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The Fruit Crops of Vietnam: Introduced Species and Their Native Relatives

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Abstract

Introduced fruit crops from a broad geographical range have become established in Vietnam. Carambola, cucumber tree, durian, malay apple, mangosteen and tamarind have come from south and southeast Asia. Japan and China contributed apricot, pear, loquat, peach and plum. Avocado, Barbados cherry, cashew, custard apple, dragon fruit, grenadilla, guava, papaya, pineapple, passion fruit, sapodilla, soursop, sweetsop, star apple and Surinam cherry were introduced from Latin America. Europe, the Middle East and the Mediterranean regions contributed apple, fig, grape, pomegranate and strawberry. In this review, we discuss where these crops are grown in Vietnam, their native relatives and their horticultural attributes.

Even though Vietnam is blessed with numerous native crops (12, 13, 14), it has benefitted tremendously from introduced crop germplasm. Since the beginning of this century, Vietnam has been renowned for its rubber and coffee plantations which were both established from foreign materials during the colonial period. Coffee came from Ethiopia, while rubber originated in Brazil (28). In 1994, coffee generated an export revenue of USD 400 M (20) and rubber brought in USD 70 M (2).

Rice ranks first in Vietnamese staple crop production with well over 1 million ha cultivated. Maize from Mesoamerica ranks second with 500,000 ha cultivated (8, 9). Sweet potatoes and cassava which originated in South America are cultivated on 400,000 ha and 350,000 ha, respectively. Both have become the primary food of the poor and act as "famine insurance" (26). Among protein and oil crops, the peanut, introduced from South America, is the most important (25) and is cultivated on 260,000 ha. The native Asian crop soybean is in second place at 121,000 (5).

Of all the introduced crops, however, fruits and nuts may offer the highest future potential for Vietnamese economic development in both export and domestic markets. In recent years, Vietnam's export revenue from cashew, a native of Brazil, has surpassed rubber with export earnings of USD 100 M in 1995 (21). In 1995, total fruit acreage in Vietnam was estimated to be 346, 400, excluding coconut which is grown on 172, 900 ha (11).

The bulk of the fruit production is located in southern Vietnam with 78% of the total hectarage. This makes southern Vietnam both the rice and fruit bowls of the country. Seven of the 18 most important fruit crops grown in south Vietnam have foreign origins. These are: pineapple (27,900 ha), guava (3,400 ha), durian (900 ha), papaya (500 ha), sapoche (480 ha), caimito (260 ha), and mangosteen (160 ha) (10).

Some of the more exotic fruit introductions have become so familiar to the Vietnamese that they now mistake them as of local origin. This misconception has been bolstered by many of the introduced fruit crops having closely related species in Vietnamese forests (see below). Even introduced fruit crops from such faraway places such as South and Central America are so well adapted to Vietnamese climatic conditions that they have been erroneously considered to be of Vietnamese origin. For example, *Annona squamosa*, the sugar apple or sweet sop, is called Mang Cau "Ta" in Vietnamese, meaning "Our" Mang Cau. *Annona muricata*, the

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soursop, is called Mang Cau "Xiem", meaning the Mang Cau from Thailand. The Caimito from South America, was even planted by the late President Ho Chi Minh in his garden, to express his sentiments for the Vietnamese living in Southern Vietnam.

In this paper, we describe most of the fruit and nut crops that were successfully introduced into Vietnam, give their Vietnamese and English names when available (Table 1), and mention their useful close relatives that are native to Vietnam. When possible, we describe where the crops are cultivated, their economic importance and make recommendations for future research. The crops are grouped by their place of origin. We intentionally left out a number of crops that were probably introduced, but have extensive native Vietnamese relatives, including the mangoes, ***Mangifera indica* L.;** the longans, ***Dimocarpus longan*** Lour (*Nephelium longana* Lamk., *Euphoria longana* Lamk.) the rambutans, ***Nephelium lappaccum*** the litchis, ***Lichi chinensis*** Sonn.; the jackfruits, ***Artocarpus heterophyllus*** Lamk.; the jujubes, ***Ziziphus mauritiana*** Lamk and ***Z. jujuba*** Miller.; the Hog Plum, ***Evia dulcis*** (Parkinson) Kosterm. (*Spondias cythera* Sonn.) and the coconuts, ***Cocos nucifera*** L. These crops are addressed in a companion manuscript on native species (7).

South and Southeast Asia

Durian (*Durio zibethinus* Murr.) is a native of Malaysia, with triploid cultivars from Thailand now being grown in Vietnam. Durian, often referred to as the "King of Tropical Fruits", was introduced into Vietnam by missionaries, and has traditionally been cultivated in Lai Thieu, near Ho Chi Minh City. This 10 m tall tree has light yellow, thorny fruit with 5 chambers, each containing 2-3 wedges of soft, sweet and strongly fragrant flesh with large or small brown seeds. When ripe, the fruit cracks into 5 compartments (23). The fruit are highly esteemed by local people and believed to be an aphrodisiac (19). There are 63 cultivars grown in Vietnam, with 3 being particularly popular. These are: 1) 'Sau Rieng Sua' with undeveloped seeds, cultivated in Cai Mon and Ben Tre, 2) 'Sau Rieng Kho Qua Xanh,' cultivated in Tam Binh and Tien Giang, and 3) 'Sau Rieng Tu Qui' which is everbearing (15). Durian is sold in Asian stores across North America, even in areas with low numbers of Asians such as East Lansing, Michigan.

