

Honey Fungus



A Guide to its Identification, Symptoms & Control

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HONEY FUNGUS

Introduction

Honey Fungus or Armillaria is probably the most important killer of woody plants in Guernsey.

Honey Fungus used to be considered one species, *Armillaria mellea*, however research has shown that there are several species in the UK varying in their pathogenicity.

The main food source for the fungus is wood, stumps, infected trees or woody debris. It has even been known to feed on the bases of untreated fence posts and can attack herbaceous plants such as potato and strawberry. We are often asked if the Armillaria can be spread by bark chips and whilst in theory this is possible, the Arboricultural Advisory and Information Services in the UK consider it to be extremely unlikely to happen if **composted** bark chips are used. The RHS have demonstrated that infected bark chips can initiate infection but that the incidence was low. The size of the bark chip is also an important factor because larger pieces can sustain the fungus for a longer period of time which increases the risk of plant infection. It would therefore be prudent not to use fresh bark chips and only use stocks that have been well composted.

Mode of Attack

Armillaria can damage woody plants in two ways:-

1. By attacking and killing the conductive tissue under the bark at the base of the plant, this is a very obvious symptom of certain species of Armillaria. The effect is similar to ring barking and the plant often produces abundant fruit or cones before it dies.
2. By causing an internal white rot the wood is weakened by the fungus breaking down lignin. Woody tissue often becomes water-soaked initially then brittle as it dries. Whilst this does not immediately kill the tree, it seriously weakens the wood and roots making trees subject to wind throw and can therefore be dangerous.

Symptoms

The first indication that the disease is present is often the wilting of leaves followed by the rapid death of a tree or shrub. In some other plants decline in shoot growth, abnormally small leaves, a heavy crop of fruit or cones, or gradual dieback may be the first symptoms. In hedgerows a gradual progression of dead or dying plants is a good indication of *Armillaria*. Sometimes gummy or resinous exudations can be seen on infected tree trunks as they become stressed by the infection.

Armillaria has three distinct stages, mycelial sheets, toadstools and rhizomorphs.

1. White Fan-Shaped Mycelium

A white fan-shaped fungal or a 'felty' growth of mycelium will be seen just under the bark, running up the stem from soil level. These soft, white sheets are about paper-thick and the fan-shaped edge contrasts sharply with the bark and wood, a strong 'mushroomy' smell is noticeable when fresh. This fan-shaped mycelium, which penetrates the bark on the roots, crown or stem grows between wood and the bark, separating them. As it extends under the bark it eventually girdles the tree and kills it. It is this separation of bark from the underlying

wood, combined with toxins excreted by the fungus into the water and nutrient bearing cells of the tree, which causes the death of the tree. This white fungal sheet is the best indicator of *Armillaria*.

2. Toadstools

This is the reproductive stage of the fungus and each toadstool is capable of producing masses of spores, which may spread by wind over considerable distances. Whilst the spores are able to colonise stumps of recently felled trees, it rarely does, and the spores are of little danger to healthy trees.

The toadstools appear in autumn (October-November) and will be seen on many of the Guernsey hedgerows. They are very variable in colour, size and shape but generally:-

Cap: 3-15cm across, honey-brown colour with fine dark scales especially in the centre.

Stem: 60-150 x 5-15mm, tapering towards the base, or swollen, whitish becoming reddish-brown, and initially it has a whitish to yellow cottony ring.

Gills: Adnate to subdecurrent or distinctly decurrent (i.e. continue slightly down the stem), are white at first turning pale cream and may become darker and spotted with age.

Flesh: White, tastes astringent and has a strong smell.

3. Rhizomorphs

These are the structures that give the fungus the name Bootlace or Shoestring fungus and they are the main means of spread. They are long, black/brown, flat, root-like cords which may be seen growing out from the bark or roots. Rhizomorphs are usually produced during the terminal stages of decay. They are formed by the aggregation of fungal threads and they have a tough protective rind. Rhizomorphs are less branched than roots but grow in a similar manner from an infected stump through soil or surface litter and they may spread out several metres from the infected tree forming a web-like system.

This web-like network survives as long as a sequence of food sources continues to be accessible. Rhizomorphs of some species are produced in waves, whilst others are long lived. Rhizomorphs vary in size from a millimetre in diameter to almost pencil thick. As no other British fungus is known to produce rhizomorphs like this they are a good indicator that *Armillaria* is present.

Research indicates the rhizomorph abundance varies with species and that rhizomorphs of the different species behave in different ways. The rhizomorphs of the more pathogenic species do not need a wound to penetrate roots as they attach themselves to roots. The tip of the rhizomorph penetrates the bark scales either by mechanical force or by production of toxic substances. These species have less abundant, more fragile rhizomorphs than those of the less parasitic species. The less virulent species need wounds to enter the roots and produce many tough rhizomorphs. These highly visible rhizomorphs are not so dangerous to healthy trees, although they will infect seriously injured ones whose damaged roots are biochemically predisposed to infection.

