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On-Farm Evaluation of Growth and Yield of some Local and Exotic Genotypes of Sweetpotato in Piedmont Plains

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Abstract—*Sweetpotato has multifarious uses and can be used as diversified crop. In order to ensure food security to the people of the valley of Northern and Eastern Piedmont Plains of Bangladesh, the experiment was conducted at farmer's field in Sylhet Sadar Upazila during November 2016 to April 2017. Nine sweetpotato genotypes namely Local-1, Local-2, Local-5, Local-8, Exotic-1, Exotic-2, Exotic-3, Exotic-4 and BARI SP-4 were planted as Randomized Complete Block Design (RCBD) with three replications. Morpho-physiological character, yield and yield contributing character and cost effectiveness were examined to find out suitable genotypes for piedmont soils. Observation and data collection were started after 15 days of planting and continued until 150 days age. Data were analyzed by analysis of variance (ANOVA) technique and mean separations by Duncan's Multiple Range Test (DMRT) using MSTAT-C program. Results revealed that Local-8, Local-5 and Local-1 had higher vine establishment rate. Local-8, Local-1 and Local-2 showed higher performance in morphological traits. Local-1 had the higher leaf area index whereas Local-8 had greater total dry matter. Storage roots of Exotic-4, Exotic-2 and Local-1 had higher dry matter content while Local-2, Local-5 and Local-1 had higher harvest index. Bulking rates of storage roots were increased significantly up to 105-120 DAP by Local-1, Local-2, Local-8, Exotic-4 and BARI SP-4, and up to 120-135 DAP by Local-5, Exotic-1, Exotic-2 and Exotic-3. Genotypes Local-2 and Local-1 partitioned the highest dry matter into storage roots. Exotic-2 had the highest number of storage roots plant^{-1}. Local-1 and Local-2 had the longest storage roots. The thickest storage root was found in Local-8 and Exotic-4. The higher fresh storage roots weight plant^{-1} was in Local-1, Local-2 and Local-8. Yield attributes were significantly correlated with yield except storage roots number plant^{-1}. Storage roots of Exotic-3, Exotic-2 and Local-5 had the highest Brix %. The highest storage roots yield was in Local-1 (66.42±0.75) followed by Local-8 (48.72±0.97). Local-1 and Local-8 had higher gross return, net margin and benefit cost ratio. Therefore, local-1 and Local-8 are suitable for piedmont soil.*

1. INTRODUCTION

Sweetpotato popularly known as ÔÔMisti AluÕÕ in Bangladesh is believed to have originated from the Northwest of South America and has been dispersed worldwide because of its high yield potential and wide adaptability (Hue *et al*., 2011). It ranks as the fifth most important food crops after rice, wheat, maize, and cassava (Laurie *et al*., 2012) in the developing countries like Bangladesh. Sweetpotatoes are produced about 105.2 million tons on about 8.6 million hectares of land with an average yield of about 12.23 t ha^{-1} globally (FAOSTAT, 2017) where as in Bangladesh it was about 0.761 million ton on about 0.045 million ha of land with an average yield of 16.91 t ha^{-1} (MoA, 2017). National average yield of sweetpotato in Bangladesh is though quite higher against global yield but it is characterized by low production, yield and storage root quality compared to Japan, Senegal and Israel (FAO, 2014).

Storage roots are rich source of energy, several minerals and micronutrients (Laurie *et al*., 2012). Sweetpotato leaves are rich in vitamin B, beta-carotene, iron, calcium, zinc and protein (Islam, 2014). Sweetpotato has increased phenols, flavonoids, β-carotene, anthocyanin, and caffeoylquinic acid derivatives (Rumbaoa *et al*., 2009). Sweetpotato tips (top 10 cm of tender vines with leaves) can be harvested several times in a year and thus their annual yield is much higher than other green vegetables.

Sweetpotato is easy to grow, requires low input and less management practices (Kozai *et al*., 2006) and capable of growing under adverse weather and soil conditions. Marginal lands such as acidic soils of piedmont plains, valley of low lying hills, charlands, homestead areas, saline belts, and newly accreted land can be used for its growing. Bangladesh has a total arable land of 8.56 million hectares of which 2.45% is cultivable waste (BBS, 2015) and about 6.7 million hectares of arable land are acidic. Sylhet division has about 1.2 million hectares of cultivable land (SRDI, 2010) of which 17.2 % of cultivable land of Sylhet division remains fallow in a year (DAE, 2017). About 87.8% of households own a homestead in the country. Minor crop like sweetpotato production has tremendous potential if seasonal fallow land and homestead is brought under irrigation with technology packages to the farmers.

On the other hand, vegetable production is very limited in piedmont plains like Sylhet region in Bangladesh. The price of different vegetables is relatively high due to low production and unavailability in this region. Thus, there is a great scope for the expansion of sweetpotato cultivation in Sylhet region. Besides, sweetpotato is generally harvested during March to May in Bangladesh when cereal supply like rice is the minimum. Sweetpotato plays an important role to compensate the demand of cereals of the needy people of Bangladesh.

Bangladesh is largely dependent on cereals and needs to grow more food on less area for rapid growing populations. In fact, the cropping intensity has increased from 148 to 192 percent and food grain production almost tripled during the period from 1969-70 to 2015-16 (BBS, 2016) but the yield of other non-cereal crops become almost stagnate. Consequently the nutritional status of Bangladeshi diet is on a declining trend due to low intake of vegetables. Introducing appropriate and eco-friendly technologies like sweetpotato cultivation may increase yield along with vegetable production in the region.

There are many local sweetpotato genotypes available in Sylhet region and many of them are growing at the farmer's level sporadically but their yield performance is unknown. While sweetpotato export countries like China, Japan, USA and organizations like International Potato Centre (CIP) has developed many high yielding, nutritious varieties. Therefore, it is necessary to collect those varieties and conduct adaptable trials in Bangladesh. To address this situation, the experiment has taken to evaluate morpho-physiological features and yield performance of nine local and exotic genotypes in piedmont soil.

