Crop Protection Compendium - *Hedera helix* L.

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NAMES AND TAXONOMY

Preferred scientific name

Hedera helix L.

Taxonomic position

Domain: Eukaryota
Kingdom: Viridiplantae
Phylum: Spermatophyta
Subphylum: Angiospermae
Class: Dicotyledonae
Order: Araliales
Family: Araliaceae

Other scientific names

Hedera hibernica Carr.

BAYER code

HEEHE (*Hedera helix*)
HEEHI (*Hedera hibernica*)

Common names

English:
ivy
English ivy
common ivy
Atlantic ivy
Spanish:
hiedra
yedra comun
French:
Herbe de St Jean
Bourreau des arbres
lierre
lierre commun

Finland:
köynneliäs muratti
Germany:
Efeu
Gemeiner Efeu
Italy:
edera
Netherlands:
klimop
Portugal:
hera
Sweden:
murgroena
murgröna

Notes on taxonomy and nomenclature

The genus *Hedera* is a complex group that has only been recently been clarified (Ackerfield and Wen, 2002) with 16 taxa (12 species) now recognized. Ackerfield and Wen (2002) provide a key to the identification of species and sub-species of *Hedera* based on trichome and leaf morphologies (see also Ackerfield, 2001). On the basis of differences in trichome positioning, leaf shape and chromosome number, McAllister (1990) recognised *H. hibernica* as a distinct species from *H. helix*. Tutin et al. (1968) have suggested that this taxon had originated from south-west Ireland. However, *H. hibernica* has still often been treated as *H. helix* subsp. *hibernica* (e.g. Stace, 1997). There are many forms and cultivars, for instance Brickell (1999) lists 28 cultivars/varieties of *H. helix* and four of *H. hibernica*. As both the taxonomic status and the extent of planting of the *Hedera* material introduced around the world is often not clear or even unknown, *Hedera helix* L. and *Hedera hibernica* Carr. are treated in this datasheet as one species complex, *H. helix*. Indeed, in the horticultural trade in the USA, the two species are commonly known as 'English ivy'. However, it is probable that *H. helix* and its various cultivars is the more common of the two taxa, especially as many more cultivars of *H. helix* are available on the market (Pennisi et al., 2001). No attempt has been made to differentiate between the two taxa in the distribution table.

Indeed the introduced material may even consist of other *Hedera* taxa including some that were only recognized as subspecies until recently. For instance, Press and Short (1994) in their flora of Madeira, reported *H. maderensis* as *H. helix* subsp. *canariensis*. Although all *Hedera* species are commonly known as ivy, H. helix is often known as the common ivy or more specifically, the English ivy, whereas *H. hibernica* is known specifically as the Atlantic ivy, due to its limited, coastal distribution.

HOST RANGE

Notes on host range

When fully grown in a tree, it may adversely affect the canopy of a variety of species by shading out part of the host's foliage. In exposed sites, the vine will increase the likelihood of windthrow of deciduous species, especially of trees in open conditions during winter when there is no foliage and storms are more frequent. There is some evidence to suggest that *H. helix* has an allelopathic effect on seed germination (Le and Sonu, 2002). Although generally an environmental weed, it may also affect plantation trees.

HABITAT

This versatile plant is commonly found in a variety of natural and human-induced habitats. It is a common forest species, growing on the forest floor or up the trunks of canopy trees. It is readily found on rocks and cliffs including those located in the close vicinity of the sea. In human-dominated habitats it is readily found on walls, houses, fences, posts, hedges and ornamental trees.

Habitat descriptors

Serious weed in: urban areas; managed forests; natural forests

GEOGRAPHIC DISTRIBUTION

Notes on distribution

No attempt has been made to differentiate between the two *Hedera* taxa in the distribution records. McAllister (1990) noted that *H. helix* subsp. *helix* is widespread throughout much of Europe and *H. hibernica* occurs along the Atlantic Coast of Europe with much range overlap. However, being such an important horticultural taxon, *H. hibernica* is probably now widely planted throughout much of western Europe. *H. helix* subsp. *rhizomatifera* is restricted to southern Spain and *H. helix* f. *poetarum* is found in Italy and western Transcaucasia. The general distribution of these closely related taxa is given by Ackerfield and Wen (2002). The species is likely to be more widespread than indicated in the distribution table.

