This text is an integral part of the *EPPO Study on bark and ambrosia beetles associated with imported non-coniferous wood* and should be read in conjunction with the study

Pest information sheet
Ambrosia beetle

XYLOSANDRUS COMPACTUS (COLEOPTERA: SCOLYTINAE)
black twig borer

EPPO Lists: Xylosandrus compactus was added to the EPPO Alert List in 2017 (EPPO, 2017). In the EPPO region, it is a quarantine pest for Israel (EPPO Global Database; EPPO, 2018). The assessment of risk in this datasheet is not based on a full PRA for the EPPO region, but on an assessment of the information for that species used to prepare the information sheet, including a PRA for France (ANSES, 2017).

PEST OVERVIEW

Taxonomy
Xylosandrus compactus (Eichhoff, 1875). Synonyms: *Xyleborus compactus* Eichhoff; *Xyleborus morstatti* Hagedorn, 1912; *Xylosandrus morstatti* (Hagedorn).

Associated fungi
18 fungal species have been recorded so far in the female mycangium, on the body or inside galleries of *X. compactus*. Some are known to be saprophytes (e.g. *Ambrosiella xylebori, A. macrospora*), but others are plant pathogenic (e.g. *Epicoccum nigrum, Fusarium solani, Geosmithia pallida*) and might play a role in the symptomatology observed on infested plants (EPPO, 2017; Vannini *et al.*, 2017). ANSES (2017 citing others) also mention *Cryptococcus* sp. *Cladosporium* sp., *Acremonium* sp. *Fusarium* spp., *Pestalotiopsis* sp. and *Verticillium* sp. Finally, a *Fusarium* sp. was recently found associated with *X. compactus* and wilting of cocoa in Uganda (Kagezi *et al.*, 2017).

Morphology and biology (from EPPO, 2017, except where a reference if indicated)
Adults measure 0.9-1.8 mm long (males are smaller than females). Females are shiny black and males reddish black in colour. *X. compactus* is an inbreeder. It is an arrhenotokous species (males derive from unfertilized eggs – females from fertilized ones). Mating primarily occurs between siblings just after adult emergence. After mating, the male remains in the gallery while the female leaves the tunnel through the entry hole and colonizes branches, boring an entry hole and a subsequent brood gallery. The number of larval stages appears to vary between locations (2 to 3 larval stages have been observed). There are several overlapping generations per year (EPPO, 2017). In Italy, two generations per year have been observed (ANSES, 2017, citing others).

X. compactus is mainly a borer of seedlings, shoots and small twigs, but it can also breed in cut branches up to a diameter of about 6 cm (rarely in larger material). The entrance holes bored by females are small (0.8 mm diameter) and are located on the underside of branches or the side of shoots (EPPO, 2017).

X. compactus attacks healthy plants as well as plants that are under stressed conditions such as drought, pruning, or recent transplanting (Greco and Wright, 2012). *X. compactus*, as well as the related species *X. crassiusculus* and *X. germanus*, have been reported as occasional pests of live trees and shrubs in their native southern and eastern Asia (Hulcr *et al.*, 2017, citing others).

Spread biology
Flight of adult females is the main means of movement and dispersal to new plants and new areas over short distances. In the literature, it is noted that adult females can disperse over at least 200 m, and that dispersal over several kilometres is probably possible, especially if wind-aided (EPPO, 2017).

Nature of the damage
Damage is caused by the wood boring activity of the insect and the introduction of ambrosia fungi which are necessary for larval development (EPPO, 2017). *X. compactus* attacks the shoot growth of the year, which may lead to breakage or death. Boring damage may have impact on the quality of products, but the most important

damage is due to fungi (ANSES, 2017). *X. compactus* may cause the dieback of the thinner branches of the canopy or of entire young plants (1-2 years old) (Francardi *et al.*, 2017).

