The Evaluation of Growth Performance of Sweet Potato (Ipomoea Batatas L.) Awassa Var. by Using Different Type of Vine Cuttings

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Abstract
Sweet potato is commonly grown from small tubers and vegetative by vine cutting is common phenomena to get good growth performance of it before planting. A study was conducted to evaluation of the growth performance of sweet potato (Ipomoea batatus L.) by using different types of vine cuttings in 2016 at Wolaita Sodo collage of Agriculture and Department of Horticulture. It was laid out in randomized complete block design (RCBD) with four replications and three treatments of vine cutngs of length (25cm) each were used. Data collected on growth parameters were analyzed using SAS version 9.2.The study objective was to find out the best vine cutting type for Awassa variety for production of sweet potato under Wolaita climatic condition. The growth parameters soft wood cuttings was preferable, early and late days of leave initiation (25.21, (11.58) recorded soft wood and hard wood cutting respectively. The investigation indicated that soft wood cutting of sweet potato vines were accelerate rate of leave initiation after planting than the other ones. There was very highly significance leaf number between all treatment according to analysis of variance. Highest (135.07) and lowest (68.28) number of leaves was observed in the treatment with soft and hard wood cuttings respectively. Leave diameter (8.02 and 4.98) at soft wood and hard wood vines cuttings respectively. With the same treatment the number of branches were affected the highest and lowest number of primary branches (6.25 and 1.93) soft and hard wood cuttings while the higher and lower(38.35 and 11.12) secondary branches was the same effect as the rest vine cuttings with soft wood and semi hard wood cuttings of sweet potatoes showed wider canopy (127.91 and 65.86) and hard wood cuttings showed narrower canopy(18.20).Analysis of variance for branch number was indicated highly significantly different between treatment at probability level 50% The highest plant height (71.108) was obtained at the by soft wood cutting and highly significant from semi hard wood and hard wood cuttings. The calculated coefficient of variation (Cv%) indicated there was relatively high significant difference among all parameters (CV>10) except for the days of leaf initiation. Number of leaves and leaf diameter (CV<10) on the other hand the shorts plant height (24.175) was observed from hard wood cuttings. The highest root volume (28.83) was observed at the soft wood cutting while the lowest canopy width (14.56) was recorded at the third treatment of hard wood cuttings case plant circumference the highest (34.64) and 16.91) was recorded at soft and hard wood cuttings respectively.
Keywords: Sweet Potato, Cuttings, Verities, Wolaita

1. INTRODUCTION

Sweet potato (*Ipomea batatus*) is belongs to the member of the canvolvulaceae (morning glary) family. The crop is originated in the central or south America low land with subsequent dispersed to north America, Europe, Africa and pacific between 15th and 20th century (Rai,2005). The exact time of introduction of sweet potato in to Ethiopia traditional farming system is not clearly known. The first introduce cultivars of Ethiopia were from USA and Nigeria (Tesfaye *et al,* 2006).

The crop is a dicotyledonous, herbaceous, perennial vine, cultivated as an annual, sweet potato is a crop that is very well suited to local growing conditions, especially during our prolonged dry season.when growing with irrigation, high yield are obtainable and root quality is good poor yield and quality associated with low ambient and soil temperatures are problems for southern growers, which can provide a market opportunity for locally grown crops(Gulluoglu,L.and H. Arloglu,2009). Sweet potato is an important Food security crop grown in many of the poorest regions of the world mainly by women for food and as a source of food and family cash income (Woolfe, 1992).

Sweet potato has a wide adaptability to hawaii's environments and has a high content of vitamins, beta carotene, and ascorbic acid. The young leaves, common in some oriental and Filipino dishes, have 25to 35 % protein content on a dry weight basis (Getachew *et. al*. 2010). Sweet potato is a crop that is very well suited to local growing conditions, especially during our prolonged dry season. When grown with irrigation, high yields are obtainable and root quality is good. Poor yields and quality, associated with low ambient and soil temperature are problems for southern growers, which can provide a market opportunity for locally grown crops (Gulluglu, L. and H. Arloglu, 2009). Sweet potato is an important food security crop grown in many of the poorest regions of the world mainly by women for food and as a source of food and family cash income (Woolfe, 1992).

