

## Genetic Resources of Fruit Crops : Achievements and Gaps

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*The Indian sub-continent is the home of many fruits such as mango, Citrus, banana and jackfruit. In the past few centuries in particular, several fruits—custard apple, guava, papaya, pineapple, pomegranate, grape, sapota, apple, pear, peach, plum, almond and other nuts, got introduced in different agro-climatic regions. The paper deals with this diversity of introduced and native fruits now prevalent in tropical, sub-tropical, temperate areas and in stress prone climatic zones such as the arid regions. Gaps in diversity exist and need for collection from other areas of diversity are indicated. Through in situ conservation, the maintenance of fruit crops in 78 centres in the national context is highlighted. It is also stressed that less known native types and wild useful species i.e. ber, limes, jackfruit, aonla, bael, jamun, karonda, (Carissa congesta), phalsa (Grewia subinequalis) and others need to be collected, utilised and conserved.*

India is a natural genetic reservoir for several fruit species such as *Mangifera indica*, *Citrus* spp., *Musa* spp. and *Artocarpus heterophyllus*. Nevertheless, quite a few delicious fruits came to India through introductions and have become commercially important in the country. Several of these introductions are also being used for improving productivity, quality and inducing resistance against biotic and abiotic stresses in the available commercial cultivars. Several introductions are also useful as rootstocks and pollenisers.

### EARLY HISTORY OF FRUIT PLANT INTRODUCTION

Fruit plant introductions into India occurred during the ancient times through traders, invaders, travellers, etc. Thus, grape is reported to have been introduced in tropical India during 620 BC and subsequently by invaders from Afghanistan and Persia in 1300 AD. Custard-apple was perhaps introduced into India even before the Portuguese brought the other species of *Annona*. Pomegranate, sapota and loquat reached India so early that their exact period of introduction is difficult to trace. Pineapple reached India as early as 1548. Fruits like guava and papaya introduced in the 16th century and litchi in the 17th century, have naturalised so much that these appear to be native to India. Most of the present day commercial cultivars of these fruits are selections from the variability generated by the introduced types.

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After 1870, European and American settlers and missionaries carried out introductions of pome, stone and nut fruits. During this period, Captain Lee in Kulu Valley, Coutts in Shimla and S. C. Stokes in Kotgarh made valuable introductions in Himachal Pradesh (Singh, 1969). A Frenchman, Mr. M. Pychard introduced many varieties in Kashmir during 1910 and 1920. Consequently, several varieties of different temperate fruits namely, apple, pear, peach, plum, apricot, walnut and almond got fully adapted and established in Indian temperate regions. The prominent cultivars among these were Red Delicious, Golden Delicious, Cox's Orange Pippin, Red Gold, Richared, Starking Delicious, Granny Smith and Yellow Newton of apple besides Ambri introduced from Central Asia; William's Bartlett, Conference, Winter Nelis, Keiffer, Fertility and Beurre Hardy of pear; Stark Lambert, Bigarreau Noir Gross, Bedford Prolific and Early Purple Black, Heart of cherry, Elberta, J. H. Hale, Alexander, Early Rivers, Crawford's Early and C. O. Smith of peach; Santa Rosa, Beauty, Green Gage, Mariposa, Maynard and Grand Duke of plum; New Castle, Royal, Moorpark, St. Ambrose and Turkey of apricot; and Thin Shelled, Non Pareil and California Paper Shelled of almond.

#### SIGNIFICANT INTRODUCTIONS

In recent years, planned introduction of tropical, sub-tropical and temperate fruits has been undertaken through Plant Introduction Division of IARI subsequently upgraded as National Bureau of Plant Genetic Resources during 1976. As a result, thousands of cultivars of several fruits were introduced from all over the world. Some of the notable introductions are—grape cultivars, Thompson Seedless, Perlette, New Perlette, Beauty Seedless, Delight, Himrod and Early Muscat from USA, Kishmish Charni and Kishmish Beli from USSR, Kinnow mandarin from USA, and low chilling peach varieties namely, Flordasun and Sunred from USA. Several of these introductions are now commercially grown and have made significant impact on the fruit industry of the country. Similarly, out of several temperate fruit cultivars introduced in recent years, Skyline Supreme Red Delicious, Mollie's Delicious, Spur type Red Delicious II, EC 32221 and EC 38683 of apple, Flemish Beauty, Devoe, Max. Red and Manning Elizabeth of pear, Stark Earliglo and Candoe of peach, Lake English, Payne, Waterloo, Tuttle 31 and Ideal of walnut and Allison cultivar of Chinese gooseberry proved promising (NBPGR, 1984, 1986). Similarly, Hachiya persimmon, Mahan pecan, Solo papaya, and some introduced olive varieties have also shown promise.

