EVALUATION OF SWEET POTATO GENOTYPES UNDER VARIED HARVESTING STAGE AND PLANTING TIME

A
Thesis By

AYSHA AKTER SHIMU

Examination Roll No.1202020502
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Submitted to the

Department of Horticulture

Faculty of Agriculture

Sylhet Agricultural University, Sylhet-3100.

In partial fulfillment of the requirements for the degree of

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IN
HORTICULTURE

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DEDICATED

TO

MY

BELOVED PARENTS

ABSTRACT

EVALUATION OF SWEET POTATO GENOTYPES UNDER VARIED HARVESTING STAGE AND PLANTING TIME

By

AYSHA AKTER SHIMU

The present study was conducted during two consecutive winter seasons of 2012-2013 and 2013- 2014 at the experimental field and Laboratory of Horticulture Department at Sylhet Agricultural university with a view to characterize seven exotic sweet potato genotypes, to observe the effect of harvesting stages and effect of planting dates on growth and yield of sweet potato under AEZ Sylhet condition. The seven sweet potato genotypes viz., SP001, SP002, SP003, SP004, SP005, SP006 & SP007 were evaluated under RCB (Factorial) design to estimate growth and storage root yield at 120 day and 150 day after planting. In addition chemical analysis of storage root of seven genotypes harvested at 120 day were done to estimate nutrient content. In the winter season of 2013 the three selected genotypes of SP004, SP006 and SP007 were evaluated at three different planting dates under RCB (Factorial) design to observe growth and yield of sweet potato. Variation in physical-morphological characteristics like colour of vine, leaf vein, petiole, root, flesh was observed among the genotypes. Length of the root was varied from 7.34 cm (SP002) to 12.18 cm (SP004). The highest root width was recorded from the genotype SP004 (6.68 cm) while it was the lowest for SP002 (3.35 cm). Most of the genotypes produced storage root had red purple in colour while SP004 was white in colour. Flesh colour of the root was mostly creamy white except SP006 which had flesh with orange in colour. Among the seven sweet potato genotypes, SP004 produced the highest root yield per plant (310.83 g) and corresponding root yield per hectare (17.2 t) followed by SP007 (14.7 t/ha) and SP006 (12.77 t/ha). All the genotypes performed better in relation to root yield at 150 day after planting compared to 120 day after planting. Average root yield per plant (230.90 g) and per hectare (12.77 ton) of the genotypes at 150 day after planting was much higher than the yield when the plants harvested at 120 day after planting (9.0 t/ha). Chemical analysis of the storage root revealed that the genotype SP007 was comparatively better source of Ca, Mg, Fe and Zn whiles the genotype SP001 rich in potassium and phosphorus and copper. The genotype SP004 also a rich source of the elements of Ca (1.39%), Mg (0.40 %), K (1.83 %) and Zn (10.08 ppm). Dry matter content in the storage root ranged from 25 % to 32 % among the seven genotypes at 120 day after planting while it was ranged from 26-33 % at 150 day after planting. The highest root yield was recorded from the plants grown from 1 November planting (20.5 t/ha) closely followed by the plants of 1 October planting (20.13 t/ha). However, the genotype SP007 produced the highest root yield (22.5 t/ha) when grown from 1 November planting followed by the same genotype in 1 October planting (21.9 t/ha) and SP006 (21.9 t/ha) at 1 November planting. The highest dry matter content in the root was estimated from the plants grown from 1 September planting (32.3 %) closely followed by 1 November (31.9 %) and 1 October planting (29.7 %).

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CHAPTER ONE
INTRODUCTION

Sweet potato *(Ipomoea batatas* L.), commonly known as "Misti Alu" in our country belongs to the family Convolvulaceae is an important starch rich root crop of Bangladesh. Sweet potato is believed to originate in Central America. From there it was disseminated first to tropical islands of the pacific and later to tropical Asia and Africa by the Spanish and Portuguese explorers and/or traders after Columbus (Thompson and Kelly, 1957).

This crop is one of the most popular among the poor people for its low price, which is cultivated more or less in all the districts of Bangladesh. The tuberous roots of sweet potato are used as supplementary food crop in many densely populated countries. It has higher food value, and it requires low input and less management (AVRDC, 1977).

Among the food crops of Bangladesh, it stands fourth in respect of total production. The country produces 378 thousand metric tons of sweet potatoes in an area of 40.89 thousands hectares of land and the average yield was 9.29 metric tons per hectare during the year 1999-2000 (BBS, 2001). The average yield of this crop in Bangladesh is very low compared to the yield of 22.7 and 21.0 metric tons per hectare in Japan and Korea, respectively (FAO, 1999).

The production of sweet potato is decreasing in Bangladesh, and it is a major concern to the consumers and policy makers. Among different causes, lack of suitable varieties is important. Rashid *et al.* (1982) stated that the poor yield potential of the indigenous varieties and sub-optimal production methods have been identified as the major reasons for the poor yield.

Sweet potato is a good source of Vitamin B6, which helps to reduce the chemical homo cysteine in our bodies. Another important Vitamin-C, it is also found in sweet potato. It helps to accelerate wound healing, produces collagen which helps to maintain skin's youthful elasticity, and is essential to helping us cope with stress. On the other hand Vitamin-D and iron are very important for our body fitness, and sweet potato is a rich source of them.

Sweet potato is grown over a wide range of environmental and edaphic conditions (Kotama, 1972). It requires low inputs and less management practices (AVRDC, 1977). In Bangladesh, sweet potato is generally harvested during March to May when cereal supply like rice is the minimum. Sweet potato plays an important role to compensate the demand of cereals of the needy people of Bangladesh.

The plant requires warm growing season. It needs a growing period of four and half to five month's warm weather. Long day and strong sunshine promote heavy vegetative growth. Relatively short days, high temperature and a long growing season are required to grow the sweet potato to produce an abundant flower.

In an experiment various factor plays important role, which maintain yield and quality of the crop. Among some important factors, harvesting dates are one of them, which plays important role for high yield and good quality of sweet potato. In this experiment, two harvesting duration were observed, first harvesting duration was 120 days and second was 150 days after planting. Planting dates also held significant effect of any crop yield. The highest production and good quality are mostly depends on planting dates. So planting dates another important factor for successful crop production. Since climatic factors are vary at different locations therefore suitable planting time may also vary at different locations. Optimization of suitable planting dates for sweet potato cultivation in Sylhet region was not standardized in the past. Therefore, it would be worthy to identify suitable planting time of sweet potato for Sylhet region.

Many sweet potato genotypes have been introduced in the East Pakistan and present Bangladesh by several organizations such as BARI, AVRDC, MCC, BAU etc and scattered throughout the country. Bangladesh Agriculture Research Institute (BARI) which is a big research institute in Bangladesh. This institute also released many improved varieties of sweet potato of which Tripti, Kamalasunduri, Daulatpuri, BARI Sweet Potato-4 and BARI Sweet Potato-5 are very popular (Razzaque *et al.,* 2000). Besides, many local varieties are also gown at the farmer's level.

Further improvement of sweet potato can be made through various ways, since the growth, yield, development and quality of sweet potato are influenced by environmental factors, among which the growing season, the date of planting (Islam *et al.,* 1995), harvesting duration becomes an important factor affecting growth, development and yield of sweet potato. Sweet potatoes grown in the lowlands take more than 4 months to mature, but planting early-maturing clean materials and using best management and production practices promote crops to mature in only 3 months with good quality and increased yields.

Many research works on sweet potato were conducted before, but recently no research works on sweet potato of Japanese genotypes were conducted. Now Sylhet Agricultural University (SAU) has introduced some sweet potato genotypes from Japan. These new genotypes adaptability are needed to be evaluated under Sylhet condition.

Considering the above statement seven exotic sweet potato genotypes were evaluated under varied harvesting stages and planting dates under climatic conditions of Sylhet

With the following objectives:

1. To characterize the sweet potato genotypes.
2. To evaluate the performance of sweet potato genotypes at varied harvesting dates.
3. To observe the effect of planting time on growth and yield of sweet potato.

CHAPTER TWO
REVIEW OF LITERATURE

Sweet potato is an important food crop in the world and harvesting duration and planting time are most important factors responsible for controlling growth and yield of it. Several research works have been done in different parts of the country and also the world on this aspect. The available research findings relevant to the present study have been reviewed in this chapter.

Morphological features

Tuberous roots of sweet potato varieties vary in size, shape, colour and quality. Plant height, number of branches, vine coverage, number of root, weight of vine, yield of root etc differ widely from one variety to another. Also crop duration generally depends on the variety and climate. An average temperature of 24^0c favors root formation and 22^0c favors root enlargement in sweet potato (Wang, 1975).

Rahman and Haque (1983) found variations in morphological characters in the number of vines per plant, length and weight of vines per plant, number and weight of storage root per plant, skin and flesh colour of storage roots in six exotic and one local red variety. The highest yield (45.70 t/ha) was found from line AIS-243-2 followed by AIS-0122-2 (34.90 t/ha). However, very small variation was obtained among the varieties in terms of dry matter content.

Thompson and Kelly (1957) studied the morphological features to differentiate different varieties of sweet potato. They stated that the storage roots have white, yellow, salmon, red or purplish red skin while the flesh is white or various shades of yellow, orange, or salmon. The size and shape differed from variety to variety.

Ahmed *et al.* (1998) investigated the genetic divergence of 90 accessions of sweet potato. Multivariate analysis of divergence among the accessions for 12 characters (plant type, petiole length, vine growth rate, vine pigmentation, mature leaf shape, foliage colour, total vine length, storage root skin and flesh colour, yield of storage root at 115 and 140 days after planting (DAP), and dry matter content led to their grouping into 6 clusters. The highest contributions towards total divergence were made by the storage root at 115 DAP (32.57 %) and at 140 DAP (19.42 %), which were the most important characters responsible for the grouping of the accession on a genetic basis. The next important characters were dry matter content (13.07 %) and petiole length (9.72 %). Accession SP-484 and SP-527 from cluster I; SP-108, SP-161 and SP-161 from cluster II; SP-161 and SP-161 from cluster III; SP-281, SP-296 and SP-396 from cluster IV; SP-436 and SP-495 from cluster V; and SP-013 and SP-395 from cluster VI were recommended for use as parents for future hybridization programs.

Ghosh *et al*. (1988) reported that the process of tuberization in sweet potato consists of two distinct phases, namely, storage roots initiation or differentiation and storage roots development or storage roots bulking. Storage roots initiation requires an inductive environment, where storage roots bulking depends on the assimilate supply from the top for which optimum canopy size and strong conductive tissue are essential. Mannan *et al.* (1984) also conduct a study about this aspect and seasonal effect on growth pattern of sweet potato.

Islam *et al.* (2000) conducted an experiment at institute of Food and Radiation Biology to study the effect of irradiation and storage temperature on shelf life of 'Kamalasunduri' variety of sweet potato.

Bhuiyan *et al.* (1997) reported that clones D-44 and D-53 of sweet potato exhibited high yield, attractive tuber shape, flesh colour and good taste and flavor. These are developed from a polycross between BARI SP-2 (Kamalasunduri) (female) and BARI SP-1 (Tripti), BARI SP-3 (Daulatpuri) SP-092 (males). Both clones have been superior for the majority of morphological and quality traits in tests carried out during 1991-1993 at different agro-climatic zones of Bangladesh. The National Seed Board of Bangladesh has recommended D-44 and D-53 for release as commercial varieties under the names BARI SP-4 and BARI SP-5 respectively.

National Seed Board (NSB) released two high yielding sweet potato varieties namely BARI SP-1 (Tripti) and BARI SP-2 (Kamalasunduri) in the year 1985 (Anonymous,1988). A new improved local variety Daulatpuri was also released by the technical committee of National Seed Board. Tripti and Kamalasunduri were selected from exotic germ plasm while Daulatpuri was selected from local germ plasm.

A yield trial of three high yielding sweet potato genotypes (AIS-0122-2, Tinirining and BNAS-white) was conducted at BAU farm, Mymensingh. The genotypes AIS-0122-2 produced 44.5 tons of tubers per hectare (Siddique *et al*., 1988).

Hossain *et al*. (1987) studied the five exotic cultivars of sweet potato namely 'Tinirining', AIS-01220-2, BNAS-White, USA No.1 Cinjhi and one local cultivar at Bangladesh Agriculture Research Institute, Joydebpur, Gazipur as check for estimating their dry matter content and organoleptic taste. The local white contained the highest dry matter (30.03 %) followed by Tinirining (28.31 %). The cultivar BNAS-White contained the lowest dry matter content (15.05 %). In organoleptic taste Tinirining scored the best in respect of colour, shape, softness, texture and sweetness.

Hossain *et al*. (1987) studied the storage ability of sweet potato cultivars at Bangladesh Agricultural University, Mymensingh. Storage of sweet potato tubers with dry tobacco or neem leaf as insect repellent was found to improve the keeping quality considerably. Storage in sand bed apparently failed to contribute to the keeping quality. At 60 days of storage, tubers stored in sand bed were rotten and dehydrated and insect damage was 100 %.

Siddique (1985) conducted a comparative yield trial with 24 sweet potato genotypes during the 1982-1983 seasons at Horticulture farm, BAU, Mymensingh, Bangladesh. Yield and yield contributing characters varied widely. A significant variation was found in number of vine, total length of vines, weight of vines per plant at harvest, shape and size of leaves, shape and size of tuberous roots and yield, colour of leaf, vine tips, skin colour of tuber and flesh colour of tuber also varied. The vine length ranged from 93.33 to 488.73 cm. The yield ranged from 14.34 to 55.63 tons per hectare.

Rahman (1981) reported a sweet potato trial under the Bangladesh Agricultural University Horticultural Farms conditions. The sweet potato cultivar S-243-2 gave the highest yield (45.67 t/ha) followed by S-0122-2 (34.90 t/ha). There were wide difference in carotene and protein contents among the cultivars. The cultivars S-272-9, S-35-1 and Local Lal contained the highest amount of protein, carotene and ascorbic acid respectively.