Detection and identification

- *Symptoms*. Infested plants display leaf and stem necrosis extending from the entrance hole. Flagging of branches occurs about 5-7 days after initial tunnelling and gallery formation. Wilting of twigs and branches usually becomes evident within weeks of infestation. Cankers are commonly seen around the attacked areas of larger twigs and branches (EPPO, 2017).
- *Trapping. X. compactus* is attracted by ethanol (ANSES, 2017, citing others) and repelled by verbenone (Dudley *et al.*, 2007; Burbano *et al.*, 2012).
- *Identification.* Keys to the females of *Xylosandrus* species in Europe are provided in Nageleisen *et al.* (2015) and Gallego *et al.* (2017).

Distribution (see Table 1)

X. compactus is thought to originate from East Asia (EPPO, 2017). It is widely distributed in Africa, Asia and South America. It has been introduced in some Pacific Islands, Southeastern USA, and more recently in Europe (Italy and France).

In Italy, *X. compactus* was first found in 2011 in urban parks in the province of Napoli (Campania region). It was later also found in Lazio, Liguria, Sicilia and Toscana. During summer 2016, the pest was found in the Lazio region causing serious decline and wilting of Mediterranean maquis plants in the Circeo National Park, in an area covering more than 13 ha, as well as in the neighbouring area of San Felice Circeo, the Villa Fogliano's Botanic Garden and a nursery in Fogliano (Vannini *et al.*, 2017; Francardi *et al.*, 2017; EPPO, 2018).

In France, it was first found in 2016 in an ornamental garden in the municipality of Saint-Jean-Cap-Ferrat (Provence-Alpes-Côte d'Azur) (ANSES, 2017). It has been observed several times on the French Riviera (L-M Nageleisen and T. Noblecourt, pers. comm. 2018-05).

Host plants (See Table 2)

X. compactus attacks over 224 plant species belonging to 60 families (ANSES, 2017). Table 2 includes over hosts in over 65 families. Most species are tropical or subtropical, but some have been introduced in southern Europe; the genera mentioned as widespread in France (ANSES, 2017) are, for example, *Acacia*, *Acer, Alnus, Azalea, Castanea, Celtis, Cornus, Eucalyptus, Fagus, Ficus, Fraxinus, Hibiscus, Liquidambar, Magnolia, Malus, Platanus, Quercus, Tilia,* and *Vitis*, and would also be present in most of the EPPO region in a wide diversity of habitats (in the wild, plantations for wood or fruit production, parks and gardens, cities etc.). In addition to a broad range of dicotyledonous trees and shrubs, *X. compactus* has been found attacking monocotyledonous plants such as orchids, ginger (*Zingiber*) and conifers (*Pinus* spp.) (EPPO, 2017).

In Italy, *X. compactus* has been recorded mainly on *Quercus ilex*, *Laurus nobilis* and *Ceratonia siliqua*, but it has also been found on *Viburnum tinus, Fraxinus ornus* and *Celtis australis.* In recent outbreaks in Lazio (including the Circeo National Park), it was found on a large number of evergreen maquis species such as *Q. ilex, Viburnum tinus, Ruscus aculeatus, Pistacia lentiscus, L. nobilis* and *C. siliqua* (EPPO, 2018) as well as on *Q. robur, Acer pseudoplatanus, Liquidambar styraciflua, Ficus carica, Magnolia grandiflora* (Francardi *et al.*, 2017). In France, it has been recorded on *Arbutus unedo, Laurus nobilis, Phillyrea* sp. and *Quercus ilex* (EPPO, 2017).

The host list is known to be incomplete and host plants of importance to the EPPO region can be found in other publications. For example, Chong *et al.* (2009) reports attacks in South Carolina on the following ornamentals, adding new species or families to the list: *Buxus sempervirens* (Buxaceae), *Hydrangea macrophylla* (Hydrangeaceae), *Morella* (*Myrica*) *cerifera* (Myricaceae), *Cercis canadensis*, or specifying species for genera on the host list, such as *Ficus carica*, *Gardenia jasminoides* and *Magnolia grandiflora*. Dixon *et al.* (2005) add also many species and families from Florida records, including *Carya* (Juglandaceae), *Salix* (Salicaceae). Several of these, apart from also being ornamentals in the EPPO region, are of major economic and environmental importance, such as *B. sempervirens*, *Ficus carica* or *Salix* spp.