Distribution List

Europe			
Albania	widespread	native	Tutin et al., 1968
Andorra	widespread	native	Tutin et al., 1968
Austria	widespread	native	Tutin et al., 1968

Belarus	widespread	native		Tutin et al., 1968
Belgium	widespread	native		Tutin et al., 1968
Bosnia and Herzegovina	widespread	native		Tutin et al., 1968
Bulgaria	widespread	native		Tutin et al., 1968
Croatia	widespread	native		Tutin et al., 1968
Cyprus	present	native		USDA-ARS, 2003
Czech Republic	widespread	native		Tutin et al., 1968
Denmark	widespread	native	invasive	Tutin et al., 1968; Hartvig, 2002
Estonia	widespread	native		Tutin et al., 1968
France	widespread	native		Tutin et al., 1968
Corsica	widespread	native		Tutin et al., 1968
Germany	widespread	native		Tutin et al., 1968
Greece	widespread	native		Tutin et al., 1968
Hungary	widespread	native		Tutin et al., 1968
Ireland	widespread	native		Stace, 1997
Italy	widespread	native		Tutin et al., 1968
Latvia	widespread	native		Tutin et al., 1968
Liechtenstein	widespread	native		Tutin et al., 1968
Lithuania	widespread	native		Tutin et al., 1968
Luxembourg	widespread	native		Tutin et al., 1968
Macedonia	widespread	native		Tutin et al., 1968
Moldova	widespread	native		Tutin et al., 1968
Netherlands	widespread	native		Tutin et al., 1968
Norway	widespread	native		Tutin et al., 1968
Poland	widespread	native		Tutin et al., 1968
Portugal	widespread	native		Tutin et al., 1968
Azores	present	native		USDA-ARS, 2003
Madeira	present	native		USDA-ARS, 2003
Romania	widespread	native		Tutin et al., 1968
[Russian Federation]				
Central Russia	widespread	native		Tutin et al., 1968
Southern Russia	present	native		USDA-ARS, 2003
Serbia and Montenegro	widespread	native		Tutin et al., 1968
Slovakia	widespread	native		Tutin et al., 1968
Slovenia	widespread	native		Tutin et al., 1968
Spain	widespread	native		Tutin et al., 1968
Canary Islands	present	native		USDA-ARS, 2003
Sweden	widespread	native		Tutin et al., 1968
Switzerland	widespread	native		Tutin et al., 1968
Ukraine	widespread	native		Tutin et al., 1968
United Kingdom	widespread	native		Stace, 1997
Channel Islands	widespread	native		Tutin et al., 1968
Asia				

Armenia	present	native		USDA-ARS, 2003
Georgia (Republic)	present	native		USDA-ARS, 2003
Israel	present	native		USDA-ARS, 2003
Japan	present	introduced		Takeuchi & Horie, 1998
Lebanon	present	native		USDA-ARS, 2003
Syria	present	native		USDA-ARS, 2003
Turkey	widespread	native		Tutin et al., 1968
Vietnam	present	native		Missouri Botanical Garden, 2003
Africa				
Algeria	present	native		USDA-ARS, 2003
Libya	present	native		USDA-ARS, 2003
Morocco	present	native		USDA-ARS, 2003
Tunisia	present	native		USDA-ARS, 2003
North America				
[Canada]				
British Columbia	localized	introduced	invasive	Murray & Jones, 2002
Ontario	localized	introduced	invasive	Anon., 2002
[USA]				
Alabama	present	introduced		USDA-NRCS, 2002
Alaska	present	introduced		USDA-NRCS, 2002
Arizona	present	introduced		USDA-NRCS, 2002
California	present	introduced	invasive	Reichard, 2000; USDA-NRCS, 2002
Florida	present	introduced		USDA-NRCS, 2002
Georgia (USA)	present	introduced		USDA-NRCS, 2002
Hawaii	present	introduced	invasive	USDA-NRCS, 2002; Starr et al., 2003
Illinois	present	introduced		USDA-NRCS, 2002
Indiana	present	introduced		USDA-NRCS, 2002
Kentucky	present	introduced		USDA-NRCS, 2002
Louisiana	present	introduced		USDA-NRCS, 2002
Maryland	present	introduced		USDA-NRCS, 2002
Massachusetts	present	introduced		USDA-NRCS, 2002
Michigan	present	introduced		USDA-NRCS, 2002
Mississippi	present	introduced		USDA-NRCS, 2002
Missouri	present	introduced		USDA-NRCS, 2002
New Jersey	present	introduced		USDA-NRCS, 2002
New York	present	introduced		USDA-NRCS, 2002
North Carolina	present	introduced		USDA-NRCS, 2002
Ohio	present	introduced		USDA-NRCS, 2002
Oregon	present	introduced	invasive	Moriarty, 2001; USDA-NRCS, 2002
Pennsylvania	present	introduced		USDA-NRCS, 2002
South Carolina	present	introduced		USDA-NRCS, 2002
Tennessee	present	introduced		USDA-NRCS, 2002
Texas	present	introduced		USDA-NRCS, 2002