It is tolerant of a wide range of edaphic and climatic conditions (Solomon E, 1999), adapts well to areas that are marginally suitable, for the production of other crops, and are food-insecure providing a continuous supply of food or fodder throughout the year (Bourke, 1982). The plant is traditionally cultivated for food as a root crop (Ruiz *et al*., 1981). However, the top is also used as valuable forage for ruminants and other livestock species

(Giang, 2004). The tuberous roots and leaves of sweet potato are an excellent source of carbohydrate , protein, iron, vitamins A,C and fibre (Qadir, G., M. Ishtiaq and Ali, 1999).sweet potato vines have crude protein contents ranging from 16 to 29% on dry matter basis which is comparable to leguminous forages increased milk yield (Etela *et al.,* 2008). The fresh tuberous root contains 80 to 90% carbohydrate of dry matter (Dominguez, 1992).

Sweet potato has widely grown in Ethiopia, currently covering about 75,000 ha of land with an average national yield of about 8 kg ha-1(Assefa *et, al*, 2007) which is low compared to the world's average production of about 14.8k.gha-1.The tuberous root are used as food by humans whereas the vines are used as supplementary feed for gouts (Tesfaye *et al.,* 2008).

Two types of sweet potato are grow in Hawaii. The dry fleshed with white to pale yellow or purple skin type is locally referred to as sweet potato. Hawaii is population prefers the drier and firmer varieties of sweet potato. Sweet potato is, in fact, one word and should not be confused with the Irish or Peruvian potato (*Solomun tuberosum* L), nor with the true "yam'' (*Dioscorea* Sp.). grown commercially or in home gardens through of the state. Cultivar selection should be based on market demand, yields, and resistance to pests and disease. Current cultivars recommended for local commercial production include (Berke, T.T, and 1994).

Tillage methods significantly influenced the growth of sweet potato. This is shown by trend in the values of vine length, number of leaves and leaf area per plant gave relatively low soil bulk density, water content and relatively high soil temperature compare with mound clearing. The lower value of bulk density and higher total porosity produced by tilled plots compared with mound clearing was attributed to the loosening effects of tillage (Agbede and Adekiya, 2009)

The higher water content in the untilled manually cleared soil could be related to its higher bulk density lower porosity and reduced evaporation rate (Rani,S,2011).Tamiru,H.,2004) also found that for loamy sand and sandy clay soil in south west Nigeria, Volumetric water content increased with bulk density. This shows that soil water was highest in the manually cleared soil due to reduced evaporation rate associated with its relatively high bulk density, this observation is in line with that no till plots are protected by a layer of low conductivity (dry sail on the surface which reduce evaporation losses. it is possible this phenomenon of differential in high water regimes in the reduce tillage system .Hence, untilled manually cleared soil with high bulk density value recorded high water content the finding that soil temperature of tilled soil was higher than that of untilled soil had been previously confirmed by other workers (Rani, S., 2011).

Farmer propagates sweet potato vegetative, using vine cutting from the SWC of the vine are the best planting material in that have excellent growth performance and yield. Cutting from the SHWC and the HWC of the vine can be used, but they usually produce lower yields as well as poor growth performance. Also cutting from the HWC of the vine more often carry weevils. But in case of Ethiopia, especially Wolaita area, there is no recommendation about effect of types of sweet potato vine cutting on growth performance, development and yield of sweet potato. There is also no recorded data which are related to types of sweet potato vine cutting on production potential and constraints for expansion of the crops. Therefore, studies on effect of types of vine cutting growth performance of sweet potato will have paramount importance as it will serve to recommend the best vine cutting for the farmers or other producers to increase the yield.

1.2. Objectives

1.2.1. General objectives

To evaluate the growth performance of sweet potato (*Ipomea batatus* L) Awassa var. by using different type of vine cuttings.

1.2.2. Specific objective

To find out the best vine cutting type for Awassa variety.
To asses different growth parameters using different types of vine cuttings.

2. LITERATURE REVIEW

2.1. Ecological Requirement of the Crop

Sweet potato is a tropical and sub-tropical plant which can adapt to more temperature climates providing the average temperature does not drop below 20^0c and minimum temperature stay above 15^0c .In other words it can be cultivated between the 30^0c and 40^0c latitudes in the hemispheres .(Bourke,1982).