Rhizomorphs have been recorded as growing a metre per year, but growth rate correlated to size and type of the food source and to the substrate, with peat encouraging growth whilst sand inhibits it. Seasonal desiccation of upper soil levels can govern the vertical distribution of the fungus but rhizomorphs can penetrate up to a metre depth in light soils.

Root Transmission

There is one other way in which *Armillaria* spreads from plant to plant; this is by root to root contact. When infected roots meet in the soil, the fungus is able to spread into the other plant.

Control of Infection

There is no control of this disease once it has penetrated the plant as the major problem is getting sufficient control agents to the site whilst they are still active. *Armillaria* is well protected, producing antibiotics, thick walled fungal cells and pseudosclerotia which chemical or biological agents need to get past to control. There are no approved chemicals for use in the control of *Armillaria* in garden & amenity situations.

A. Cultural Control

No woody plant is totally immune to the fungus but some trees resist infection longer than others, some become more resistant with age and sometimes the fungus only attacks part of a tree allowing it to survive for many years.

Stress predisposes a tree to infection by *Armillaria* so it is important to ensure the trees/shrubs are given good growing conditions. Waterlogging, shading, drought, defoliation, advanced age, declining vigour of the host plant, damage due to pollution, nutrient deficiency, insects and fungi etc, all affect the plant's growth and can predispose the tree to infection.

Whilst there is no effective chemical control of *Armillaria* at the present, there are various cultural measures you can take to prevent spread and to protect any new plantings:-

a) It is most important to remove the source of infection

- I. As woody material is food for *Armillaria*, rhizomorphs usually radiate out from the infection. *Armillaria* may stay active for decades in very large stumps especially from hard wood stumps, so it is important that grubbing or chipping removes these sources of food.
- II. Remove as many roots as possible, especially the larger ones. But remember to be careful when removing roots from around healthy trees, as damaging these roots will leave them open to infection by the less virulent *Armillaria* species and other soil pathogens.
- III. Look for other infected plants in the area and remove these and their root systems.
- IV. In hedges remove one apparently healthy plant on either side of the dead ones, as these are probably infected by root contact, even if they are not showing symptoms.
- V. As rhizomorphs need to be attached to their woody food in order to grow and spread, regular deep cultivation of the infected area for at least one year will also help control the spread of the disease. Cultivation breaks up the rhizomorphs and detaches them from their food source. However, remember *Armillaria* forms a web and can remain active as long as

some of its rhizomorphs are attached to a woody food source, so can re-enter an area from any direction.

If the site is suitable, planting annual bedding plants in the area for 1-3 years will help control the problem as non-woody annuals are unlikely to be infected by *Armillaria*. When preparing the soil for annuals, cultivate the soil to a depth of at least 30-45cm. When doing this you will break up any rhizomorphs present and detach them from their food source. Adding fertiliser and organic matter will also improve the soil structure and lead to healthy plant growth.

Several years of this treatment will greatly improve the fertility of the soil and give resistant shrubs or trees a good chance of survival when you eventually replace them.

- VI. Leaving the infected area fallow for one or two years is another possibility but as the area is left uncultivated the rhizomorphs may still be viable. Improve the soil structure and fertility before re-planting with more resistant shrubs or trees.
- VII. Some areas of the garden are not suitable for the above treatments, especially old hedge areas as here it is often essential to replace the hedging quickly.

Apart from putting in a fence or wall, removing the contaminated soil and swapping it with disease free soil before replanting is another alternative.

b) Protection of Trees

If the above measures are impractical for your situation, then it may be worth considering protecting your other trees and shrubs by putting down a physical barrier. Physical barriers however are only useful for really valuable trees and if the source of *Armillaria* is known. Remember *Armillaria* often has a web of rhizomorphs and can attack from any direction.

Barriers can be either:-

- I. Heavy gauge polythene sheet. (The polythene sheet should also be inspected occasionally).
- II. Trenches. Rhizomorphs can go deep so these barriers should be down at least 45cm (18 inches) in heavy soils and up to a metre in light ones and need to be re-dug annually.
- III. Deep cultivation. Rhizomorphs continue to grow until the food supply is exhausted so cultivations will have to be repeated regularly. Be very careful not to damage the roots or the tree you wish to protect.

c) Air Spades:

This is a relatively new technique from the US where compressed air is used to reduce compaction around the base of trees without damaging the roots. This improves root growth and is believed to help the plant to resist fungal infections such as *Armillaria*.

d) Resistant Plants

If none of these control methods are feasible then plant resistant types of trees or shrubs. As *Armillaria* is a very successful fungus, it is unlikely that any woody plant is truly immune although grasses such as Bamboo and Pampas Grass are considered to be immune or highly resistant to the fungus so in areas of high infection these should be considered.

