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GROWTH AND TUBER YIELD IMPROVEMENT OF SWEET POTATO CULTIVARS *(IPOMOEA BATATAS* L.*)* AS INFLUENCED BY VINE PATTERNS OF PLANTING IN TARABA STATE

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ABSTRACT: *Field experiments were conducted for two locations in (2021) at the Teaching and Research Farm of the Federal University, Wukari, and Taraba State University Teaching and Research Farm, Jalingo, to determine the growth and tuber yield attribute as influenced by vine pattern of planting, using seven varieties of sweet potato and three planting patterns. The experiment was a randomized complete block design with three replicates. Data collected were subjected to analysis of variance where significant means were separated by least significant difference (LSD) at 5% probability level. The varieties used are Donga white local (V2), Tropical Ipomoea Selection (TIS-91/198 (V1), TIS-008164 (V3), TIS-91/62 (V4), TIS-87/0087 (V5)), Donga purple local (V6) and Jalingo local (V7) and three vine patterns of planting (direct, ring and double ring planting) for 2021 cropping season. Results of the experiment show that both main effects (variety and vine planting patterns) had a significant influence on all the parameters measured vis: length of primary vine (cm), number of secondary vine, number of leaf, number of tuber per plant, weight of tuber per plant (kg) and tuber fresh yield per hectare (ton/ha) except number of nodes which was not been significantly influenced by variety and vine planting patterns.Vine planting pattern enhanced growth and yield performance on the varieties used. The highest value in all the yield characters measured was observed in Donga white local variety at single ring. Generally, all traits except number of nodes were significantly affected by the interactive effect of variety and vine planting pattern, indicating that determining vine planting pattern for each variety by considering their vegetative growth and yield habit is very important in crop production. Further research should be repeated on variety selection and vine planting patterns under cropping season at different locations in Southern and Northern guinea savanna of Taraba State.*

KEYWORDS: Sweet potato, vine planting pattern, location of studies.

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INTRODUCTION

Sweet potato (*Ipomoea batatas (L) Lam)* is a herbaceous dicotyledonous plant; it is commonly called morning glory and it is the only member of the genus *Ipomoea* whose roots are edible. It is widely grown in tropical, subtropical and warm temperate regions of the world. Sweet potato is an important root crop serving as food, feed and raw material globally (Chiona, 2009; Wang *et al*., 2011).

Despite its importance as a food crop, the production of sweet potato in Northern and Southern Guinea Regions of Nigeria and as such local producers are not able to meet the demand for this crop in the country. Although the National Root Crop Research Institute (NRCRI), Umudike, has released improved cultivars of sweet potato, it has been observed that the few Nigerian farmers who engage in small scale sweet potato cultivation in some selected areas in the country face a myriad of problems such as low soil fertility and low tuber yield per land area on which the crop is grown (Balogun *et al*., 2021). Vine cuttings are the usual method of propagating sweet potato. It is better than using sprouts from tubers (Belehu, 2003; Adeyeye *et al*., 2023).

The vine pattern of planting should also be an important point of focus because vine style of planting is a new innovation that will improve the yield of sweet potato tuber per unit land.

Availability of farm land is decreasing rapidly as a result of increase in population and land tenure systems in Nigeria. Therefore, there is a need to increase yield of crops per unit land area to solve this problem. One of the ways out is to develop new innovations such as vine pattern of planting that improves the tuber production of the plant per unit land. The ring pattern of vine planting is one of the new ways of increasing the tuber yield of sweet potato. The ring patterns of planting provide nodes of 5 to 12 instead of 2 to 3 nodes from traditional direct plant method (Adeyeye *et al*., 2024). In view of the above findings, this study will be conducted to evaluate the best cultivar with the best vine style of planting for the growth and tuber yield of sweet potato in the study area.

Hence, more research works are needed to evaluate the effects of the vine style of planting and different fertilizer sources on the growth and tuber yield of sweet potato in this environment with the following objectives.

Objectives of the Study

1. Investigate the effect of vine planting pattern on the growth and tuber yield of sweet potato (*Ipomea batatas*).

2. Study the interactive effect of variety and vine planting pattern on growth and development of sweet potato (*Ipomea batatas*).

