

Tropical Root and Tuber crops

Tropical root and tuber crops are rich in calories and nutrients and have immense scope to become the future crop in the context of climate change for combating poverty, Hunger and malnutrition.

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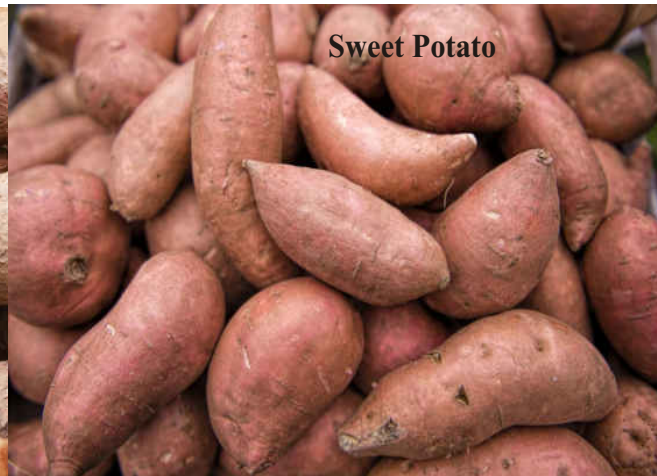
Agriculture plays a significant role in Indian economy which contributes 16.5 % of total Gross Domestic Product (GDP) in our country and provides livelihood to two thirds of the population and raw materials for many industries. The Indian agriculture has witnessed profound changes due to advanced cutting edge technologies. Increasing the agricultural productivity is necessary to feed the burgeoning population and thereby to reduce hunger and poverty. Poverty is one of the causes of food insecurity, hunger and malnutrition and affects human welfare which has direct bearing on the agricultural growth and development of the country. In general, food and nutrition security is achieved, if adequate food (quantity, quality, safety,

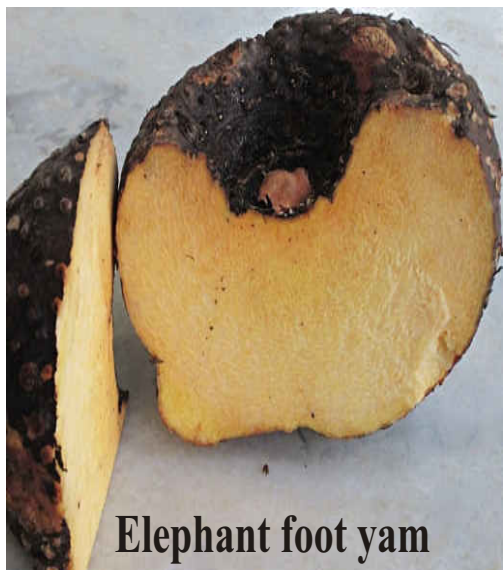
socio-cultural acceptability) is available and accessible for and satisfactorily utilized by all individuals at all times to live a healthy and active life. Food and nutrition security has four dimensions viz., availability, access, utilization and stability that encompass both chronic and acute situations. Food insecurity arises when the people don't have reliable access to a sufficient quantity of affordable nutritious food. This food insecurity creates hunger which reduces the human performance both physical activities and cognitive functions.

According to FAO estimates in 'The state of Food security and Nutrition in the world 2019 report, 194.4 million (14.5 %) of the population is undernourished in India. This scenario is reflected in the Global Hunger Index 2019

which ranked India at 102 out of 117 countries. Global hunger index (GHI) is calculated based on the four indicators viz., child mortality, undernourishment, child wasting (weight for age) and child stunting. India's GHI score is 30.3 which indicates that the level of hunger is serious in the country. The report warned that climate change was causing alarming levels of hunger and making it more difficult to feed people in the world's most vulnerable regions. Climate change is affecting the quality and safety of food and worsening the nutritional value of produced food.

In this context, there is a need for 'food-based approaches' to end poverty, hunger and also to combat malnutrition. Tropical root and tuber crops like cassava/tapioca, sweet potatoes,

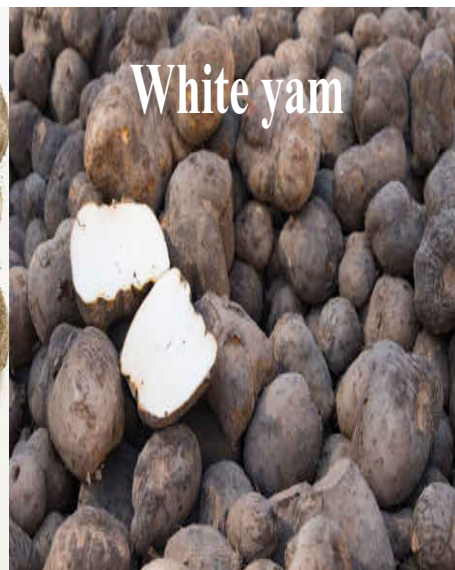




Elephant foot yam



Taro



White yam

yams, elephant foot yam, taro, tannia, Chinese potato, arrowroot and yam bean can provide viable options for ensuring food and nutritional security, reduce hunger and combat malnutrition of the country. With this background, an attempt has been made to delineate the importance of root and tuber crops for food, nutrition, health and livelihood options.