According to ANSES (2017, citing Pennacchio *et al.*, 2012), hosts that may be attacked have the following characteristics: small diameter woody twigs, no hair at the twig surface, and no release of gum, latex or other liquids during attacks.

Known impacts and control in current distribution

According to the literature, the main economic host is coffee (more particularly *Coffea canephora*), and *X. compactus* is also recorded as a pest of tea (*Camelia sinensis*), cacao (*Theobroma cacao*), fruit trees (e.g. *Annona*, *Ficus carica*, *Macadamia ternifolia*, litchi (*Litchi chinensis*), avocado (*Persea americana*) and forest trees in young plantations (e.g. *Aucoumea* sp., *Eucalyptus*, *Entandrophragma*, *Khaya*, *Erythrina, Melia azedarach, Swietenia*) (EPPO, 2017). CABI CPC (2018 citing sources from the 1960s-2000s) mentions losses in India of 21% on 45-year old coffee plants and 23.5% on young plants; infestation rates of 60-70% in African mahogany in India; losses of ca. 20% of the coffee crop in Cameroon. In Japan, *X. compactus* was reported as a pest of tea causing extensive dieback, and in China an attack rate of 78% was recorded on the main stems of young chestnut trees. In Peru, *X. compactus* has been known since the 1970s, but it was reported for the first time on cocoa in 2014, causing serious damage in nurseries in the Peruvian Amazon region, and it can also cause important losses in nursey on *Myrciaria dubia* and *Swietenia macrophylla* (Delgado and Couturier, 2017). In Uganda, it was reported as a new but rapidly spreading pest of coffee and other species (Kagezi *et al.*, 2012), Bukomeko *et al.* (2018) highlight that since 2012 *X. compactus* has spread to 68 % of Robusta coffee farms in Uganda, where it infests 40 % of coffee trees per farm. It has also been reported as a pest of cocoa (Kagezi *et al.*, 2017). In Hawaii, it was first found in 1960 and was a sporadic pest on many crops, but it recently emerged as a significant and predictable pest in coffee, boring berries, reaching the endosperm and causing damage without making galleries or ovipositing (Greco and Wright, 2012, 2013).

In the USA, Chong *et al.* (2009) mention that *X. compactus* was reported as an occasional severe pest of landscape ornamentals in the southeastern USA in the mid-1970s. However, they observed damaged ornamental plants in both urban landscape and forests, suggesting that *X. compactus* is more abundant and widespread in South Carolina than previously reported.

In Italy, *X. compactus* has caused extensive withering and dieback of *Laurus nobilis* hedges in several coastal areas in Tuscany (province of Lucca) (Francardi *et al.*, 2017). It has affected *Ceratonia siliqua* in Sicily, and *Cupressus sempervirens* and *L. nobilis* in several urban areas in Rome (Lazio) (Francardi *et al.*, 2017, citing others). Dieback of thinner branches or entire young plants was observed in *Laurus nobilis* in the Fogliano's plant nursery and in *Magnolia grandiflora* in the Villa Fogliano's Botanical Garden (Francardi *et al.*, 2017). In the Circeo National Park (Lazio), serious damage has recently been observed on a large number of evergreen species of Mediterranean maquis in a natural habitat, such as *Q. ilex, Viburnum tinus, Ruscus aculeatus, Pistacia lentiscus, L. nobilis* and *C. siliqua* presented wilting branches (up to 2-3 cm in diameter) or mortality of young plants (Vannini *et al.*, 2017). Attacks on rare native species has also been reported from Hawaii (ANSES *et al.*, 2017, citing others), and La Réunion (Soubeyran, 2008). No damage has been reported from continental France to date.

Control: Reviewing available control methods, ANSES *et al.* (2017) notes that chemical control is difficult, although sometimes mentioned in the literature. Infested plants or plant parts should be cut and destroyed as soon as symptoms appear. At present there is no biological control agent available. In France, sanitation measures based on destruction of infested plants were recommended. Trapping could be put in place along the Mediterranean coast, and together with the fact that symptoms appear rapidly, this may allow for eradication or containment (ANSES, 2017).

