

Effects of number of nodes of sweet potato varieties on yield and yield characteristics

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ABSTRACT

A factorial field experiment was carried out in two planting seasons at Osun State University Teaching and Research Farm to evaluate the effects of number of vines and varieties on the growth and yield components of the sweet potato. The treatments comprised three vine nodes (3, 6, 9) and three varieties (King J., Ex-igbarian, and Mother's delight). These treatments were arranged in a split plot layout and replicated three times. The results revealed that six nodes cuttings used for sweet potato propagation had the best performance for vine length (60 ± 2.60) and survival rate (7.89 ± 1.02), high root number per plant (10 ± 3.94) and vine yield. King J gave the highest value for vegetative propagation, high yield (1.51 ± 0.29) and marketable tuber (10.88 ± 3.47). The stem cutting size had no significant influence on the weight of root per plant. Therefore, farmers are encouraged to reduce the length of planting materials. Also, King J variety and stem cutting size of six nodes are recommended for adoption by farmers.

Keywords: Nodes, Sweet potato, season

INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) is a dicotyledonous plant that belongs to the family *Convolvulaceae* (Tortoe, 2010). It is grown as a starchy food crop throughout the tropical, sub-tropical and frost-free temperate climate zones in the world. Sweet potato is among the world's most important versatile food crop grown generally for its storage roots (Tortoe, 2010). It is a short cycle crop usually matures three up to four months (Anyaeibunam *et al.*, 2008) and may be grown two or three times in a year..

Sweet potato is the seventh among all food crops worldwide from the point of view of

total production, thirteenth in value of production and fifth in caloric contribution to human diet (Choudbury *et al.*, 1986; Tortoe, 2010). China accounts for the highest sweet potato production in the world, followed by Uganda and Nigeria (Udemezue, 2019). In that order, the crop can be considered very important in promoting nutritional security particularly in agriculturally backward areas with poor soils (Mwanja *et al* , 2017). Sweet potato is an important crop worldwide which is cultivated in more than 110 countries on an estimated area of 8.5 million ha. The annual global production of sweet potato is estimated at 106.5 million metric tons of

which 15% is from East and Central Africa. Nine African countries namely Uganda, Nigeria, Tanzania, Angola, Burundi, Mozambique, Madagascar, Rwanda and Ethiopia are among the top 15 sweet potato producers in the world. The other six are China, Indonesia, Vietnam, India, USA and Japan (FAOSTAT, 2015).

Based on Central statistics office (CSO) report of 1993/94 the national average yield of sweet potato in Ethiopia was 7 tons per hectare. However, previous 2006 and 2007 research result of Adami Tulu Agricultural Research Center (ATARC) reported the yield up to 37.1 tons per hectare from improved varieties. The crop is planted using vine cuttings for production. Utilizing the vines as planting material give the farmers the opportunity to use all storage roots for consumption or for sale. The length or the number of nodes per cutting of the vine cuttings varies from farmer to farmer and from location to location (Amoah 1997). Vine cuttings are better planting material in tropical regions than sprouts from tubers for several reasons. Plants derived from vine cuttings are free from soil-borne disease (Onwueme, 1978; Ray and Ravi 2005). By propagating with vine cuttings, the entire tuber harvest can be saved for consumption or marketing instead of reserving some of it for planting purposes and vine cuttings yield better than sprouts, and produce roots of more uniform size and shape.

There are conflicting results regarding the optimum length of vine cuttings. Onwueme (1978) indicated that tuber yield tends to increase with increase in the length of the vine cuttings used, and recommended a length of about 30 cm (9-node numbers per cutting). Cuttings longer than 30 cm tend to be wasteful of planting material, while much shorter cuttings established slower, and gave poorer yields

Yield of sweet potato could be improved by the use of good planting materials. The most common method of sweet potato propagation is by the use of vine cuttings (Tanaka *et al.*, 2017). In many places, farmers use any length of cuttings which are available or convenient to handle. Some farmers use short cuttings for planting just because they are easy for handling or in order to economize the planting materials. Others also take very long cuttings, fold them several times and insert them in the soil. In other places, after harvesting the previous crop, the vines left on the field to grow again without any organized propagation (Amoah, 1997). Vine cuttings stored under shade in the main field for 3 days produced plants with highest marketable root yield followed by 4 days old cuttings (Essilfie *et al.*, 2016). Cut vines with intact leaves are stored under shade for two days prior to planting in the main field to promote better root initiation, easy establishment of vines and higher root yield (Yoshimoto, 2010).