2. MATERIAL AND METHODS

The experiment was conducted on Farmer's field of Dashpara village of Sylhet Sadar Upazila, Sylhet lies between 24°54′32.8″ to 24°54′33.5″ N latitude and 91°56′ 59.5″ to 91°57′00.9″ E longitude. The piedmont soil is consisted of Northern and Eastern Piedmont Alluvium categorized as Bijipur soil series. Texture of top soils was sandy loam (55% Sand, Silt 42%, Clay 3%). Moderately well drained soil where surface water receded within September, 2015. Top to sub soil is light brown to brown mottled grey colour. Nine genotypes of sweetpotato namely Local-1, Local-2, Local-5, Local-8, Exotic-1, Exotic-2, Exotic-3, Exotic-4 and BARI SP-4 were used as planting materials. BARI SP-4 were used as planting materials

2.1 Conduction of experiment

The land was prepared through plowing and cross-plowing four times followed by laddering. The whole experimental field was divided into three equal blocks for three replications. Each block was divided into nine plots for each genotype resulting 27 plots in total. The size of the plot was of 4.8 m × 4.2 m. The adjacent blocks and plots were separated by 1.0 m and 0.6 m, respectively. Sweetpotato vine cuttings were planted in lines with a spacing of 0.60 m and 0.30 m for row to row and plant to plant, respectively following Randomized Complete Block Design (RCBD). Genotype was allocated randomly in each plot. Manures and fertilizers application rate (kg ha^{-1}) rate was Cowdung =5000 kg, Urea =214 kg, TSP =171 kg, MoP =188 kg, Gypsum =56 kg, Zinc sulfate (Hepta) =10 kg, Solubor =3 kg, Magnesium sulfate = 82 kg, Dolomite = 988 kg. Dolomite was applied in the field 15 days prior to planting (FRG, 2012). Sixty days old vines cuttings ranged from 30 to 40 centimeters long with five to six nodes were planted.

Gap filling was done within 15 days after planting with healthy seedlings of nursery. Weeding was done as and when necessary to keep the field free from weeds. Light spading as well as soil earthing-up was done after each side dressed of fertilizer to mix it up with soil. Lifting up of vines and placing it again in previous position was done in every fortnight. Irrigation was done at 30, 60 and 90 DAP.

2.2 Observation and data collection and analysis

The observations and data collection on morpho-physiological study was started at 45 DAP and continued up to final harvest (150 DAP). For morpho-physiological studies, four plants in each plot were harvested at 45, 60, 75, 90, 105, 120, 135 and 150 DAP. At final harvest, the plants of the middle three rows were harvested and yield contributing characters and yields of the genotypes were calculated. For cost effectiveness of sweetpotato production gross return, net margin and benefit cost ratio were estimated. Analysis of variance of all the characters studied was performed by F–test (Gomez and Gomez, 1984) and the significance of the difference between the pair of means was evaluated by Duncan's Multiple Range Test (DMRT) using MSTAT-C program (Russel, 1986).

3. RESULTS AND DISCUSSION

3.1 Establishment rate of vine cuttings (%)

Establishment rate of vine cuttings was varied significantly among the genotypes (Fig. 1) at 15 DAP. The highest vine establishment rate was 99.32 in Local-8 followed by Local-5 (97.96), Local-1(93.88) and BARI SP-4 (94.56). The lowest establishment rates were both in Exotic-1 (62.59), Exotic-2 (63.95) and Exotic-3 (65.31).

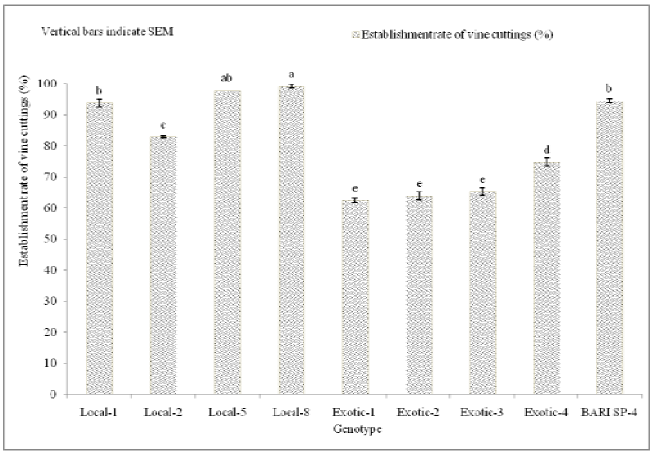

Fig. 1: Effects of genotype on the establishment rate of vine cuttings of sweetpotato at 15 DAP (days after planting). Similar letters on bars do not differ significantly at .01 LS (level of significance) by DMRT

The variation in rate of establishment of vine cuttings is probably due to soil moisture content, age of vine cuttings and genetic makeup. Ravi and Saravanan (2012) reported that adequate soil moisture, aeration, light and heat are necessary for better establishment of vine cuttings.

3.2 Vine number plant^{-1}

Primary vine number was increased from 60 to 150 DAP in all of the genotypes except Local-2 (Fig. 2). The increment of Local-1 and Local-8 was rapid whereas rest of the genotypes was gradual. The highest number of primary vines (8.73±0.12) was in Local-8 followed by Local-1 (8.63±0.09). The lowest number (2.40±0.06) was in Exotic-1 at 150 DAP.

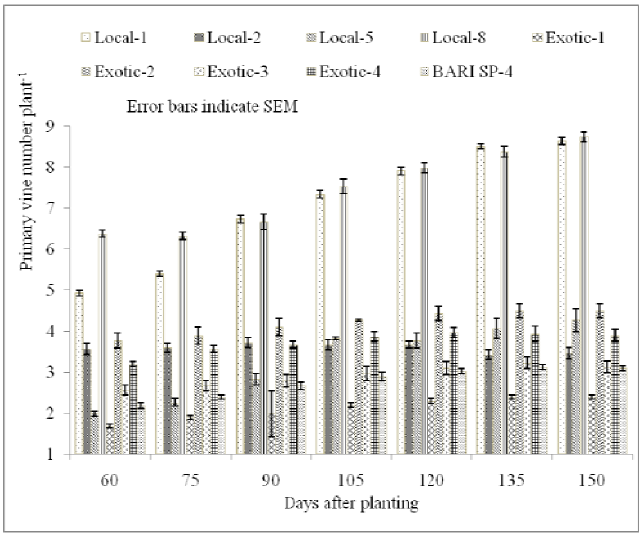

Fig. 2: Effects of genotype on the primary vine number plant^{-1} of sweetpotato at different DAP. Similar letters on bars do not differ significantly at .01 LS by DMRT

Secondary vine numbers were increased up to 150 DAP in all of the genotypes except Exotic-2 (Fig. 3). The increment of Local-1 was rapid whereas rest of the genotypes was gradual upto 120 DAP. The highest secondary vine number was in Local-1 (29.43±0.41) followed by BARI SP-4 (18.0±0.58), and the lowest number was found in Local-5 (7.03±0.07) at 150 DAP.

