



Sweet potato cultivation: Approaches of doubling farmer's income and source of nutrition

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Sweet potatoes are root vegetables (meaning that the part you eat is the root) of the morning glory family of flowering plants. This crop is mainly grown because of its sweet taste, starchy roots and edible after boiled or cooked. Sweet potatoes are important nutritious crop and it is a rich source of carbohydrates, vitamins and minerals etc., and traditionally considered to be hardy crops for the poor farmers in many developing countries as well as grown worldwide. Sweet potatoes varieties are available in rich diversity and different in colour like white, yellow, orange, pink and purple etc. and each colour sweet potato containing different ratio of nutritional values. This crop can be cultivated in low cost and may be earned more profit by farmer's. Today many recommended high yielder and nutritious varieties are available for specific location and climate that could be utilized in cultivation for doubling farmer's income.

Introduction: Sweet potato [*Ipomoea batatas* (L.) Lam] is known as Shakarkand in Hindi, Lal Alu in Bengali, Ratalu in Marathi and Kanangi or Sakaria in Gujarati, belongs to family Convolvulaceae or morning glory family, is grown for its enlarged storage roots (Low *et al.*, 2015). Sometimes the tender leaves and shoots are consumed as green leafy vegetables. It is the only known natural auto-hexaploid ($2n=6x=90$). It is an herbaceous perennial vine having lobed or heart shaped leaves. Its tubers are edible, smooth skin, tapered and long. This crop is mainly grown because of its sweet taste and starchy roots. The tubers are rich source of beta-carotene and are used as anti-oxidants (Singh *et al.*, 2004). Sweet potato is grown as a rain fed crop during *Kharif* (June - August) and as

an irrigated crop during *Rabi* (October-December). Globally sweet potato is cultivated in 117 countries in an area of 8.62 million ha producing 105.19 million tons with a yield of 12.20 t ha^{-1} (FAO, 2016). Africa is the world largest sweet potato growing region and majority of the sweet potato production about 95 per cent comes from developing countries, of which China having the maximum share of 67.09 per cent (FAO, 2016). Specially, African countries are most depending on this crop. They people have also been conserved high diversity of this crop. India has been ranked eighth in the world for its cultivation and produces mostly in Odisha, West Bengal, Uttar Pradesh, Chhattisgarh, Assam and Karnataka states (Table 1). Odisha is the largest producer of sweet potato in India

Table 1: State wise in area, production and productivity of sweet potato in Indian states and sharing %age (Source: NHB, 2018)

States	Area ('000 ha)	Production ('000 metric tons)	Productivity (metric tons/ha)	% share of area	% share of production
Assam	10.21	55.930	5.5	7.57	3.41
Bihar	0.91	8.480	9.3	0.67	0.52
Chhattisgarh	5.57	200.03	35.9	4.13	12.21
Karnataka	2.54	36.02	14.2	1.88	2.20
Madhya Pradesh	4.2	50.57	12.0	3.11	3.09
Meghalaya	4.65	17.85	3.8	3.45	1.09
Odisha	40.8	384.51	9.4	30.25	23.46
Uttar Pradesh	17.18	227.25	13.2	12.74	13.87
West Bengal	22.7	240.62	10.6	16.83	14.68
Kerala	19.23	318.05	16.5	14.26	19.41
Other states	6.9	99.54	14.4	5.12	6.07
India	134.88	1638.84	12.2	100.00	100.00

and share 23.46 per cent of the total production. The area under sweet potato cultivation in India is 0.13 million ha with a production of 1.63 million tonnes (NHB, 2018). Compound annual growth rate, farm business analyses and Garrett's ranking technique were used to assess the growth rate, cost and returns and constraints faced by the farmers. The cost and returns analysis indicated that the labour cost accounted for 42 per cent of the total cost of production and the sweet potato production is profitable (Prakash *et al.*, 2016 and 2018). Aim of this article is to cultivation of high yielder and nutritious varieties of sweet potato for doubling farmer's income.