Utah	present	introduced		USDA-NRCS, 2002
Virginia	present	introduced		USDA-NRCS, 2002
Washington	present	introduced		USDA-NRCS, 2002
West Virginia	present	introduced		USDA-NRCS, 2002
South America				
Argentina	localized	introduced	invasive	Zalba & Villamil, 2002
Bolivia	present	native		Missouri Botanical Garden, 2003
Chile	present	introduced	invasive	Pauchard & Alaback, 2002
Ecuador	present	native		Missouri Botanical Garden, 2003
Oceania				
Australia	present	introduced	invasive	Adler & Stephens, 2001
New South Wales	present	introduced	invasive	Turton et al., 2001
Victoria	present	introduced	invasive	Freshwater, 1991
New Zealand	localized	introduced	invasive	Williams et al., 2002

HISTORY OF INTRODUCTION AND SPREAD

H. helix is native to Europe, North Africa and the Near East (USDA-ARS, 2003). It was brought to North America by colonial settlers (Morisawa, 1999), but the exact date of introduction and subsequent timing and pattern of distribution within North America is unknown. During the 1900s, it was widely planted throughout the USA (Reichard, 2000; Moriarty, 2001) and it is commonly found near old and existing habitations where it often escapes; infestations are more prevalent in forest parks close to urban centres (Akerson and Gounaris, 2000). In New Zealand, *H. helix* was introduced as an ornamental species, being first recorded in the wild in 1873, but in the Auckland Region it is thought to have become invasive more recently, i.e. between 1940 and 1970. The species is now found throughout the North Island and parts of the South Island (Anon., n.d.). *Hedera* taxa including many horticultural varieties have been introduced throughout much of Europe and are known to spread (Clement and Foster, 1994). In Denmark, seeds from garden cultivars spread into natural plant communities and non-native populations have become established (Hartvig, 2002).

BIOLOGY AND ECOLOGY

Genetics

The respective chromosome numbers of *H. helix* and *H. hibernica* are 2n=48 and 2n=96, suggesting that *H. helix* is the more ancient species, and *H. hibernica* may have evolved from it via chromosome doubling or hybridization with another *Hedera* species. The amount of nuclear DNA is 3.6 pg (Grime et al., 1988).

Physiology and Phenology

H. helix exhibits strong heterophily and intermediate shoots and leaves are rare. If a reproductive shoot is detached and roots, it will continue to grow with leaves and shoots typical of that phase. However, 'reversion' to the juvenile vegetative phase can be induced by spraying the plant with the growth hormone gibberellic acid, and abscisic acid reverses the effects. This suggests that the balance of gibberellic acid and abscisic acid is involved in the change from juvenile to mature stage (Briggs and Walters, 1997). In Europe, at its

northern, eastern and high altitude distribution limits, the species will remain at its juvenile phase (Andergassen and Bauer, 2002). Flowering and fruiting occur over a number of months with flowering taking place during autumn and early winter. On some plants the distal part of the inflorescence may bear fruits that are already fully-grown when the last flowers on the rest of the inflorescence are just at anthesis. Berry-like fruits ripen in the following spring, April to June in Western Europe (Grime et al., 1988). Germination is epigeal and it takes 6 days for 50% of samples to germinate, and is to some extent inhibited by light (Grime et al., 1988).