Bamboo can make a good dense screen, although in certain conditions some varieties can be invasive. Regular cutting back will keep most under control and you will always have a ready supply of bamboo canes. Take advantage of the less invasive clump forming varieties currently available to fill a gap where *Armillaria* is endemic.

Pampas grass can produce an impenetrable border and be less suitable for some areas, but it needs a border of at least 3m (3 yards) wide. Pampas grass has become less popular in recent years due to its invasive nature if not controlled.

Yew is one woody plant considered to be very resistant once it is established, but we have seen other fungal and cultural problems with this plant when it is young. However, given good soil conditions and careful watering this plant can make an effective hedge.

A list of resistant and susceptible trees and shrubs can be found at the back of this leaflet. Other plants not mentioned in the list may also be suitable, but remember that as a general rule the faster the plant grows the more likely it is to succumb to *Armillaria*. It is the slower growing shrubs that resist the fungus.

Many of the plants in this list are resistant enough to plant in infected areas. However, even resistant plants will succumb if growing conditions are poor and the plants are under stress. Young newly planted trees are also vulnerable especially if their roots are damaged.

When planting new trees, cultivate the area thoroughly and give them the correct conditions (e.g. do not plant lime haters in calcareous soil or salt haters near the coast). Also, water regularly until the plants are fully established. Do not over-water as this can kill young feeding roots and encourage fungal entry.

B. Biological Control

The use of well-rotted compost or manure can also reduce the ravages of *Armillaria* in two ways. Firstly, it can create a better growing environment for the plants by improving the soil structure and the water holding capacity of the soil. Less stressed plants are more likely to resist the disease. Good quality compost also contains a lot of beneficial bacteria and fungi which can be antagonistic towards *Armillaria* species.

Professional products based on antagonistic bacteria or fungi may also prove beneficial as they not only strengthen the plant to resist attack but can also compete for space in the root zone against other fungi. ALWAYS CHECK THE LABEL TO ENSURE THAT THE PRODUCT IS APPROVED FOR USE IN YOUR PARTICULAR SITUATION.

C. Chemical Control

Currently there are no pesticides approved for the control of *Armillaria* in Guernsey.

HELP WITH IDENTIFICATION

If you suspect an *Armillaria* infection in your garden plants follow these instructions below and bring samples into the States Analytical Laboratory at Burnt Lane, St Martins. Site visits can be made, but only on a chargeable basis.

Either: Bring in the whole plant, if it is not too large!

or: If the shrub is too big take samples of bark from just above soil level or a few pieces of roots (about the thickness of a finger) where they join the base of the plant stem / trunk, as this is usually where the fungus is found.

It is important not only to bring in the correct type of sample but also to keep it fresh, so put the sample in a polythene bag and bring it to the lab on the same day or refrigerate before bringing it in within 2-3 days of sampling.

Useful Links:

The RHS Website has several pages on Honey Fungus and its Management

<https://www.rhs.org.uk/advice/profile?PID=180>

ARMILLARIA

LIST OF RESISTANT AND SUSCEPTIBLE PLANTS

A – Annual	D – Deciduous	E – Evergreen	FH – Frost Hardy
FT – Frost Tender	H – Fully Hardy	HH – Half Hardy	SE – Semi Evergreen
T – Tender			

PROBABLY IMMUNE MONOCOTYLEDONS

<i>Arundinaria</i> and related genera	Bamboo	E/HH-H
<i>Cordaderia selloana</i>	Pampas Grass	E/H
<i>Cordyline australis</i>	New Zealand cabbage palm	HH
<i>Nandina domestica</i>	Heavenly or Sacred bamboo	E-SE-FH
<i>Phormium spp</i>	New Zealand Flax	E/H

PROBABLY HIGHLY RESISTANT TREES

<i>Acer negundo</i>	Ash-leaved maple, Box elder	D/FH
<i>Taxus baccata</i>	Yew	E/H

RESISTANT TREES, SHRUBS & CLIMBERS

NB: Observations and records indicate that these plants are resistant to the disease under good conditions. They are not immune and can be infected by *Armillaria*. Poor growing conditions where plants are under stress (due to root damage, drought or waterlogging etc.) can result in infection.

