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Physiological and biochemical variability studies among orange flesh sweet potato (*Ipomoea batatas* (L.) Lam.) Genotypes

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Abstract
An investigation on physiological and biochemical variability was conducted with 25 genotypes of OFSP at Horticultural College and Research Institute, Dr. Y. S. R. Horticultural University, Venkataramannagudem, West Godavari district, Andhra Pradesh to study the physiological variability at 30, 60, 90 and 120 days after planting (DAP) and biochemical variability at 90 and 120 days after planting (DAP). There was a wide variation among genotypes for all the physiological and biochemical parameters during the growth stages. Net assimilation rate (NAR) and relative growth rate (RGR) were high in earlier days therefore more attention is needed in between 30 and 90 DAP. Hence, breeding for physiological traits are considered at the early stages of growth i.e. 30 to 90 DAP. There was a wide variation among genotypes for all the biochemical parameters during tuber growth stages. All the genotypes showed progressive development of starch, sugars (reducing, non-reducing, total) and β-carotene content from 90 to 120 DAP. Breeding for physiological traits should be taken care and the early rapid growth during 30 to 90 DAP will be helpful to increase the production and productivity of orange flesh sweet potato (OFSP). Yield contributing characters like leaf area index, specific leaf area, crop growth rate, net assimilation rate and non-reducing sugar are the most dependable characters and could be effectively used in breeding for improvement in yield in OFSP.

Keywords: DAP; NAR; RGR; physiology; OFSP; (*Ipomoea batatas* (L.) Lam.)

Introduction
The sweet potato (*Ipomoea batatas* (L.) Lam.) is an important starchy food crop grown throughout the tropical and sub-tropical parts of the world. Being rich in β-carotene, the orange-flesh sweet potato is gaining importance as the cheapest source of antioxidant. The major carotenoid pigment present in the orange flesh sweet potato is β-carotene which is a precursor of vitamin A and is an essential micronutrient for normal immune function of the human beings. In India, sweet potato is being cultivated in almost all the states with an area of 111 ha, with a production of 1450 metric tonnes and productivity of 10.4 MT/ha (NHB, 2015). India accounts for about 68% of the total production of South Asia followed by 27% in Bangladesh and about 5% in Sri Lanka. In India, Sweet potato is cultivated mainly in Odisha, Uttar Pradesh, West Bengal, Bihar, Karnataka, Andhra Pradesh, Tamil Nadu and Kerala. Crop growth parameters are important traits in crop physiology because they could be associated with some aspects of crop growth, competition and survival. Information is scarce on growth parameters of root. Therefore, experiment is conducted to determine the trends and relationships among growth parameters. Researchers therefore want to know the relationship between the magnitude of yield fluctuations, physiological and biochemical factors which influence the growth and development.
Therefore the present investigations were carried out to study the variability in growth and development pattern and biochemistry of OFSP genotypes with respect to the prevailing tropical conditions to analyze the variations in growth and development patterns and biochemical composition in OFSP genotypes.

Material and Methods
The experiment was carried out at Horticultural College and Research Institute, Dr. Y. S. R. Horticultural University, Venkataramannagudem, West Godavari district, Andhra Pradesh during *kharif* 2015. The experimental material for the present study consisted of 25 genotypes *viz.* ST-14, Sree Kanaka, SWA-2, Kamala Sundari, CIP-440127, ACC-22, ACC-11, Kiran,

Gouri, CO-1, VRSP-1, VRSP-2, ACC-5, VRSP-3, VRSP-4, VRSP-5, VRSP-6, VRSP-7, VRSP-8, VRSP-9, VRSP-10, VRSP-11, VRSP-12, VRSP-13 and VRSP-14.

The experiment was laid out in a Randomized Block Design (RBD) with three replications each consisting of 25 genotypes. Each plant was grown in 60 cm* 20 cm. Five plants were taken at random each in genotype and tagged for recording observations. Observations were taken by uprooting the whole plant at 30 days intervals up to harvest.

All the cultural operations like nursery raising, main field preparation, transplanting, fertilization, irrigation, weeding, plant protection etc. were carried out as per the recommendations in order to raise a successful crop.