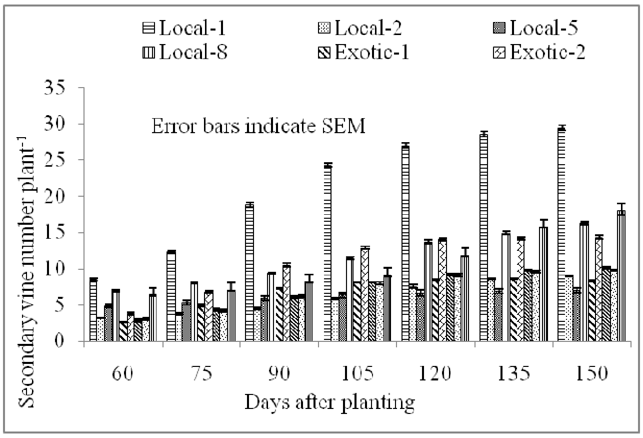

Fig. 3: Effect of genotype on secondary vine number of sweetpotato at different DAP

The variation among the primary vine number and secondary achieved may be due to genetic, soil fertility status and environmental conditions. Rajesh Kumar *et al*. (1993) reported that branching system in sweetpotato is heavily influenced by spacing, photoperiod, and soil moisture and nutrients.

3.3 Vine length (cm)

Primary vine lengths increased rapidly up to 120 DAP and then gradually upto 150 DAP (Fig. 4). The highest primary vine length was in Local-2 (187.7±3.38) and followed by Local-8 (165.4±2.39). The lowest primary vine length was in Exotic-4 (87.82.20) at 150 DAP.

Secondary vine lengths of Local-1, Local-2, Local-8, Exotic-1 and Exotic-2 were increased rapidly whereas Exotic-3, check variety BARI SP-4 and Local-5 increased gradually up to 150 DAP (Fig. 5). The longest secondary vines were in Local-2 (127±2.08) followed by BARI SP-4 (112.7±1.46) whereas the shortest vines were in Local-5 (56.8±2.46), Exotic-2 (60.8±1.01) and Exotic-4 (64.4±2.47).

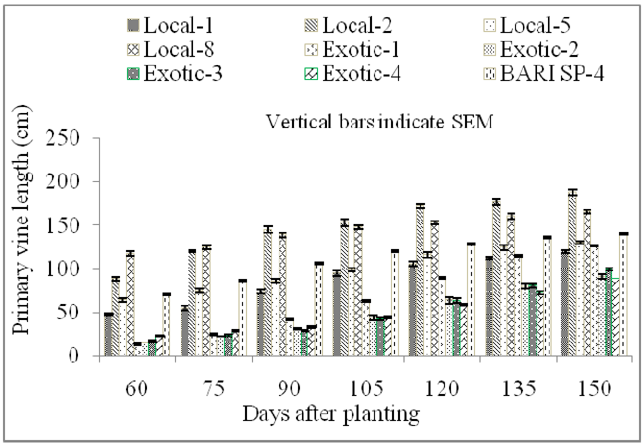

Fig. 4. Effect of genotype on the primary vine length of sweetpotato at different DAP

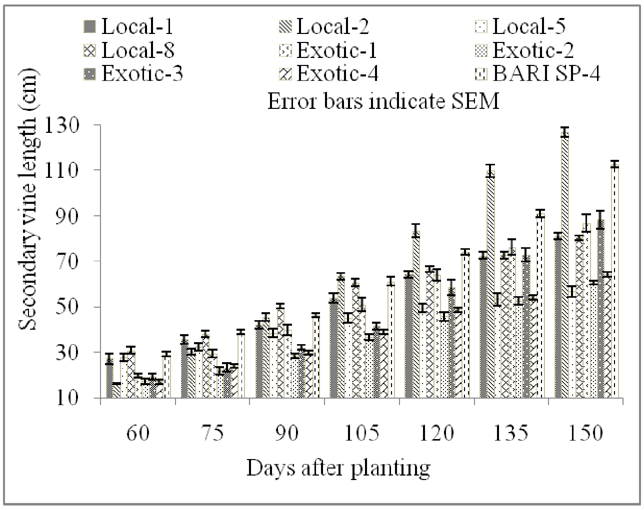

Fig. 5: Effect of genotype on the secondary vine length of sweetpotato at different DAP

Rahman *et al*. (2015) reported that vine length differs due to the genetic make-up present in the genotypes as well as tolerance to the acidic soil. Kareem (2013) reported that medium sized vine length ranged from 140-180 cm gave the best yield of sweetpotato and differs from 220.17-264.43 cm due to their genetic make-up of sweetpotato. Haque (1995) stated that the rate of increase in plant height of sweetpotato was slow in the beginning but increased sharply attaining peak during the late vegetative stage (between 60 and 80 DAP).

3.4 Leaf number plant^{-1}

Leaves number increased rapidly upto 120 DAP and then continued up to 135 DAP except Exotic-2 (Fig. 6). Leaves number of all genotypes increased dramatically up to 105 DAP and thereafter increased gradually up to 135 DAP except Exotic-2 and then declined except Local-1. After 150 days of planting, the highest number of leaves was in Local-1 (360.60±1.14) followed by check variety BARI SP-4 (208.80±2.23), and the lowest was in Exotic-2 (105.70±1.17).

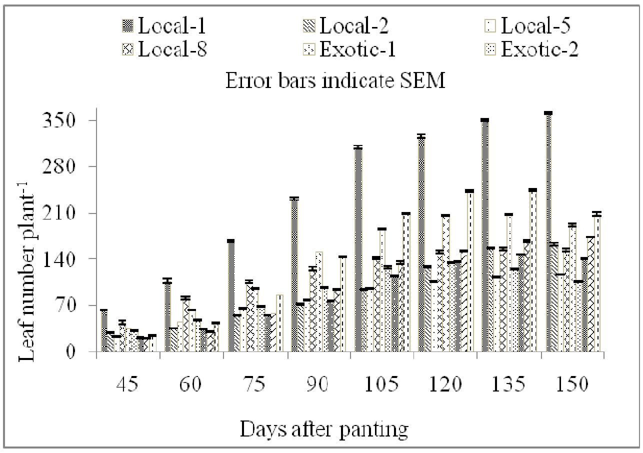

Fig. 6. Effect of genotype on the leaf number of sweetpotato at different DAP

Tom (2014) reported that leaf number increased with time reaching up to 280 leaves at the end of the experiment. Hossain (2002) evaluated 10 sweetpotato genotypes where numbers of leaves plant^{-1} ranged from 310.4 to 590.5 with ages from 115 to 165 DAP. The variation between the own findings and the references might be due to genetic as well as soil-climatic conditions.