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MATERIALS AND METHODS

Experimental Site Description: The research was conducted in Wukari and Jalingo local government during the 2021 raining season. The experiment was carried out at the Teaching and Research farm, Federal University, Wukari (Southern Guinea Savannah) and Teaching and Research Farm, Taraba State University, Jalingo (Northern Guinea Savannah). Taraba State lies between latitude 60 30, 80 30N of the equator and between longitude 90 and 120 E of the Greenwich meridian with a land mass of 54,426km^2. It shares boarders with Bauchi and Gombe States in the North, Adamawa State in the East and Cameroon Republic in the Southwest. The state has a tropical wet-dry climate, well drained alluvial soils and has both savannah and rainforest vegetations. The rainfall ranges between 1000 mm to 2500 mm per annum in the north with the driest and wettest season lasting from December to February and July to September respectively.

Experimental Materials

The planting materials consist of seven different cultivars of sweet potato vine: Local cultivars which were purchased from local market in Jalingo and improved cultivars which were collected from National Root Crop Research Institute (NRCRI) Umudike. The sweet potato cultivars used for the experiment were: Cultivar TIS 91/198, a white tuber flesh with light purple skin color of sweet potato and low sugar content, which have a yield of over 20.6 t/ha, that matured in 120 days; Cultivar TIS 91/62, a light orange skin with deep reddish flesh tuber that also matured in 120 days after planting with over 19.3 t/ha in tuber yield; and Cultivar TIS 87/0087 and Cultivar TIS 8164 which also have low sugar content, purple leaves with white flesh tubers and which both matured in 128 days. The four cultivars are developed by the National Root Crop Research Institute (NRCRI), Umudike. The local cultivars were white skin cultivar with white flesh tuber (Donga white local cultivar), yellow tuber cultivar (Donga purple) and red skin cultivar with white flesh tuber (Jalingo local).

Experimental Design and Treatments

Field Experiment was laid out in a 3 x 7 factorial, arranged in randomized complete block design (RCBD) with three replications. The treatments consisted of three different local cultivars (White color fresh cultivar, Red skin leaf cultivar, and Light-yellow tuber cultivar) with four improved cultivars (TIS 91/198, TIS 91/62, TIS 87/0087 and TIS 08164*)* and three different vine patterns of planting (Direct Planting, Single Ring Planting and Double Ring Planting). The size of each plot was 4 m x 3 m = 12 m^2. There was a 1 m pathway between plots and 2 m between replications. The total land area for the experiment was 36 m x 39 m = 1404 m$^{2.}$ There was a total of 756 heaps.

Cultural Practices

Vine cuttings from topmost apical sections and other actively growing sections were used for planting. All open leaves were detached from mature vines; the removal of leaves was done to reduce transpiration and ensure good vine establishment. The 3 patterns of vine planting were direct planting, where two-thirds of each erect vine planting pattern (with 2-3 nodes) was buried into the soil at an angle, leaving one-third above the soil. The ring vine pattern of planting, i.e., a ring shape of vine with 5-7 nodes was planted into the soil and the two ring shape vine patterns with 10-12 nodes were planted in the soil at one vine per heap/stand at a spacing of 1 m x 1 m. Each experimental plot contained twelve (12) heaps with twelve (12) plant stands within each

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plot area. The plot size was 4 m x 3 m which lay with heaps, each measuring about 50 cm high. The heaps were manually constructed with a hoe. Sweet potato vine cutting was planted on the heap of 1 m x 1 m, which was 12 heaps per plot.

Weeds were controlled in both field experiments at 3 weeks after planting and when necessary using cutlass and hand hoeing methods before close of the canopy and to reduce competition with crops. Subsequent weed control was by hand pulling and reshaping of heaps or beds. The plants were allowed to grow and develop till maturity.

DATA COLLECTION

Growth Parameters

Five plants from each net plot were randomly selected and tagged for collection of data during crop growth. Measurement of some growth parameters was made at three weeks intervals. Destructive samplings were carried out from the discard.

Length of the Primary Vine (cm)

Length of primary vine was determined by measuring the length from the base directly above the ground to the terminal bud of the tagged plants using measuring tape. The primary vine lengths were added and divided by three for the average. This was determined at 3, 6, 9 and 12 weeks after planting (WAP).

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. This was determined at 3, 6, 9 and 12 WAP.

Number of Leaves per Plant^{-I}

Numbers of leaves per plant were determined by counting the number of green leaves on each of the tagged plants. The total number of five plants leaves were added and divided by five for the average. This was determined at 3, 6, 9 and 12 WAP.

