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Research Note

Evaluation of some promising sweet potato clones for early maturity

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Abstract:
Early maturity studies were carried out with 8 high yielding clones for 3 seasons. The harvesting was done at 75, 90 and 105 days after planting (DAP). At 75 days, the yield of three clones ranged from 12 - 14 t ha^{-1} and at 90 days, 20 – 26 t ha^{-1}. At 105 days, only one clone had higher yield. Dry matter content analysis indicated that it varied from 24 – 32% and 28- 38 % at 75 and 90 days. At 105 days no significant difference was observed in the dry matter. However, in some clones it was less than at 90 days. The yield and dry matter analysis at the early growth stages helps to screen a large number of progenies and to identify high yielding clones in a breeding programe. Considering the above factors, it is worthwhile to harvest the storage roots of most cultivars at around 90-100 days after planting.

Keywords: Sweet potato, early maturity, , tuber yield, dry matter, day after planting

Sweet potato (*Ipomoea batatas* (L.) Lam), commonly known as 'morning glory', is a dicotyledonous plant belonging to the family Convolvulaceae. It is an important tuber crop grown in the tropics, sub-tropics and warm temperate regions of the world. The crop is of a short duration (3 – 4 months). The storage roots of sweet potato are of economic importance and valued for vegetable and food (Woolfe, 1992). The flesh colour of the root varies from various shades of white, cream, yellow to dark-orange depending upon the pigment present. In the orange-fleshed sweet potato the major pigment present is carotenoids, especially β-carotene, while anthocyanin is present in purple-fleshed varieties. Carotenoids have been linked with the enhancement of immune system and decreased risk of degenerative diseases such as cardiovascular problems, age-related macular degeneration and cataract formation (Byers and Perry, 1992). Sweet potato is a rich source of provitamin A, vitamin B1 (Thiamin) and vitamin C (Huang et al., 1999). The roots also serve as a source of carbohydrate and dietary fibre which helps in reducing the incidence of a variety of diseases in man including colon cancer, diabetes, heart diseases and digestive disturbances (Palmer, 1982). The young leaves and shoots are sometimes consumed as green vegetable. Other uses include making dyes, Moche ceramics, alcohol fuel and as ornamental plant. The plant as a whole is used as animal fodder. Sweet potatoes are grown on a variety of soils, but well-drained light and medium textured soils with a pH range of 4.5-7.0 are more favorable for the plant (Woolfe, 1992; Ahn, 1993). It is harvested between 90 – 100 days. The maturity of the roots can be determined by cutting fresh tubers. The cut surface of the immature tuber gives a dark greenish colour while, the cut ends dry clearly in the case of mature tubers. The objective of the present study was to find out the time of maturity which gave the highest economic yield at different days after planting in some clones.

The materials for the study consisted of eight high yielding sweet potato clones planted at Central Tuber Crops Research Institute, Thiruvananthapuram. It consisted of 4 white-fleshed clones (CO3 -50-1, CO3-4, SV-280 and Sree Arun- a released variety from CTCRI), 2 orange-fleshed clones (362-7 and SV-98) identified from the breeding programme and 2 yellow fleshed clones (ST-10 and IGSP-14) which were selected from the All India Coordinated project on tuber crop of CTCRI. Each clone was planted in three rows/ replication. In each row, there were 10 mounts and in each mount 4 cuttings were planted. For each clone, the plot size per replication was 9.0 x 2.7 m. The distances between and within the rows were 90 and 90 cm, respectively, accommodating 120 plants/clone/replication and the crop was raised as per the recommended package of practices of CTCRI (2004). The trial was harvested at 75, 90 and 105 days after planting. One row (10 mounds) each/ clone/ replication was harvested. The weight of the root was recorded at the time of harvest. The storage root samples were analyzed (triplicate) for dry matter content. The same experiment was repeated for three seasons during the year Sep –Dec, 2008 and Dec – Mar, 2009 and Mar – June, 2009. The statistical analysis of variance and comparison of mean values with least significance difference were carried out with the package Genstat DE (Genstat, 2008).