3.5 Leaf area index (LAI)

Leaf area index increased gradually upto 75 DAP and geared up dramatically up to 120 DAP, and thereafter slowed down the rate (Fig. 7). At 120 DAP, the maximum LAI were in Exotic-1 (13.34±0.16) followed by Local-1 (11.36±0.01), and the lowest was in Exotic-3 (4.39±0.03). At final harvest, the highest LAI was recorded in Local-1 (11.87±0.12) followed by Exotic-1 (11.1±0.17), and the lowest was in Local-5 (4.42±0.06).

Leaf area index differed significantly during early and late phases of growth but showed an inconsistent relationship with yield (Bhagsari and Ashley (1990), Nair and Nair, 1995). Hossain (2002) found LAIs of BARI SP-4 were 8.146, 9.883, 10.149 after 115, 140 and 165 days of planting, respectively. The present results were supported by the above references.

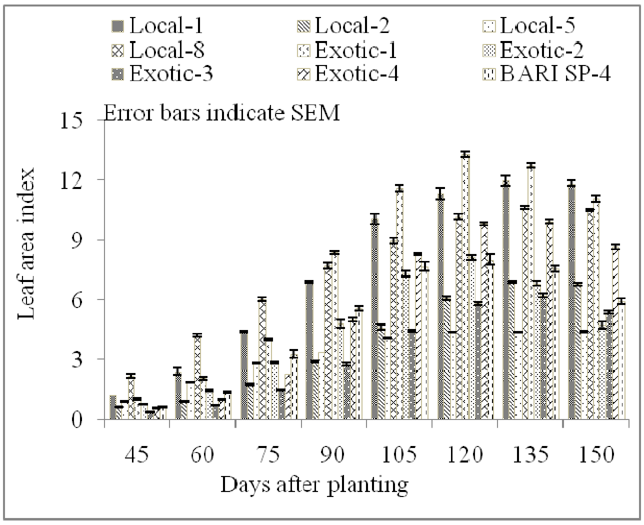

Fig. 7. Effect of genotype on the leaf area index of sweetpotato at different DAP

3.6 Total dry matter (TDM)

At final harvest, the highest total dry matter (g plant^{-1}) was in Local-8 (447.8±7.28) followed by Local-1 (407.6±7.74), and the lowest was in Exotic-1 (179.90±1.89) (Table 1). Total dry matter production of a crop is dependent on the source and its activities as well as the length of its growth period, during which photosynthesis continues (Watson, 1958). Hossain and Islam (2010) reported that total dry weights of 10 sweetpotato genotypes increased up to 165 DAP.

Table 1. Effect of genotype on total dry matter, dry matter content in storage root and harvest index at 150 DAP

Genotypes	Total dry matter (g plant^{-1})	Dry matter content in storage root (%)	Harvest Index (HI) (%)
Local-1	407.60±7.74 b	27.13±0.09 e	66.36±1.32 b
Local-2	335.40±2.13 c	24.33±0.12g	73.50±0.09 a
Local-5	253.20±4.46 e	31.27±0.12d	66.81±1.01 b
Local-8	447.80±7.28 a	32.43±0.20 c	54.03±1.27 d
Exotic-1	179.90±1.89 g	31.40±0.06d	45.74±1.85 e
Exotic-2	239.00±3.02ef	35.25±0.20b	59.96±0.50 c
Exotic-3	182.00±1.22 g	25.30±0.07 f	60.01±1.21 c
Exotic-4	236.20±1.57 f	35.97±0.15 a	53.69±1.38 d
BARI SP-4	292.60±4.45 d	27.33±0.09 e	64.63±0.28 b
CV%	2.36	0.74	3.15
LSD	16.090	0.528	4.552

Values (Mean ± SEM) in a column having similar letters do not differ significantly at 1% level of significance by DMRT

3.7 Dry matter content in storage root (%)

The highest dry matter content in storage roots was in Exotic-4 (35.97±0.15) followed by Exotic-2 (35.25±0.20) (Table 1), whereas the lowest dry matter content was in Local-2 (24.33±0.12) at 150 DAP. High dry matter content and storage root yield are important characteristics of good sweetpotato varieties (Richardson, 2012; Mwanga *et al.*, 2007; Uganda and Onunka, 2006). Hossain and Islam (2010) estimated that dry matter content of storage roots of exotic genotypes ranged from 24.91 to 37.46%, whereas in local varieties it ranged from 18.46 to 30.54% at 165 DAP. David *et al.* (1994) reported that dry matter content varied significantly from genotype to genotype.

3.8 Harvest index (%)

At final harvest, the highest harvest index was in Local-2 (73.51±0.09) followed by Local-5 (66.78±1.01), Local-1 (66.28±1.32) and BARI SP-4 (64.63±0.28) (Table 1). The lowest harvest index was in Exotic-1 (45.64±1.85). A wide variation in HI of root and tuber crops has been reported by several researchers such as from 64-84 (Lowe and Wilson, 1975), 38-88 (Enyi, 1977) and 37-81 (Bouwkamp and Hassam, 1988). Thus the study corroborate with the above researchers.

3.9 Storage roots bulking rate (g day^{-1})

Bulking rates of storage roots were increased significantly upto 105-120 DAP by Local-1, Local-2, Local-8, Exotic-4 and BARI SP-4, and up to 120-135 DAP by Local-5, Exotic-1, Exotic-2 and Exotic-3 (Fig. 8). Bulking rates was slow upto 75 - 90 DAP, rapid upto 105 - 120 DAP and then declined with some exceptions. The highest bulking rate was in Local-1 (22.70±1.54) followed by Local-2 (17.90±0.28), and the lowest rate was in Exotic-1 (5.21±0.31) during 105-120 DAP. At 135-150 DAP, the highest bulking rates were in Local-2 (11.76±0.44) and Local-1 (10.24±0.46) followed by Exotic-2 and Exotic-3, and the lowest was in BARI SP-4 (1.59±0.32). Sweetpotato storage roots yield was determined by the duration and rate of storage roots growth which varies widely among cultivars due to changes in the agroclimatic conditions (Ravi and Saravanan, 2012).

