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Evaluation of Orange Fleshed Sweet Potato (*Ipomoea batatas L.*) Genotypes for Higher Yield and Quality

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Abstract

Four orange fleshed sweet potato (OFSP) genotypes viz., CIP 194513.15, CIP 194515.15, CIP 441132 and CIP 440267.2 collected from International Potato Centre (CIP) and four BARI (Bangladesh Agricultural Research Institute) - hybrid orange flesh sweet potato genotypes viz., H_{16}/06, H_{19}/06, H_3/07 and H_6/07 were evaluated against BARI SP-3 and BARI SP-4 having orange fleshed at Agricultural Research Station, Bangladesh Agricultural Research Institute, Pahartali, Chittagong for yield and quality. The highest (31.59 t/ha) tuberous root yield was found in CIP 194513.15 which was followed by CIP 440267.2 (30.97 t/ha) and the lowest yield (13.34 t/ha) was obtained in BARI SP 3. The maximum dry matter (29.83%) was obtained in H_6/07 while the minimum dry matter (17.61%) was obtained in CIP 441132. Among the tested genotypes the highest (approximately) Vitamin A (919.2 µg/100 g RE, FW) was recorded in CIP 440267.2, which had red skin and latex absent flesh and the lowest was (approximately) in H_6/07 (Vit A 0.0 µg/100 g RE, FW)**.** The results of the present study indicated that CIP 440267.2 is suitable among the OFSP genotypes for cultivation in Bangladesh on the basis of yield and quality mainly carotinous.

Keywords: Orange fleshed sweet potato, yield and vitamin A

1. Introduction

Sweet potato (*Ipomoea batatas L.*) is one of the most traditional root crops in many countries like Bangladesh. It is traditionally regarded as a 'poor man's crop as it is consumed by poor households. It gives satisfactory yield under adverse climatic and soil conditions, as well as under low or non-use of external inputs (Carey *et al.*, 1999; Ndolo *et al*., 2001; Githunguri and Migwa, 2004). The plant is a herbaceous perennial vine having alternate heart-shaped or palmately lobed leaves and medium-sized sympetalous flowers. The edible tuberous root is long and tapered, with wide ranges of skin colour such as yellow, orange, red, brown, purple, and beige. Its flesh colour ranges from beige through white, red, pink, violet, yellow, orange, and purple. Sweet potato varieties with white or pale yellow flesh are less sweet and moist than those with red, pink or orange flesh (Huaman, 1992 and Wikipedia, 2013).

Vitamin A deficiency is a wide spread nutritional and health problem affecting most people in the developing countries including Bangladesh. The deficiency increases children's risk to common illnesses, impaired growth, development, vision,

and immune systems, and in severe cases results in blindness and death (Ruel, 2001). In women, vitamin A deficiency increases risk of dying during pregnancy, as well as giving birth to low weight children, and may increase the spread of HIV/AIDS virus infection. New research findings suggest that vitamin A can have important effects on maternal mortality and can protect infants from the effects of maternal to child transmission of HIV/AIDS Virus (Semba *et al.*, 1995).

Approximately one million children have clinical signs of vitamin A deficiency, and more than 0.9 million children under 6 years of age suffer from some degree of Xerothalmia and 30 thousand children become blind every year due to severe vitamin A deficiency in Bangladesh (Siddiqui, 1995). It is estimated that about 29% of the population suffer from protein, while people suffering from vitamin A, B and C are 89, 81 and 93%, respectively (Hossain, 1993). Bangladeshi children also suffer from high rates of micronutrient deficiencies, particularly vitamin A, iron, iodine and zinc deficiency. A recent survey reported a decline in the prevalence of night blindness among preschool-age children in rural Bangladesh from 3.6 % in 1982/83 to 0.67% (HKI/IPHN, 1998). Among women of reproductive age, clinical vitamin A deficiency continues to be a serious problem. More than 2.7% of pregnant women, 2.4% of lactating women and 2.0% of non pregnant/non lactating women reported being night blind in 1997 (HKI/IPHN, 1997).

There is a clear need to diversify food sources both in terms of land/environmental sustainability, development of the rural economy and increased consumption to achieve improvements in the nutritional status of the people of Bangladesh. Orange fleshed sweet potato is quite rich in β-Carotene. According to Royal Horticultural Society (RHS) color chart, β-Carotene content of the sweet potato genotypes are presented in the table 1. To combat malnutrition and vitamin A deficiency, Orange Fleshed Sweet Potato (OFSP) may be a suitable item. Therefore, the present investigation was undertaken to select the suitable orange fleshed sweet potato clones having higher yield potentiality.

