International Journal of Plant & Soil Science
9(5): 1-14, 2016; Article no.IJPSS.22776
ISSN: 2320-7035

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Number of Nodes and Part of Vine Cutting Effect on the Growth and Yield of Sweetpotato *(Ipomoea batatas (L.)* Lam) in Transitional Zone of Ghana

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Authors' contributions

This work was carried out in collaboration between all authors. Author HKD designed the study, wrote the protocol, analyzed data and edited manuscript. Author MEE was involved in the design of the study, carried out the field work and wrote the first draft. Author KD collected and compiled data. Author JWT managed the literature searches and critically reviewed the first draft. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2016/22776
Editor(s):
(1) Marco Trevisan, Institute of Agricultural Chemistry and Environmental Research Centre BIOMASS, Faculty of Agriculture, Catholic University of the Sacred Heart, Italy.
Reviewers:
(1) Shelley Gupta, P G Moze College of Engineering, Pune, India.
(2) Mohammad Arif, Kansas State University, Kansas, USA.
Complete Peer review History: http://sciencedomain.org/review-history/12726

Original Research Article

Received 26th October 2015
Accepted 23rd November 2015
Published 18th December 2015

ABSTRACT

Two field experiments were conducted at the Multipurpose crop nursery of the University of Education, Winneba, Mampong campus from May to September, 2013 and June to October, 2014 respectively to investigate into the effect of number of nodes (4, 5 and 6) and vine part (apical and semiwoody) on the growth and yield of sweetpotato. The results from both seasons showed that many of the characters measured increased with increase node number up to 6 nodes and with apical vine part. The apical vine cuttings established earlier than semiwoody cuttings in both seasons. Node numbers did not have significant effect on any of the yield characters measured although the 5 and 6 node cuttings gave higher marketable tuber weight per plot, tuber length and marketable tuber number per plot than the 4 node cuttings during 2014 growing season. The 5 node apical cuttings produced significantly higher vegetative biomass than 5 node semiwoody and the 4 and 6 node apical and semiwoody cuttings.

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Keywords: Sweetpotato; apical vine cutting; number of nodes; semiwoody vine cutting.

1. INTRODUCTION

Among the root and tuber crops grown in the world, sweetpotato ranks second after cassava [1]. Sweetpotato has one of the highest dry matter productivity rates among crops [2]. The crop produces 152 MJ ha^{-1} day^{-1} calories as compared to 121 MJ ha^{-1} day^{-1} in cassava, 151 MJ ha^{-1} day^{-1} in rice, 135 MJ ha^{-1} day^{-1} in wheat and 159 MJ ha^{-1} day^{-1} in maize [3]. The carbohydrate rich root is used as subsidiary food after boiling or baking. In some countries the vine tops are used as vegetables. In previous studies in Ghana, consumers accepted and utilized sweetpotato leaves as food through modified and culturally-acceptable traditional recipes [4]. 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 [5]. The average storage root yield of sweetpotato varies between 10 and 28 t ha^{-1} [3]. When compared with other root and tuber crops, sweetpotato yields considerably high amount of energy per unit area such that it comes third to the potato (*Solanum tuberusom*) and cassava (*Manihot esculenta*) in production across the world [6]. The Crop Research Institute of the Council for Scientific and Industrial Research (CSIR-CRI) in Ghana has developed the *Okumkom* variety of sweetpotato which has a yield capacity of over 19 t ha^{-1} and are for human consumption as *'ampesi'* and chips. Important as it is, the crop has hitherto received little attention from consumers in Ghana. Sweetpotato appears to be the least recognized by both farmers and consumers. This is probably because the crop is considered poor man's food and also as a dessert rather than as a staple food even though it is comparable to the other root crops in yield and quality. Yields of sweetpotato could be improved by the use of good planting materials in terms of number of nodes and part of vine used.

Vine cuttings of sweetpotato are better planting materials than sprouts from vine cutting free from soil-borne diseases [7]. Yield of sweetpotato could be improved by the use of good planting materials. Cuttings from the apical portion of the shoot are regarded as a better planting material than middle or basal vine cuttings [8,9]. Apical cuttings may ensure better rooting and establishment and faster shoot growth and therefore early closure for weed suppression [10,8]. The apical and middle portion vine cuttings are also regarded to be the best planting materials for getting higher root yield [11]. Basal vine cuttings are usually thick and woody, sometimes fail to establish and there is a greater chance of weevil incidence due to proximity with the crown portion where sweetpotato weevil multiplies [12]. Cuttings from apical shoot grow more vigorously and produce large storage roots compared with cuttings from middle and basal portions. Tewe et al. [13] reported that apical cuttings of sweetpotato had significantly higher marketable and total tuber yield than the middle followed by the basal cuttings. Cuttings from the shoot apex give more branches due to the fact that they establish quickly in the soil by initiating more roots and thereby encourage subsequent production of branches and greater number of root tubers than semi hardwood and hardwood cuttings [14].

The number of nodes on cuttings used as planting material may be an important aspect of yield variability. Increase in node number might result in more nodes buried and more roots initiated from the nodes for early establishment. In higher node number cuttings, early rapid growth, tuber initiation and bulking began earlier than in lower node number cuttings. This translates into higher tuber yield in the higher node number cuttings. Onwueme and Sinha [15] indicated that tuber yield tends to increase with increase in the length of the vine cutting used and a length of about 30 cm is recommended. Cuttings of greater length than this tend to be wasteful of planting material, while shorter cuttings establish more slowly, and give poor yields. Farmers in Ghana generally use long lengths of vine as planting material obtained from established sweetpotato field. This method uses quite a lot of plant material that if taken from older portions of the vine may be a potential source of insect pests and diseases [16]. The length of vine and the part used may affect the growth and yield of sweetpotato favourably or unfavourably. Most farmers plant the crop using the vine cuttings irrespective of the number of nodes and part of vine cutting. The agronomy of sweetpotato is well documented. Nevertheless, understanding the effect of number of nodes and part of vine cutting on growth and development is important for improving the yield and quality of sweetpotato. The objective of this study was to assess the effect of number of nodes and part of vine cutting on the growth and yield of *Okumkom* variety of sweetpotato in the transitional zone of Ghana.