2.1.1. Temperature

For the cultivar of sweet potato a temperature range be 25c^o to 30^{o}c is required during the vegetative cycle with optimum temperature being between 20^0c to 25^{o}c. the highest yield are obtained when temperatures are high during the day (15 to 20^0c); low temperature during the night favor the formation of tubers and high temperatures by day favor vegetative development. (note tuber development only occurs within a temperature range of 20 to 30^{o}c optimum 25^{o}and generally stop below 10^{o}c) (Qadir, G.,and Ali, 1999).

2.1.2. Light

Sweet potato is a short day plant, which needs light for maximum development .However the growth of the tuber appears to not to be influenced by photoperiod alone .It is probable that temperature and fluctuation in temperature together with short day favor the growth of tubers and limit the growth of foliage (Gulluoglu and.Arloglu,2009).

2.1.3. Altitude

In tropical region it is possible to cultivate sweet potato from sea level to 2500m.for example in Bolivia,peru and Colombia it is cultivate from sea level to 2300m (Tesfaye G., 2012).

2.1.4. Moisture

Moisture has a significant influence on sweet potato growth and production .In this context it is relevant to note the water content of the leaf is (86%).,stem(88.4%) and the tuber (70.6%).At planting it is important to have moist soils in order to achieve good leaf imitation. The soil must also be kept moist during the growth period (60-120 days) through at harvesting the humidity must be low in order to prevent the tuber rotting (Busha, (2006).). Condition which favors the development of the vegetative part of the plant includes an 805 relative humidity and moist soils (bourke, 1982).

2.1.5. Soil

Sweet potato can be cultivated in a wide range of soil, which the best result obtained in ferralitic brown humic and carciorphologic soil. Ideally the soil should be friable have a depth of more than 25cm and have good superficial and internal drainage. The chemical properties of the soil are less limiting than structural properties in obtaining good yields .For example in sandy soils poor in nutrients good yield can be obtained whereas the soils riches in nutrient the vegetation often becomes luxuriant and the root is large and irregular, yields of 28 ha^{-1} have been obtained).other problem include the difficult of using machinery on hilly land and drainage of flat land Sweet potato also prefers lightly acid or neutral soil, with the optimum PH beings 5.5 to 6.5. Soils which are excessively acid or alkaline of ten encourage deterioration of tuber and negatively influence yields (Hanley, F,R .Jarvis and W.Ridgman,1965). Short days promote development of flowering. While long days promote top growth. The optimum growing temperatures for top growth air > 77^{o}f (>25^{o}c). Sweet potato can be grown at altitude of ups to 2000 feet. It is considered to be drought tolerant. However, the plants are the most sensitive to water deficit it needs irrigation during the first 40 days after planting. Sweet potato yields in sandy loam soils with 25% moisture content will generally be similar or greater than yields in soils with 40, 60, and 80% moisture contents. Most cultivars are susceptible to water logging and to water tables <1.5 feet (<0.5m). Sweet potato tolerates a rainfall range of 20 to 50 inches (500 to 1300mm) per growth cycle with optimum levels at 35 to 50 inches (900 to 1300mm Bourke, 1982).

2.2. Nutritional value

Nutrition's sweet potatoes are law in calories (provide just 90 cal/100g, on comparison with starch rich cereals) and contains on saturated fast and cholesterol but are rich source of dietary fiber anti-oxidants, vitamins, carbohydrate and minerals. They are store house of starch, a complex carbohydrate, which raise the blood sugar; therefore, which raises the blood sugar level slowly on comparison to simple sugars; therefore, recommended as a healthy food supplement even in diabetes. They are excellent source of flavonoids like beta carotene and Vitamin A (provides 14187 IV of vitamin A and contain B carotene).The value is one of the highest among root vegetables category. These compounds are powerful natural antioxidants. Vitamin A is also required by the body to maintain integrity of healthy mucus membranes and skin. It is also vital nutrient for lung and oral cavity concerns. They also contain good amounts of minerals like iron, calcium, magnesium, manganese, and potassium that are very essentially for body metabolism (Woolfe, 1992).

2.3. Factors Affecting The Growth Ability of Sweet Potato.

2.3.1. Sweet Potato Weevil

This is the most serious pest of sweet potato. adults are ant-like which lay eggs an stems and roots .They can pupate in the stems and be transferred in planting material. Once established in a crop this pest is difficult to control. Research (1993 soil insect control trial-page 13) has shown that a pre-plant treatment of cutting with chlorpyrifos combined with foliar applications of chlorprifos at 5 10 weeks from planting provides significant control. Material connected from an infected clop would require insecticide dipping before planting. Destroying all crop residues after harvest and crop rotations are the best ways to keep weevil numbers dawn (Busha, 2006).