POTENTIAL RISKS FOR THE EPPO REGION

Pathways

Entry

Plants for planting and cut branches are possible pathways as the pest attacks twigs and branches between 0.5-6.5 cm. Such plants are normally subject to controls during production, and attacked plants may be detected and discarded. Cut branches are a less likely pathway, as they are used indoors, and the pest is unlikely to be able to transfer to a suitable host. *X. compactus* has a very wide host range, which includes species used for fruit production, as ornamentals or as forest trees. While some hosts are likely traded as plants for planting, it is not known if cut branches of hosts are used and traded (no data was sought).

Bark on its own is considered a potential pathway because overwintering adults may take shelter under the bark (ANSES, 2017).
ANSES (2017) noted that cut trees are a pathway, but attacks on large trunks are exceptional. The host list of *X. compactus* includes major traded woods, such as *Quercus*, *Fagus*, mahoganies (*Swietenia*, *Khaya*, *Entandrophragma*), meranti (*Shorea*). *X. compactus* attacks mostly small diameter material, and is therefore unlikely to be found in most wood consignments. However, wood commodities that include whole trees or harvesting residues may carry the pest, such as firewood. It is not clear whether the hosts of *X. compactus* would be used in this manner, or if such commodities would be traded internationally. There is no data on whether such small wood could be used for commodities such as wood chips, hogwood, processing wood residues or wood packaging material (e.g. dunnage) (although some hosts are known to be used for such commodities, e.g. *Pinus*). However, some wood chips may be made from harvesting or processing residues, such as branches, tree tops and thinnings (EPPO, 2015).
Finally, *X. compactus* is an inbreeder, which is favourable to entry and establishment.

Summary of pathways (uncertain pathways are marked with '?'):

- *plants for planting (except seeds) of hosts*
- *cut branches of hosts (incl. Christmas trees)?*
- *bark of hosts*
- *wood (round or sawn, with or without bark, incl. firewood) of hosts?*
- *wood chips, hogwood, processing wood residues (except sawdust and shavings)*
- *wood packaging material if not treated according to ISPM 15*

Because of the large and uncertain host range, pathways may also cover all non-coniferous and coniferous woody plants.

Spread (following introduction, i.e. within EPPO region)
Natural spread may occur, and at long distances, trade of commodities, especially plants for planting can transport *X. compactus*. It is thought to have been introduced to other parts of the world most probably with trade of plants and wood (EPPO, 2017). ANSES (2017) observed that the pest has spread along the Mediterranean coast of France, and it has spread within few years along a large part of the Tyrrhenian coast of Italy, in several Italian regions. It is not known if the spread in Italy was natural or human-assisted or a combination of both.

Establishment
Areas with suitable climates and host plants are available in the EPPO region, therefore establishment is possible. In most of its range, *X. compactus* occurs mostly in tropical and subtropical countries. However, it has established in France and Italy in areas that are less warm than its native range. Based on the climate classification of Köppen Geiger (see Annex 6 of the study), the climate type of these areas is the Mediterranean climate type Csa[1], which occurs in Portugal and around the Mediterranean Basin, Turkey and the Black Sea. In the USA, *X. compactus* has established in Cfa[1] type climates, which occurs in Northern Italy, Balkans and around the Black Sea. There is an uncertainty about whether it would be able to establish in more temperate areas, and therefore may establish beyond Csa and Cfa type areas.
Although host plants in its native range relate to tropical plants, it has been reported from France, Italy and the USA on many more temperate and Mediterranean species. It is likely to be able to find hosts in other parts of the EPPO region.

Potential impact (including consideration of host plants)
Many woody plants attacked by *X. compactus* are important fruit crops, forest trees or woody ornamentals in the EPPO region. ANSES (2017) notes that given its large host range and the role of associated fungi (especially *F. solani*), it is not unreasonable to foresee damage to native forest, fruit or ornamental plants in France. The fact that serious damage has been reported in Lazio region (Italy) on several species in the Mediterranean maquis, clearly demonstrates that *X. compactus* has the potential to become a pest in natural environments (EPPO, 2017). *X. compactus* and *Xylosandrus crassiusculus* have caused damage in the Circeo National Park in Italy, and these species may represent a serious phytosanitary risk in this natural area because of the wide variety of susceptible plants in the park or in the neighbouring areas (Francardi *et al.*, 2017). The potential impact will also depend on whether the pest is able to establish in cooler areas.

