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Effects of severity of apical shoot harvest on growth and tuber yield of two sweet potatoes varieties

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Leaf harvesting of sweet potato during vegetative stage is common in most parts of Liberia. There is little information on the effects of severity of apical shoot harvesting on tuber yield of sweet potato. Experiments were conducted in 2017 at the Federal University of Agriculture, Abeokuta to determine the effects of severity of apical shoots harvest on growth and tuber yields. Experiment consisted of two varieties (SHABA and SPK-004) and three levels of cutting severity; no cutting, cutting of 15 and 30 cm long apical shoots at 4-weeks. Treatments were arranged in split plot with variety as the main plot and cutting severity as sub-plot arranged in (RCBD) with three replications. Data were collected on vine length, number of leaves per plant, number of branches per plant, leaf area, and leaf area index, fresh and dry apical shoots weight, tuber, unmarketable yield, marketable yield and total number of tuber. Data collected on growth, yield parameters were subjected to analysis of variance and mean values separated using standard error at (p<0.05). In cutting severity, vegetative growth and tuber yield of SHABA were significantly higher than those of SPK-004. Cutting at 15 cm long apical shoots gave higher total tuber yields in SHABA than SPK-004. Cutting at 30 cm long apical shoots increased fresh apical shoot weigh in SPK-004 than in SHABA. For SHABA and SPK-004 had more tuber weight than 30 cm long apical shoots. Therefore, sweet potatoes whose apical shoot was cut at 15cm long for 4 weeks are recommended.

Key words: Bacterial blight, disease development, grain yield, planting densities, percentage severity index.

INTRODUCTION

The herbaceous dicot sweet potato plant (*Ipomoea batatas* Lam.) is a native of tropical and subtropical region of America and belongs to the Convolvulaceae family. Many parts of the plant are edible, including leaves, roots, and vines, and varieties exist with a wide range of skin and flesh colour, from white to yellow-orange and deep purple (CIP,1999). In Sub-Saharan Africa, sweet potato is the third most important root (tuber) crop after *cassava (Manihot esculenta)* and yam (*Dioscorea* spp) (Ewell and Mutuura, 1994). This crop plays an important role in household food security and income generation among farmers and supplies substantial amount of nutritional diets that can greatly reduce risk of heart disease, stroke, and even cancer (Carey et al., 1999; Helen, 2012). It yields about 60% industrial starch in Japan and also used as a sweetener in local drinks in Nigeria (Collins, 1993; Agbo and Ene, 1994). In some countries such as Ghana and Liberia, vine tops are used as vegetables and dry forage during scarce grazing periods (Abindin, 2004), Leaf harvesting has been reported to have some detrimental effect on tuberous root yield of sweet potato. Dahniya

(1980) compared the effects of harvesting shoots of two varieties of sweet potato TIS 2154 and TIS 2328. Harvesting the crop for shoots led to a reduction in tuber yield. The reduction was 48% in variety TIS 2328 and 31% in variety TIS 2154. Harvesting the shoots at base led to a reduction of 62% for variety TIS 2328 and 50% for variety 2154. Similarly, Gonzales et al. (1977) reported that topping the sweet potato plants reduced tuberous root yield. Highest tuber yield was obtained where no topping was done.

MATERIALS AND METHODS

Experimental site condition

The experiment was conducted in April, 2017 at the Federal University of Agriculture Abeokuta. The study site lies between Latitude 7°14"N and Longitude 3°26"E and is located within a forest Savannah transition zone (Salako et al., 2007); it has two distinct seasons: wet season, which extends from March to October, and the dry season, which is usually from November to February. The rainfall is bimodal in distribution- usually from March to July and from September to October, with a characteristic of August break. Its temperature is between 32.4 and 33.47°C, relative humidity is 77.38% in April but decreases to 63.24% in November.

Source of planting materials

Sweet potato vines were sourced from the International Institute of Tropical Agriculture (IITA) in Ibadan. The vines obtained were cut into 20 cm length by using a sterilized sharp knife.

Land preparation

The field was ploughed and harrowed mechanically. Ridges were constructed manually with traditional hoes in the two experiments, and a walkway of 1m was left in-between plots.

Pre cropping and soil analysis

Soil sample (0-20 cm) was randomly taken before planting and bulked to form a composite sample. This sample was air dried pass through 2 mm sieve and laboratory for both physical and chemical analysis to determine soil texture and soil fertility

Experimental design and planting methods

The entire plot was measured as 28 m^2 length × 19 m^2 widght giving an area of 532 m^2 and the plots size was 5 m × 3.5 m each. There was walk way of 1 m each between two plots; 1m walk way was also maintained around the perimeter of the entire plot. Five ridges were constructed in each plot with dimension of 35 cm ridge. Planting was done on the ridges in each plot at an inter-row spacing of 0.5 m and intra-row spacing of 1 m. Thus, there were 7 plants on each ridge and 35 plants per plot. This gave a plant population of 630 plants (equivalent to 20,000 plants per hectare). There were two sweet potatoes varieties (SHABA and SPK-004) and three levels of cutting severity, (no cutting, cutting 15 and 30 cm long apical shoots at 4 weeks interval); the experiment was arranged in split-plot with variety as the main plot and cutting severity as sub-plot,in romdonmized complete block designed (RCBD). Weeding was done manually with hoe to minimize weeds infestation to the sweet potato plants. Four weedings were done at 4, 8, 12, 16 (WAP). Earthling up was done on all ridges to establish a desirable soil bulk for root expansion and moisture conservation.

Data collection

Data were randomly collected from 5 plants in the three mid- rows on the following parameters.

Vine length (cm)

Vines length was determined in centimeter using rope to tread from the base of the plant to the tip of five selected plants from the three middle inter rows at 5, 9, 13, 17 (WAP).

Number of leaves per plants

The total number of leaves per plant was counted from 5, 9, 13, 17 (WAP) and recorded as sample from the field.

Number of main branches per plant

The number of main branches per plant was counted and recorded at 5, 9, 13, 17 WAP.

Fresh apical shoot weight

The vine fresh apical shoots were weighed on an electronic balance scale and recorded in gram.

Dry apical shoots weight per plant in gram

The total weight obtained from the apical shoot was oven-dried in the laboratory at 70°C and expressed in gram.

Leaf area per plant (LA) (cm_2)

Leaf area was obtained by using meter rule to measure the length and breadth of the leaf. 90 samples of leaves of different sizes which were traced on graph sheet. The length and breadth measured were regressed on the leaf area as derived by Olasantan and Salau (2008). From the experiments, leaf area was derived for SHABA in equation I and for SPK-004 in equation II. The linear equation ise as follows:

$$Y = 8.2988x + 11.981 \quad r^2 = 0.4904 \qquad (1)$$

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Table 1. Weather data, temperature relative humidity and sunshine hour's in 2017.

Months	Rainfall (mm)	Temperature (°C)		Relative humidity (%)	Sunshine hours
		Maximum	Minimum		
January	15.9	35.29	22.39	58.34	4.39
February	0	36.36	23.95	55.31	4.19
March	34.3	35.86	24.07	60.28	5.96
April	112.8	33.47	23.75	63.24	5.64
May	146	32.4	23.16	69.05	5.46
June	111	31.43	31.05	73.83	4.33
July	156.1	29.16	22.8	74.5	2.11
August	90.3	28.18	22.45	77.38	1.28
September	50	30.02	22.12	69.1	2.11
October	92.2	31.94	27.62	72.78	4.16
November	85.4	30.2	24.75	65.54	0.21

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$$Y= 4.279x-56.393 \quad r^2 = 0.6314 \qquad (2)$$

Where Y = leaf area, X = leaf breadth.

The Leaf Area Index (LAI) was calculated as leaf areas of all plants divided by number of plants/ plot size.

$$LAI= \frac{\text{Leaf areas all of plants (cm}^2\text{) /plot}}{\text{Plot size (cm}^2\text{)}}$$

Number of tuber per plant

The number of tuber harvested per plant was counted and recorded.

Fresh tubers weight per plant during harvest

The fresh tubers' weight was recorded and measured in kilogram and expressed in metric tons per hectare

Numbers of marketable tubers per plant

The number of marketable fresh tuber weight per plant was sampled and sorted for tuber sizes; tuber above 1.5 cm was considered as marketable tuber; disease free tuber, and non-rotten tubers were considered and recorded

Number of unmarketable tubers

The numbers of unmarketable tubers, fresh weight per plant were sorted out; signs of being damaged by disease tubers, rough skin tubers and those eaten by rats and below 1.5 cm were recorded as unmarketable yield and expressed in tons per hectare. The total tuber yield per plot was measured on the field in kilogram and expressed in ton per hectare.

Tuber dry weight per hectare

The tuber weighed were oven dried to constant weight of 70°C and recorded.

Statistical analysis

All sweet potato plants were harvested at 6-7 months and number of tubers and their weight, and fresh tuber yield per hectare were recorded. Statistical analyses were conducted using the analyses of variance procedure according to spilt-plot design of statistical analyses system institute (1990). Treatment means were presented with the associated standard error of the means (S.E.) at 5% probability.