Several native relatives of Durian are utilized in Vietnam for their non-edible parts (12) including: 1) *Ceiba pentandra* L. Gaert, the Silk cotton tree ("Cay Bong Gon"), which has a capsule full of white, shiny fibers used in filling pillows, and 2) *Bombax anceps* Pierre ("Hoa Gao Do") which is a tall (15 m) deciduous tree that is a strikingly attractive ornamental with red flowers which bloom before the arrival of its leaves.

Mangosteen (*Garcinia mangostana* L.), is an Indonesian native. Often referred to as the "Queen of Tropical Fruits", it is an evergreen tree (12-20 m tall), with round, purple-black skinned fruits that have white flesh. The fruit are 4-5 cm wide, with four to eight segments, each containing 1 to 2 seeds. They are highly fragrant and have a sour taste with a trace of sweetness. Mangosteen is an obligate agamosperm (18) and is easy to propagate clonally.

Recently, high demand has helped to expand mangosteens international market, although Vietnamese acreage is very low with only 160 ha in the south. This is surprising as mangosteen is highly esteemed by the Vietnamese and numerous relatives of it are found in Vietnamese forests. These have provided a wide array of edible fruits and dyes (12, 13, 14). It seems likely that a science-based effort to cultivate this crop would benefit both the domestic and export markets. Ton-that (23) suggested that Vietnam should introduce new sources of mangosteen from Malaysia and Thailand.

There are 14 edible species of mangosteen found native in Vietnam, including *Garcinis planchonii* Pierre ("Bua Planchon"), *G. multiflora* Cham.ex Benth ("Doc"), *G. cochinchinensis* (Lour)

Choisy ("Bua Nha", "Tai Chua"), *G. benthami* Pierre ("Bua Bentham"), *G. fusca* Pierre ("Bua Lua"), *G. merguensis* Wight ("Son Ve"), *G. oliveri* Pierre ("Bua Nui"), *G. harmandii* Pierre ("Bua Moi"), *G. penduculata* Roxb. ("Bua Cong") and *G. cowa* Roxb. ("Tai Chua"). These native species might serve an important role in the genetic improvement of mangosteen.

Two important species of *Averrhoa*, both small trees of Malaysian origin, are cultivated widely in the plains of Vietnam: 1) **Carambola (*Averrhoa carambola* L.),** grown for its sour, yellow fruit with 5 deep ribs, and 2) **Cucumber tree (*A. bilimbi* L.)** grown for it's 3-6 cm long green-yellow berries with longitudinal grooves and very sour flesh. Home for the Vietnamese is where they can grow the carambola tree, as it is used in many native dishes. There are several native species of *Averrhoa* in Vietnam, but, in general, they are not widely utilized (13). Carambola is growing in popularity in the West and Vietnam would benefit greatly in supplying it to an already converted population of these cosmopolitan Westerners.

Malay apple (*Syzygium malaccense* (L.) Merr.) is a Malaysian native. This small tree is very attractive during its reproductive phase with flowers as strikingly beautiful as that of the Flame of the Forest ("Phuong Vy") (23). Its flowers are large with 5-8 mm wide sepals, red petals and numerous long, red stamens (2.5-3.0 mm). The flowers develop into large round, red berries which have a white, watery flesh, a single seed and a slightly sour taste.

Tamarind *(Tamarindus indica)* is cultivated countrywide , but the most impressive stand of giant tamarind trees (10-12 m tall) can be seen lining the street by the Trung Vuong Girls' High School in Ho Chi Minh City. Tamarind has 7-12 cm cylindrical, sour fruit with hard brown seeds. Its versatile fruit is eaten fresh, pickled, in dried preserved forms, or cooked in soup. Its wood is used in building construction and as fuel (27). A native relative of the tamarind, ***Dialium cochinchinensis* Pierre.,** called the velvet tamarind, is also utilized in Vietnam. It is a small tree with 1-1.5 cm round to oval fruits which are in clusters at branch terminals. The fruit is covered with a brittle, black velvety pubescent shell. Its sweet and sour flesh contains one brown and shinny flat seed (12). Both types of tamarinds are sold in Asian stores in North America with fresh *Tamarindus indica* (Me) sold at 3 times the price of longan in Toronto (HTL, pers. obs.)

Temperate China and Japan

The Vietnamese have enjoyed since antiquity a number of fruit crops from temperate China and Japan. These fruits, belonging mainly to the *Rosaceae* family, are: 1) **Apricot (*Prunus armeniaca* L.)** which is highly esteemed in Vietnam, with 7-8,000 MT being produced annually (4). It is processed into a dried, sweet and sour pickle that fetches a high price in the Hanoi market of about USD 3/kg. 2) **Japanese apricot (*P. mume* Sieb. & Zucc.).** 3) **Peach (*P. persica* L. Batsch.).** 4) **Plum (*P. salicina* Lindl. var. *salicina* Prun., *P. trifolia* Roxb.).** 5) **Pear (*P. ussurensis* Maxim.)** and 6) **Chinese Pear (*Pyrus pyrifolia* (Burm.f) Nakai.**

Loquat, ***Eriobotrya japonica* Lindl,** is found wild in northern Vietnam, mostly in Cao Bang, Lang Son and Hanoi, but was domesticated in Japan and China. It is a small, 6-8 m tall plant, with pubescent fruits that are globulous, 3-4 cm wide, and yellow when ripe (12).