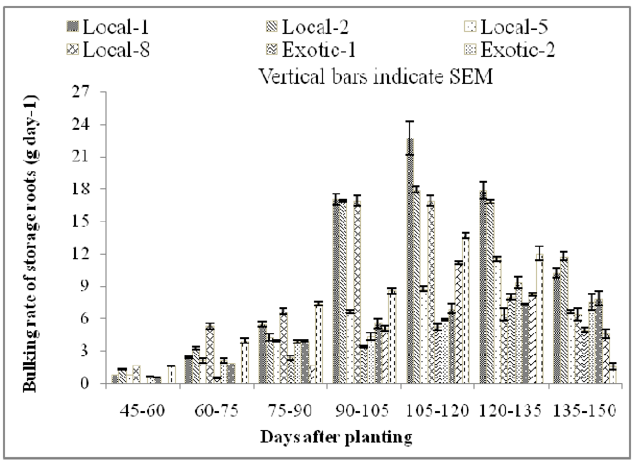

Fig. 8 Bulking rates of storage roots of sweetpotato genotypes at successive stages of growth

3.10 Dry matter partitioning (%)

Dry matter partitioning into leaves, vines, fibrous roots and storage roots varied significantly (Fig. 8). In case of leaves At 150 DAP, the highest dry matter partitioning occurred into leaves was in BARI SP-4 (20.69±0.27) followed by Exotic-1 (18.46±0.32), and the lowest was in Local-8 (10.10±0.02). The highest dry matter partitioning into vines was occurred in Local-8 (24.08±1.19) followed by Exotic-1 (16.95±1.70) and the lowest in Local-1 (7.22±1.24). In case of fibrous roots the highest dry matter was partitioned in Exotc-3 (0.88±0.02) and the lowest in check variety BARI SP-4 (0.21±0.01). Dry matter partitioning into storage roots showed that Local-2 partitioned the highest percent (78.50±0.03) which was statistically similar to Local-1, Exotic-2 and Local-5. The lowest percent of dry matter was deposited in Exotic-1 (63.80±1.52).

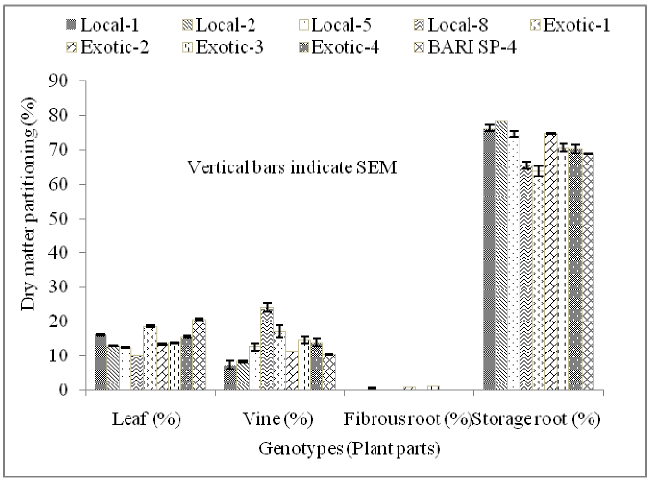

Fig. 8. Effect of genotype on the dry matter partitioning into plant parts of sweetpotato at 150 DAP

Lewthwaite and Triggs (2000) reported that the partitioning of DM into vine tissue was higher than leaf tissue. Haque (1995) reported that dry matter partitioning into leaves increased upto 70 DAP and then declined although vine and storage roots continued to accumulate dry matter till harvest. Ravi and Indira (1996) reported that genetic and environmental factors affect storage root formation and development, dry matter partitioning and storage root yield of sweetpotato. The present results are in line of references and the variation among the genotypes is their genotypic activities and soil group. Thus the variation among the genotypes is perhaps due to genetic makeup.

3.11 Storage root number plant^{-1}

The highest number of storage roots were counted in Exotic-2 (10.23±0.78) which was statistically similar to Exotic-3 (9.77±0.44) and BARI SP-4 (9.23±0.56) followed by Local-1, Local-2, Local-8 and Exotic-1 (Table 2). The lowest storage root number was in both Local-5 (3.30±0.06) and Exotic-4 (3.80±0.34). The results are in the line of some researchers viz. 4.0-11.0 (Marzouk *et al*., 2011) and 4.7-11.0 (Hussain *et al*., 1987).

3.12 Storage root length (cm)

The longest storage roots were recorded in Local-1 (17.03±0.46) which was statistically similar to Local-2 (16.0±0.83) (Table 2). The shortest storage roots were in Exotic-3 (10.07±0.34), Local-5, Exotic-2, Exotic-4, BARI SP-4, Exotic-1 and Local-8. The results are agree with a number of researchers whom were found a wide variation on the storage root length, such as 11.0-24.0 cm (Akter, 2016), 0.0-21.67 cm (Egbe *et al*., 2012) and 15.39 cm in BARI SP-4 (Hossain, 2002).

Table 2. Effect of genotype on storage root number plant^{-1}, storage root length and diameter of sweetpotato at 150 DAP

Genotypes	Storage root no. plant^{-1}	Storage root length (cm)	Storage root diameter (cm)
Local-1	6.97±0.43b	17.03±0.46 a	4.6±0.40a-c
Local-2	6.17±0.19b	16.00±0.83 a	4.4±0.29a-d
Local-5	3.30±0.06c	11.77±0.65 b	3.0±0.07e
Local-8	6.40±0.26b	11.57±0.41 b	5.4±0.10a
Exotic-1	6.63±0.26b	11.57±0.30 b	3.3±0.03c-e
Exotic-2	10.23±0.78a	10.07±0.20 b	3.2±0.07de
Exotic-3	9.77±0.44a	10.07±0.34 b	3.6±0.07b-e
Exotic-4	3.80±0.34c	10.67±0.27 b	4.9±0.66ab
BARI SP-4	9.23±0.56a	11.40±1.61 b	4.9±0.16ab
CV%	8.94	9.53	12.23
LSD	1.482	2.781	1.207

Values (Mean ± SEM) in a column having similar letters do not differ significantly at 1% level of significance by DMRT

3.13 Storage root diameter (cm)

The thickest storage root was found in Local-8 (5.43±0.10) followed by Exotic-4, BARI SP-4, Local-1 and Local-2 (Table 2). The thinnest storage roots were in Local-5 (2.97±0.07). Diameter of storage roots of 9 genotypes ranged from 2.97 to 5.43. The results are in line with Egbe *et al*. (2012) and Haque (1995) where they recorded storage root diameter 0.0-8.23 cm and 3.03-3.70 cm, respectively.

3.14 Fresh weight of storage roots (g plant^{-1})

The highest fresh storage roots weight plant^{-1} was in Local-1 (1148.0±10.6) followed by Local-2 (1082.0±9.4) and Local-8 (905.7±28.3) (Table 3). The lowest weight was in Exotic-1 (365.3±5.0). The variations among the genotypes are probably due to soil test based fertilization production practices and genetic potentials of the sweetpotato genotypes. Akter (2016) found different fresh weights of storage root plant^{-1} from 339.0-2431.0 g.