The process of identification of fruit plant cultivars as well as their introduction has been continuously in progress (NBPGR, 1982, 1984, 1986). Several cultivars of mango from Miami and Peru, *Citrus* species and rootstocks from Japan and USA, Bunchy top resistant banana from Australia, *Psidium* and *Ficus* species, pecan and *Pistacia* from USA, *Annona*, *Actinidia*, *Pistacia* and macadamia nut from Australia, *Carica* species from Venezuela, pomegranate from Spain, USSR and Tunisia, date palm cultivars from Oman, USA and Saudi Arabia, grape cultivars from several countries and scab resistant apple cultivars from UK and USA

have been introduced. A large number of new cultivars of apple from Denmark, West Germany and USA, of peach from Czechoslovakia and Canada and of apricot from Italy and Czechoslovakia have also been introduced and are now under evaluation.

#### CRITICAL GAPS

Despite a large amount of introduction in a diverse variety of fruit crops, there are critical gaps and India does not possess commercially cultivated varieties of several important as well as less common fruits. These gaps need to be bridged to ensure a sound fruit industry.

#### *Commercial fruits*

Although, India has a rich genetic diversity in *Mangifera indica*, introduction of several coloured cultivars, both from Florida and Hawaii, are yet to be made. Similarly, closely related species from South-East Asia, e. g. *M. altissima*, *M. caesia*, *M. decandra*, *M. sylvatica*, *M. quadrifida*, *M. longipes*, *M. minor*, *M. pajang*, *M. similis*, *M. monandra*, *M. incarpoides*, *M. macrocarpa*, *M. odorata*, *M. griffith*, *M. coloneura*, *M. camptosperma*, *M. flava*, *M. cochinchinensis*, *M. duperreana*, *M. gracilipes*, *M. pentandra* and *M. lagenifera* from Indonesia, Malayan Peninsula, Papua New Guinea, Philippines, Singapore, Thailand and Burma are to be obtained (Iyer and Subramanian, 1987).

In citrus fruits, several mandarin hybrids released from USA, namely Osceola, Page, Lee, Ponkan, Robinson, Sunburst, Murcott, Bower, Fairchild, Fremont, and Fortune from Egypt, Balady and Sukkar are considered useful. Different types of Satsuma mandarin from Japan are other critical plant types for introduction. Several species of citrus and relatives and rootstocks need to be introduced from Algeria, Brazil, China, Taiwan, Japan, Spain, Thailand and USA. *Poncirus* rootstocks from Japan should also prove promising.

Promising banana cultivars from Honduras and *Musa* species from Malaysia, New Guinea, Indo-china, East Africa, Indonesia, Solomons, Fiji, New Hebrides, Tonga, Margueses, Hawaii and the Pacific Islands should be introduced (Iyer and Subramanian, 1987). Critical fruit plant cultivars for introduction in India are Merbein Seedless and *Shandu Khani* grape from Australia and Afghanistan respectively, seedless and seeded varieties of litchi from China and Australia, *Carica* species from Venezuela and ringspot resistant papaya cultivar Cariflora from Florida, drought resistant *Ananas annasoides* and *A. erectifolius* adapted to hot lowlands from Brazil, *Psidium montanum* from Jamaica, olive from Turkey, Algeria and Portugal and cultivars of macadamia nut from Hawaii, Jujube cultivars from China (Honey Jujube, Jin Jujube, Linze Small Jujube, Ming Shan Large, Jujube), atemoyas from Australia (African Pride) and Florida (Keller, Page, Bradley, Caves), *Annona scleroderma*, *A. testudinea*, *A. purpurea*, *Asimina longifolia* and *A. triloba* from Florida, fig cultivars from UAR (Kadota, Berdrashomi, White Genoa), Algeria, USA (Conadria, Deanna, Excel, Flanders, Tena, Nardine,