Storing of vines for a long time caused failure of establishment in the field due to drying. Planting of sweet potato vine cuttings is preferably done as soon as possible, after they are selected and cut. However, this may not always be possible, for instance, when it is too hot, when the field is not ready yet, labor for planting may be scarce, or due to any other reasons. Cuttings can be kept for a maximum of seven days, before losing condition that leads to large reduction in storage root yield. Storing vine cuttings for 1 - 3 days does not affect the final yield (Ahmad *et al.*, 2014). Kaundo., (2016) cited that in order to preserve the food reserves in the stem, most of the leaves on the cuttings should be removed, leaving only a few leaves at the tip. Then the cuttings are tied in small

bundles with their bases covered with a wet cloth or sack. The bundles are kept in a cool and shady place. Alternatively, may be partially buried in a narrow trench under the shed of a tree with the vines spread out along the trench, with two-thirds of the vines under the soil surface.

Despite the high potentials of sweet potato as a short duration crop (3-4 months) that could be cropped more than once a year, its production is faced with constraints such as low yielding varieties, difficulty in maintaining the vines (planting material) during the dry season when water is scarce, scarcity of vines as planting material, inbreeding depression as a result of continuous use of vines as planting material which is characterized by decrease in vigor and yield. It is against this that the study sought to investigate the effect of nodes numbers on sweet potato growth and yield. Therefore, the objective of this study is to determine the effect of number of nodes on growth and yield of sweet potato varieties.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at Osun State University, Teaching and Research Farm in two seasons. The climate of the experimental site is humid and it is located in the rain forest vegetation zone of Western Nigeria. The farm is located on latitude 7°54N and Longitude 4°18E at an altitude 426m above sea level

Land Preparation

After the selection of a suitable land for the trial (a loamy or sandy soil with neutral pH) operations such as land preparation involving incorporation of crop debris and other weeds was carried. Ridging was done with traditional hoe.

Experimental Design

The experiment was designed in a split plot arrangement whereby number of nodes were the main plot and varieties were the subplot. The number of nodes (3,6,9) and the varieties (King J, Ex-Igbarian and Mothers delight) were replicated three times in a Randomized Complete Block Design (RCBD)

Planting Operation

Vines cutting with three different numbers of nodes were planted on ridges. The nodes of experimental sweet potato with varying nodes number three, six and nine nodes respectively were cut with sharp knife and planted with two-third of the vine planted below the soil. The vines cuttings were planted on a row spacing of 1m apart and with 0.3 m spacing within the row.

Post Planting Operation

Weeding: weeding was consistently carried out with the use of hand, cutlass and hoe to keep the plot weed-free throughout the growing period. Atrazine was applied at week four for pest control.

Harvesting: Harvesting of the root tuber crop was done after twelve (12) weeks i.e. three months and necessary yield parameters were measured.

Data collection

Data's were collected on growth parameters and yield parameters of the crop in each plot. The growth parameters collected includes

- Survival rate at two weeks
- Vine length 7 WAP
- Number of branches 7 WAP
- Leaf Area of the most expanded leaf

The yield parameters collected includes

- Root weight per plant (g)
- Number of tuber per plant
- Root yield (t/ha)
- Root crack
- Root formation
- Number of marketable roots
- Number of non-marketable roots

Statistical Analysis

All data collected were subjected to Analysis of variance (ANOVA) using Statistical Analysis Software (SAS, 2009). Treatment means were separated using Least Significant difference (LSD) at 5% probability level.

RESULT

Effects of varieties on growth characters of Sweet potato

Growth performance of three varieties of Sweet potato is given in Table 1. The result revealed significant ($P \leq 0.05$) difference among the varieties for vine length, survival rate and vine weight. King J variety showed the highest value for vine length (64.31 ± 2.25 cm) while Mother's delight showed the least value (49.89 ± 1.94 cm). Furthermore, Ex-igbarian variety gave the highest value for survival rate (8.67 ± 0.58) and vine weight (4.54 ± 0.44) while Mother's delight gave the highest value for survival rate (8.44 ± 0.55) and vine weight (3.20 ± 0.50).