RESISTANT CLIMBERS

<i>Clematis species</i>	Clematis	D/SE/E/H
<i>Hedera helix</i>	Common English ivy	E/H
<i>Lonicera periclymenum</i>	Common honeysuckle, Woodbine	D/H
<i>Polygonum baldschuanicum</i>	Russian vine	D/H

RESISTANT SHRUBS

<i>Abelia x grandiflora</i>	Glossy Abelia, White Abelia	SE/FH
<i>Buxus sempervirens</i>	Common box	E/H
<i>Camellia species</i>	Camellia	E/H
<i>Chimonanthus praecox</i>	Wintersweet	D/FH
<i>Cistus species</i>	Rock rose	E/FH-HH
<i>Fabiana imbricata</i>	Fabiana	E/FH
<i>Hibiscus syriacus</i>	Rose of Sharon, Shrubby Althea	D/H
<i>Lagerstroemia indica</i>	Crape myrtle	D/FH
<i>Lonicera nitida</i>	Lonicera, Box honeysuckle	E/H
<i>Mahonia species</i>	Oregon grape	E/H-HH
<i>Mahonia aquifolium</i>	Holly Mahonia	E/H

<i>Mahonia japonica</i>	Mahonia	E/H
<i>Myrtus communis</i>	Myrtle	E/FH
<i>Olearia macrodonia</i>	Daisy bush	E/FH
<i>Olearia traversii</i>		E/FH
<i>Pittosporum species</i>	Pittosporum	E/FH-FT
<i>Prunus laurocerasus</i>	Cherry laurel	E/FH
<i>Prunus spinosa</i>	Blackthorn, Sloe	D/H
<i>Pyracantha crenulata</i>	Firethorn	E/H
<i>Raphiolepis indica</i>	Indian hawthorn	E/HH
<i>Raphiolepis umbellata</i>	Yeddo hawthorn	E/FH
<i>Shepherdia argentea</i>	Buffalo berry	D/H
<i>Ulex europeus</i>	Gorse, Furze	E/H

RESISTANT HEDGING PLANTS

<i>Berberis species</i>	Barberry	D/SE/E/H-FH
<i>Berberis darwinii</i>	Darwin's Barberry	E/H
<i>Berberis thunbergii</i>	Japanese Barberry	D/H
<i>Berberis wilsoniae</i>	Wilson Barberry	D/SE/H
<i>Euonymus japonicus</i>	Japanese spindle	E/FH
<i>Ilex aquifolium</i>	Common holly	E/H
<i>Olearia macrodonta</i>	Daisy bush	E/FH
<i>Olearia traversii</i>		E/FH
<i>Pittosporum toberia</i>	Japanese Pittosporum Mock orange	E/FH
<i>Quercus ilex</i>	Holm oak	E/FH
<i>Tamarix species</i>	Tamarisk	D/E/H-FH
<i>Tamarix gallica</i>	French tamarisk	D/FH

RESISTANT TREES

<i>Abies alba</i>	Silver fir	E/H
<i>Abies concolor</i>	White fir	E/H
<i>Abies grandis</i>	Giant fir	E/H
<i>Abies procera</i>	Noble fir	E/H
<i>Abies species</i>	Firs	E/H
<i>Abutilon species</i>	Flowering maple	E/SE/FH-FT
<i>Abutilon vitifolium</i>	Vine-leaved Abutilon	D/FH
<i>Acacia verticillata</i>	Star/Whorl-leaved acacia	E/HH
<i>Acer macrophyllum</i>	Oregon maple	D/H
<i>Acer negundo var. californicum</i>	California box elder	D/H
<i>Acer pseudoplatanus</i>	Sycamore	D/H
<i>Ailanthus altissima</i>	Tree of heaven	D/H
<i>Albizia julibrissin</i>	Silk tree	D/HH
<i>Arbutus menziesii</i>	Madrona	E/FH
<i>Broussonetia papyrifera</i>	Paper mulberry	D/F
<i>Calocedrus decurrens</i>	Incense cedar	E/H
<i>Carpinus betulus</i>	Common hornbeam	D/H
<i>Catalpa bignonioides</i>	Indian bean tree	D/H
<i>Celtis occidentalis</i>	Hackberry	D/H
<i>Cotinus coggygria</i>	Smoke tree	D/H