Nakatani *et al.* (1988) observed that storage root formation dependent largely on the characteristics of the stock cultivar, but storage roots enlargement showed effects of both stock and scion.

In Papua New Guinea, Bourke (1984) observed the significant differences for the storage root yield, number of storage roots per plant, mean storage roots weight and weight of storage roots per plant.

Mukhopadhyay *et al.* (1999) conducted a field experiment at the Horticulture Research Station of Bidhan Chandra Krishi Viswavidyalaya Mondouri, Nadia,West Bengal, India to study the effect of planting materials (top, middle ,and bottom vine cuttings both fresh and stored) on dry matter (dry matter) accumulation in sweet potato at different stages of plant growth. Dry matter accumulation in leaves increased up to 120 days, where in shoots and tubers, it increased gradually up to 15 days, irrespective of the cuttings. Rooted top vines produced maximum dry matter in tubers (69.70 q/ha) while rooted bottom vines produced maximum DM in shoots (36.63 q/ha) and leaves (30.95 q/ha). Starch content in tubers increased with the age of crop up to 150 days after planting (DAP).

Sweet potato is a versatile and nutritious food for all. It has considerable untapped potential as a nutritious food crop particularly for the poor and more vulnerable groups of society in developing countries (Woolfe, 1992).

The growth habit of sweet potato in vines and storage root is dependent on several factors. Environment plays an important role on growth (Varma and Nasker, 1986).

According to Hossain and Siddique (1985), the growth of sweet potato comprises 3 phases:

i) An initial phase consisting of the growth of the vines and absorbing roots only;

ii) An intermediate phase consisting of growth of the vines and absorbing roots simultaneously with the initial development of the fleshy roots; and

iii) A final phase consisting of the rapid development of the fleshy storage roots.

Apparently, a slow growth of the vines and presumably a rapid growth of the absorbing root system, the second might characterize the first period by a rapid development of the vines and the initial development of the storage roots, and the third by a cessation in the growth of the vines and a rapid development of the fleshy storage roots.

Uddin *et al.* (1994) observed in field trials at Bogra, Bangladesh in rabi (Winter), vines of sweet potato cv. Tripti and a local cultivar were cut 95-155 days after planting (DAP). Fodder yields increased with delay in cutting. Tubers yields were highest in the uncut control, but did not differ significantly from tuber yields of plots cut for fodder 125 DAP. BARI SP-1 (Tripti) gave better average fodder and tuber yields than the local cultivar. It is suggested that fodder can be harvested from 125 DAP without adversely affecting tuber yield.

Yield

Five sets of preliminary yield trial involving 249 local cultivars and 98 advanced lines of sweet potato were conducted to evaluate their yield potential and adaptability at Philippines Root Crop Research and Training Centre (Basuca *et al.,* 1990). The highest root yielders in set 1,2,3,4 and 5 were NPSP514, NPSP712, NPSP172, NPSP189 and NPSP403 with yields of 11.23, 10.25, 13.46, 20.96 and 15.54 t/ha, respectively. A total of 142 varieties were selected in the general yield trial for further evaluation.

Farooque and Husain (1973) conduct a comparative yield trial with seven exotic sweet potato varieties and a local white fleshed variety to evaluate the performance of the exotic varieties in comparison to local white at Horticulture Farm, Bangladesh Agricultural University, Mymensingh during the period from November 1971 to April 1972. They observed a wide variation among the varieties in respect of yield contributing characters.

Among the varieties, A.U. Selection No. 2 gave the highest yield (19.37 t/ha). Number of tubers per plant ranged from 4.70 to 11.76 while number of vines per plant varied from 9.1 to 25.0.

Hossain (1995) while working with 30 sweet potato genotypes stated that the number of vines per plant at harvest varied among the genotypes ranging from 8.43 to 14.0. The highest number of vines (14.0) was recorded in SP-25 followed by SP1(13.47) and the lowest number of vine was recorded in SP21 (8.43).

A yield trial of three high yielding sweet potato genotypes (AIS-0122-2, Training and BNAS- white was conducted at BAU farm, Mymensingh. The genotype AIS-0122-2 gave the highest yield (56.5 t/ha) followed by BNAS- white (50.7 t/ha) and Tinirining produced 44.5 tons of storage roots per hectare (Siddique et al., 1988).

A study was conducted at Joydebpur for characterization of 226 sweet potato germplasms. There was significant variation recorded among the germplasms in plant character and storage roots yield (Anonymous, 1992). The yield range was recorded from 1.1 to 44.0 t/ha. The maximum yield was obtained from SP-386. Majority of the germplasms produced storage roots yield ranging from 10 to 20 t/ha.

Clone K-17 gave the highest yield (48.22 t/ha) containing 25.24 % dry matter and clone D-51 produced second highest yield (45.92 t/ha) containing 26.87 % dry matter when a evaluation trial of ten selected clones was conducted at Joydebpur (Anonymous, 1991). There was a remarkable variation in the flesh and skin colour of storage roots, number of storage roots per plant and percent dry matter content.

Biswas *et al.* (1997) exercised sweet potatoes cv. Pusa Safed at soil moisture tensions of 0.3, 0.6 or 0.9 atm., or were grown without irrigation. Tuber yields were 16.4, 23.6, 20.1 and 11.7 t/ha in the 4 treatments. Carbohydrate contents of plant organs were highest with irrigation at 0.6 atm soil moisture at all growth stages.

Rashid *et al.* (1982) conducted a yield trial consisted of 41 sweet potato cultivars in Bangladesh during 1979-80. Among them cv. BNAS-51 from the Philippines gave the highest average root yield of 41.3 t/ha closely followed by Kokeia (40.0 t/ha) a Japanese cultivar.

Goswami (1995) observed sweet potato cultivars at 90-135 days after planting (DAP). Based on tuber yield, the cultivars were grouped into early, medium and late. When harvested at 105 DAP, tuber yield was highest in cv. X-5 and V-35 (mean 19.2 and 18.9 t/ha, respectively), whereas at 135 DAP it was highest if cv. Dergaon Red and S-107 (24.8 and 22.8 t/ha, respectively).

Sweet potatoes grown on ridges, in furrows or a flat seedbed gave storage roots yields of 10.8, 9.1 and 8.6 t/ha of 5 vine lengths (20, 40, 60, 80, and 100 cm) tested, planting vines 40 cm long gave the highest yields followed by vines 60 cm long (Prasad,1989).

Sen *et al.* (1995) observed some genotypes and found Kalmegh, H-85/16, V35 and S30 early bulking and produced more than 15 tons of storage roots per ha. at 90 days, and 20 tons and above at 105 days, while X69, OP217,cross-4, C71 and op219 were identified as late bulking types and produced 15 tons or more only after 105 days. H-80/168, X24 and local was poor yielder in both dates and season.

Sarker *et al.* (1992) evaluated a field trial on sandy loam during the kharif (rainy) seasons in Bihar 13 short duration sweet potato cultivars. Storage root length was the highest in RS5 (11.2 cm) while Samarat and V_{35} had the highest storage root girth (14.0 cm). Kalmegh gave the highest marketable storage roots yield (mean) of 20.91 t/ha, followed by 760 P21 (19.27 t/ha).

Singhel *et al.* (1990) observed 10 sweet potato cultivars. He observed mean leaf area and storage roots yield were highest in coll. No.4306 (43.3 cm^2 and 39.46 t/ha, respectively). Storage roots yield of other cultivars ranged from 6.56 (local cultivars) to 31.48 t/ha (cv. Pusa saved).

CHAPTER THREE

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the experimental field of Horticulture Department, Faculty of Agriculture, Sylhet Agricultural University (SAU), Sylhet. The location of the experimental site is north-east corner of the Bangladesh lying between $23^0 57'$ to $25^0 13'$ North latitude and $90^0 56'$ to $92^0 21'$ East longitude. The site falls under the Agro-ecological Zone-20: Eastern Surma-Kushiyara Floodplain. Elevation of the experimental site is 30m above the sea level. The land is situated just below some tilas of the southern part of the SAU campus.

Duration of the Experiment

Two different experiments were conducted during two consecutive winter seasons of 2012-2013 and 2013-2014.

Climate of the study

The site was situated in the subtropical climatic zone, characterized by heavy rainfall during the month of May to September and scanty rainfall during rest of the year. In general, the lowest temperature is 10 ^{0}C during the month of January and the highest temperature is 35 ^{0}C during the month of April while the average temperature is 20-25 ^{0}C and annual average rain fall is 4000mm. Detail weather data is given in Appendix I.

Soil of the Experimental Site

The soil of experimental site was gray, sandy loams in texture and belongs to the 'Non-calcareous Grey' soils under Eastern Surma-Kushiyara Floodplain. Organic matter content of soils is moderate. The reaction of soils ranges from strongly acidic to neutral (p^H4.7-6.9). Previously no crop was grown in the experimental field therefore it was a fallow land. Detail soil related data is given in Appendix II.

Experiment 1. Performance of sweet potato genotypes at varied harvesting stage

Plant materials

Seven exotic sweet potato genotypes were evaluated in the presented in this study. These genotypes were collected from Japan. Their original genotypic and accession number are given below:

Sl. No.	Original accession number	Given accession number	Remark
1	TS (15)	SP001	All these sweet potato genotypes were collected from Japan by the Department of Crop Botany and Tea Production Technology of Sylhet Agricultural University.
2	BA (1)	SP002	
3	BA (2)	SP003	
4	SU	SP004	
5	QS	SP005	
6	JQ	SP006	
7	HR	SP007	

Harvesting stage

Two harvesting stages were considered in this study. All these genotypes were harvested at 120 day (H_1) and 150 day (H_2) after planting.

Land preparation

The experimental land was first opened by using a power tiller and subsequently spading and followed by laddering to obtain the desirable tilth. The land was prepared by removing weeds, stubbles and crop residues and trimming ails. Hence the land was acidic in nature, lime (Dolomite) was applied in the field @ 4 kg/decimal. Each plot was fertilized with basal dose of manures during the final land preparation. The layout was done as per experimental design. The surface of the plot was leveled smoothly and irrigation channels were made around each block.

Design and layout

The experiment was conducted in Randomized Complete block Design (RCB) with three replications. Seven sweet potato genotypes were evaluated at two different harvesting stages. The treatment combinations and their symbols are given below.

Sl. No.	Treatment combinations	Symbol
1.	SP001 harvested at 120 days	V_1H_1
2.	SP002 harvested at 120 days	V_2H_1
3.	SP003 harvested at 120 days	V_3H_1
4.	SP004 harvested at 120 days	V_4H_1
5.	SP005 harvested at 120 days	V_5H_1
6.	SP006 harvested at 120 days	V_6H_1
7.	SP007 harvested at 120 days	V_7H_1
8.	SP001 harvested at 150 days	V_1H_2
9.	SP002 harvested at 150 days	V_2H_2
10.	SP003 harvested at 150 days	V_3H_2
11.	SP004 harvested at 150 days	V_4H_2
12.	SP005 harvested at 150 days	V_5H_2
13.	SP006 harvested at 150 days	V_6H_2
14.	SP007 harvested at 150 days	V_7H_2

The unit plot size of the experiment was 2.4 m × 3.0 m where spacing was maintained at 60 cm and 30 cm between row to row and plant to plant, respectively. So, therefore, there were 4 rows per unit plot and ten plants per row. Out of four rows, plants of two rows were harvested at 120 day after sowing to observe yield and yield attributes. Again, the other two rows were harvested at 150 day after planting for yield and yield attributes.

Manure and fertilizer application

The following recommended dose of manure and fertilizers were applied in the experimental field. The full dose of cow dung, TSP and half dose MP were applied basally during land preparation one week before transplanting. The remaining MP and urea were applied in three equal installments as top dressing at 20, 40 and 60 days after planting. Doses of manure and fertilizers were applied in the experimental field are presented below.

Manure and fertilizer	**kg/hectare**
Cowdung	20,000
Urea	135 g
TSP	60
MP	150
$ZnSO_4$	5

Planting of vine

Fifteen centimeter long terminal vines having at least three nodes were transplanted in the experimental field at afternoon on 16 October, 2012. Just after planting, the planted vines were irrigated with a watering cane for better establishment. Light irrigation was also given in the following three days to the planted vine to ensure plant establishment.

Gap filling

The damaged vines were replaced immediately by new ones to keep the plant stand uniform.

Intercultural operation

Weeding and mulching

Weeding was done manually using *niri* whenever it was felt necessary to keep the plots free from weeds and the plots were mulch to pulverize them.

Irrigation

The plants were initially irrigated by watering cane and later on surface irrigation was given whenever required. During heavy rainfall proper drainage facilities was provided to protect the plant from water stagnant condition.

Pest and disease control

The crop was protected from the attack of pest mainly aphids, jute hairy caterpillar,and pod borer by regular spraying of Maladan @ 2 ml/L.

Vine lifting

Frequently the vines of all plants were lifted from the soil to prevent the vine to producing new roots from nodes and thus discourage the plants from anchorage to the soil.

Harvesting

For estimating tuber yield and yield attributes plants of two rows from each replication of each genotype were harvested by spade at 120 day and 150 day after planting. Just after harvest the roots were cleaned by removing the adhered soil.

Collection of data

Observations of different characters were recorded from each genotype. To characterize the genotypes, data on different vegetative parameters were recorded. For tuber yield and yield attributes data were recorded at both of the time of harvesting. Collected data on some parameters were subjected to MSTATC software for analysis of variance and mean separation was done as per Duncan's Multiple Range Test (DMRT) at 5 % level of probability.

