J. Agrofor. Environ. 2(2): 213-216, 2008 ISSN 1995-6983

Fruit research and development in India

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Abstract: India is the second largest producer of fruits in the world contributing 10.23% and highest producer of mango, banana, sapota and acid lime and has recorded highest productivity in grape. The productivity of banana has increased manifolds. The importance and potential of fruit crops was realized early in post independence India. India has achieved 3 times increase in fruit production after independence. Systematic research on fruit crops was initiated by creating a section of Horticulture under Division of Botany at IARI, New Delhi in 1954 which was upgraded later to a division of Horticulture in 1959.Presently research on fruit crops under ICAR is being carried out in Central Institute, Regional Station, National Centers, All India Coordinated Projects, State Agriculture Universities and ICAR multidisciplinary Institutes. As a consequence India has made a fairly good progress in fruits with a total production touching over 45.5 million tones. In the plant improvement programme a large number of variety of fruit crops like mango, banana, citrus, pineapple, papaya, guava, sapota, jackfruit, litchi and grape among tropical and subtropical fruits: apple, peach, pear, plum, apricot, almond and walnut among temperate fruits and aonla, ber, pomegranate, annona, phalsa among arid zone fruits have been developed. Regular bearing mango hybrids and export quality grape varieties are now available. Development of improved propagation techniques have led to increased production and availability of quality planting materials. Improved agro- techniques have been standardized for their large scale adoption and maximizing yield of fruit crops. Biological control measures against some fruit pest have also been developed. Research and post harvest management has resulted in generation of information on maturity standards, grading, pre-harvest treatments, packaging and transportation. Since1961, area, production of fruits has increased by 6.2 and 2 times respectively. India has made significant progress in the production of lesser known fruits such as aonla, ber, bael, sapota and pomegranate.There has been a steady increase in the area and production of these fruits as a result of development of suitable varieties and improved production technologies. The corporate sector is showing great interest in fruit crops. There has been a major shift in consumption pattern of fresh and processed fruits in the country.
Key words:

Fruit growing has been inherently linked in the Indian life from ancient times. Medicinal uses of fruits *like* aonla, bael, wild dates, grapes, hog plum, jackfruit, wild fig, monkey jack, jamun, ber, karonda, lemon, lime, mango, mulberry, orange, sour orange, phalsa, banana, pomegranate, walnut, almond, pistachio nut, woodapple etc., have been mentioned in the many ancient literature. Mango, banana, bael, aonla and coconut have been associated with the festivals and rituals in India. Of the several fruits, mango, banana, fig, grape and date palm were the most favourite.

In the early times, the development in Indian fruit industry brought about largely by making selections from the indigenous variability for large scale production. Simultaneously, exotic germplasms were also introduced. These activities performed by the local growers, often patronized by the rulers, continued over the years and resulted in the development of several popular types of different fruits.

Before the establishment of Indian Council of Agricultural Research, the development work on fruit crops was the responsibility of the states. There was no organized work in this field and also not much efforts were made to solve various problems of orchards. With the establishment of ICAR in the year 1929, the organized work in the development of fruits could be taken up. A good deal of work could be carried out on regional problems of fruits growing during the period from 1929 to 1954 and a number of research stations could be established in different states with the help of ICAR. The research work on fruits could be organized on regional basis during the second 5- year Plan (1957-1962) and this led to the opening of eight Regional Fruit Research Stations in different states.

Several Co-ordinated schemes run by the ICAR was initiated to solve certain specific problems, e.g.- die back scheme on citrus, hormone application in horticulture, improvement in date palm and banana cultivation etc. The Regional Fruit Research Stations were handed over to their respective States during the Third Five-Year Plan. The Indian Institute of Horticultural Research was established during Third Five-Year Plan is engaged in conducting research work on fruits, vegetables and flowers. During the Forth Five-Year Plan, All India Coordinated Fruit Improvement Project was initiated so as to solve different problems of fruit industry with two main centres – one at Hessarghata, Bangalore and other at IARI, New Delhi. Later on, different Regional Stations were established in different climatic regions under this scheme. The research work on mango, papaya, grape, citrus, banana, pineapple etc. is specially being carried out under this project. In 1968 Indian Institute of Horticultural Research was established at Bangalore.