2. MATERIALS AND METHODS

Two field experiments were conducted at the Multi-purpose crop nursery of the University of Education, Winneba, Mampong-Ashanti campus from May to September, 2013 and June to October, 2014 respectively. The soil type is the savanna ochrosol formed from the Voltaian sandstone of the Afram plains. Texturally, the soil is friable with a thin layer of organic matter and is deep and brown-sandy loam and well-drained. It however has a good water-holding capacity. The soil has been classified by FAO / UNESCO legend as Chronic Luvisol and locally as the Bediesi series with a pH range of 4.0-6.5.The weather conditions during the experimental periods are summed up in Tables 1 and 2.

The planting material used for the study was vine cuttings of *Okumkom* variety of sweetpotato obtained from Crop Research Institute of CSIR at Fumesua near Kumasi. The experimental design was a 2 x 3 factorial arranged in randomized complete block design (RCBD) with three replicates made up of three number of nodes (4, 5 and 6) and two parts of vine cuttings (apical and semiwoody) was assigned to each block. Each treatment plot measured 4.0 m x 3.0 m. Ridges were constructed 1.0 m between rows and planted at 0.3 m within row plants.

Vine cuttings of sweetpotato variety *Okumkom* of node numbers 4, 5 and 6 and topmost apical and semiwoody sections were planted after preparation of ridges. Number of branches were counted on three plants from the two central rows and three plants were also randomly sampled for vine length, vine diameter, fresh and dry matter accumulation. Data were collected from four weeks after planting and at two weeks interval for twelve weeks. Percentage crop establishment was estimated by counting the number of vine sprouted and established from the two central rows and the percentage estimated for each treatment plot. Fresh vine weight and tuber dry weight at harvest, number of marketable and unmarketable tubers, marketable and unmarketable tuber weight, tuber yield, and yield components including tuber length, tuber diameter, percentage pest infested tuber were estimated from the two central rows. Data analysis was done using ANOVA and Genstat Statistical Package. Least Significant Difference (LSD) was used to separate means at 5% level of probability.

3. RESULTS AND DISCUSSION

3.1 Percentage Crop Establishment

The percentage crop establishment during the 2013 and 2014 growing seasons range from (79.6 – 98.1) and (72.2-92.6), respectively. There was no significant difference between node numbers (4, 5 and 6) in percentage crop establishment during the 2013 and 2014

Table 1. Climate data for 2013 rainy season for experiment one (1)

Month	Total rainfall (mm)	Mean relative humidity (%)		Mean temperature (℃)	
		06:00 h	15:00 h	Min	Max
May	207.4	97	62	22.7	31.6
June	114.9	96	67	22.6	30.0
July	138.0	97	72	21.9	48.3
August	6.0	95	70	21.5	27.7
September	219.8	97	69	22.9	29.6
Total	686.1				

Meteorological Department – Mampong Ashanti, (2013)

Table 2. Climate data for 2014 rainy season for experiment two (2)

Month	Total rainfall (mm)	Mean relative humidity (%)		Mean temperature (℃)	
		06:00 h	15:00 h	Min	Max
June	268.0	97	67	23.0	30.4
July	71.6	96	71	22.2	28.7
August	56.4	96	73	21.8	28.0
September	113.2	95	72	22.4	29.2
October	180.1	97	64	22.5	31.0
Total	689.3				

Meteorological Department – Mampong Ashanti, (2014) growing seasons although 6 node cuttings produced higher percentage establishment during the 2013 growing season than in the 2014 growing season (Table 3). This might be due to the fact that with increase in node number, the number of buds increased and these acted as sources of hormones for rooting and sprouting. The increase in percentage establishment with increase in number of nodes per cutting is in agreement with Amoah [17] that the 5- node and 7- node cuttings took significantly less number of days to achieve 100 percent establishment than the 3- node cuttings. The apical vine part had significantly higher percentage crop establishment than the semiwoody vine part. This might be due to actively growing portion of the vine part coupled with reduction in weed competition for good plant growth later during the season [10]. There was no significant difference between node numbers in percentage crop establishment. This might be attributed to the fact that with increasing node number, vine cutting use for planting tends to be wasteful while shorter cutting establish more slowly [15].

Table 3. Percentage crop establishment (%) during 2013 and 2014 experimental periods

Treatment	2013	2014
4 nodes + apical vine part	94.4	92.6
4 nodes + Semi Woody part	79.6	72.2
5 nodes + apical vine part	90.7	88.9
5 nodes + Semi Woody part	85.2	83.3
6 nodes + apical vine part	98.1	87.0
6 nodes + Semi Woody part	83.3	74.1
Mean	88.6	83.0
LSD (P=0.05) node	NS	NS
LSD (P=0.05) Vine part	6.74	NS
LSD (P=0.05)Node + Vine part	NS	NS
% CV	9.73	11.11

A substantially higher percentage crop establishment was produced during the 2013 growing season than during the 2014 growing season. This might be due to initial higher rainfall experienced during the 2013 growing season (Table 3).

3.2 Vegetative Growth

3.2.1 Vine fresh weight, vine dry weight and root dry weight

Vine fresh weight, vine dry weight and root dry weight with the different node numbers (4,5 and 6) and vine part (apical and semiwoody cuttings) did not differ significantly from treatments in both 2013 and 2014 growing seasons (Figs. 1, 2 and 3). The lack of significant response showed by the different node numbers and vine part might be attributed to the innate characteristics of the sweetpotato variety, *Okumkom* used for the study. *Okumkom* can colonize or establish on marginal soils in spite of the prevailing climatic conditions of the growing area. It readily produces adventitious roots, trailing vines and exhibits aggressive ground cover [18].

3.3 Vine Length

Vine length of sweetpotato grown during the 2013 growing season with semiwoody vine part was significantly higher than the apical vine cutting (Fig. 4). The 4 node apical cutting produced higher vine length compared with 5 and 6 node cuttings at 86 days after planting (DAP) in both growing seasons. This result however, contradicts the report of Ray et al. [6] who reported that increasing the number of nodes increased vine length. Apical and semiwoody cuttings with 4, 5 and 6 nodes grown during the 2014 growing season produced higher vine length than in 2013. This might be due to better climatic condition experienced during the 2014 growing season than 2013 season. The result is in conformity with the report of Rasco et al. [19] that field and environmental conditions may influence the relationship between cutting length of sweetpotato and the crop improvement.