RESULTS

Weather data during the study in 2017 at Alabata Road in Abeokuta

Total rainfall at the Federal University of Agriculture, Abeokuta was 894 mm in 2017. The total rainfall during the period of the experiment (April-November) was 843.3 mm in 2017 (Table 1). Higher rainfall was recorded in July (156.1 mm) while the lowest rainfall was recorded in September (50 mm). Minimum temperature was between 12.12 and 22.8°C, from April to November 2017, while maximum temperature was between 32.4 and 33.47°C, relative humidity was 77.38 in April but decreased to 63.24% in November. Higher sunshine rate per hour during the period of the experiment was 5.64 h recorded in April 2017 and the lowest was 1.28 h which was recorded in August.

Experimental site of soil analysis

The soil used for the experiment was sandy loam, slightly acidic (pH 5.6). The soil was moderate in nitrogen content (0.15 %) but very high in Phosphorus and Potassium contents (40.36 respectively) (Table 2).

Table 2. Soil elements of experimental site.

Parameter	Content
pH	5.6
Clay (g/kg^{-1})	4.4
Sand (g/kg^{-1})	80.6
Silt (g/kg^{-1}	15.0
K-(cmol/kg	0.462
Ca_2 (emol/kg)	0.201
Mg^2-(emol/kg)	0.236
Organic Carbon (%)	2.476
Na Cmol (%)	0.435
AV.P (Mg/kg)	40.36
Nitrogen (%)	0.177
Exchangeable Ac (Cmol/kg)	2.1

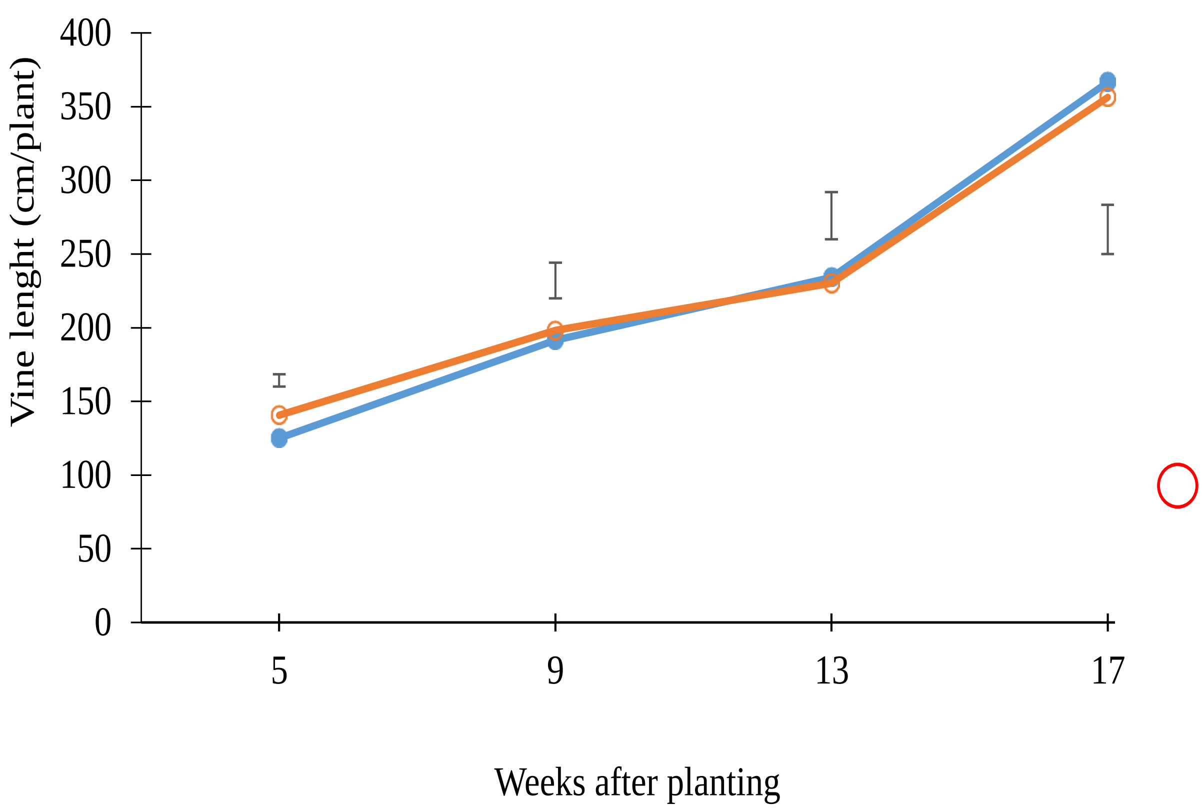

Figure 1. Vine length of two sweet potato varieties. SHABA (●), SPK-004 (○). Bars are SE at p≤0.05.

Vine length of sweet potato as affected by variety and cutting severity

The vines of SPK-004 was longer than that of SHABA at 9 WAP, while from 9-17 WAP, the two vines were similar (Figure 1). The control plant was significantly (P ≤0.05) longer than those plants whose apical shoots were cut at 15 and 30 cm long throughout the period of the experiment (Figure 2). Vine length of plant whose apical shoots were cut at 30 cm long were similar to plants whose apical shoot were cut at 15 cm long at 5 and 9 WAP. At 13 and 17 WAP, however sweet potato plants whose apical shoot was removed at 30 cm long was longer than sweet potato plant whose apical shoot was cut at 15 cm long.

The vine of SPK-004 control plant was significantly

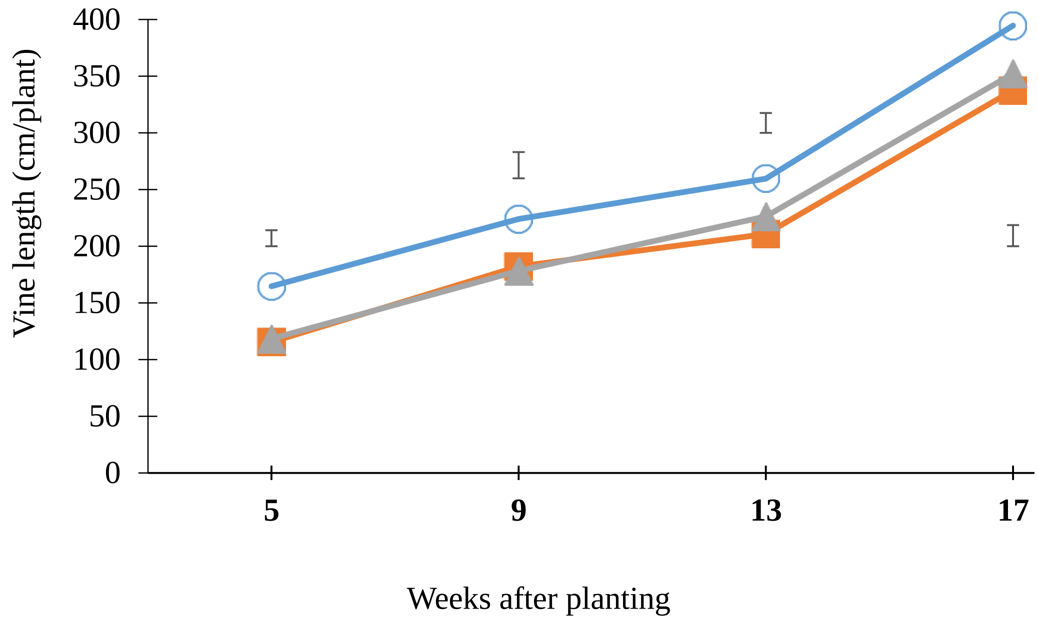

Figure 2. Vine length of two sweet potato Varieties as affected by cutting severity. Control ( ), 15 cm ( ) and 30 cm ( ). Bars are SE at p≤0.05.

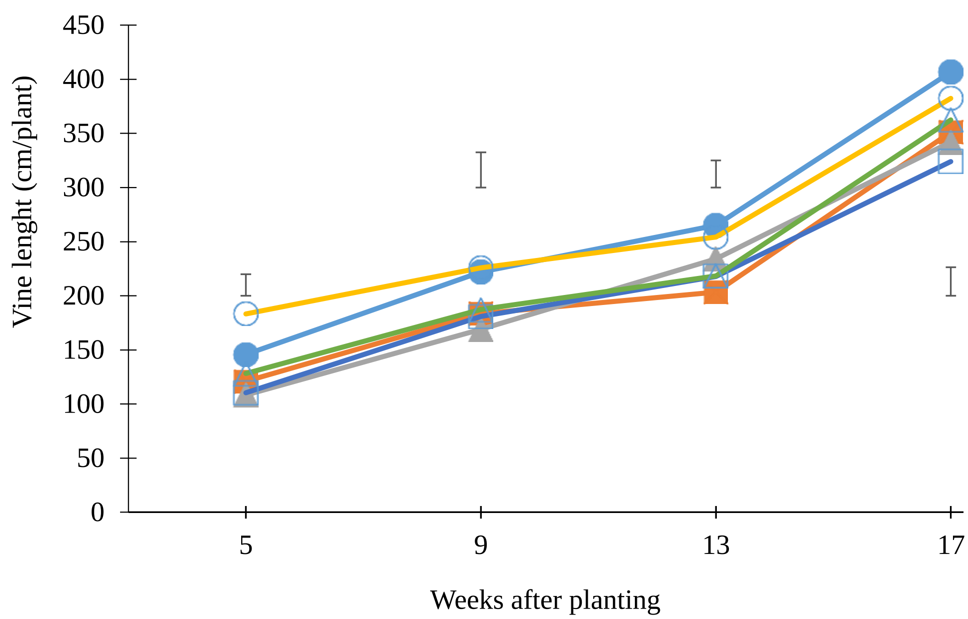

Figure 3. Interaction between variety and cutting severity on vine length of two sweet potato varieties. SHABA x Control ( ), SHABA x 15 cm ( ), SHABA x 30 cm ( ), SPK-004 x Control ( ), SPKK-004 x 15 cm ( ) and SPK-004 x 30 cm ( ). Bars are SE at p≤0.05.

