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Participatory evaluation of orange-fleshed sweet potato varieties in Sylhet region

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ABSTRACT

The present study, comprising of four high yielding sweet potato varieties viz. BARI SP-4, BARI SP-7, BARI SP-8 and BARI SP-13 was conducted at two locations namely Rahimpur and Dithpur of Bishwanath upazila of Sylhet region of Bangladesh during 2016-17 cropping seasons for their yield potentiality, suitability and acceptability. Among the studied varieties, it was observed that BARI SP-4 performed better and BARI SP-13 performed least. At Rahimpur, BARI SP-4 produced the highest yield (29.33 t ha^{-1}) followed by BARI SP-7 (20.74 t ha^{-1}) and BARI SP-8 (20.00 t $ha^{-1)}$ while the lowest yield was recorded in BARI SP-13 (10.00 t ha^{-1}). At Dithpur, BARI SP-4 produced the highest yield (21.24 t ha^{-1}) followed by BARI SP-7 (19.31 t ha^{-1}) and BARI SP-8 (18.60 t ha^{-1}) while the lowest was recorded in BARI SP-13 (11.29 t ha^{-1}). However, the mean of 2 locations appeared the highest in BARI SP-4 (25.28 t ha^{-1}) followed by BARI SP-7 (20.02 t ha^{-1}) and BARI SP-8 (19.30 t ha^{-1}) and the lowest was recorded in BARI SP-13 (10.65 t ha^{-1}). No significant variations were observed in foliage yield and foliage coverage (%) at both locations. The average foliage yield of two locations ranged from 3.35 to 4.15 t ha^{-1}. In an organoleptic assessment, storage roots and leaves of BARI SP-4 got best preferences among the respondents in respect to their appearances, color, taste, texture and fiber content. Therefore, BARI SP-4 may be suitable and community acceptable variety in Sylhet region of Bangladesh.

INTRODUCTION

Sylhet is a heavy rainfall prone area of Bangladesh. The people of that area are dependable to import vegetables from other part, hence the people especially women and children are suffering for hidden hunger due to minimum or no intake of vitamins and minerals. About 57% poor people of Sylhet region are living in food insecurity. The stunting rate of under 5 children is 50% where national average is about 36%. The stunting prevalence at adolescent girls is 40% whereas national figure is 30% (BDSH, 2014). These are the indicators to realize about nutritional status of Sylhet region of Bangladesh. In broader sense, Bangladesh is also challenged by hidden food insecurity issues, like micro-nutrient deficiency among small farming households in rural areas, in which more than 43% of preschool age children are stunted and 56% are underweight (USAID, 2013). Vitamin-A deficiency is a major problem in Bangladesh. About 30,000 children annually suffer from blindness (Bhuiyan et al., 2008). 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). Hossain (1993) reported that about 29% of the populations suffer from protein, while people suffering from vitamin A, B and C are 89, 81 and 93%, respectively. The children of Bangladesh also suffer from high degrees of micronutrient deficiencies, particularly vitamin A, iron, iodine and zinc deficiency. More than 2.7% of pregnant women, 2.4% of lactating women and 2.0% of non-pregnant/non lactating women

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reported being night blind in 1997 (HKI/IPHN, 1997).

Intake of vitamin-A rich foods is common among nutrition sensitive food-based approaches to increase health and developmental resistance to micronutrient deficiencies (MND; Jan et al., 2007). OFSP is a promising food from plant sources because of high levels of vitamin- A content ranging from 600 to 7500 IU per 100 g of fresh storage roots (Mondal et al., 2011) and on an average 1600 IU per 100 g of fresh leaves (Bhuiyan et al, 2008). Van Jaarsveld et al. (2005) stated that the daily consumption of OFSP have a positive effect on total body vitamin-A assimilation. Tumwegamire et al. (2004) reported that high yielding varieties of OFSP can supply the least expensive, year-round source of dietary vitamin-A to resource poor small farming households. Orange-fleshed sweet potato varieties are rich in beta-carotene, while purple-fleshed ones are high in anthocyanin. These two important antioxidants thought to prevent chronic heart diseases and cancer (Teow et al., 2007). Increased availability of beta-carotene (Pro-vitamin A) and crude protein content is good for nutrition and health (Ukom et al., 2009).