Latin America

Cashew (*Anacareum occidentale* L.) is a native of Central and South America. Its achenes are processed primarily into what are called cashew nuts, although its enlarged receptacles are also edible and rich in vitamins. There has been a recent attempt to process the receptacles into juice with promising results (1).

Cashews tolerance to poor soils, its tasty fruits and a favorable world market have helped expand its cultivation in Vietnam from 22, 167 MT in 1989-91 to 80,000 MT in 1995 (4). This impressive export revenue has been achieved even

though Vietnamese cashews are of low grade. To expand export markets, it is important that Vietnam evaluate improved cultivars from India to attain higher quality and better yields.

Dragon fruit (*Hylocereus undatus* (Haw.) Britt. & Rose) was introduced from Nicaragua in the late 1980s. This climbing vine of the *Cactaceae* family is a component of the traditional integrated farming system of VAC ("Vuon, Ao, Chuong") in southern Vietnam. At 200 ha of cultivation, its acreage is higher than that of the more familiar mangosteen in southern Vietnam (10). Farmers in Binh Thuan extend day length using artificial light to induce flowering. Dragon fruit has a bland taste which is very different from the common sweet taste of most other tropical fruits, but it is very popular among local people. The fruit is egg shaped, about 300 g and is colored dark red, purple or pink with shiny black seeds.

Papaya (*Carica papaya* L.) was introduced to Vietnam via the Philippines (23), but was probably first domesticated in southern Mexico and Costa Rica. A bisexual, self-fertile variety, 'Solo,' was selected in Hawaii and introduced to Vietnam in 1950-52; however, it was not well-received due to its bitter taste and small fruit size. The new self fertile varieties 'Dai Loan Tim' and 'Hong Kong Da Bong' are now more popularly cultivated. The Vietnamese use the shredded green fruits of this species in salads. Its ripe fruits are also a popular dessert, after the hundred tiny black seeds in the center are removed. The fruits of papaya lose their sweetness in cold temperatures, so finding more cold resistant cultivars would increase cultivation in the temperate high mountains (23).

Numerous fruit crops in the family *Sapotaceae* have been successfully introduced into Vietnam from Latin America. 1) **Star apple, Cainito (*Chrysophyllum cainito* L.),** has an origin in the West Indies and Central America (22). It was introduced in 1930 to Vietnam and adopted widely in southern Vietnam where it is commonly grown in backyards. It has an attractive canopy with dense two colored foliage: the upper leaf surface is shinny green and the lower leaf surface is velvety brown. Its round, pale green or dark brown skinned berries, 7-8 cm wide, have succulent, sweet opaque-translucent flesh and 2-5 seeds. There are at least 5 land races grown in Vietnam, but 'Vu Sua Lo Ren Trang' is considered the most superior (15), 2) **Sapodilla [*Achras sapota* (*Manilkara achras* [Mill.] Fosb.)]** was introduced into Vietnam in the late 19th century (23). Sapoche is a 10-12 m tall tree whose origin is from Mexico to southern Venezuela (22). It has rough and rust colored fruits that are 5-10 cm long. Sapoche is a very popular dessert that is harvested all year round. When ripe, its ovoid fruits have a sweet, aromatic yellow brown flesh with a soft, sandy texture. It has shiny black seeds that do not cling to the flesh. Cultivation of an improved sapoche, Sapo Day,' in the Mekong Delta has been found to be more profitable than that of the native longan (17), 3) **Canistel or Lekima (*Pouteria campechina* Zaaposa (Jacq.) Morre & Stearn.)** was introduced into Vietnam in the 1930s, but did not become a familiar sight in gardens in Southern Vietnam until the mid 1950s and 60s. This 8-10 m tall tree bears numerous round, pointed fruits which have an orange, sweet flesh and 1-3 brown and shinny seeds. Most of the lekima have a dry texture, similar to that of boiled egg yolk, thus, the Vietnamese name, "Trung Ga". However, there are reports of Lekima with moist flesh (22).

There are also 4 edible native species of *Sapotaceae* utilized in Vietnam. These are: 1) ***Manilkara hexandra* (Roxb.) Dub. ("Gang Neo")** found in degenerated forests and cultivated in Con Son. This 20 m tall tree has white latex and short branches around its stem. Its cymes of white flowers turn into 1 cm wide, round berries with yellow flesh and 1-2 flat and shinny seeds, 2) ***M. kauki* (L.) Dub. ("Viet"),** cultivated in Chau Doc for its quail's egg-sized fruits with flesh similar to that of the sapodilla. Its yellow-grey seeds are 1.8 cm long, 3) ***Madhuca pasquieri* (Dub) H. J. Lam ("Sen Dua,**

Lau"), distributed in the mountains from Quang Yen to Vinh. This large tree, with red brown wood has 3 cm wide ovoid berries that have a single seed containing edible oil, 4) ***Xantolis cambodiana* (Dub.) Van Royen (Sen Gang),** distributed in forests in Ha Son Binh, Bac Thai, Phu Khanh, Phan Rang to 400 m elevation. This small, white latexed tree has pubescent, oval and edible fruits which have a hard pericarp with a single flat and long seed. Its leaves and roots are thought to improve health and induce milk production in humans (12).