(P≤0.05) longer than SPK-004 whose apical shoot was removed at 15 cm long and in (Figure 3). At 5 and 17 WAP, the vine length of SPK-004 control plant was significantly (P≤0.05) longer than sweet potato plant whose apical shoot was cut 30 cm long at 5-9 WAP. However at 13 and 17 WAP SPK-004 control plant whose apical shoot was removed at 30 cm long was similar. At 5 WAP SHABA control plant whose apical shoots were

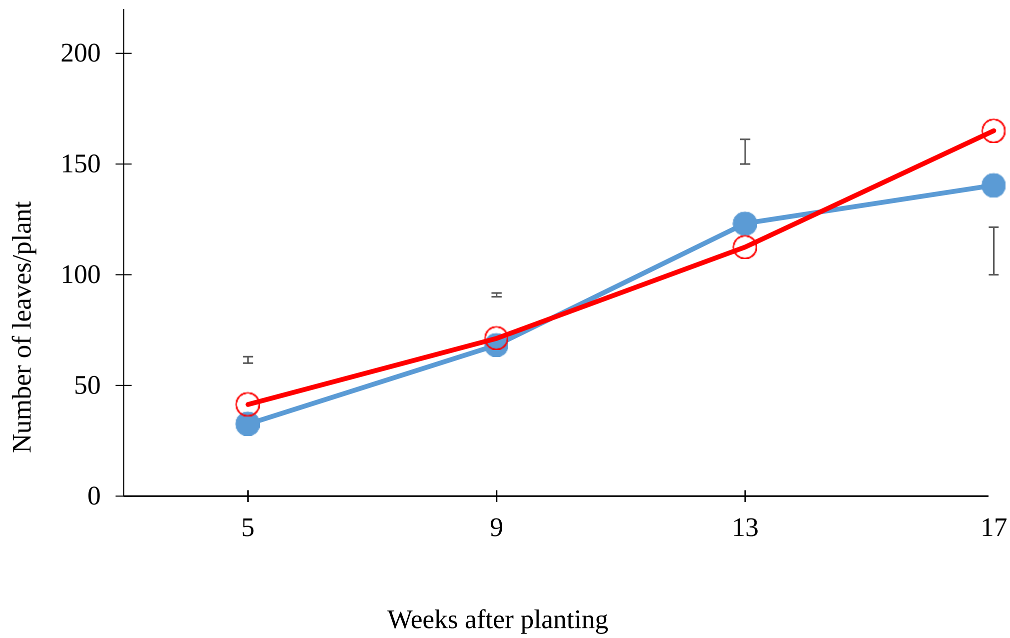

Figure 4. Number of leaves of two sweet potato varieties SHABA (●), SPK-004 (○). Bars are SE at p≤0.05.

removed at 15 and 30 cm long were at similar, while at 9 and 17 WAP SHABA control plant was significantly (P ≤ 0.05) longer than sweet potato whose apical shoot was removed at 30 cm long; but at 13 WAP control plant and SHABA whose apical shoot was cut at 15 cm long have similar vine length. At 5 to 17 WAP SHABA plant whose apical shoots were removed at 15 and 30 cm long produced similar vines (Figure 3).

Number of leaves of two sweet potato varieties (SHABA and SPK-004) as affected by cutting severity

The result in Figure 4 shows the varietal effect on number of leaves of SHABA and SPK-004. At 5-17 WAP the number of leaves on SPK-004 plant was significantly (P≤0.05) highest than the number of leaves on SHABA; however both varieties have similar number of leaves at 9 WAP, whereas at 13 WAP SHABA produced higher number of leaves than SPK-004. There was a gradual increase in the production of leaves of two sweet potato with respect to time. At 5 to 17 WAP, number of leaves of control plant was significantly (p ≤ 0.05) higher than sweet potato plant whose apical shoots were cut at both 15 and 30cm long. However the number of leaves on sweet potato plant whose apical shoots were removed at 15 and 30cm long were also similar at 5- 9 WAP; although at 13 - 17 WAP, the number of leaves on sweet potato plant whose apical shoot were removed at 15cm long were more than sweet potato plant whose apical shoots were removed at 30 cm long (Figure 5). At 5-17 (WAP), leaves produced by SHABA control plant were more than those produced by plant whose apical shoots were removed at both 15 and 30 cm long. However, for SPK-004 number of leaves produced by control plant was similar with that of plant whose apical shoots were removed at both 15 and 30 cm long at 5 WAP; at 13 WAP control sweet potato plant and plant whose apical shoot was removed at 15 cm long had more number of leaves than sweet potato whose apical shoot was removed at 30 cm long. However, control plant, cutting at 15 and 30cm long have similar vine length at 17 WAP .

Varietal effects on number of branches of two sweet potato variety

SPK-004 produced more branches than SHABA from 5-13 WAP, but from 15-17 there was significant (P≤ 0.05) increase in number of branches produced by SHABA as compared to SPK-004 (Figure 6). At 5 WAP, control plant produced higher number of branches than sweet potato plant whose apical shoots were removed at 15 and 30 cm long (Figure 7); however both sweet potato plant whose apical shoots were cut at 15 and 30 cm long were similar, whereas at 9 - 17 WAP control plant had significantly (P≤ 0.05) highest number of branches than sweet potato plant whose apical shoots were removed at 30 cm long. At 9 WAP control plant had significantly (P≤ 0.05) higher number of branches than sweet potato plant whose apical shoot was cut at 15 cm long, whereas at 13 -17 WAP control plant produced more number of branches

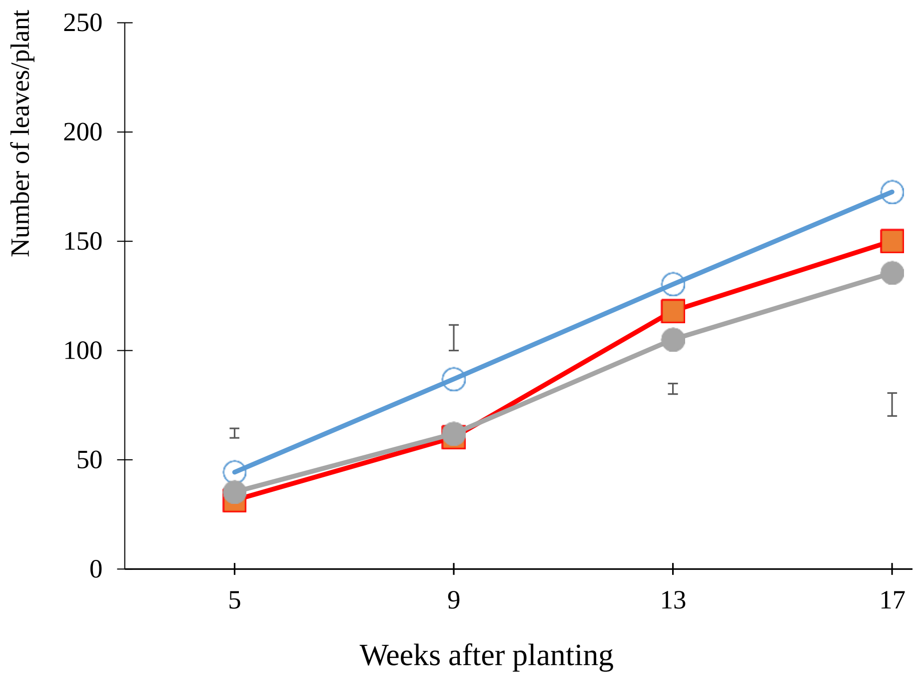

Figure 5. Number of leaves of two sweet potato varieties as affected by cutting severity Control ( ), 15 cm ( ) and 30 cm ( ). Bars are SE at p≤0.05.