To combat under nutrition due to hidden hunger Orange Fleshed Sweet Potato (OFSP) may be a suitable commodity for the people of Sylhet regions as well as Bangladesh. So, OFSP is viewed as a most promising low-investment nutritional solution for resource poor farming households of Sylhet regions and whole Bangladesh. Accordingly, there is strong potential for reducing micro-nutrient deficiency, particularly vitamin-A deficiency through indorsing OFSP cultivation and consumption at household level. Besides, due to its easy cultivation technology, rapid vegetative propagation and to some extent drought and salinity tolerance and acidic loving character, OFSP can be one of the important vegetables for cultivation at homestead in different parts of Bangladesh.

Recently though Bangladesh Agricultural Research Institute (BARI) developed some orange fleshed sweet potato varieties but their dissemination to Sylhet region is very scanty.

Considering the above facts, the present study was taken for the following objectives:

(i) Participatory evaluation of yield performance of four OFSP varieties BARI SP-4, BARI SP-7, BARI SP-8 and BARI SP-13 (varietal characteristics in Annexure 01) in homestead vegetable production system by involving women members of the marginal farming households,
(ii) Evaluation of community acceptance to select best suitable variety for Sylhet regions of Bangladesh.

MATERIALS AND METHODS

The present study was carried out at two locations of Sylhet region during 2016-17 cropping season. Vines of four BARI developed sweet potato varieties viz. BARI SP-4, BARI SP-7, BARI SP-8 and BARI SP-13 were collected from Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. Fourteen farmers were selected from Rahimpur and Dithpur villages of Bishawnath Upazila of Sylhet district. Vines were planted on 05 November 2016 at both locations having plot size of 3.0 x 3.0m with 3 replications following RCB design. Fertilizers were applied in the experimental plots @ 70-25-90 kg/ha of N-P-K as a source of Urea, TSP, and MoP, respectively. Weeding, irrigation, earthing-up, vine lifting and other intercultural operations were done as and when necessary. The sweet potato was harvested on 22 March 2017 and 23 March 2017 at Rahimpur (location 1) and Dithpur (location 2), respectively.

All the yield and yield contributing characters were recorded and analyzed statistically by using Statistical Tool for Agricultural Research (STAR) software. Mean separation were done following Turkey's Honest Significant Difference (HSD) test at 0.05 level of probability.

At harvesting stage, participatory variety selection as well as organoleptic evaluation test for leaves and storage roots was done at both locations. Thirty and twenty one participants (scientists, extension staffs and farmers) were gathered to choose better one of the studied sweet potato variety for storage roots and leaves, respectively at the time of harvesting and the process was done in

two separate days. At first, the author briefed the trial objectives and the procedure of evaluation. Then individual voting was done to select the best variety for storage roots and leaves. Each participant tested the variety one after one and placed tick mark range from 1-5. Two kilograms of sweetpotato roots from each variety was boiled. Each boiled variety was placed on a separate plate and clearly identified by number as well as name tag. On the other side's 500 gm of leaves of each variety was fried with equal amount oil and spices by one cook. In case of root, each panelist was given an evaluation form which was used to record the evaluation in reference to the appearance, flesh color, fiber, texture and taste of each variety (Figure 1). And in case of leaves, panelist provided vote for appearance, texture and taste also. The procedures of evaluation were explained to the members of the panels using simple words.

Figure 1
Physical appearance (root) of four studied varieties.