Physiological and biochemical observations which are used to study were recorded for every 30, 60, 90, 120 and 90, 120 days after planting (DAP) respectively. The observations recorded for physiological parameters were leaf area index (LAI), specific leaf area (SLA), specific leaf weight (SLW), crop growth rate (CGR), relative growth rate (RGR) and net assimilation rate (NAR) and for biochemical parameters starch, sugars (total, reducing and non-reducing) and β-carotene content.

Results and Discussion

Physiological Parameters

Leaf Area Index (LAI)

All the genotypes showed their maximum leaf are index at 90 DAP (Table 1) and minimum at 30 DAP. LAI gradually increased from 30 DAP to 90 DAP, later it declined. It might be due to decrease in the leaf area per plant due to ageing and drying of leaves at 120 DAP. These results are in accordance with the findings of Shivanand *et al.* (2015) [13] in ridge gourd.

Specific Leaf Area (SLA)

Increased leaf area might be lead to more assimilation of photosynthates and contributed to high specific leaf area. Maximum SLA was observed in all the genotypes at 90 DAP except in ST-14, Sree Kanaka, SWA-2, Kamala Sundari, ACC-11, Kiran, Co-1, VRSP-7 (Table 2). Among these eight genotypes ST-14, SWA-2, Kamala Sundari, Co-1 and VRSP-7 recorded maximum SLA at 30 DAP indicating that these genotypes had more vegetative potential at initial stages, whereas Sree Kanaka, ACC-11 and Kiran recorded maximum SLA at 60 DAP indicating that these genotypes had more vegetative potential at later stages. These results are in accordance with the findings of Shivanand *et al*. (2015) [13] in ridge gourd.

Specific Leaf Weight (SLW)

Specific leaf weight is the reverse condition of the specific leaf area which indicates the leaf thickness. SLW was recorded maximum at 30 DAP in all the genotypes of OFSP indicating that these genotypes accumulated more photosynthates in their early stage, except in ST-14, SWA-2, Kamala Sundari, ACC-22, Co-1, VRSP-1, VRSP-2, VRSP-12, VRSP-13 and VRSP-14 (Table 3). Among these 10 genotypes ACC-22, Co-1, VRSP-1 and VRSP-2 recorded maximum SLW at 90 DAP, whereas in ST-14, SWA-2, Kamala Sundari, VRSP-12, VRSP-13 and VRSP-14 at 120 DAP indicating that these genotypes accumulated more photosynthates in their later stage. These results are in accordance with the findings of Shivanand *et al*. (2015) [13] in ridge gourd.

Crop Growth Rate (CGR)

Maximum CGR values were recorded at 90-120 DAP. Based on the results obtained it may be concluded that CGR increased gradually from 30-120 DAP in all the genotypes except in Sree Kanaka, ACC-11, Kiran, ACC-5, VRSP-4, VRSP-6, VRSP-10, VRSP-11 and VRSP-14 where maximum CGR was recorded at 60-90 DAP, indicated that these genotypes put forth their maximum growth at 60-90 DAP (Table 4). Whereas in case of Kamala Sundari and ACC-11 more CGR was observed between 30 and 60 DAP than 90 and 120 DAP, indicated that these genotypes put forth their maximum growth at 90-120 DAP. These results are in accordance with the findings of Shivanand *et al*. (2015) [13] in ridge gourd.

Relative Growth Rate (RGR)

Relative growth rate has showed an increased trend from 30-60 DAP followed by 90-120 DAP and 60-90 DAP except in ST-14 and CIP-440127 where minimum RGR was observed in between 90 and 120 DAP (Table 5). In these genotypes the tuber growth was not remarkable at later stages. It reveals that with the passage of time, plant dry weight was increased by the translocation of photo assimilates to storage organs (tubers) and thereafter a decrease in the photosynthetic activity of the matured leaves results in constant growth of tuber in these genotypes. The RGR was higher at early stage when the LAI was minimum and it declined with increase in plant age and LAI. The above results are in conformity with the results obtained by Tiwari *et al*. (1985) [14] in sweet potato.