Cultivation of sweet potato: Sweet potatoes are now cultivated throughout tropical and warm temperate regions wherever there is sufficient water to support their growth. The plant does not tolerate frost. It grows best at an average temperature of 24 °C (75 °F), abundant sunshine and warm nights. Annual rainfalls of 750–1,000 mm (30–39 in) are considered most suitable, with a minimum of 500 mm (20 in) in the growing season. The crop is sensitive to drought at the tuber initiation stage 50–60 days after planting and is not tolerant to water-logging, as it may cause tuber rots and reduce growth of storage roots if aeration is poor. For sweet potato plantation, the land should be well prepared and before sowing land must be ploughed 3-4 times. The field should be weed-free. Waste and sandy loam land also can be utilized during cultivation.

Use 25,000-30,000 of vines cutting in per acre land. Sowing of 35-40 kg tubers in half a kanal land is done for raising vines in February to March month. Vines are then planted in the main fields in one acre land. Limited fertilizers (30 N₂: 20 K₂O: 25 P₂O₅) required for cultivation of sweet potato. Weed management can apply by using Metribuzine 70WP@200g per acre or Alachlor@2 ltr per acre before sprouts emergence. On 5-10 per cent sprout emergence and ridge are infested with weeds then only apply Paraquat@500-750ml per acre (Prakash *et al.*, 2016 and 2018).

Harvesting is mainly done when tubers get mature and the leaves turn yellow and depending on the cultivar in two to nine months. With care, early-maturing cultivars can be grown as an annual summer crop in temperate areas, such as the northern United States. Sweet potatoes rarely flower when the daylight is longer than 11 hours, as is normal outside of the tropics. They are mostly propagated by stem or root cuttings or by adventitious roots called "slips" that grow out from the tuberous roots during storage. Freshly harvested tubers are ready for market purposes. The crop cultivation duration is about

120 days or 4 months and yields about 8–10 ton per acre or 80.00 to 100.00 q/acre (Prakash *et al.*, 2017).

They grow well in many farming conditions and have few natural enemies; pesticides are rarely needed. 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 favourable for the plant. They can be grown in poor soils with little fertilizer. However, sweet potatoes are very sensitive to aluminum toxicity and will die about 6 weeks after planting if lime is not applied at planting in this type of soil. Because they are sown by vine cuttings rather than seeds, sweet potatoes are relatively easy to plant. Because the rapidly growing vines shade out weeds, little weeding is needed. In the tropics, the crop can be maintained in the ground and harvested as needed for market or home consumption. In temperate regions, sweet potatoes are most often grown on larger farms and are harvested before first frosts. The rest are grown for human food and for other products. Some are grown for export, mainly to Japan. China grows over 100 varieties of sweet potato.

Cost and profit for farmers: Sweet potato are traditionally considered to be hardy crops and it is a rich source of carbohydrates, vitamins and minerals for the poor farmers in many developing countries and also it can produce more edible energy per ha per day than wheat, rice or cassava (Low *et al.*, 2015). Sweet potato is mostly consumed as snacks in boiled or baked form and also used for vegetables. This is one of the main crops as majority of farmers consider it as major source of food mainly for human consumption and having substantial role by ensuring food security and increasing the income of farmers (Prakash *et al.*, 2016). In a study, marginal and small famers which accounts 81.25 per cent with a farm size of not more than 2 ha, 16.15 per cent of the respondents had farm size between 2-4 ha while 1.29 per cent of the farmers had between 4-10 ha. About 99 per cent of the sweet potato farmers were marginal farmers with a farm holding of 1 ha (Prakash *et al.*, 2017).

A farmer would pay minimum cost for seedling/seeds/seed treatment (Rs. 5000), for using pesticides (Rs. 4500), for using fertilizers (Rs. 1500) and for labour cost (Rs. 9257) in 1 acre of sweet potato cultivation. Whereas, an average farmer sells sweet potato tubers at the rate of Rs. 975/quintal. It is also estimated that the gross cost of Rs. 21,995 which incurs for cultivation of sweet potato in one hectare. Gross income of Rs. 77,025 and a net income of Rs. 55,029 expected from one hectare of sweet potato cultivation. Farm business income to be expected for Rs.