Avocado (*Persea americana* Miller) was brought to Vietnam from Central America in the 1960s, but Ton-that (23) suggested that there are numerous improved cultivars that should be introduced into Vietnam.

There are a large number of introduced *Annonaceae* grown in Vietnam: 1) **Soursop (*A. muricata* L.)** is cultivated widely in southern and central Vietnam for its delicious fruits and its spicy young leaves. This 8 m tall tree has reddish young shoots and shiny dark-green, fragrant leaves. Its large, 20 cm wide spiny, green syncarps contain delicious and fragrant white flesh surrounding its shiny, black-brown seeds, 2) **Sugar apple or sweet sop (*A. squamosa* L.)** is a small tree which produces syncarps (5-9 cm wide) with easily peeled skins. The soft, sweet fruits have a white flesh that surrounds shiny, black-brown seeds. The flesh may be firm ("Na Dai") or soft ("Na Bo"), with the former being preferred, 3) **Custard apple (*A. reticulata* L.)** is a small, 7-8 m tall tree which has brown or red syncarps, 5-12 cm wide. These have shallow pentagon shaped, concaved surfaces that demark each individual member of the syncarps (14), 4) **Cherimoya (*A. cherimola*)** is a native of the highlands of Peru and Ecuador. It was introduced into Vietnam between 1930-1940. Cherimoya fruit are smaller than the sour sop and not as tasty to the Vietnamese, and as a result, were slow to be adopted. However, new varieties from Mexico are now being cultivated by the Vietnamese refugees whom settled in California. Cherimoya is probably suitable for cultivation in the temperate climate of the West Plateau and the highlands of Northern Vietnam (23). It is a tree that is about the same size as that of the soursop, and its fruit are approximately the same size as the custard apple ("Binh Bat") with a greener, rougher skin and harder flesh (23). Cherimoya can be found in special Asian stores and in upscale supermarkets in North America.

Three edible native of *Annonaceae* species are utilized in Vietnam: 1) ***A. glabra* L.** Mangrove Annona, Alligator Apple, Monkey Apple ("Binh Bat Nuoc") is a small, 2-5 m tall tree, found in areas of brackish water. Its spineless, green-yellow syncarps are 7-10 cm long and have white flesh with black-brown seeds. Its fruits have a bland taste, but it can be used as grafting stock for other *Annona* (34), 2) ***Rauwenhoffia siamensis* Scheff ("Du De")** is a small standing or climbing tree found in degenerate forests along the seashore, 3) ***Mitrella mesnyi* Pierre ("Ban", "Com Nguoi")** is found in degenerated forests in Dong Nai, Tay Ninh and Phu Quoc. It is a 9-10 m tall tree that has shiny, black-purple fruits with one seed and sour flesh.

Several introduced species in the genus *Passiflora* are economically important in Vietnam. These are: 1) **Giant Grenadilla (*P. quadrangularis* L.),** cultivated from the plains to 1,000 m elevation. It has a South American origin. This large climbing vine has elongated berries, up to 30 cm long, with yellow flesh and flat, black seeds of 7-9 mm, 2) **Purple and Yellow passion fruits (*P. edulis* Sims var. *edulis* and *P. edulis* Deg. var. *flavicarpa*),** from Brazil. This species is a climbing vine with egg-shaped, purple berries (4-6 cm long) and orange, sweet and sour arils, 3) ***P. coerulea* L.** is a small climbing vine with berries (4 x 6 cm) that are orange and contain lense-shaped seeds and transparent arils, 4) ***P. laurifolia* L.** has a South American origin and is cultivated in the Saigon Botanical Garden. It has egg-shaped berries with white flesh and 3 longitudinal stripes on their surface, 5) ***P.***

suberosa which has its origin in Guadeloupe in South America. It has small white flowers and 1 cm wide berries (12), 6) **Passion flowers, passion vine (*P. incarnata* L.),** an African native with violet flowers and small yellow berries which taste like apricots (14, 23). There are an additional 9 native *Passiflora* species found in the high mountains that have small, edible berries (1-2 cm), but these are not as widely exploited as the introduced species (12).