2.3.2. Giant Termite

Termite can be a major problem especially on newly cleared where the activity of established colonies has not been identified .Avoiding know termite infested areas may be successful in the short term. Aggregation techniques to locate and concentrate termite activity followed by a baiting program is the best way to clear future planting areas of this pest (Tesfaye *et al*.,2008).

2.3.3. Leaf Feeding Caterpillars

Leaf feeding caterpillars may cause problems if infestations is severs enough to cause significant leaf reduction. At the start of the wet season, hungry magpie geese can cause serious damage by trampling crops and eating the roots. Black-footed tree rats are also a problem in the Katherine area along the river (Busha, 2006)

2.3.4. Mycoplasma (Little Leaf Disease).

Infected plants have small pale yellow stunted leaves and stems. The infection is spread by leaf hoppers and if pant are infected while young, yields are greatly reduced. Control is by regular monitoring for symptoms and the removal and destruction of infected plants (Zaag *et al.,* 1989)

2.3.5. Viruses

Feathery mottle virus has been in the NT but research has shown that the infection had no significant effect on yield. In other major production areas of Australia, severe infection has caused yield reduction and distorted roots. Symptoms are often not visible on infected plants and laboratory testing is required to confirm any infection. The virus is spread by insect vectors and by infected planting material. If sweet potato is to be grown over an extended period then new virus free material should be planted from the virus' free program in Queensland every few years (Busha, 2006).

2.3.6. Fungal Disease

Soil borne fungal diseases can infect the roots but are not a large problem on well drained sandy soils. Any organic matter added to the soil should be well decomposed before planting (Busha, 2006)

3. Materials and Methods

3.1. Description of Study Area

The experiment will be conducted under the field condition of Wolaita Sodo University College of Agriculture Department of Horticulture demonstration site (research field) in the year 2014 under supplementary irrigation. It is located in the southern part of Ethiopia which is 390 km far from Addis Ababa and geographically located at altitude of 1800 masl 6^{o} 49' N and 37^{o} 45' E with annual mean temperature and rainfall of 20^{o} c and 1212mm respectively. The soil of the area is clay loam with a PH of 5.9-6.4 (W.S.U Student hand book, 2009).

3.2. Experimental Material

The experimental material was hard, semi hard and soft wood planting materials of sweet potato of Awassa variety were used. The planting materials of this crop are obtained from .W.S.U. Research field.

3.3. Method of Plating

3.3.1. Soil Preparation

The soil was prepared 2 weeks before planting. We have dug it deep enough to avoid compactness. Dig again to loosen the soil and as the result, stimulates the root expansion. The twelve beds that have 2m long 1.30m wide for each bed have been prepared and 50cm each between the plant and the rows. The cutting was left in the shade for 2 day to accelerate root initiation before they were planted.

3.3.2. Planting material and selection

Cutting are gathered together in convenient sized bundles, tied, or wrapped in bur lap vines of 25cm length with at least 4(four) nodes were used for planting material. The cutting obtained from the bottom, middle and apical portion of vine are selected to be used. The cutting with intact leaves will be stored under shade for two day before planting to promote better growth performance.

3.3.3. Maintenance

Weeding had been carved out particularly in the early stage of growth (during the 2nd two weeks after planting), to protect the crop from weed competition. Newly planted cuttings were watered frequently for 1-3 weeks, depending on the weather condition. Very little water had been applied after those three months. it was protected from any living animals and other seeding destroying matter by guarder.

3.4. Experimental Design and Treatment

The experiment was laid out in randomized complete block design (RCBD) with three treatments and four replication of bed preparations for sweet potato cutting with hard wood ,Semi hard wood and soft wood cutting material. The size of main plot was 9.5 x 5m and distance between treatment and replication is 0.5m respectively. The distance between rows will be 30cm and 35cm is between each plant. While the edges of beds will be 10cm on the width ways sides and 15cm on the length for bed. The length and the width of each bed are 2m and 1.30cm respectively. When planting we have assigned that (as SWC, SHWC and HWC).