63,228 (Prakash *et al.*, 2017 and 2018). Benefit cost ratio (BCR) is found to be 3.50:1 (Expected data). In case of marketing, about 80 per cent is sell through retail markets in India and rest export to other countries. According to a report during 2015-17, the total market size of sweet potato for direct consumption was estimated as Rs.36.4 billion, with a compound annual growth rate of 13.7 per cent during 2011-17 (Passport, Euro monitor International, May 2017). Generally, sweet potato export to United Arab Emirates (56%), Nepal (29%) and Maldives (13%) mostly as fresh tubers in a year. Farmer's should high yielder and commercial varieties during cultivation for obtaining more profits.

Nutritional value of sweet potato: Sweet potatoes are sweet to eat, very delicious and nutritious with high amount of vitamins and nutrients. It is widely used for preparation of alcohol, starch and contains 3-6 per cent sugar. The tubers are rich source of vitamin A, B and C. Sweet potato also found superior as compare to the potato and colocasia on the basis of edible portion, energy (fat), carbohydrate, calcium, vitamin 'C' and riboflavin content (Rose and Vasanthakalam, 2011). In support of our findings that the sweet potato is rich source of sugar, carotene and starch which is opt to the given source (Singh, 2004). Sweet potato flour can be used as a supplement to cereal flours for making bread, pastery, biscuits, pancakes, pudding, stabilizer in ice-cream etc. Sweet potato is also the cheapest source of calories and per unit time basis it produces highest amount of food calories between the tuber and root crops (Table 2). Traditionally in India sweet potato consumed during the fasts however in China and Africa it is used in daily routine. In USA about 60 – 70

per cent of the sweet potato is utilized for the human food.

Sweet potatoes varieties are found in white, yellow, pink and purple colour. Two phytochemicals in sweet potatoes are responsible for colour *i.e.*, Beta-carotene gives orange sweet potatoes their orange flesh and anthocyanins give purple sweet potatoes. Although the orange variety is the most common in the United States. The carotene (vitamin A) content is more in orange or yellow fleshed varieties. While, the purple or pink varieties contain high levels of antioxidants (Rose and Vasanthakalam, 2011). They also explained that the boiled sweet potatoes retains more beta-carotene and makes this nutrient easier for the body to absorb and cooked sweet potatoes with their skin on also helps prevent the loss of nutrients. Different varieties of sweet potatoes have different flavours, sizes, shapes, textures and firmness, but they basically all feature one of three flesh colours and such variety can be cultivated for doubling income and improve the health:

Orange flesh: These types of sweet potatoes normally have rose or reddish coloured skin. They have a slightly sweet taste and are fairly firm inside. These sweet potatoes are confusing with yams and one medium sweet potato contains (<https://paleoflourish.com/types-of-sweet-potatoes-with-images-and-why-you-should-eat-them>, 2020):

– Calories	112
– Fat	0.07g
– Carbohydrates	26g (4g fibre)
– Protein	2g
– Vitamin A	369%
– Vitamin C	5%

Table 2: Nutritional composition of sweet potato per 100 g edible portion

Micronutrients	Particulars	Amount
	Energy (Kcal)	114
	Moisture (g)	70.6
	Protein (g)	1.7
	Fat (g)	0.4
	Carbohydrates (g)	26.3
	Vitamins	Vitamin 'A' (IU)
Thiamine (mg)		0.10
Riboflavin (mg)		0.06
Niacin (mg)		0.6
Ascorbic acid (mg)		21
Minerals	Calcium (mg)	32
	Phosphorus (mg)	47
	Iron (mg)	0.7

– Calcium	4%
– Iron	4%
– Potassium	438mg (13%)
– Vitamin B5:	10%
– Vitamin B6	14%
– Manganese	17%



White or cream flesh: This type of sweet potato often has a pale copper to red or golden brown skin. The flesh is dryer in texture and tastes starchier than other types and one medium sweet potato contains (<https://paleoflourish.com/types-of-sweet-potatoes-with-images-and-why-you-should-eat-them>, 2020):

– Calories	112
– Fat	0.02g
– Carbohydrates	26g (4g fibre)
– Protein	2g
– Vitamin A	369%
– Vitamin C	5%
– Calcium	4%
– Iron	4%
– Potassium	438mg (13%)
– Vitamin B6	14%
– Manganese	17%



Purple flesh: These potatoes have a buff- coloured skin. Purple sweet potatoes have a creamy texture and delicate, sweeter taste than their orange-fleshed cousins and one medium sweet potato contains (<https://paleoflourish.com/types-of-sweet-potatoes-with-images-and-why-you-should-eat-them>, 2020):