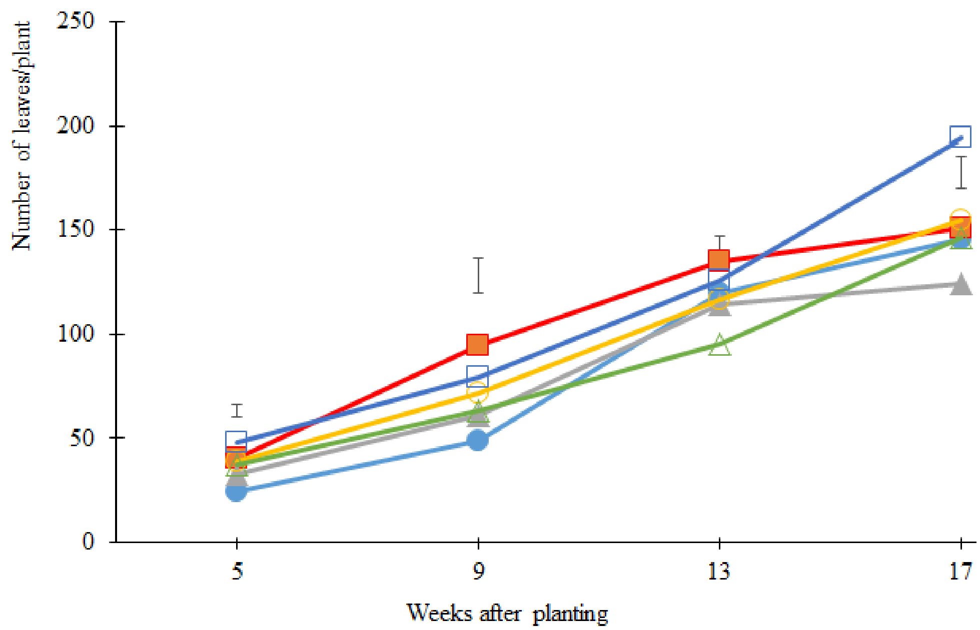

Figure 6. Interaction between variety and cutting severity on number of leaves of two sweet potato varieties. SHABA x Control ( ), SHABA x 15 cm ( ), SHABA x 30 cm ( ), SPK-004 x Control ( ), SPKK-004 x 15 cm ( ) and SPK-004 x 30 cm ( ). Bars are SE at p≤0.05.

than sweet potato plant whose apical shoot was removed at 15 cm long, although at 17 WAP sweet potato plant whose apical shoot was removed at 15cm long produced higher number of branches than sweet potato plant whose apical shoot was removed at 30 cm long. (Figure 8).

At 5-13 WAP SHABA control plant and cutting severity at 15cm long had similar number of branches, however at

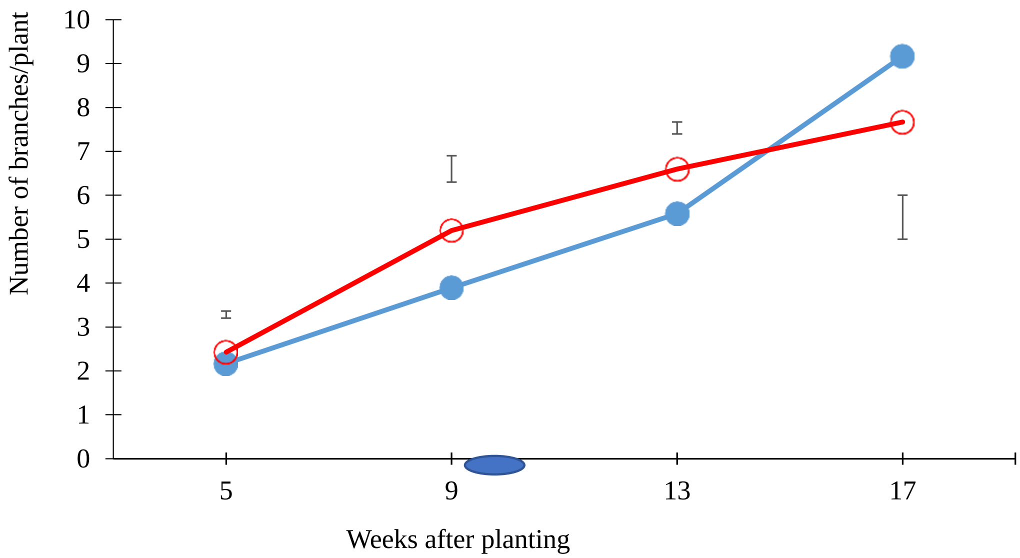

Figure 7. Number of branches of two sweet potato SHABA and SPK-004 of two sweet potato varieties SHABA ( ), SPK-004 ( ). Bars are SE at p≤0.05.

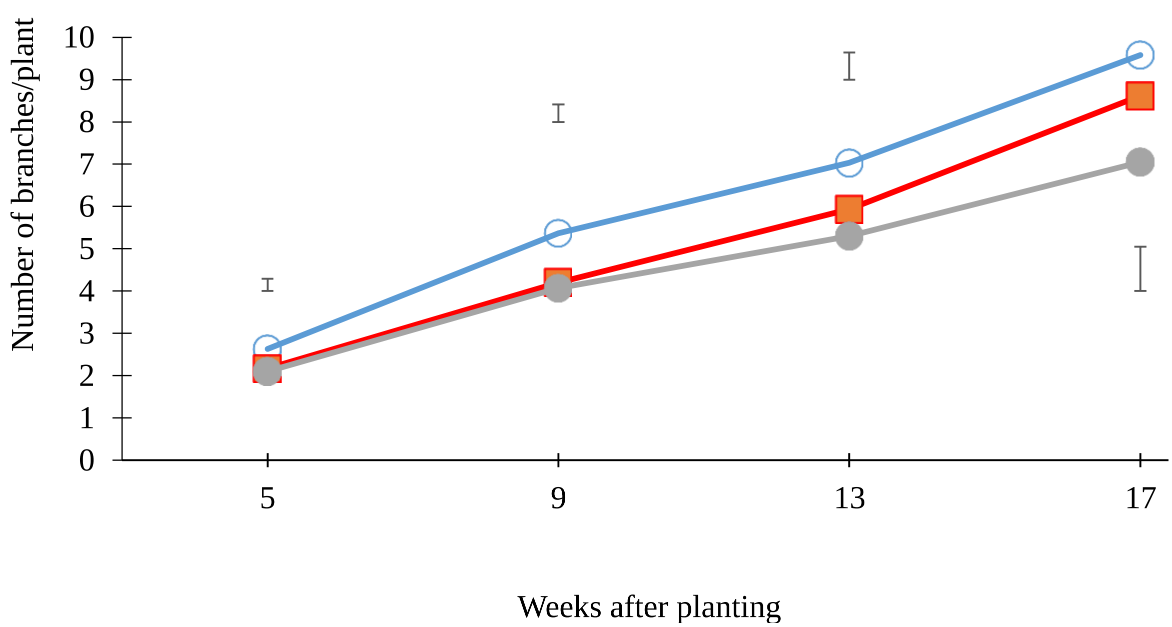

Figure 8. Number of branches of two sweet potato varieties as affected by cutting severity. Control ( ), 15 cm ( ) and 30 cm ( ). Bars are SE at p≤0.05.

5-17 WAP SHABA control plant significantly (P≤ 0.05) produced higher number of branches than sweet potato plant whose apical shoot was removed at 30cm long (Figure 9); at 9 WAP control plant produced higher number of branches than sweet potato plant whose apical shoot was removed at 15 cm long. At 13 WAP cutting severity at 15 cm long had higher number of branches than sweet potato plant whose apical shoot was removed at 30 cm long and control plant. At 5-9 WAP SPK-004 control plant had similar number of branches with sweet potato plant whose apical shoots were cut at 15 and 30 cm long and at 13 WAP SPK-004 control plant produced higher number of branches than sweet potato plant whose apical shoots were removed at

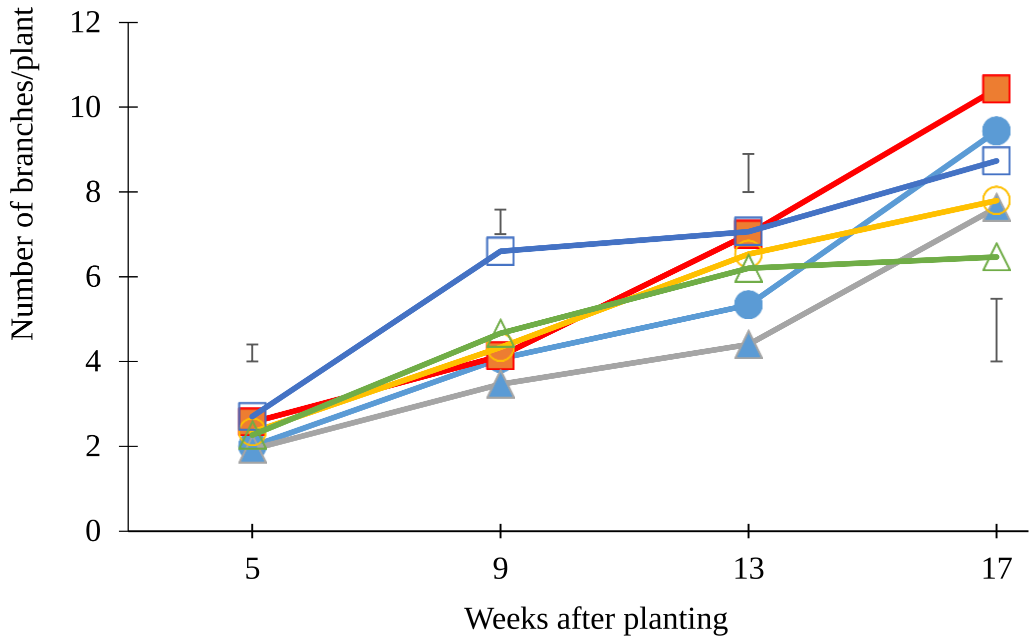

Figure 9. Interaction between variety and cutting severity on number of branches of two sweet potato varieties, SHABA x Control ( ), SHABA x 15 cm ( ), SHABA x 30 cm ( ), SPK-004 x Control ( ) SPKK-004 x 15 cm ( ) and SPK-004 x 30 cm ( ). Bars are SE at p≤0.05.

30 and 15 cm long; although at 17 WAP sweet potato plant whose apical was cut at 15cm long significantly (P≤ 0.95) produced higher number of branches than sweet potato plant whose apical shoot was removed at 30 cm long and control plant (Figure 9).