<i>Crataegus species</i>	Hawthorn	D/H
<i>Crataegus laevigata</i>	Hawthorn, May	D/H
<i>Crataegus monogyny</i>	Common Hawthorn	D/H
<i>Crataegus phaenopyrum</i>	Washington Thorn	D/H
<i>Eucalyptus species</i>	Gum tree	E/FH-FT
<i>Eucalyptus polyanthemos</i>	Redbox, Australian beech	E/FT
<i>Fagus sylvatica</i>	Common beech	D/H
<i>Fraxinus species</i>	Ash	D/H
<i>Fraxinus excelsior</i>	Common ash	D/H
<i>Ilex aquifolium</i>	Common holly	E/H
<i>Juniperus species</i>	Junipers	E/H
<i>Koelreuteria paniculata</i>	Golden-rain tree, Pride of India	D/FH
<i>Larix species</i>	Larch	D/H
<i>Larix kaempferi</i>	Japanese larch	D/H
<i>Larix decidua</i>	European larch	D/H
<i>Larix x eurolepis</i>	Dunkeld larch	D/H
<i>Liquidambar styraciflua</i>	Sweet gum	D/H
<i>Liriodendron tulipifera</i>	Tulip tree	D/H
<i>Magnolia species</i>	Magnolia	D/SE/E/HFH
<i>Maytenus boaria</i>	Maiten	E/FH
<i>Morus species</i>	Mulberry	D/H
<i>Notofagus species</i>	Southern beech	D/H
<i>Phellodendron amurense</i>	Amur cork tree	D/H
<i>Phellodendron chinense</i>	Chinese cork tree	D/H
<i>Pistacia chinensis</i>	Chinese pistachio	D/H
<i>Platanus species</i>	Plane	D/H-FH
<i>Platanus x acerifolia [hispanica]?</i>	London plane	D/H
<i>Populus species</i>	Poplar	D/H
<i>Prunus laurocerasus</i>	Cherry laurel	E/FH
<i>Pseudotsuga menziesii</i>	Douglas fir	E/H
<i>Quercus species</i>	Oaks	D/E/H-FH
<i>Quercus chrysolepis</i>	Maul oak, Golden cup oak	E/H
<i>Quercus petraea</i>	Sessile/Durmast oak	D/H
<i>Quercus robur</i>	Common, Pedunculate oak	D/H
<i>Rhus species</i>	Sumach	D/H-HH
<i>Rhus typhina</i>	Stag's-horn Sumach	D/H
<i>Robinia species</i>	Locust	D/H
<i>Robinia pseudoacacia</i>	Locust, False acacia	D/H
<i>Sambucus nigra</i>	Common elder	D/H
<i>Tilia species</i>	Linden, lime	D/H
<i>Tilia x europaea</i>	Common lime	D/H
<i>Ulmus species</i>	Elm	D/H
<i>Vitex agnus-castus</i>	Chaste tree	D/FH
<i>Zelkova serrata</i>	Japanese Zelkova	D/H
<u>RESISTANT FRUIT & NUTS</u>		
<i>Castanea dentata</i>	American chestnut	D/H

<i>Castanea sativa</i>	Spanish/Sweet chestnut	D/H
<i>Cydonia oblonga</i>	Quince	D/H
<i>Diospyros kaki</i>	Chinese persimmon	D/FH
<i>Diospyros lotus</i>	Date plum	D/H
<i>Diospyros virginiana</i>	Common persimmon	D/H
<i>Ficus carica</i>	Common fig	D/H
<i>Malus species</i>	Crab-apple	D/H
<i>Malus ioensis</i>	Prairie Crab-apple	D/H
<i>Malus prunifolia</i>	Pear-leaf Crab-apple	D/H
<i>Malus cerasifera</i>	Cherry plum, Myrobalan	D/H
<i>Prunus Americana</i>	American plum	D/H
<i>Prunus avium</i>	Sweet cherry	D/H
<i>Prunus insititia</i>	St. Julien plum	D/H
<i>Prunus spinosa</i>	Blackthorn, Sloe	D/H
<i>Prunus species</i>	Plum	D/H
<i>Pyrus betulaefolia</i>	Birch-leaf pear	D/H
<i>Pyrus calleryana</i>	Callery pear	D/H
<i>Pyrus communis</i>	Pear	D/H

SUSCEPTIBLE TREES, SHRUBS & CLIMBERS

These plants are liable to be infected by Armillaria and should not be planted in areas where Armillaria has been found.

SUSCEPTIBLE CLIMBERS

<i>Humulus lupulus</i>	Hop	H
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SUSCEPTIBLE SHRUBS