[1] **Csa**: warm temperate climate, summer dry, hot summer; **Cfa**: warm temperate climate, fully humid, hot summer.

Table 1. Distribution (all records are from EPPO Global Database, except where indicated)

EPPO region
Italy Campania, Lazio, Liguria, Sicilia and Toscana (first found in 2011)
France Provence-Alpes-Côte-d'Azur region (first found in 2016)
Africa
Benin
Cameroon
Central African Republic
Comoros
Congo
Congo (Democratic Republic of)
Cote d'Ivoire
Equatorial Guinea
Gabon
Ghana
Guinea
Guinea-Bissau
Kenya
Liberia
Madagascar
Mauritania
Mauritius
Nigeria
Reunion
Senegal
Seychelles
Sierra Leone
South Africa
Tanzania
Togo
Uganda
Zimbabwe
Asia
Cambodia
China (Guangdong, Guizhou, Hainan, Hunan)
East Timor
India (Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Tamil Nadu)
Indonesia (Irian Jaya, Java, Kalimantan, Sulawesi, Sumatra)
Japan (Hokkaido, Honshu, Kyushu, Ryukyu Archipelago, Shikoku)
Korea Rep. (first report, Sangwook, 2016)
Laos
Malaysia (Sabah, West)
Myanmar
Philippines
Singapore
Sri Lanka
Taiwan
Thailand
Vietnam
North America
USA -Alabama, Florida, Georgia, Hawaii, Louisiana, Mississippi, South Carolina, Texas) (first found in 1941 in Florida; Haack and Rabaglia, 2013); North Carolina (Rabaglia *et al.*, 2006), Illinois, Pennsylvania (Gomez *et al*., 2018) *Uncertain records:* Arkansas, Indiana, Kentucky, Tennessee (Atkinson, 2018; considered uncertain as unpublished)
Caribbean
Cuba
Netherlands Antilles
Puerto Rico
Trinidad (Gomez *et al*., 2018)
Virgin Islands (British)
Virgin Islands (US)
South America
Brazil (Amazonas, Goias, Tocantins)
Peru
Oceania
American Samoa
Fiji
Papua New Guinea
Samoa
Solomon Islands
Absent: New Zealand

Table 2. Host plants (from ANSES, 2017, which indicates sources; species from Chong *et al.*, 2009 or Dixon *et al.* 2005 are additional species, and are marked with * (also for new family records))

Family	Genus/Species
Acanthaceae	*Graptophyllum pictum*
Adoxaceae*	*Sambucus simpsonii**
Altingiaceae	*Liquidambar formosana*
Altingiaceae	*Liquidambar* spp.
Altingiaceae	*Liquidambar styraciflua**
Amaranthaceae	*Charpentiera* spp.
Anacardiaceae	*Anacardium occidentale*
Anacardiaceae	*Mangifera indica*
Anacardiaceae	*Schinus terebinthifolius*
Anacardiaceae	*Spondias purpurea*
Annonaceae	*Annona cherimola*
Annonaceae	*Annona glabra*
Annonaceae	*Annona montana*
Annonaceae	*Annona muricata*
Annonaceae	*Annona reticulata*
Annonaceae	*Annona squamosa*
Annonaceae	*Rollinia emarginata*
Apocynaceae	*Vinca* spp.
Aquifoliaceae	*Ilex anomala*
Araceae	*Anthurium andraeanum*
Araucariaceae	*Araucaria heterophylla*
Arecaceae	*Euterpe oleracea*
Betulaceae	*Alnus* spp.
Betulaceae	*Corylus* spp.
Betulaceae	*Ostrya* spp.
Bignoniaceae	*Tabebuia pentaphylla*
Bixaceae	*Bixa orellana L.*
Bombacaceae	*Matisia cordata*
Boraginaceae	*Cordia alliodora*
Buxaceae*	*Buxus sempervirens**
Cannabaceae	*Celtis laevigata**
Cannabaceae	*Celtis* spp.
Casuarinaceae	*Casuarina equisetifolia*
Celastraceae	*Perrottetia sandwicensis*
Cornaceae	*Cornus florida*
Dipterocarpaceae	*Shorea* spp.
Ebenaceae	*Diospyros* spp.
Ericaceae	*Azalea* spp.
Ericaceae	*Rhododendron* spp.
Euphorbiaceae	*Acalypha wilkesiana*
Euphorbiaceae	*Aleurites moluccana*
Euphorbiaceae	*Antidesma pulvinatum*
Euphorbiaceae	*Claoxylon sandwicense*
Euphorbiaceae	*Croton reflexifolius*
Euphorbiaceae	*Drypetes phyllanthoides*
Euphorbiaceae	*Hevea brasiliensis*
Fabaceae	*Acacia auriculiformis*
Fabaceae	*Acacia farnesiana*
Fabaceae	*Acacia koa*
Fabaceae	*Acacia mangium*
Fabaceae	*Acacia melanoxylon*