Reproductive Biology

A combination of sexual reproduction and vegetative propagation ensures the spread of this species. Age of first reproduction is variable but can be in the region of 10 years (Reichard, 2000). Flowers are insect pollinated and are visited by a variety of insect species, many of which visit the flowers for its nectar (Proctor and Yeo, 1973). A wide number of insects will visit the flowers as they are produced aseasonally when few if any other species are in flower, provided the weather conditions are conducive. In Britain, frequent visitors include the common wasp (Vespula sp.), the hornet (Vespa crabro), the blow-fly (Calliphora sp.), the crane fly (Tipulidae), Tilupa sp. and Dilophus febrilis. However, it is probably mostly pollinated by bees (Apis spp.). Green fruits are born through the winter, ripening in early spring and are readily dispersed by a variety of birds. Up to 70% of the seeds are viable but scarification appears to be essential for germination and this is achieved when seeds pass through a bird's digestive system (Reichard, 2000). Germination mostly takes place in spring (Grime et al., 1988).

Environmental Requirements

H. helix appears to be tolerant of a rather broad spectrum of environmental conditions in the temperate zone. It occurs from sea-level to altitudes of over 1000 m in Europe and has been found up to 3300 m in Bolivia (Missouri Botanical Garden, 2003). It is readily found across a variety of rainfall zones in Europe. It is often found in riparian zones but it does not grow well in areas where the water table is high and soil is waterlogged (Thomas, 1980). It is reported as growing well in acidic and basic soils (Reichard, 2000) and tolerates a wide range of soil pH, but is most frequent and abundant above pH 6 and is seldom found below pH 4 (Grime et al., 1988). In North America (Midwest and New England states) it is reported that severe winter cold inhibits its spread (Moriarty, 2001) and in late autumn, flowers are susceptible to frost (Grime et al., 1988). It is tolerant of salt deposition. The increased winter light under deciduous trees apparently allows this evergreen vine to grow rapidly upward in winter (Thomas, 1980). Although *H. helix* grows much better in higher light intensities, it is markedly tolerant of shade as well as drought (Thomas, 1980; Sack and Grubb, 2002). It is often considered as a nitrogen indicator species, and plant density has increased over time in forests where nitrogen deposition has increased since the late 1970s (Lameire et al., 2000).

Climatic amplitude (estimates)
- Altitude range: 0 - 3300 m
- Rainfall regime: winter; uniform
- Absolute minimum temperature: -35 - 0ºC

Soil descriptors
- Soil texture: light; medium; heavy
- Soil drainage: free; impeded
- Soil reaction: acid; neutral; alkaline
- Special soil tolerances: shallow

MEANS OF MOVEMENT AND DISPERSAL

Stem fragments may possibly be dispersed by running water but there are no documented cases of local dispersal by these means.

Vector Transmission (Biotic)

H. helix is bird-dispersed although its berries are mildly toxic. This mild toxicity can prevent consumption of too many fruits in one period of foraging and regulate seed retention time, thus ensuring better seed dispersal (Barnea et al., 1993). In North America, the fruits do not provide a valuable food source for native songbirds; however, starlings, cedar waxwings, robins and Stellar's jays consume them (Moriarty, 2001) and presumably disperse them.

Accidental Introduction

Vegetative material which can easily root can be readily dispersed accidentally to new suitable habitats. Careless dumping of surplus trimmings from gardens is a major risk (Auckland Regional Council, 2003) but soil movement or transport of logs bearing *H. helix* stems may also result in the establishment of new infestations. In the USA, recommendations have been given to the public for the safe disposal of garden clippings (Simon, 2002).

Intentional Introduction

The species is widely used as an ornamental and therefore likely to be introduced more widely unless legislation is set up to prevent further introductions.

Transport pathways for long distance movement

- Soil, Gravel, Water, Etc.

NATURAL ENEMIES

H. helix suffers from a variety of pests and diseases (Pennisi et al., 2001), but these appear to have little impact on the health of the species apart from affecting the ornamental value of the plant.

IMPACT

Economic impact

Although generally an environmental weed, it may also affect plantation trees, though costs of *H. helix* control in commercial forestry plantations have not been documented.

Environmental impact

This species is often viewed as having a high potential impact on the environment and more specifically in completely covering the forest floor and climbing to the tops of the tallest trees, smothering them. Smothering and causing tree dieback or even tree death is an impact not readily reported from its native range. It is widely thought that the dense carpet often produced in some forests suppresses natural regeneration of understorey and forest species maybe as a result of increased nitrogen levels produced by its leaf litter (Thomas, 1980; Akerson and Gounaris, 2000; Reichard, 2000). *H. helix* has a competitive impact on native plants but this is variable, with various species exhibiting contrasting

growth responses (Le and Sonu, 2002). In North America it is thought that the additional weight of water and/or ice on the evergreen leaves may increase storm damage to trees (Reichard, 2000) and a number of other impacts have been postulated by Simon (2002).