Net assimilation rate

NAR in all the genotypes of OFSP was more between 30 and 60 DAP followed by 90-120 DAP and 60-90 DAP except in Sree Kanaka, ACC-11, Kiran, ACC-5, VRSP-4, VRSP-6, VRSP-10, VRSP-11 and VRSP-14 (Table 6). It may be due to low dry weight and leaf area at 120 DAP these genotypes showed low NAR at 120 DAP. NAR decreased due to ageing of leaves and also due to mutual shading with each other decreased the photosynthetic activity of leaves thereby a decreased NAR was recorded. When all the leaves were exposed completely to sunlight maximum NAR was recorded. It declined with increase in LAI. The above results are in conformity with the results obtained by Tiwari *et al*. (1985) [14] in sweet potato.

Biochemical Variability

Starch Content (%)

All the genotypes showed their maximum starch content at 120 DAP and minimum at 90 DAP (Table 7). On day 90, among all the genotypes SWA-2 recorded the maximum starch content (18.2%), while ACC-11 recorded the minimum starch content (7.3%). On day 120, among all the genotypes Co-1 recorded the maximum starch content (23.3%), followed by SWA-2 (22.3%) while Kiran recorded the minimum starch content (10.8%). Rajendran *et al*. (1985) [11] reported a range of 11 to 29% starch content in their studies on sweet potato accessions at Thiruvananthapuram. The observed differences may be due to genetic differences among genotypes. This suggestion is in agreement with Tsakama *et al*. (2010) [15].

Table 1: Leaf Area Index in different Orange Flesh Sweet Potato genotypes under study

Name of genotypes	Leaf area index			
	30 days	60 days	90 days	120 days
ST-14	1.6	5.0	15.0	5.0
Sree Kanaka	0.5	28.1	79.9	29.1
SWA-2	1.4	6.2	18.7	6.2
Kamala Sundari	1.1	4.5	14.1	4.6
CIP-440127	0.6	19.9	63.9	21.1
ACC-22	1.3	32.6	96.2	37.0
ACC-11	0.2	14.3	44.8	14.7
Kiran	1.1	3.9	11.2	4.1
Gouri	0.3	13.7	42.5	14.0
CO-1	0.7	30.3	90.5	31.6
VRSP-1	1.7	51.4	170.0	58.0
VRSP-2	0.7	43.9	87.2	45.7
ACC-5	0.9	34.3	109.2	35.8
VRSP-3	1.1	52.9	258.3	64.6
VRSP-4	0.8	34.2	170.4	40.4
VRSP-5	1.1	50.8	152.3	51.6
VRSP-6	1.2	37.8	192.6	39.3
VRSP-7	2.3	4.9	24.0	5.3
VRSP-8	0.7	43.6	139.2	46.0
VRSP-9	0.9	47.7	150.0	48.9
VRSP-10	1.3	19.8	136.3	20.3
VRSP-11	0.8	24.6	70.5	25.7
VRSP-12	1.3	104.4	267.3	122.0
VRSP-13	0.7	72.3	322.7	79.4
VRSP-14	1.1	35.6	105.2	37.8
Gm	1.06	32.7	113.3	35.5
SEm±	0.09	2.39	11.51	3.29
CD at 5%	0.27	6.83	32.85	9.39

Table 2: Specific Leaf Area (cm^2/g) in different Orange Flesh Sweet Potato genotypes under study

Name of genotypes	Specific leaf area (cm^2/g)			
	30 days	60 days	90 days	120 days
ST-14	428.7	313.4	181.0	67.2
Sree Kanaka	220.9	980.7	971.2	358.5
SWA-2	259.9	172.1	164.2	56.0
Kamala Sundari	271.6	103.5	181.2	62.3
CIP-440127	185.8	580.2	652.2	215.6
ACC-22	262.6	750.8	816.2	337.6
ACC-11	47.4	331.7	280.9	95.7
Kiran	137.2	946.3	897.1	309.6
Gouri	36.9	279.5	373.2	128.9
CO-1	282.6	105.2	199.5	45.8
VRSP-1	97.5	1874.6	2618.6	692.4
VRSP-2	215.5	1197.2	1334.5	483.8
ACC-5	100.1	857.3	875.3	298.0
VRSP-3	430.5	2124.5	2820.9	996.8
VRSP-4	199.2	815.0	1447.5	350.8
VRSP-5	195.2	1402.6	2128.6	665.7
VRSP-6	110.5	740.8	1225.4	259.1
VRSP-7	146.0	78.9	75.9	30.3
VRSP-8	148.7	965.8	1310.6	487.0
VRSP-9	226.4	1355.3	1627.4	613.2
VRSP-10	104.6	417.2	1069.0	179.2
VRSP-11	141.3	583.9	729.9	271.3
VRSP-12	178.7	1424.2	1376.2	1695.7
VRSP-13	147.2	2255.0	2661.0	1266.1
VRSP-14	59.5	732.5	847.5	342.3
Gm	185.4	855.5	1074.6	412.4
SEm±	15.53	61.15	66.41	25.40
CD at 5%	44.29	174.42	189.42	72.46