<i>Buddleia davidii</i>	Butterfly bush	D/H
<i>Buddleia davidii</i> var. <i>magnifica</i>	Oxeye butterfly bush	D/H
<i>Buddleia globosa</i>	Orange butterfly bush	D/SE/H
<i>Caesalpinia gilliesii</i>	Paradise Poinciana	D/FH
<i>Callistemon viminalis</i>	Weeping Bottlebrush	E/HH
<i>Caryopteris x clandonensis</i>	Bluemist	D/FH
<i>Ceanothus species</i>	Ceanothus	D/E/FH-HH
<i>Ceanothus thyrsiflorus</i>	Blue-blossom	E/FH
<i>Choisya ternata</i>	Mexican orange blossom	E/FH
<i>Cotoneaster species</i>	Franchet Cotoneaster	D/SE/E/H-FH
<i>Cotoneaster franchetii</i>	Tree Cotoneaster	E/SE/H
<i>Cotoneaster frigidus</i>	Harrow Cotoneaster	D/H
<i>Cotoneaster harroviana</i>		E/H
<i>Cotoneaster horizontalis</i>	Wall-spray	D/H
<i>Cotoneaster microphylla</i>	Rock-spray Cotoneaster	E/H
<i>Cotoneaster microphylla</i> var. <i>vellea</i>		E/H

<u>SUSCEPTIBLE SHRUBS cont.</u>		
<i>Cotoneaster pannosa</i>	Silver-leaf Cotoneaster	E/SE/H
<i>Cotoneaster salicifolia</i> var. <i>floccosa</i>	Hardy willow-leaf Cotoneaster	E/HH
<i>Cytisus x spachianus</i>	Easter broom	E/H
<i>Deutzia scabra</i>	Fuzzy Deutzia	D/H
<i>Elaeagnus species</i>	Eleagnus	D/E/H-FH
<i>Eleagnus angustifolia</i>	Oleaster	D/H
<i>Erica species</i>	Heather	E/H-FH
<i>Erica carnea</i>	Alpine heath, Winter heath	E/H
<i>Escallonia montevidensis</i>	Montevideo Escallonia	E/H
<i>Escallonia pulverulenta</i>		E/H
<i>Forsythia species</i>		D/H
<i>Fremontodendron mexicanum</i>	Southern Fremontia	E/SE/FH
<i>Fuchsia species</i>	Fuchsia	D/E/FH-FT
<i>Hebe species</i>	Hebe	E/H-HH
<i>Hebe andersonii</i>	Anderson speedwell	E/HH
<i>Heteromeles arbutifolia</i>	Toyon, Christmas berry	E/FH
<i>Hydrangea macrophylla</i>	Hydrangea	D/FH
<i>Hibiscus species</i>	Hibiscus	D/E/H-FT
<i>Hypericum patulum</i> cv. <i>henryi</i>	St. Johnswort, Goldflower	E-SE/FH
<i>Hypericum prolificum</i>	Shrubby St. Johnswort	H
<i>Juniperus species</i>	Prostrate junipers	E/H
<i>Kerria japonica</i>	Japanese Rose, Globe Flower	D/H
<i>Philadelphus species</i>	Mock orange	D/H-FH
<i>Pyracantha angustifolia</i>	Narrow-leaf firethorn	E/FH
<i>Pyracantha coccinea</i>	Scarlet firethorn	E/H
<i>Pyracantha coccinea</i> cv. <i>lalendei</i>	Lalande Pyracantha	E/H
<i>Pyracantha rogersiana</i>	Rogers firethorn	E/FH
<i>Rhus trilobata</i>	Ill-scented sumac	D/H
<i>Rhododendron species</i>	Rhododendron	E/SE/D/HFT
<i>Rosa species</i>	Rose	D/SE/H
<i>Spartium junceum</i>	Spanish broom	D/FH
<i>Spiraea prunifolia</i>	Bridal wreath	D/H
<i>Viburnum species</i>		/SE/E/HFH
<i>Viburnum tinus</i>	Laurustinus	E/FH
<u>SUSCEPTIBLE HEDGING PLANTS</u>		
<i>Chamaecyparis species</i>		E/H
<i>Chamaecyparis lawsoniana</i>	Lawson cypress	E/H
<i>x Cupressocyparis leylandii</i>	Leyland cypress	E/H
<i>Escallonia macrantha</i>	Red Escallonia	E/H
<i>Euonymus japonicus</i>	Golden Euonymus	E/FH
<i>Ligustrum species</i>	Privet	D/SE/E/HFH
<i>Ligustrum japonicum</i>	Japanese privet	E/FH
<i>Ligustrum ovalifolium</i>	Privet	E/SE/H
<i>Ligustrum vulgare</i> cv. <i>aureum</i>	Yellow-leaf European Privet	D/SE/H