A. Colour of plant parts

1. **Vine colour:** Vine colour of all genotypes was noted visually.
2. **Localized pigmentation:** Localized pigmentation of all genotypes was noted visually.
3. **Leaf colour:** Leaf colour of all genotypes was noted visually.
4. **Leaf vein colour:** Leaf vine colour of all genotypes was noted visually.
5. **Petiole colour:** Petiole colour of all genotypes was noted visually.

B. Vegetative characteristics

1. **Vine diameter (mm):** At full growing stage diameter in the middle of vines was

measured from five vines from each replication of all genotypes and average was made.

2. **Internode length (cm):** At full growing stage internode length of vines was measured from five vines from each replication of all genotypes and average was made.
3. **Leaf length (cm):** Leaf length of five fully developed terminal leaves was measured from each replication of all genotypes and average value was calculated.
4. **Leaf breadth (cm):** Leaf breadth of five fully developed terminal leaves was measured from each replication of all genotypes and average was calculated.
5. **Petiole Length (cm):** Petiole length of five fully developed leaves was measured from each replication of all genotypes and average was calculated.
6. **Leaf shape:** It was determined by visually from fully developed leaf.
7. **Leaf tip shape:** It was determined by visually from fully developed leaf.

C. Tuber yield and yield attributes

1. **Length of vine (cm):** Length of vine of five plants from each replication of all genotypes at both of the harvesting was made and average was calculated.
2. **Root length (cm):** Root length of 10 representative roots from each replication of all genotypes was made at both of harvesting.
3. **Root width (cm):** Root width of 10 representative roots from each replication of all genotypes was made at both of harvesting.
4. **Number of vines/hill:** Number of vines was recorded from five hills of each replication for both of the harvesting.
5. **Foliage weight (kg):** Weight of foliage of five hills from each replication was measured and average was calculated for both of the harvesting. Further

calculation was made through kilogram (kg) converted into gram (g).

6. **Number of roots/plant:** Number of roots for five plants was recorded from each replication for both of the harvesting.
7. **Weight of roots/plant (g):** Weight of roots from 10 randomly selected plants from each replication was recorded for both of the harvesting and average was made.
8. **Tuber yield (t/ha):** Tuber yield per hectare was calculated from unit plot yield.
9. **Dry matter (%) in foliage and tuber:** To determine dry matter (%) of the foliage and tuber of all genotypes of both of the harvest 100 g of tuber and foliage were measured just after harvest, chopped and dried for one day in room temperature to remove excess water from the samples. Then the samples dried at 70 °C with the help of electrical oven for 72 to 80 hrs until the constant dry weight was attained. The estimated dry weight of the samples was converted into per cent dry matter for tuber and foliage.

D. Some qualitative characters

1. Root colour: After harvesting of root among seven genotypes root colour are taken through our visual observation**.**

2. Flesh colour: Flesh colour of the tuber of all genotype was noted before and after boiling of the roots.

3. Taste: The most important character of sweet potato is sweetness, which also taken properly after boiling the root.

4. Fibreness: It is also taken properly after boiling the root.

E. Chemical Analysis

To estimate nutrient elements presence in the tuberous roots of the genotypes, 100 g of root sample of all genotypes harvested at 120 day after planting were sent to the Central Laboratory of Bangladesh Agricultural Research Institute, Gazipur. To determine the nutrients elements of the supplied samples the following standard procedures were followed; The supplied samples of different sweet potato genotypes were cleaned, dried and kept for chemical analysis. For nitrogen determination, samples were digested with conc. H_2SO_4 in presence of K_2SO_4 catalyst mixture (K_2SO_4 : $CuSO_4$. $5H_2O$: Se=10 : 1 :0.1). For other elements determination, plant samples were digested with in di-acid mixer (HNO_3-$HClO_4$ = 5:1).

Standard methods were used for plant analysis as follows:

Soil parameter	Digestion	Determination	References
N	Plant sample was digested with conc. H_2SO_4 in presence of K_2SO_4 catalyst mixture (K_2SO_4 : $CuSO_4$. $5H_2O$: Se=10 : 1 :0.1).	Nitrogen in the digest was estimated by distilling the digest with 10N NaOH followed by titration of the distillate trapped in H_3BO_3 indicator solution with 0.1N HCl.	Bremner and Mulvaney, 1982
P	Digesting the samples in di-acid mixture (HNO_3-$HClO_4$)	Determined colorimetrically using molybdate blue ascorbic acid method by spectrophotometer.	Olsen and Dean, 1954
K, Na, Ca & Mg	Digesting the samples in di-acid mixture (HNO_3-$HClO_4$)	Directly measured by AAS	Peterson, 2002
S	Digesting the samples in di-acid mixture (HNO_3-$HClO_4$)	Determined turbidity method using $BaCl_2$ by spectrophotometer	Fox *et al.*1964
Cu, Fe, Mn & Zn	Digesting the samples in di-acid mixture (HNO_3-$HClO_4$)	Determined directly by Atomic Absorption Spectrophotometer	Johnson *et al.* (1978)
B	Digesting the samples in	Determined by	Jackson, 1973

	di-acid mixture (HNO_3-$HClO_4$)	azomethine-H colour development method by spectrophotometer	

Experiment 2. Evaluation of sweet potato genotypes under varied planting time

Experimental site and duration

This investigation was conducted at the experimental field and Laboratory the department of the Horticulture, Sylhet Agricultural University from September 2013 to March 2014.

Planting Material

Three sweet potato genotypes selected from the previous study was included in the present study. These were SP004, SP006 and SP007.

Planting time

Three planting time was considered in this study. These were 1 September, 1 October and 1 November 2013

Land preparation

The experimental land was first opened by using a power tiller and subsequently spading and followed by laddering to obtain the desirable tilth. The land was prepared by removing weeds, stubbles and crop residues and trimming ails. Each plot was fertilized with basal dose of manures during the final land preparation. The layout was done as per experimental design. The surface of the plot was leveled smoothly and irrigation channels were made around each block.

Manure and fertilizer application

It was done as per the previous experiment.

Design and Lay out

The experiment was conducted in Randomized Complete block Design (RCBD) with three replications. Three sweet potato genotypes were planted on 1 September, 1 October and 1 November in 2013. The unit plot size of the experiment was 1.2 m × 3.0 m where spacing was maintained at 60 cm and 30 cm between row to row and plant to plant, respectively. So, therefore, there were 2 rows per unit plot and ten plants per row.

The treatment combinations and their symbols are given below

Sl. No.	Treatment combinations	Symbol
1	SP004 planted at 1 September	V_1T_1
2	SP005 planted at 1 September	V_2T_1
3	SP006 planted at 1 September	V_3T_1
4	SP004 planted at 1 October	V_1T_2
5	SP005 planted at 1 October	V_2T_2
6	SP006 planted at 1 October	V_3T_2
7	SP004 planted at 1 November	V_1T_3
8	SP005 planted at 1 November	V_2T_3
9	SP006 planted at 1 November	V_3T_3

Planting of vine

Fifteen cm long terminal vines of vines having at least three nodes were transplanted in the experimental field in the afternoon time on each planting dates. Just after planting, the planted vines were irrigated with a watering cane for better establishment of the vines. Mild irrigation was also given in the following three days to the planted vine to ensure plant establishment.

Gap filling

The damaged vines were replaced immediately by new ones to keep the entire plant stand uniform.

Intercultural operation

All intercultural operations like weeding, fertilizer application, irrigation, mulching, vine lifting etc were done as was performed in the previous experiment.

Harvesting

Tubers of sweet potato genotypes from all planting dates were harvested at 135 day after planting with the help of spade to record yield and yield attributing parameters.

Collection of data

Yield and yield attributes

1. **Length of longest vine (cm):** Length of longest vine of five plants from each replication of all genotypes at both of the harvesting was made and average was made.
2. **Root length (cm):** Root length of 10 representative roots from each replication of all genotypes was made at both of harvesting.
3. **Root width (cm):** Root width of 10 representative roots from each replication of all genotypes was made at both of harvesting.
4. **Number of vines/hill:** Number of vines was recorded from five hills of each replication for both of the harvesting.

5. **Foliage weight (kg):** Weight of foliage of five hills from each replication was measured and average was calculated for both of the harvesting. Further calculation was made through kilogram (kg) converted into gram (g).

6. **Number of roots/plant:** Number of roots for five plants was recorded from each replication for both of the harvesting.

7. **Weight of roots/plant (g):** Weight of roots from 10 randomly selected plants from each replication was recorded for both of the harvesting and average was made.

8. **Tuber yield (t/ha):** Tuber yield per hectare was calculated from unit plot yield.

9. **Dry matter of foliage**: 100 g of foliage was dried in an electric oven at 70 ^{0}C for three days to determine dry matter of foliage.

10. **Dry matter of tuber**: 100 g of tuber was dried in an electric oven at 70 ^{0}C for three days to determine dry matter of tuber.

Statistical analysis

For interpretation of results some simple statistical parameters viz., mean, range, standard deviation and co efficient of variation were estimated for morphological characteristics of vine diameter, internode length, petiole length, leaf length and leaf breadth. Data on root yield and yield attributes were analyzed following the Analysis of Variance (ANOVA) technique and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) using a computer based software.

CHAPTER FOUR

RESULTS AND DISCUSSION

Experiment 1. Evaluation of sweet potato genotypes under varied harvesting stage

The results obtained from the present study regarding morphological characteristics of seven sweet potato genotypes are presented in tables and figures. Main effect of genotype, harvesting stage and interaction effect between genotype and harvesting stage are presented in separate tables. Character wise discussion is presented below.

A. Colour of vegetative parts of plant

Vine colour

Three types of vine colour viz., purple, green and mixed colours were observed among the genotypes (Table 1.1). Of which the genotypes SP001, SP004 and SP005 had green vine colour. On the other hand the genotype SP002, SP003 and SP007 had vine with purple colour. The only genotype SP006 had mixed colour (purple with green) vine. Ahmed (1998) also reported about variation in vine colour among different genotypes.

Localized pigmentation

Localized pigmentation especially at the junction of leaf and petiole was observed in all genotypes. Junction place of leaf and petiole was found deep purple in colour for all genotypes (Table 1.1).

Leaf colour

Variation in leaf colour was observed among the genotypes (Table 1.1; Image 1.1). The genotypes SP001, SP002, SP006 and SP007 had mixed that is purple with green leaf colour while the genotypes SP003, SP005 had green leaf with red margin. Among the genotypes only SP004 had dark green leaf. Several researchers also recorded difference in leaf colour three sweet potato genotypes.

Leaf vein colour

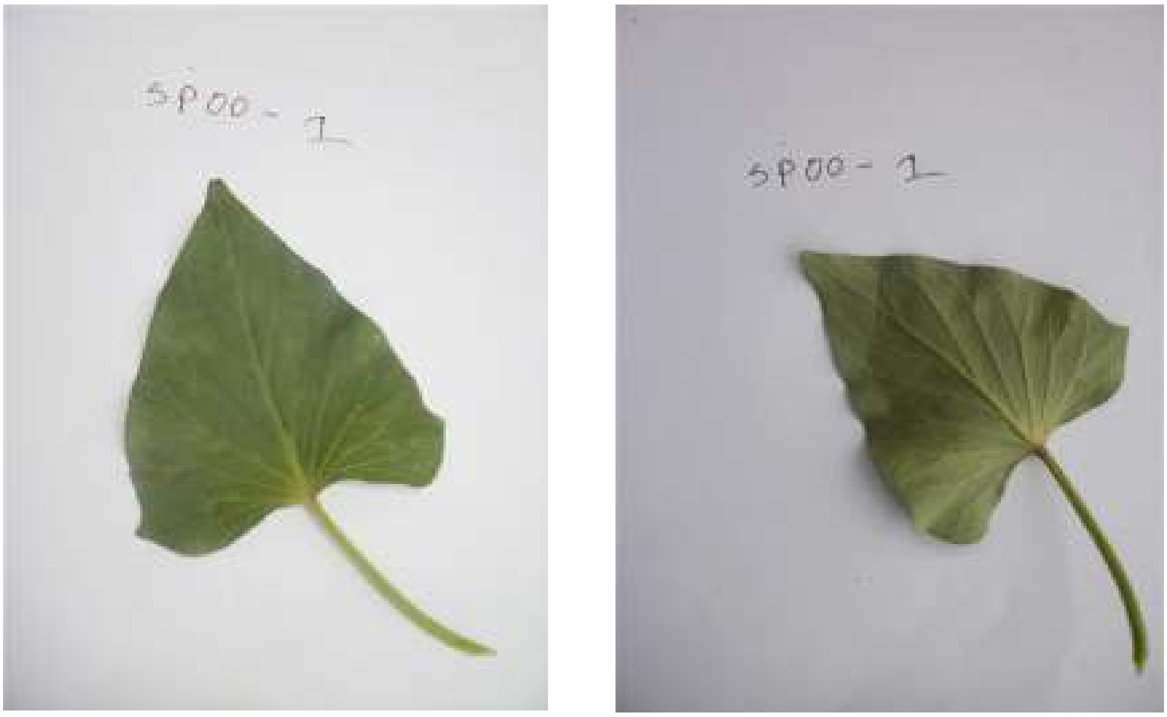
Five genotypes had green leaf vein colour (Table 1.1; Image 1.1). The other two genotypes SP006 had purple and SP001 had light green leaf vein colour. Ahmed (1998) also reported variation in leaf vein colour.

Petiole colour

All the genotypes exhibited green petiole colour (Table 1.1; Image 1.1). However, some researchers reported variation in petiole colour among different genotypes of sweet potato (Ahmed, 1998; Anonymous, 2000).