Table 3: Specific Leaf Weight (g/cm^2) in different Orange Flesh Sweet Potato genotypes under study

Name of genotypes	Specific leaf weight (g/cm^2)			
	30 days	60 days	90 days	120 days
ST-14	0.002	0.003	0.006	0.015
Sree Kanaka	0.005	0.001	0.001	0.003
SWA-2	0.004	0.006	0.006	0.018
Kamala Sundari	0.004	0.010	0.006	0.017
CIP-440127	0.006	0.002	0.002	0.005
ACC-22	0.005	0.001	0.006	0.002
ACC-11	0.021	0.003	0.004	0.010
Kiran	0.008	0.001	0.001	0.003
Gouri	0.027	0.004	0.002	0.008
CO-1	0.007	0.001	0.030	0.002
VRSP-1	0.005	0.001	0.008	0.002
VRSP-2	0.002	0.001	0.004	0.001
ACC-5	0.010	0.001	0.001	0.003
VRSP-3	0.010	0.001	0.004	0.001
VRSP-4	0.005	0.001	0.008	0.003
VRSP-5	0.006	0.001	0.005	0.001
VRSP-6	0.009	0.001	0.009	0.004
VRSP-7	0.007	0.001	0.004	0.001
VRSP-8	0.005	0.001	0.005	0.002
VRSP-9	0.004	0.001	0.001	0.003
VRSP-10	0.010	0.002	0.001	0.006
VRSP-11	0.007	0.002	0.001	0.004
VRSP-12	0.004	0.010	0.005	0.022
VRSP-13	0.007	0.013	0.013	0.033
VRSP-14	0.017	0.001	0.001	0.033
Gm	0.007	0.002	0.005	0.008
SEm±	0.001	0.000	0.000	0.001
CD at 5%	0.003	0.001	0.001	0.002

Table 4: Crop Growth Rate ($g/m^2/d$) in different Orange Flesh Sweet Potato genotypes under study

Name of genotypes	Crop growth rate ($g/m^2/d$)		
	30-60 days	60-90 days	90-120 days
ST-14	9.36	47.3	53.1
Sree Kanaka	18.9	40.0	27.1
SWA-2	22.6	55.3	59.0
Kamala Sundari	28.9	27.8	28.0
CIP-440127	23.0	52.5	60.5
ACC-22	25.3	41.4	63.5
ACC-11	28.2	80.5	16.6
Kiran	28.9	82.8	26.9
Gouri	29.4	51.3	55.9
CO-1	19.6	25.9	26.1
VRSP-1	27.2	58.4	87.6
VRSP-2	29.2	45.9	71.0
ACC-5	22.7	60.9	35.8
VRSP-3	32.3	66.8	90.0
VRSP-4	28.0	55.3	39.9
VRSP-5	22.9	27.3	87.1
VRSP-6	28.9	76.5	44.4
VRSP-7	27.9	51.0	59.9
VRSP-8	17.8	28.5	80.2
VRSP-9	27.8	58.5	86.5
VRSP-10	27.4	56.3	48.5
VRSP-11	27.9	42.4	39.4
VRSP-12	34.6	49.7	93.4
VRSP-13	32.8	59.4	90.2
VRSP-14	24.3	51.3	47.8
Gm	25.8	51.7	56.7
SEm±	1.46	2.92	5.20
CD at 5%	4.19	8.34	14.85