Number of Secondary Vines per Plant

Number of secondary vines per plant was determined by counting the number of secondary branches on tagged plants. The total of five plants was divided by five for the average. This was determined at 3, 6, 9 and 12 WAP.

Number of Nodes per Plant

Numbers of nodes per plant was determined by counting the number of nodes on tagged plants. The total of five plants was divided by five for the average. This was determined at 3, 6, 9 and 12 WAP.

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Number of Tubers per Plant

The number of mature tubers was counted from five randomly tagged plants in each of the plots and the mean values were recorded.

Weight of Tubers per Plant (kg)

Each of the five tagged plants tubers per plot was weighed using the weighing scale and the average values were recorded.

Weight of Tubers per Hectare (t ha^{-1})

All the tubers from each net plot were harvested and weighed using Mettler Toledo SB16001 electronic digital weighing scale. The total weight was then converted to tons per hectare and recorded.

DATA ANALYSIS

Statistical Analysis of Data

The Data collected were subjected to analysis of variance (ANOVA) appropriate for randomized complete block design, where significant means were separated by least significant difference (LSD) at 5% probability level.

RESULTS

The Influence of Vine Planting Pattern on the Length of Primary Vine (cm)

The analysis of variance for vine planting pattern on sweet potato cultivars 2020/2021 cropping season on length of primary vine is presented in Tables 1a and b.

Cultivars significantly ($p<0.05$) influenced primary vine at 12 weeks after planting. C2 (82.00) had significantly higher length than all other cultivars, followed by C1 (76.50), followed by cultivars 3 and 5 which both had 75.40 and 75.90 respectively, while C6 had the least primary vine at all sampling periods. At 3 to 9 weeks, C5 had significantly ($p<0.05$) higher length than C1, C2, C3, C4, C6 and C7. But at 12 weeks, C2 had the highest length of primary vine. Vine planting patterns did not really significantly ($p<0.05$) influence the primary vine at 6 and 9 weeks except at 3 and 12 weeks after planting, which shows that there was a highly significant difference between the vine planting patterns. VPP1 significantly showed the highest length of primary vine (70.00) followed by VPP3 which had (63.10). The least primary vine was in VPP2 (62.60). The highest length of primary vine was obtained at VPP1 in C2 (82.00).

There exists significant ($p<0.05$) interaction points. The highest length of primary vine (LPV) was obtained for VPP1 and VPP3 at 6, 9 and 12 weeks after planting. VPP1 and VPP3 were at C2, C1 and C5. The highest length of primary vine was obtained for cultivar 2 (82.00) at VPP1 followed by cultivar 5 at VPP3. The least primary vine was at cultivar 6 VPP2 (62.60). The highest primary vine was obtained at C2 in planting pattern 1 (82.00). This was more significant than the length of primary vine obtained in all planting patterns at all sampling points.

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The Influence of Vine Planting Pattern on the Number of Secondary Vines

The analysis of variance for vine planting pattern on sweet potato cultivars 2020/2021 cropping season on number of secondary vines is presented in Tables 2a and b below. Cultivars ($p<0.05$) did not significantly influence the number of secondary vines at all weeks after planting, except at 9 weeks. C1 (6.04) had a significantly higher number of secondary vines than all other cultivars, followed by C2 (3.55), while C6 had the least number of secondary vines at 3 and 9 weeks. At 6 and 12 weeks, C3 and C7 had the least at all sampling periods. At 3 and 12 weeks, C1 had a higher number of secondary vines than C2, C3, C4, C5, C6 and C7. But at 6 and 9 weeks, C2 had the highest number of secondary vines. Vine planting pattern did not significantly ($p<0.05$) influence the secondary vine at 3 and 9 weeks except at 6 and 12 weeks after planting, which shows that there was significant difference between the vine planting patterns. VPP1 significantly showed the highest number of secondary vines at 6 and 12 weeks (2.65 and 9.15) respectively, followed by VPP2 at 12 weeks, which had (6.81). The least number of primary vines was in VPP (6.05). The highest number of secondary vines was obtained at VPP1 in C1 (8.99).

The least number of secondary vines was at C3 and C7 in VPP3 (6.66 and 6.66) respectively. The highest number of secondary vines was obtained at C1 in planting pattern 1 (9.15). This was significantly more than the number of secondary vines obtained in all planting patterns at all sampling points.