Gulbun, Saleeb), Saudi Arabia (Al Madinah, Hur, Al Abbad) and Tunisia (Bousas-almas, Hash, Khazmi, Mari, Tonsi), pomegranate cultivars from UAR (Banati, Manfaloti), Iran (Meykhosh, Saive, Manfaloti), Tunisia (Tonsi) and USA (Wonderful, Early Wonderful, Ruby Red) and early maturing date palm cultivars from Sudan, Tunisia, UAR and Iraq need to be introduced (Pareek, 1987). Besides this, Paper Shelled walnut and Giant Kew pineapple are other introductions which are very important from the commercial point of view.

#### *Less known Fruits*

India has yet to introduce and evaluate seriously several less known fruits which have potential for cultivation considering the diverse agro-climatic conditions available in India. Some less known fruits of potential in tropical India are acai (*Enterpe oleracea*), bacuri (*Platonia insignis*), brazilnut (*Bertaolotia excelsa*), mangerba (*Hancornia speciosa*), muria (*Byrsonima crassifolia*), taperba (*Spondias lutea*), gurana (*Panthenis cupana*), calbura (*Muntingia calabura*), genipapo (*Genipa americana*), maracuja and pitomba (*Eugenia inschnathiana*) from Brazil, durian (*Durio zibethinus*), longan (*Euphoria longan*), langsung (*Lansium domesticum*) and rambutan (*Nephelium lappaceum*) from Thailand, Sweet carambola (*Averrhoa carambola*) from China, gandaria (*Bouea macrophylla*) from Indonesia, mangosteen (*Garcinia mangostana*) from Italy and babaco from New Zealand.

#### CONSERVATION OF PLANT INTRODUCTIONS

Full utilisation of the introduced germplasm depends on its successful conservation, multiplication and exploitation. In India, most of the germplasm of fruit crops is being maintained *in situ* through fruit repositories or field gene banks since other methods of long-term conservation are not yet fully developed. At present, 78 centres under various Central Institutes and Agricultural Universities are maintaining collections of important fruit species. NBPGR has also located a gene sanctuary in the Garo hills, Meghalaya in the north-eastern region for *Citrus indica*. It is also proposed to preserve here wild and cultivated types of *Musa*, *Mangifera* and other *Citrus* species. There is a need for establishing national fruit repositories in different fruit crops for better conservation and utilisation of genetic resources.

Besides fruit repositories, the Indian Institute of Horticultural Research has established the first germplasm bank in the country. Attempts have also begun and need to be intensified on other means of preservation like storage of propagating materials, tissue culture, cryogenic storage, etc.

#### EXPLOITATION OF INDIGENOUS GERMPLOSM

Several fruit species of at least 20 genera such as *Artocarpus*, *Carissa*, *Citrus*, *Diospyros*, *Emblica*, *Ficus*, *Grewia*, *Juglans*, *Mangifera*, *Musa*, *Malus*, *Morus*, *Prunus*, *Punica*, *Pyrus*, *Ribes*, *Rubus*, *Syzygium*, *Vitis* and *Zizyphus* offer great variability in India (Hooker's Flora of British India). Fruits like mango, several

citrus fruits, banana, jackfruit, *ber* (*Zizyphus mauritiana*), *aonla* (*Emblca officinalis*), *bael* (*Aegle marmelos*), *phalsa* (*Grewia subinequalis*), *jamun* (*Syzygium cumini*), *karonda* (*Carissa carandas*), etc. are indigenous to India besides several other less known fruits. The position in important fruits is summarised below :

**Mango :** Rich variability in mango is present all over the country. Wild forms of *Mangifera indica* have existed in the evergreen forests of the north-east region and in the *terai* ranges. Tribal areas at the junction of Madhya Pradesh, Andhra Pradesh and Orissa and Madhya Pradesh, Gujarat and Rajasthan besides south Tamil Nadu and Kerala are some prominent centres. Some *Mangifera* species are native to north east India (Tripura, Manipur, Mizoram, south Assam, Chota Nagpur plateau, Rajmahal hills) and the Andamans. It has been reported that at least six out of 41 *Mangifera* species are native to India.