Family	Genus/Species
Fabaceae	*Albizzia lebbeck*
Fabaceae	*Andira inermis*
Fabaceae	*Caesalpinia kavaiensis*
Fabaceae	*Cassia glauca*
Fabaceae	*Cassia* spp.
Fabaceae	*Ceratonia siliqua*
Fabaceae	*Cercis canadensis**
Fabaceae	*Crotalaria* spp.
Fabaceae	*Dalbergia* spp.
Fabaceae	*Erythrina abyssinica*
Fabaceae	*Indigofera suffruticosa*
Fabaceae	*Inga paterno*
Fabaceae	*Leucaena leucocephala*
Fabaceae	*lnocarpus fagifer*
Fabaceae	*Pithecellobiutn dulce*
Fabaceae	*Prosopis pallida*
Fabaceae	*Samanea saman*
Fagaceae	*Castanea* spp.
Fagaceae	*Fagus* spp.
Fagaceae	*Quercus laurifolia**
Fagaceae	*Quercus nigra**
Fagaceae	*Quercus robur*
Flacourtiaceae	*Flacourtia indica*
Hydrangeaceae*	*Hydrangea macrophylla**
Juglandaceae*	*Carya glabra**
Juglandaceae*	*Carya illinoensis**
Lamiaceae	*Callicarpa americana**
Lamiaceae	*Callicarpa pedunculata*
Lamiaceae	*Vitex trifolia*
Lauraceae	*Cinnamomum camphora*
Lauraceae	*Cinnamomum verum*
Lauraceae	*Cryptocarya oahuensis*
Lauraceae	*Eusideroxylon zwageri*
Lauraceae	*Laurus nobilis*
Lauraceae	*Persea americana*
Lauraceae	*Persea borbonia**
Liliaceae	*Asparagus myriocladus*
Magnoliaceae	*Liriodendron* spp.
Magnoliaceae	*Magnolia grandiflora**
Magnoliaceae	*Magnolia* spp.
Malpighiaceae	*Byrsonima crassifolia*
Malvaceae	*Abutilon grandifolium*
Malvaceae	*Hibiscus elatus*
Malvaceae	*Hibiscus rosa-sinensis*
Malvaceae	*Hibiscus* spp.
Malvaceae	*Hibiscus tiliaceus*
Malvaceae	*Malvastrum*
Malvaceae	*Malvastrum coromandelianum*
Malvaceae	*Tilia* spp.
Malvaceae	*Melochia umbellata*

