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Significance of Wild Species in Crop Improvement of Tropical Fruits – A Review

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ABSTRACT

Fruit crops serve as an important source of minerals and nutrients in human diets. However, pests and diseases are strong constraints to low-input cultivation systems and cause great losses both at pre and post harvest stages. While control measures exist for some diseases and pests, there is a strong pressure from the global community to limit the use of pesticides because of their effect on the environment and public health. Genetic improvement using wild species for resistance to the principal pests and diseases offers an alternative solution. Also, with the advent of climate change and greater ecosystem instability, crop wild relatives (CWRs) are likely to prove a critical resource in ensuring food security, eliminating poverty and to maintain the sustainable agro- ecosystems.

Key words: *Wild species, Tropical fruits, Crop wild relatives (CWRs), Crop improvement*

INTRODUCTION

From the past, edible wild fruits have played a very vital part in supplementing the diet of the people. They are edible and having nutritional food value, which provides the minerals like sodium, potassium, magnesium, iron, calcium, phosphorus etc. They are immune to many diseases and often used in different formulation of Ayurveda' in Indian Folk-medicine. Apart from this, wild fruits are source of different resistant genes. Crop wild relatives are wild plant species that are genetically related to cultivated crops. They are a critical source of genes for resistance to diseases, pests and stresses such as drought and extreme temperatures.

The potential of wild species as a source for genetic variation to bring about crop improvement was recognized early in the twentieth century .As a result of genetic bottlenecks imposed during early domestication and modern breeding activities, cultivated varieties carry only a fraction of the variation present in the gene pool. Wild ancestors of most crop plants can still be found in their natural habitats and germplasm centres have been established to collect and conserve these resources.

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The present article reviewed the Significance of wild species in crop improvement of major tropical fruits.

Wild species: Typical form of an organism, strain, gene, or characteristics as it occurs in nature, as distinguished from mutant forms that may result from selective breeding. A crop wild relative (CWR) is a wild plant closely related to a domesticated plant, It may be a wild ancestor of the domesticated plant, or another closely related taxon. CWRs have contributed many useful genes to crop plants, and modern varieties of most major crops now contain genes from their wild relatives.

Significances of wild species for crop improvement

1. Wild species represent a vital source of untapped genetic diversity.
2. Crop wild relative (CWR) have traits allowing them to be successful at the current extremes of a crop's range and beyond, wild relatives can be extremely important in adapting crops to climate change.
3. Display characteristics - such as heat and drought tolerance, pest and disease resistance and the ability to thrive in saline soils which would allow crops to cope with a wider range of environments and stresses.

Mangos belong to the genus of the family Anacardiaceae. 41 recognised species of mango originating as forest trees with fibrous and resinous fruits .The genus *Mangifera* contains several species that bear edible fruit. The other edible *Mangifera species* generally have lower quality fruit and are commonly referred to as wild mangos.

In mango, screening of 80 accessions for their reactions to anthracnose using virulent isolates of *C. gloeosporioides* over the past four seasons (2006 to 2009) resulted in the identification of source of resistance in *M. laurina* accession 'Lomboc'(artificial inoculation) which could be used for interspecific hybridization[1].

Table 1: Species of mango resistant to different traits

Species	Traits
Mangifera laurina	Resistance to anthracnose
Mangifera mangifica	Fibreless
Mangifera rufocostata and *mangifera swintonioides*	Off season bearing habit
Mangifera pajang and *mangifera foetida*	Good quality fruits
Mangifera casturi	A prolific bearer , small black sweet fruits
Mangifera altissima	Resistance to hoppers, Tip and seed borers
Mangifera zeylanica	Salinity Tolerance

Cultivated banana are derived from intra or interspecific hybridisations between two wild diploid species, *Musa acuminata* Colla (contributing the A genome) and *Musa balbisiana* Colla (B genome). Bananas are cultivated in more than 120 countries in tropical and subtropical zones and are an essential food source in many countries in Asia and Africa, playing a key role in satisfying the ever-increasing global demand for food. But banana is infected by different Diseases like Sigatoka leaf spot (*Mycosphaerella musicola),* Black leaf streak *(Mycosphaerella fijiensis),* Fusarium wilt (*Fusarium oxysporum f. sp. cubense),* Banana bunchy top virus *(BBTV)* and pest like Black weevil of banana *(Cosmopolites sordidus).*Aphids *(Pentalonia nigronervosa),* Nematodes *(Radopholus similis and Pratylenchus sp*.). So to increase production, the first goal of banana breeding is to confer resistance to diseases and pests.

Development of sigatoka leaf spot resistant banana hybrids with improved fruit quality using diploid wild accessions '*Malaccensis*', 'IDN110/AAcv Rose' and *Musa balbisiana* with 'Kunnan 4X' resulted in the development of new superior hybrids with sigatoka leaf spot resistance at Guadeloupe[2].

Table 2: Species of Banana resistant to different traits

Species	Traits
Musa acuminata ssp. Malaccensis	Resistance to sigatoka leaf spot
Musa acuminata ssp. Burmannica	Resistance to black leaf streak
Musa haekkinenii	Dwarf plants (1 to 1.5 m high)
Musa ornata and Musa veluntina	Ornamental plants
Musa textilis	Fiber
Ensete superbum	Medicinal and ornamental plant

India stands first in the production of papaya in the world. Diseases are the major problem. Among all, viral diseases are the limiting factors of papaya cultivation particularly papaya leaf curl and papaya ring spot virus. Papaya ring spot cause heavy loss of 40–90 percent.

