Crop Protection Compendium - *Syzygium jambos* (L.) Alston

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NAMES AND TAXONOMY

Preferred scientific name

Syzygium jambos (L.) Alston

Taxonomic position

Domain: Eukaryota
Kingdom: Viridiplantae
Phylum: Spermatophyta
Subphylum: Angiospermae
Class: Dicotyledonae
Order: Myrtales
Family: Myrtaceae

Other scientific names

Eugenia jambos L.
Jambosa jambos Millsp.
Jambosa vulgaris DC.
Caryophyllus jambos (L.) Stokes

BAYER code

SYZJA (*Syzygium jambos*)

Common names

English:
rose apple
roseapple
rose-apple
plum rose
Spanish:
poma rosa
pomarosa
manzana rosa
pomarrosa
French:
pomme rose
jambosier
jamerosier
jamrose
jambrosade
pommier rose

Brazil:
jambeiro
jambo amarelo
jambos amarello
Cambodia:
chem'-puu
Caribbean:
malabar plum
Colombia:
manzanita de rosa
Cook Islands:
ka'ika papa'a
ka'ika
ka'ika takataka
ka'ika varani
Dominican Republic:
pomo
Federated states of Micronesia:
apel en wai
iouen wai
youenwai
Fiji:
kavika ni india
kavika ni vavalangi
kavika
French Polynesia:
ahi'a papa'a
ahi'a popa'a
Germany:
Rosenapfelbaum
Guinea-Bissau:
crioulo jambô
Hawaii:
'ohi'a loke
India:
jaman
Indonesia:
jambu air mawar
jambu kraton
jambu mawar
Laos:
chièng
kièng
Madagascar:
zamborozano
Malaysia:
jambu kelampok
jambu mawer
Martinique:
pòm wòz
Mauritius:
jambrosade
jamrosa
Mayotte:
goyavier parfum
pouéra marachi
Philippines:
balobar
bunlauan
bunlaun
tampoi
tampoy
tanpul
yambo
yampoi
Ryukyu Archipelago:
futo-momo

futo
Samoa:
seasea palagisam
seasea papalagi
Sao Tome and Principe:
jamboeiro
Sierra Leone:
krio roz-apul
Sri Lanka:
nir-nawal
seenijambu
veli jambu
Suriname:
appelroos
pommeroos
Thailand:
chomphu-namdokmai
manomhom
yamu-panawa
Tonga:
fekika papalangi
USA:
Malabar plum
Vietnam:
bô dào
lye
roi

Notes on taxonomy and nomenclature

In most of the earlier literature the tree is referred to as *Eugenia jambos* L. or even *Jambosa vulgaris* DC.

HOST RANGE

Notes on host range

A variety of tropical crops are affected by the tree's shallow rooting or the heavy shade produced by spreading branches.

HABITAT

It is unclear what was its original habitat in its native range, but it is now commonly found around homesteads and forms large stands, often pure, in many parts of the tropics. It has been used as an agroforestry tree to form field boundaries and provide shelter, is also known to occur under the canopy of mature disturbed forest, and is also found in pastures and waste places.

GEOGRAPHIC DISTRIBUTION

Notes on distribution

The native range of *S. jambos* is uncertain due to prehistorical introductions. It is thought to be native to South-East Asia, Indonesia, the Philippines and Malaysia, and its natural distribution probably did not extend to India where the tree is thought to have been introduced. Morton (1987) suggested that it was also introduced to the former Indochina region. It is likely that the species is now present in the majority of countries in the humid tropics, although generally very locally and often in low numbers.

Distribution List

Europe				
[Portugal]				
Madeira	present	introduced	invasive	Turland, 1994
Asia				
Bangladesh	present			van Lingen, 1991
Cambodia	present			Morton, 1987
[China]				

Hong Kong	present	introduced	not invasive	Jim, 1990
Taiwan	present	introduced	invasive	Chang, 1995
India	present	introduced	not invasive	Morton, 1987
Tamil Nadu	present	introduced		Matthew, 1969
Indonesia	present			Morton, 1987
Israel	present	introduced	not invasive	Morton, 1987
[Japan]				
Ryukyu Archipelago	present	introduced	invasive	Walker, 1976
Laos	present			Morton, 1987
Malaysia	present	native		Morton, 1987
Philippines	present	introduced	not invasive	Brown, 1954
Sri Lanka	localized	introduced	invasive	Ashton, 1981
Thailand	present	native		Chantaranothai & Parnell, 1994
Vietnam	present	introduced		Morton, 1987
Africa				
Congo Democratic Republic	present	introduced	not invasive	Pauwels, 1993
Ghana	present	introduced (before 1893)		Morton, 1987
Guinea-Bissau	present	introduced		Burkill, 1997
Madagascar	localized	introduced	invasive	Binggeli, 2003
Mauritius	localized	introduced	invasive	Lorence & Sussman, 1986
Rodriguez Island	widespread	introduced	invasive	Strahm, 1989
Réunion	localized	introduced	invasive	Macdonald et al., 1991
Sao Tome and Principe	present	introduced	not invasive	Exell, 1944
Seychelles	localized	introduced	invasive	Küffer et al., 2003
Sierra Leone	present	introduced		Burkill, 1997
South Africa	localized	introduced	invasive	Anon., 2001
Tanzania	localized	introduced	invasive	Binggeli, 2001
Zanzibar	present	introduced	invasive	Morton, 1987
Central America & Caribbean				
Antigua and Barbuda	present	introduced		Harris, 1965
Bahamas	present	introduced		Morton, 1987
Barbados	present	introduced	not invasive	Gooding et al., 1965
Belize	present	introduced		Meerman, 2003
Bermuda	present	introduced		Morton, 1987
British Virgin Islands	present	introduced		Little & Wadsworth,