Evaluation of storage roots

Appearance: The appearance refers to the visual aspect: how the boiled sweet potatoes root from each variety look when presented on plates (Scale: 5=Excellent, 4=Good, 3=Fair, 2=Bad and 1=Very bad)

Flesh color: After cross section of boiled sweet potatoes, how the flesh color look of each variety (Scale: 5= Excellent,, 4=Good, 3=Fair, 2=Bad and 1=Very bad)

Taste: The taste is very personal criterion (Scale: 5= Excellent, 4=Good, 3=Fair, 2=bad and 1=very bad)

Texture: The texture refers to the dry matter that the sweet potatoes possess (Scale: 5=Mealy/Floury, 4=Less floury, 3=Fair/Intermediate, 2=Watery/soggy and 1= More watery/soggy)

Fiber: The fiber refers to the presence of fiber in boiled sweet potato flesh with nacked eye (Scale: 5= No fiber present, 4=Less fiber present, 3=Fair/moderate fiber present, 2=Bad/high fiber present and 1= Roots are fibrous)

Evaluation of leaves

Appearance: The appearance refers to the visual aspect: how the fried sweet potatoes leaves from each variety look when presented on plates (Scale: 5= Excellent, 4=Good, 3=Fair, 2=Bad and 1=Very bad)

Taste: The taste is very personal criterion (Scale: 5= Excellent, 4=Good, 3=Fair, 2=Bad and 1=Very bad)

Texture: The texture refers to the stickiness that the sweet potatoes leaves possess (Scale: 5=Mealy, 4=Less mealy, 3=Fair/Intermediate, 2=Watery/soggy and 1= More watery/soggy)

RESULTS AND DISCUSSION

In case of Foliage coverage (%) did not vary significantly ($p>0.05$) at 90 DAP in both the locations (Table 1). At location 1, BAR SP-7 exhibited the highest foliage coverage (100%) and BARI SP-4 showed the lowest foliage coverage (83.33%) but in location 2, all varieties showed foliage coverage ranges from 99.33% to 99.67%. According the findings of Burgos et al. (2009)

there was no significant variation of foliage coverage of OFSP genotypes

Number of storage roots plant-^{1} varied significantly ($p<0.05$) in both the locations. At location 1, number of storage root per plant^{-1} ranged from 2.33 to 5.00 whereas at location 2 it varied from 2.33 to 4.33 (Table 1). In both locations, highest number of storage roots plant^{-1} was produced in BARI SP-4 and the lowest was found in BARI SP-13 (2.33). Besides in location 2, BARI SP-7 also gave the lowest number of storage roots plant^{-1}. Farooque and Husain (1973) reported that the number of storage roots plant^{-1} varied from 4.70 to 11.76. Siddique (1985) also found the number of storage roots plant^{-1} which varied from 1.73 to 6.03.

Among the studied varieties, storage root length varied significantly ($p<0.05$) in both locations. At location 1, the highest root length (20.60 cm) was found in BARI SP-4 followed by BARI SP-7 (16.00 cm) while the lowest was in BARI SP-13 (13.00 cm). Same trend also found in location 2. The highest root length (18.20 cm) was found in BARI SP-4 followed by BARI SP-7 (17.67 cm) while the lowest was in BARI SP-13 (11.17 cm) (Table 2). Considering both the locations, average root length ranged from 12.09 cm to 19.40 cm. The storage root length is a genetic character which differed from variety to variety that agrees with the findings of Siddique (1985).

There were significant variations among the varieties on storage root diameter ($p<0.05$) in both locations (Table 2). In location 1, the highest diameter was recorded in BARI SP-7 (5.85 cm) followed by BARI SP-4 (5.47 cm) and while the lowest was in BARI SP-13 (3.80 cm). Similar trend also found in location 2. At location 2, the root diameter was ranged from 2.89 cm to 6.87 cm. The mean diameters were varied from 3.34 cm to 6.36 cm.

Table 1
Foliage cover (FC) at 90 DAP and no. of storage roots plant^{-1} at two locations of Sylhet region of Bangladesh during 2016-2017 crop seasons.