3.5. Data Collection

The evaluation effect of vine cutting types on sweet potato growth parameters like, day to leave initiation, plant height, number of leaf, ,leaf diameter, number of branches, rooting ability, canopy width, rooting ability, root volume, and circumstance (Zebarth *et al.* 2006), from 6 randomly selected plants of the two middle rows except the growth data which is taken per plot basis. (Ahmed *et al*,2000)

3.6. Data analysis

Data were subjected to analysis of variance (Montgomery, 2005) of the GLM procedure for factorial, randomized complete block design (RCBD) of SAS version 9.2. Statistical software (SAS Institute Inc, 2002), after the data was checked for meeting the various ANOV assumptions. Means were compared by using LSD value at 5% significance level (Montgomery, 2005).

4. RESULT AND DISCUSSION

Soft wood cutting resulted better growth performance than other types of cutting which limits the growth of the plants. because soft wood cutting is youngest in age, has high amount of photo assimilate, has high ability of rooting, and reduced wilting as compared to other. In other types of cutting all the above characteristics are limited for example hard wood cutting is over aged, has high wilting ability which cause rapid loss of water that reduces rooting ability of the cutting. with soft wood better growth are obtained. Early and Late days of leave initiation (25. 21) (11.58) recorded soft wood and hard wood cutting respectively.

The investigation indicated that soft wood cuttings of sweet potato vines were accelerate rate of leave initiation after planting than the other ones. There was very highly significance leaf number between all treatment according to analysis of variance. Highest (135.07) and lower (68.28) number of leaves was observed in the treatment with soft and hard wood cuttings respectively. Leave diameter (8.02 and 4.98) at soft wood and hard wood vines cuttings respectively. The number of branches were affected the number of primary branches soft and hard wood cuttings, while, the higher and lower secondary branches was the same effect as the rest vine cuttings with soft wood showed wider canopy(127.91) and hard wood cutting showed narrower canopy (18.20) .Analysis of variance for branch number was indicated highly significantly different between treatment at probability level 0.05.The effect of both intra row spacing and time of earthling up were found highly significant ($p<0.005$) on all the growth parameters days to leave initiation. Leave numbers, Leaf diameters, number of branches plant, plant height, canopy width, rooting ability, circumference of the plants.

4.1. Days to Leave Initiation

The highest day to leaf initiation (25.21) was at soft wood cutting, while, the lowest (11.58) was at hard wood cuttings this may be photo assimilate and wilting ability accumulation of the cuttings. As the vine become aged longer the rooting ability become reduced for this reason lastly hard wood cutting stated to initiate leaves later after twelve days. This result is in conformity with the finding of Ahmed et al.,(2000) who reported that hard wood cutting.

Resulted in poor vegetative growth such as plant leaf initiation compared to the soft wood cutting the cutting were left in the shade for 2 days to accelerate root initiation before they were planted as recommended by Edmond (1999).From the work soft wood cutting have rooted earlier than other cuttings, sometimes under the scarcity of vine cuttings semi hard wood cutting can be used as planting material (propagation material) .This is may be due to the age of the vines, amount of water content, and may content of assimilated the cut constituted (Table 1).

4.2. Leave numbers

The highest leaf number (135.07) was observed at soft wood cutting and the lowest (68.28) was belonged to hard wood cutting than semi hard wood cutting, With using shoot cutting the number of leafs, leaf growth were increased. The pattern of branch production followed that increasing branch production resulted in the production of more leaves Enyi (2004).The effect different vine cutting was highly significant on the leaf number of sweet potato *(Ipomea Batatus* L.*)*.The result showed that the tip part of sweet potato vine cutting has increased number of leaf per plant. Similarly, Qadir *et al*.,(1999) also concluded that the number of leaf per plant was significantly higher in soft wood cutting .In agreement with Edmond (1971) and Onwueme (1978) also made similar observations that maximum growth of the leaves and vines of sweet potato occurred up to about 16 weeks after planting. The younger the vine cutting, the shorter the days for leaf initiation. The effect of vine cutting was highly significant ($p<0.01$).Based on the result, leaf numbers was increased by using appropriate types of vine cuttings. At the time of data collection process, we able to observe that the leave number of SEC was higher than others. SHWC was the second and HWC was the last by their number (table 1).

4.3. Leaf diameters

The effect of vine cutting was highly significant on leaf diameter .The highest (8.020) was recorded at soft wood cutting ,but the narrower (6.28 and 4.98).was observed at semi hard wood cutting and hard wood cutting respectively. Different vine cuttings had significant effect on leaf diameter with using over aged vine cutting leaf diameter was decreased, so that using soft wood cutting caused the larger leaf diameter and using hard wood cutting jointly, caused smaller leaf.