Leaf area index of two sweet potato as affected by variety and cutting severity

The leaf area index of SHABA had more leaf index cover than SPK-004 at 5 WAP; however at 9 -17 WAP SHABA plant produced significantly (P≤ 0.05) more leaf area index cover than SPK-004 plant (Figure 10). The leaf area index of two sweet potato as affected by cutting severity (Figure 11). Between 9 and 17 WAP, the leaf area index of sweet potato with control plant significantly (P≤ 0.05) produced higher leaves area index cover than that of plant whose apical shoots were removed at 15 and 30 cm long. However, there was no significant difference between sweet potato plants whose apical shoots were removed at 15 and 30 cm long at 5-17 WAP (Figure 11). Between 5-17 WAP, the leaf area index of SHABA control plant produced higher leaf area index cover than SHABA plant whose apical shoots were removed at 15 and 30 cm long (Figure 12). At 5-13 WAP, sweet potato plants whose apical shoot was removed at 30 cm long produced more leaf area index cover than SHABA control plant, whereas at 17 WAP SHABA control plant produced higher leaf area index cover than that of sweet potato plant whose apical shoots were cut at 30 cm long. At 5-9 WAP control plant and sweet potato plant whose apical shoots were removed at 15 and 30 cm long have similar leaf area index cover and at 13 WAP SPK-004 control plant and sweet potato plant whose apical shoots were cut at 15 cm long were similar. But both control plant and sweet potato plant whose apical shoot was cut at 15 cm long produced more leaf area index cover than SPK-004 whose apical shoot was removed at 30 cm. However at 17 WAP sweet potato whose apical shoot was cut at 15 cm long produced more leaf area index cover than control plant and sweet potato whose apical shoot was cut at 30 cm long (Figure 1).

The fresh apical shoot weight as affected by cutting severity

Fresh apical weight of SHABA was higher than that of SPK-004 at 9 WAP, but at 17 WAP, SPK-004, fresh apical shoots decreased at 21 WAP (Figure 13). Between 5 to 9 WAP, the fresh apical shoots weight of sweet potato plant whose apical shoots were removed at 15 -30cm long was similar except at 13 to 21 WAP (Figure 14). Sweet potato plants whose apical shoot was removed at 30cm long produced significantly (P≤ 0.05) higher fresh shoots weight than sweet potato plant whose apical shoot was removed at 15 cm long (Figure 14). Between 5- 19 WAP, SHABA plant whose apical shoots were removed at 15 cm long produced significantly (P≤

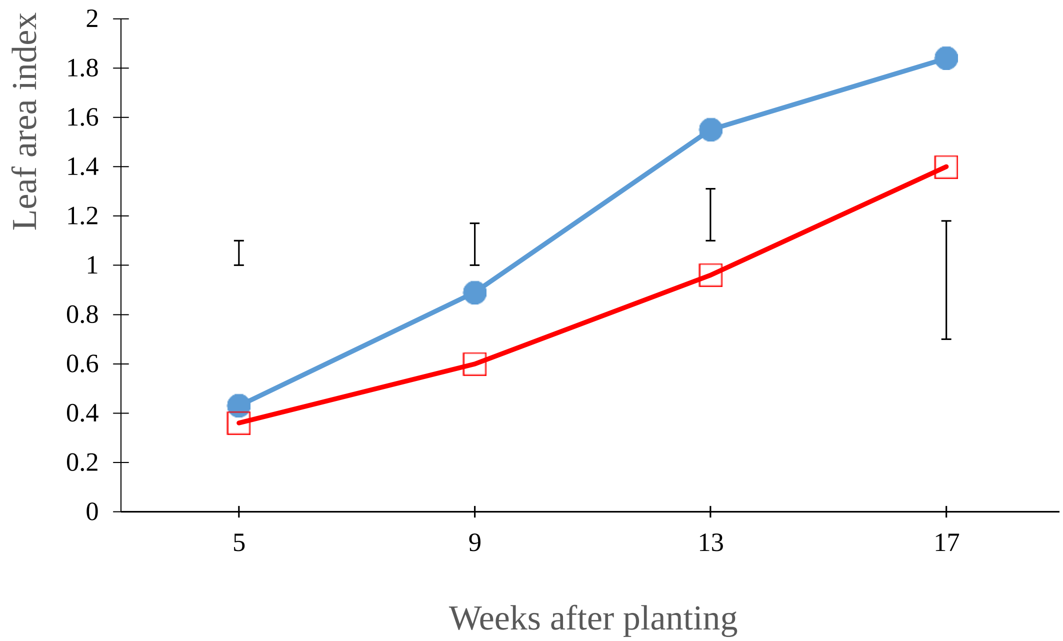

Figure 10. Varietal effect on leaf area index of two sweet potato varieties. SHABA ( ), SPK-004 ( ). Bars are SE at p≤0.05.

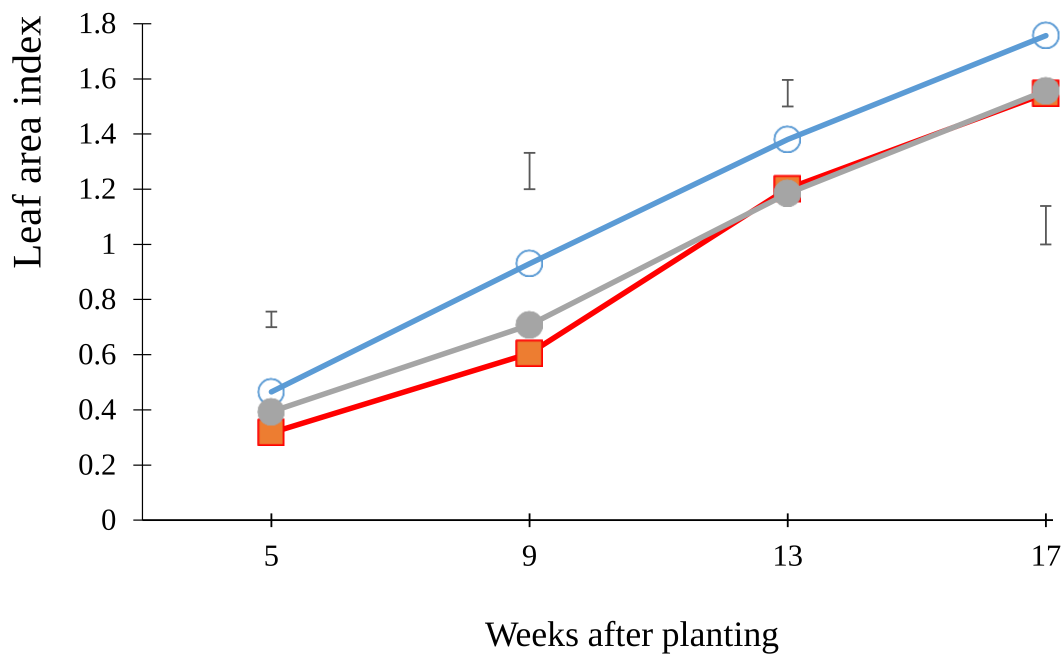

Figure 11. Leaf area index of two sweet potato varieties as affected by cutting severity. Control ( ), 15 cm ( ) and 30 cm ( ). Bars are SE at p≤0.05.

0.05) higher fresh apical shoot weight than SHABA whose apical shoots were removed at 15 cm long (Figure 15). At 9, 13 and 19 WAP, SPK-004 plant whose apical shoots were removed at 30 cm long produced significantly more fresh apical shoot weight than SPK-004 plant whose apical shoot was cut at 15cm long. However, at 5 and 9 WAP, SPK-004 plant whose apical shoot was cut at 15 and 30 cm long produced similar fresh apical

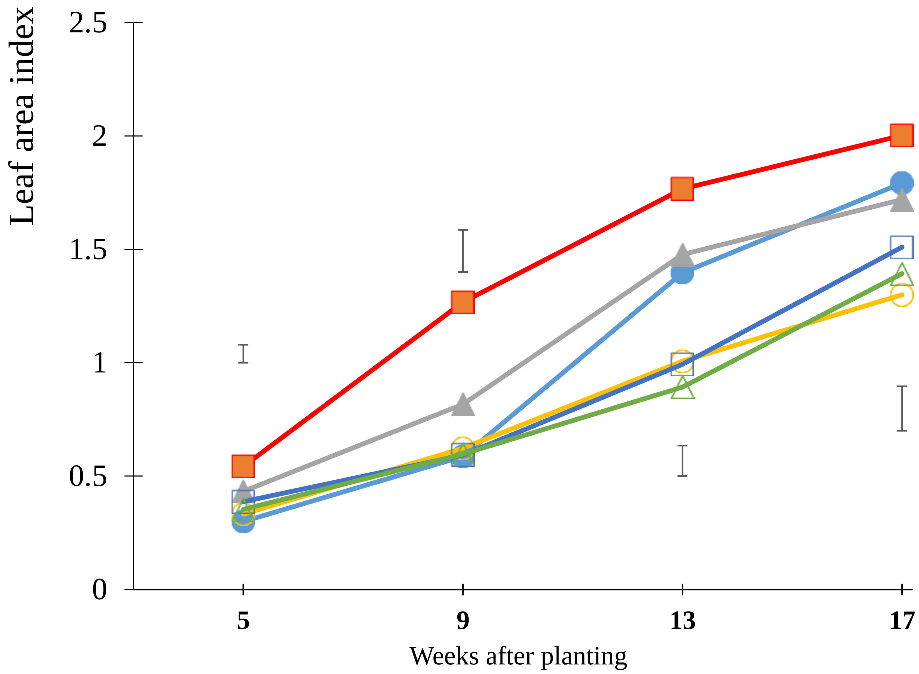

Figure 12. Interaction between variety and cutting severity on leaf area index of two sweet potato varieties. SHABA x Control ( ), SHABA x 15 cm ( ), SHABAx 30 cm ( ), SPK-004 x Control ( ), SPKK-004 x 15 cm ( ) and SPK-004 x 30 cm ( ). Bars are SE at p≤0.05.