– Calories	177
– Fat	0.26g
– Carbohydrates	42g (6g fibre)
– Protein	2.29g
– Vitamin A	4%
– Vitamin C	43%
– Calcium	3%
– Iron	5%
– Potassium	1224mg (35%)
– Vitamin B6	22%
– Manganese	30%



Selection of varieties: Some recommended varieties should be used with true seeds and may also be used for breeding purposes. These varieties are high yielder and

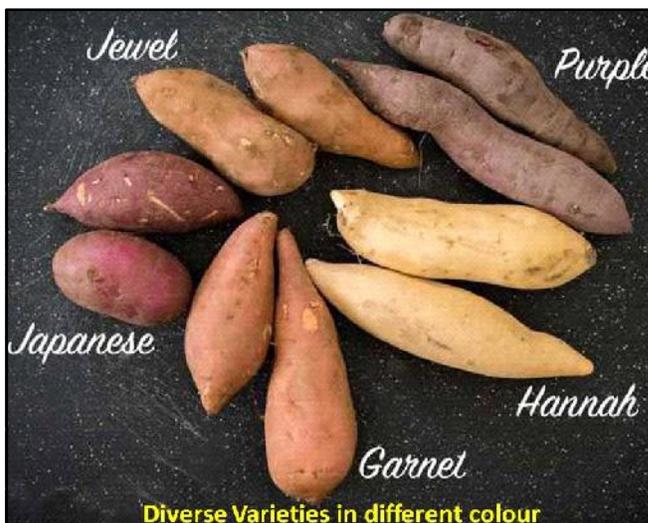


Table 3: Recommended varieties for growing in Indian states

States	Recommended varieties
Orissa	Bhuban, Shankar, Gouri
Tamil Nadu	CO1, CO2, CO3, H-41, SP local, SP 4, SP 13, SP 18 and Musiri Thandel
Kerala	H-41, Shree Nandini, Shree Vardhini
Karnataka	H41, H42, Rajendra Shakarkand 5, Rajendra Shakarkand 47
Maharashtra	H42, Rajendra Shakarkand 35, Varsha
Andhra Pradesh	Kiran, Samrat
Bihar	Rajendra Shakarkand 5, Rajendra Shakarkand 35, Rajendra Shakarkand 47
West Bengal	Rajendra Shakarkand 5, Rajendra Shakarkand 35, Rajendra Shakarkand 43
Assam	Rajendra Shakarkand 35, Rajendra Shakarkand 43
Uttar Pradesh	VL Shakarkand 6, Punjab Sweet Potato-21

Table 4 : Popular varieties for growing in Indian states

Bangladesh	BARI SP-6 (Lalkothi), BARI SP-7 (Kalmegh), BARI SP-8 and BARI SP-9
China	Xuzhou 18
Ethiopia	Balella and Bareda
India	Pusa Safed, Co-1, VL Sakarkand-6, Sree Nandini, Sree Vardhini, Co-2, Co-3, Samrat, Sree Bhadra, Sree Arun, Sree Varun, Sankar, Gouri, Kalinga, Gautam, Sourin, Kishan, H-41, H-42, H-268, Rajendra Sakarakand-5, Sree Rethna, Sree Kanaka, Kamala Sundari, S-1221, WBSP-4, Tripti, Bidhan Jagannath, BCSP-5, Birsa Sakarakand-1 and Indira Sakarakand-1
Japan	Quick Sweet, Kokei No.14, Beniuzuma, Norin No.2, Koganesengan and Satsumahikari
Korea	Mokpo 32, Mokpo 34, Hongmi, Hwangmi, Sinjami, Shinmi, Wonmi, Poongmi, Borami and Enumi
Malaysia	Jalomas, Minamiyutaka, Pisang Kapas, Madu, Bawang, Gendut, Telong, Kangkung Cina, Ikan Selayang, Kangkung Kampung, Bukit Naga, Taiwan and Pasar Borong-1, Serdang, Suberang Perai, Kundang, Bidor, Pontian, Rhu Tapai, Sungai Baging and Kuala Linggi
New Zealand	Toka Toka Gold, Owairaka Red and Beaugard
Papua New Guinea	Koitaki 2, K9, K42, UIB016, Wanmun murua, Wanmun and Large
Taiwan	Taoyuan No.1, Taoyuan No.2 and Tainung No.71
Thailand	PIS 205, PIS 65-16, PIS 166-5, Maejo and Taiwan
United States of America	Goldrush, Redgold, Centennial, Beaugard and Jewel
Vietnam	H12, K51 and TV1

nutritious and also most suitable for cultivation in Indian farmer's area wise (Table 3).