3.4 Number of Branches

The interaction between number of nodes and vine part was significant in number of vine branches during the 2013 and 2014 growing seasons (Fig. 5). The 5 nodes apical cutting produced higher numbers of branches from 58 DAP to 86 days after planting in both growing seasons than 4 and 6 nodes apical cutting. However, the 4 nodes semiwoody cutting produced higher number of branches from 58 DAPS to 86 days after planting in both growing seasons than 5 and 6 nodes semiwoody cutting (Fig. 5). This might be due to differences in node number and vine part used as planting material. This result is in agreement with Mukhopathyay et al. [11] that apical and semiwoody portions of vine cutting are found to be the best planting materials for getting higher root yield which is as a result of production of higher number of vine branches.

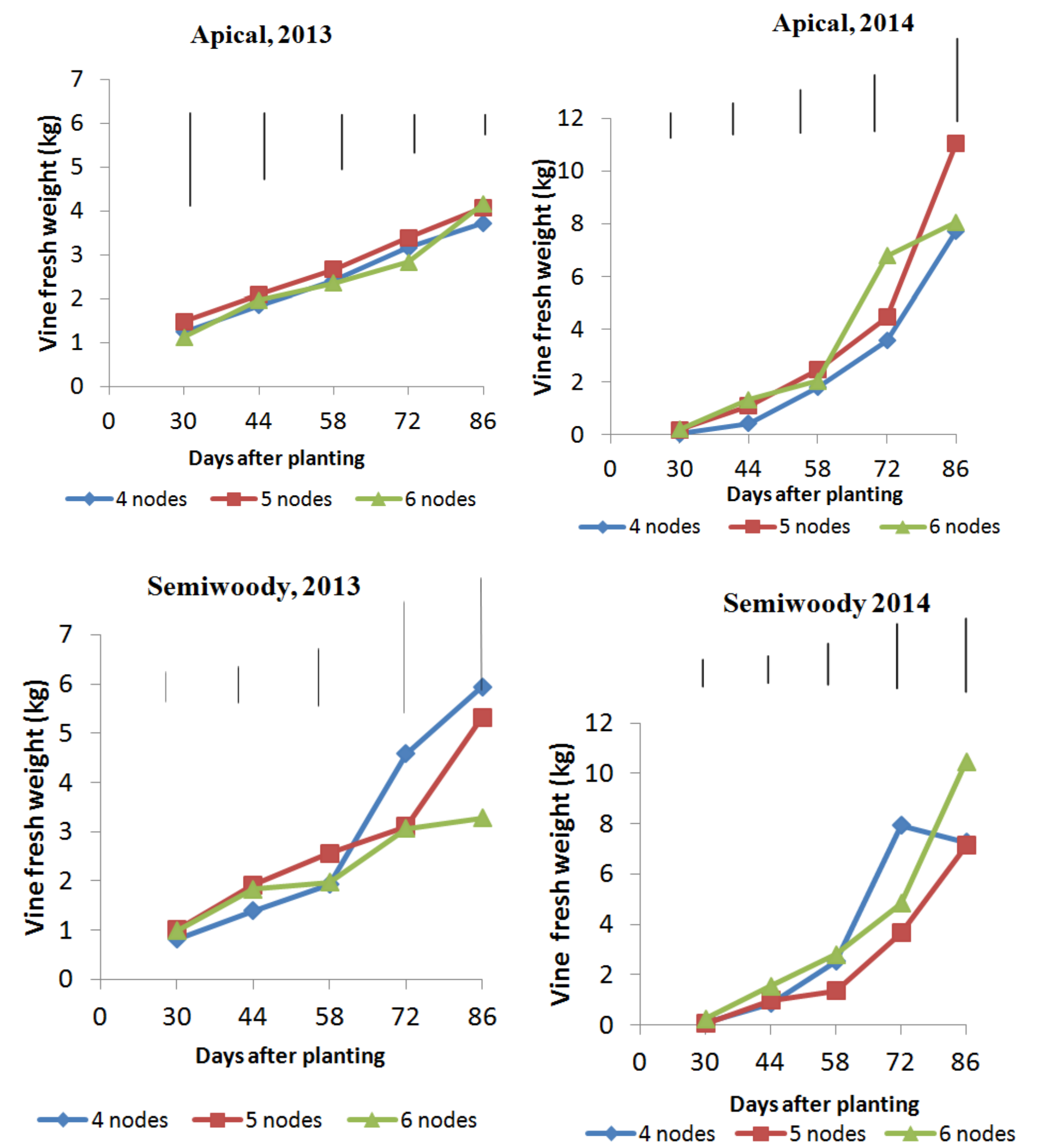

Fig. 1. Vine fresh weight of apical and semiwoody cuttings 30-86 days after planting during 2013 and 2014 growing seasons

There was a significant difference between apical and semiwoody vine cutting in number of branches during both growing seasons (Fig. 5). This result is similar to that found by Choudbury et al. [14] that cuttings from the shoot apex give more branches due to the fact that they establish quickly in the soil by initiating more roots and thereby encourage subsequent production of branches than semi hardwood cuttings. Degras [20] also reported that for better performance of sweetpotato the apical vine cuttings are the best planting material to use.

3.5 Vine Diameter

The 5 nodes apical cutting produced higher vine diameter from 58 DAP to 86 days after planting in both growing seasons than 4 and 6 nodes apical cutting (Fig. 6). The increase in stem diameter with 5 node apical cuttings in both growing seasons might be due to its early establishment than the 4 and 6 node cuttings and this agrees with the findings of [17]. However, the 4 nodes semiwoody cutting produced higher vine diameter from 58 DAP to 86 days after planting with the lowest recorded by the 5 nodes cutting in both growing seasons. This might be due to differences in node number and its interaction with the environment. Semiwoody vine part is also regarded to be one of the best planting material and this is in agreement with the findings by Mukhopathyay et al. [11].

3.6 Yield and Yield Components of Sweetpotato

3.6.1 Number of marketable tubers per plot

Apical vine with 4 and 6 nodes had higher number of marketable tuber per plot for 2013 and 2014 growing season respectively. Apical vine part produced significantly higher number of marketable tubers per plot than semiwoody vine during the 2013 growing period (Table 4). A significantly higher number of marketable tubers per plot with apical vine part might be due to more vigorous growth and actively growing part of the vine [8, 10 and 13] indicated that apical cutting ensure better rooting and establishment and faster shoot growth and also getting higher marketable root tubers [11]. In the 2013 growing season both apical and semiwoody vines with 4, 5 and 6 nodes had higher number of marketable tubers per plot than during the 2014 season. The lower number of marketable tubers per plot for apical vine part with 4 and 6 nodes during 2014 growing season might be due to higher rainfall during tuber formation stage that resulted in the higher vegetative growth at the expense of tuber formation [21].