Numerous species in the family *Myrtaceae* have been introduced into Vietnam. In particular *Psidium,* the guava, has a special place in the hearts of Vietnamese, as many have strong childhood memories of eating these fruits with a mixture of salt and crushed fresh hot pepper (23). There are three introduced species of guava cultivated in Vietnam: 1) ***Psidium gujava* L.** is originally from Central America. This small 3-6 m tall tree has pear shaped berries which have a delicious, white flesh which turns pink when ripe and contains yellow seeds (2-3 mm long). There is an almost seedless type of *Psidium gujava* sold in the open market by the dock of the My Thuan ferry in the Mekong Delta, which weighs close to 1 kg/fruit. *Psidium gujava* is as crunchy as the Bartlett pear although to Vietnamese, it is tastier. Fruit from Tien Giang is reported to be crisper than those from My Thuan (15). A recent survey by the Long Dinh Fruit Crop Center recognized 12 landraces of *Psidium gujava* in Vietnam and identified *P. gujava* as being important to the juice processing industries, 2) ***P. cujavillus* Burm. f.** is a small 2-3 m tall tree which has round berries with pink flesh and many hard brown seeds. It is grown most widely as an ornamental, 3) **Purple guava or Strawberry guava (*P. littorale* Raddi),** has its origin in China. This small tree (6 m tall) has 2.3-3 cm round berries with small seeds; its flesh tastes like strawberries (12). A relative of the guava, **Surinam cherry or Cayenne cherry (*Eugenia uniflora* L.),** was introduced from the American continent and has 1.5-2.5 cm white berries with 8 longitudinal grooves on their surface. Its sweet flesh has a fragrance similar to that of the mango. A large number of important native species of *Myrtaceae* are also grown in Vietnam and have been described elsewhere (7, 12)

Pineapple (*Ananas comosus* (L.) Merr.) is cultivated country-wide for its fruits. In Southern Vietnam, pineapple occupies the largest acreage among introduced fruit crops and is second only to the native banana in terms of total commercial acreage (10). This South American native was introduced to Vietnam mainly from Australia. Pineapples are eaten fresh as a dessert and have become a part of many indigenous dishes including sour soups and "Mam Nem", a special fish sauce dip used in the famous Vietnamese dish, beef fondue in vinegar.

In northern Vietnam, only the name "Dua" is used for pineapple, whereas the South Vietnamese differentiate two forms by leaf and fruit morphology, "Thom" and "Khom". Thom has fewer spines at its leaf margin than Khom and its green fruit are not as sweet as those of the yellow-red Khom. The Khom's fruit are also less spiny, larger, and as a result are more highly prized than Khom. Khom cultivation is particularly widespread in Kien Giang Province, thus the name "Khom Kien Giang". The Khom varieties, 'Queen Singapore,' 'Queen Gold,' 'Queen Alexandria' and 'Queen McGregor' were originally introduced for experimentation in the Mekong Delta in the late 1930s. At the same time, the 'Smooth Cayenne,' 'Sarawak' and 'Red Spanish' group ('Thom Gai Do,' 'Thom Lua,' 'Thom Be Do,' 'Dua Ta,' 'Dua Buom' or 'Dua Tam Luong') were introduced to Vietnam (16). The Queen group, called "Na Hoa" in Vietnamese, were first cultivated in northern Vietnam in Lang Son around 1955-60. In recent years, with decreasing export of processed pineapples to the former Communist block, pineapple acreage has been shifted to fruit crops favored by local people such as introduced grapes or popular natives such as

Table 1. Introduced fruit crops in Vietnam

Origin	Common English name	Vietnamese name	Scientific name	Principle locations
South and South East Asia	Carambola	Khe	*Averrhoa carambola* L.	Countrywide
	Cucumber Tree	Khe Tau	*A. bilimbi* L.	Countrywide
	Durian	Sau Rieng	*Durio zibethinus* Murr.	Mekong Delta, West Plateau
	Malay apple	Dieu Do, Man Huyet Trung Luong	*Syzygium malaccense* (L.) Merr.	Mekong Delta
	Mangosteen	Mang Cut	*Garcinia mangostana* L,	Mekong Delta
	Tamarind	Me	*Tamarindus Indica* L.	Countrywide
Temperate Japan and China	Apricot	Mo	*Prunus armeniaca* L.	Highlands of Northern Vietnam
	Chinese Pear	Le	*Pyrus pyrifolia* (Burm.f) Nakai and *P. ussurensls* Maxim.	Highlands of Northern Vietnam
	Japanese apricot	Mo hoa vang	*P. mume* Sleb. & Zuce.)	Highlands of Northern Vietnam
	Loquat	Nhot Nhat Ban, Phi Pha, Ty Ba Diep	*Eriobotrya japonica* Lindl.	Northern Vietnam
	Peach	Dao	*P. persica* L. Batsch	Highlands of Northern Vietnam and West Plataeu
	Plum	Man	*P. salicina* Lindl. var. *salicina,* cultivated form: *P. trifolia* Roxb.	Northern Vietnam and West Plateau
Latin America	Avocado	Cay Bo	*Persea americana* Mill.	Highlands of Northern and West Plateau
	Barbados Cherry, West Indian Cherry	Hong Quan, Ban Quan	*Malpighia glabra* L.	Mekong Delta
	Cashew	Dao Lon Hot, Hot Dieu	*Anacareum occidentale* L.	Central and Southern Vietnam, southwardly from Quang Nam province.
	Cherimoya	Mang Cau Tay	*A. cherimola*	West Plateau
	Custard apple	Binh Bat	*A. reticulata* L.	Countrywide
	Dragon fruit	Thanh Long, Tuong Lien	*Hylocereus undatus* (Haw.) Britt. & Rose	Mekong Delta and Central Vietnam
	Giant Grenadilla	Chum Bao Dua, Day Dua Bo, Dua Gang Tay	*Passiflora quadrangularis* L.	West Plateau
	Guava	Oi	*Psidium gujava* L.	Mekong Delta
	Ornamental guava	Oi Kieng	*P. cujavillus* Burm.f.	Countrywide
	Papaya	Du du	*Carica papaya* L.	Countrywide
	Pineapple	Dua, Thom, Khom	*Ananas comosus* (L.) Merr.	Countrywide

Table 1. Continued.