The chronology of establishment of Institutes/Centers involved in research on fruit crops

Year of establishment	Institutes/Centres
1905	Establishment of six Agricultural Colleges at Coimbatore, Kanpur, Lyalpur (pre-partition), Nagpur, Pune and Sabour.
1920	Imperial Agricultural Research Institute (IARI) at Pusa, Bihar.
1936	A Fruit Research Station (Pomological) at Connor, Karnataka.
1945	Indian Agricultural Research Institute (IARI) shifted from Pusa (Bihar) to New Delhi.
1947	A survey of deciduous fruit crop was undertaken in Jammu and Kashmir.
1950	Central Horticultural Experimental Station (CHES), Kayangulam, Kerala.
1954	Two Horticultural Research Station were established each at Kandaghat and Kulu .
1956	Cental Horticultural experimental Station (CHES), Gonnikoppal, Karnataka.
1956	Eight Research Stations were established.
1961	Division of Horticulture was created in IARI, New Delhi.
1968	Horticultural Research Station at Kodaikanal (Tamilnadu).
1971	Indian Institute of Horticultural Research (IIHR), Bangalore, Karnataka.
1972	All India Coordinated Fruit Improvement Project (AICFIP) started under two cells (I and II).
1972	Central Mango Research Station (CMRS), Lucknow, Uttar Pradesh
1975	Central Arid Zone Research Institute (CAZRI), Jodhpur, Rajasthan.
1976	ICAR Research Complex, Goa and Norht-Eastern Hill Region, Shillong , Meghalaya.
1977	An *adhoc* Research on someselected fruits of aruid and semi- arid areas in India.
1977	AICRP on Biological control of major pests of fruit crops.
1978	Central Horticultural Research Station (CHES), Chethali, merged with Indian Institute of Horticultural Research(IIHR), Bangalore, Karnataka.
1979	Central Research Institute for Andaman and Nicobar group of Island, Port Blair.
1982	Central Horticultural Experimental Station (CHES), Godhra, Gujarat and Ranchi, Bihar.
1985	Separate Division of Fruits and Horticultural Technology at IARI, New Delhi.
1986	Indo- USAID sub Project on PHT of fruits and vegetables.
1986	National Research Station for Citrus, Nagpur, Maharashtra.
1991	AICRP on Sub-tropical fruits was renamed as AICRP on Sub-tropical and Temperate Fruits.
1993	Central Institute for Temperate Horticulture (CITH), Srinagar, Jammu and Kashmir.
1993	National Research Center for Banana, Tiruchirapalli, Tamil Nadu.
1995	National Research Center for Arid Horticulture, Bikaner, Rajasthan.
1997	CIHNP renamed as Central Institute for Sub- tropical Horticulture (CISH).
	National Research Center for Grapes, pune, Maharastra.

Later on, two more research centres on litchi and citrus have been established at Muzaffarpur, Bihar and Nagpur, Maharashtra. Besides, Central Institutes, AICRPs related to fruit crops and National Research Centers, Agricultural and Horticultural Universities are also involved in fruit research

Genetic resources

India is an important centre of diversity of crop plant and has rich variability of several fruits. This genepool has provided cultivars of several fruits grown commercially in the country. Simultaneously, exotic introduction of new fruit species were made and different plant types of severalfruits were added to the existing variability. As a result, a rich genetic reservoir of species and cultivars of several fruit crops has been built up at the Indian research centers, e.g. mango cultivars at CIHNP, Lucknow, IIHR, Bangalore and APAU, Sangareddy; grape cultivars at IIHR, Bangalore and IARI, New Delhi; guava collection at CISH, Lucknow and IIHR, Bangalore; banana collection at NRC banana Trichy; citrus collection at NRC citrus Nagpur; pomegranate collection at MAPU, Rahuri; ber collection at CAZRI, Jodhpur and HAU, HIssar; and apple cultivars at YSPUHF, Solan/Mashbra. Evaluation of these collections resulted in identification of cultivars suited to the different agroclimatic regions of the country.

National Active Germplasm Sites for fruit crops in India

Fruit crops	Germplasm sites	Number of accessions
Tropical fruits	Indian Institute of Horticultural Research, Bangalore	13118
Subtropical fruits	Central Institute of Subtropical Horticulture, Lucknow	587
Temperate fruits	NBPGR Regional Station, Phagali, Simla	454
Arid and semi-arid fruits	Central Institute for Arid Horticulture, Bikaner	698
Citrus species	National Research Centre on Citrus, Nagpur	…
Grapes	National Research Centre on Grapes, Pune	..
Litchi, Bal, Aonla and Jackfruit	HARP, Ranchi	…
Banana	National Research Centre on Banana, Trichi	900