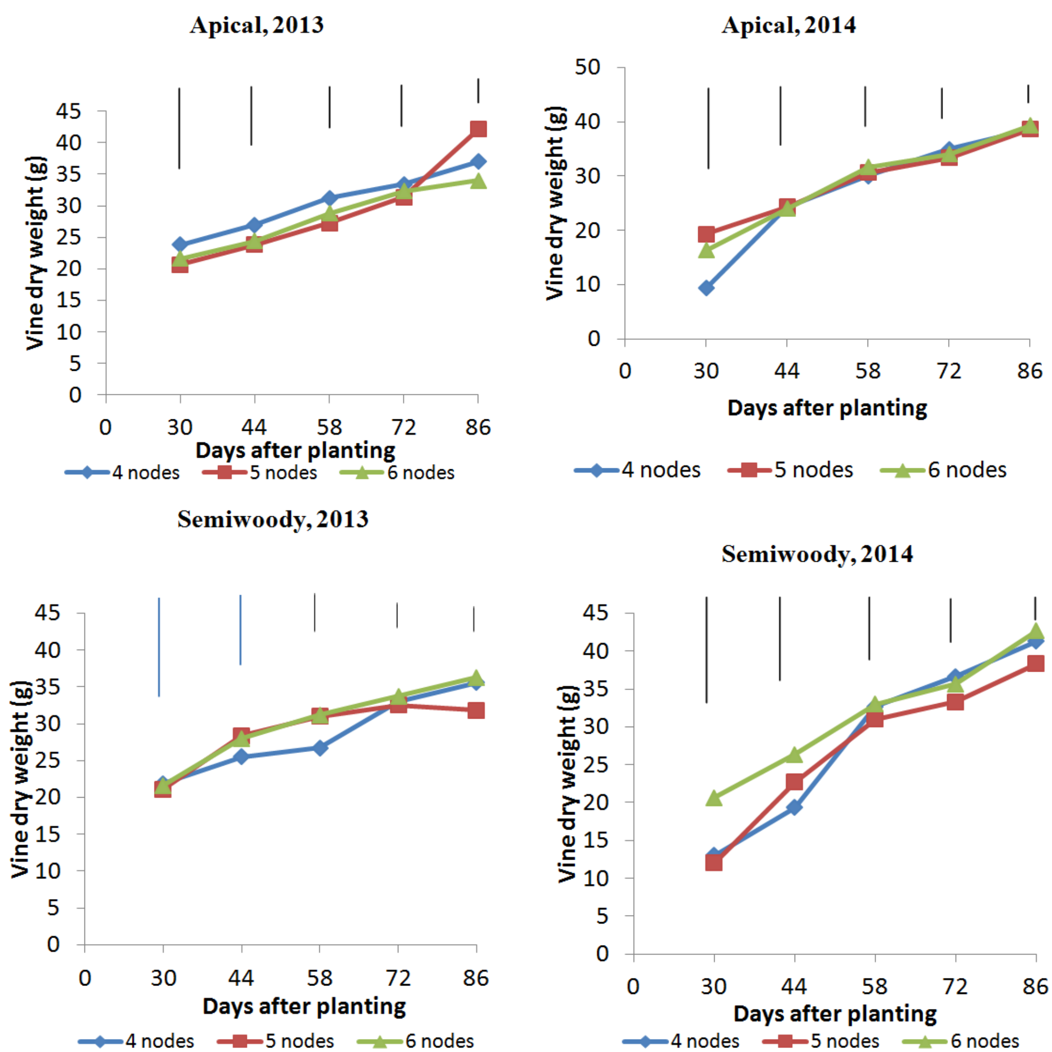

Fig. 2. Vine dry weight of apical and semiwoody cuttings 30-86 days after planting during 2013 and 2014 growing season