				1964
Costa Rica	present	introduced	invasive	Di Stefano et al., 1998
Cuba	present	introduced	invasive	Seifriz, 1943
Dominican Republic	present	introduced	invasive	Wadsworth, 1943
El Salvador	present	introduced		Morton, 1987
Guatemala	present	introduced	invasive	Morton, 1987
Honduras	present	introduced	invasive	Morton, 1987
Jamaica	localized	introduced (1762)	invasive	Asprey & Robbins, 1953
Martinique	present	introduced		Palli, 2002
Nicaragua	present	introduced		Morton, 1987
Panama	present	introduced	invasive	Morton, 1987
Puerto Rico	localized	introduced	invasive	Little & Wadsworth, 1964
United States Virgin Islands	present	introduced	invasive	Morton, 1987
North America				
Mexico	present	introduced		Soto-Pinto et al., 2000
[USA]				
California	present	introduced	not invasive	Morton, 1987
Florida	present	introduced (1877)	invasive	Morton, 1987
Hawaii	localized	introduced (1825)	invasive	Smith, 1985
South America				
Brazil	present	introduced (before 1825)		Morton, 1987
Goias	present	introduced	not invasive	Tessmann et al., 2001
Rio de Janeiro	present	introduced		Morton, 1987
Colombia	present	introduced		Morton, 1987
Ecuador	present	introduced		Morton, 1987
French Guiana	present	introduced		Little & Wadsworth, 1964
Peru	present	introduced		Morton, 1987
Suriname	present	introduced		Little & Wadsworth, 1964
Oceania				
American Samoa	present	introduced	not invasive	Space & Flynn, 2000
[Australia]				
Queensland	present	introduced (1890s)		Morton, 1987
Belau	present	introduced		Space et al., 2003
Cook Islands	present	introduced		Space et al., 2003
Fiji	present	introduced		Smith, 1985

French Polynesia	localized	introduced	invasive	Meyer, 2000
Guam	present	introduced	invasive	Space et al., 2003
New Caledonia	present, few occurrences	introduced	not invasive	Guillaumin, 1942
Niue	present	introduced	not invasive	Space & Flynn, 2000
Pitcairn Islands	widespread	introduced	invasive	Binggeli & Starmer, 1997
Samoa	present	introduced	not invasive	Whistler, 1988
Tonga	present	introduced		Space & Flynn, 2001

HISTORY OF INTRODUCTION AND SPREAD

In South-East Asia, indigenous people must have spread *S. jambos* beyond its native range, including to many of the offshore islands long ago, but no records exist. *S. jambos* was introduced into Jamaica in 1762 and subsequently to much of the neotropics from Mexico to Peru and to most of the Caribbean islands as a fruit tree. In Guatemala the tree has been planted as a living fencepost or in hedgerows around coffee plantations (Morton, 1987) and in many parts of the neotropics it forms dense stands and thickets. In Puerto Rico it is particularly common in secondary forest and riparian vegetation (Heartsill-Scalley and Aide, 2003) and it is spreading in Costa Rica (Di Stefano et al., 1998). It was recorded in Florida, at Jacksonville, prior to 1877 and in California it was planted as far north as San Francisco as an ornamental. In 1825, eight saplings were taken from Rio de Janeiro to Hawaii by ship and in 1853 a United States warship delivered trees from Central America to the island of Hilo. It is thought to have been first planted in Queensland, Australia, in the 1890s (Morton, 1987). In the Pacific, *S. jambos* has become invasive on the islands of Kauai, Molokai, Oahu, Maui and Hawaii (Smith, 1985). On the island of Pitcairn it is often reported as a major invasive (Diamond, 1994), but is more a feature of a largely abandoned agroforestry system rather than highly invasive of natural vegetation. In West Africa, it was reported as already cultivated in Ghana in 1893 and it is 'semi-naturalized' in some areas of tropical West Africa (Morton, 1987). It is now a major environmental weed on Indian Ocean Islands and is locally regenerating freely in the East Usambara forests and the islands of Zanzibar and Pemba, Tanzania. It was also introduced to the coastal plain of Israel where it is an ornamental (Morton, 1987).