Cultivar improvement

Many new cultivars have come up in several fruit crops. Selection from the indigenous and exotic variability gave rise to promising cultivars. A good number of mango hybrids viz. Amrapali. Mallika, Neeluddin, Neelgoa, Swarna Jehangir, Manjeera, Au-rumani, Neeleshan, Neelphonso, Ratna Sindhu, Arka Aruna, Arka Puneet,Arka Anmol, Arka Neelkiran, Prabhashankar, Sunda Langra, PKM-1, Jawahar, Pusa Aruna, Pusa Surya, CISHM1 have been released. Cluster bearing acid lime Promalini and Vikram at Parbhani and Kasipentla at Tirupati, seedless and thornless Kadayam acid lime at Periyakulam, the precocious NA 7 and other aonla and bael selection made at NDUAT, Faizabad: pomegranate selections Ganesh from Pune, Jyoti and IIHR Selection at Bangalore and Yercaud-1 atYercaud, tamarind selections at Rahuri, Periyakulam and Parbhani: and peach and plum selections for subtropical regions in Punjab.

Plant material multiplication

Multiplication of healthy planting material of high yielding new varieties would go a long way in increasing production of fruits in India. Mist propagation, fogging technique, use of bottom heat along with treatments with growth regulators (e.g. IBA), etiolation, invigoration, etc., have increased the success in induction of rooting in cuttings and layers. Protocol for micropropagation of banana have been standardized.

High density planting and pruning and training

Under the high input and intensive culture, high density planting has given very high productivity per unit area in pineapple, banana, mango, apple etc, in the tree species, high density planting has become possible by the development of suitable plant types, such as spur type cultivars in pome fruits, by use of dwarfing rootstocks, training and pruning and growth regulators such as B-9 and chlomaquat.

Nutrients and water management

Efficient use of fertilizers has become necessary to increase yields per unit area. Nutritional requirements for the commercial fruits have been determined based on long- term fertilizer trials, studies of uptake and fertilizer use efficiency using radio- tracer technique and root studies. Leaf sampling techniques and nutrient guides for several fruits have also been standardized.

Disease and pest management

Several pests and disease causes considerable losses of fruits in India. Some of the Serious fungal disease are *Phytophthora* rots in citrus, pineapple and apple: root rot and collar rot in papaya and apple; powdery mildews in mango, grape, ber and apple; Panama and Sigatoka disease in banana; anthracnose in grape and apple; wilt in guava and scab in apple. The bacterial disease, such as canker in sour lime, Moko disease and soft rot in banana and gummosis in peach and plum are serious. Virus diseases, such as tristeza in citrus, bunchy top in banana, mosaic in banana and papaya and leaf curl in papaya cause diseases have been developed.

Control measures have also been standardized for the insect pests, such as hopper and stone weevil in mango; mealy bug in mango, citrus and pineapple; aphids in citrus, banana, peach and plum; scales in citrus; thrips in grape and banana; fruit flies and borers in mango, citrus, guava and pomegranate; stem borers and bark eating insects in several fruits; wooly aphid and San Joes Scale in apple, etc. the problem of nematodes can be minimized by using resistant rootstock in grape and resistant plat types in banana and by prophylactic measures and chemical control in banana, grape and papaya.

Other production problems

A number of severe production problems such as alternate bearing, malformation, spongy tissue and black tip in mango, dieback and granulation in citrus, internal fruit necrosis in mango, aonla, apple and jackfruit, fruit cracking in pomegranate and litchi and ecophysiological disorders such as bud, flower and berry drop and bud killing in grape.

Impact of fruit research and development

i) Year round availability of apple/guava

ii) Increased internal consumption, export of mango products

iii) Introduction of new crops and varieties e.g., Kinnow mandarin, Perlette grape and subtropical peach, plum, pear.

iv) Commercial grape cultivation in Andhra Pradesh, Maharastra, Karnataka and Tamil Nadu.

v) Massive area expansion under fruits like pomegranate and ber.

vi) Change in dietary habit with increased consumption of fruits.

Future strategies

i) Emphasis to develop high yielding varieties resistant to biotic and abiotic stresses using conventional and biotechnological approaches.

ii) To develop suitable rootstocks resistant to biotic and abiotic stresses.

iii) To develop dwarf stature perennial fruit trees for the intensive management and high density planting systems.

iv) To develop mass multiplication protocol using tissue culture

v) Utilization of under-exploited and exotic fruit species.

vi) To develop cost effective pest control protocol and disease forecasting system

vii) Emphasis on post-harvest handling and storage