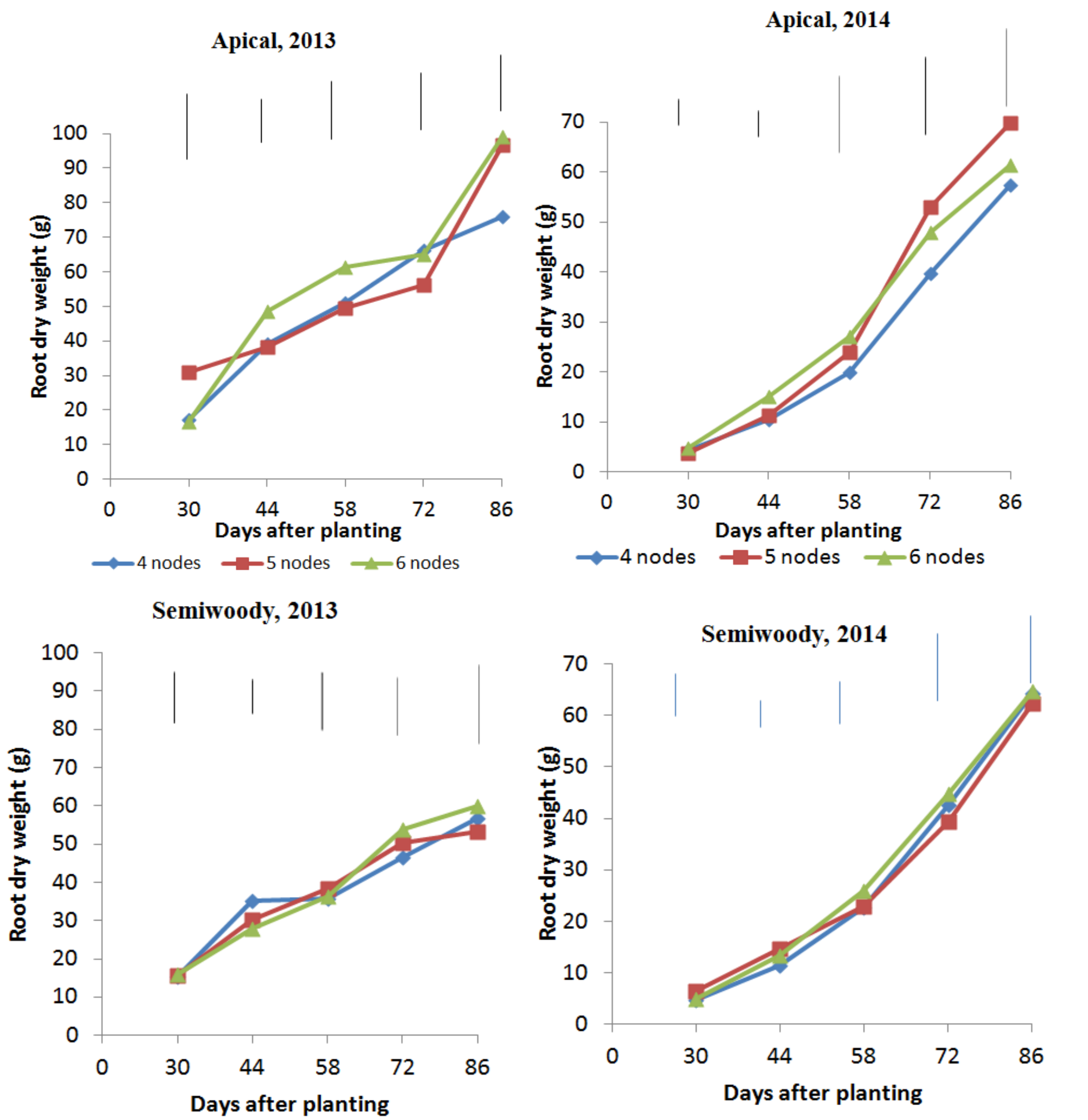

Fig. 3. Root dry weight of apical and semiwoody cuttings 30-86 days after planting during 2013 and 2014 growing seasons

Table 4. Number of marketable tuber per plot during 2013 and 2014 experimental periods

Treatment	2013	2014
4 nodes + apical vine part	52.0	11.0
4 nodes + Semi Woody part	31.0	20.0
5 nodes + apical vine part	50.0	29.0
5 nodes + Semi Woody part	39.0	17.0
6 nodes + apical vine part	45.0	32.0
6 nodes + Semi Woody part	32.0	21.0
Mean	41.4	21.6
LSD (P= 0.05) Node	NS	NS
LSD (P= 0.05) Vine part	9.09	NS
LSD (P= 0.05) Node x Vine part	NS	NS
%CV	46.60	66.44

3.6.2 Number of unmarketable tubers per plot

There was a significantly higher number of unmarketable tuber per plot between apical vine part from semiwoody vine part during 2013 growing season (Table 5). This might be due to higher number of branches produced by the apical vine cutting than the semiwoody cuttings that resulted in more tuberous root formation than the semiwoody [14]. There was however, no significant difference between node numbers (4, 5 and 6) in unmarketable tuber per plot. In the case of 2014 growing season, there was no significant difference between node number and vine part. In the 2013 growing season higher number of unmarketable tubers was produced than in the 2014 growing season. This might be due to initial higher rainfall during the 2013 growing season. [21] indicated that excessive rain prevent proper root formation and that luxurious growing condition caused by excessive irrigation lead to luxurious vine growth that result in poorly developed roots.

3.7 Tuber Length

There was no significant difference between node numbers (4 ,5 and 6) and vine part (apical and semiwoody) in tuber length during the 2013 and 2014 growing seasons although apical and semiwoody cuttings with node numbers (4, 5 and 6) produced higher tuber length during the 2014 growing season than in the 2013 growing season (Table 6). The reduction in tuber length during the 2013 growing season might be due to initial drought experienced during tuber formation stage for the growing period. Similarly, the higher rainfall during the 2014 growing season might have contributed to the result obtained. Similar result was found in [22,16] who indicated that irrigation generally increase yields and improve the quality of storage roots of sweetpotato.

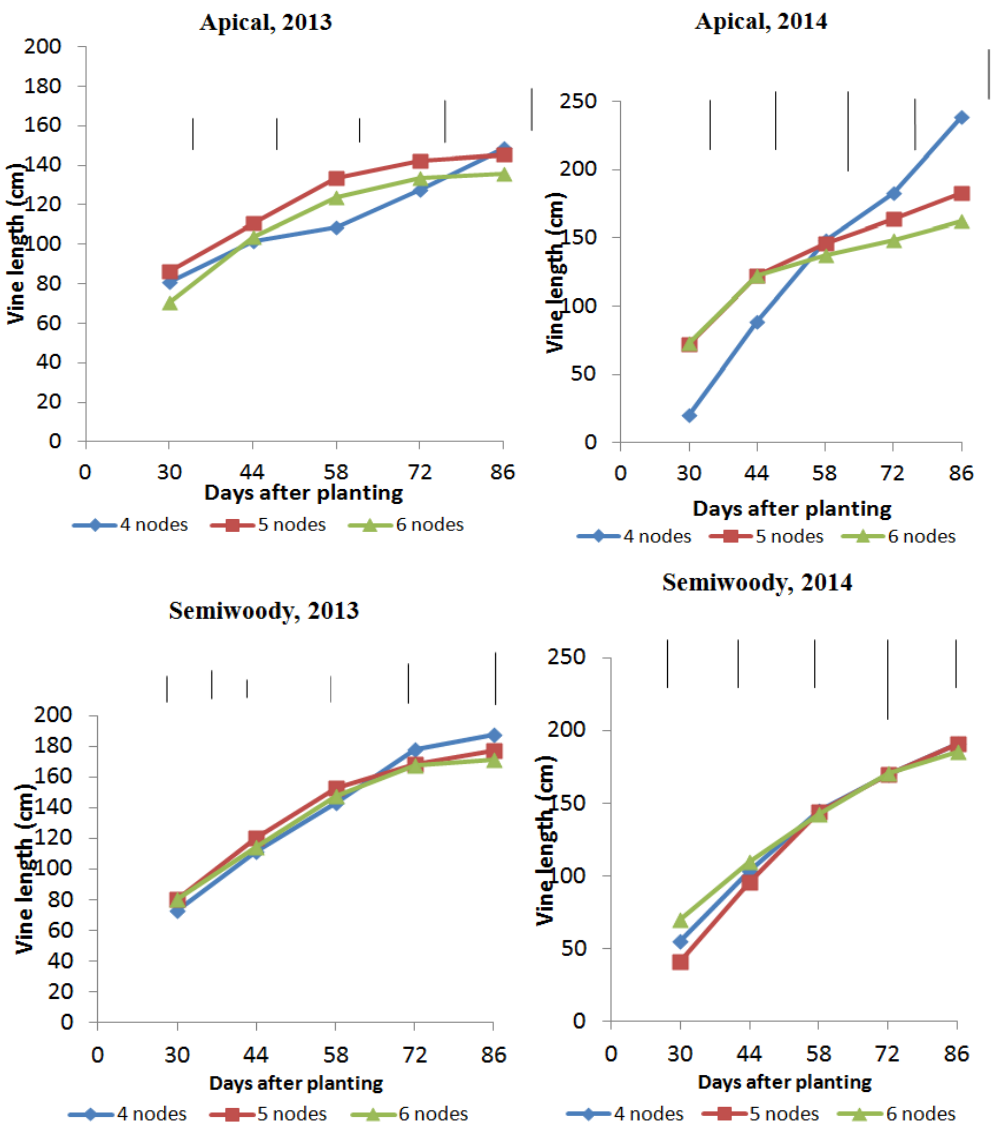

Fig. 4. Vine length of apical and semiwoody cuttings 30-86 days after planting during 2013 and 2014 growing seasons