The Influence of Vine Planting Pattern on the Number of Nodes

The analysis of variance for vine planting pattern on sweet potato cultivars for 2020/2021 cropping season on number of nodes is presented in Tables 3a and b below. Cultivars did not significantly ($p<0.05$) influence number of nodes at 3 weeks after planting, but at 6 and 12 weeks, C2 (47.90 and 70.40) had a significantly higher number of nodes than all other cultivars, followed by C1 (63.50) and C5 (60.80), whereas C5 significantly had the highest number of nodes at 9 weeks (64.00), while C6 had the least number of nodes at 9 and 12 weeks. At 3 and 6 weeks, C3 had the least numbers (20.50 and 25.00 respectively) at all sampling periods. At 6 and 12 weeks, C2 had higher nodes than C1, C3, C4, C5, C6 and C7. Vine planting pattern did not significantly ($p<0.05$) influence the number of nodes at 3 but at 6, 9 and 12 weeks after planting, it showed that there was a significant difference between the vine planting patterns. VPP1 significantly showed the highest number of nodes at 6, 9 and 12 weeks (51.30, 65.30 and 70.10) respectively, followed by VPP3 at 6, 9 and 12 weeks (33.30, 49.50 and 50.70) respectively. The least node was in VPP2 (24.60, 39.30 and 44.10). The highest number of nodes was obtained at VPP1 in C2 (70.40). This was significantly more than the number of nodes obtained in all planting patterns at all sampling points.

The Influence of Vine Planting Pattern on the Canopy Formation of Sweet Potato Cultivar

The analysis of variance for vine planting pattern on sweet potato cultivars 2020/2021 cropping season on canopy formation is presented in Tables 4a & b below. Cultivars did not significantly ($p<0.05$) influence canopy formation at 3 weeks after planting, but at 6 and 9 weeks, C2 (19.83 and 31.20) had a significantly higher canopy formation than all other cultivars, followed by C1 (18.77 and 28.60) and C3 (16.01 and 27.50), whereas C2 significantly had the highest canopy formation at 12 weeks (37.60), while C6 had the least canopy formation at 6 and 9 weeks (13.99

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and 20.90). At 12 weeks, C5 had the least canopy formation (28.90) at all sampling periods. At 6 and 9 weeks, C2 had a higher canopy formation than C1, C3, C4, C5, C6 and C7.

Vine planting patterns did not significantly ($p<0.05$) influence canopy formation at 3 and 6 weeks but at 9 and 12 weeks after planting, it showed that there was a significant difference between the vine planting patterns. VPP1 significantly showed the highest canopy formation at 9 and 12 weeks (27.20 and 52.30) respectively, followed by VPP3 at 9 and 12 weeks (28.30 and 35.50) respectively. The least canopy formation was in VPP2 (23.90 and 43.70). The highest canopy formation was obtained at VPP1 in C1 (151.00).

The Influence of Vine Planting Pattern on Tuber Yield and Its Components of Sweet Potato Cultivar

The analysis of variance for vine planting pattern on sweet potato cultivars 2021 cropping season on number of tubers per plant, weight of tuber per plant and ton per hectare, is presented in Tables 5a & b below.

Cultivars significantly ($p<0.05$) influenced the number of tubers per plant, weight of tuber per plant and ton per hectare. C2 (3.77, 2.70 and 1.79 respectively) had a significantly higher number of tubers, weight of tubers and ton per hectare than all other cultivars, followed by C3 (3.51, 2.52 and 1.58) and C5 (2.52, 2.53 and 1.59), whereas C2 significantly had the highest tuber yield performance, while C6 had the least tuber yield performance (2.36, 1.44 and 1.15) respectively at all sampling periods. C2 had a higher tuber yield performance than C1, C3, C4, C5, C6 and C7.

Vine planting patterns did not significantly ($p<0.05$) influence tuber yield performance except at VPP1, which showed that there was a significant difference between the vine planting patterns. VPP1 significantly showed the highest tuber performance (3.20, 0.49 and 1.65) respectively, followed by VPP3 (2.58, 0.49 and 1.39 respectively). The least tuber yield performance was in VPP2 (2.43, 0.48 and 1.37).

The highest tuber yield performance was obtained at VPP1 in C2 (8.70). This was significantly more than the tuber yield performance obtained in all planting patterns at all sampling points, followed by VPPI at C3 (6.80). The least tuber yield performance was in VPP3 at C4 (1.90).