Table 1.1. Colour of different plant parts of sweet potato genotypes

Genotype	Vine colour	Localized pigmentation	Leaf colour	Leaf vein colour	Petiole colour
SP001	Green	Present	Mixed	Light green	Green
SP002	Purple	Present	Mixed	Green	Green
SP003	Purple	Present	Green	Green	Green
SP004	Green	Present	Dark green	Green	Green
SP005	Green	Present	Green	Green	Green
SP006	Mixed	Present	Mixed	Deep purple	Green
SP007	Purple	Present	Mixed	Green	Green



SP001

SP002

Image 1.1. Leaf of different sweet potato genotypes

SP003

SP004

Image 1.1. (Contd)

SP005

SP006

Image 1.1. (Contd)

SP007

Image 1.1. (contd.) Leaf of different sweet potato genotypes

B. Vegetative/morphological characteristics

Vine Diameter (mm)

Remarkable variation in vine diameter was observed among the sweet potato genotypes (Table 1.2). The highest vine diameter was recorded from the genotype of SP003 (2.4 mm) closely followed by SP002 (2.1 mm) and SP006 (2.0 mm). The genotype SP007 exhibited the lowest vine diameter among the genotypes (1.70 mm). However, the vine diameter was ranged from 1.70 mm to 2.4 mm.

Internode length (cm)

Internodes length of the genotypes was greatly varied (Table 1.2) from 1.99 cm to 3.48 cm of which the genotype SP005 had the highest internode length (3.48 cm) followed by SP004 (2.96 cm) and SP007 (2.66 cm). The other genotypes SP003 and SP001 had internode length of 2.54 cm and 2.3 cm respectively. The lowest internode length was recorded from the genotype of SP002 (1.99 cm). Similar variation in internode length was also reported by Ahmed (1998). The variation in internode length might be the inherent potential of the genotypes.

Petiole length (cm)

A large difference in petiole length was observed among the sweet potato genotypes (Table 1.2). It was as high as 9.72 cm for the genotype of SP004 while the second highest was 6.68 cm for SP001 followed by SP003 (6.44 cm) and SP007 (6.26 cm). The lowest petiole length was observed for the genotype of SP006 (5.08 cm).

Leaf length (cm)

Leaf length of sweet potato genotypes is presented in Table 1.2. It was ranged from 10.98 cm to 13.5 cm. The plants of SP007 produced the highest leaf length (13.5 cm) very close to the leaf of the genotype of SP004 (13.4 cm) followed by SP001 (12.83 cm). The lowest leaf length was recorded from SP006 (10.98 cm). The other genotype SP002 and SP003 had leaf length of 12.0 cm and 11.59 cm, respectively. Leaf length variation in sweet potato was also reported by Anonymous (2012).

Leaf breadth (cm)

Difference of leaf breadth was observed among the genotypes (Table 1.2). The highest leaf breadth was recorded from the genotype SP007 (11.98 cm) very close to the genotype of SP004 (11.95 cm). The other genotypes SP002, SP003 and SP006 had the leaf breadth of 11.10 cm, 10.90 cm and 10.30 cm, respectively. The lowest leaf breadth was found from the genotype of SP005 (9.56 cm). Similar leaf breadth variation among different sweet potato genotypes was reported by Anonymous (2012).

Leaf tip

Leaf tip shape was classified in to three groups like highly acute, medium acute and less acute (Table 1.2). The genotypes SP004, SP005 and SP006 had highly acute leaf tip while SP001, SP003 and SP007 had medium acute leaf tip. The only genotype SP002 had less acute leaf tip. Ahmed (1999) reported similar morphological variation among different sweet potato genotypes in diversity study.

Table 1.2. Vine and leaf characteristics of sweet potato genotypes

Genotype	Vine diameter (mm)	Internodes length (cm)	Petiole length (cm)	Leaf length (cm)	Leaf breath (cm)	Leaf tip
SP001	1.9	2.3	6.68	12.83	10.1	Medium acute
SP002	2.1	1.992	6.14	12.0	11.10	Less acute
SP003	2.4	2.54	6.44	11.59	10.90	Medium acute
SP004	1.9	2.96	9.72	13.4	11.95	Highly acute
SP005	1.75	3.48	5.96	11.65	9.56	Highly acute
SP006	2.00	2.24	5.08	10.98	10.30	Highly acute
SP007	1.70	2.66	6.26	13.5	11.98	Medium acute
Mean	1.96	2.59	6.61	12.27	10.84	
Range	1.70-2.4	1.99-3.48	5.08-9.72	10.98-13.5	9.56-11.98	
Stdev	0.23	0.50	1.46	0.97	0.92	
CV%	12.0	19.26	22.10	7.92	8.48	

C. Yield and yield attributes

Main effect of genotype

Main effects of sweet potato genotypes on different yield and yield parameters are presented in Table 1.3. Parameter wise discussion is also given below.

Length of vine (cm)

Length of vine was significantly different among the genotypes (Table 1.3). The highest vine length was recorded from the genotype SP006 (50.33 cm) which was statistically identical with that of genotype SP002 (49.99 cm). On the other hand the lowest longest vine length was recorded from the genotype SP001 (31.07 cm). Siddique (1985) recorded the vine length of sweet potato genotypes varied from 93.33 to 488.73 cm.

Root length (cm)

A remarkable variation was recorded in root length among the genotypes (Table 1.3). The highest root length was recorded from the genotype of SP004 (12.18 cm) followed by SP003 (10.62 cm) and SP007 (10.13 cm). The genotypes SP006, SP005 and SP001 produced root had a length of 9.75 cm, 9.25cm and 8.61 cm, respectively. The lowest root length was recorded from the genotype SP002 (7.34 cm).

Root width (cm)

Root width was significantly different among the genotypes (Table 1.3). Here highest root width SP004 (6.68 cm). Genotypes SP005 (5.27 cm), SP006 (5.15 cm), SP007 (5.64 cm) are statistically identical for their root width. The lowest root width was recorded at SP002 (3.35 cm). Siddique (1985) also conducted an experiment with 24 genotypes of sweet potato.

Number of vines/hill

Number of vines/hill was significantly different among the genotypes (Table 1.3). The highest number of vines/hill was recorded from SP004 (10.15). The genotypes SP005 (7.68) and SP006 (7.80) were statistically identical for their value. The lowest value was recorded from SP001 (5.91).

Foliage weight (g)

A significant variation was recorded in foliage weight of the genotypes (Table 1.3). In the present study the highest foliage weight was recorded from the genotype SP006 (310.33 g). The genotypes SP001 (97.83 g), SP002 (94.16 g) and SP003 (103.33 g) were statistically identical for their foliage weight. The lowest foliage weight was recorded at SP002 (94.16 g).

Number of roots/plant

A remarkable variation was observed in number of roots/hill among the genotypes. The highest number of roots/plant was recorded at genotypes SP006 (6.28). The genotypes SP004 (4.90), SP005 (4.35) and SP007 (4.35) were statistically identical for their number of roots/plant. The lowest number of roots/plant was recorded from SP001 (3.18). Siddique (1985) evaluated 24 sweet potato genotypes during 1982-1983 season at Horticulture farm, BAU, Mymensingh about this aspect.

Weight of roots/plant (g)

Weight of root was significantly different among the genotypes (Table 1.3). The highest weight of root was measured from genotype SP004 (310.83 g). The genotypes SP001 (144.50 g), SP002 (123.66 g) and SP005 (132.50 g) are statistically identical for their root weight/plant. The lowest weight of root were recorded at SP002 (123.66 g). Similar root weight variation among different harvesting dates of sweet potato was also reported by several researchers (Hossain, 1995).

Table 1.3. Effect of genotype on growth and yield of sweet potato

Genotypes	Length of vine (cm)	Root length (cm)	Root breadth (cm)	Number of vines/hill	Foliage weight (g)	Number of roots/plant	Weight of roots/plant (g)
SP001	31.07 d	8.61 cd	4.18 c	5.91 e	97.83 e	3.18 c	144.50 e
SP002	49.99 a	7.34 d	3.35 d	6.39 de	94.16 e	3.55 c	123.66 e
SP003	37.17 c	10.62 b	4.41 c	6.84 d	103.33 e	3.53 c	170.33 d
SP004	42.86 b	12.18 a	6.68 a	10.15 a	290.33 b	4.90 b	310.83 a
SP005	37.88 c	9.25 bc	5.27 b	7.68 c	130 d	4.35 b	132.50 e
SP006	50.33 a	9.75 bc	5.15 b	7.80 c	310.33 a	6.28 a	230 c
SP007	45.44 b	10.13 bc	5.64 b	9.35 b	184.16 c	4.35 b	265.83 b
F-test	**	**	**	**	**	**	**
CV%	5.93	9.38	7.90	6.39	6.26	8.12	7.47

**indicates significant at 1% level of probability

Yield (t/ha)

Remarkable yield variation was recorded among the genotypes (Figure 1.1). The genotype SP004 produced the highest root yield (17.2 t/ha) followed by the genotype SP007 (14.7 t/ha). The genotypes SP006 and SP003 produced 12.77 and 9.4 tons of tubers per hectare, respectively. However, the genotype SP002 produced the lowest yield (6.8t/ha) was obtained from the genotypes. Similar tuber yield variation among different harvesting dates of sweet potato was also reported by several researchers (Bhuiyan *et al.,* 1997).

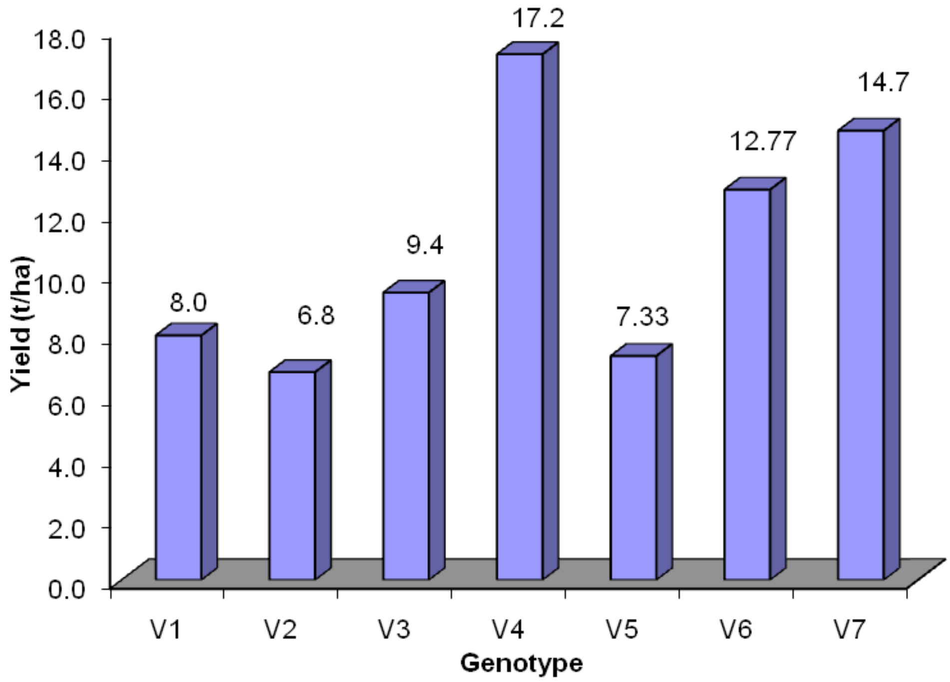


Fig.1.1. Yield of sweet potato genotypes

V_1 = SP001, V_2 = SP002, V_3 = SP003, V_4 = SP004, V_5 = SP005, V_6 = SP006, V_7= SP007

Main effect of harvesting stage

All genotypes were harvested at 120 day and 150 day after planting. Main effect of these two harvesting stage is presented in Table 1.4. Parameter wise discussion was also made below.

Length of vine (cm)

Vine length was significantly affected by harvesting stage (Table 1.4). The longest vine was considered at this experiment. The longest vine was measured when the plants were harvested at 150 days after planting at 45.77 cm while it was only 38.44 cm at 120 day after planting.

Root length (cm)

Root length was markedly influences by harvesting stage (Table 1.4). At first harvesting stage which was 120 days, the length of root was recorded 9.04 cm and second harvesting stages i.e. 150 days the root length was recorded 10.35 cm.

Root width (cm)

Root width was greatly affected by harvesting stages (Table 1.4). At first harvesting stage (at 120 day) the width of root was recorded 4.47 cm and second harvesting stage (at 150 day) it was recorded 5.44 cm.

Number of vines/hill

Number of vines/hill was markedly influence by harvesting stage (Table 1.4). At first harvesting stage (120 days) the number of vines/hill was recorded at 7.36 and second harvesting stage the number of vines/hill was recorded at 8.10.

Foliage weight (g)

Foliage weight was markedly influenced by varied harvesting stages. At first harvesting stage (120 days) the foliage weight was recorded (136.14 g), while it was 209.61 g at 150 day after planting. It was clearly observed that that second harvesting stage give more foliage weight than first harvesting stage (150 days), the plants get more time for their further vegetative growth.

Number of roots/plant

Number of root was not affected due to harvesting stage (Table 1.4). The average number of roots/plant was 4.41 at 150 days after planting, while it was 4.20 at 120 day after planting.

Weight of roots/plant (g)

Weight of roots/plant was markedly influence with harvesting stage (Table 1.4). The highest amount of root 230.90 g per plant was recorded when the plants were harvested at 150 days after planting, while it was only 172.7 g at 120 day after planting. This variation might be attribute since the plants of later harvesting not more time in the field for tuber growth.

Table 1.4. Effect of harvesting stage on growth and yield of sweet potato

Harvesting duration	Length of vine (cm)	Root length (cm)	Root width (cm)	Number of vines/hill	Foliage weight (g)	Number of roots/ plant	Weight of roots/plant (g)
H_1	38.44 b	9.05 b	4.47 b	7.36 b	136.14 b	4.20	162.71 b
H_2	45.77 a	10.35 a	5.44 a	8.10 a	209.61 a	4.41	230.90 a
F-test	**	**	**	**	**	NS	**
CV%	5.93	9.38	7.90	6.39	6.26	8.12	7.47

Here, NS indicates non-significant, * indicates significant at 5% level of probability, **indicates significant at 1% level of probability, H_1 = First harvest at 120 days after planting, H_2 = Second harvest at 150 days after planting

Yield (t/ha)

Yield of sweet potato tuber (t/ha) was presented in (Figure 1.2). It was 12.77 t/ha when the plants harvested at 150 day after planting while it was 9.0 t/ha at 120 day after planting. Similar tuber yield variation among different harvesting dates of sweet potato was also reported by several researchers (Ahmed, 1998; Bhuiyan, *et al.*,1997). The tuber yield of the later harvest (150 days) was higher than first harvest (120days), because the plants of later harvest (150 days) got more time for their efficient tuber growth.