Family	Genus/Species
Malvaceae	*Theobroma cacao*
Malvaceae	*Theobroma grandiflorum*
Melastomataceae	*Clidemia hirta*
Melastomataceae	*Melastoma malabathricum*
Meliaceae	*Carapa guianensis*
Meliaceae	*Cedrela odorata*
Meliaceae	*Entandrophragma utile*
Meliaceae	*Khaya grandifoliola*
Meliaceae	*Khaya ivorensis*
Meliaceae	*Khaya nyasica**
Meliaceae	*Khaya senegalensis*
Meliaceae	*Melia azedarach*
Meliaceae	*Swietenia macrophylla*
Meliaceae	*Swietenia mahagoni*
Meliaceae	*Swietenia* spp.
Meliaceae	*Taona ciliata* var. *australis*
Meliaceae	*Toona ciliata*
Moraceae	*Ficus carica**
Moraceae	*Ficus* spp.
Moraceae	*Pseudomorus sandwicensis*
Myricaceae*	*Morella (Myrica) cerifera**
Myrsinaceae	*Myrsine lessertiana*
Myrtaceae	*Eucalyptus pilularis*
Myrtaceae	*Eucalyptus robusta*
Myrtaceae	*Eucalyptus sideroxylon*
Myrtaceae	*Eucalyptus* spp.
Myrtaceae	*Eugenia cumini*
Myrtaceae	*Eugenia malaccensis*
Myrtaceae	*Eugenia uniflora*
Myrtaceae	*Melaleuca leucadendra*
Myrtaceae	*Myrciaria dubia*
Myrtaceae	*Syncarpia glomulifera*
Myrtaceae	*Tristania conferta*
Oleaceae	*Fraxinus ornus*
Oleaceae	*Fraxinus uhdei*
Oleaceae	*Jasminum multiflorum*
Oleaceae	*Jasminum sambac*
Orchidaceae	*Cattleya* spp.
Orchidaceae	*Dendrobium* spp.
Orchidaceae	*Epidendrum* spp.
Passifloraceae	*Passiflora edulis*
Pinaceae	*Pinus* spp.
Pittosporaceae	*Pittosporum tobira*
Platanaceae	*Platanus occidentalis**
Platanaceae	*Platanus* spp.
Proteaceae	*Macadamia integrifolia*
Proteaceae	*Macadamia ternifolia* var. *integrifolia*
Punicaceae	*Punica granatum*
Rhamnaceae	*Colubrina oppositifolia*
Rosaceae	*Malus pumila*
Rosaceae	*Malus* spp.
Rosaceae	*Prunus laurocerasus*
Rosaceae	*Rubus rosifolius*

Family	Genus/Species
Rubiaceae	*Coffea arabica L.*
Rubiaceae	*Coffea canephora*
Rubiaceae	*Coprosma* spp.
Rubiaceae	*Gardenia jasminoides**
Rubiaceae	*Gardenia* spp.
Rubiaceae	*Gouldia* spp.
Rutaceae	*Casimiroa edulis*
Rutaceae	*Citrus reticulata*
Rutaceae	*Flindersia brayleyana*
Rutaceae	*Murraya paniculata*
Rutaceae	*Pelea* spp.
Salicaceae*	*Salix**
Santalaceae	*Santalum freycitzetianum*
Sapindaceae	*Acer barbatum**
Sapindaceae	*Acer negundo**
Sapindaceae	*Acer rubrum**
Sapindaceae	*Acer* spp.
Sapindaceae	*Alectryon* spp.
Sapindaceae	*Euphoria longana*
Sapindaceae	*Koelreuteria elegans**
Sapindaceae	*Litchi chinensis*
Sapindaceae	*Melicoccus bijugatus*
Sapindaceae	*Pometia pinnata*
Sapindaceae	*Sapindus oahuensis*
Sapindaceae	*Nephelium lappaceum*
Scrophulariaceae	*Buddleia asiatica*
Solanaceae	*Solanum sodomeum*
Symplocaceae*	*Symplocos tinctoria**
Theaceae	*Camellia sinensis*
Theaceae	*Camellia* spp.
Thymeliaceae	*Wikstroetnia* spp.
Ulmaceae	*Ulmus* spp.
Urticaceae	*Olmediella betschleriana*
Urticaceae	*Pipturus albidus*
Verbenaceae	*Citharexylum caudatum*
Verbenaceae	*Lantana camara*
Verbenaceae	*Stachytarpheta australis*
Vitaceae	*Vitis labruscana*
Vitaceae	*Vitis* spp.
Zingiberaceae	*Alpinia purpurata*
Zingiberaceae	*Tapeinochilos ananassae*

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