Tuber crops production in India: Cassava, sweet potatoes and elephant foot yam are the most important tuber crops in India due to its large area under commercial cultivation and its varied uses. Cassava is grown in an area of 0.23 million ha producing 4.65 million tons with an average productivity of 20.39 t ha⁻¹ during 2018. Tamil Nadu, Kerala and Andhra Pradesh are the major cassava growing states in India. Whereas, sweet potatoes is

cultivated in an area of 0.12 million ha with production of 1.40 million tons and an average productivity of 11.44 t ha⁻¹ during 2018. It is grown almost all the states in India but mainly grown in Odisha, Kerala, West Bengal and Uttar Pradesh. The elephant foot yam is cultivated in 0.035 million ha producing 0.917 million tons with an average productivity of 26.2 t ha⁻¹ during 2018 (Government of India, 2018). West Bengal, Andhra Pradesh and Kerala are the major elephant foot yam growing states in India.

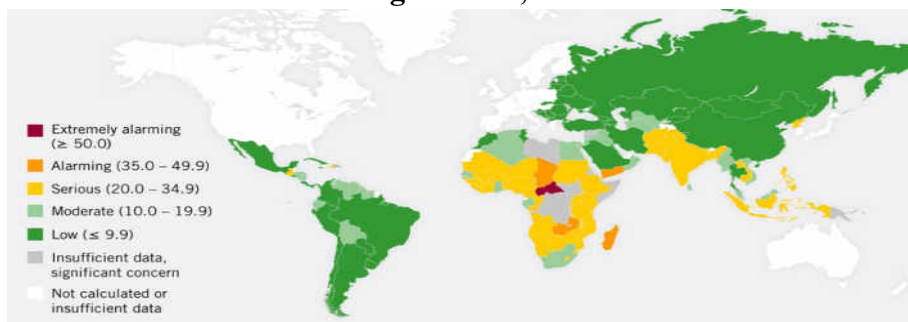
Characteristics of tropical root and tuber crops: These species belong to different botanical families but, for the purpose of scientific research, are grouped together because they are vegetatively propagated, produce underground food, and are bulky and perishable..

India holds a rich genetic diversity of tropical root and tuber crops, viz., cassava, sweet potatoes, aroids, yams, and several minor tuber crops. The economically and socially important tropical tuber crops are cassava; sweet potatoes; yams; aroids which include elephant foot yam, taro, and tannia; and other minor tuber crops, namely, Chinese potato, arrowroot, yam bean, etc .

There are five major areas of distribution of root and tuber crops in India. .

Technologies on root and tuber crops: Technological innovations and diffusion of new technologies are the key drivers to enhance the productivity and profitability of tuber crops farming. Through the systematic research conducted at ICAR-CTCRI during the last fifty six years, many technologies were developed both in production and processing of tuber crops. Technologies viz., improved varieties (67 nos.) with high yield and other quality traits; production technologies including soil and water conservation, site specific nutrient management, organic farming, cropping/farming system;

Global hunger Index, 2019



Tannia



protection technologies on integrated pest and disease management for major pests and diseases, development of biopesticides and diagnostic tools/kits; processing technologies on development of machineries, value added products, modified starches and by products utilization and technologies on IT tools/devices are being disseminated among the farmers and other stakeholders through various programmes by research and development institutions. The adoption of improved technologies of tuber crops by the farmers is crucial for enhancing the productivity and profitability of tuber crops farming in the country.

Tuber crops for food and nutritional security

- High production of edible energy: Root and tuber crops provide a substantial part of the world's food supply and are also an important source of animal feed and industrial products. The population of India is projected to grow to 1.62 billion by 2050, and the demand for food grains, which is projected to increase to 345 million tons in 2030, can even go up to 360 million tons by 2050. The tuber crops can produce cheap edible energy with over 120 Kcal produced from 100 g of tubers.
- Reducing food insecurity and hunger: Root and tuber crops play an important role in food security and nutrition for the global population especially the small and marginal famers and the tribal community. In the tribal areas of North East, Eastern and Central India, tuber crops are abundantly available throughout the year and are easily accessible by tribes owing to their low price. Apart from tubers, the tribes traditionally consume various

plant parts like sweet potatoes and taro leaves, taro petioles and elephant foot yam flowers, either they are consumed freshly or as minimally processed form throughout the year. A study conducted among *Konyak* tribes of Nagaland indicated that semi-processed tuber crops products replaced 55% of the cereals and 45% of the vegetables consumed during lean season or period of unemployment indicating the importance of food and nutritional security in the villages.