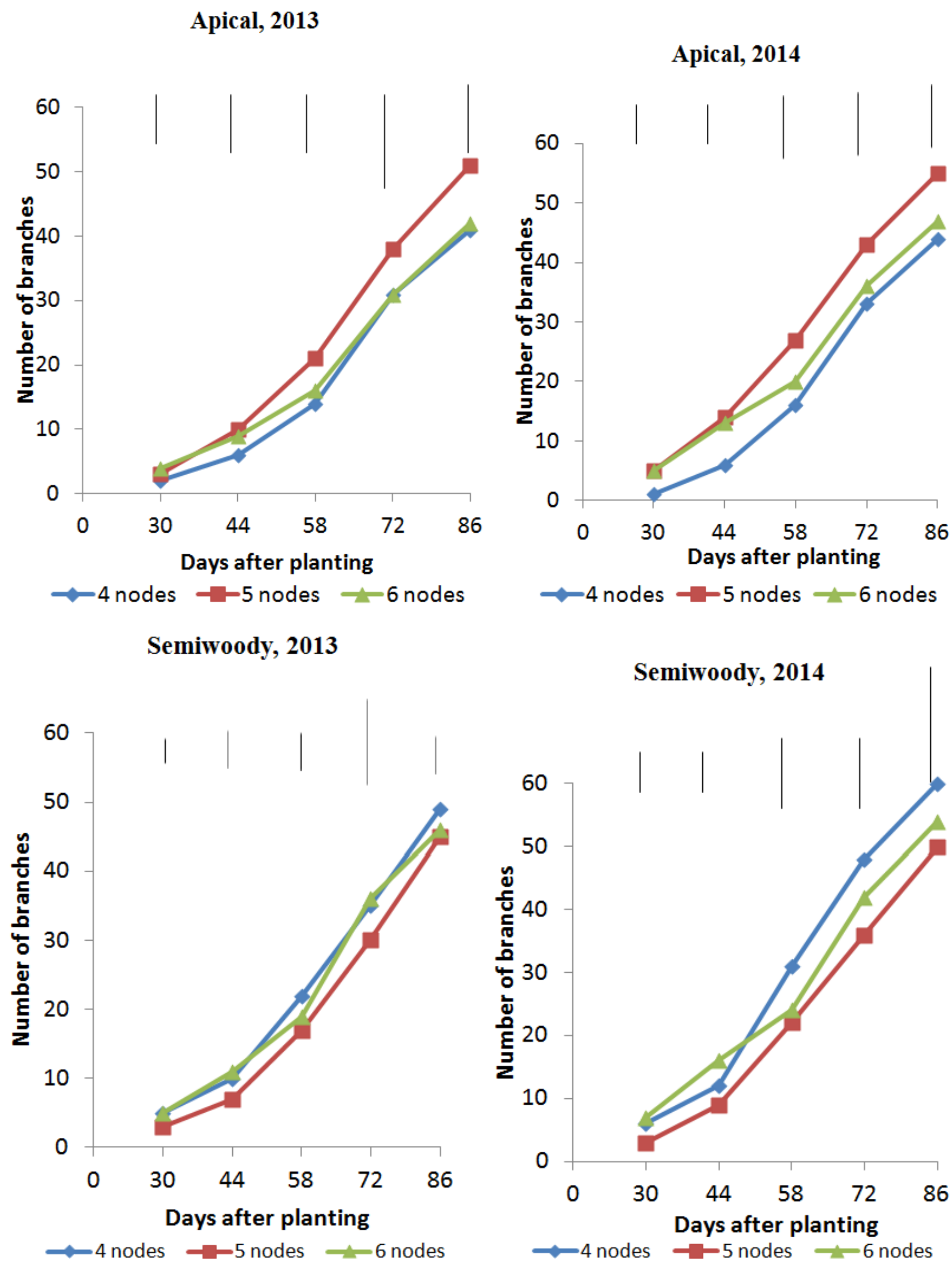

Fig. 5. Number of branches of apical and semiwoody cuttings 30-86 days after planting during 2013 and 2014 growing seasons

3.8 Tuber Diameter

There was no significant difference between node numbers (4, 5 and 6) and vine part in tuber diameter during 2013 and 2014 growing seasons although 5 node apical cutting grown during 2013 growing season produced higher tuber diameter than the 4 and 6 nodes cutting while in 2014 season 4 nodes apical had the highest tuber diameter (Table 7). Tuber diameter increase due to apical vine part used might be due to the fact that vine cuttings from apical shoot grow more vigorously and produce large storage roots compared with cuttings from middle and basal portions. This result is similar to those found by [13] that apical cuttings of sweetpotato had significantly higher tuber size than the middle followed by the basal cuttings.

The higher tuber diameter produced by the 5 node cuttings than the 4 and 6 nodes cutting during the 2013 growing season might be due to increase in root tuber size. Increase in root tuber size occurs through increase in cell number and cell size while the storage root weight increases through accumulation of photosynthates. Wilson [23] reported that storage root growth (bulking) involves increase in size and weight. The higher tuber diameter produced during the 2014 growing season than during 2013 growing season (Table 7) might be due to differences in rainfall experienced during the 2014 growing season than the 2013 season. Increase in cell number and cell size in root tuber is under the control of high rainfall. This is in line with the findings of [16] that irrigation generally improves the grade and quality of storage roots of sweetpotato.