Variety	FC (%) at 90 DAP		Avg.	No. of storage roots plant^{-1}		Avg.
	Location 1	Location 2		Location 1	Location 2	
BARI-SP-4	83.33	99.67	91.50	5.00 a	4.33 a	4.67
BARI-SP-7	100.00	99.33	99.67	3.33 b	2.33 c	2.83
BARI-SP-8	99.00	99.33	99.17	4.33 a	3.33 b	3.83
BARI-SP-13	98.33	99.33	98.83	2.33 c	2.33 c	2.33
Mean	95.17	99.42		3.75	3.08	
CV (%)	10.56			18.89		
LS	NS			0.05		

Means with the same letters in a column are not significantly different

Table 2
Storage root length (cm) and diameter (cm) of sweet potato at 2 locations of Sylhet region of Bangladesh during 2016-2017 crop seasons.

Variety	Storage root length (cm))		Avg.	Storage root diameter (cm)		Avg.
	Location 1	Location 2		Location 1	Location 2	
BARI-SP-4	20.60 a	18.20 a	19.40	5.47 ab	4.06 b	4.77
BARI-SP-7	16.00 b	17.67 a	16.84	5.85 a	6.87 a	6.36
BARI-SP-8	14.10 bc	11.50 b	12.80	4.15 b	3.83 b	3.99
BARI-SP-13	13.00 c	11.17 b	12.09	3.80 c	2.89 b	3.34
Mean	15.93	14.64		4.82	4.41	
CV (%)	15.18			28.16		

Means with the same letters in a column are not significantly different at 5% level of probability

Table 3
Fresh storage root weight (kg plant^{-1}) and root weight (kg plot^{-1}) of sweet potato at 2 locations of Sylhet region of Bangladesh during 2016-2017 crop seasons.

Variety	Storage root weight (Kg plant^{-1})		Avg.	Storage roots weight (Kg plot^{-1})		Avg.
	Location 1	Location 2		Location 1	Location 2	
BARI-SP-4	0.66 a	0.52 a	0.59	26.40 a	19.13 a	22.77
BARI-SP-7	0.47 b	0.40 b	0.43	18.67 b	17.47 a	18.07
BARI-SP-8	0.45 b	0.43 ab	0.44	18.00 b	17.20 a	17.60
BARI-SP-13	0.20 c	0.26 c	0.23	9.00 c	10.22b	9.61
Mean	0.44	0.40		18.02	16.00	
CV (%)	20.83			14.21		

Means with the same letters in a column are not significantly different at 5% level of probability ($p>0.05$)

Considering storage roots weight plant^{-1}, significant effect (P value 0.0001) was found in all the varieties at both locations. The highest storage roots weight plant^{-1} was recorded in BARI SP-4 (0.66 kg at location 1 and 0.52 kg at location 2) while lowest was observed in BAR SP-13 (0.20 kg at location 1 and 0.26 kg at location 2) (Table 3). The mean yield ranged from 0.23 kg to 0.59 kg.

There were significant variations ($p<0.05$) among the varieties on storage roots weight plot^{-1} at both locations. At location 1, the maximum weight plot^{-1} was noted in BARI SP-4 (26.40 kg) followed by BARI SP-7 (18.67 kg) and BARI SP-8 (18.00 kg) while the lowest was in BARI SP-13 (9.00 kg). At location 2, the highest weight plot^{-1} was found in BAR SP-4 (19.13 kg) which was statistically similar to BAR SP-7 (17.47 kg) and BAR SP-8 (17.20 kg). On the other hand, the lowest yield plot^{-1} was produced in BAR SP-13 (10.22 kg). The average weight plot^{-1} of two locations ranged from 9.61 kg to 22.77 kg (Table 3).

