (N)						
Poultry	46.23	50.23	62.31	88.23	92.23	114.01
Goat manure	38.22	43.33	56.23	73.21	86.23	103.12
Cow dung	35.23	40.23	51.12	70.67	81.34	100.12
Control	5.00	7.23	12.22	16.22	18.11	20.11
F-LSD (0.05)	1.98	2.11	2.45	2.56	2.14	2.32
Interaction						
VXN	NS	NS	NS	NS	NS	NS

F-LSD = Fishers' Least Significant Differences at 5% Level of Probability

On the number of branches, table 2 showed that the application of organic nutrients significantly enhances branch development. Among the treatments, poultry manure resulted in the highest average number of branches, with a maximum of 7.63 branches recorded by week 12, compared to the control group's maximum of 5.14 branches. The findings indicate that while vine length had some impact on branching, the type of nutrient applied was a more critical factor for promoting branch formation. Tanaka and Sekioka (2011) have highlighted the importance of this specific vine length range. Vines lengths of 40cm have been associated with higher yields and multiplication rates compared to vines that are either shorter or longer. Notably, no significant interaction effects between vine length and nutrient type were observed. These results underscore the potential of organic fertilizers, particularly poultry manure, in optimizing branch growth in potato cultivation, contributing to improved crop management practices in Nigeria's agricultural sector.

Table 2: Effect of different vine length and inorganic nutrients on Number of Branches of potato grown in Makurdi, Nigeria

	Number of Branches					
Vine length (V)	**2**	**4**	**6**	**8**	**10**	**12 WAP**
20	1.12	2.23	3.78	4.22	5.27	5.12
25	1.11	2.00	3.56	4.30	5.54	6.11
30	1.22	2.32	3.12	5.21	5.86	6.22
40	1.00	2.45	3.00	5.86	6.87	7.00
F-LSD (0.05)	0.01	0.03	0.08	0.03	0.12	0.31
Nutrient (N)						
Poultry	1.63	2.81	3.73	5.13	6.41	7.63
Goat manure	1.35	2.23	3.61	4.83	5.87	6.75
Cow dung	1.23	2.13	3.32	4.46	5.23	6.13
Control	1.14	2.00	2.42	3.34	4.54	5.14
F-LSD (0.05)	0.04	0.06	0.08	0.10	0.12	0.24
Interaction						
VXN	NS	NS	NS	NS	NS	NS

LSD = Fishers' Least Significant Differences at 5% Level of Probability

Table 3 indicates that both vine length and the type of nutrient significantly influence leaf development. Notably, potato plants applied with poultry manure produced the highest leaf number, reaching an impressive 144.01 leaves by week 12, compared to the control plot with 110.11 leaves. Vine length also played a role in leaf production, with the 40 cm vine length consistently yielding higher leaf number than other vine lengths. This aligns with the consensus among different studies and organizations, such as the FAO (2010) and IITA (2011) which reinforces the idea that a vine length of 40cm is the most efficient and economically viable choice for sweet potato propagation. It ensures better root development, higher marketable yields. The significance of higher response to the application of poultry manure in number of leaves is

often depending nutrient source and on climatic conditions, soil fertility and its nutrients which are critical determinants of plant growth. This finding is supported by the work of Tetteh *et al.*, (2021) who found that sweet potatoes growth was significantly impacted by soil nutrients and texture. However, no significant interaction between vine length and nutrient type was observed. These findings highlight the critical role of organic fertilizers, especially poultry manure, in enhancing leaf development, which may lead to improved overall potato yield.

Table 3: Effect of different vine length and inorganic nutrients on Number of Leaves of potato grown in Makurdi, Nigeria

	Number of Leaves					
Vine length (V)	**2**	**4**	**6**	**8**	**10**	**12 WAP**
20	8.22	12.12	38.23	67.23	80.22	115.23
25	8.12	11.12	32.12	58.12	91.23	127.12
30	6.89	10.22	34.32	72.12	87.21	131.56
40	10.21	14.12	41.12	81.01	98.12	140.23
F-LSD (0.05)	0.02	1.01	2.09	8.88	5.10	10.12
Nutrient (N)						
Poultry	10.23	14.23	42.31	88.23	102.23	144.01
Goat manure	9.22	12.33	36.23	73.21	96.23	137.12
Cow dung	8.12	11.32	32.43	70.54	90.12	125.22
Control	7.00	9.23	29.22	68.22	82.11	110.11
F-LSD (0.05)	1.08	1.01	2.85	2.50	3.64	10.32
Interaction						
VXN	NS	NS	NS	NS	NS	NS

LSD= Least Significant Differences at 5% Level of Probability

Results presented in table 4 shows that longer vine length of 40cm significantly had higher yield (12.56t/ha) when compared with other spacing as the shorter vine length 20cm recording lower yield and other parameters measured. On nutrient sources, it was evident nutrient application significantly enhances all measured parameters. Potatoes applied with poultry manure exhibited a maximum yield of 13.01 t/ha and other parameters evaluated as compared to other nutrient sources. This was as a result of abundant source of organic matter and nutrients, including nitrogen, phosphorus and potassium. This is in agreement to the findings of Kumar *et al.*, (2020) and Madina *et al.* (2024a and 2024b) and Iyough *et al.* (2024) who found that the application of poultry manure significantly increased soil organic matter, total nitrogen, and available phosphorus levels. Furthermore, Madina *et al.* (2022) and Nazifi *et al.* (2023) affirmed that poultry manure has ability to release its nutrient faster than other nutrient source leading to increase on vegetative stage of plant and overall yield.