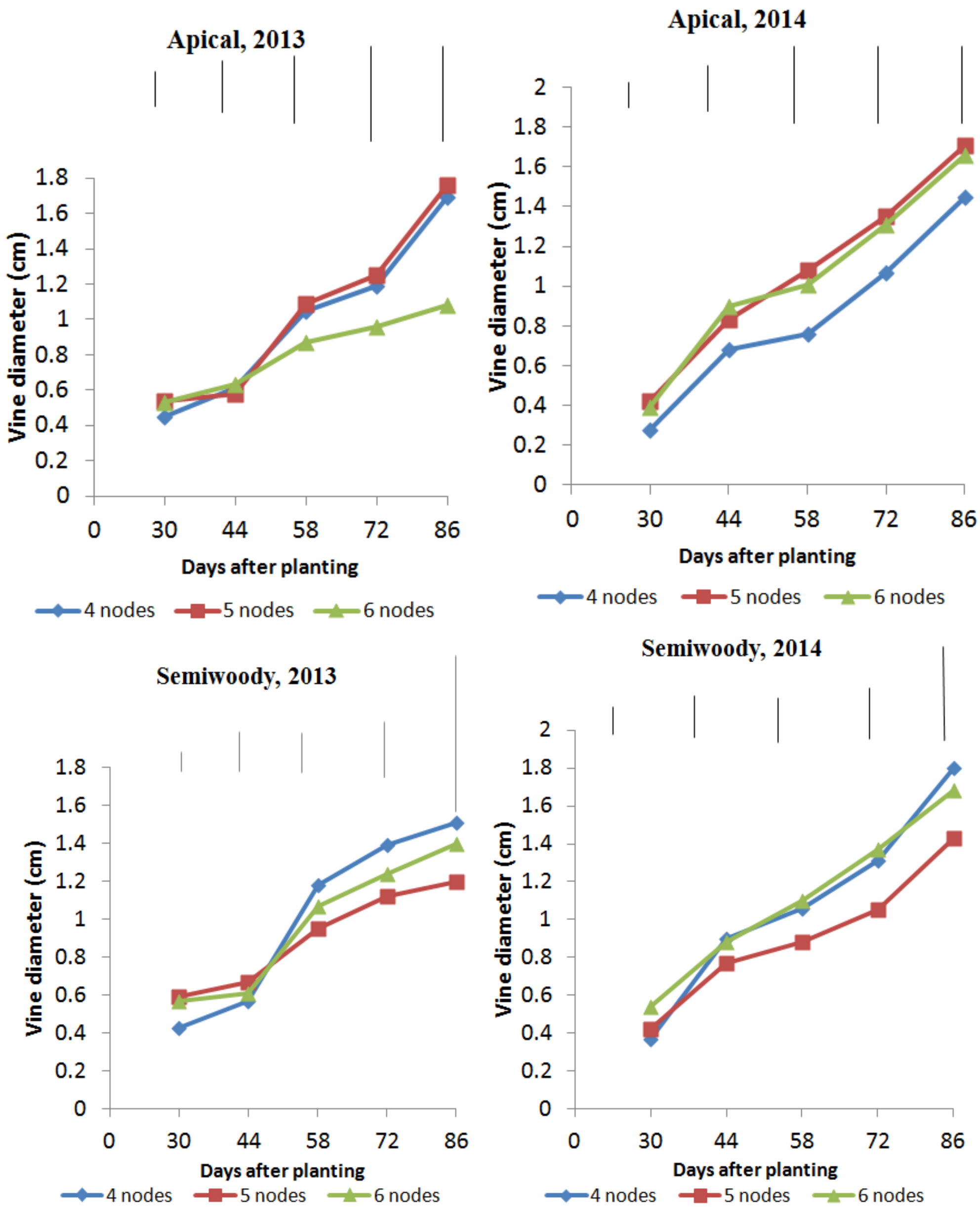

Fig. 6. Vine diameter of apical and semiwoody cuttings 30-86 days after planting during 2013 and 2014 growing seasons

Table 5. Number of unmarketable tuber per plot during 2013 and 2014 experimental periods

Treatment	2013	2014
4 nodes + apical vine part	33.0	9.0
4 nodes + Semi Woody part	12.0	7.0
5 nodes + apical vine part	25.0	13.0
5 nodes + Semi Woody part	21.0	5.0
6 nodes + apical vine part	28.0	11.0
6 nodes + Semi Woody part	18.0	9.0
Mean	22.9	9.0
LSD (P=0.05) node	NS	NS
LSD (P=0.05) Vine part	6.12	NS
LSD (P=0.05) Nodes x vine part	10.61	NS
% CV	36.14	66.44

Table 6. Tuber length (cm) during 2013 and 2014 experimental periods

Treatment	2013	2014
4 nodes + apical vine part	14.7	18.3
4 nodes + Semi Woody part	13.5	18.5
5 nodes + apical vine part	14.3	21.0
5 nodes + Semi Woody part	13.6	17.1
6 nodes + apical vine part	14.6	19.4
6 nodes + Semi Woody part	14.6	19.6
Mean	14.2	18.8
LSD (P=0.05) node	NS	NS
LSD (P=0.05) Vine part	NS	NS
LSD (P=0.05) Nodes x vine part	NS	NS
% CV	25.81	12.98

Table 7. Tuber diameter (cm) during 2013 and 2014 experimental periods

Treatment	2013	2014
4 nodes + apical vine part	3.2	7.8
4 nodes + Semi woody part	4.3	7.4
5 nodes + apical vine part	4.7	7.3
5 nodes + Semi woody part	4.6	7.1
6 nodes + apical vine part	4.5	7.1
6 nodes + Semi woody part	3.4	6.5
Mean	4.1	7.2
LSD (P=0.05) node	NS	NS
LSD (P=0.05) Vine part	NS	NS
LSD (P=0.05) Nodes x vine part	NS	NS
% CV	25.89	11.80

3.8.1 Marketable tuber weight per plot

There was no significant difference between node numbers (4 ,5 and 6) and vine part (apical and semiwoody) cuttings in marketable tuber weight per plot in both growing seasons although 5 and 6 nodes apical cuttings grown during 2013 and 2014 growing seasons produced higher marketable tuber weight per plot respectively than the 4 node cutting (Table 8). This might be due to initial drought experienced during tuber formation stage with supplementary irrigation that resulted in higher marketable tuber weight per plot during the 2013 growing season. According to [24] supplementary irrigation may significantly improve root quality in terms of tuber weight when the rainfall distribution is erratic. Similarly, yield increase due to increasing node number might be due to increasing node number points for tuber formation. Due to early rapid growth in higher node number cuttings, tuber initiation and bulking began earlier than in lower node number cuttings which translated into higher tuber yield in the higher node number cuttings. The higher tuber weight of the 5 and 6 nodes cuttings is in agreement with the findings of [17] that the 5 and 7 node cuttings produced significantly higher tuber weight than the 3 node cuttings. The interaction between number of nodes and vine part was significant in marketable tuber weight per plot during the 2014 growing season than in 2013.