Yield of storage roots per hectare varied significantly ($p<0.05$) among the studied varieties in location 1 and location 2. Due to higher adaptability of Sylhet climatic condition, BARI SP-4 produced the highest yield (29.33 t ha^{-1}) followed by BARI SP-7 (20.74 t ha^{1}) in location 1 while the lowest was recorded in BARI SP-13 (10.00 t ha^{1}). In location 2, BARI SP-4 also produced the highest yield (21.24 t ha^{1}) which was statistically significant to BARI SP-7 (19.31 t ha^{1}) and BARI SP-8 (18.60 t ha^{1}) while, the lowest was recorded in BARI SP-13 (11.29 t ha^{1}). However, the mean of 2 locations appeared the highest in BARI SP-4 (25.28 t ha^{1}) followed by BARI SP-7 (20.02 t ha^{1}) and BARI SP-8 (19.30 t ha^{1}) and the lowest was recorded in BARI SP-13 (10.65 t ha^{1}) (Table 4). The storage root yield of different varieties varied location to location also reported by Hossain et al. (2016).

Table 4
Storage root and leaves yield (t ha^{-1}) of sweet potato at 2 locations of Sylhet region of Bangladesh during 2016-2017 crop seasons.

Variety	Storage root yield (t ha^{-1})		Avg.	Leaves yield (t ha^{-1})		Avg.
	Location 1	Location 2		Location 1	Location 2	
BARI-SP-4	29.33 a	21.24 a	25.28	3.85	4.44	4.15
BARI-SP-7	20.74 b	19.31 a	20.02	3.52	3.33	3.43
BARI-SP-8	20.00 b	18.60 a	19.30	3.70	3.00	3.35
BARI-SP-13	10.00 c	11.29 b	10.65	4.18	4.07	4.13
Mean	20.02	17.61		3.81	3.71	3.76
CV (%)	14.35			30.46		

Means with the same letters in a column are not significantly different at 5 % level of probability ($p>0.05$)

Among the studied varieties, there were no significant variations in leave yield (t ha^{1}) in both locations. At location 1, the leaves yield ranged from 3.52 t ha^{1} to 4.18 t ha^{1} and in location 2 it was varied from 3.00 to 4.44 t ha^{1}. The average leave of two location ranged from 3.35 to 4.15 t ha^{1} (Table 4).

Organoleptic evaluation of sweet potato leaves and storage roots:

Storage root evaluation

30 participants (male and female farmers, scientists and extension staffs) participated in the organoleptic evaluation of storage roots. Considering appearance of the roots, flesh color, taste, presence of fiber and flesh texture, BARI SP-4 ranked first followed by BAR SP-13 while participants' choice was the poorest to BAR SP-7 followed by BARI SP-8 (Figure 2).