<u>SUSCEPTIBLE TREES</u>		
<i>Acacia longifolia</i> var. <i>floribunda</i>	Sydney golden wattle	E/FH
<i>Araucaria araucana</i>	Chile pine, Monkey puzzle	E/FLH
<i>Acer species</i>	Maple	E/D/FLH-FH
<i>Arbutus unedo</i>	Strawberry tree	E/H
<i>Betula species</i>	Birch	D/H
<i>Betula pendula</i>	Silver birch	D/H
<i>Betula pubescens</i>	White birch	D/H
<i>Caesalpinia gilliesii</i>	Paradise Poinciana	D/FH
<i>Caenothus arboreus</i>	Mountain lilac	E/FH
<i>Cedrus species</i>	Cedar	E/H
<i>Cedrus atlantica</i>	Atlas cedar	E/H
<i>Cedrus doedara</i>	Deodar	E/H
<i>Cedrus libani</i>	Cedar of Lebanon	E/H
<i>Cercidiphyllum japonicum</i>	Katsura	D/H
<i>Cercis canadensis</i>	Eastern Redbud	D/H
<i>Cryptomeria japonica</i>	Japanese cedar	E/H
<i>Cupressus species</i>	Cypress	E/H
<i>Cupressus macrocarpa</i>	Monterey cypress	E/H
<i>Eriobotrya japonica</i>	Loquat	E/FH
<i>Heteromeles arbutifolia</i>	Toyon, Christmas Berry	E/FH
<i>Hydrangea species</i>		D-E/H-FH
<i>Juglans species</i> (except <i>J. hindsii</i>)	Walnut	D/H
<i>Juglans regia</i>	Walnut	D/H
<i>Laburnum species</i>		D/H
<i>Laburnum anagyroides</i>	Golden-Chain	D/H
<i>Leptospermum laevigatum</i>	Australian tea-tree	E/FH-HH
<i>Lithocarpus densifolia</i>	Tanbark oak	E/FH
<i>Malus species</i>	Apples	D/H
<i>Malus hupehensis</i>	Hupeh crab	D/H
<i>Malus x purpurea</i> cv. <i>Eleyi</i>	Eley crab	D/H
<i>Malus sargentii</i>	Sargent crab	D/H
<i>Malus toringoides</i>	Cutleaf crab-apple	D/H
<i>Myrtus communis</i> cv. <i>variegata</i>	Variegated myrtle	E/FH
<i>Picea abies</i>	Common/Norway spruce	E/H
<i>Picea omorika</i>	Serbian spruce	E/H
<i>Picea sitchensis</i>	Sitka spruce	E/H
<i>Pinus species</i>	Pine	E/H
<i>Pinus contorta</i>	Lodgepole pine, Shore pine	E/H
<i>Pinus nigra</i> var. <i>maritima</i>	Corsican pine	E/H
<i>Pinus radiata</i>	Monterey pine	E/H
<i>Pinus sylvestris</i>	Scots pine	E/H
<i>Salix species</i>	Willow	D/H-FH
<i>Salix babylonica</i>	Weeping willow	D/H
<i>Sequoiadendron giganteum</i>	Wellingtonia, Giant redwood, Big tree	E/H
<i>Syringa vulgaris</i>	Lilac	D/H
<i>Thuja plicata</i>	Western red cedar	E/H
<i>Tsuga heterophylla</i>	Western hemlock	E/H

SUSCEPTIBLE FRUIT AND NUTS

<i>Castanea mollissima</i>	Chinese chestnut	D/H
<i>Fragaria species</i>	Strawberry	H
<i>Fragaria chiloensis</i> var. <i>ananassa</i>	Strawberry	H
<i>Malus baccata</i>	Siberian crab-apple	D/H
<i>Prunus species</i>	Cherry and Plum	D/H
<i>Prunus amygdalus</i>	Almond	D/H
<i>Prunus armeniaca</i>	Apricot	D/H
<i>Prunus dasycarpa</i>	Purple apricot	D/H
<i>Prunus davidiana</i>	David peach	D/H
<i>Prunus domestica</i> cv. <i>Clyman Plum</i>	Clyman plum	D/H
<i>Prunus domestica</i> cv. <i>Diamond</i>	Diamond plum	D/H
<i>Prunus domestica</i> cv. <i>French Prune</i>	French prune	D/H
<i>Prunus mahaleb</i>	Mahaleb peach	D/H
<i>Prunus mune</i>	Japanese apricot	D/H
<i>Prunus persica</i>	Peach	D/H
<i>Prunus serrulata</i>	Japanese flowering cherry	D/H
<i>Prunus sibirica</i>	Siberian apricot	D/H
<i>Prunus tomentosa</i>	Downy Cherry	D/H
<i>Pterocarya stenoptera</i>	Chinese wing nut	D/H
<i>Ribes grossularia</i>	Gooseberry	D/H
<i>Ribes nigrum</i>	Blackcurrant	D/H
<i>Rubus species</i>	Blackberry, Brambles	D/SE/E/H-FH
<i>Rubus idaeus</i>	Raspberry	D/H
<i>Vitis species</i>	Grape vine	D/F-H
<i>Vitis vinifera</i>	Grape vine	D/H
<i>Solanum tuberosum</i>	Potato	A
<i>Zantedeschia species</i>	Calla lily	FH