BIOLOGY AND ECOLOGY

Genetics

The chromosome number is variable, 2n=28, 33, ~44, 46, ~54 and 66 having all been recorded by van Lingen (1991). As the quality and quantity of the fruit produced is variable, Burkill (1997) considered that there is scope for selection. Young seedlings have also been noted as being highly variable (Morton, 1987). Breeding of the tree for the production of essential oils or to enhance its ornamental value has also been suggested, but to-date no such programme has been initiated.

Physiology and Phenology

The tree grows in more or less synchronous flushes, one of which brings on flowering. Flowering occurs after a quiescent period, e.g. in spring in the subtropics, late in the dry

season in East Java. The fruit ripens 3 months after bloom. In Puerto Rico and Jamaica, flowering and fruiting occurs nearly throughout the year, though infrequently in the summer (Little and Wadsworth, 1964; Morton, 1987). In the Bahamas and Florida, USA, the main reproductive season is from May through to July. In India, fruiting time varies according to regions; in the south flowering usually occurs in January, with fruit ripening in March and April, whereas elsewhere, fruit ripening takes place in April and May or in July and August. Some varieties produce fruit in February and March (Morton, 1987). In the East Usambara mountains of Tanzania there are two flowering seasons, December to January and September to October and fruits take a few weeks to ripen (Voigt, 1914). Van Lingen (1991) stated that fruits take 3 months to mature.

Reproductive Biology

Little is known about the reproductive biology of *S. jambos*. Sexual reproduction may start from as early as 4 years old and at higher altitude trees fail to flower and fruit. It is probably solely or mostly bee pollinated and produces a limited amount of fruits per tree, with mature trees yielding 2 kg of fruit each season (Morton, 1987), which probably reflects the low number of large fruit produced rather than pollination failure or fruit abortion. Chantaranothai and Parnell (1994) found that in cultivation, 73% of flowers set fruit and that apomixis and self-fertilization occur freely. The seeds are polyembryonic (producing 1 to 4 sprouts), germination requires 10 to 25 days to start and continues for up to 120 days (Voigt, 1914; Wadsworth, 1943; Schmitt and Riviere, 2002). After one week of drying, seed viability remains high (Schmitt and Riviere, 2002) but there is no seed bank. Trees coppice freely when cut and vegetative propagation can occur via layering. Various propagation techniques are described by Morton (1987). Establishment normally takes place in established vegetation where there is some shade and plenty of moisture.

Environmental Requirements

S. jambos flourishes in tropical and near-tropical climates only. It is found from sea level to around 900-1300 m in Jamaica, Hawaii and India but it is reported to reach an altitude of 2300 m in Ecuador. At its upper altitudinal limit the tree grows vigorously but does not bear fruit (Morton, 1987). It withstands temperatures down to freezing and is tolerant of wind and salt (van Lingen, 1991). Being commonly associated with riparian zones, it does best in damper habitats, yet Morton (1987) reported that it tolerates semi-arid conditions, although dry spells are detrimental. It copes with poor drainage as well as flooding and grows on various soil types, including sand and limestone. However, it is considered that a deep loamy soil with a pH of 5.5-7.0 is ideal (Smith, 1985; Morton, 1987). It tolerates shade but its growth rate tends to be small, about 10 cm per year in height increment in seedlings and saplings (Di Stefano et al. 1998).

Climatic amplitude (estimates)
- Altitude range: 0 - 2300 m
- Mean annual rainfall: 1000 - 4000 mm
- Rainfall regime: bimodal; uniform
- Dry season duration: 0 - 4 months
- Absolute minimum temperature: 15 - 0ºC

Soil descriptors
- Soil texture: light; medium; heavy
- Soil drainage: free; seasonally waterlogged
- Soil reaction: acid; neutral
- Special soil tolerances: shallow; saline

- Soil types: alluvial soils; clay soils; sandy soils; tropical soils; saline soils; calcareous soils; acid soils

MEANS OF MOVEMENT AND DISPERSAL

Natural Dispersal (Non-Biotic)

In areas with steep topography fruits can be locally dispersed by gravity down slopes. As the tree is common along some riparian forests, dispersal by water probably occurs.

Vector Transmission (Biotic)

It is thought to be dispersed by animals as clumps of naturally regenerated saplings are often found some distance from a seed source. Wadsworth (1943) suggested that bats and rodents may be involved, and on Pitcairn Island Polynesian rats are probably the principal disseminators.