Social impact

All parts of the plant are toxic to man (Schepens, 1997). Generally when the fruits are eaten, this results in a combination of stomach pain, nausea, vomiting and diarrhoea. Ingested leaves induce a narcotic effect not unlike that of atropine (Jordan, 1976) and *H. helix* can cause contact dermatitis, with repeated exposure to wet leaves causing vesicular eruption of the face, hands and arms within 48 hours of contact (Benezra et al., 1985). People most likely to be affected are children who clamber up walls or trees covered with ivy or adults who cut back the plant. Schepens (1997) provides a detailed overview of the toxic properties of *H. helix* including the symptoms caused and necessary cures. In Australia, where it is introduced and a common plant used by the nursery and garden industry, it is listed as a plant of concern to human health (Adler and Stephens, 2001).

Impact on biodiversity

H. helix is one of a number of invasive species that are threatening populations of the shrub Epacris hamiltonii in the Australian Blue Mountains, west of Sydney. Only just over 4000 individuals of this endangered shrub are known to grow on cliff edges along three adjacent valleys (Turton et al., 2001). In North America this vine is widely viewed as reducing native plant diversity which in turn reduces habitats for native wildlife species (Moriarty, 2001) and is often said to produce "ivy deserts" (Okerman, 2000; Reichard, 2000).

Summary of impact

Negative impact on: biodiversity; environment; native fauna

PHYTOSANITARY SIGNIFICANCE

In the USA, over 100 commercially popular *Hedera* cultivars (mainly *H. helix*) are available and The American Ivy Society is dedicated to this group of plants including the registration of new *Hedera* cultivars (Pennisi et al., 2001). This clearly indicates the potential for new introductions of plants from this genus. In Oregon, the Department of Agriculture has declared *H. helix* a noxious weed; however, State agencies have carried on with the use of this plant in landscaping. Moriarty (2001) reported that an effort was being made to have the plant placed on the noxious weed quarantine list, "making it illegal to bring ivy into the state, offer it for sale, sell it, purchase it, or propagate it." However, because *H. helix* is a popular landscape plant it was expected that some Oregon nurseries and plant retailers would lobby strongly against such a classification. In Washington, *H. helix* is on the State Noxious Weed List and native plant alternatives are being promoted (Anon., 2002) and control is not required but is strongly recommended (Anon., 2002; Simon, 2002). In the Auckland Region of New Zealand, *H. helix* "is no longer permitted to be sold, propagated, distributed or commercially displayed on the basis that it is now a Regional Surveillance Plant Pest" but landowners are encouraged to control infestations of this plant without legal obligation (Auckland Regional Council, 2003).

SUMMARY OF INVASIVENESS

H. helix is an important horticultural woody climber from Europe introduced to many other temperate zones and it is now spreading in many regions. Seeds of this toxic plant are readily dispersed by birds. Once established it spreads vegetatively on the forest floor and then climbs trees up to the canopy where it flowers and fruits freely. It reduces native plant diversity and associated fauna, threatens endangered species and alters nutrient dynamics of forest soils. It is difficult to control particularly in view of the ineffectiveness of herbicide sprayed on the foliage.

Risk and Impact Factors

- invasive in its native range: yes
- proved to be invasive outside its native range: yes
- highly adaptable to different environments: yes
- high reproductive potential: yes
- highly mobile locally: yes
- its propagules remain viable for more than one year: no
- tolerates cultivation, browsing pressure, mutilation, fire etc.: no
- competitive in crops or pasture: no
- affects ecosystem: unknown
- adversely affects natural communities: yes
- adversely affects community structure: yes
- adversely affect human health: yes
- has sociological impacts on recreational patterns, aesthetics, property values: unknown
- harmful to animals: yes
- produces spines, thorns or burrs: no
- host or vector of pests or diseases: no
- 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: ; woody; vegetatively propagated; seed propagated; perennial.