The response of sweet potato to different methods of vine planting showed that the single ring planting method gave the best performance in all the growth parameters taken while the direct planting method recorded the lowest. This may be due to the ability of the ring vine planting method that provides 5-8 nodes, buried into the soil that resulted in increased number of leaves, nodes and length of primary vine. This generally improved the growth parameters of sweet potato. This is the new innovation that should be adopted by farmers for better yield. This is in conformity with Ignatius (2018) and Adeyeye *et al*. (2023) who reported the same trend that direct vine planting method of sweet potato is a traditional practice which needs to be transformed to a more and highly profitable ring vine planting method for optimum production of the crop; the single ring vine method produced a higher number of leaves which may translate to higher photosynthesis activities and also high tuber yield. This is also in line with the work of Enyi (2004) who reported that the methods of vine planting followed that increasing branch production resulted in the production of more leaves, thus enhancing the photosynthetic activities of the plant.

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The number of leaves produced by the ring planting method was high, shading the soil surface from sunshine thereby reducing the rate of weed growth within the sweet potato plots, hence saving the farmer some cost of weeding. This may be attributed to the new innovation pattern of planting. This is in conformity with the finding of the following workers: Moyo et al. (2004), Ignetus (2018), Adeyeye *et al*. (2023).

The single ring planting method also had the highest yield performance when compared to the direct vine planting method for both locations in the study. This may be due to more production of tubers arising from more points (nodes or eyes) of the sweet potato vine. This agrees with Ignetus (2018) and Adeyeye *et al*. (2023) who made similar observations on the yield of the crop and indicated that the yield components of the tuber are significantly higher in plants that were treated with the ring method of planting. This may be due to production of more tubers arising from more growing points (eyes) of the potato vine.

Furthermore, the yield performance in variety with planting methods showed that Donga local with ring method (Donga x Single ring method) had a higher yield performance compared to other varieties and planting methods used in the study. This could be attributed to varietal genotypic makeup and the new innovation of vine planting pattern (single rings method). These differences in tuber yield could also be attributed to genetic variations among different varietal make-ups in partitioning photosynthates. This result is in line with the finding of Ejim (2022) and Adeyeye *et al*. (2024) who reported that the response of sweet potato to the method of planting depends on the variety used because the ring method of planting produced a large amount of foliage (leaves), which gave the plant a good canopy spread at the early growth stages, thereby producing a higher number of tubers than those growing using the direct planting method.

Table 1a: The influence of vine planting pattern on the length of primary vine (cm) of sweet potato cultivar at all sampling stages 2021 cropping season

Treatment	WEEKS AFTER PLANTING			
	3WAP	6WAP	9WAP	12WAP
Cultivar				
CV1	25.80b	41.10ab	61.60b	76.50ab
CV2	27.50b	46.60b	63.40b	82.00b
CV3	22.60ab	39.60ab	54.10ab	75.40ab
CV4	17.80ab	34.60ab	54.70ab	52.50a
CV5	27.70b	47.20b	64.20b	75.90ab
CV6	11.00a	21.20a	39.10a	53.50a
CV7	15.00a	29.80a	44.00a	40.80a
$LSD_{(0.05)}$	11.654	20.435	18.422	25.786
Vine planting pattern				
VPP1	22.60 a	40.90a	57.90a	70.00a
VPP2	19.80 a	34.10b	50.30b	62.60b
VPP3	23.80 a	37.50a	55.00ab	63.10b
$LSD_{(0.05)}$				

Mean with the same letter are not significantly different. Jalingo Data.

KEY:

VPP1 = Vine Planting Pattern One Ring (Single Ring)

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VPP2 = Vine Planting Pattern Two Ring (Double Ring)
VPP3 = Vine Planting Pattern Erect (Direct Planting)
C1 = Cultivar One (Donga white local)
C2 = Cultivar Two (TIS 91/198)
C3 = Cultivar Three (TIS 008164)
C4 = Cultivar Four (TIS 91/62)
C5 = Cultivar Five (TIS 87/0087)
C6 = Cultivar Six (Purple local (red skin with white flesh tuber))
C7 = Cultivar Seven (Jalingo local (yellow skin)).