3.15 Yield of storage roots (t ha^{-1})

The highest storage roots yield was in Local-1 (66.42±0.75) followed by Local-8 (48.72±0.97) (Table 3). The lowest yield of storage roots was in Local-5 (17.94±0.57). Yield of Local-2 was very close to that of check variety BARI SP-4 (45.24±0.34). Rest of the genotypes performed inferior to check variety BARI SP-4). The results are in line of works of several researchers. Laurie *et al*. (2015) recorded mean total yield from 40.8 to 72.1 t ha^{-1} in South Africa. Calskan *et al.* (2007) stated that storage root yield varied due to cultivar, location and year, ranged from 6.72–112.60 t ha^{-1}. Tewe *et al.* (2003) estimated yields of sweetpotatoes in the research fields in Nigeria varied from 40 to 70 t ha^{-1}.

3.16 Total soluble solids in storage roots (° Brix)

Sugar in sweetpotato is a fundamental aspect of its eating quality (Lewthwaite, *et al.*, 1997). Among the genotypes, the highest total soluble solids (° Brix) was in the storage roots of Exotic-3 (13.10±0.12) followed by Exotic-2 (11.50±0.29) and Local-5 (11.50±0.21) (Table 3). The lowest Brix% was found in Exotic-1 (10.00±0.21). Albuquerque *et al*. (2018) reported that total soluble solids were increased with late harvesting. Adu-Kwarteng *et al*. (2014) reported that sugar contents and composition of sweetpotato cultivars were significantly affected by harvest age. Timely harvesting is a simple and effective means of controlling of the eating quality and processing characteristics of such cultivars. This could possibly be applied in targeting desired sugar levels for specific end-uses, for instance, low sugar for staple food uses and high sugar for industrial production of sweeteners from sweetpotato.

Table 3. Effect of genotype on Storage root fresh weight, Storage root yield and total soluble solids of sweetpotato

Genotypes	Storage root fresh weight (g $plant^{-1}$)	Storage root yield (t ha^{-1})	Total Soluble Solids (Brix %)
Local-1	1148±10.6a	66.4±0.8a	10.3±0.1cd
Local-2	1082±9.4b	42.8±0.7c	11.2±0.2bc
Local-5	605.3±7.8e	17.9±0.6f	11.5±0.2b
Local-8	905.7±28.3c	48.7±0.9b	10.8±0.3b-d
Exotic-1	365.3±5.0g	11.4±0.4c	10.0±0.3d
Exotic-2	504.8±8.2f	25.7±0.5d	11.5±0.3b
Exotic-3	508.8±10.9f	22.2±0.6e	13.1±0.1a
Exotic-4	461.1±9.6f	20.4±0.3ef	10.8±0.2b-d
BARI SP-4	738.1±14.2d	45.2±0.3c	10.5±0.2cd
CV%	2.78	3.13	3.17
LSD	46.500	2.498	0.840

Values (Mean ± SEM) in a column having similar letters do not differ significantly at 1% LS by DMRT

3.17 Correlation of yield attributes with storage root yield of sweetpotato genotypes

Correlation between yield attributes and storage root yield revealed that primary length and diameter of storage roots, and storage roots fresh weight had positive significant correlation with yield, whereas number of storage root $plant^{-1}$ were correlated with yield but not significant (Table 4).

Table 4. Correlation coefficients of yield attributes and storage root yield of sweetpotato genotypes at 150 DAP

Attributes	NSR	LSR	DSR	SFW
LSR	-0.168			
DSR	-0.098	0.231		
SFW	-0.046	0.787^{**}	0.476^{*}	
YLD	0.163	0.646^{**}	0.589^{**}	0.910^{**}

Legend: NSR = Number of storage root $plant^{-1}$, LSR = Length of storage root (cm), DSR = Diameter of storage root (cm), SFR = Storage roots fresh weight (g $plant^{-1}$), YLD = Yield (t ha^{-1}).

The results are in line of a notable number of researchers whom established a correlation between morphological parameters with yield attributes and yield like as storage root number $plant^{-1}$ (Mbah and Eke-Okoro, 2015), storage root length, storage root diameter and storage root fresh weight $plant^{-1}$ (Egbe *et al*., 2012) with storage root yield. Islam *et al.* (2006) estimated that storage root yield had significant and positive correlation with number of storage roots $plant^{-1}$, diameter of storage root and weight of storage roots $plant^{-1}$. Anshebo *et al.* (2004) showed that characters such as weight of a single storage root, diameter of storage root and length of storage root number showed strong positive correlations with root yield.

3.18 Cost effectiveness of sweetpotato production

Total cost of production of sweetpotato was BDT 163493 of which 83.59 % was variable cost and 16.41% was fixed cost (Table 4.40). Among the variable cost items labour cost was 42.53% and manures and fertilizers cost was 26.31% of the total cost. Cost of land preparation, irrigation, insecticides, and miscellaneous were 5.50 %, 4.77 %, 2.60 % and 1.86 %, respectively.

Ahmed *et al*. (2015) accounted labor cost for sweetpotato production 48.4 % of the total cost followed by vine/planting materials cost (27.5%). Irrigation and chemical cost accounted for only a minimal of 0.36 % and 0.04 %, respectively. Yusuf and Wuyah (2015) reported the cost of labor, fertilizer, planting materials and insecticides were 47.39%, 29.77%, 3.11% and 19.74% of the total cost. The variation of cost of sweetpotato production was in the line of the references.

Table 5. Cost of production of sweetpotato genotypes

Cost item	Cost (BDT ha^{-1})	% of total cost
1. Labour	69540.00	36.65
2. Manures and fertilizers	43022.00	22.67
3. Land preparation	9000.00	4.74
4. Planting materials	25000.00	13.18
5. Insecticides:	4250.00	2.24
6. Irrigation	7800.00	4.11
7. Miscellaneous	3048.00	1.61
A) Total variable cost	161660.00	85.20
(a) Land use	20000.00	10.54
(b) Interest on operating capital	8083.00	4.26

(12% for the period of 5 months)		
B) Total fixed cost (FC = a+b)	28083.00	14.80
C) Total cost (TC = A+B)	189743.00	100.00

The highest gross return (GR) ha^{-1} was in Local-1 followed by Local-8 and the lowest in Exotic-1 (Table 5). The GR of BARI SP-4 and Local-2 was closely related and higher than GR of Exotic-2 and Exotic-3. The highest net margin (NM) was found in Local-1 followed by Local-8. The lowest NM was in Exotic-1. The NM of check variety BARI SP-4 was very close to NM of Local-2. The highest benefit cost ratio (BCR) on total cost basis was in Local-1 (4.88) followed by Local-8 (3.78). BCR of Local-2 was very close to that of check variety BARI SP-4. BCR of Exotic-2 was closer to Exotic-3. The lowest BCR was in Exotic-1 (1.03) which was very close to that of Local-5 (1.40).