Effects of varieties on morphological characters of Sweet potato

The effect of varieties on morphological characters of Sweet potato is displayed in Table 2. Mother's delight showed the highest value for root number (19.00 ± 1.23), root crack (2.00 ± 0.5), Root form (5.89 ± 0.38) and Root shape (6.00 ± 0.88) while Ex-igbarian variety showed the least value with (15.67 ± 1.22), root crack (0.38 ± 0.44), Root form (4.56 ± 0.29) and

Root shape (3.44 ± 0.47) with a significant ($P \leq 0.05$) difference observed for root crack and root shape.

Effects of varieties on morphological characters of Sweet potato

The effects of varieties on yield characters of sweet potato is displayed in Table 3. King J variety showed the highest value for number of root per plant (11.25 ± 3.47), weight per plant (1.51 ± 0.29), number of non-marketable size of root (1.41 ± 0.29) and number of marketable size of root (10.88 ± 3.47) while Ex-igbarian showed the least value for number of root per plant (4.78 ± 0.86), weight per plant (0.57 ± 0.18), number of non-marketable size of root (0.61 ± 0.15) and number of marketable size of root (4.88 ± 0.86).

Table 1: Effects of varieties on growth characters of Sweet potato

Varieties	Vine Length	Survival rate	Vine Weight
King J.	64.31±2.25 ^a	5.44±1.03 ^b	4.16±0.57 ^a
Ex-igbarian	59.40±1.50 ^a	8.67±0.58 ^a	4.54±0.44 ^a
Mother's delight	49.89±1.94 ^b	8.44±0.55 ^a	3.20±0.50 ^a

Key: ^{ab}= means on the same row with different superscripts are significantly different (P<0.05).

Table 2: Effects of varieties on morphological characters of Sweet potato

Varieties	Root number	Root Crack	Root form	Root Shape
King J.	18.88±1.23 ^a	0.67±0.44 ^b	5.29±0.52 ^a	5.38±1.02 ^{ab}
Ex-igbarian	15.67±1.22 ^a	0.38±0.38 ^b	4.56±0.29 ^a	3.44±0.47 ^b
Mother's delight	19.00±1.23 ^a	2.00±0.5 ^a	5.89±0.48 ^a	6.00±0.88 ^a

Key: ^{ab}= means on the same row with different superscripts are significantly different (P<0.05).

Table 3: Effects of varieties on yield characters of Sweet potato

Varieties	Number of Root Per Plant	Weight per plant	Number of non-marketable size of root	Number of Marketable size of root
King J.	11.25±3.47 ^a	1.51±0.29 ^a	1.41±0.29 ^a	10.88±3.47 ^a
Ex-igbarian	4.78±0.86 ^a	0.57±0.18 ^b	0.61±0.16 ^b	4.73±0.86 ^b
Mother's delight	6.22±5.33 ^a	0.67±0.14 ^b	0.62±0.15 ^b	8.67±5.33 ^a

Key: ^{ab}= means on the same row with different superscripts are significantly different (P<0.05).

Effect of various nodes on selected growth characteristics of three varieties of Sweet potato.

The effect of different number of nodes on growth characters of sweet potato is displayed in Table 4. Vines with 6 number of nodes showed the highest value for vine length (60.86±2.06) and survival rate of (7.89±1.02) while usage of 3 number of nodes showed the lowest value for vine length (52.92±2.23) and survival rate (6.75±0.75). Furthermore, vines with 9 number of nodes showed the highest value for vine weight (5.71±0.72) while vine with 3 number of nodes showed the least value (2.71±0.39).

Effect of various nodes on selected morphological characteristics of three varieties of Sweet potato.

The effects of vine length on morphological characters of Sweet potato is shown in Table 5. Vines with 3 number of nodes showed the lowest value for number of root (16.00±4.56), root crack (0.37±0.38) and root shape (3.75±0.79). However, vines with 6 number of nodes showed the highest value for number of root (19.75±3.19) while 9 number of nodes showed the highest value for root crack (1.67±0.53) and (4.78±1.09).

Effect of various nodes on selected yield characteristics of three varieties of Sweet potato.