Accidental Introduction

Seeds are dispersed by people, and children in particular, who eat the fruit more readily than adults. When the fruits are consumed during walks in the countryside, viable seeds are discarded mainly along paths.

Intentional Introduction

In recent decades there appears to have been only limited interest in the food or ornamental value of this species, or even no interest in other uses, such as a component of agroforestry systems, therefore very few intentional introductions must have occurred.

NATURAL ENEMIES

S. jambos has few insect enemies, though the fruits are highly susceptible to fruit fly infestations (Leblanc and Putoa, 2000). In humid climates, the leaves are often coated with sooty mould growing on the honeydew excreted by aphids. The tree is also prone to various fungal diseases such as leaf spot caused by *Cercospora* sp., *Gloeosporium* sp., and *Phyllosticta eugeniae*; algal leaf spot (*Cephaleuros virescens*); black leaf spot (*Asterinella puiggarii*); and anthracnose (*Glomerella cingulata*). It is susceptible to root rot caused by Fusarium sp., and mushroom root rot (*Armillariella* (*Clitocybe*) *tabescens*) (Morton, 1987). In Brazil, where it is an ornamental and fruit tree, it is severely damaged by the neotropical rust fungus *Puccinia psidii*, and this causes premature defoliation, destructive dieback, and loss of flowers and fruits every year around Brasilia (Tessmann et al., 2001).

IMPACT

Economic impact

S. jambos has an indirect economic impact being a species highly susceptible to a number of fruit fly species. It is one of the preferred hosts of the Caribbean fruit fly (*Anastrepha suspensa*) that attacks several species of tropical and sub-tropical fruit trees. In some Pacific islands it is the host of *Bactrocera* spp. including Queensland fruit fly (*Bactrocera tryoni*) introduced in the late 1960s and known to be the most damaging fruit fly pest in

Australia (Leblanc and Putoa, 2000). Similarly in Brazil, urediniospores of the rust fungus *Puccinia psidii* produced on *S. jambos* may serve as inoculum for other Myrtaceae, including some economically important species such as *Eucalyptus* spp. and *Psidium guajava* (Tessmann et al., 2001). On Pitcairn Island, the spreading, shallow and dense rooting system makes cultivation of gardens next to trees an arduous task and its heavy shading is deleterious to crop growth (Binggeli, 2001). In the Dominican Republic it became a serious weed in *Pinus occidentalis* forests, preventing the regeneration of the pine (Wadsworth, 1943).

Environmental impact

On a number of oceanic tropical islands the presence and perceived spread of *S. jambos* has been viewed with some concern in recent years. A set of attributes (production of monotypic stands, ability to cast dense shade, and establishment of seedlings under shade) have been viewed as serious threats to native vegetation and associated fauna. On some small islands *S. jambos* now constitutes a high proportion of the woodland resource. By the 1990s *S. jambos* covered a large area of Pitcairn Island and the species was viewed as a major threat to the biodiversity of the island because of its rapid spread into various native plant communities (Diamond, 1994). However, spread into semi-natural vegetation is limited and slow (Binggeli, 2001). It clearly impacts on native vegetation and monotypic stands generally have a very limited number of native species. It outcompetes native trees but also suppresses other invasive species such as *Lantana camara*. In doing so it allows some native species such as tree ferns (*Cyathea medullaris*) to regenerate under a *S. jambos* canopy. However, this regeneration will die unless the canopy opens up. Once *S. jambos* produces mature monotypic stands, soil erosion becomes prevalent. The lack of ground vegetation and the near absence of small rootlets allow soil to be washed away even on moderately sloping hillsides. In extreme cases all soil may be washed away from surface roots. On Pitcairn Island, streams originating from unmanaged *S. jambos* stands have produced deep gullies down to the bedrock.

Social impact

Both the seeds and the roots are said to be poisonous. A hydrocyanic acid has been reported in the roots, stems and leaves and an alkaloid, jambosine, has been found in the bark of the tree and of the roots (Morton, 1987).

Impact on biodiversity

The heavy shade cast by *S. jambos* stands reduce species richness, but does allow some native species to regenerate. It also appears to be an important substrate for some epiphytes. In Puerto Rico, it is the most important phorophyte for a species of orchid (Rodriguez-Robles et al., 1990). It also appears to be a favoured habit for some endemic species. In the Seychelles *S. jambos* is not listed, like other invaders, as a threat to orthopteroids, a group of large striking insects, instead it is given as one of the host species (Matyot, 1998). The endangered Rodrigues Warbler *Acrocephalus rodericanus* were mostly found in *S. jambos*-dominated woodland (Showler et al., 2002).

Summary of impact

Negative impact on: environment; crop production; native fauna

VARIATION AND BREEDING

Whereas some authors maintain that the trees are rather variable, others do not mention this aspect. There are no cultivars. For successful selection or breeding work, a better insight into yield, yield-limiting factors, and variability of characteristics is necessary. Such work may also be directed towards enhancing the production of essential oils or the ornamental value. However, germplasm collections have yet to be established.