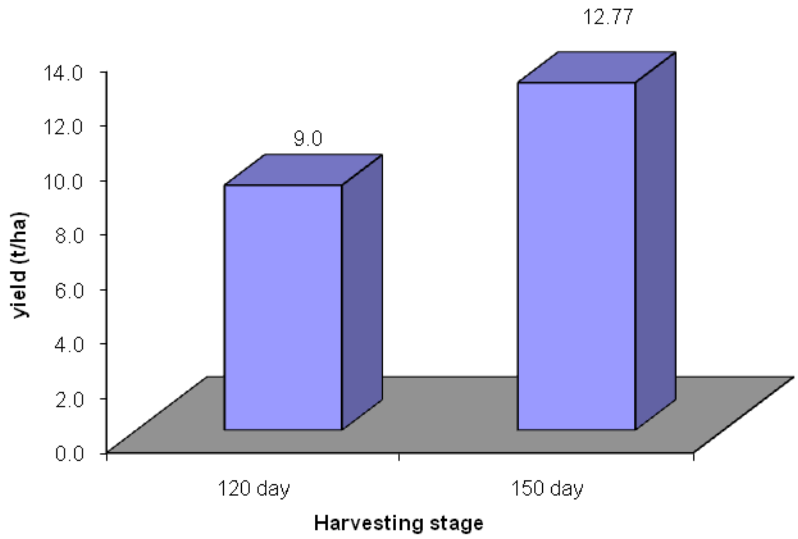


Fig. 1.2. Yield of sweet potato at different harvsting stage

H_1 = harvest at 120 day after planting and H_2 = harvest at 150 day after planting.

Interaction effect

Length of vine (cm)

Length of vine was largely affected by the interaction effect of genotype and harvesting stage (Table 1.5). The longest vine was recorded from the genotype of SP007 when harvested at 150 day after planting (53.77 cm) which was statistically identical with genotype SP006 (53.22 cm) and SP002 (53.21 cm) when harvested at 150 day after planting (53.22 cm). The lowest longest vine length was recorded from the genotype of SP001 (29.26 cm) closely followed by SP003 (29.34 cm) when harvested at 120 day after planting. The variation in length of vine might be attributed due to differences in growth behavior of the genotypes.

Root length (cm)

Root length was not influenced by the interaction effect between genotype and harvesting stage (Table 1.5). However, the highest root length was measured in genotype SP004 (12.83 cm) at 150 day after planting which was closely followed by the same genotype when harvested at 120 day after planting (11.54 cm). This result indicated that the genotype SP004 had produced longest tuber among the genotypes. The genotype SP002 produced root had lowest root length (6.86 cm).

Root width (cm)

Root width was significantly affected due to interaction between genotype and harvesting stage (Table 1.5). The highest root width was recorded from the genotype SP004 when harvested at 150 days (7.59 cm) which was statistically identical with the genotype of SP005 (6.99 cm) harvested at the same harvesting stage. The genotype SP006 also produced root had appreciable root width (6.01 cm) when harvested at 150 day after planting. The lowest root width (3.31 cm) was measured from the genotype of SP002 closely followed by the genotype of SP005 (3.56 cm) when harvested at 120 day after planting.

Number of vines/hill

Number of vines/hill was largely affected by the interaction of genotype and harvesting stage (Table 1.5). The highest number of vines/hill (10.16) was recorded from the genotypes SP004 at first harvesting stage (120 days) which was statistically identical with that of same genotype (10.14) harvested at 15 day after planting and SP007 (10.13) when harvested at 150 day after planting. The lowest number of vines/hill was recorded from genotypes SP001 (5.59) followed by SP003 (6.19) when harvested at 120 day after planting.

Foliage weight (g)

A significant variation was recorded in foliage weight due to interaction of genotype and harvesting stage (Table 1.5). In the present study the highest foliage weight was recorded from the genotype SP004 (406.66 g) with second harvesting stage (150 days). The lowest foliage weight was recorded from genotypes SP001 (77.33 g) with first harvesting stage (120 days).

Number of roots/plant

Number of roots was not significantly influenced by the interaction between genotype and harvesting stage (Table 1.5). However, the highest number of roots per plant was recorded from the genotype of SP006 under of harvesting stages (6.40 and 6.16, respectively). On the other hand, the lowest number of roots per plant was harvested from the treatment combinations of V_1H_1 (3.16) and V_1H_2 (3.20).

Weight of roots/plant (g)

Weight of roots/plant was largely affected by the interaction of genotype and harvesting stage (Table 1.5). The highest root weight (408.33 g) was recorded from the genotype SP004 when the plants were harvested at 150 day after sowing which was significantly highest than all other treatment combinations. The second highest root yield/plant was observed for the genotype of SP007 (318.33 g) at second harvest. Result revealed that all the genotypes showed better tuber yield performances at later harvesting stage. Mannan and Rashid (1984) also reported that yield of sweet potato was gradually increased with delay in harvesting from 100 day after planting up to 170 day after planting. The variation of tuber yield among the genotypes might be attributed due to their inherent genetic potentiality.

Table 1.5. Interaction effect of harvesting stage and genotype on yield and yield attributes of sweet potato

Genotype × Harvesting stage	Length of vine (cm)	Root length (cm)	Root Width (cm)	Number of vines/hill	Foliage weight (g)	Number of roots/ plant	Weight of roots/plant (g)
V_1H_1	29.26 g	7.43	4.06 def	5.59 f	77.33 i	3.16	106.66 h
V_1H_2	32.89 fg	9.80	4.31 de	6.24 def	118.33 g	3.20	182.33 de
V_2H_1	46.77 c	6.86	3.3 1 f	6.33 de	81.66 hi	3.50	115.00 gh
V_2H_2	53.21 ab	7.82	3.39 ef	6.45 de	106.66 gh	3.60	132.33 fg
V_3H_1	29.34 g	10.33	4.81 cd	6.19 e	93.33 ghi	3.40	162.33 ef
V_3H_2	45.00 c	10.92	4.01 def	7.49 c	113.33 g	3.66	178.33 de
V_4H_1	41.84 cde	11.54	5.77 b	10.16 a	174 e	4.33	213.33 cd
V_4H_2	43.89 cd	12.83	7.59 a	10.14 a	406.66 a	5.46	408.33 a
V_5H_1	37.33 ef	8.33	3.56 ef	7.63 c	101.66 ghi	4.33	86.66 h
V_5H_2	38.44 def	10.16	6.99 a	7.73 bc	158.33 ef	4.36	178.33 de
V_6H_1	47.44 bc	9.33	4.30 de	7.10 cd	276.66 c	6.40	241.66c
V_6H_2	53.22 ab	10.16	6.01 b	8.50 b	344 b	6.16	218.33 c
V_7H_1	37.11 ef	9.50	5.46 bc	8.56 b	148.33 f	4.30	213.33 cd
V_7H_2	53.77 a	10.77	5.82 b	10.13 a	220 d	4.40	318.33 b
F-test	**	NS	**	*	**	NS	**
CV	5.93	9.38	7.90	6.39	6.26	8.12	7.47

Here, NS indicated non-significant, * indicates significant at 5% level of probability, **indicates significant at 1% level of probability

V_1 = SP001, V_2 = SP002, V_3 = SP003, V_4 = SP004, V_5 = SP005, V_6 = SP006, V_7 = SP007, H_1= harvest at 120 day after planting, H_2 = harvest at 150 day after planting.

Tuber yield (t/ha)

A remarkable variation in tuber yield was found in the interaction effect between genotype and harvesting stage (Figure 1.3). In graphical presentation of interaction effect between genotypes and harvesting stage, it was clearly understood that genotype SP001 and second harvesting dates which was counted at 150 days (V_1H_2)gave the highest tuber yield (22.66 t/ha). After that second highest yield (17.66 t/ha) was noticed from genotype SP007 at second harvest dates which was measured at 150 days (V_7H_2) and then followed by V_4H_2 (13.38 t/ha) and V_5H_2 (12.11 t/ha). The lowest tuber yield (4.77 t/ha) was recorded from genotype SP002 when harvested at 150 day after planting (V_2H_2). Dayal and Sharma (1993) also conducted an experiment effect of harvesting stage on sweet potato. Details about the yield performance of sweet potato at varied harvesting stage were given at appendix III.

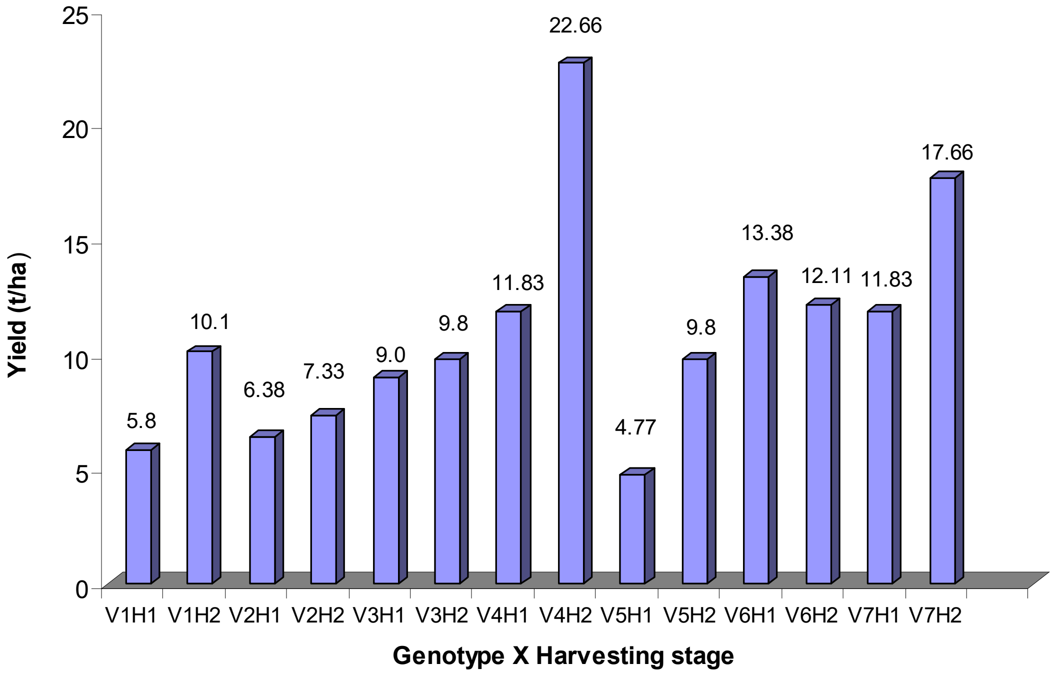


Fig. 1.3. Yield of sweet potato genotypes at varied harvesting stage

V_1 = SP001, V_2 = SP002, V_3= SP003, V_4= SP004, V_5= SP005, V_6= SP006, V_7= SP007,

H_1= harvest at 120 day after planting, H_2= harvest at 150 day after planting.

D. Qualitative characters

Root colour

There two root colours were observed among the sweet potato genotypes (Table 1.6; Image 1.2). These were also understood through visual observation before and after boiling of tuberous roots in each treatment. By visual observation it was showed that the root colour of genotypes SP001, SP002, SP003, SP005, SP006 and SP007 was red purple in colour. On the other hand, only genotype SP004 was exceptional, that had white root colour.

Flesh colour

Flesh colour of all the genotypes was creamy white only exception was recorded from genotype SP006, which was orange in colour before boiling (Table 1.6; Image 1.2). After boiling different types of flesh colour also found which is given at Table 1.6.

Taste

Taste of among sweet potato genotypes was different. Genotypes SP001, SP004, SP005 and SP006 were sweet in taste (Table 1.6). On the other hand, genotypes SP002, SP003, SP007 were less sweet in taste.

Fibreness

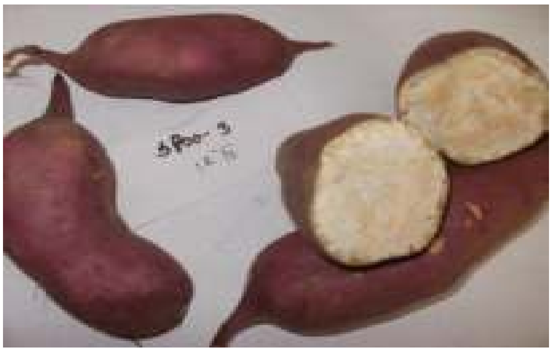
Among the seven sweet potato genotypes, only SP007 was fibrous in nature while all other genotypes exhibited very low fiber in the tuberous root.