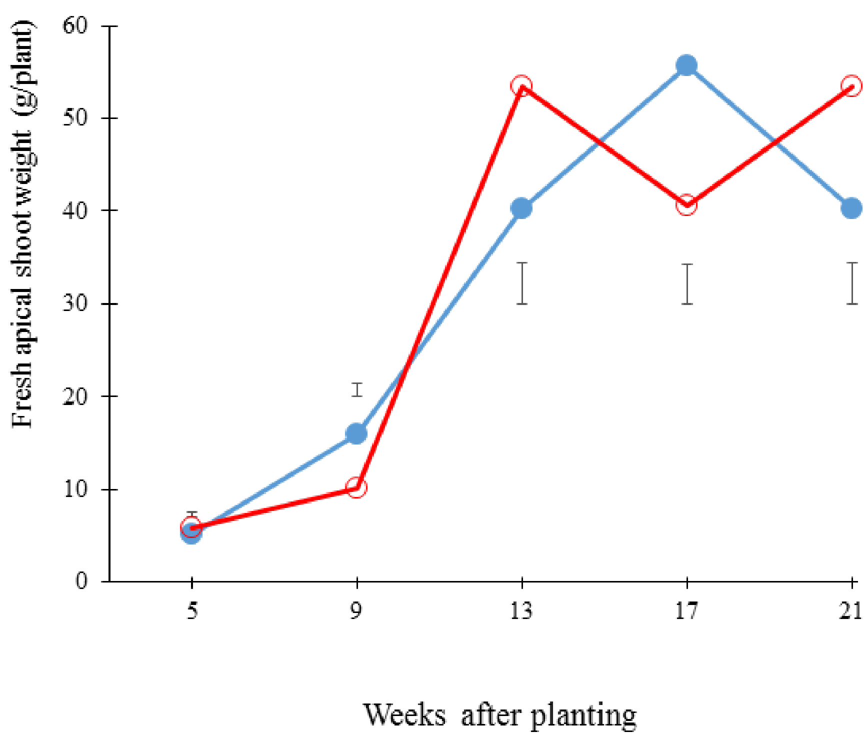

Figure 13. Fresh apical shoots weight of two sweet potato varieties. SHABA ( ) SPK-004 ( ). Bars are SE at p≤0.05.

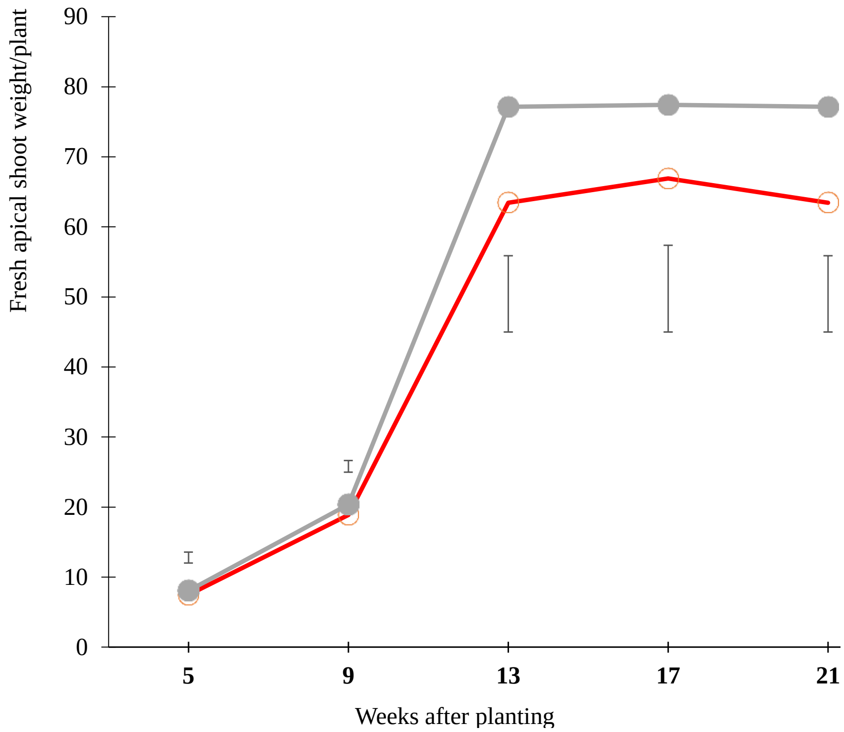

Figure 14. Fresh apical shoots weight of two sweet potato varieties as affected by cutting severity. 15 cm ( ) and 30 cm ( ). Bars are SE at p≤0.05.

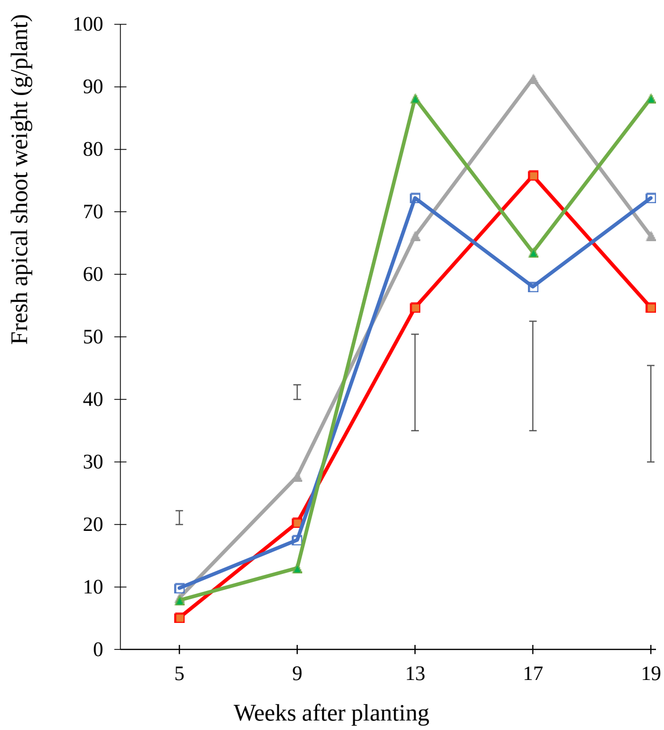

Figure 15. Interaction between variety and cutting severity on fresh apical shoot weight of two sweet potato, SHABA x 15 cm ( ), SHABA x 30 cm ( ), SPKK-004 x 15 cm ( ) and SPK-004 x 30 cm ( ). Bars are SE at p≤0.05.

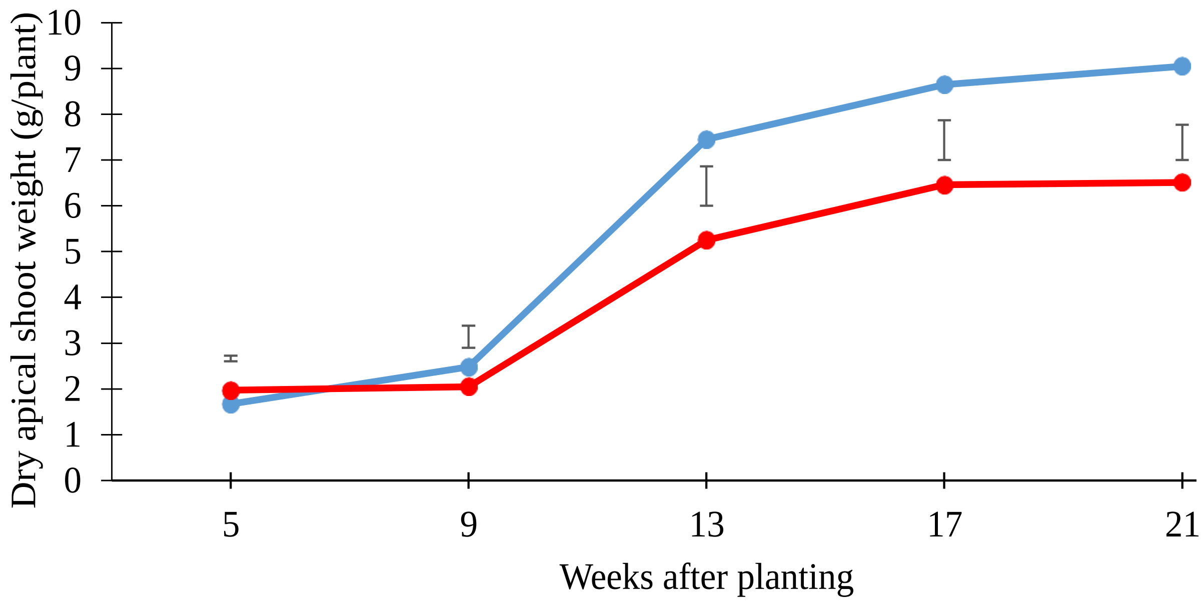

Figure 16. Dry apical shoot weight of two sweet potato varieties SHABA (●), SPK-004 (○). Bars are SE at p≤0.05.

shoot weight. Whereas at 13, 17 and 19 WAP, SPK-004 plant whose apical shoot was removed at 30cm long produced more apical shoot weight than SPK-004 plant whose apical shoot was removed at 1m long (Figure 15).