PHYTOSANITARY SIGNIFICANCE

Concern with this species has only arisen in countries where the awareness of biological invasion is high. In Dade County, Florida, USA, homeowners are encouraged not to plant *S. jambos* close to native plant communities (Anon., 2000). In Durban, South Africa, it is an escaped ornamental that has been listed as a Category 3 plant 'which have amenity value and which may be grown, but not planted, propagated, imported or traded', and cannot be grown within 30 m of a watercourse (Anon., 2001).

SUMMARY OF INVASIVENESS

S. jambos is widely distributed pantropically, but is often rare where introduced and has now limited economic value. It has been spreading on oceanic islands where it is viewed with concern because of its perceived high impact on biodiversity. *S. jambos* casts a heavy shade, is able to regenerate under forest canopy, and is often found in monotypic stands. It is poorly dispersed and as a result it does not spread rapidly further afield. Once established it reduces plant species richness but tends to favour some native species and produces a habitat conducive to some endemic bird species. As it also suppresses light-demanding species, such as the invasive *Lantana camara*, in some instances *S. jambos* should not be eradicated but instead contained and managed to produce habitats favouring endemic species.

Risk and Impact Factors

- invasive in its native range: no
- proved to be invasive outside its native range: yes
- highly adaptable to different environments: unknown
- high reproductive potential: yes
- highly mobile locally: no
- its propagules remain viable for more than one year: no
- tolerates cultivation, browsing pressure, mutilation, fire etc.: no
- competitive in crops or pasture: yes
- affects ecosystem: yes
- adversely affects natural communities: unknown
- adversely affects community structure: yes
- adversely affect human health: no
- has sociological impacts on recreational patterns, aesthetics, property values: no
- harmful to animals: no
- produces spines, thorns or burrs: no
- host or vector of pests or diseases: yes
- likely to be accidentally transported internationally: no
- likely to be deliberately transported internationally: yes
- difficult to identify or detect as a commodity contaminant: no
- difficult to identify or detect in the field: no

- difficult or costly to control: yes

MORPHOLOGY

Plant type: tree; woody; seed propagated; perennial.

S. jambos is an evergreen small tree reaching a height of 7-12 m, with a generally short bole, to 50 cm diameter. Stems are terete, sometimes quadrangular when young, generally twisted at the base, with brown, furrowed, smooth bark. When young, it has an erect main stem but as it matures, it tends to produce arching branches resulting in a widespread crown with a diameter of over 20 m in multi-stemmed individuals. The leaves are opposite, lanceolate or narrow-elliptic, thinly coriaceous, cuneate at base, acuminate at apex, 10-22 cm long and 2.5-6 cm wide. They are somewhat leathery, glossy, dark-green above when mature but reddish when young, lighter green and obscurely glandular punctate beneath, petiole 5-6(-13) mm. Inflorescences short terminal or axillary corymbs, 5-10 cm long, 4-5(-10)-flowered; flowers large, 5-10 cm wide, white to greenish-white; calyx lobes 4, suborbicular, up to 10 x 7 mm; petals 4, suborbicular, 15-18 mm diameter, white to greenish-white; stamens about 400, up to 4 cm long; style up to 4 cm long; pedicel up to 1.5 cm long. The fruit is a drupe, up to 4-5 cm long, nearly round, oval, or slightly pear-shaped, and is capped with a prominent, green, tough calyx and style. The skin is smooth, thin, green at first, then pale yellow or whitish, sometimes pinkish, and covers a crisp, mealy, dry to juicy layer of yellowish flesh, that is sweet with a distinct scent of rose. Each fruit contains in its hollow centre one to four brown, rough-coated, medium-hard, polyembryonic, more or less rounded seeds, 1-1.5 cm in diameter. When they mature, they loosen from the inner wall and rattle when the fruit is shaken.

SIMILARITIES TO OTHER SPECIES

There are over 500 species in the genus, and *S. jambos* may be confused with several of them, notably another weedy species, *S. cumini*. However, the rosewater smell of *S. jambos* fruit is distinctive for the species.

CONTROL

Mechanical Control

Seedlings can be removed by hand-pulling (Soria et al., 2002).

Chemical Control

Wadsworth (1943) suggested that infestations in Dominican pine forest should be treated with sodium arsenite, but thought this method would be expensive and had not been tried. In the Galapagos, *S. jambos* has been successfully controlled by hacking the plant and applying one of three different herbicides: picloram/methyl metsulfuron, picloram alone in diesel, and pure glyphosate (effective but not very economical) (Soria et al., 2002). In Hawaii, glyphosate was applied to notches in the trunks but was found to be ineffective (Motooka et al., 1983).