Evaluation of F_2 intergeneric population of the combination from *Carica papaya* (var. Pusa Nanha, CP 50 and CO 7 as female parents) and *Vasconcellea cauliflora* for Papaya Ring Spot Virus (PRSV) resistance under laboratory (challenge inoculation) as well as field condition resulted in the identification of eighteen plants from the cross Pusa Nanha × *V. cauliflora*, five plants from the cross CP 50 × *V. cauliflora* and one plant from the cross CO 7 × *V. cauliflora.* These were found to be promising based on the disease intensity score, reaction to the papaya ring spot virus and mean performance for morphological, yield and quality attributes[4].

Table 3: Possible Sources of Resistance in different wild species of Papaya

Diseases	Resistant / tolerant Species	Reference
PRSV – P	*V. cundinamarencis, V. cauliflora, V. quercifolia* and *V. stipulata*	Jimenez and Horovitz, 1957, Drew *et al.*, 1998; Magdalita *et al.*, 1997)
Phytophthora	*V. goudotiana*	Drew *et al*., 1998
Paw paw die back (Mycoplasma) Blackspot	*V. parviflora* *cundinamarencis* *(syn. V. pubescens)*	Drew *et al*., 1998 Manshardt and Wenslaff., 1989
Bacterial Canker (Erwinia papayae)	*V. goudotiana and V.cauliflora*	Maselli et al ., 2010.

Vitis venifera variety - susceptible against a wide range of fungus among which Powdery mildew and downy mildew has highest economical impact. Main goal - development of new varieties with combined quality and resistance characteristics by using wild species. Recent success in grapevine research - development of various genetic maps, genome sequencing raise hopes for more efficient use of the genetic resources of wild species within breeding programme.

The wild *Vitis* germplasm, including Chinese and American wild *Vitis* and *Vitis vinifera* cultivars, to powdery mildew (*Uncinula necator* Burr.) resistance was evaluated for two consecutive years under natural conditions where most of the Chinese and North American species displayed a resistant phenotype, while all of the European species were highly susceptible[5].

Table 4: Possible Sources of Resistance in different wild species of Grape

Species	Traits	Reference
V. aestivalis, V. champinii, V. cinerea, V.rupestris and Muscadinia rotundifolia	Resistance to *Meloidogyne incognita*	Walker *et al.,* 1994; Cousins *et al.,* 2003
V. arizonica, V. candicans, and M. rotundifolia	Resistance to *Xiphinema spp.*	Harris, 1984
Vitis berlandieri	Adaptation to limestone soils.	Schmid, *et al.,* 2009
V.rotundifolia,V.aestivalis, V. cordata	Powdery mildew resistence	Staudt 1997
V. munsoniana, V.rotundifolia,V.candicans	Downy mildew resistant	Staudt and Kassemeyer 1995,

It is one of the most important fruit crop grown throughout tropic and sub - tropic on the world. Citrus production is affected by both biotic and abiotic stresses, including drought, extreme temperature, salinity, citrus canker, citrus tristeza virus and Huanglongbing (or citrus greening), among others. Therefore exploiting the wild crop relative is the only way to combat the problems.

Twelve combinations of citrus rootstocks and interstocks were chosen for potential use against HLB (Huanglongbing/citrus greening) disease. It was reported that HLB symptoms were not observed on the scion with *C. grandis* as rootstock and *C. hystrix* as interstock and on (*C. hystrix* as the rootstock and *C. grandis* as the interstock) while there was higher rate of HLB disease severity when *C. aurantium* was used as rootstock with *C. aurantifolia* as the interstock or vice versa[3].

Table 5: Possible Sources of Resistance in different wild species of Citrus

Species	Traits	Reference
Poncirus	Resistant to citrus tristeza virus(CTV), *Phytophthora*-induced diseases & nematode	Castle, 1987
Microcitrus	Resistance to drought, flooding	O'Bannon & Ford, 1977
Severinia	Cold resistance, salt and boron tolerance, resistance to *Phytophthora* and nematodes	Cooper, 1961
Atalantia	Wet soils, *Phytophthora* resistance, and exhibits good cold hardiness	Bitters, 1969
Citropsis	Resistance to *Phytophthora* induced diseases And burrowing nematode.	Swingle & Reece, 1967
Feronia	Drought tolerant	Swingle & Reece, 1967
Feroniella lucida	Dwarf, resistant to CTV.	Swingle & Reece, 1967,Yoshida, 1996
Fortunella	Cold hardy	Swingle & Reece, 1967

Table 6: List of wild relative species in Pineapple, Sapota & Custard apple

Species	**Traits**
Pineapple	
1. *A.comosus var. annanasoides*	Tolerant to wilt, crown rot and nematodes
2.A.comosus var. erectifolius	Resistant to heart rot and root rot
3. *A. macrodontes*	Source of fibre, resistant to drought
4.A.comosus var. bracteatus	Vigorous, resistant to heart rot &root rot
Sapota	
1. Manilkara hexandra (Rayon)	Vigorous rootstock
2.Manilkara kauki	Rootstock
Custard apple	
1.Annona crysophella	Medicinal
2.Annona glabra	Drought tolerance
3. Annona puprea	Insect tolerance
4. Annona atemoya	Frost tolerance

CONCLUSION

Thus, it is concluded that the wild species of the fruit crops constitute an increasingly important resources for improving horticultural production and for maintaining sustainable agro-ecosystems. Therefore, conservation, exploration, and use of the wild genetic diversity underlying horticultural production represent a critical piece of collective global potential for sustainable productivity and increased crop quality.

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