Dry apical shoot weight of two sweet potato as affected by variety and cutting severity

At 5 WAP, SPK-004 produced higher dry apical shoots weight than SHABA; however at 9 WAP SHABA and SPK-004 produced similar dry apical weight. While at 13-21 WAP SHABA plant produced higher dry apical weight than SPK-004 plant (Figure 16). At 5, 9 and 21 WAP, sweet potato whose apical shoot was removed at 30 cm long produced more dry apical shoot weight than sweet potato plant whose apical shoot was cut at 15 cm long; however at 13 - 17 WAP sweet potato plant whose apical shoot was cut at 30 cm long produced higher apical shoot weight than sweet potato plant whose apical shoot was removed at 15 cm long (Figure 17). At 5, 9 and 21 WAP SHABA plant whose apical shoots was cut at 30cm long produced similar dry apical shoot weight, whereas, at 13 and 17 WAP, SHABA plant whose apical shoot was cut at 30cm long produced significantly (P≤ 0.05) more apical shoot than SHANA plant whose apical shoot was removed at 15 cm long (Figure 18). At 5-9 WAP SPK-004 whose apical shoots were cut at 15 and 30cm long produced similar dry apical shoots. However at 13, 17 and 21 WAP SPK-004 plant whose apical shoot was cut at 30cm long produced drier apical shoots weight than 15 cm long (Figure 18) .

Total fresh and dry apical shoot weight of sweet potato as affected by variety and cutting severity

The interaction between variety and cutting severity showed that SHABA whose apical shoots were cut at 30 cm long had significantly (P≤0.05) higher total fresh weight than SHABA cut at 15cm long.SPK-004 whose apical shoots were cut at 30cm had significantly (P≤0.05) higher total fresh shoots weight than SHABA cut at 15cm long (Table 3).

SHABA whose apical shoots was removed at 30cm long had significantly (P≤0.05) higher total dry apical shoot weight than SHABA removed at 15 cm. However, SPK-004 whose apical shoots were cut at 15 and 30 cm long was similar with respect to total dry apical shoot weight. Total dry apical shoot weight of SHABA was significantly (P≤0.05) higher than that of SPK-004. Total fresh and dry apical shoot weight of sweet potato plant whose apical shoots was cut at 30 cm long was significantly higher than those cut at 15 cm long.

Unmarketable, marketable and total tuber weight of sweet potato as affected by variety and cutting severity

The interaction between variety and cutting severity significantly (P≤ 0.05) affected unmarketable, marketable and total tuber weight of sweet potato (Table 4). SHABA plant cut at 15 and 30 cm long produced similar unmarketable and marketable tuber weight. However, SHABA plant whose apical shoot was harvested at 15 cm

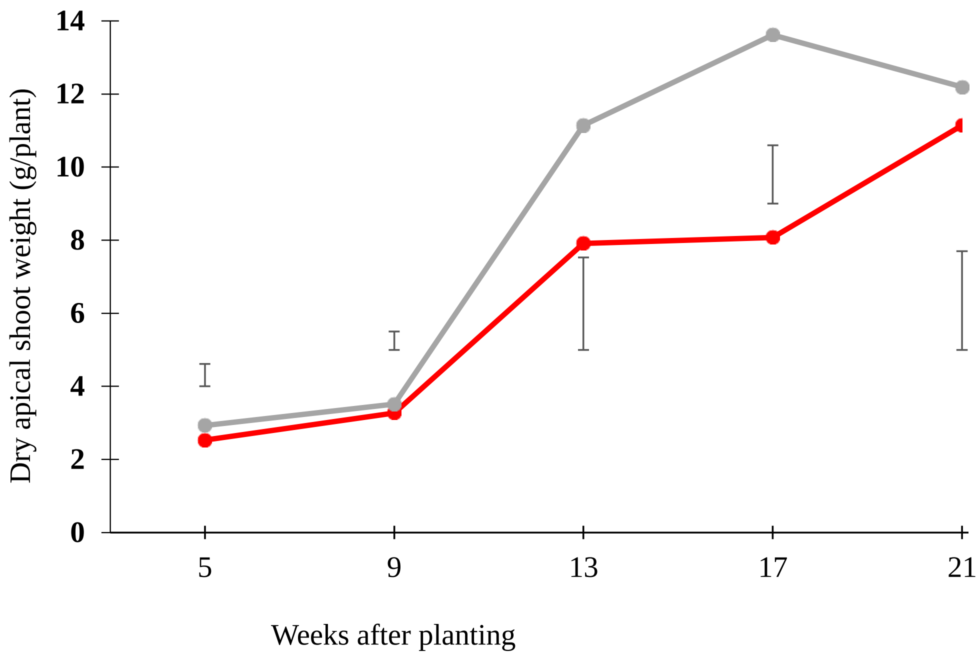

Figure 17. Weight of dry shoot of two sweet potato varieties as affected by cutting severity. 15 cm ( ) and 30 cm ( ). Bars are SE at p≤0.05.

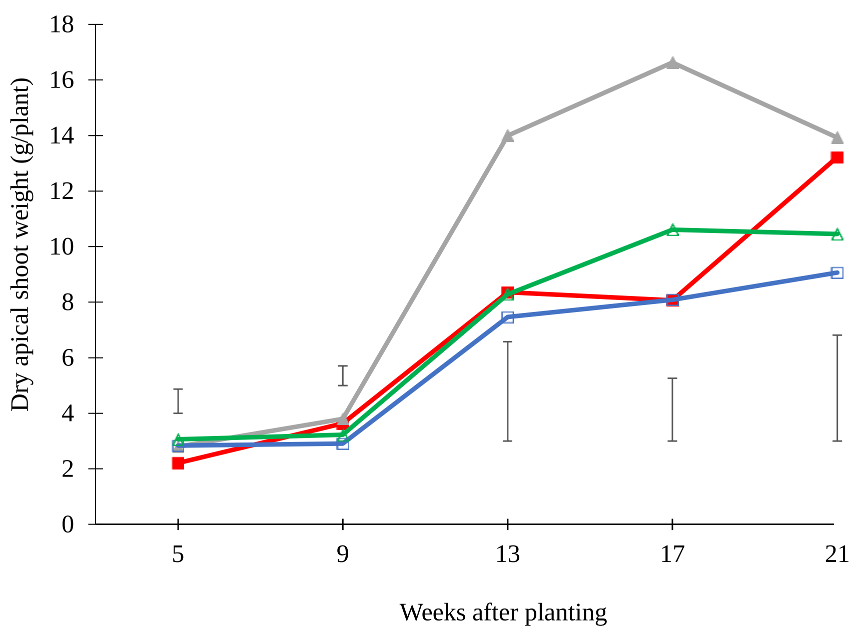

Figure 18. Interaction between variety and cutting severity on dry apical shoot weight of two sweet potato variety. SHABA x 15 cm ( ), SHABA x 30 cm ( ), SPKK-004 x 15 cm ( ) and SPK-004 x 30 cm ( ). Bars are SE at p≤0.05.

long produced significanly (P ≤0.5) highest total tuber weight, followed by SHABA control plant and the least was recorded in SHABA plant whose apical shoot was removed at 30 cm long.

The SPK-004 plant without cutting produced highest unmarketable tuber weight than SHABA whose apical

Table 3. Total fresh and dry apical shoot weight per plant of sweet potato as affected by variety and cutting severity.

Treatments		Total fresh shoot weight g/plant	Total dry shoot weight g/plant
Variety	**Severity**		
SHABA	Control	--	--
	15 cm	212.7	35.5
	30 cm	259.3	51.2
SPK-004	Control	-	--
	15 cm	229.8	30.4
	30 cm	260.8	35.6
	SE(8 D.F.)	20.4	7 .9
	Variety		
	SHABA	157.3	29.3
	SPK-004	163.5	22.2
	SE(8 D.F.)	3.9	2.4
	Severity		
	Control	-	-
	15 cm	221.3	32.9
	30 cm	260.0	43.4
	SE(8 D.F.)	14.4	5.6

shoots were removed at 15 and 30 cm long. SPK-004 plant without cutting and those plants whose apical shoots were removed at 15 and 30 cm long produced similar marketable and total tuber weight. The effects of variety on unmarketable, marketable and total tuber weight of sweet potato was not significant at (P≤t0.05).