Table 5: Relative Growth Rate (mg/g/d) in different Orange Flesh Sweet Potato genotypes under study

Name of genotypes	Relative growth rate (mg/g/d)		
	30-60 days	60-90 days	90-120days
ST-14	41.6	33.6	27.0
Sree Kanaka	75.0	35.0	42.0
SWA-2	58.3	37.0	41.0
Kamala Sundari	72.0	20.3	37.0
CIP-440127	71.6	30.0	29.0
ACC-22	65.0	30.0	37.0
ACC-11	65.0	41.0	47.2
Kiran	65.0	41.0	49.6
Gouri	52.3	29.0	45.0
CO-1	53.3	23.6	44.8
VRSP-1	70.6	32.0	32.3
VRSP-2	58.6	30.0	39.3
ACC-5	47.0	36.6	46.0
VRSP-3	55.3	35.0	38.0
VRSP-4	71.0	33.0	33.0
VRSP-5	66.6	25.0	35.6
VRSP-6	50.3	37.3	41.6
VRSP-7	53.3	28.6	40.3
VRSP-8	60.6	35.0	40.0
VRSP-9	69.6	30.0	32.0
VRSP-10	45.0	31.0	34.6
VRSP-11	64.0	29.0	34.0
VRSP-12	57.6	32.0	36.0
VRSP-13	62.3	33.0	38.0
VRSP-14	33.6	29.0	34.0
Gm	59.38	31.88	38.17
SEm±	2.914	2.497	2.928
CD at 5%	8.312	7.122	8.350

Table 6: Net Assimilation Rate (mg/cm²/d) in different Orange Flesh Sweet Potato genotypes under study

Name of genotypes	Net assimilation rate (mg/cm²/d)		
	30-60 days	60-90 days	90-120 days
ST-14	17.2	3.5	5.1
Sree Kanaka	26.8	8.0	5.4
SWA-2	23.4	5.7	6.6
Kamala Sundari	33.8	8.5	14.6
CIP-440127	41.9	13.9	15.8
ACC-22	19.5	4.4	6.8
ACC-11	79.4	30.3	6.3
Kiran	27.0	10.0	3.2
Gouri	20.1	4.5	6.4
CO-1	22.2	4.3	13.6
VRSP-1	68.7	48.8	51.9
VRSP-2	12.1	2.9	7.7
ACC-5	25.5	9.5	5.6
VRSP-3	31.0	59.1	57.9
VRSP-4	31.1	6.5	4.4
VRSP-5	24.7	4.7	47.4
VRSP-6	27.7	8.1	4.6
VRSP-7	12.4	2.7	3.8
VRSP-8	79.5	20.0	22.1
VRSP-9	121.0	32.9	33.2
VRSP-10	40.3	9.3	7.9
VRSP-11	40.3	9.7	8.9
VRSP-12	154.0	95.5	132.1
VRSP-13	92.9	49.6	73.3
VRSP-14	24.3	8.0	7.2
Gm	43.87	18.41	22.07
SEm±	2.90	1.01	1.59
CD at 5%	8.28	2.90	4.53

Table 7: Starch Content (%) in different Orange Flesh Sweet Potato genotypes under study

Name of genotypes	Starch content (%)	
	90 days	120 days
ST-14	15.2	16.8
Sree Kanaka	8.4	12.8
SWA-2	18.2	22.3
Kamala Sundari	7.8	12.9
CIP-440127	10.3	15.7
ACC-22	8.3	12.7
ACC-11	7.3	12.4
Kiran	7.5	10.8
Gouri	15.2	17.1
CO-1	15.3	23.3
VRSP-1	12.5	19.4
VRSP-2	10.6	14.1
ACC-5	15.1	16.4
VRSP-3	9.5	13.6
VRSP-4	12.5	18.1
VRSP-5	15.1	16.4
VRSP-6	13.3	14.7
VRSP-7	14.9	17.9
VRSP-8	13.4	16.3
VRSP-9	14.0	16.8
VRSP-10	12.2	18.3
VRSP-11	12.1	13.4
VRSP-12	13.2	15.3
VRSP-13	13.1	16.1
VRSP-14	11.4	14.7
Gm	12.28	15.94
SEm±	0.41	0.47
CD at 5%	1.17	1.34