Biological Control

S. jambos has never been considered as a target for biological control attempts.

USES

Fruits of *S. jambos* were once viewed as desirable and valuable, but today they are of limited economic value especially as trees are very low yielding. The fruits must be freshly picked, bruise easily and are highly perishable, and therefore they are rarely marketed (Morton, 1987). They are slightly bland and around the tropics fruits are mostly eaten out-of-hand by children. In some regions they are made into preserves, jellies or sometimes prepared in a number of other ways, often mixed with other types of fruits (Morton, 1987). A yellow-coloured essential oil, important in the perfume industry, is derived from the leaves by distillation. In southern Mexico, *S. jambos* is one of the commonest shade-trees in coffee cultivation (Soto-Pinto et al., 2000). It has been used in agroforestry to provide shelter, as the species is rather wind resistant. It makes a good ornamental species with its regular shape, attractive foliage and striking appearance in bloom, it is a useful avenue tree along driveways, and urban situations. It is an excellent firewood and is commonly used for domestic fuel on Pitcairn Island. Wadsworth (1943) reported that large quantities of *S. jambos* wood were used as fuel for drying tobacco in Puerto Rico and branches used as tobacco poles in Cuba. Trees coppice profusely and the wood makes very good charcoal. The wood has been used in small quantities for a variety of minor products ranging from baskets to furniture and musical instruments. The heartwood is heavy and hard and is suitable for use as construction timber; however, the wood is very susceptible to termite attack and not durable in the soil. Seedless fruits were formerly distilled to make 'rosewater' (Morton, 1987), said to be equal to the best obtained from rose petals. On Pitcairn Island, where honey production is one the few exportable products produced by the islanders, *S. jambos* is probably one of the main sources of nectar for bees. Morton (1987) reported that the honey has a good amber colour and that much was produced in the San Cristobal River Valley in Cuba. The bark contains 7% tannin on a dry weight basis and is used for tanning and dyeing purposes. A number of traditional medicinal uses have been reported (Morton, 1987) such as in tonics or diuretics, but their actual importance to human health is unknown.

PESTS

Notes on pest problems

Rose apple does not seem to suffer much from insect pests, but it is a host to most fruit flies (*Anastrepha* and *Ceratitis* spp. as well as *Dacus* spp.). It is attacked by several fungi, causing leaf spots, anthracnose and root rot.

Pests listed in the database

Major host of:
Anastrepha suspensa (caribbean fruit fly), *Bactrocera aquilonis* , *Bactrocera carambolae* (carambola fruit fly), *Bactrocera dorsalis* (Oriental fruit fly), *Bactrocera dorsalis species complex* (Oriental fruit fly species complex), *Bactrocera kandiensis* , *Bactrocera tryoni* (Queensland fruit fly), *Frankliniella occidentalis* (western flower thrips), *Glomerella cingulata* (anthracnose), *Heliothrips haemorrhoidalis* (black tea thrips), *Protopulvinaria pyriformis* (pyriform scale), *Selenothrips rubrocinctus* (red-banded thrips)

Minor host of:
Anastrepha fraterculus (South American fruit fly), *Anastrepha ludens* (Mexican fruit fly), *Anastrepha obliqua* (fruitfly, West Indian), *Anastrepha striata* (guava fruit fly), *Bactrocera*

correcta (guava fruit fly), *Bactrocera facialis* , *Bactrocera frauenfeldi* (mango fruit fly), *Bactrocera jarvisi* (Jarvis' fruit fly), *Bactrocera kirki* , *Bactrocera neohumeralis* , *Bactrocera papayae* (papaya fruit fly), *Bactrocera psidii* (South Sea guava fruit fly), *Ceratitis capitata* (mediterranean fruit fly), *Ceratitis rosa* (Natal fruitfly), *Cryphonectria cubensis* (Eucalyptus canker), *Dialeurodes citri* (citrus whitefly), *Diaprepes abbreviatus* (citrus weevil), *Puccinia psidii* (guava rust)

Host of (source - data mining):
Drosophila flavohirta , *Retithrips syriacus* (black vine thrips)

PROSPECTS

There have always been advocates who claim that rose apple is one of the best, if not the best, *Syzygium* fruit. However the marketplace has never vindicated these claims. Low yield, susceptibility to bruising and short shelf life are serious handicaps. Therefore it is to be expected that rose apple will remain a home garden tree, appreciated for its ornamental value as much as for its fruit. Perhaps there is scope for the rose apple as an agroforestry species in denuded areas where soil conservation is important. In addition to producing timber, the stand might be used for the essential oil in the leaves, the pectin in the fruit, or as forage for bees.

REFERENCES

Anon., 2000. Plants to avoid when landscaping homes in Dade County. Dade Chapter of the Florida Native Plant Society. http://www.fnps.org/chapters/dade/pubs/PlantsToAvoid.pdf.