- Combating malnutrition and enhance general wellness: Besides providing adequate cheap energy of over 120 Kcal produced from 100 g of tubers, the tubers also supply essential micronutrients. The speciality sweet potatoes are rich in anti-oxidants like Beta-Carotene (>11 mg/100g) and anthocyanin (>90 mg/100g). The elephant foot yam is rich in nutrients like Phosphorus (152 mg/ 100g) and Zn (1.47 mg/100 g).
- Besides, the tuber crops also have medium glycemic index (GI Range 44 to 70) along with low digestibility of starch prolong the satiety).
- Climate resilience to provide economic yields under unfavourable conditions: Sweet potatoes with a prolific root system has the advantage of

Nutritional profile of tropical tuber crops

Particulars	Cassava	Sweet potatoes	Yams	Aroids
Dry matter (% fresh weight, FW)	30–40	20–35	20–40	20–30
Starch (%FW)	27–37	18–28	20–25	15–25
Starch grain (in microns)	5–50	2–40	1–70	1–6
Amylose (%starch)	15–30	8–32	10–30	3–45
Gelatinization temperature (°C)	49–73	58–65	69–88	68–75
Total sugars (%FW)	0.5–2.5	1.5–5.0	0.5–2.0	2.0–3.0
Proteins (%FW)	0.5–2.0	1.0–3.0	2.0–4.0	1.5–3.0
Fibers (%FW)	1.0	1.0	0.6	0.5–3.0
Vitamin A (µg/100 gFW)	17	900	117	0–42
Vitamin C (mg/100 gFW)	50	35	25	10
Minerals (%FW)	0.5–1.5	1.0	0.5–1.0	0.5–1.5
Energy (kj/100 gFW)	600	500	440	400





supporting accelerated plant growth during early crop growth stages and extracts water from shallow soil layers that is otherwise easily lost to

evaporation. The elephant foot yam is shade loving and grow well in water-logged conditions. Cassava is drought resistant, can grow almost anywhere, and

Characteristics of tropical root and tuber crops

Characteristics	Cassava	Sweet potatoes	Yams	Aroids
Planting material (Propagule)	Stems	Vine cuttings	Tubers	Corms, Suckers
Growth period (months)	8–36	3–6	8–36	6–16
Optimal rainfall (mm)	1000 –1500	750 –1000	1200 –1500	2500 –3500
Optimal temperature (°C)	25 –30	20–25	30	20–35
Drought resistant	Yes	Yes	Yes	No
Waterlogged tolerant	No	No	No	Yes
Shade tolerant	No	No	No	Yes
Soil fertility requirements	Low	Low	High	High
Seasonality of crop cycle	No	Yes	Yes	No
In ground storage life	Long	Moderate	Moderate	Long
Postharvest storage life	Very short	Short	Long	Moderate
Leaves used for human consumption	Yes	Yes	No	Yes
Leaves used for animal feed	Yes	Yes	No	Yes

Important tuber crops grown in India

S.No.	Name of the Crop	Growing regions
1	Cassava (<i>Manihot esculenta</i>)	Southern, North eastern and Western regions
2	Sweet potatoes (<i>Ipomoea batatas</i>)	Eastern, North eastern and southern regions
3	Greater yam (<i>Dioscorea alata</i>)	Southern and North eastern regions
4	White yam (<i>Dioscorea rotundata</i>)	Southern and North eastern regions
5	Lesser yam (<i>Dioscorea esculenta</i>)	Southern, North eastern and Eastern regions
6	Elephant foot yam (<i>Amorphophallus paeoniifolius</i>)	Southern, Northeast and Eastern regions
7	Taro (<i>Colocasia esculenta</i>)	Northeast, Eastern and Southern regions
8	Tanna (<i>Xanthosoma sagittifolium</i>)	Southern and North eastern regions
9	Chinese potato (<i>Plectranthus rotundifolius</i>)	Southern parts of India
10	Yam bean (<i>Pachyrhizus erosus</i>)	North eastern region
11	Arrowroot (<i>Maranta arundinacea</i>)	Southern parts of India

is not easily destroyed by heavy rains.

- Diversification and value addition: The important edible products harvested from yams are tubers and from cassava and sweet potatoes are roots, while aroids give corms or cormels. Individually, cassava, sweet potatoes, and yam rank among the most important food crops worldwide. This group of crops provide a substantial part of the world's food supply (contributes about 6 % of the world's dietary calories) and are also an important source of animal feed and raw materials for industrial products. On a global basis, approximately 45 % of root and tuber crop production is consumed as food, with the remainder used as animal feed or for industrial processing for products such as starch, distilled spirits, and a range of minor products.

Conclusion: Tropical root and tuber crops are rich in calories and nutrients and have immense scope to become the future crop in the context of climate change for combating poverty, hunger and malnutrition. They play an important role in food and nutritional security of the country, employment generation and socio-economic empowerment of farmers and other stakeholders. These are the crops which can address holistically the issues related to inclusive growth of rural population across the nations. A greater thrust is needed in policies and programs which support research, extension, and value chain management, besides a concerted effort to bring down the cost of cultivation of tuber crops and expand their utilization spectrum which will help in the sustainable development of these crops in India.