Origin	Common English name	Vietnamese name	Scientific name	Principle locations
	Purple guava, Strawberry guava	Oi Se	*P. littorale* Raddi	Quang Tri, Thua Thien provinces in Central Vietnam.
	Purple and Yellow Passion Fruits	Chum Bao Trung	*P. edulis* Sims var *edulis* and *P. edulis* Deg. var. *flavicarpa*	West Plateau
	Sapodilla	Sapoche, Hong Xiem	*Manilkara achras* (Mill.) Foscb.	Mekong Delta
	Soursop	Mang Cau Xiem	*Annonaceae muricata* L.	Southern and Central Vietnam
	Star apple, Caimito	Vu Sua	*Chrysophyllum cainito* L.	Mekong Delta
	Surinam cherry, Cayenne cherry	Tram sori	*Eugenia uniflora* L.	Hue
	Sweetsop, sugar apple	Mang Cau Ta, Na	*A. squamosa* L.	Countrywide
	Unknown	Nhan Long Lam	*P. coerulea* L.	Quang Nam, Da Nang, Saigon
	Unknown	Guoi Tay	P. laurifolia L.	Saigon Botanical Garden
	Unknown	Nhan Long Sube	*P. suberosa*	Ho Chi Minh City
European/ Middle East Mediterranean	Apple	Tao	*Malus domestica*	West Plateau
	Fig	Va, Sung	*Ficus carica* L.	Nha Trang, Central Vietnam
	Grape	Nho	*Vitis* spp.	Phan Rang, Ninh Thuan in Central Vietnam
	Pomegranate	Luu	*Punica granatum* L.	Countrywide
	Strawberries	Dau Tay	*Fragaria vesca* and *F.* x *ananassa*	Northern Vietnam and West Plateau
Africa	Passion flowers, passion vines	Mac Mat, Lac Tien	*P. incarnata* L.	Hanoi, Dalat

the Thieu lychees or the Hung Yen longan (Le-van Thuyet, pers. comm.).

Barbados Cherry, West Indian Cherry (*Quan-Malpighia glabra* L.) is a recent introduction to southern Vietnam. Its fruits can be harvested 3-5 times/year, with yields reaching 60 tons/ha/year (23). Its fruits are larger and higher in vitamin content than its cultivated Vietnamese relatives *Flacourtia rukkam* Zoll. & More (Hong Quan and Muong Quan), *F. jangosmas* (Lour.) Raeusch (Hong Quan, Ban Quan and Muong Quan) and their wild Vietnamese relatives *F. montana* Grah. (Hong Quan Nui) and *F. indica* (Burm.f).Merr. (Hong Quan An) (7, 12). Barbados cherry is a beautiful ornamental that is almost in continual bloom and has small white flowers covering all its branches.

European/Mediterranean/Middle East

Grape *(Vitis spp.)* is cultivated in Phan Rang and Ninh Thuan where the suitable dry climate, sandy soil and availability of water has allowed farmers to harvest 3 crops/ann (23). There are also plans to cultivate grapes in Ba Vi, northern Vietnam with imported stock from France (Le-van Thuyet, 1995, pers. comm.). Most grapes cultivated in Vietnam are red and it is not known whether they are Mus-

cadine *(V. rotundifolia)* or a Muscat *(V. vinifera)* (23).

It has been suggested that more grape cultivars should be introduced to Vietnam and tested for their adaptation, as there is room for expansion in the domestic fresh fruit market (23). 'Thompson Seedless' and the 'Red' and 'White Malaga' *(V. vinifera),* are cultivated in Thailand where conditions are similar to that of Vietnam. In 1994, at the Sub-Institute of Biotechnology in the Institute of Tropical Biology in Ho Chi Minh City, tissue culture propagation of the 'Thompson Seedless' was achieved.

Apple *(Malus domestica)* is currently little cultivated in Vietnam but there is high demand for the fruit, particularly among the Saigonese. Until 1975, apples and other temperate fruits were imported from Europe and were sold at much higher price than all tropical fruit crops. Efforts were made in 1940-55 to cultivate apple in the highlands of the West Plateau, but these initial efforts failed as the fruit were small and deformed. In the last few years, apples imported from neighboring China have been sold in Hanoi markets at prices competitive with other popular tropical fruit crops such as litchis, mangoes and durians. This drop in price may increase the popularity of apples and encourage local cultivation.

Fig (*Ficus carica* L.) is cultivated in the sunny, dry climate of Nha Trang (14). A number of panthenocarpic cultivars have been recommended for introduction to Vietnam (23).