Table 4: Effect of different vine length and inorganic nutrients on leaf area and yield attributes of potato grown in Makurdi, Nigeria

			Yield Parameters			
Vine length (V)	**Leaf area (cm^2)**	**Tuber Length (cm)**	**Tuber Diameter (cm^2)**	**Number of Tuber/ plant**	**Tuber weight (g)**	**Yield (t/ha)**
20	72.22	25.14	18.23	3.23	212.32	9.23
25	60.12	24.79	29.65	3.00	218.42	10.03
30	61.21	21.27	20.22	4.23	220.52	8.12
40	86.89	23.25	21.32	4.67	237.21	12.56
F-LSD (0.05)	1.02	1.41	1.29	0.18	3.00	3.12
Nutrient (N)						
Poultry	86.23	25.24	22.31	4.23	252.23	13.01
Goat manure	74.22	23.35	20.23	3.71	236.23	12.12
Cow dung	71.43	21.16	19.12	3.00	227.10	10.23
Control	68.00	20.28	18.22	2.82	218.11	7.11
F-LSD (0.05)	1.99	1.11	2.45	0.10	10..24	3.42
Interaction						
VXN	NS	NS	NS	*	*	*

LSD= Least Significant Differences at 5% Level of Probability, * = 95% level of probability

Table 5 shows significance on the interaction effect between vine length and nutrient sources showed significant effects on tuber number and weight. Specifically, potato plants at a vine length of 30 cm treated with poultry manure produced the highest average number of tubers (4.21), maximum tuber weight (247.75 g), and overall yield (12.52 t/ha). In contrast, shorter vine lengths, particularly at 20 cm, consistently resulted in lower yields across all nutrient treatments. The findings highlight the effectiveness of poultry manure in enhancing tuber production and weight, while goat manure also demonstrated notable improvements compared to cow dung and control treatments. this is true where organic manure especially chicken manure interaction with 40cm vine length. Earlier researchers like Uddin *et al.* (2009), Draghici *et al.* (2015), and Chowdhury and Rahman (2021) have reported comparable study findings indicating that plants fed with poultry manure and lengthier vine cutting exhibited the highest growth metrics and marketable yield. This research underscores the importance of integrating optimal vine length with appropriate nutrient sources to maximize potato yield, providing valuable insights for farmers and agricultural practitioners in Nigeria.

Table 5: Interaction Effect of Vine length x Nutrient sources on Number of tubers/plant, Tuber weight and Yield of Sweet potato grown in Makurdi, Nigeria

		Number of tubers per plant		
		Nutrient Sources (N)		
Vine length	**Poultry Manure**	**Goat manure**	**Cow dung**	**Control**
20	3.23	3.12	2.96	2.20
25	3.30	3.68	2.86	2.00
30	4.21	3.94	3.68	2.87
40	3.56	3.00	3.00	2.12
F-LSD (0.05)	0.17	0.11	0.21	0.03
		Tuber Weight		
20	210.93	217.13	210.81	220.23
25	233.52	222.12	220.10	198.89
30	247.75	234.42	224.13	218.12
40	223.01	212.23	220.12	210.12
F-LSD (0.05)	10.02	2.13	3.19	2.98
		Yield (t/ha)		
20	8.96	8.02	7.21	7.01
25	10.01	10.00	9.92	9.00
30	12.52	11.75	10.60	9.61
40	9.56	9.20	8.76	8.00
F-LSD (0.05)	1.21	1.16	1.03	1.00

F-LSD = Fishers' Least Significant Differences at 5% Level of Probability

4.0 CONCLUSION

In conclusion, the study investigated the effect of different planting vine lengths and application of different types of organic manures on various growth parameters and yield attributes of sweet potatoes. Significant difference was observed on both vine length and organic sources of nutrient where the use of vine length at 40cm showed superior performance in all the parameters under consideration and the use of cow dung outperforming the other nutrients sources used. The study thus recommends sweet potato vine length at 40cm and the application of poultry manure be adopted for the cultivation of sweet Potato in Makurdi, Benue State.

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CITATION

Akinyemi, B. K., Madina, P., & Iyough, D. D. (2024). Effect of Vine Length and Organic Manures Application on Growth and Yield of Sweet Potatoes (Ipomoea Batatas L.) In Makurdi, Nigeria. In Global Journal of Research in Agriculture & Life Sciences (Vol. 4, Number 6, pp. 20–25).
https://doi.org/10.5281/zenodo.14099127