Anon., 2001. Beautiful but dangerous - Invasive alien plants of Durban and the eastern, sub-tropical region of South Africa with some indigenous alternatives. http://www.durban.gov.za/environment/pdfs/MoreAliens11_14.pdf.

Ashton PS, 1981. Myrtaceae. In: Dassanayake MD, Fosberg FR, eds. A revised handbook to the flora of Ceylon. Volume II. Smithsonian & NSF, Washington, 403-472.

Asprey GF, Robbins RG, 1953. The vegetation of Jamaica. Ecological Monographs, 23:359-412.

Binggeli P, 2001. Time-lags between introduction, establishment and rapid spread of introduced environmental weeds. In: Proceedings of the III International Weed Science Congress, CD-ROM, International Weed Science Society, Corvallis. Chapter 8.

Binggeli P, 2003. Invasive plants. In: Goodman SM, Benstead, JP, eds. The natural history of Madagascar. Chicago, USA: University of Chicago Press.

Binggeli P, Starmer J, 1997. Pitcairn Island. Aliens, 6:2.

Brown WH, 1954. Useful plants of the Philippines. Volume 2. Department of Agriculture and Natural Resources, Manila.

Burkill HM, 1997. The useful plants of West tropical Africa. Volume 4. Families M-R. Kew, UK: Royal Botanic Gardens.

Chang TT, 1995. *Phellinus eugeniae* sp. nov. on *Eugenia jambos* in Taiwan. Mycological Research, 99(12):1527-1528. View Abstract

Chantaranothai P, Parnell JAN, 1994. The breeding biology of some Thai *Syzygium* species. Tropical Ecology, 35(2):199-208. View Abstract

Di Stefano JF, Fournier LA, Carranza J, Marin W, Mora A, 1998. Invasive potential of *Syzigium jambos* (Myrtaceae) in forest fragments: the case of Ciudad Colon, Costa Rica. Revista de Biologia Tropical, 46:567-573.

Diamond JM, 1994. Biogeography - Pitcairn before the Bounty. Nature, 369:608-609.

Exell AW, 1944. Catalogue of the Vascular Plants of S. Tome. Norwich: Jarrold and Sons Ltd., 270.

Gooding EGB, Loveless AR, Proctor GR, 1965. Flora of Barbados. London, UK: Ministry of Overseas Development.

Guillaumin A, 1942. Les plantes introduites en Nouvelle-Calédonie. Revue de Botanique Appliquée et d'Agriculture Tropicale, 22:13-47.

Harris DR, 1965. Plants, animals and man in the Outer Leeward islands. University of California Publications in Geography, 18.

Heartsill-Scalley T, Aide TM, 2003. Riparian vegetation and stream condition in a tropical agriculture-secondary forest mosaic. Ecological Applications, 13:225-234.

Jim CY, 1990. Trees in Hong Kong: species for landscape planting. Hong Kong, China: Hong Kong University Press.

Küffer C, Edwards PJ, Fleischmann K, Schumacher E, Dietz H, 2003. Invasion of woody plants into the Seychelles tropical forests: habitat invasibility and propagule pressure. Bulletin of the Geobotanical Institute ETH, 69:65-75.

Leblanc L, Putoa R, 2000. Fruit flies in French Polynesia and Pitcairn Islands. Pest Advisory Leaflet, 29. Secretariat of the Pacific Community, Suva.

Little EL, Wadsworth FH, 1964. Common trees of Puerto Rico and the Virgin Islands. US Department of Agriculture, Agricultural Handbook 249.

Lorence DH, Sussman RW, 1986. Exotic species invasion into Mauritius wet forest remnants. Journal of Tropical Ecology, 2:147-162.

Macdonald IAW, Thébaud C, Strahm W, Strasberg D, 1991. Effects of alien plant invasions on native vegetation remnants on La Réunion (Mascarene Islands, Indian Ocean). Environmental Conservation, 18:51-61.

Matthew KM, 1969. The exotic flora of Kodaikanal Palni Hills. Records of the Botanical Survey of India, 20(1).

Matyot P, 1998. The orthopteroids of the Seychelles: a threatened island fauna. Journal of Insect Conservation, 2:235-246.

Meerman J, 2003. Non-native flora of Belize. http://biological-diversity.info/invasive_flora.htm.

Meyer JY, 2000. Preliminary review of the invasive plants in the Pacific islands (SPREP Member Countries). In: Sherley G, tech. ed. Invasive species in the Pacific: a technical review and draft regional strategy. South Pacific Regional Environment Programme, Samoa.

Morton JF, 1987. Fruits of warm climate. Miami, USA: JF Morton.

Motooka PS, Nagai G, Ching L, 1983. Cut-surface application of glyphosate to control tropical brush species. In: Abstracts. Meeting of the Weed Science Society of America 1983, 96.