TABLE 1b: The influence of vine planting pattern and cultivar interaction on length primary vine (LPV)

Planting pattern /cultivar	C1	C2	C3	C4	C5	C6	C7
					3WAP		
VPP1	41.50b	42.10b	28.30ab	34.90ab	36.20ab	20.40a	30.30ab
VPP2	36.11b	36.90b	29.45ab	36.55b	32.99ab	21.10a	26.66ab
VPP3	38.87b	39.22b	24.89a	34.18ab	38.18b	20.11a	24.33a
					6WAP		
VPP1	111.59b	108.70b	60.87a	88.32ab	108.27b	51.69a	82.12ab
VPP2	73.59b	67.70ab	51.87a	61.32ab	71.27b	40.69a	62.12ab
VPP3	98.60b	89.67b	67.33a	70.50ab	88.17b	57.07a	70.89ab
					9WAP		
VPP1	196.00b	182.00ab	116.87a	132.67a	189.17b	124.33a	162.67ab
VPP2	185.00b	173.83ab	124.70a	140.00ab	162.23ab	120.32a	133.45a
VPP3	194.10b	180.67b	132.89a	149.33a	166.77ab	131.00a	157.56ab
					12WAP		
VPP1	279.00b	277.50b	148.00a	188.67ab	272.45b	140.89a	243.20ab
VPP2	215.67b	207.67b	166.33ab	149.65a	243.00b	157.55a	196.45ab
VPP3	272.33b	254.17b	172.12a	157.33a	254.33b	151.60a	245.00ab

Mean with the same letter are not significantly different.

KEY:

VPP1 = Vine Planting Pattern One Ring (Single Ring)
VPP2 = Vine Planting Pattern Two Ring (Double Ring)
VPP3 = Vine Planting Pattern Erect (Direct Planting)
C1 = Cultivar One (Donga white local)
C2 = Cultivar Two (TIS 91/198)
C3 = Cultivar Three (TIS 008164)
C4 = Cultivar Four (TIS 91/62)
C5 = Cultivar Five (TIS 87/0087)
C6 = Cultivar Six (Purple local (red skin with white flesh tuber))
C7 = Cultivar Seven (Jalingo local (yellow skin)).

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Table 2a: The influence of vine planting pattern on the number of secondary vines of sweet potato cultivar

Treatment	WEEKS AFTER PLANTING			
	3WAP	6WAP	9WAP	12WAP
Cultivar				
CV1	1.09	1.66	2.06	8.99
CV2	0.93	1.99	2.50	7.21
CV3	0.73	1.43	2.33	6.66
CV4	0.97	1.54	2.11	6.88
CV5	0.60	1.64	2.19	8.10
CV6	0.72	1.41	1.79	6.88
CV7	0.73	1.34	1.97	6.66
$LSD_{(0.05)}$	ns	0.342	0.9112	2.012
Vine planting pattern				
VSP1	0.97	1.67	2.45	9.15
VSP2	0.68	1.34	1.96	6.81
VSP3	0.82	1.77	1.99	6.05
$LSD_{(0.05)}$				

Mean with the same letter are not significantly different.

KEY:

VPP1 = Vine Planting Pattern One Ring (Single Ring)
VPP2 = Vine Planting Pattern Two Ring (Double Ring)
VPP3 = Vine Planting Pattern Erect (Direct Planting)
C1 = Cultivar One (Donga white local)
C2 = Cultivar Two (TIS 91/198)
C3 = Cultivar Three (TIS 008164)
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TABLE 2b: The influence of vine planting pattern and cultivar interaction on number of secondary vine (NSV)

Planting pattern /cultivar	C1	C2	C3	C4	C5	C6	C7
				3WAP			
VPP1	2.50a	3.10a	2.30a	3.10a	3.20a	2.40a	3.30a
VPP2	2.11a	2.90a	2.45a	2.55a	3.29a	2.10a	2.66a
VPP3	2.87a	3.22a	3.19a	2.68a	3.18a	1.81a	2.93a
				6WAP			
VPP1	6.03b	5.07b	3.11a	3.32a	4.27a	3.99a	4.22a
VPP2	4.05a	3.70a	3.13a	3.51a	3.72a	4.89a	3.92a
VPP3	4.60a	3.67a	3.18a	3.50a	4.17a	5.00a	4.19a
				9WAP			
VPP1	17.00a	22.00b	16.87ab	13.67a	18.11a	24.32b	16.67b
VPP2	24.00b	18.83a	24.70b	14.00a	16.83a	20.32ab	13.45a
VPP3	17.10a	18.67a	13.89a	14.33a	16.77a	13.00a	15.56ab
				12WAP			
VPP1	22.20a	27.50b	19.00a	18.67ab	27.45b	26.19b	24.20ab
VPP2	25.17b	20.67a	24.33b	19.65b	23.00a	21.55ab	19.45a
VPP3	22.33a	24.17ab	17.72a	15.33a	21.33a	15.60a	23.00ab

Mean with the same letter are not significantly different.