However, both SHABA and SPK-004 plant produced similar unmarketable, marketable and total tuber weight. The weight of unmarketable tuber in sweet potato as affected by cutting severity was significant. Table 4 shows that the unmarketable tuber weight of the sweet potato control plant was significantly ($P \leq 0.05$) more than those plant whose apical shoot was removed at 30 cm, while the weight of marketable tuber and total tuber weight were similar in control plant, at 15 and 30 cm long (Table 4)

Unmarketable, marketable and total tuber number of sweet potato as affected by cutting severity

There was no significant difference between SHABA without cutting and those whose apical shoots were removed at 15 and 30 cm long with respect to unmarketable, marketable and total tuber number (Table 5). Similarly SPK-004 without cutting and those whose apical shoots were cut at 15 and 30 cm long had similar unmarketable, marketable and total tuber number. SHABA produced significantly ($P \leq 0.05$) similar number of unmarketable and marketable tubers than SPK-004. But total tuber, number of SHABA was more than that of SPK-004 (Table 5). The number of unmarketable, marketable and total tuber of sweet potato as affected by cutting severity is shown in Table 5. The number of unmarketable and total marketable tubers were similar in sweet potato without cutting and those whose apical shoots were cut at 15 and 30 cm long.

Unmarketable, marketable and total tuber yield of sweet potato as affected by cutting severity

The interaction between variety and cutting severity as it affects unmarketable, marketable and total tuber yield of sweet potato is shown in Table 5. Yield of unmarketable and marketable tuber of SHABA without cutting and those whose apical shoots were removed at 15 and 30 cm long were similar. However, SHABA whose apical shoots were removed at 15cm long produed more tuber yield than SHABA without cutting and SHABA whose apical shoots were removed at 30cm long. SPK-004 without cutting had significantly highest unmarketable tuber yield than SPK-004 plant whose apical shoots were removed at 15 and 30 cm long. SPK-004 plant without cutting and those whose apical shoots were removed at 15 and 30 cm long were similar in their marketable and total tuber yield.

Variety did not significantly influence unmarketable, marketable and total tuber yield sweet potato yield of unmarketable, marketable and total tuber yield of SHABA

Table 4. Unmarketable, marketable and total tuber weight per plant of two sweet potato as affected by cutting severity.

Treatment		Unmarketable tuber weight (g/plant)	Marketable tuber weight	Total tuber weight (g/plant)
Variety	**Severity**			
SHABA	Control	77.0	251.8	328.5
	15 cm	102.0	299.9	401.9
	30 cm	53.7	229.0	282.7
SPK-004	Control	115.7	201.0	316.4
	15 cm	74.7	191.9	266.9
	30 cm	64.3	238.4	302.6
	SE(8 D.F.)	27.5	71.5	92.0
	Variety			
	SHABA	260.3	337.7	597.7
	SPK-004	210.4	295.3	505.7
	SE(8 D.F.)	74.1	86.5	160.6
	Severity			
	Control	96.3	226.4	322.4
	15 cm	88.3	245.9	334.4
	30 cm	59.0	233.7	292.6
	SE(8 D.F.)	19.4	50.6	65.1

Table 5. Unmarketable, marketable and total tuber number per plant of two sweet potato as affected by variety and cutting severity.

Treatment		Number of unmarketable tuber/plant	Number of marketable tuber/plant	Total number of tuber/plant
Variety	**Severity**			
Shaba	Control	3.00	2.67	5.67
	15 cm	3.00	3.00	5.67
	30 cm	2.33	2.33	4.67
SPK-004	Control	2.33	3.00	5.33
	15 cm	1.67	2.00	3.33
	30 cm	2.00	2.33	4.33
	SE(8 D.F.)	0.77	0.96	1.33
	Variety			
	SHABA	2.78	2.67	5.33
	SPK-004	2.00	2.44	4.33
	SE(8 D.F.)	0.68	0.29	0.38
	Severity			
	Control	2.67	2.83	5.50
	15 cm	2.33	2.50	4.50
	30 cm	2.17	2.33	4.50
	SE(8 D.F.)	0.54	0.68	0.94

was similar compared to that of SPK-004. The yield of unmarketable, marketable and total tuber of sweet potato as affected by cutting severity is shown in Table 6. The control plant produced more marketable tuber compared to plant whose apical shoots were removed at both 15 cm and 30 cm long; however, unmarketable tuber yield was

Table 6. Unmarketable, marketable and total tuber yield of affected by variety and cutting severity.

Treatment		Unmarketable tuber yield t/ha	Marketable tuber yield t/ha	Total tuber yield t/ha
Variety	**Severity**			
Shaba	Control	3.06	10.07	13.14
	15 cm	4.08	12.00	16.07
	30 cm	2.15	9.16	11.31
SPK-004	Control	4.61	8.04	12.66
	15 cm	3.00	7.68	10.67
	30 cm	2.57	9.53	12.11
	SE(8 D.F.)	1.10	2.86	3.68
	Variety			
	SHABA	3.09	10.41	13.51
	SPK-004	3.39	8.42	11.81
	SE(8 D.F.)	0.81	2.96	3.46
	Severity			
	Control	3.84	9.06	12.90
	15 cm	3.54	9.84	13.37
	30 cm	2.36	9.35	11.71
	SE(8 D.F.)	0.78	2.02	2.60

Table 7. Correlations between yield parameter.

Variable	Severity of cutting			
	Total tuber weight	**Total unmarketable weight**	**Total dry vine weight**	**Total fresh vine weight**
Total marketable weight	0.929**	0.459	0.013	-0.095
Total tuber weight		0.672**	0.005	-0.079
Total unmarketable weight			-0.096	-0.077
Total dry vine weight				0.681**

more in apical shoot cut at 15 cm long than apical shoot cut at 30 cm long. There was no significant difference between control plant and sweet potato whose apical shoots were cut at 15 and 30 cm long in marketable and total tuber yield.

Correlations between yield parameter

Total marketable weight was significantly correlated with total tuber weight; total tuber weight positively correlated with total unmarketable weight and total dry apical shoot weight was significantly correlated with total fresh apical shoot weight under both treatments of cutting severity and frequency of cutting (Table 7).

DISCUSSION

There was high rainfall in May which was maximum in July, while high amount was also recorded in October after a period of low rainfall in August and September. This indicates tri-modal pattern of rainfall. This was against the bi-modal pattern of rainfall reported by Adejuwon and Odekunle (2006). Sweet potato crop grows on negligible soils with partial inputs. It has the capability to tolerate harsh soil and climatic conditions and yet give satisfactory yield. It grows well in fertile and high organic matter, well-drained, light, and medium textured soils. The relatively low fertility status of the soil of the study location is a peculiar characteristic of most soil in South-western Nigeria. This low fertility status could be attributed to the degraded state of most tropical soil Agboola (1973) wrote about some of the farmers in the south who have refused to apply fertilizer to any farmland used in yam production because they have noticed that using fertilizer to grow white yam changes the colour of the yam to brown during pounding. Also this could be as a result of soil erosion and nutrient mining as a result of continuous cropping.

The results obtained in this experiment showed that variety does not influence vine length and number of leaves of sweet potato. However, SHABA variety produced significant higher (P ≤ 0.05%) leaf area index. Severity of cutting affected the growth of sweet potato. Sweet potato without cutting had longer vine length, number of leaves, branches and leaf area and leaf area index. This influence of cutting severity on sweet potato shows that harvesting of sweet potato leaves affect growth. This was in line with result by Olorunnisomo (2007) who reported that leaf harvest intensity influences the branching intensity in sweet potato crop. Better growth performance of SHABA variety cut at 15cm could be as a result of the better ability of the variety response to cutting severity . The dry matter yield and total yield of sweet potato was enhanced by variety. Better performance obtained in the SHABA variety could be attributed to the efficiency of the variety in utilization of photosynthates and soil nutrients. Cutting 15cm long apical shoot generally gave higher total tuber yield than cutting at 30cm long apical shoot at 4 weeks. However, better performance was recorded in SHABA variety cut at 15 cm than SPK=004. This indicated that minimal vine cutting in sweet potato does not adversely affect yield of the variety.

Higher nutrient content was recorded in the SPK-004 than SHABA. The higher nutrient content in the less vigorous variety could be as a result of less dilution effect with respect to moisture accumulation by the vigorous variety. Cutting severity at 30 cm had higher nutrient content and the response of each variety to severity of cutting indicated both varieties cut at 30 cm had higher nutrient content. Harvesting of forage at regular intervals is a potent agronomic tool used in maintaining a balance between yield and quality in forage species (Hong et al., 2003). The result obtained in this study on effect of variety on growth of sweet potato shows that variety affects vine length, number of leaves, number of branches and leaf area index. SHABA variety was more vigorous than SPK-004 vine length and Leaf area index.

Conclusion

Severity of apical shoot harvest had effects on the growth of the sweet potato varieties with the best cutting severity being the control with respect to vine length and number of leaves while cutting at 15 cm was the best for number of branches and leaf area.However, cutting at 30 cm increased shoot yield while cutting at 15 cm increased root yield and nutritional value. Furthermore, cutting severity had effect on the growth performance of the sweet potato varieties; SHABA had the best growth performance with respect to vine length, number of branches and leaf area while variety SPK-004 had the best growth performance with respect to the number of leaves. In the study, variety SPK-004 performed better than SHABA with respect to fresh shoot yield while SHABA performed better than SPK-004 with respect to total tuber yield.

Recommendation

Cutting sweet potato apical shoots at 30 cm is recommended for cultivation intended for optimum shoot production while cutting at 15 cm is recommended if the root yield is of interest. Variety SHABA is recommended for production intended for optimum tuber yield while variety SPK-004 is recommended as shoot yield of interest. A repeat of this study is recommended for the purpose of validation, especially in regions where both sweet potato shoot and root production are of significant economic importance.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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