Strawberries (*Fragaria* spp). *F. vesca* L. and *F.* x *ananassa* are cultivated in Dalat and most recently, in northern Vietnam (24). *F.* x *ananassa* is a hybrid of *F. chiloensis* from Chile and *F. virginiana* from North America, while *F. vesca* is native to temperate Asia, North America and Europe (6). Strawberries were probably introduced by the French, as its Vietnamese name indicates that they are "berries from the West". The importation of modern large-fruited cultivars appears warranted, as most of the cultivars now grown in Vietnam are old varieties with small, soft fruit. Strawberries are highly esteemed by the Vietnamese and command a high price in Vietnam markets. A native species, *F. nilgerensis* Schlecht.ex Gray ("Dau Tay"), is found along roadsides in Lai Chau and Lao Cai (12).

Pomegranate (*Punica granatum* L.) is cultivated both for its fruit and as an ornamental. This small plant from Iran, has solitary flowers with 6 bright red petals, many anthers and a red inferior ovary. Its berries have many red seeds in a transparent, sweet and sour pericarp.

Conclusions

Since 1989, Vietnam has been a rice exporter, after more than 3 decades of being a net importer. This increase has come primarily in the fertile deltas of the Red and Mekong Rivers, but low returns have induced some rice farmers to shift to fruit crops. In fact, fruit acreage is now expanding at the expense of rice acreage in the Mekong Delta (10).

In the mountainous, less fertile regions of Vietnam where indigenous people face constant food shortages (3), fruit crop cultivation is also a particularly attractive option. These regions have not shared in the benefits of rice improvement, and the perenniality of fruit crop cultivation could help reduce the severity of soil erosion and watershed destruction due to deforestation, caused in part by slash and burn agriculture. People making a living on a perennial fruit crops, will not need to rely on clearing forest to feed their families.

The Vietnamese government has encouraged fruit crop cultivation in the high mountains with decree 327, but the areas lack the kind of scientific support given to rice cultivation, and there is little socio-economic infrastructure to assist the indigenous people. With the appropriate policy and infrastructure in place, the opportunities are almost limitless. While Vietnam is lagging behind her neighbors in fruit cultivation, she has a proven base of germplasm that was introduced from all over the world, and improved cultivars are available from her neighbors with similar climatic conditions such as Thailand, Malaysia, China, Taiwan, Korea

and India or from faraway continents such as Africa, Americas, Australia and Europe. Since the labor cost in Vietnam is still the lowest in Asia, fruit farming offers a ready option to diversify farmers' portfolios while enriching Vietnam germplasm resources.

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Literature Cited

1. Dubuc, B. 1995. Cashew apple juice, Anyone? IDRC Reports (23) 1. gopher://gopher.idrc.ca:70/00/.PUBLICATIONS/.MAGARCHIVE/.V231/.V23108
2. Far Eastern Economic Review, 1995. Asia 1995 Yearbook, p. 224.
3. FAO. 1994. How they did it: Vietnam's incredible rice boom. Ceres 146: 12-14.
4. FAO. 1995. FAO production year book. Volume 49. Food and Agriculture Organization of the United Nations. Rome, Italy.
5. FAO. 1997. FAOSTATE Agriculture Data. http://apps.fao.org/lim500/nph-wrap.pl?Trade.CRopsLivestockProducts& Domain=SUA
6. Hancock, J. F. and J. J. Luby. 1993. Genetic Resources at our doorstep:The wild strawberries. Bioscience 43:141-147.
7. Le, H. T., J. F. Hancock, Ton-that Trinh and Pham-hoang Ho. 1998. The fruit crops of Vietnam Native species. (Submitted–Fruit Var. J.)
8. Mai-van, Quyen and Hoang-Kim, 1996. Contribution of germ bank of field crops for production in Vietnam, p 114-118. In: Plant Genetic Resources in Vietnam. Proc. Nat. Workshop on Strengthening of Plt. Gen. Res. Programme in Vietnam. Agriculture Publishing House. Hanoi, Vietnam.
9. Ngo-huu, Tinh, 1996. Evaluation and utilization of maize genetic resources in Vietnam, pp. 122-125. In: Plant Genetic Resources in Vietnam. Proc. Nat. Workshop on Strengthening Plt. Gen. Res. Programme in Vietnam. Agriculture Publishing House. Hanoi, Vietnam.
10. Nguyen-van, Luat. 1995. Tiem Nang Vuon Cay An Trai Nam Bo, p. 5-30. Phu Truong Nguoi Lam Vuon, So Thang Hai. Vietnam.
11. Nien Giam Thong Ke. 1996. Nha Xuat Ban Thong Ke. Hanoi. Vietnam.
12. Pham-hoang, Ho. 1991. Cay Co Vietnam. Quyen I Tapl and 2. An illustrated flora of Vietnam. Mekong Printing. Santa Ana, CA.
13. Pham-hoang, Ho. 1992. Cay Co Viet Nam. Quyen II Tap 1. An illustrated flora of Vietnam. Mekong Printing. Santa Ana, CA.
14. Pham-hoang, Ho. 1993. Cay Co Viet Nam. Quyen III Tap 1 and 2, Quyen II Tap 2. An illustrated flora of Vietnam. Mekong Printing. Santa Ana, CA.
15. Pham-ngoc, Lieu and Pham-van, Vui. 1995. Nhung giong cay an trai duoc ua chuong, p. 8. Phu Truong Nguoi Lam Vuon. So Thang Hai. Vietnam.
16. Phan-gia, Tan. 1984. Cay dua va ky thuat trong dua o Viet Nam. Nha Xuat Ban Thanh Pho Ho Chi Minh. Vietnam.
17. Phan-van, Nga. 1995. Kinh nghiem trong Sapo Day, p. 19. Phu Truong Nguoi Lam Vuon. So Thang Hai. Vietnam.
18. Richards, A. J. 1990. Studies in *Garcinia*, dioecious tropical forest trees: the origin of the mangosteen (*G. mangostana* L.) Bot. J. Linnean Soc. 103: 301-308.
19. Richardson, J. 1990. The worldwide selection of exotic fruits and vegetables. Les editions heritages Inc.
20. Schwarz, A. 1995. Full of beans. Vietnam coffee industry is bubbling over. Far Eastern Econ. Review. September 7, p. 62-64.
21. Schwarz, A. 1996. Money grows on trees. Cashews, Vietnam finds a lucrative business. Far Eastern Econ. Review. January 25, p. 52.
22. Tankard, Glenn. 1987. Tropical fruit. An Australian guide to growing and using exotic fruits. Viking O'Neil. Penguin Books Australia Ltd.
23. Ton-that, Trinh. 1995. Tim hieu ve cac loai cay an trai co trien vong xuat khau. Nha xuat ban nong nghiep. Vien Khoa Hoc Nong Nghiep Mien Nam. Vietnam.
24. Tran-dinh, Long. 1996. The strategy for conservation and utilization of plant genetic resources in Vietnam. p. 54-59. In: Plant Genetic Resources in Vietnam. Proc. Nat. Workshop Strengthening Plt. Genet. Res. Programme. Agricultural Publishing House, Hanoi.
25. Tran-van, Lai. 1993. Vietnam. Country Report, p. 143-150. In: Narong Chomchalow and Paisan Laosuwan (eds.). Proc. of the planning workshop for the establishment of the Asian component of a global network on tropical and subtropical soybeans. Chiang Mai, Thailand, 1992. RAPA Publication: 1993/6. Food and Agriculture Organization of the United Nations. Bangkok, Thailand.
26. Truong-van, Ho and Nguyen-ngoc, Hue. 1996. Root and tuber crop genetic resources in Vietnam, p. 126-129. In: Plt. Gen. Res. in Vietnam. Proc. Nat. Workshop on Strength-