2. Materials and Methods

Four orange fleshed sweet potato genotypes collected from International Potato centre (CIP) viz., CIP 194513.15, CIP 194515.15, CIP 441132 and CIP 440267.2 and four BARI hybrid genotypes viz., H_{16}/06, H_{19}/06, H_3/07 and H_6/07 along with BARI SP 3 and BARI SP 4 having orange flesh were evaluated at Agricultural Research Station, Bangladesh Agricultural Research Institute (BARI), Pahartali, Chittagong during December 12, 2011 to April 21, 2012. The experiment was laid out following RCBD design with three replications. Unit plot size was 3.0 m x 3.0 m. Vine were planted on 12 December, 2011 with a spacing of 60 cm x 30 cm. Fertilizers were applied as per recommendation (BARI, 2011) @ 10000-170-160-190 kg/ha of Cowdung, urea, TSP and MoP, respectively. Full amount of Cowdung & TSP and 50% of urea and MoP were applied as basal and the remaining amount of urea and MoP were side dressed at 60 DAPs. Weeding, irrigation, earthing up and other intercultural operations were done as per recommendation (BARI, 2011).

All the data on yield and yield contributing characters were recorded. Data on tuberous root number per plant, tuberous root weight per plant, tuberous root length, breadth, number per plot, root weight per plot, yield per hectare and also foliage coverage percent, length and weight of vines per plant, number of branch per plant, dry matter percent, skin colour, flesh colour and latex were collected. The tuberous roots were harvested on 21 April 2012. Tuberous roots were also graded as marketable (>50 g) and non-marketable (<50 g) by weight basis. The fleshed colour and Vit.-A was determined by comparing with colour chart of Burgos *et al.* (2009). All the recorded data were analyzed statistically and the means were separated by least significant difference (LSD) test using MSTATC software.

3. Results and Discussion

All the information and data of the experiment are presented in Tables 2, 3 and 4 and Fig. 1. Table 2 shows the morphological features of the test genotypes. Skin colours were light red of CIP 194513.15, CIP 194515.15 and H_3/07, red of CIP 441132 and CIP 440267.2, light brown of H_{16}/06 and H_6/07, brown of H_{19}/06, deep brown of BARI SP 4, cream of BARI SP 3. Flesh colours were deep orange to intermediate orange in CIP 194513.15, CIP 440267.2 and CIP 441132, intermediate orange to intermediate orange in CIP 194515.15 and BARI SP 4, intermediate yellow to pale yellow orange in H_{16}/06, pale yellow orange to intermediate orange in H_{19}/06, orange to intermediate orange in H_3/07, cream to pale yellow in H_6/07 and cream in BARI SP 3. Latex are absent in CIP 194513.15, CIP 440267.2, CIP 441132, H_{16}/06, H_{19}/06 and H_6/07, moderate in CIP 194515.15, H_3/07, BARI SP 3 and BARI SP 4 (Table 2).

The yield and yield contributing characters of the studied varieties and the genotypes varied significantly. Table 3 shows the genotype CIP 440267.2 produced the maximum number of tuberous root/plant (9.40). These results are closely related with those reported by Anonymous (2009-10) where the number of tuberous root per plant was about 5.13 in CIP 440267.2. Farooque and Husain (1973) reported that the number of tubers per plant varied from 4.70 to 11.76. Siddique (1985) also found the number of tubers per plants which varied from 1.73 to 6.03.

The highest tuberous root weight/plant was observed in the genotype H_3/07(1.10 kg). The results are in agreement with the findings of Siddique (1985) where the weight of tubers per plant of the different genotypes ranged from 260 to 1120 g. The highest tuberous root length was observed in the genotype BARI SP 3 (14.97 cm). Jahan *et al. (*2001) reported that the variety Daulatpuri produced the maximum root length (14.44 cm) which is similar to that in the present study.

The highest tuberous root diameter was observed in the genotype H_{19}/06 (6.92 cm). The genotype CIP 440267.2 produced the maximum number of tuberous root/plot (335.00) where, marketable root number was 308 and non-marketable was 27. The highest root weight per plot was observed in the genotype CIP 194513.15 (28.43 kg) where, marketable root weight was 25.07 kg and non-marketable was 3.37 kg followed by CIP 440267.2 (27.88 kg) and H_{19}/06 (27.43 kg) (Table 3). The genotype CIP 194513.15 produced the maximum yield of tuberous root (31.59 t/ha) where, marketable root yield was 27.85 t/ha and non-marketable was 3.74 t/ha. These results are in good agreement with those in other reports (Anonymous, 2011-12) where yield of tuberous root per hectare was about 19.44 tones in CIP 194513.15.