Table 6. Profitability analysis of sweetpotato genotypes at Bijipur soil ha^{-1}

Genotypes	Gross return	Net margin	BCR (Undiscounted)
Local-1	926172	736429	4.88
Local-2	598559	408816	3.16
Local-5	265551	75808	1.40
Local-8	716391	526648	3.78
Exotic-1	195377	5634	1.03
Exotic-2	370331	180588	1.95
Exotic-3	324779	135036	1.71
Exotic-4	307281	117538	1.62
BAARI SP-4	631631	441888	3.33
SD	246201	246201	1.300

Average selling price of storage roots (BDT kg^{-1}) = 13.00 and average selling price of fodder (BDT kg^{-1}) =1.30, Source: Authors calculation based on expt. expenditure, 2017.

Sweetpotato production is profitable (Ahmed *et al.*, 2015; Yusuf and Wuyah, 2015). Sweetpotato production is also profitable than potato and Panikachu (Begum *et al.*, 2017 and Hajong *et al.* 2015). Paraiso *et al.* (2012) found benefit cost ratio of sweetpottato upto 8.18 in the North-eastern part of Benin. The variation in BCR is perhaps due to genotypic as well as soil and environmental condition. Thus sweetpotato production is profitable and this would be more profitable to them who have own land.

4. CONCLUSION

Considering morpho-physiological characteristics, yield performance and cost-effectiveness studies, it can be concluded that Local-1 and Local-8 showed the best performance over check variety BARI SP-4 for piedmont soils while local-2 Exotic-3 were suggestive of further trial.

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REFERENCES

[1] Adu-Kwarteng E, Sakyi-Dawson EO, Ayernor GS, Truong VD, Shih FF, Daigle K. 2014: Variability of sugars in staple-type sweetpotato (*Ipomoea batatas*) cultivars: The effects of harvest time and storage. *International Journal of Food Properties*, 17:410-420, DOI: 10.1080/10942912.2011.642439

[2] Ahmed MT, Nath SC, Sorwar MA, Rashid MH. 2015: Cost-effectiveness and resource use efficiency of sweetpotato in Bangladesh. *Journal of Agricultural Economics and Rural Development,* 2(2):026-031.

[3] Akter J. 2016: Studies on growth, yield and nutrient contents of eight sweetpotato lines, MS Thesis, Dept. of Horticulture, Bangladesh Agricultural University, Mymensingh.

[4] Albuquerque JRTD, Ribeiro RMP, Sousa LVD, Oliveira GBS *et al*. 2018: Quality of sweetpotato cultivars planted harvested at different times of two seasons, *Australian J. Crop Sci*. 12(06):898-904, doi: 10.21475/ajcs.18.12.06.PNE884

[5] Anshebo T, Veerraragavathatham D, Kannan M. 2004: Genetic variability and correlation studies in sweetpotato (*Ipomoea batatas* L. Lam.). *Madras Agricultural Journal* 91 (7-12):420-424.

[6] BBS 2016: The Yearbook of Agricultural Statistics of Bangladesh. Statistics Division, Ministry of Planning, Govt. of the People's Republic of Bangladesh, Dhaka.

[7] BBS 2015: The Yearbook of Agricultural Statistics of Bangladesh. Statistics Division, Ministry of Planning, Govt. of the People's Republic of Bangladesh, Dhaka. pp. 136- 372.

[8] Begum MM, Saha JK , Rahman MA, Ahmed MR. 2017. an economic study of potato production in selected areas of sylhet district. *J. Sylhet Agril. Univ*. 4(1):129-136.

[9] Bhagsari AS, Ashley DA. 1990: Relationship of photosynthesis and harvest index to sweetpotato yield. *Journal of the American Society of Hort. Sci*. 115:288-293.

[10] Bouwkamp JC, Hassam MNM 1988: Source-sink relationships in sweetpotato. *Journal of the American Society of Horticultural Science* 113:627-629.

[11] Caliskan, ME, Erturk E, Sogut T, Boydak E, Arioglu H 2007: Genotype x environment interaction and stability analysis of sweetpotato (*Ipomoea batatas*) genotypes. *New Zealand J. Crop Hort*. 35(1):87-99.

[12] DAE 2017: Annual Report of Regional Office for 2016-17, Dept. of Agril. Extn., Ministry of Agriculture, People's Republic of Bangladesh, Sylhet.

[13] David PP, Troatman AA, Clark OC, Douglas DZ. 1994: *Screening sweetpotato germplasm for high dry matter*. In: Caribbean Food Crop Soc. Meeting, July 31-5 August, pp. 156-179.

[14] Egbe OM, Afuape SO and Idoko JA 2012: Performance of improved sweetpotato (*Ipomoea batatas* L.) varieties in Makurdi, Southern Guinea Savanna of Nigeria. *Am. J. Exp. Agric*. 2:573-586.

[15] Enyi BAC 1977: Analysis of growth and tuber yield in sweetpotato (*Ipomoea batatas* (L.) cultivars. *J. Agric. Science* 88:421- 430.

[16] FAO 2014: FAO Statistical Year Book, Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific Bangkok. pp.176. Available at: www.fao.org

[17] FAOSTAT 2017: Statistics Division, Food and Agriculture Organization of the United Nations, 1. Vialedelle Terme di Caracalla, Rome Italy. Available at: http://www.fao.org/faostat/en/data/qc (Accessed: 5 June 2018).

[18] FRG 2012: Fertilizer Recommendation Guide, Bangladesh Agricultural Research Council (BARC), Farmgate, Bangladesh, Dhaka-1215. pp. 274.

[19] Gomez KA, Gomez AA 1984: Statistical procedures for agriculture research, 2nd Edn., John Willy and Sons, Newyork, USA. pp. 97-411.

[20] Hajong P, Mondal S, Saha D, Ishtiaque S, PaulS K 2015: An economic study on panikachu production in Jashore district. *J. Sylhet Agril. Univ.* 2(1):137-141.

[21] Haque MM 1995: Productivity of Maize/sweetpotato intercropping in relation to planting system, population density and application of nitrogen and potassium fertilizers, PhD Dissertation, Dept. of Agronomy, Institute of Post-Graduate Studies in Agriculture, Salna, Gazipur-1703, Bangladesh. pp.164.

[22] Hossain MAS 2002: Growth and yield comparison of some exotic and local genotypes of sweetpotato. MS Thesis, Dept. of Crop Botany, Bangladesh Agricultural University, Mymensingh.