The root yield was found to vary between the clones as well as between the two seasons. The ANOVA table and data on storage root yield and dry matter content at 75, 90 and 105 days are given in Table 1. The analysed data showed that at 75 days for all the three seasons, the yield of three clones (362-7, CO3-4, IGSP-14) ranged from 12-14 t ha^{-1}. In the other clones, it was less than 10 t ha^{-1}. At 90 days, majority of the clones produced a yield of 20 – 26 t ha^{-1}. The high yield of 24 -26 t ha^{-1} was recorded in 2 clones, CO3-4 and 362-7 at 90 days. At 105 days, only one clone the clone SV-280 produced the maximum yield of 32 – 35 t ha^{-1}. Compared to the yield of Oct – Dec '08 and Dec - Mar '09 season, the yield of Mar – June '09 season was low. There was not much significant difference in yield at 105 days in all the three seasons. The clones, IGSP-14 and SV-280 gave maximum yield during two seasons. The yield of these clones at 105 days was significantly higher than the yield at 90 days. Both the clones produced big sized tubers, which may be due to the high bulking rate. In some clones, the yield at 105 days was low compared to 90 days. The reduction in marketable yield in some clones was due to the infestation of sweet potato weevil. In all the clones the tuber yield at 90 days was above 50% than the yield at 75 days. It was observed that maximum tuber bulking takes place during this period. When the harvest was delayed beyond 90 days the quality of the tubers was decreased due to the sweet potato weevil infestation. The big sized tubers were also not good for marketing. The results of the studies of three seasons showed that, to get optimum tuber yield and to get good quality tubers the optimum time for harvest is 90 days after planting. Present studies showed that the variation in tuber yield in different clones may be either due to the difference in the number of storage roots per plant or size of individual roots or difference in bulking rate as reported by Wilson and Lowe (1975). Similarly, Jones et al. (1969) reported that tuberous root weight is an important component of yield in sweet potato and it could be expressed as differential plant vigour.

Usually, the root yield per plant increases when the crop remains in the field longer time but, at the cost of palatability. Percentage of weevil infestation was seen to increase with increase in the age of the crop as reported by Pandey (2007). In the present study, some of the clones turned out to be early maturing type, thereby giving maximum yield at 90th DAP and an increase in the DAP to 105th day showed a slight deterioration in the yield. However, some clones (CO-3-4, IGSP-14, S. Arun and SV-280) were comparatively late maturing type as the root yield was found to increase even up to 105th day.

The data on the dry matter content of eight clones for three seasons showed that dry matter increased significantly from 75 – 90 days when the maximum bulking occurs during this period and tends to deteriorate after that. During Mar - Jun '09 season, the dry matter content of 6 clones decreased significantly. The highest dry matter was observed in ST-10, a white fleshed clone. In the other two seasons also (Sep - Dec '08 and Dec – Mar '09), majority of the clones (ST-10 and SV 280) showed a significant decrease in the dry matter content. No significant seasonal variation was observed for dry matter content among individual clones. The content of dry matter at 75 days ranged from 23 – 32% while at 90 days it varied from 27 – 38% and at 105 days it was between 26 – 37 %. It was observed that the dry matter content in all the clones significantly increased at 75 – 90 days. However. at 105 days, the dry matter content in majority of the clones decreased.

Sweet potato is considered as a food security crop which is important for the livelihoods of many poor mass. Traditional people prefer white fleshed varieties which possess high dry matter content than the orange fleshed sweet potato. Orange fleshed sweet potato possess low dry matter content since β-carotene is negatively correlated to dry matter content (Simonne et al., 1993). In the present study, the orange fleshed clones: 362-7 and SV-98 possess dry matter content of 35 – 37% and 32 – 34%, respectively at 90 days while β-carotene was 6 – 7 µg/100g.f.w, respectively. Usually, a balance of yield and dry matter is particularly important if selection is targeted to biofortification.