Table 1.6. Root characteristics of sweet potato before and after boiling

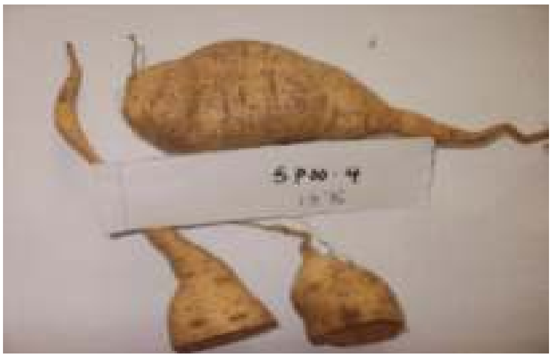
Genotype	Root colour	Flesh colour (Before boiling)	Taste	Flesh colour (after boiling)	Fibreness
SP001	Red purple	Orange white	Sweet	Creamy white	Trace
SP002	Red purple	Creamy white	Less sweet	Orange +gray white	Trace
SP003	Red purple	Creamy white	Less sweet	Creamy white	Trace
SP004	White	Creamy white	Sweet	Creamy white	Trace
SP005	Red purple	Creamy white	Sweet	Dark white	Trace
SP006	Red purple	Orange	Sweet	Orange	Trace
SP007	Red purple	Orange white	Less sweet	Orange	Fibrous

SP001

SP002



SP003



SP004

SP005

SP006

SP007

Image1.2. Root and flesh colour of different sweet potato genotypes

E. Chemical analysis

Sample of sweet potato genotypes were sent to central lab at BARI (Bangladesh Agriculture Research Institute) Gazipur, Dhaka with a view to estimate nutritional element of sweet potato tubers. Rahman and Haque (1983) also studied about nutritive value of seven genotypes of sweet potato. Nutrient elements estimated in the sweet potato genotypes are presented in Table 1.7.

Calcium is one of the most important nutrient elements of plant. The genotype SP007 had contained the highest amount of calcium which was 1.57 % while it was the lowest for the genotype of SP006 1.34 %. However, the average amount of calcium was 1.42 % among sweet potato genotypes.

Presence of magnesium (%) was also varied among the genotypes. The highest amount of magnesium was estimated from the genotype of SP007 (0.42 %) followed by SP005 (0.41 %) and SP006 (0.40 %) and SP004 (0.40 %). The lowest amount of magnesium was found for the genotype of SP001 (0.36 %).

Presence of potassium among the genotypes ranged from 1.94 % to 1.75 % of which the genotype SP001 had the highest amount of potassium (1.94 %) followed by SP002 (1.87 %) and SP003 (1.86 %). The genotype SP007 exhibited the lowest amount of potassium in the tuber (1.75 %).

Nitrogen is one of the most important nutrient elements of plant. The highest amount of nitrogen was estimated from the genotype of SP003 (1.21 %) followed by SP001 (1.19 %) and SP004 (1.18 %) and SP002 (1.13 %). The lowest amount of magnesium was found for the genotype of SP007 (1.07 %). However, the average amount of nitrogen was 1.14 % among sweet potato genotypes.

Phosphorus is another important nutrient element of plant. The highest amount of phosphorus was estimated from two genotypes SP001 (0.27 ppm) and SP005 (0.27 ppm), followed by SP006 (0.25 ppm) and SP002 (0.24 ppm), SP003 (0.24 ppm)) and SP004 (0.24 ppm). The lowest amount of magnesium was found for the genotype of SP007 (0.22 ppm). Bray *et al*. (1945) also done same work about on phosphorus.

Presence of sulphur (ppm) was also varied among the genotypes. Genotypes SP003 had contained highest amount of sulphur 0.28 ppm, while lowest amount also found from genotype SP001 was 0.18 ppm. However, the average amount of sulphur was 0.21 ppm among sweet potato genotype Palaskar *et al*. (1981) also done same work about on sulphur.

Boron is an essential micronutrient of plant. The highest amount of boron was determined from genotypes SP003 (24 ppm) and the lowest amount of boron also found from genotypes SP006 (15.0 ppm).

Copper is another important nutrient element of plant. The highest amount of copper was estimated from the genotype SP001 (6.18 ppm) followed by SP002 (5.88 ppm), SP006 (5.70 ppm), SP007 (5.64 ppm)) and SP003 (5.46 ppm). The lowest amount of copper was found for the genotype of SP004 (5.28 ppm).

Iron is another essential plant nutrient, which plays important role for plant growth. The highest amount of iron was determined from genotype SP007 (310 ppm) and the lowest amount of boron also found from genotype SP001 (106 ppm).

Manganese is an important micronutrient of plant. The highest amount of manganese was determined from the genotype SP006 (5.64 ppm), followed by SP007 (5.52 ppm), SP005 (5.46 ppm) and SP003 (5.34 ppm). The lowest amount of manganese was found from the genotype of SP002 (5.10 ppm). Another important micro nutrient elements molybdenum, several researchers like Grigg, (1953), C. M. *et al.* (1954) and Parvis *et al.* (1956) also done an experiment for determination of molybdenum in plant tissue.

Presence of zinc among the genotypes ranged from 9.12-11.52 ppm of which the genotype SP007 had the highest amount of zinc (11.52 ppm) followed by SP002 (1.87 %) and SP005 (10.14 ppm) and SP004 (10.8 ppm). The genotype SP001 exhibited the lowest amount of zinc (9.12 ppm) in the tuber. However, the average amount of zinc was 9.98 ppm among sweet potato genotypes.

Table 1.7. Nutritive analysis of sweet potato tubers

Lab. No.	Sample No.	Ca %	Mg %	K %	Total N %	P ppm	S ppm	B ppm	Cu ppm	Fe ppm	Mn ppm	Zn ppm
4078	SP001	1.46	0.36	1.94	1.19	0.27	0.18	16.8	6.18	106	4.92	9.12
4079	SP002	1.44	0.38	1.87	1.13	0.24	0.19	18.0	5.88	114	5.10	9.66
4080	SP003	1.43	0.39	1.86	1.21	0.24	0.28	24.0	5.46	118	5.34	10.02
4081	SP004	1.39	0.40	1.83	1.18	0.24	0.21	19.2	5.28	127	5.22	10.08
4082	SP005	1.34	0.41	1.77	1.09	0.27	0.22	19.8	5.34	192	5.46	10.14
4083	SP006	1.35	0.40	1.83	1.11	0.25	0.20	15.0	5.70	247	5.64	9.36
4084	SP007	1.57	0.42	1.75	1.07	0.22	0.20	17.4	5.64	310	5.52	11.52
Mean		1.42	0.39	1.83	1.14	0.24	0.21	18.6	5.63	173.4	5.31	9.99
Range		1.34-1.57	0.36-0.42	1.57-1.94	1.07-1.21	0.22-0.27	0.18-0.28	15.0-24.0	5.28-6.18	106-310	4.92-5.64	9.12-11.52

F. Dry matter (%) determination

Variation in dry matter content in the roots and foliage among the seven genotypes of sweet potato was observed in both of the harvesting stage is given in Table 1.8. In the first harvest which was made at 120 day after planting (H_1) the highest amount of dry matter content in the root was measured from the genotype of SP001 (32.0 %) closely followed by the genotype of SP007 (31.0 %) and SP004 (30 %). The genotype SP005 exhibited the lowest dry matter content in roots at first harvest (25.0 %). Islam *et al.* (1995) estimated 26.52 % dry matter in sweet potato roots when harvested at 120 day after planting. While among five sweet potato genotypes Islam *et al*. (1995) also reported that the variety Daulatpuri produced the highest dry matter in the roots (30.9 %). In the second harvest which was made at 150 day after planting (H_2) the genotype SP003 produced the highest amount of dry matter (33.0 %) followed by SP001 (32.0 %) and SP004 (31.0 %). Similar dry matter content variation among different sweet potato genotypes at 150 day after harvest was also reported by Islam *et al*. (1995). However, irrespective of genotypes and harvesting dates dry matter content in tuberous root varied from 25.5 % to 32.0 % with an average of 29.71 %. Mean dry matter content in the tuberous root in the first harvest (29.0 %) and the second harvest (30.43 %) indicated that dry matter accumulation beyond 120 day after planting was not much pronounced.

Dry matter content in the foliage of the sweet potato genotypes was varied in both of the harvest. At first harvest (H_1) the highest dry matter was measured from the genotype SP002 (17 %) while it was the lowest for the genotype of SP005 (12 %). Similar trend was also observed for second harvest (H_2) which was made at 150 day after sowing. Although variation in foliage dry matter among the genotypes was pronounced but very little variation in mean foliage dry matter in the first harvest (14.57 %) and second harvest (14.48 %) indicated that beyond 120 day after planting accumulation of dry matter was not remarkable.

Table 1.8. Dry matter determination of sweet potato tubers and foliage at varied harvesting stage

Genotype	Dry matter in root (%)			Dry matter in foliage (%)		
	H_1	H_2	Mean	H_1	H_2	Mean
SP001	32.0	32.0	32.0	14.0	15.0	14.5
SP002	28.0	30.0	29.0	17.0	16.0	16.5
SP003	29.0	33.0	31.0	15.0	15.0	15.0
SP004	30.0	31.0	30.5	14.0	13.0	13.5
SP005	25.0	26.0	25.5	12.0	14.0	13.0
SP006	28.0	29.0	28.5	13.5	14.0	13.6
SP007	31.0	32.0	31.5	15.2	15.0	15.1
Mean	29.0	30.43	29.71	14.39	14.57	14.48
Range	25-32	26-33	25.5-32.0	12-17	13.0-16	13.0-16.5
St. dev.	2.31	2.37	-	1.56	0.98	-

H_1= harvest at 120 day after planting, H_2= harvest at 150 day after planting

Experiment 2. Evaluation of sweet potato genotypes at varied planting time

Results obtained from the present study were presented in the Table from 2.1 to 2.3. Parameter wise discussion under genotypic effect, planting time effect and interaction effect was also made below.

Main effect of genotype

Main effects of sweet potato genotypes on different yield and yield parameters are presented in Table 2.1.

Length of longest vine (cm)

Length of longest vine was significantly different among the genotypes (Table 2.1). The highest vine length was recorded from the genotype SP007 (233.77 cm) which was statistically identical with that of genotype SP006 (222.77 cm). On the other hand the lowest vine length was recorded from the genotype SP004 (95.11 cm). Siddique (1985) recorded the vine length of sweet potato genotypes varied from 93.33 to 488.73 cm.

Foliage weight/ plant (g)

A significant variation was recorded in foliage weight of the genotypes (Table 2.1). The highest foliage weight was recorded from the genotype SP004 (690.77 g), which were statistically identical with genotype SP006 (685.88 g). The lowest foliage weight was recorded from the genotype SP007 (646.88 g).

Number of vines/hill

A remarkable variation was observed in number of vines/hill among the genotypes (Table 2.1). The highest number of vines/hill was recorded from SP004 (6.09) where the lowest number of vines/hill was recorded from genotypes SP007 (5.05).

Number of roots/plant

A remarkable variation was observed in number of roots/hill among the genotypes (Table 2.1). The highest number of roots/hill was recorded from the genotype SP006 (4.93) which were statistically identical with the genotype SP004 (4.44) while the lowest number of roots/hill was recorded from the genotype SP007 (3.74). Siddique (1985) examined 24 sweet potato genotypes during the 1982-1983 seasons at Horticulture farm, BAU, Mymensingh and found significant variation in number of roots/hill.

Root length (cm)

A remarkable variation was recorded in root length among the genotypes (Table 2.1). The highest root length was recorded from the genotype of SP006 (10.34 cm) followed by SP007 (10.31 cm). The lowest root length was recorded from the genotype SP004 (9.28 cm). Several researchers also observed similar variation in root length among 10 sweet potato genotypes.

Root width (cm)

Root width was not influenced by the genotypes (Table 2.1).The highest root width was recorded from the genotype of SP007 (4.641 cm) while the lowest root width was recorded from the genotype SP006 (4.42 cm). Siddique (1985) also had done an experiment with 24 genotypes of sweet potato where he observed differences in root width among the genotypes.

Weight of roots/plant (g)

Weight of root was significantly different among the genotypes (Table 2.1). The highest weight of roots/plant was measured from genotype SP006 (381.44 g). The lowest weight of roots/plant was recorded from genotype SP004 (324.67 g). Similar root weight variation among different harvesting dates of sweet potato was also reported by Hossain, 1995.

Table 2.1. Effect of genotype on growth and yield of sweet potato

Genotype	Length of longest vine (cm)	Foliage weight/ plant (g)	Number of vines/hill	Number of roots/plant	Root length (cm)	Root width (cm)	Weight of roots/plant (g)
SP004	95.11 b	690.77 a	6.0 9 a	4.44 a	9.29 b	4.49	324.67 c
SP006	222.77 a	685.88 a	5.42 ab	4.93 a	10.34 a	4.42	381.44 a
SP007	233.77 a	646.88 b	5.06 b	3.74 b	10.31 a	4.64	359.67 b
F-test	**	**	**	**	*	Ns	*
CV%	12.61	3.16	10.76	9.01	7.77	5.27	11.43

Ns indicating non-significant, * indicates significant at 5% level of probability, **indicates significant at 1% level of probability.

Yield (t/ha)

Remarkable yield variation was recorded among the genotypes (Figure 2.1). The genotype SP006 produced the highest root yield/hectare (24.6 t/ha) followed by the genotype SP007 (19.9 t/ha). However the genotype SP004 produced 18.03 tons of tubers/hectare, respectively. Similar tuber yield variation among different harvesting dates of sweet potato was also reported by several researchers (Ahmed, 1995:1999; Bhuiyan, 1997).