Table 8: Sugars (%) in different Orange Flesh Sweet Potato genotypes under study

Name of genotypes	Reducing sugar (%)		Non-reducing sugar (%)		Total sugar (%)	
	90 days	120 days	90 days	120 days	90 days	120 days
ST-14	1.7	3.2	0.7	0.7	2.4	3.9
Sree Kanaka	4.4	6.2	1.3	1.2	5.7	7.4
SWA-2	2.2	3.0	0.8	0.7	3.0	3.7
Kamala Sundari	4.1	6.8	0.8	0.8	4.9	7.7
CIP-440127	2.5	3.1	0.6	0.8	3.1	3.9
ACC-22	2.1	2.8	0.6	0.8	2.8	3.7
ACC-11	4.7	6.5	1.1	1.6	5.9	8.2
Kiran	2.1	3.2	1.1	0.4	3.2	3.7
Gouri	2.8	3.3	0.4	0.6	3.2	3.9
CO-1	4.5	7.1	1.0	1.2	5.5	8.4
VRSP-1	2.8	5.0	1.1	2.8	3.9	7.8
VRSP-2	2.0	3.3	0.7	1.7	2.7	5.0
ACC-5	1.9	3.8	0.8	0.6	2.7	4.5
VRSP-3	2.0	3.5	1.2	2.8	3.2	6.3
VRSP-4	2.5	3.9	0.6	2.4	3.2	6.4
VRSP-5	2.4	4.4	0.5	2.1	2.9	6.5
VRSP-6	1.7	4.2	1.1	3.2	2.9	7.2
VRSP-7	2.3	3.6	1.1	3.8	3.4	7.4
VRSP-8	2.2	3.3	0.7	2.5	3.0	5.8
VRSP-9	2.4	4.0	0.7	2.6	3.2	6.6
VRSP-10	2.3	4.8	0.9	1.0	3.2	5.8
VRSP-11	2.5	4.4	0.6	1.9	3.2	6.3
VRSP-12	2.2	3.1	0.5	2.0	2.8	5.1
VRSP-13	2.0	3.4	1.2	2.4	3.3	5.8
VRSP-14	1.8	2.8	0.7	1.4	2.6	4.2
Gm	2.59	4.13	0.87	1.71	3.47	5.84
SEm±	0.28	0.24	0.04	0.09	0.30	0.26
CD at 5%	0.81	0.69	0.11	0.27	0.85	0.76

Table 9: β- carotene (mg/100g f.w.) in different Orange Flesh Sweet Potato genotypes under study

No. of genotypes	β- carotene (mg/100g f.w.)	
	90 days	120 days
ST-14	4.00	8.30
Sree Kanaka	3.70	7.70
SWA-2	3.53	6.90
Kamala Sundari	3.20	6.49
CIP-440127	3.23	5.90
ACC-22	2.10	5.10
ACC-11	1.50	3.56
Kiran	2.00	4.44
Gouri	2.80	5.50
CO-1	1.30	2.80
VRSP-1	3.30	6.33
VRSP-2	1.76	3.96
ACC-5	1.32	2.50
VRSP-3	2.13	4.23
VRSP-4	2.46	3.86
VRSP-5	2.31	5.13
VRSP-6	4.70	5.13
VRSP-7	4.90	5.93
VRSP-8	3.30	4.33
VRSP-9	1.93	4.40
VRSP-10	2.36	3.73
VRSP-11	2.03	3.33
VRSP-12	2.80	3.50
VRSP-13	3.53	4.40
VRSP-14	4.90	5.30
Gm	2.84	4.91
SEm±	0.13	0.15
CD at 5%	0.37	0.45

Sugars (%)