Palli F, 2002. Arbres de la Martinique. http://www.palli.ch/~kapeskreyol/divers/arbres.html.

Pauwels L, 1993. Nzayilu N'ti - Guide des arbres et arbustes de la région de Kinshasa - Brazzaville. Scripta Botanica Belgica, 4:1-495.

Rodriguez-Robles JA, Ackerman JD, Melendez EJ, 1990. Host distribution and hurricane

damage to an orchid population at Toro Negro Forest, Puerto Rico. Caribbean Journal of Science, 26:163-164.

Schmitt L, Rivière JN, 2002. Comparative life-history traits of two *Syzygium* species (Myrtaceae): one invasive alien in La Réunion, the other native. Acta Botanica Gallica, 149(4):457-466. View Abstract

Seifriz W, 1943. The plant life of Cuba. Ecological Monographs, 13:376-426.

Showler DA, Cote IM, Jones CG, 2002. Population census and habitat use of Rodrigues warbler Acrocephalus rodericanus. Bird Conservation International, 12:211-230.

Smith CW, 1985. Impact of alien plants on Hawaii's native biota. In: Stone CP, Scott JM, eds. Hawaii's Terrestrial Ecosystems: Preservation and Management. Honolulu, Hawaii, USA: University of Hawaii Press, 180-250.

Soria M, Taylor U, Tye A, Wilkinson SR, 2002. Manual de identificación y manejo de malezas en Galápagos. Charles Darwin Research Station, Puerto Ayora, Galapagos.

Soto-Pinto L, Perfecto I, Castillo-Hernandez J, Caballero-Nieto J, 2000. Shade effect on coffee production at the northern Tzeltal zone of the state of Chiapas, Mexico. Agriculture, Ecosystems and Environment, 80:61-69.

Space JC, Waterhouse BM, Miles JE, Tiobech J, Rengulbai, 2003. Report to the Republic of Palau on invasive plant species of environmental concern. Honolulu, USA: USDA Forest Service.

Space JC, Flynn T, 2000. Observations on invasive plant species in American Samoa. USDA Forest Service, Honolulu, 51.

Space JC, Flynn T, 2000. Report to the Government of Niue on invasive plant species of environmental concern. USDA Forest Service, Honolulu, 34.

Space JC, Flynn T, 2001. Report to the Kingdom of Tonga on invasive plant species of environmental concern. Institute of Pacific Islands Forestry, Honolulu, Hawaii, USA: USDA Forest Service.

Strahm W, 1989. Plant Red Data Book for Rodrigues. Konigstein, Germany: Koeltz Scientific Books.

Tessmann DJ, Dianese JC, Miranda AC, Castro LHR, 2001. Epidemiology of a Neotropical rust (*Puccinia psidii*): periodical analysis of the temporal progress in a perennial host (*Syzygium jambos*). Plant Pathology, 50(6):725-731; 22 ref. View Abstract

Turland NJ, 1994. Myrtaceae. In: Press JR & Short MJ, eds, Flora of Madeira. London, UK: HMSO, 231-233.

van Lingen TG, 1991. *Syzygium jambos* (L.) Alston. In: Verheij EWM, Coronel RE, eds. Plant Resources of South-East Asia No. 2. Edible fruits and nuts. Wageningen, The Netherlands: Pudoc, 296-298.

Voigt W, 1914. Tropische Fruchtbäume. Ihre Beschreibung, Kultur und die Verwendung ihere Ergebnisse. Der Pflanzer, 10(5):255-262.

Wadsworth FH, 1943. Pomarrosa, *Jambosa jambos* (L.) Millsp. and its place in Puerto Rico. Caribbean Forester, 4:183-194.

Walker EH, 1976. Flora of Okinawa and the Southern Ryukyu Islands. Smithsonian Institution Press, Washington, DC, 439.

Whistler WA, 1988. A revision of *Syzygium* (Myrtaceae) in Samoa. Journal of the Arnold Arboretum, 69:167-192.

Upper part of Pitcairn Island (alt. 250 m) with a mosaic of native and *S. jambos* woodland (partly defoliated grey stands). NB Although *S. jambos* is often described as wind resistant, trees at the edge of the woodland do suffer from exposure.

S. jambos dominated stand on Pitcairn Island with a relict dying *Metrosideros collina* laying on the ground. Apart from a few native ferns all native species are absent from this stand.

S. jambos: coppice stand on Pitcairn Island where no management has taken place for many years. Note the lack of ground and shrub layer.

S. jambos: natural layering occurs when branches come into contact with the ground.

Dense *S. jambos* stand that contains three age groups. Sparse large trees, a dominant pole layer and a scarce sapling layer. Note that even relatively young stems start arching (right of photo).

The tree produces a dense mat of horizontal roots. The lack of rootlets allow for rapid soil erosion (scale = 30 cm).