Percent ground foliage coverage showed non-significant variation among the germplasms (Table 4). The highest vine length was observed in the genotype H_{19}/06 (253.3 cm). Siddique (1985) found that the vine length ranged from 93.3 to 488.7 cm which is consistent to the present study. The highest vine weight (998.3 g) was observed in the genotype CIP 441132. The vine weight result of the experiment is in agreement with the findings of Jahan *et al.* (2001).

The highest branch number (13.67) was observed in the genotype CIP 441132. Among the genotypes the highest dry matter percent was obtained in the genotype H_6/07 (29.83) (Table 4). The present study is more or less in agreement with the findings of Jahan *et al. (*2001). They reported that the variety Daulatpuri contained the highest dry matter (33.5 %).

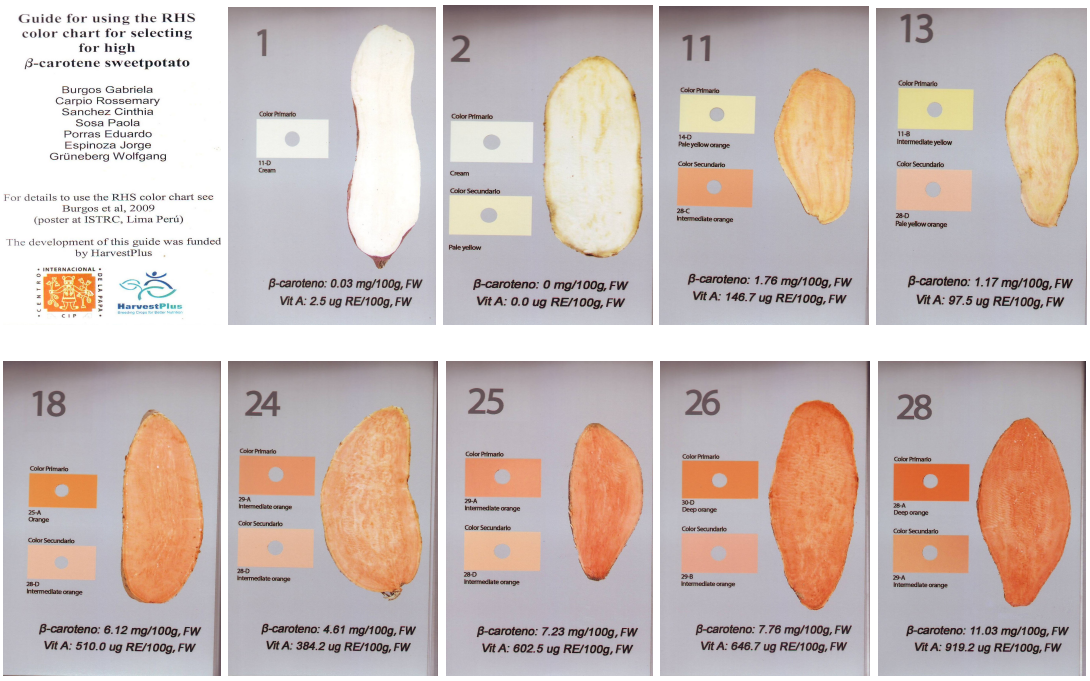

Fig. 1. RHS (Royal Horticultural Society) color chart for selecting for high β-Carotene Sweet potato

Table 1. ISTRC, Lema, Peru-published guide for using the Royal Horticultural Society (RHS) color chart for selecting high β-Carotene in sweet potato

No. of flesh colour	β-carotene (mg/100 g, FW)	Vit A (µg/100 g RE, FW)	No. of flesh colour	β-carotene (mg/100 g, FW)	Vit A (µg/100 g RE, FW)
1	0.03	2.5	16	4.41	257
2	0	0.0	17	4.92	410.0
3	0.12	10.0	18	6.12	510
4	0.02	1.7	19	5.46	455.0
5	0	0.0	20	3.96	330.0
6	0.5	12.5	21	5.49	457.5
7	1.38	115.0	22	3.03	252.5
8	1.65	137.5	23	3.76	313.3
9	1.5	125.0	24	4.61	384.2
10	1.74	145.0	25	7.23	602.5
11	1.76	146.7	26	7.76	646.7
12	0.69	57.5	27	10.5	875.0
13	1.17	97.5	28	11.03	919.2
14	1.32	110.0	29	12.39	1032.5
15	1.04	86.7	30	14.37	1197.5

Source: Burgos *et al*. (2009)