Total Sugar

All the genotypes showed their maximum total sugar content at 120 DAP and minimum at 90 DAP (Table 8). On day 90, among all the genotypes ACC-11 recorded the maximum total sugar (5.9%), while ST-14 recorded the minimum total sugar (2.4%). On day 120, among all the genotypes Co-1 recorded the maximum total sugar (8.4%), ACC-11 (8.2%), VRSP-1 (7.8%) and Kamala Sundari (7.7%), while SWA-2, ACC-22 and Kiran recorded the minimum total sugar (3.7%). This suggestion might be supported by Frankin (1988) [2] who reported that total sugar concentration is genetically controlled trait in sweet potato. Andrade (2009) [1] reported that the concentration of total sugar of five sub Saharan Africa sweet potato collection was laid between 1.7 mg 100 g -1 to 27 mg 100-1 which this result was strongly agree with the present result. According to Onwueme (1991) [8] the range of recommended total sugar concentration was between 6.98 to 14.59 g 100 g-1 and this result strongly agree with the present finding. Average (11.2 mg 100 g-1) total sugar concentration of four sweet potato varieties was recorded by Hamed (1973) [4].

Reducing Sugar

All the genotypes showed their maximum reducing sugar content at 120 DAP and minimum at 90 DAP (Table 8). On day 90, among all the genotypes ACC-11 recorded the maximum reducing sugar (4.7%), while ST-14 and VRSP-6 recorded the minimum reducing sugar (1.7%). On day 120, among all the genotypes Co-1 recorded the maximum reducing sugar (7.1%), while VRSP-14 recorded the minimum reducing sugar (2.8%). This statement is in agreement with Frankin (1988) [2] who reported that reducing sugar of storage root was genetically controlled traits.

Hacineza (2010) [3] and Picha (1985) [9] stated that the total reducing sugar in fresh sweet potato was 6.94 mg 100 g-1 and, 7.84 mg 100 g-1, respectively. Walter (1986) [16] reported that the concentration of reducing sugar of fresh fry type sweet potato ranges from 5.88 to 6.31 mg g -1 similar result were also found by Loretan (1989) [5]. This work is in agreement with the findings of Ruinard (1976) [12] who reported that the reducing sugar concentration of four varieties was between 2.9 and 5.8 mg 100 g-1.

Non-reducing Sugar

All the genotypes showed their maximum non-reducing sugar content at 120 DAP and minimum at 90 DAP (Table 9). On day 90, among all the genotypes Sree Kanaka recorded the maximum non-reducing sugar (1.3%), while Gouri recorded the minimum non-reducing sugar (0.4%). On day 120, among all the genotypes VRSP-7 recorded the maximum non-reducing sugar (3.8%), while Kiran recorded the minimum non-reducing sugar (0.4%). Similar trend was observed by Prarthana Mohanty (2014) [10].

β-carotene content (mg/100g f.w)

All the genotypes showed their maximum β-carotene content (mg/100g f.w) content at 120 DAP (Table 9) and minimum at 90 DAP. On day 90, among all the genotypes VRSP-7 and VRSP-14 recorded the maximum β-carotene content (4.90 mg/100g f.w), while Co-1 recorded the minimum β-carotene content (1.30 mg/100g f.w). On day 120, among all the genotypes ST-14 recorded the maximum β-carotene content (8.30 mg/100g f.w), while ACC-5 recorded the minimum β-carotene content (2.50 mg/100g f.w). Onwueme (1978) [7] and Lila Babu (1988) also found similar variation of (0.93 to 7.56 mg/100g f.w.) β-carotene content in their studies.

Conclusion

Based on the above mentioned findings of the present investigations it may be concluded that the period between 30 to 90 DAP is the most decisive period for OFSP plant to initiate tuber and tuber bulking. Breeding for physiological traits should be taken care and the early rapid growth during 30 to 90 DAP periods will be helpful to increase the production and productivity of OFSP.

The physiological traits revealed significant differences among the genotypes for all the growth indices studied. For LAI, on day 30, among all the genotypes VRSP-7 recorded the maximum leaf area index, on day 60, VRSP-12, on day 90, VRSP-13, on day 120, VRSP-12. In between 30 and 60 days, among all the genotypes VRSP-12 recorded the maximum CGR, whereas RGR was maximum in Sree Kanaka at 30-60 days interval. In case of NAR, VRSP-12 recorded maximum in all the intervals. Regarding qualitative characters genotype ST-14 for β-carotene, Co-1 for starch content, total sugars and reducing sugars and VRGSP-7 for non-reducing sugars were found to be elite among all the genotypes. VRSP-1 performed well regarding β-carotene content and total sugars.

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