The effect of number of nodes on the yield characters of sweet potato is shown in Table 6. Vines with 6 number of nodes was observed to give the highest value for number of root per plant (10.00 ± 3.94) while 3 number of nodes showed the least

value for (4.00 ± 1.46). Furthermore, vines with 9 number of nodes showed the highest value for root weight per plant (1.14 ± 0.21), number of non-marketable size root (1.12 ± 0.21) and marketable size root (11.40 ± 5.11) while vines with 3 number of nodes showed the least value for the same characters 0.70 ± 0.14 , 0.50 ± 0.28 and 3.46 ± 0.53 respectively.

Table 4: Effects of number of nodes on growth characters of Sweet potato

Number of Nodes	Vine Length	Survival rate	Vine Weight
3	52.92 ± 2.23^b	6.75 ± 0.75^a	2.71 ± 0.39^b
6	60.86 ± 2.06^a	7.89 ± 1.02^a	3.32 ± 0.49^b
9	59.53 ± 2.03^a	7.80 ± 0.87^a	5.71 ± 0.72^a

Key: ^{ab}= means on the same row with different superscripts are significantly different ($P < 0.05$).

Table 5: Effects of vine cutting length on morphological characters of Sweet potato

Number of Nodes	Root number	Root form	Root Crack	Root Shape
3	16.00 ± 4.56^a	5.25 ± 0.20^a	0.37 ± 0.38^b	3.75 ± 0.79^a
6	19.75 ± 3.19^a	5.25 ± 0.59^a	1.00 ± 0.5^{ab}	4.33 ± 0.67^a
9	17.89 ± 3.26^a	5.22 ± 0.52^a	1.67 ± 0.53^a	4.78 ± 1.09^a

Key: ^{ab}= means on the same row with different superscripts are significantly different ($P < 0.05$).

Table 6: Effect of number of nodes on the yield characters of Sweet potato

Number of Nodes	Number of Root Per Plant	Weight per plant	Number of non-marketable size of root	Number of Marketable size of root
3	4.00 ± 1.46^b	0.70 ± 0.14^a	0.50 ± 0.28^a	3.46 ± 0.53^b
6	10.00 ± 3.94^a	0.93 ± 0.28^a	0.90 ± 0.20^a	8.59 ± 3.27^a
9	7.44 ± 1.53^a	1.14 ± 0.21^a	1.12 ± 0.21^a	11.40 ± 5.11^a

Key: ^{ab}= means on the same row with different superscripts are significantly different ($P < 0.05$).

DISCUSSION

Percentage of sprouting depended on variety, and difference were attributed to difference in length of internodes among the varieties. Longer vines result in wastage of planting material, while shorter ones establish more slowly and give

poorer yield (Kaundo, 2016). King J had longest vine length while Mother's delight variety had the shortest vine length. This implies that for Mother's delight, the vine exposed was liable to dessication due to environmental conditions. The number of roots per plant is varietal characteristic,

and it is expected that less adapted variety, like Ex-igbarian should have the least number of roots per plant. The same applies to number of marketable roots per plant. Ex-igbarian had the lowest marketable roots per plant due to the limited number of root. Furthermore, with more nodes on the vine, number of buds increases which implies increased chance of growth for rooting and sprouting. The use of six nodes gave the longest vine length, this observation corroborates with the report by Amoah (1997) who revealed that cuttings with more than 5 nodes attained 100% establishment earlier than cuttings with fewer nodes. The findings also agrees with the report. The significant influence of number of nodes on the total number of roots, root yield, and marketable roots yield could be explained and related to vine length with 9 number of nodes providing more points for tuber root initiation. According to Amoah (1997), tuber initiation and bulky begins earlier on cuttings with more nodes than those with fewer nodes as a result of the early rapid growth which translated into higher roots yield and greater marketable roots. This might be due to the development of more roots on cuttings with more nodes. However, tubers on such plants are highly to be smaller due to competition among the roots for available nutrients and assimilate.

CONCLUSION

The results of this study revealed that cuttings used for sweet potato propagation should contain at least six nodes for optimum vegetative growth, high yield and marketable tuber which could help the farmers increase root yield and good plant growth. In the same vain, King J variety of sweet potato which gave the highest performance for vegetative characteristics, high yield and marketable tuber could be adopted as a good variety for high productivity.

Therefore, planting of King J variety of sweet potato with vine cutting of six nodes is recommended for optimum productivity in the production area similar to the trial location.

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