Table 3a: The influence of vine planting pattern on the number of nodes per plant of sweet potato cultivar

Treatment	WEEKS AFTER PLANTING			
	3WAP	6WAP	9WAP	12WAP
Cultivar				
CV1	13.32a	41.20ab	60.00ab	63.50ab
CV2	13.72a	47.90b	60.90ab	70.40b
CV3	10.59a	25.00a	43.90ab	43.30a
CV4	10.12a	35.80ab	41.80ab	53.80ab
CV5	14.61a	46.30b	64.00b	60.80ab
CV6	9.46a	24.00a	39.90a	40.10a
CV7	10.58a	34.70a	49.40ab	52.80ab
$LSD_{(0.05)}$	5.854	20.767	20.311	24.022
Vine planting pattern				
VSP1	11.55	51.30	65.30	70.10

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VSP2	11.23	24.60	39.30	44.10
VSP3	12.54	33.30	49.50	50.70
$LSD_{(0.05)}$	2.087	13.630	16.160	12.870

TABLE 3b: The influence of vine planting pattern and cultivar interaction on number of nodes (NN)

Planting pattern /cultivar	C1	C2	C3	C4	C5	C6	C7
					3WAP		
VPP1	8.70a	10.30ab	8.60a	10.10ab	12.20b	12.40b	13.00b
VPP2	8.19a	12.10b	9.15a	09.15a	11.59b	12.10b	11.66b
VPP3	10.11ab	9.42a	9.09a	10.18ab	12.18b	13.01b	12.33b
					6WAP		
VPP1	52.04c	33.00ab	24.91a	27.21b	44.19bc	33.99b	41.22bc
VPP2	51.33c	46.70bc	31.13ab	23.01a	53.64c	34.89b	33.92b
VPP3	34.33b	27.17a	22.68a	23.44a	34.33b	33.00ab	44.19bc
					9WAP		
VPP1	139.20ab	124.10ab	148.52ab	98.17a	186.11b	104.32a	169.67ab
VPP2	301.07c	214.23bc	105.18a	104.09a	169.83ab	100.32a	188.45b
VPP3	95.83a	208.34bc	144.53ab	78.43a	169.77ab	94.00a	192.56b
					12WAP		
VPP1	312.20b	357.00bc	237.00a	218.67a	359.45bc	326.19b	324.20b
VPP2	265.17ab	333.37bc	254.33ab	249.65ab	385.00c	221.55a	319.45b
VPP3	234.33a	324.12b	227.72a	265.33ab	315.33b	265.60ab	223.00a

Mean with the same letter are not significantly different.

Table 4a: The influence of vine planting pattern on the canopy formation of sweet potato cultivar

Treatment	WEEKS AFTER PLANTING			
	3WAP	6WAP	9WAP	12WAP
Cultivar				
CV1	10.44a	18.77b	28.60ab	37.60b
CV2	11.33a	19.83b	31.20b	25.10a
CV3	6.68a	16.01ab	27.50ab	31.30ab
CV4	8.89a	15.94ab	27.90ab	33.30b
CV5	9.23a	14.36a	22.50a	28.90a
CV6	8.08a	13.99a	20.90a	30.00ab
CV7	7.97a	15.41ab	26.70ab	30.50ab
$LSD_{(0.05)}$	3.940	3.222	7.111	7.544
Vine planting pattern				
VSP1	9.19	17.31	27.20	52.30
VSP2	8.82	15.10	23.90	43.70

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VSP3	9.68	16.58	28.30	35.50
$LSD_{(0.05)}$	2.264	3.956	4.354	9.990

Mean with the same letter are not significantly different.