RESISTANT TENDER PLANTS

<i>Acacia decurrens</i> var. <i>mollis</i>	Black acacia, Black wattle	D/T
<i>Arctostaphylos species</i>	Manzanita	E/H-FT
<i>Brachychiton populneum</i>	Kurrajong bottle tree	E/FT
<i>Carya illinoensis</i> (<i>C. pecan</i> ?)	Pecan	D/FT
<i>Eugenia species</i> <i>Syzygium</i>	Eugenia	E/FT
<i>Grevillea robusta</i>	Silky oak	E/FT
<i>Jacaranda acutifolia</i>	Jacaranda	D/E/FT
<i>Lagerstroemia indica</i>	Crape myrtle	D/FT
<i>Mahonia [nevinii] haematocarpa</i>	Nevin mahonia	E/FT
<i>Melaleuca styphelioides</i>	Malaleuca	E/FT
<i>Nerium oleander</i>	Oleander	E/T
<i>Persea americana</i>	Avocado	D/T
<i>Persea indica</i>	Indian avocado	D/T
<i>Pinus canariensis</i>	Canary pine	E/FT

<i>Pinus patula</i>	Mexican pine	E/HH-FT
<i>Pinus torreyana</i>	Torrey/Soledad pine	E/FT
<i>Prunus ilicifolia</i>	Holly-leaf cherry, Islay, California cherry	E/T
<i>Prunus salicina</i>	Japanese plum	D/T
<i>Prunus salicina</i> cv. <i>Methley</i>	Methley plum	D/T
<i>Quillaja sopenaria</i>	Soapbark tree, Soap bush	E/T
<i>Ternstroemia sylvatica</i>	Mexican Ternstroemia	E/T
<i>Tibouchina semidecandra</i>	Pleroma, Princess flower, Glory-bush	E/T

SUSCEPTIBLE TENDER PLANTS

<i>Arecastrum romanzoffianum</i>	Queen palm	E/FT
<i>Cassia tomentosa</i>	Senna	D/FT
<i>Cinnamomum camphora</i>	Camphor tree	E/FT
<i>Citrus species</i>	Citrus	E/T
<i>Coprosma repens</i>	Coprosma, Mirror shrub	E/FT
<i>Erythrina crista-galli</i>	Cockspur coral tree	D/SE/HH/FT
<i>Eucalyptus maculata</i> v. <i>citriodora</i>	Lemon-scented spotted gum	E/FT
<i>Eucalyptus sideroxylon</i> var. <i>rosea</i>	Pink iron bark	E/FT
<i>Euphorbia pulcherrima</i>	Poinsettia	E/FT
<i>Hakea laurina</i>	Sea urchin tree	E/FH-FT
<i>Melaleuca hypericifolia</i>		E/FT
<i>Melaleuca genistifolia</i>		E/FT
<i>Melaleuca leucadendra</i>	Cajeput tree or Punk tree	E/FT
<i>Pelargonium species</i>	Geranium	E/FT
<i>Quercus virginiana</i>	Southern live oak	E/T
<i>Schinus molle</i>	California pepper tree	E/FT

RESISTANT HERBACEOUS PLANTS

Robison-Bax (1999) tested some common herbaceous plants and the results are below:

<i>Polygonum rude</i>		
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SUSCEPTIBLE HERBACEOUS PLANTS

<i>Alchemilla mollis</i>	Lady's mantle	H
<i>Arundinaria pumila</i>	Bamboo	H
<i>Beta vulgaris</i> ssp <i>maritime</i>	Sea Beet	H
<i>Cimifuga species</i>	Bugbane	H
<i>Epimedium species</i>	Epimedium	H
<i>Geranium albanum</i>	Cranebill, Hardy Geraniums	H
<i>Hosta species</i>	Plantain Lily	H
<i>Lamium species</i>	Deadnettles	H
<i>Oenothera species</i>	Evening Primrose	H
<i>Pelargonium 'Multi'</i>	Geranium	HH
<i>Phlox paniculata</i>	Phlox	H
<i>Physalis alkekengi</i>	Bladder cherry, Winter cherry	H
<i>Saxifraga x urbium</i>	London pride	H
<i>Sedum 'Autumn Joy'</i>	Stonecrop	H

<i>Seseli osseum</i>	Umbelliferae family	H
<i>Strobilanthes species</i>	Acanthaceae family	H
<i>Succisella petteri</i>	Dipsaceae family	H
<i>Thymus species</i>	Thyme	H
<i>Valerianella rimosa</i>	Valerianaceae family	H
<i>Vinetoxicum nigrum</i>	Apogynaceae family	H

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