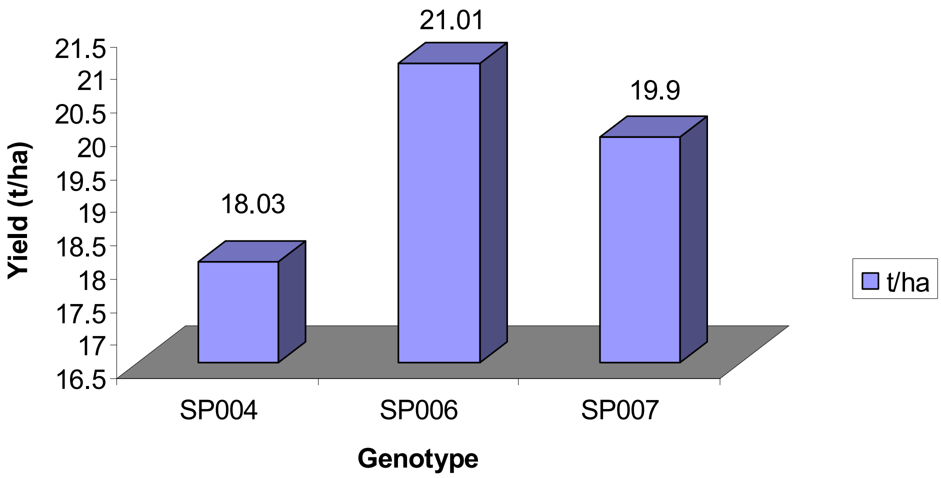


Fig. 2.1. Yield of sweet potato genotypes

Main effect of planting time

Length of longest vine (cm)

There was no significant effect of planting time on length of longest vine and varied from 174.67 cm to193.44 cm (Table 2.2). The highest vine length was recorded from 1 November planting and lowest vine length was found in 1 September planting.

Foliage weight (g)

Foliage weight showed a significant variation due to variable planting dates (Table 2.2). The range varied from 407.22-838.67 g. The highest foliage weight 838.67 g was found in 1 November planting and lowest weight 407.22 g was recorded from 1 September planting.

Number of vines/hill

There was an appreciable variation in number of vine per hill (Table 2.2). Maximum number of vines/hill (6.90) was recorded 1 September planting while the lowest number of vines/hill (4.89) was recorded from 1 October planting.

Number of roots /plant

The effect of planting date on number of roots /plant was non-significant. The range varied from 4.27 to 4.46 (Table 2.2). The maximum number of roots/plant (4.46) was recorded from 1 September planting while it was the minimum (4.27) for 1 November planting.

Root length (cm)

There was no significant effect of planting date on root length and the range varied from 9.63 cm to 10.31 cm (Table 2.2). The planting time did not show appreciable response in root length. However the highest root length (10.31 cm) was recorded from 1 September planting and lowest root length from 1 October planting.

Root width (cm)

Influence of planting time on root width was found insignificant. It was varied from 4.32 cm to 4.64 cm (Table 2.2). The highest root width was recorded from 1 October planting and the lowest from 1 November planting.

Weight of roots/ plant (g)

There was no significant effect of planting time on weight of root/plant and the range varied from 330.67g to 370.67 g (Table 2.2). Planting time did not show appreciable response in weight of root per plant. However the highest weight (370.67 g) was recorded from 1 November planting while the lowest (330.67 g) from 1 September planting.

Table 2.2. Effect of planting time on growth and yield of sweet potato:

Planting time	Length of longest vine (cm)	Foliage weight (g)	Number of vines/hill	Number of roots/plant	Root length (cm)	Root width (cm)	Weight of roots/plant (g)
1 September	174.66	407.22 c	6.90 a	4.45	10.31	4.60	330.66
1 October	183.55	777.66 b	4.48 b	4.39	9.63	4.64	364.44
1 November	193.44	838.66 a	5.17 b	4.27	10.00	4.32	370.66
F-test	NS	**	**	NS	NS	NS	NS
CV%	12.61	3.16	10.76	9.01	7.77	5.27	11.43

NS indicates non-significant, * indicates significant at 5% level of probability, **indicates significant at 1% level of probability

Yield (t/ha)

Yield of sweet potato tuber (t/ha) was presented in (Figure 2.2), it was 20.5 ton/ha when planted at 1 November. It was 20.13 t/ha at 1 October planting and the lowest yield was 18.36 t/ha recorded from 1 September planting.

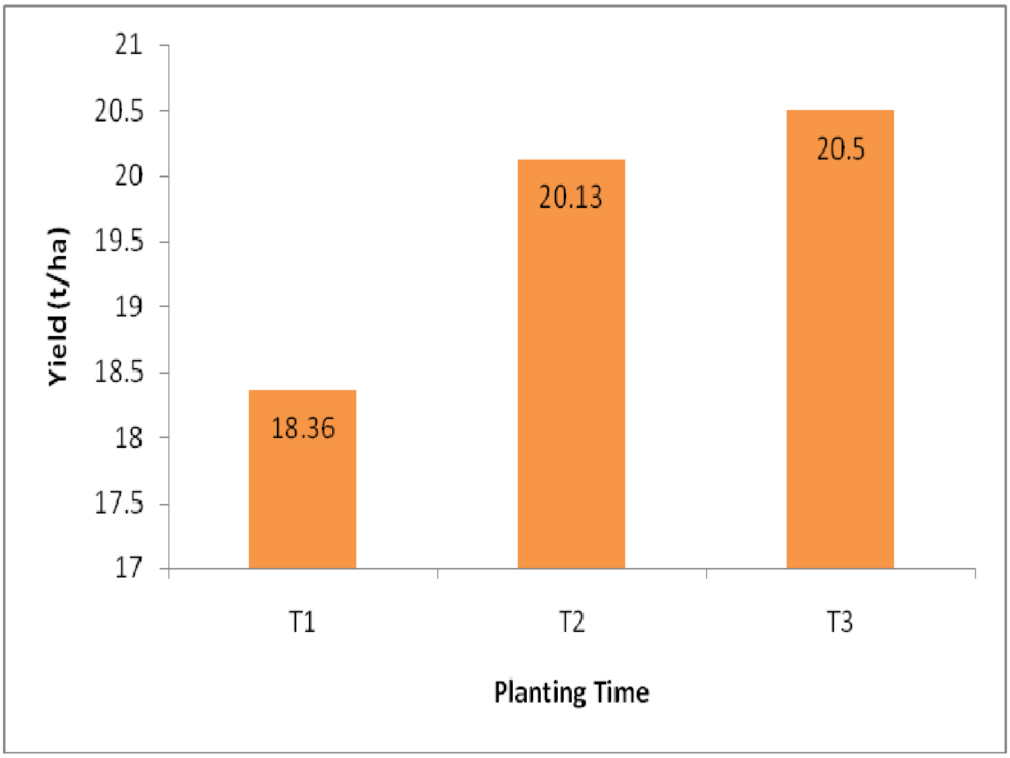


Figure 2.2 Yield of sweet potato at different planting time

T_1 = 1 September planting, T_2 = 1 October planting, T_3 = 1 November planting

Interaction Effect

Length of longest vine (cm)

Length of longest vine was not influenced by the interaction between genotype and planting time (Table 2.3). The longest vine was recorded from the genotype of SP007 in 1 November planting when harvested at 45 days after planting (240.0 cm). The lowest longest vine length was recorded from the genotype of SP004 (86.0 cm) in 1 September planting. The variation in length of vine might be attributed due to differences in growth behavior of the genotypes.

Foliage weight (g)

A significant interaction between genotypes and planting time was recorded for foliage weight (Table 2.3). In the present study the highest foliage weight was recorded from the genotype of SP006 (871.66 g) in 1 November planting. Which was statistically identical with the genotype SP004 (842.33 g) for their foliage weight. The lowest foliage weight was recorded for the genotype SP007 (388.33 g) in 1 September planting.

Number of vines/hill

Number of vines/hill was not affected by the interaction of genotype and harvesting stage (Table 2.3). The highest number of vines/hill was recorded from the genotype SP004 (7.45) in 1 September planting while the lowest number of vines/hill was recorded from the genotype SP007 (3.87) in 1 October planting.

Number of roots/plant

Number of roots/plant was not significantly influenced by the interaction between genotype and planting time (Table 2.3). However, the maximum number of roots/plant was recorded from the genotype of SP006 (5.03) in 1 September planting. On the other hand, the lowest number of roots per hill was recorded from the treatment combination of V_3T_2 (3.60) and V_3T_3 (3.72).

Root length (cm)

Root length was not affected by the interaction between genotype and planting time (Table 2.3). However, the maximum root length was noticed in genotype SP006 (11.0 cm) in 1 September planting when harvested at 45 days after planting. The shortest root length was noticed in genotype SP004 (9.27 cm) in 1 September and 1 October planting. This result indicated that Root length of 1 September planting was observed longer than the other dates of planting (Table 1.9).

Root width (cm)

Root width was not influenced by the interaction effect of genotype and planting time (Table 2.3). The highest root width was recorded from the genotype SP004 (4.67 cm) in 1 September planting. The genotype SP006 also produced appreciable root width (4.18 cm) in 1 November planting. This result indicated that root width of 1 November planting was relatively slender than the other dates of planting (Table 2.3).

Weight of roots/ plant (g)

Weight of roots/plant was largely affected by the interaction of genotype and planting time (Table 2.3). The highest root weight was recorded from the genotype SP007 (405.33 g) in 1 November planting which were statistically identical with genotypes SP007 (399.33 g) in 1 October planting. The second highest root yield per plant was observed for the genotype of SP007 (399.33 g) in 1 October planting. This result revealed that all the genotypes showed better tuber yield performances at later planting time. The lowest root weight was recorded from genotypes SP007 (274.33 g) in 1 September planting.

Table 2.3. Interaction effect of planting time and genotype on yield and yield attributes of sweet potatoes

Genotype × Planting time	Length of longest vine (cm)	Foliage weight (g)	Number of vines/hill	Number of roots/plant	Root length (cm)	Root width (cm)	Weight of roots/plant (g)
V_1T_1	86.00	444.0 d	7.45	4.43	9.27	4.66	360.00 c
V_1T_2	95.00	786.0b c	5.10	4.78	9.26	4.63	299.00 e
V_1T_3	104.33	842.33 a	5.73	4.11	9.33	4.19	315.00 d
V_2T_1	210.00	389.33 e	6.56	5.03	11.00	4.53	357.00 c
V_2T_2	222.33	796.66 b	4.50	4.80	9.86	4.56	395.00 a
V_2T_3	236.00	871.66 a	5.20	4.97	10.16	4.18	391.66 ab
V_3T_1	228.00	388.33 e	6.70	3.90	10.66	4.60	274.33 f
V_3T_2	233.33	750.33 c	3.86	3.60	9.76	4.73	399.33 a
V_3T_3	240.00	802.00 b	4.60	3.72	10.50	4.59	405.33 a
F-test	NS	*	NS	NS	NS	NS	**
CV%	12.61	3.16	10.76	9.01	7.77	5.27	11.43

NS indicates non-significant, * indicates significant at 5% level of probability, **indicates significant at 1% level of probability

Dry matter (%) determination

Dry matter content (%) of root

Variation in dry matter content in the root and foliage of the sweet potato genotypes at different planting dates presented in Table 2.4. A minor variation in dry matter content in the root of three genotypes grown from 1 September was observed of which the genotype SP007 showed the highest dry matter content (33 %), followed by genotypes SP006 (32 %) and SP004 (32 %). Similar minor variation in dry matter content in the roots of the three genotypes was also recorded in the subsequent plantings. However, the overall dry matter content in the roots irrespective of genotype and planting time varied from 29 % to 33 %.

Table 2.4. Dry matter (%) of root at varied planting time

Planting time/ Genotypes	Dry matter (%) in root			
	SP004	SP006	SP007	Mean
1 September	32	32	33	32.3
1 October	29	30	30	29.7
1 November	32	31	32.8	31.9
Mean	31	31	31.9	31.3
Stdev	1.73	1.0	1.68	1.47

Dry matter content (%) of foliage

Per cent dry matter content of the foliage of three sweet potato genotype grown from three different planting times is given in Table 2.5. Dry matter content in the foliage was not much varied among the genotypes and planting date, However, the highest average dry matter was recorded from the genotype of SP006 (17 %) followed by SP004 (16 %) and SP007 (16 %). Regarding planting time the highest average dry matter content of foliage was recorded when the plants grown in 1 November (17 %), closely followed by 1 October (8.7 %) and 1 September planting (8.5 %).

Table 2.5. Dry matter (%) of foliage at varied planting time

Planting time/ Genotypes	Dry matter (%) in foliage			
	SP004	SP006	SP007	Mean
1 September	16	15	14	15.0
1 October	15	16	15	15.3
1 November	14	17	16	15.7
Mean	15	16	15	15.3
Stdev	1.0	1.0	1.0	1.0

Tuber yield (t/ha):

A remarkable yield variation was found in the interaction effect between genotypes and planting dates (Figure 2.3). In graphical presentation of interaction effect between genotypes and planting dates it was clearly indicated that the genotype SP007 and 1 November planting (V_3T_3) gave the highest yield (22.5 t/ha). After that second highest yield (21.9 t/ha) was noticed from two genotypes of SP006 and SP007 at 1 October planting (V_2T_2, V_3T_2). Finally the lowest yield (15.3 t/ha) was recorded from the genotype SP003 when planting was done at 1 September (V_3T_1). Details about the yield performance of sweet potato at different planting dates were given at appendix IV.