TABLE 4b: The influence of vine planting pattern and cultivar interaction on canopy formation (CF) Bag Experiment

Planting pattern /cultivar	C1	C2	C3	C4	C5	C6	C7
					3WAP		
VPP1	12.50a	13.10a	12.30a	13.10a	13.20a	12.40a	13.30a
VPP2	12.11a	12.90a	12.45a	12.55a	13.29a	12.10a	12.66a
VPP3	12.87a	13.22a	13.19a	12.68a	13.18a	11.81a	12.93a
					6WAP		
VPP1	46.03ab	45.07ab	33.11a	43.32ab	54.27b	33.99a	44.22ab
VPP2	44.05ab	43.70ab	43.13ab	43.51ab	53.72b	34.89a	43.92ab
VPP3	44.60ab	43.67ab	43.18ab	43.50ab	54.17b	35.00a	34.19a
					9WAP		
VPP1	104.57c	82.43b	87.07b	75.62ab	102.11c	62.32a	75.56ab
VPP2	98.03bc	79.16ab	70.70ab	70.80ab	97.31bc	66.32a	73.32ab
VPP3	69.13a	61.03a	70.89ab	72.43ab	86.77b	55.00a	75.06ab
					12WAP		
VPP1	151.00c	143.11bc	100.13a	130.27ab	137.21b	115.16ab	128.50ab
VPP2	139.97b	139.34b	93.17a	111.15ab	125.40ab	121.25ab	127.32ab
VPP3	139.33b	114.21ab	91.27a	115.42ab	121.03ab	98.87a	113.30ab

Mean with the same letter are not significantly different

Table 5a: The influence of vine planting pattern on tuber yield and its components of sweet potato cultivar

Treatment	number of tubers Tuber yield (t ha^{-1})		Weight of tuber
	Per plant	kg $plant^{-1}$	Ton/Ha
Cultivar			
CV1	2.74ab	2.48ab	1.57b
CV2	3.77ab	2.70ab	1.79b
CV3	3.51b	2.52b	1.58a
CV4	2.88ab	2.44a	1.49ab
CV5	2.52a	2.53b	1.59ab
CV6	2.46b	1.46a	1.20a
CV7	2.36a	1.44a	1.15a
$LSD_{(0.05)}$	1.090	0.311	0.401
Vine planting pattern			
VPP1	3.20	0.49	1.65

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VPP2	2.43	0.48	1.37
VPP3	2.58	0.49	1.39
$LSD_{(0.05)}$	*	ns	ns

Mean with the same letter are not significantly different.

TABLE 5b: The influence of vine planting pattern and cultivar interaction on tons per hectare, weight of tuber per plant (kg) and number of tubers per plant

Planting Pattern/ Cultivar	number of tubers Per plant	Weight of tuber kg $plant^{-1}$	Tuber yield (t ha^{-1}) Ton/Ha
VPP1C1	4.82b	3.07b	6.40b
VPP2C1	3.82ab	1.94a	2.90a
VPP3C1	4.02b	2.17ab	3.30a
VPP1C2	4.62ab	3.93ab	8.70c
VPP2C2	4.00b	2.24ab	3.90ab
VPP3C2	4.07b	2.17b	4.30ab
VPP1C3	3.23a	3.86a	6.80a
VPP2C3	3.12a	1.45a	2.62a
VPP3C3	4.34b	2.80b	4.10ab
VPP1C4	3.82a	2.26a	3.20a
VPP2C4	4.05ab	2.00a	2.60a
VPP3C4	4.15ab	2.17a	1.90a
VPPIC5	4.25ab	3.30a	6.44a
VPP2C5	4.02ab	2.10a	2.90a
VPP3C5	4.08ab	2.30a	3.00a
VPP1C6	4.15ab	2.20a	3.13a
VPP2C6	4.35ab	2.10a	3.20a
VPP3C6	4.01ab	2.30a	3.19a
VPP1C7	4.00ab	2.36a	3.33a
VPP2C7	4.02ab	2.00a	3.55ab
VPP3C7	4.20ab	2.22a	3.41a

Mean with the same letter are not significantly different.

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CONCLUSION

In conclusion, the main objective of this research was to evaluate the performance of varieties and vine planting patterns for the crop in Southern and Northern guinea savanna of Taraba State. It will give an opportunity for farmers to select the best variety and vine planting pattern suitable for their agronomic practices.

Secondly, the outcome of this research has also revealed the appropriate vine planting pattern needed to be the single ring method. This knowledge will help farmers on the specific planting pattern needed that will yield a desirable result.

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