ening of Plt. Gen. Res. Programme in Vietnam. Agriculture Publishing House. Hanoi. Vietnam.
27. Vien Kinh Te Sinh Thai (VKTST). 1994. Tai nguyen rung Vietnam. Trang 25-34. Chu bien. GS. TS. Nguyen Van Truong. Nha Xuat Ban Nong Nghiep. Hanoi. Vietnam.
28. Wacherley, P. R. 1995. In: J. Smartt & N. W. Simmonds (eds.) Evolution of Crop Plants. Second Edition. Longman Scientific & Technical. Essex, England.
29. Yang S. L. and T. W. Walters. 1992. Ethnobotany and the economic role of the Cucurbitaceae of China. Econ. Bot. 46(4): 349-367.

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'Flordastar' and 'Hermosillo' Peaches and 'Lara' Nectarine: Early Varieties for Argentina

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Abstract

'Flordastar,' 'Hermosillo' and 'Lara' are recommended for trial plantings in the central peach growing region of Argentina. 'Flordastar' is a good alternative for the 'EarliGrande' season because of its superior firmness, flavor and color. 'Hermosillo' is better than 'Barceló' in flavor, and in tree vigour and health. 'Lara' is a good alternative for its season because of its superior fruit size, shape and firmness, and it has good tree health and vigour.

Introduction

'Flordastar' and 'Hermosillo' peaches and 'Lara' nectarine are released and recommended by INTA for the fresh market fruit production area of Argentina that includes the Northeastern part of Buenos Aires Province and southern part of Santa Fe Province. About 10000 ha of stone fruit are grown in this area (near 35° S x 60° W). This production area has adequate annual rainfall for peaches (no irrigation) and the winter chilling averages 500 hours below 7°C.

These varieties also show potential to be grown outside 'non traditional' stone fruit regions such as in northern areas of Argentina, which are specializing in low-chill early varieties for the fresh market.

'Flordastar' ripens with 'EarliGrande' and earlier than 'Flordaking,' while 'Hermosillo' ripens between 'June Gold' and 'Flavorcrest,' in the same harvest period of a local peach variety named 'Barceló.' 'Lara' has a ripening time that overlaps the end of 'Obligado INTA' and covers the harvest period of 'Nectarrojo INTA.' Both 'Obligado INTA' and 'Nectarrojo INTA' are local nectarine varieties.

Origin

'Flordastar' originated in 1976 from a cross of 'EarliGrande' x 'Flordagold,' and was selected in 1978 and tested as Fla 8-1, and named by the University of Florida (1). 'Hermosillo' originated from a cross of Fla 5-5 x Fla 3-4N and was tested as Fla 81-30, and named in Northwestern Mexico (2). 'Lara' originated from a cross of Fla 15-85W x 'Columbina' and was tested as Fla 3-4N, and named in Argentina. Lara was introduced into Argentina in 1978, whereas 'Flordastar' and

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