Diameter ,Oliveira,(2000) also stated that leaf diameter decreased in the hard wood cutting compared to the soft wood cutting that resulted in lager leaf diameter. As compared to hard wood cutting soft wood cutting and sometimes semi hard wood cutting has a bit larger leaf diameter than that of hard wood cuttings (Table 1).In similar manner (Nkambule and Ossom ,2010) stated that the largest mean leaf diameter was obtained in the soft wood cutting. This may be because of amount of photo assimilate, amount of water contents or the age of the cuttings. Qadir *et al.,*(19990 and Qadir,(1997) also stated that higher stem diameter was recorded at earthling up of two weeks after plant emergence.

4.4. Number of Branches Plant

4.4.1. Primary Branch Plant

The highest number of primary branches (6.25), while the lowest is (1.93) was obtained at soft and hard wood cutting respectively and was significantly different from semi hard wood cutting and hard wood cutting which is used as planting materials .Zelalem *et al*.,(2009) and Mukatar *et al.,(*2010) found significant increase in stem number per plant of potato in soft wood cutting. This could be because this trait is much more influenced by the inherent characteristics of the than wilting ability. In agreement with the result of the current study, different scholars reported that branches number is determined very early in the ontogeny of plant (De al Morena *et al.,*1994;Lynch and Rowberry,1997).On the other hand, the smallest number of primary branches (1.93) at hard wood cutting. The result of the current investigation is in agreement with the work of Qadir,(1997) who found that number of primary branch per plant was significantly higher when plants propagated with soft wood cutting. This is may be due to the age of the vines, amount of water content, and may content of assimilates the cut constituted or the wilting data.

4.4.2. Secondary Branch Plant

The highest number of secondary branches (38.35) was found that by using soft wood cutting as plant materials than that of semi hard wood cutting and hard wood cutting (38.35 and 11.12) .This agrees with the findings of Idrisu (1998).Adu-Baffour (1977) and Gumah (1974).who observed in sweet potato, yam and cassava propagation respectively that the percentage of cuttings which established increased in branches with increasing node number per cutting .The number of secondary branch was highly significant at ($p<0.05$). In conformity with Austin, D.F.(1988) the number of secondary branches increase as they become young, this may be due to age and branching ability of the cuttings. This could be due to the positive effect of shoot cuttings. Where it has high branching habits of the cuttings and high accumulation of photo assimilates (table 1).

Table 1: Means for days to leaf initiation, number of leaves per plants, leaf diameter, primary branching secondary branches as affected by vine cuttings.

Treatment	DI	LN	LD	NB	
				PB	SB
Soft cutting	25.21^{a}	135.07^{a}	8.02^{a}	6.25^{a}	38.35^{a}
SHWC	18.17^{b}	121.88^{a}	6.28^{b}	3.28^{b}	27.25^{b}
HWC	11.58^{c}	68.28^{b}	4.98^{c}	1.93^{c}	11.12^{c}
Cv (%)	7.27	7.3790	7.18	12.95	13.04
LSD(0.05)	2.3031	13.84	0.798	0.86	5.77

Means followed by the same or no letter (s) with in the same column are not significantly different at a probability level of 0.05

4.5. Plant height

The highest plant height (71.108) was obtained at the by soft wood cutting and highly significant from semi hard wood and hard wood cuttings. On the other hand, the lowest plant height (24.18) was observed from hard wood cuttings (Table 2) .This may be high growing behavior of tips cuttings and best photo synthetic ability of the cuttings. This is in agreement with the finding of Zaag *et al.* (1989) who indicated that plant height was different in all treatments. This result is in conformity with the finding of Qadir *et al*. (1999) who confirmed that plant height was significantly higher in soft wood cutting. This may be due to high accumulation of photo assimilate and age, rooting ability of the cuttings. This result is in conformity with the finding of Ahmed *et al*., (2000) who reported that hard wood cutting resulted in poor vegetative growth such as plant speed compared to the wider intra row spacing. Plant height and relative leaf-water content were reduced under drought conditions, while plant wilting and number of days to grow were increased.