**Citrus :** India is considered to be the home of several *Citrus* species. There are three major centres of diversity, namely, north-eastern, north-western and southern region. Maximum concentration of wild species is in the north-eastern region. Bhattacharya and Dutta (1956) described 17 *Citrus* species, their 52 cultivars and a few probable natural hybrids from this region. In rough lemon alone, as many as 32 strains are available and need exploitation.

**Banana :** Maximum genetic variability of *Musa acuminata* and *M. balbisiana* occurs in north east India. *M. flaviflora* is localised to Manipur and Meghalaya. There are several other species in north Bengal, Sikkim, Khasi hills and even in the western Ghats which need systematic collection and conservation.

**Grape :** There is a lot of indigenous germplasm in grape in India. Hooker (1875) in Flora of British India mentioned as many as 75 species of *Vitis* in India. Hayes mentioned four species occurring in the foothills of the Himalayas from Kashmir to Burma which give edible fruits. Wild species of grape are also available in the Khandala hills near Pune, on the western Ghats, the Andamans, the Chota Nagpur plateau, Jammu and Himachal Pradesh (Kinnaur).

**Other fruits :** There is a lot of variability in several other fruits all over the country. Several species of *ber* are found in the peninsular tract, western and eastern Ghats; *Phoenix* and *Ficus* species in north-eastern region; Indian gooseberry in the sub-tropical plains; tamarind in Tamil Nadu, Karnataka and Andhra Pradesh; custard-apple in Andhra Pradesh and date palm in Kutch, jackfruit in eastern and southern India and pome and stone fruits in the temperate region. A systematic attempt for their collection and exploitation is called for. Further, a rich wealth of 17 wild and less known species of edible fruits exists in India out of a total of 337 species in the world (Arora, 1985). In the temperate region, *Amygdalus*, *Carya*, *Castanea*, *Corylus*, *Cotoneaster*, *Crataegus*, *Cydonia*, *Docynia*, *Juglans*, *Malus*, *Persea*, *Pistacia*, *Prunus*, *Pyrus* and *Sorbus* are available (Chadha, 1978).

**Recent indigenous collections :** Although several promising types were selected and popularised at different times from this rich indigenous diversity, systematic survey to exploit this wealth is necessary before the useful plant types are lost

due to genetic erosion. Some attempts in this regard were initiated (NBPGR, 1986) by the Indian Council of Agricultural Research which have led to the collection of promising mango types (regular bearing-Paushia, scented Haldibas, bunch bearing-Seetabhog, flavoured Topisundari, Baunia, Karpurkeli and other elite types-Belgaja, Theki, Chanamunda, Mahorajpasand, Manda Sagarlangra) from Orissa, land races of banana (seeded Ladiarit and Ladison, Rigitchi and other elite types, Hatigola, Eboke, Ginde, Egitchi and Essing) from Meghalaya, citrus types (Mimangnarang, Chinora and Sohkwit of *C. macroptera*, Sohsyng of *C. assamensis*, Sohkhylah, a natural hybrid, Sohmyngor of *C. grandis* and Soh sien, a vermilion coloured *C. reticulata*) from Meghalaya, custard-apple types from Chota Nagpur, Bastar and AP, jackfruit types (Varikka, Kooza and Nerarikka-Pazem-varikka) from the western Ghats, and some wild edible temperate fruits like *Sorbus cuspidata*, *Malus baccata*, *Pyrus pashia*, *Prunus cornuta*, *Punica granatum*, *Juglans regia* and *Ribes himalense* from the Kumaon hills.

In spite of the rich indigenous variability in several fruits, India has received a number of fruits from other countries since times immemorial. The diverse Indian agro-climatic conditions helped not only in their acclimatisation but also successful commercial culture. A systematic attempt in this regard with clear objectives is now being made and is expected to yield useful introductions which will help in improving the productivity and quality of fruits in India. Exploitation of our vast and so far untapped wild germplasm resource needs to be undertaken with a sense of urgency. Besides, it is also necessary to popularise and fully utilise the promising plant materials introduced from abroad or identified from within the country.

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