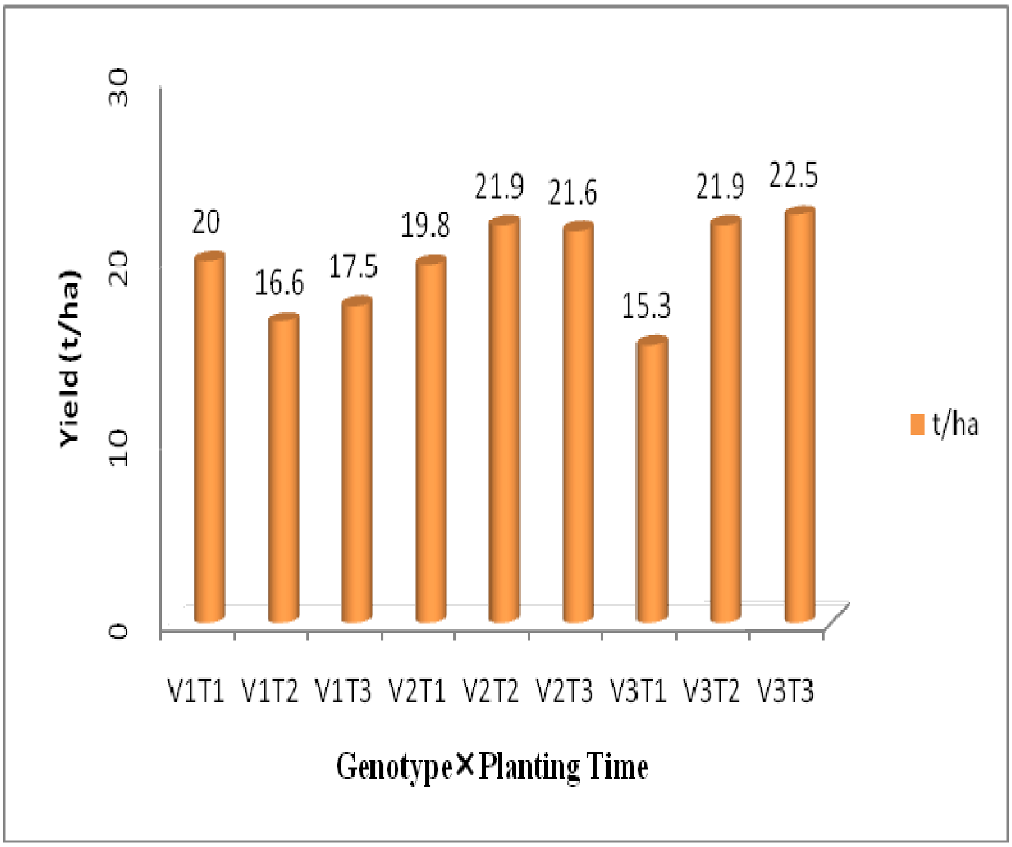


Figure 2.3 Yield of sweet potato genotypes at different planting time

V_1 = SP004, V_2 = SP006, V_3= SP007

T_1 = 1 September planting, T_2 = 1 October planting, T_3 = 1 November planting

Image 2.1. Experimental field view

Image 2.2. Variation of root colour among three genotypes

Image 2.3. Variation of flesh colour among three genotypes

CHAPTER FIVE

SUMMARY

Two experiment was conducted during two consecutive winter seasons of 2012-2013 and 2013- 2014 at the experimental field and Laboratory of Horticulture Department of Sylhet Agricultural University with a view to characterize seven exotic sweet potato genotypes and to observe the effect of harvesting stage and planting time on growth and yield of sweet potato under Sylhet condition. Seven sweet potato genotypes viz., SP001, SP002, SP003, SP004, SP005, SP006 and SP007 were planted in 15 November 2012 under RCB (Factorial) design with three replications to estimate growth and tuberous root yield at 120 and 150 day after planting. In addition samples of tuberous root of seven genotypes harvested at 120 day after planting were sent to the Central Laboratory of BARI, Gazipur for chemical analysis to determine nutrient content in the tuberous root. In the subsequent winter season of 2013-2014 the selected genotypes from the first experiments of SP004; SP006 and SP007 were planted in 1 September, 1 October & 1 November under RCB (Factorial) design with three replications to observe their growth and yield.

The highest vine length (50.33 cm) was recorded from the genotype SP006 which was statistically identical with that of genotype SP002 (49.99 cm). On the other hand the lowest vine length (31.07 cm) was recorded from the genotype SP001. The highest root length was recorded from the genotype of SP004 (12.18 cm) followed by SP003 (10.62 cm) and SP007 (10.13 cm). The genotypes SP006, SP005 and SP001 produced root length of 9.75 cm, 9.25cm and 8.61 cm, respectively. The lowest root length (7.34 cm) was recorded from the genotype SP002. The highest root width SP004 (6.68 cm) and the lowest root width (3.35 cm) was recorded at SP002. The highest value of number of vines/hill was recorded from SP004 (10.15). The lowest value was recorded from SP001 (5.91). In the present study the highest foliage weight/hill was recorded from genotype SP006 (310.33 g) and the lowest foliage weight (94.16 g) was recorded at SP002. A remarkable variation was observed in number of root among the genotypes. The highest number of roots/plant was recorded at genotypes SP006 (6.28). The lowest number of roots/plant was recorded from SP001 (3.18). The highest weight (310.83 g) of root was measured from genotypes SP004, the lowest weight of root was recorded for SP002 (123.66 g).

Vine length was significantly affected by harvesting stage. The longest vine was measured when the plants were harvested at 150 days after planting (45.77 cm) while it was only 38.44 cm at 120 day after planting. At first harvesting stage which was 120 days, the length of root was recorded 9.04 cm and second harvesting stage i.e. 150 days the root length was recorded 10.35 cm. At first harvesting stage (120 days) the width of root was recorded 4.47 cm and second harvesting stage (150 days) it was recorded 5.44 cm. At first harvesting stage (120 days) the foliage weight was recorded (136.14 g), while it was 209.61 g at 150 day after planting. The average number of roots/plant was 4.41 at 150 days after planting, while it was 4.20 at 120 day after planting. The highest amount of root/plant 230.90 g was recorded when the plants were harvested at 150 days after planting, while it was only 172.71 g at 120 day after planting.

The mean longest vine was recorded from the genotype of SP007 (53.77 cm) at 150 day after planting while it was the lowest for SP001 (29.26 cm) at 120 day after planting. The highest root length was measured in genotype SP004 (12.83 cm) at 150 day after planting. The highest Root width was recorded from the genotype SP004 when harvested at 150 days (7.59 cm) and the lowest root width was measured from the genotype of SP002 (3.31 cm) closely followed by the genotype of SP005 (3.56 cm) when harvested at 120 day after planting. The highest number of vines/hill was recorded from the genotype SP004 (10.16) at first harvesting stage (120 days) and the lowest number of vines/hill was recorded from genotype SP001 (5.59) followed by SP003 (6.19) when harvested at 120 day after planting. The highest number of roots/plant was recorded from the genotype of SP006 under both of harvesting stages (6.40 and 6.16, respectively). On the other hand, the lowest number of roots/plant was harvested from the treatment combination of V_1H_1 (3.16) and V_1H_2 (3.20). The highest root weight was recorded from the genotype SP004 when the plants were harvested at 150 day after planting (408.33 g) and the second highest root yield per plant was observed for the genotype of SP007 (318.33 g) at second harvest. Chemical analysis of the tuberous root revealed that the genotype SP007 was comparatively richer source of Ca, Mg, Fe and Zn whiles the genotype SP001 rich in potassium and phosphorus and copper. The genotype SP004 also rich in Ca (1.39 %), Mg (0.40 %), K (1.83 %) and Zn (10.08 ppm). Dry matter content in the tuberous root ranged from 25 % to 32 % among the seven genotypes at 120 day after planting while it was ranged from 26-33 % at 150 day after planting. Average dry matter content in the root at first harvest (29 %) and second harvest (30.43 %) was almost similar.

Three sweet potato genotypes were largely affected by the planting time in terms of on growth and yield. The highest longest vine was recorded from the genotype SP007 (233.77 cm), where the lowest longest vine length was recorded from the genotype SP004 (95.11 cm). The highest root length was recorded from the genotype of SP006 (10.34 cm) and the lowest root length was recorded from the genotype SP004 (9.28 cm). The highest root width was recorded from the genotype of SP007 (4.64 cm) while the lowest root width was recorded from the genotype SP006 (4.42 cm). The highest number of vines/hill was recorded from SP004 (6.09) where the lowest number of vine/hill was recorded from genotypes SP007 (5.06). The highest number of roots/hill was recorded from the genotype SP006 (4.94), while the lowest number of roots/hill was recorded from the genotype SP007 (3.74). The highest weight of roots/plant was measured from genotype SP006 (381.44 g) while it was the lowest for SP004 (324.67 g).

In respect to planting time the highest longest vine as well as the highest foliage weight (838.67 g) was recorded from November planting. Maximum number of vines/hill (6.90) was recorded from 1 September planting while the lowest (4.89) for 1 October planting. Maximum roots/hill (4.46) was recorded from 1 September planting while it was minimum (4.27) for 1 November planting. The highest root length (10.31 cm) was recorded from 1 September planting and lowest root length (9.63 cm) from 1 October planting. The highest root width was recorded from 1 October planting and the lowest (4.32 cm) from 1 November planting. The highest root weight (370.67 g) was recorded from 1 November planting while the lowest (330.67 g) from 1 September planting.

The longest vine was recorded from the genotype of SP007 in 1 November planting while it was the lowest for SP004 (86.0 cm) in 1 September planting. Foliage weight ranged from 871.67 g (SP006) in 1 November planting to 388.33 g (SP007) in 1 September planting. The maximum root length was noticed in genotype SP006 (11.0 cm) in 1 September planting and the shortest root length was noticed in genotype SP004 (9.27 cm) in 1 September and 1 October planting. The highest root width was recorded from the genotype SP004 (4.67 cm) in 1 September planting. The highest number of vines/hill was recorded from the genotype SP004 (7.45) in 1 September planting while the lowest number of vines/hill was recorded from the genotype SP007 (3.87) in 1 October planting. The maximum number of roots/hill was recorded from the genotype of SP006 (5.03) in 1 September planting. On the other hand, the lowest number of roots/hill was recorded from the treatment combination of V_3T_2 (3. 60) and V_3T_3 (3.72). The highest root weight was recorded from the genotype SP007 (405.33 g) in 1 November planting and the lowest root weight was recorded from genotypes SP007 (274.33 g) in 1 September planting.

CHAPTER SIX
CONCLUSION AND RECOMMENDATIONS

Conclusion

- Variation in relation to different physico-morphological characteristics like colour of vine, leaf, leaf vein, root, flesh of the root, vine diameter, internode length, petiole length etc was observed among the sweet potato genotypes.
- Among seven sweet potato genotypes, SP007 produced the highest tuberous root yield followed by SP004 and SP006 while the average tuberous root yield at 150 day after harvest was higher than that of 120 day after harvest.
- Chemical analysis of the tuberous root revealed that the genotype SP007 was comparatively better source of Ca, Mg, Fe and Zn while the genotype SP001 was rich in potassium, phosphorus and copper.
- Planting of sweet potato at 1 October and 1 November was found more productive compared to 1 September planting.

Recommendations

- The sweet potato genotypes of SP007, SP004 and SP006 may be recommend for further evaluation along with BARI released sweet potato variety with a view to develop new sweet potato variety for Sylhet region.
- Harvesting of root at 150 day after planting can be made for higher yield.
- Planting of sweet potato in Sylhet region in the month of 1 October and 1 November can be made for better production of sweet potato.
- The genotypes SP007, SP004 and SP001 can be considered for future selection and/or breeding program to develop nutrient rich sweet potato variety.

CHAPTER SEVEN

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APPENDICES

Appendix I. Mean monthly weather data during September 2012 to March 2014

Months and Year	Maximum Temperature (°C)	Minimum Temperature (°C)	Average RH(%)	Average Rainfall (mm)
2012				
September	32.7	25.7	79	14.3
October	31.8	22.8	73	40.1
November	29.2	18.9	68	11.9
December	25.0	14.5	75	0.0
2013				
January	25.6	11.8	63	0.0
February	31.2	15.9	49	2.3
March	34.2	19.7	47	1.9
September	32.8	25.3	78	14.0
October	31.5	23.1	74	29.6
2014				
January	25.7	11.7	64	0.0
February	31.1	15.8	48	2.4
March	34.3	19.8	46	1.8

Appendix II. Morphological and chemical characteristics of the soil (1-15cm)

A. Chemical characteristics

Soil pH	:	4.98
Organic matter (%)	:	1.79
Total N (%)	:	0.09
Exchangeable K (meq 100 g^{-1} soil)	:	0.13
Available P (µg g^{-1} soil)	:	14.98
Available S (µg g^{-1} soil)	:	27.01

B. Morphological characteristics

Soil series	:	Khadimnagar
Soil tract	:	High land
Soil group/type	:	Sandy loam
Soil colour		
1. Surface	:	Deep brown
2. Sub-surface	:	Pale brown
3. Lower surface	:	Pale brown/brown

Appendix III. Analysis of variance for different characters of sweet potato genotypes at varied harvesting stage

Sources of variation	Degrees of freedom	Length of vines (cm)	Root length (cm)	Root width (cm)	Number. of vines/hill	Foliage weight (g)	Number of roots/plant	Weight of roots/plant (g)
Replication	2	47.928	0.47	0.08	0.63	1392.91	1.47	1483.19
Genotype	6	1832.17**	85.07**	42.41**	83.30**	307915.9**	40.17**	19074.14**
Harvesting stage	1	564.30**	17.92**	9.99**	5.62**	56686.88**	0.44 NS	48824.35**
Interaction	6	360.08 **	3.40 NS	18.16**	4.44*	47894.29**	1.71 NS	47594.29**
Error	26	161.99	21.53	3.99	6.34	3046.43	3.18	5619.48

** Significant at 1% level of probability; **NS**-Not significant; *Significant at 5% level of probability.

Appendix IV. Analysis of variance for different characters of sweet potato genotypes at varied planting time

Sources of variation	Degrees of freedom	Length of longest vine (cm)	Root length (cm)	Root width (cm)	Number. of vines/hill	Foliage weight (g)	Number of roots/plant	Weight of roots/plant (g)
Replication	2	1674.89	0.78	0.05	4.22	7243.19	0.01	423.63
Genotype	2	106944.6**	6.48*	0.21 NS	4.99**	10413.41**	6.49**	14768.96*
Planting time	2	1588.22 NS	2.07 NS	0.55*	27.90**	981283.2**	0.16 NS	8338.96 NS
Interaction	4	147.78 NS	1.38 NS	0.18 NS	0.58 NS	6548.15*	0.73 NS	33045.93**
Error	16	8605.11	9.62	0.91	5.65	7266.82	2.48	26387.70

** Significant at 1% level of probability; **NS**-Not significant; *Significant at 5% level of probability.