Compared to other tuber crops, the sweet potato has high moisture content resulting in relatively low dry matter content. The average dry matter content in sweet potato is approximately 30%, but are also found to vary widely depending on the factors such as cultivar, location, climate, day length, soil type, incidence of pests, diseases and cultivation practices (Bradbury and Holloway, 1988). Hamilton *et al.,* (1986) observed a positive correlation with the light flesh colour of the tuber and the dry matter content, while Dai *et al.,* (1988) suggested an additive gene effect for the starch content and dry matter. Dry matter has also been used as an indicator of starch content (Juritz, 1991). Constantine *et al.,* (1974) have suggested that high moisture level causes a decrease in the dry matter and protein content. Sweet potato exhibits hexasomic or tetra-disomic inheritance (Kumagai et al., 1990). Extensive studies have been made on the inheritance of various characters of sweet potato (Poole, 1952). Earlier reports suggest the occurrence of wide range of variation among the sweet potato cultivars for the tuber characters (Wu et al., 2008). Compared to other tuber crops, the sweet potato has high moisture content resulting in relatively low dry matter content. Juritz (1991) has pointed out that dry matter has also been used as an indicator of starch content. Earlier reports on Taiwanian and Brazilian lines of sweet potato suggested that the dry matter content ranged upto 35.1% (Anon, 1981) and 48.2% (Cereda et al., 1982) respectively. Storage roots with high dry matter and starch content are more suitable for secondary processed foods as well as they dry fast when processed and remain firm (Rees et al., 2003; Gasura et al., 2008). In the lowland condition, the prevalence of high soil moisture content could have favoured the production of high yield compared to the storage root yield of upland condition. Even though, irrigation was provided at both the locations, the evaporation of water at upland condition was higher than at lowland which resulted in the low yield. Wilson (1970) has proposed that storage root weight per plant is a measure of total tuber sink capacity. The present studies indicate that, the variation in root yield in different hybrids may be either due to the difference in the number of storage roots per plant or size of individual roots or difference in bulking rate as reported by Wilson and Lowe (1975).

Our reports are in confirmation to the fact that environmental conditions and varieties play an important role in deciding the optimum time of harvest in sweet potato as reported by Pandey (2007). Wilson and Lowe (1975) have reported that depending on the cultivar and conditions, root maturity varies from two to six months. Hence, single harvesting and double harvesting (progressive harvesting) is practised in sweet potato. With care, early-maturing cultivars can be grown as an annual summer crop as in temperate areas. However, long duration sweet potato is not possible in the tropical conditions mainly due to the sweet potato weevil problem. Wilson (1970) reported that the storage root initiation takes place at 2-4 weeks after planting of the vine cuttings which is in conformation with the results of the present studies. The yield and dry matter analysis at the early growth stages helps to screen a large number of progenies and to identify high yielding clones in a breeding programe. Considering the above factors, it is worthwhile to harvest the storage roots of most cultivars at around 90-100 days after planting. It is also possible that these early maturing clones could be released for farmer evaluation and also assessed further for early maturity as well as for yield ability at the normal harvest period to identify the varieties better suited for the normal garden practice, but at the same time offering the ability to produce an edible crop early in times of hardship.

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Table 1: Tuber yield (t ha^{-1}) and dry matter (%) of sweet potato clones during the three season at 75, 90 and 105 DAP's

Clone	75 days		90 days		105 days	
	Yield (t ha^{-1})	DM (%)	Yield (t ha^{-1})	DM (%)	Yield (t ha^{-1})	DM (%)
			Oct – Dec 08			
362-7	13.70	27.53	24.07	34.67	24.69	32.27
CO-50-1	6.17	22.90	15.77	28.23	14.94	27.30
CO-3-4	13.58	25.77	24.69	34.87	29.38	33.17
IGSP-14	13.30	28.03	25.93	29.63	28.64	30.80
S. Arun	10.83	25.27	22.84	27.40	25.31	26.77
ST-10	6.38	28.90	17.49	37.20	18.77	34.47
SV-280	12.96	31.50	24.69	38.33	29.63	32.13
SV-98	9.63	26.47	17.90	32.33	20.21	29.27
			Dec - Mar 08			
362-7	12.68	27.50	23.17	35.90	15.43	32.60
CO-50-1	7.41	24.23	18.43	28.87	16.17	31.00
CO-3-4	12.96	24.37	26.24	36.40	27.78	32.33
IGSP-14	12.04	28.00	24.41	30.70	27.82	31.00
S. Arun	10.21	26.23	21.36	28.30	21.52	25.27
ST-10	7.41	25.80	15.77	38.23	15.43	36.53
SV-280	11.73	32.27	25.68	38.27	28.40	34.47
SV-98	8.02	26.07	17.00	33.60	15.43	28.77
			Mar – Jun 09			
362-7	12.96	27.20	23.12	36.73	24.78	33.37
CO-50-1	8.40	24.50	14.20	29.10	15.21	29.47
CO-3-4	13.60	25.47	24.07	36.33	25.72	33.53
IGSP-14	12.35	28.43	14.20	30.90	25.10	31.43
S. Arun	9.26	26.40	20.37	28.40	22.63	26.10
ST-10	8.02	25.97	13.58	37.17	16.33	36.53
SV-280	8.64	31.60	16.67	37.87	19.88	34.77
SV-98	7.41	26.30	17.28	32.87	20.49	29.60
LSD	2.32	1.03				