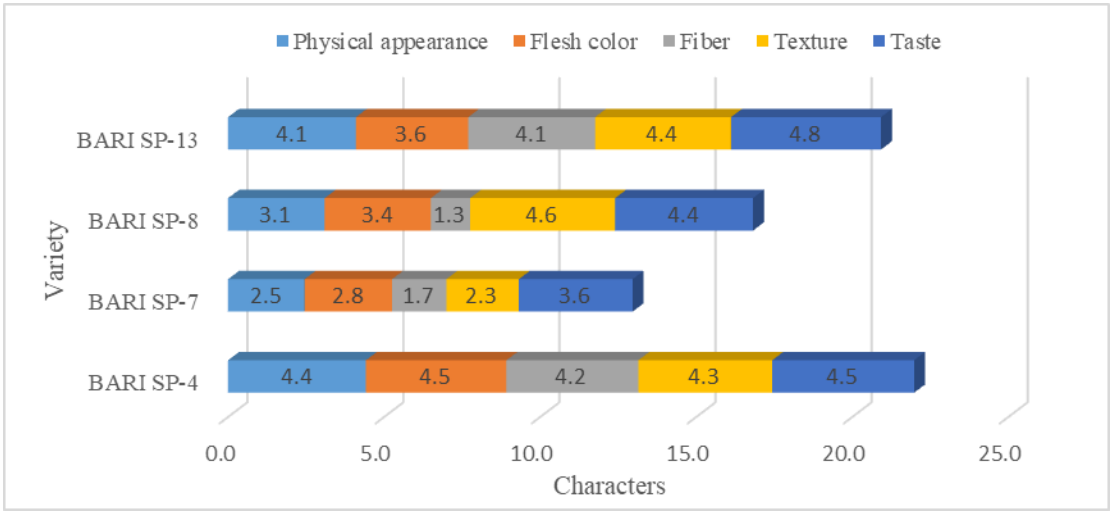

Figure 2
Organoleptic evaluation of storage roots of sweetpotato varieties at Sylhet region during 2016-2017 crop seasons. Overall Scale: 5- Excellent, 4-Good, 3- Fair, 2-Bad and I-Very bad.

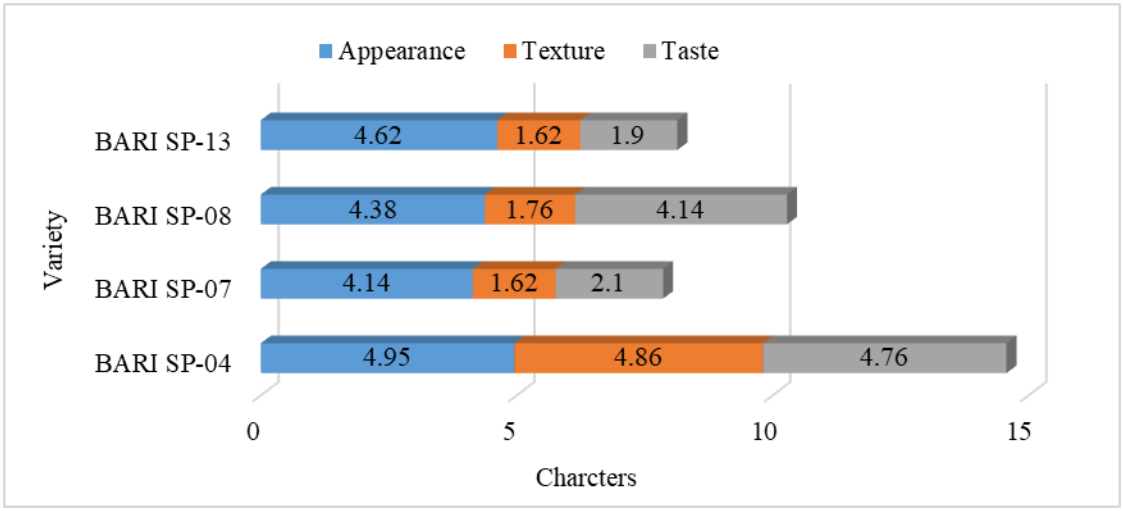

Figure 3
Organoleptic evaluation of leaves of sweetpotato varieties at Sylhet Region during 2016-2017 crop seasons. Overall Scale: 5- Excellent, 4-Good, 3-Fair, 2-Bad and I-Very bad.

Leaves evaluation

During leaves evaluation, 21 participants (male and female farmers, scientists and extension staffs) participated in the organoleptic evaluation of leaves. The evaluation was done in same way in reference to the appearance, texture and taste of each variety. Considering appearance of the fried leaves, texture and taste, BARI SP-4 ranked first followed by BAR SP-8 while participants' choice was the poorest to BAR SP-7 followed by BARI SP-13 (Figure 3).

CONCLUSION

Among the studied varieties, according to yield contributing characters and yield, BARI SP-4 was highest root yielder followed by BARI SP-7 and BARI SP-8. Through organoleptic evaluation of roots, BARI SP-4 and BARI SP-13 found good to excellent and accepted by the farmers. In case of leaves evaluation, farmers' choice also went to BARI SP-4. Considering all factors, BARI SP-4 performed better at Sylhet region of Bangladesh.

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