The high marketable tuber weight per plot during the 2014 growing season might be due to higher fresh vine weight experienced during the 2014 growing season than in 2013 season. This result is similar to that reported by Keutgen et al. [25] that storage root growth depends on the sink strength, the potential of leaves to export photosynthesis and on the photosynthetic efficiency of leaves.

Table 8. Marketable tuber weight per plot (Kg) during 2013 and 2014 experimental periods

Treatment	2013	2014
4 nodes + apical vine part	11.9	3.2
4 nodes + Semi woody part	10.8	6.5
5 nodes + apical vine part	12.2	9.1
5 nodes + Semi woody part	10.6	4.7
6 nodes + apical vine part	11.3	10.4
6 nodes + Semi woody part	9.5	5.7
Mean	11.08	6.6
LSD (P=0.05) node	NS	NS
LSD (P=0.05) Vine part	NS	NS
LSD (P=0.05) Nodes x vine part	NS	4.31
% CV	19.02	54.52

3.8.2 Unmarketable tuber weight per plot

The weight of unmarketable tuber per plot was not significantly affected by either the node number or the part of vine cutting (Table 9). However, there was a general trend towards an increase in unmarketable tuber weight per plot with apical vine cutting for the different node numbers (4, 5 and 6) in both 2013 and 2014 growing seasons. This might probably be due to higher number of branches in apical vine cutting with more number of unmarketable tubers that led to higher weight of unmarketable tuber per plot than semiwoody vine cutting [14].

Table 9. Unmarketable tuber weight per plot (Kg) during 2013 and 2014 experimental periods

Treatment	2013	2014
4 nodes + apical vine part	1.5	0.4
4 nodes + Semi woody part	0.6	0.3
5 nodes + apical vine part	1.3	0.7
5 nodes + Semi woody part	1.0	0.2
6 nodes + apical vine part	1.6	0.4
6 nodes + Semi woody part	0.8	0.3
Mean	1.13	0.45
LSD (P=0.05) node	NS	NS
LSD (P=0.05) Vine part	NS	NS
LSD (P=0.05) Nodes x vine part	NS	NS
% CV	42.09	43.20

3.8.3 Vine fresh weight at harvest

The interaction between number of nodes and vine part was significant in vine fresh weight at harvest during the 2013 growing season. The 5 and 6 nodes apical cutting had higher vine fresh weight at harvest than the 4 node apical cutting in both growing seasons (Table 10). The difference between 4, 5 and 6 nodes cutting was not significant although there was a general vine weight increase at harvest with increasing node number for both 2013 and 2014 growing seasons. This might be due to the higher number of branches recorded and resultant higher number of leaves in higher node number cutting. The vine cutting part treatment did not have significant effect on weight of fresh vegetative biomass, although there was a decreasing vine fresh weight at harvest with 4 and 6 nodes apical vine cutting during the 2014 season. The vine fresh weight at harvest for both apical and semiwoody cuttings with the different node numbers during the 2014 growing season was higher compared with the 2013 growing season. This might be due to initial higher monthly rainfall during the 2014 growing season than in 2013.

3.8.4 Percentage pest infested tuber

Percentage pest infested tuber was not significantly affected by either the node number or the part of vine cutting in both 2013 and 2014 growing seasons although there was a general trend towards an increase in the percentage pest infested tuber for both apical and semiwoody cuttings with different node numbers (4, 5 and 6) during the 2014 growing season (Table 11). The total monthly rainfall values were relatively high during the initial cropping period of 2014 coupled with high temperature (Table 2). This might have resulted in the high incidence of pest infestation. This result is similar to that found by Sowley [26] who reported that wet and warm conditions increase the likelihood of serious pest infestations in sweetpotato. Despite the fewer nodes (4 and 5) and vine part (semiwoody) vine cuttings for root formation, the 4 and 5 nodes semiwoody produced lower number of pest infested tubers than (4, 5 and 6 nodes) apical cuttings during the 2013 growing season while the 4 node apical cutting however, produced lower number of pest infested tubers during the 2014 growing season.

Table 10. Vine fresh weight at harvest (Kg) during 2013 and 2014 experimental periods

Treatment	2013	2014
4 nodes + apical vine part	17.5	24.20
4 nodes + Semi woody part	27.8	32.07
5 nodes + apical vine part	28.7	34.90
5 nodes + Semi woody part	20.9	28.20
6 nodes + apical vine part	19.8	29.13
6 nodes + Semi woody part	30.1	33.40
Mean	24.05	30.31
LSD (P=0.05) node	NS	NS
LSD (P=0.05) Vine part	NS	NS
LSD (P=0.05) Nodes x vine part	9.01	NS
% CV	27.20	19.93

Table 11. Percentage pest infested tuber (%) during 2013 and 2014 experimental periods

Treatment	2013	2014
4 nodes + apical vine part	2.9	13.3
4 nodes + Semi woody part	2.2	15.6
5 nodes + apical vine part	5.7	23.7
5 nodes + Semi woody part	2.2	17.6
6 nodes + apical vine part	4.5	19.3
6 nodes + Semi woody part	3.7	14.7
Mean	3.5	17.4
LSD (P=0.05) node	NS	NS
LSD (P=0.05) Vine part	NS	NS
LSD (P=0.05) Nodes x vine part	NS	NS
% CV	44.81	45.50

4. CONCLUSION

The results of this study revealed that cuttings used for sweetpotato propagation should come from the apical part with 4, 5 and 6 nodes. Cuttings with 4 nodes apical although do not give high yield but gave high tuber length and tuber diameter in 2013 and 2014 growing seasons respectively. Cuttings with 5 nodes apical gave high vegetative growth in both growing seasons while cuttings with 6 nodes apical gave high yield and marketable tuber during 2014 growing season. However, cuttings with 6 nodes semiwoody gave high vine fresh weight at harvest in both growing seasons. Cutting from semiwoody part with least number of nodes, especially 4 and 5 nodes did not give any significant increase in vegetative biomass and yield and found to be inappropriate planting material.

ACKNOWLEDGEMENTS

The authors are most grateful to the management of the University of Education, Winneba, College of Agriculture Education, Mampong-Ashanti campus, and the entire management of Crop Research Institute-CSIR in Kumasi for the provision of land and planting materials respectively.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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