Table 2. Physio-morphological features for orange fleshed sweet potato genotypes

Genotypes	Skin colour	No. of Flesh colour according to Burgos *et al*. (2009)	Latex
CIP 194513.15	Light red	26 (Deep orange to intermediate orange)	Absent
CIP 194515.15	Light red	25 (Intermediate orange)	Moderate
CIP 441132	Red	26 (Deep orange to intermediate orange)	Absent
CIP 440267.2	Red	28 (Deep orange to intermediate orange)	Absent
H_{16}/06	Light brown	13 (Intermediate yellow to pale yellow orange)	Absent
H_{19}/06	Brown	11 (Pale yellow orange to intermediate orange)	Absent
H_3/07	Light red	18 (Orange to intermediate orange)	Moderate
H_6/07	Light brown	2 (Cream to pale yellow)	Absent
BARI SP 3	Cream	1 (Cream)	Moderate
BARI SP 4	Deep brown	24 (Intermediate orange)	Moderate

Table 3. Yield and yield contributing characters of orange fleshed sweet potato genotypes

Genotypes	Tuberous root no. /plant	Tuberous root wt. (kg)/ plant	Tuberous root length (cm)	Tuberous root diameter (cm)	Tuberous root no. /plot			Tuberous root wt. /plot (kg)		
					Marketable	Non marketable	Total	Marketable	Non marketable	Total
CIP 194513.15	8.93	0.72	12.63	4.48	289.4	34.6	324.0	25.07	3.37	28.43
CIP 194515.15	3.73	0.59	9.90	6.79	106.4	28.6	135.0	12.13	3.83	15.97
CIP 441132	6.60	0.69	12.50	5.06	269.4	28.3	297.7	21.67	2.40	24.06
CIP 440267.2	9.40	0.7	13.04	4.48	308.0	27.0	335.0	25.00	2.88	27.88
H_{16}/06	4.00	0.66	11.83	6.49	133.1	13.6	146.7	19.40	3.40	22.80
H_{19}/06	3.60	0.93	12.83	6.92	127.1	18.6	145.7	22.60	4.83	27.43
H_3/07	6.33	1.10	12.30	6.87	174.3	16.0	190.3	19.90	3.43	23.33
H_6/07	4.40	0.68	14.40	6.20	124.0	24.3	148.3	16.53	4.63	21.16
BARI SP 3	5.67	0.47	14.97	3.98	108.0	8.0	116.0	11.05	0.97	12.01
BARI SP 4	5.67	0.70	10.71	6.28	197.3	15.4	212.7	22.00	2.70	24.70
CV (%)	11.41	15.5	10.50	10.80	11.76	31.94	10.11	7.55	21.32	7.63
$LSD_{0.05}$	1.14	0.19	2.25	1.06	37.04	11.76	35.56	2.53	1.18	2.98
Level of significance	**	**	**	**	**	**	**	**	**	**

* and ** significant at 5% and 1%, respectively

Table 4. Yield and yield contributing characters of orange fleshed sweet potato genotypes

Genotypes	Tuberous root wt. (t/ha)			Ground foliage coverage (%) at		Vine length (cm)/ plant at 135 DAP	Vine weight (g)/ plant	No. of branch /plant	DM (%
	Marketable	Non marketable	Total	60 DAP	90 DAP				
CIP 194513.15	27.85	3.74	31.59	83.3	96.6	201.3	996.6	12.6	20.5
CIP 194515.15	13.48	4.26	17.70	75.0	98.3	216.0	803.3	10.3	27.6
CIP 441132	24.07	2.67	26.73	78.3	98.3	161.6	998.3	13.6	17.6
CIP 440267.2	27.78	3.20	30.97	78.3	96.6	125.6	801.6	12.0	21.9
H_{16}/06	21.55	3.78	25.33	76.6	96.6	158.6	423.3	9.3	18.2
H_{19}/06	25.10	5.37	30.47	75.0	96.6	253.3	403.3	8.3	18.8
H_3/07	22.11	3.81	25.92	83.3	96.6	181.6	748.3	6.3	24.2
H_6/07	18.37	5.15	23.51	81.6	98.3	198.0	703.3	7.6	29.8
BARI SP 3	12.28	1.07	13.34	81.6	100	117.3	698.3	12.6	26.2
BARI SP 4	24.44	3.00	27.43	76.6	98.33	158.6	801.6	7.3	21.6
CV (%)	7.55	21.34	7.64	4.89	2.84	1.51	0.61	5.72	1.37
$LSD_{0.05}$	2.81	1.32	3.31	-	-	4.57	7.67	0.98	0.53
Level of significance	**	**	**	NS	NS	**	**	**	**

* and ** significant at 5% and 1%, respectively and NS= Non significant

4. Conclusions

The yields of sweet potato tubers differed significantly among the genotypes. The genotypes, CIP 194513.15 produced the highest amount of tubers (31.6 t/ha) followed by CIP 440267.2 (30.97 t/ha) which was red in skin colour, having primario deep orange and secundario intermediate orange flesh colour as per number of flesh colour (Burgos *et al*., 2009) and latex absent flesh. All the genotypes showed better performance except CIP194515.15 and BARI SP-3 in respect of yield.

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