4.6. Canopy width

Significantly the wider canopy width (127.91) was recorded from soft wood cutting after two weeks later after planting ,but the narrower canopy width (18.20) was obtained from hard wood cutting after complete plant emergence may be due to photo assimilate it constituted at the time of planting. The fact that amount of photo assimilate, age of the cuttings, the time it takes to wilt have impacts on canopy width as well as other growth parameters at the growth stage .Ahmed *et al.*,(2000) who reported that hard wood cutting resulted in poor canopy width such as plant spread compared to the soft wood cutting and semi hard wood cutting .In similar manner, *Zaag et al.*,(1989) reported that branching was different in all treatments but the soft wood cutting gave the highest plant canopy and in similar experiment Zebarth *et al*.,(2006) also indicated that closer intra row spacing resulted in reduced number of branches resulting in the narrowest plant canopy.

4.7. Rooting ability (Qualitative data)

Among cutting that we used as planting material, soft wood cutting has high rooting ability than other types of cutting materials. It may be due to presence of high amount of photo assimilate water contents and water contents in the cuttings.

4.8. Root volume

The highest root volume (28.83) was observed at the first treatment of soft wood cutting while the lowest canopy width (14.56) was recorded at the third treatment of hard wood cuttings (table.2).Similarly with ,Zaag *et al*, (1998) reported that Root volume increased in the soft wood cutting .It may be the soft cutting due to younger in age, sufficiently available nutrient and more light and increased their photosynthetic efficiency that further increased the vegetative growth and ultimately resulted in increased in root volume. Plants root volume decrease as the age of the planting material increase.

4.9. Circumference of the plant

The highest width circumference of sweet potato (34.65) was recorded at soft wood cutting, but the lowest was (16.91) at hard wood cutting (Table 2).This is due to good branching habit and growth performance of shoot cutting. The result of the current investigation is in agreement with the work of Qadir,(1997) who found that number of stems per plant was significantly higher when the planting material used is soft wood cutting complete plant emergence. Qadir,(1997) also concluded that better circumference of potato is recorded at soft wood cutting after complete plant emergence. This is due to higher leaf number, high number of stems and high branching ability.

Table 2: Means for plant height, canopy width, root volume circumference of the plant as affected by vine cuttings

Treatment	PH	CW	RV	CP
SOFT CUTTING	71.108^a	17.908^a	28.830^a	34.64^a
SHWC	42.510^b	65.875^b	19.868^b	26.02^b
HWC	24.175^b	18.200^c	14.560^c	16.90.26^c
CV	25.30	25.31	12.05	4.59
LSD(0.05)	20.11	19.155	4.3964	

NB: Means followed by the same or no letter (s) with in the same column are not significantly different at a probability level of 0.05

5. CONCLUSION AND RECOMMENDATION

It can be concluded that for majority growth parameters soft wood cuttings are preferable. But from all cuttings, hard wood cuttings are not be used as planting materials, because it has slower growth performance than other .In case ,if there is scarcity of planting material semi hard wood cutting may be used as a substitute. The study verified that growth of soft wood cutting can be used for optimum growth of sweet potato (*Ipomea batatus* L.). Cutting materials can significantly affects days to leave initiation, leave numbers. leaf diameters. Number of branches plant "primary branch plant-$^{1"}$ and secondary branch plant^{-1}).Plant height, canopy width. Rooting ability (Qualitative data). Root volume and circumference of the plants. The superior growth performance of sweet potato was observes at soft wood cutting planting material. The superior growth performance of sweet potato was observes at soft wood cutting planting affected by hard wood cutting as planting material. Significantly lowest growth performance parameters were observed important crop is mainly affected by many factors that are influence the growth. For example sweet potato weevil, giant termite, leaf feeding caterpillars, mycoplsm or little leaf disease, viruses and fungal disease and etc.

