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Citrus in North East India: Wonder Fruits

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Citrus L. is one of the world's most important fruit crops, distributed in the tropical and subtropical regions of the world (Randhwa & Srivastava, 1986). Citrus belonging to the family Rutaceae are of different types, such as shrubs and trees, and the fruits are commercially known as oranges, mandarins, limes, lemons, grapefruits, and citrons. Citrus is widely cultivated in more than 140 countries in the world, in tropical, subtropical, and Mediterranean climates. The north-eastern region of India is considered the centre of the genetic diversity of a variety of citrus species. As per the study, 17 Citrus species, 52 cultivars, and 7 probable natural hybrids are reported to have originated in the north eastern region. The classification of the members of the genus *Citrus* is very difficult due to the frequent formation of hybrids and the introduction of numerous cultivars through cross-pollination (Klimek-Szczykutowicz et al., 2020).

Why Citrus are important?

Citrus is placed in the number one position as a fruit in the world and ranked third in India as important fruit crop due to its nutritive value. Citrus fruits have been used as traditional medicinal herbs in several Asian countries like China, India, Japan and Korea. Citrus fruits are important because they are a key source of vitamin C and provide a multiple of other essential nutrients. They are also grown for production of oil and citric acid, while citrus by-products are mainly used as animal feed. The fruits can be used as ingredients in food, beverages, cosmetics, pharmaceutical industries as additives, spices, cosmetic ingredients and as chemoprophylactic drugs. Citrus fruits are ample source of vitamin C besides being abundant in sugar, dietary fiber, potassium, folate, calcium, thiamins, niacin, vitamin B6, phosphorus, magnesium, copper, riboflavin and pantothenic acid.

Scenario of *Citrus* cultivation in India

In India, Citrus is recognized as the third most important fruit crops with an estimated production of 9441 MT per year with an orchard area of 1039 ha. In Northeast India, annual production is 506.9 tonnes from 98.3 ha of land cultivated. In spite of these, the citrus export from the region and India is almost nil. There is a possibility of exploring more citrus and improving and characterizing them so that the market value can be increased and exported potential can be generated. The traditional mandarin growing areas of North-eastern hill states experience humid subtropical climate with high rainfall in monsoon (summer) and low temperature during winter months.

Citrus in North-East India

The North eastern region of India is considered center of genetic diversity of varies citrus species (Table no.1). A vast reservoir of *Citrus* diversity exists in wild, semi wild form and is found scattered here and there without commercial cultivation and much care. As many as 17 Citrus species, with 52 cultivars and 7 probable natural hybrids are reported to have originated in this part of the region.

Citrus based industry

The medicinal values of different parts of citrus, especially the fruit, have been reported in various studies (Parmer & Kar 2008). Citrus industry could be considered a high-yielding industry with a huge production of fruit and fruit products. As compared to the USA, the orchard area in India for citrus is equivalent, but the production is much less in India and the export is near nil (Chaturvedi et al.2001).

The biotechnological interventions such as active phytochemical identification, extraction, and Chemical marker identification would improve market value and would help in commercial exploitation of some of the untouched species in northeast India. Market trends show direction

towards the development of low-cost foods with safe additives such as natural anti-oxidants. Dietary fibre, polyphenols, and natural pigments are some of the phytoconstituents the industry is ignoring citrus. Moreover, citrus contains a range of highly beneficial bioactive compounds such as carotinoids, vitamins, etc. Citrus fruits have been reported to show antimicrobial, antioxidant, anti-lipidamic, and anti-cancer properties.

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Table 1: Some popular Citrus species with their traditional uses in north east India

Species/Varities	Common name (s)	Status	Distribution	Traditional uses
Citrus macroptera var. *anamensis* Tanaka	Satkara, shatkora (Ass.), Wild orange (Eng.)		Assam (Nagaon, Karbi angling, Karimganz, Tinsukia) Status: Endangered	The thick rind is cut into small pieces and cooked (either green or ripe) in beef, mutton, and fish curries. The rind is often sun-dried for later cooking and consumption.
Citrus indica Tanaka	Indian Wild orange (Eng.)	Status: Endangered	Nair & Nayar (1997) in Flora of India recorded its distribution in Northeastern India covering states on Assam, Manipur, Meghalaya and Nagaland. However, population structure is quite small. Assam (Nagaon, Sonitpur, Karbi angling, Karimganz, Tinsukia)	Uses a fruit.
Citrus limon Brum f.	Kaji Nemu/China lebu, Elachi lebu/Cardamom lemon, Pati lebu/Jora nemu/ Assam lemon)	Common & cultivated	Almost every part of Assam	Kaji Nemu is a highly prized fruit for its culinary and medicinal properties. It has a distinctively strong and sour flavour, which adds a zesty flavour to a variety of dishes. As per reports, it is also known for its digestive and anti-inflammatory properties.
Citrus limon Burm f. var. *Elachi lebu*	Elachi nemu (Ass.), Cardamom lemon (Eng.)		Assam: Kokrajhar, Baksa, Chirang, Tinsukua etc.	Uses a fruit.
Citrus aurantifolia	Abhayapuri lime (Oval fruited)			Uses a fruit.

(Christm.) Swin.	and Karimganj lime (Round-fruited)			
Citrus jambhiri Lush.	A round fruited variety locally called gulnemu			Uses a fruit.
Citrus maxima (Burm.) Merr	Rabab tenga (Ass.); Jambura (Bd.)			As a fruit
Citrus medica L.	Bira jora tenga (Ass.)		Assam (Kokrajhar, Baksa, Chirang, Sonitpur, Karbi angling, Karimganz, Tinsukia)	The thick rind of the fruit can be sliced and added to salads, or candied and used as flavoring in cakes, puddings, confectionery etc. The fleshy mesocarp of the fruit is sweet, eaten fresh and also the acid juice of the fruit is taken. The candied peel is sun dried or pickled. It is widely used in food industry as an aromatic ingredient.
Citrus medica L. var. *Nare/Narang/ Jora tenga*	Nare/Narang/Jora tenga (Ass.)		Assam (Kokrajhar, Baksa, Chirang, Sonitpur, Karbi angling, Karimganz, Tinsukia)	The fleshy mesocarp of the fruit is sweet, eaten fresh and also the acid juice of the fruit is taken. The candied peel is sun dried or pickled.

As many as 17 Citrus species, their 52 cultivars and 7 probable natural hybrids are reported to have originated in the northeastern region of India (Bhattacharya and Dutta 1956).

Ass.-Assamese; Bd.-Bodo; Eng.-English

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