[23] Hossain MAS, Islam AFMS 2010: Comparative study on dry matter partitioning in five exotic genotypes and five local varieties of sweetpotato. *J. Sher-e-Bangla Agric. University* 4(1):24-30.

[24] Hussain M, Ali H, Saha KC, Chowdhury BL 1987: A study of nutritional, organoleptic and storage properties of sweetpotato cultivars, *Bangladesh Hort.* 15(1):36-42.

[25] Hue S M, Boyce AN, Chandran S 2011: Influence of growth stage and variety on the pigment levels in *Ipomoea batatas* (sweetpotato) leaves. *African Journal of Agricultural Research* 6(10):2379-2385.

[26] Islam S 2006: Sweetpotato (*Ipomoea batatas* L.) leaf: its potential effect on human health and nutrition. *Journal of Food Science* 71:13–21. Available this paper at: https://www.researchgate.net/publication/229459560

[27] Islam S 2014: Nutritional and medicinal qualities of sweetpotato tops and leaves. Cooperative Extension Program, University of Arkansas, Pine Bluff, Chicago, USA.

[28] Kareem I 2013: Growth, yield and phosphorus uptake of sweetpotato (*Ipomoea batatas* L) under the influence phosphorus fertilizers. *Res. J. Chem. Environmental Sci.* 1:50-55.

[29] Kozai T, Kubota C and Kitaya Y 2006: Sweetpotato technology for solving the global issues on food, energy, natural resources and environment in the 21st century. *Environ. Control in Biol*. 34:105–114.

[30] Laurie SM, Faber M, van Jaarsveld PJ, Laurie RN, du Plooy CP, Modisane PC 2012: Beta-carotene yield and productivity of orange-fleshed sweetpotato (*Ipomoea batatas* L. Lam.) as influenced by irrigation and fertilizer application treatments. *Sci. Hortic*. 142:180-184.

[31] Laurie SM, Booyse M, Labuschagne MT, Greyling MM 2015: Orange-fleshed sweetpotato cultivars in South Africa. *Crop Science* 55:1585–1595. doi: 10.2135/cropsci2014.09.0664

[32] Lewthwaite SL, Sutton K, Triggs CM 1997: Free sugar composition of sweetpotato cultivars after storage. *New Zealand Journal of Crop and Horticultural Science* 25:33-41.

[33] Lowe SB, Wilson LA 1975: Yield and yield components of six sweetpotato (*Ipomoea batatas* L. Lam.) cultivars. II. Variability and possible sources of variation. *Expt. Agriculture* 11:49-58.

[34] Marzouk NM, El-Beltagy AS, EL-Behairy UA, Abou-Hussein SD, EL-Bedewy R, EL-Abd SO 2011: Performance of selected sweet potato germplasms under egyptian conditions. *Australian Journal of Basic and Applied Sciences* 5(10):18-21.

[35] MoA 2017: Crop situation in Bangladesh, Ministry of Agriculture, Govt. of Bangladesh, www.moa.gov.bd, file: http//F:/sweetpotato/information/crop_situation_2014-16.pdf

[36] Mbah EU, Eke-Okoro O 2015: Relationship between some growth parameters, dry matter content and yield of some sweetpotato genotypes grown under rainfed weathered Ultisols in the Humid Tropics. *Journal of Agronomy* 14 (3):121-129.

[37] Mwanga ROM, Ndiringiye C, Lemaga B, Kapinga R, Yencho GC, Odongo B 2007: *Breeding efforts to develop high-yielding, multiple pest-resistant sweetpotato germplasm in Uganda*. In: Kapinga R, Kingamkono R, Msabaha M, Ndunguru J, Lemaga B, Tusiime G (Editors), Proceedings of the 13th ISTRC Symposium, Arusha, Tanzania: ISTRC organising committee. pp 60-71.

[38] Nair GM, Nair VM 1995: Influence of irrigations and fertilizers on the growth attributes of sweetpotato, *Journal of Root Crops* 21:17-23.

[39] Onunka NA 2006: Varietal response of three sweetpotato varieties to different rates of a mixture of organic and inorganic fertilizer. Annual Report, National Root Crops Research Institute (NRCRI), Umudike, Nigeria. pp. 136-138.

[40] Paraiso AA, Gbannanhoue AC, Tokoudagba SF, Yegbemey RN 2012: Analysis of sweetpotato (*Ipomoea batatas* L. Lam) Production in the Commune of Gogounou, Benin, University of Parakou, Parakou, Republic of Benin. *International Journal of Science and Advanced Technology*, Volume 2, No. 11. Available at: http://www.ijsat.com

[41] Rajeshkumar SK, Sarkar, Jain BP 1993: Genotype performance and their interaction with environment in sweetpotato. *Journal of Root Crops* 19:89-94.

[42] Ravi V, Indira P 1996: *Investigation on the physiological factors limiting yield potensial in sweetpotato under drought stress*. In: Annual report 1996, Central Tuber Crops Research Institute, Trivandrum, India, pp. 23-24.

[43] Ravi V, Saravanan R 2012: Physiology of sweetpotato. *Fruit, Vegetable and Cereal Science and Biotechnology* 6 (Special Issue), pp. 17-29, Global Science Book, Central Tuber Crops Research Institute, Trivandrum, India.

[44] Rumbaoa RG, Cornago DFand Geronimo IM 2009: Phenolic content and antioxidant capacity of Philippine sweet potato (*Ipomoea batatas*) varieties. *Food Chem.* 113:1133–1138.

[45] Russel DF 1986: MSTATC Package Program, 1st Edn., Department of Crop and Soil Science, Michigan State, USA.

[46] Rahman H, Islam AFMS, Maleque MA, Tabassum R 2015: Morpho-Physiological evaluation of sweetpotato (*Ipomoea*

batatas L.) genotypes in acidic Soil. *Asian Journal of Crop Science* 7:267-276.

[47] Tewe OO, Ojeniyi FE, Abu OA 2003: Sweetpotato production, utilization and marketing in Nigeria. Social Sciences Department, International Potato Center (CIP) Lima, Peru. pp. 51.

[48] SRDI 2010: *Land and soil statistical appraisal book of Bangladesh*. Soil Resource Development Institute, 1st edn., Ministry of Agriculture, Dhaka, pp.11-103.

[49] Watson DJ 1958: The dependence of net assimilation rate on leaf area index. *Ann. Bot*. 22:37-54.

[50] Yusuf AK, Wuyah YT 2015: Economic analysis of small scale sweet potato production in Zaria local government area of Kaduna State. American Journal of Economics, Finance and Management 1(3): 171-178.