This research project was conducted at Wolaita Sodo University during 2014/15 cropping season under watering sprayers to the crops. The experimental material used was Hard, semi and soft wood cutting planting materials of sweet potato of Awassa varieties. The soil was prepared two weeks before planting then planting materials is selected and planted then the maintenance for watering and weeding frequently was continued. The experimental was led out in randomized complete block design (RCBD) in four replication and three treatments. The evaluation of growth parameters of different types of vine cuttings methods of sweet potato nine growth parameters was collected as data for analysis of variance through RCBD. Those are days to leaf initiating, the number of leaves, leaf diameter, and number of branches (i.e. primary branch and secondary branch). Canopy width, plant height, rooting ability, root volume ,and the circumference of the plants for three sates frequently in two weeks intervals .As the result of this variance (ANOVA) for all of growth parameter at each frequencies stage there are significant ($p<0.05$). Therefore. soft wood cutting can be used for better and improved quality of sweet

potato variety Awassa on the sandy loan in area under rainfed condition.
Therefore based on the study results and above conclusive remarks the following can be recommended:

- Any beneficiaries or farmer should prefer soft wood cutting as planting materials.
- Any sweet potato producer should be awarded not to use hard wood cuttings.
- Further study work should be under taken to investigate the appropriate cutting materials under different climatic condition of the country Ethiopia.
- Awareness should be created through so as the farmer uses this potential food crop and tackle the bottle necked problems of food self-insecurity.
- It is highly important to integrate research between this college and nearby agricultural research institute as it helps and simplify any research activities.
- Other crop family growth performance should be evaluated using similar parameters.

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APPENDIX

Appendix 1: analysis of variance (ANOVA) on effect of cutting on the days to leave intiation of the cutting (plants)

Source of variation	degree of freedom	sum of square	MSS	F_{cal}	P_{value}
Treatment	2	371.42	185.71	104.82	<.0001
Block	3	13.35	4.45	2.51	0.16
Error	6	10.63	1.75		
Total	11	395.41			

Appendix2: analysis of variance (ANOVA) ON EFFECT OF CUTTING ON THE NUMBER OF LEAVES PER PLANT

Source of variation	degree of freedom	sum of square	mean sum of square	F_{cal}	P_{value}
Treatment	2	10011	5005.49	78.22	<.0001
Block	3	44.39	1 4.39	0.23	0.88
Error	6	383.93	63.99		
Total	11	10439.31			

Appendix3: analysis of variance (ANOVA) ON EFFECT OF CUTTING ON THE LEAVE diameter of the pla

Source of variation	degree of freedom	sum of square	mean sum of square	F_{cal}	P_{value}
Treatment	2	18.64	9.32	43.76	0.0003
Block	3	4.67	1.56	7.32	0.02
Error	6	1.28	0.21		
Total	11	24.59			

Appendix 4: analysis of variance (ANOVA) on effect of cutting on primary branches of the plants

Source of variation	degree of freedom	sum of square	mean sum of square	F_{cal}	P_{value}
Treatment	2	39.10	19.55	79.90	0.0001
Block	3	1.45	0.45	1.97	0.22
Error	6	1.47	0.25		
Total	11	42.02			

Appendix 5: analysis of variance (ANOVA) on effect of cutting on secondary branches of the plants

Source of variation	degree of freedom	sum of square	mean sum of square	F_{cal}	P_{value}
Treatment	2	1500.11	750.05	67.47	0.0001
Block	3	12.99	4.33	0.39	0.76
Error	6	6.69	11.12		
Total	11	1579.79			

Appendix 6: analysis of variance (ANOVA) on effect of cutting on plant height

Source of variation	degree of freedom	sum of square	mean sum of square	F_{cal}	P_{value}
Treatment	2	4475.53	2237.77	16.57	0.0036
Block	3	192.10	64.03	0.47	0.7
Error	6	810.51	135.08		
Total	11	5478.14			

Appendix 7: analysis of variance (ANOVA) on effect of cutting on plant height

Source of variation	degree of freedom	sum of square	mean sum of square	F_{cal}	P_{value}
Treatment	2	24208.89	12104.45	98.76	0.001
Block	3	476.41	158.81	1.30	0.36
Error	6	735.39	122.57		
Total	11	25420.70			

Appendix 8: analysis of variance (ANOVA) on effect of cutting on plant height

Source of variation	degree of freedom	sum of square	mean sum of square	F_{cal}	P_{value}
Treatment	2	416.17	208.09	32.23	0.006
Block	3	7.99	2.66	0.41	0.75
Error	6	38.74	6.46		
Total	11	462.90			

Appendix 9: analysis of variance (ANOVA) on effect of cutting on plant height

Source of variation	degree of freedom	sum of square	mean sum of square	F_{cal}	P_{value}
Treatment	2	629.40	314.70	44.69	0.0002
Block	3	8.31	2.77	0.39	0.76
Error	6	42.24	7.04		
Total	11	679.96			