The sweet potato varieties are play most significant role for improving the yield. Today, many R and D organizations working on sweet potato for developing location specific sweet potato varieties. They are developing by following different methods of breeding *viz.*, clonal selection, open pollinated selection, hybridization, mutation and biotechnology (Nayar and Naskar, 1994 and Nedunchezhiyan *et al.*, 2012). Some of the high yielding varieties cultivated in different countries (Nedunchezhiyan *et al.*, 2012) are also selected for location and climate

specific (Table 4).

Conclusion: The rich variability in sweet potato has many value added characters especially carotene content which may be utilized by the human being. More over it also pertains a very high yield potential and rich source of nutrition of hunger, which is most suitable for those countries having high population like India, China and South African. Even though sweet potato plays a very important role for ensuring food security and increasing the income of farmers.

References:

Low, Jan, Nyongesa, Moses, Quinn, Sara and Parker, Monica

(2015). *Potato and sweet potato in Africa – Transforming the value chains for food and nutrition security* (Ed.1st). Publisher: CAB International. DOI: 10.1079/9781780644202.0000.

National Horticulture Board (2018). *Horticultural Statistics at a Glance*, Ministry of Agriculture and Farmers Welfare Government of India.

Nayar, G.G. and Naskar, S.K. (1994). Varietal improvement in sweet potato. In: Chadha KL, Nayar GG (Eds) *Advances in Horticulture: Tuber Crops*, 8, Malhotra Publishing House, New Delhi, India, pp. 101-112.

Nedunchezhiyan, M., Byju, G. and Jata, S.K. (2012). Sweet potato agronomy. In: *Sweet potato*, Nedunchezhiyan, M. and Byju, G. (Eds), Global Science Books, Japan, pp. 1-10.

Prakash, P., Kishore, Avinash, Roy, Devesh and Behura, Debdutt (2016). Economic analysis of sweet potato farming and marketing in Odisha. *J. Root Crops*, 42 (2) : 163-167.

Prakash, P., Kishore, Avinash, Roy, Devesh, Behurac, Debdutt and Immanuela, Sheela (2017). Biofortification for reducing hidden hunger: A value chain analysis of sweet potato in

Odisha, India. *Agricultural Economics Research Review*, 30 (2) : 201-211. DOI: 10.5958/0974-0279.2017.00042.8.

Prakash, P., Niranjan, S., Jaganathan, D. Sheela, Immanuel, Sanket, J., More, Prabhat Kishore and Denny, Franco (2018). Production and marketing status of sweet potato in Belagavi, Karnataka. *Kerala Karshakan e-journal*. 1-28pp.

Rose, I.M. and H. Vasanthakaalam (2011). Comparison of the nutrient composition of four sweet potato varieties cultivated in Rwanda. *Am. J. Food Nutr.*, 1: 34-38.

Singh, Ravindra Pratap, Sharad, Shashwat and Kapur, Suman (2004). Free radicals and oxidative stress in neurodegenerative diseases: Relevance of dietary antioxidants. *J. Indian Academy of Clinical Medicine*, 5(3) : 218-25.

Webliography:

FAO (2016). *Crop production data*. Available at <http://www.fao.org/faostat/en/#data/QC> (accessed December 29, 2016).

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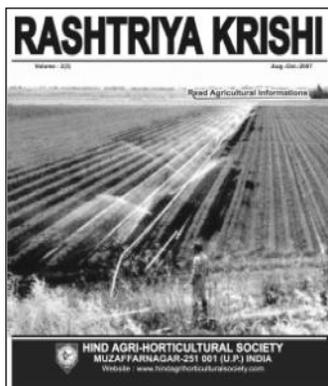
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