H. helix is an evergreen woody perennial exhibiting marked morphological changes between its sterile and reproductive phases. The stem is long, either creeping or climbing and may attain a length of up to 30 m. It can be extremely long-lived and may reach an age of over 400 years. When old, stems may reach a diameter of over 10 cm and even produce a short trunk. The stem is attached to the substrate by numerous small roots produced at each leaf node, which bear vascular-arbuscular mycorrhiza. The deep green, glossy, leathery leaves are evergreen, heterophyllous, and mostly palmately lobed on sterile stems whereas those on flowering stems are ovate and larger. Leaves of *H. helix* are usually less than 8 cm across whereas those of *H. hibernica* are greater than 8 cm wide and have petioles half as long as the leaf blade. Leaves are long-lived and have a strong smell when crushed. The perfect, sometimes protandrous, yellow-green flowers, 5-7 mm across, are clustered on terminal inflorescences born on stems climbing to canopy height. The fruit, a drupe 6-9 mm in diameter, is green turning dark purplish/black when mature and contains 2-5 seeds (Grime et al., 1988; Stace, 1997; Reichard, 2000).

SIMILARITIES TO OTHER SPECIES

Species of the genus *Hedera* are difficult to tell apart and require close examination to identify to species level. Ackerfield and Wen (2002) have recently produced a key to facilitate identification and Pennisi et al. (2001) provide brief descriptions of scores of ornamental varieties.

CONTROL

Cultural Control

Although the palatability of *H. helix* to grazing animals in North America is unrecorded (Reichard, 2000), European deer species find it edible and its biomass decreases markedly when ungulate numbers are high (González-Hernández and Silva-Pando, 1996). Mammal h

Mechanical Control

Killing the aerial portion of *H. helix*, the seed-producing part of the plant, is easy and only requires the cutting of the stems around the host tree with pruning tools. However, when *H. helix* grows on tree-ferns, it is not sufficient to cut the stems to kill the plant. All parts of the plant must be removed as *H. helix* can root and sustain itself in the fibrous tree-fern trunks. The roots of young plants can be easily dug out, particularly when the soil is moist, from the ground around the base of the infected tree, whereas old individuals generally do not resprout. When the plant carpets the forest floor, individual stems can be readily pulled off the ground; however, it is essential to remove all runners. Any overlooked live shoot may restart an infestation, thus follow-up monitoring and control is essential. Small or young ivy plants can be pulled off supporting structures or trees, and roots dug out. Soil and native vegetation disturbance must be as limited as possible because this favours the establishment of other invasive species. To avoid rerooting and resprouting, all material must be carefully removed from the site and disposed of safely. If removal of the plants is not possible, all parts of the plant must be placed off the ground in such a way that they can dry out. Gloves should be worn as skin irritation may follow contact with the plant (Freshwater, 1991; Morisawa, 1999; Reichard, 2000). One form of prescribed burning has successfully been used to control *H. helix*. Plants and resprouts are repeatedly burnt with a blowtorch until the plant's resources are exhausted (Reichard, 2000).

Chemical Control

The mechanical control of *H. helix* by cutting stems is not always successful especially if the roots of younger individuals cannot be removed. Then it is advisable to strip the bark, notch the exposed section of the vine and paint on an undiluted herbicide such as glyphosate. This combination of cutting the vine less than 20 cm above ground and an immediate herbicide application may provide better control. Metsulfuron, picloram and glyphosate have all proved successful in Australia (Anon., n.d.). As *H. helix* leaves are waxy, this often prevents the herbicides, especially hydrophilic compounds such as glyphosate, from permeating the leaves. Thus this plant does not respond well to herbicide spraying, even when a surfactant is added, and non-target native species may be affected in the process. When desirable native vegetation must not be harmed then the stump treatments should be used wherever possible. It is apparent that older plants are more resistant to herbicide treatment and even two applications may not kill them but just reduce growth. In the western USA, immediate spraying of triclopyr following the removal of most leaves and young shoots with a string trimmer has proved successful. However, in

other instance, applications of glyphosate, triclopyr and 2,4-D have proved ineffective or unsatisfactory (Morisawa, 1999; Reichard, 2000).

Biological Control

There has been no attempt to identify and introduce biological control agents, and in view of the species' importance in horticulture in the USA, it is extremely unlikely that any such attempts will be made in that country (Reichard, 2000). In view of the species' near immunity to pests and diseases in its native range, prospects for biological control are limited. Prasad (2002) has reported that the use of a bioherbicide in the form of the fungus Chondrostereum purpureum has been applied to *H. helix* but its efficacy has yet to be ascertained.

USES

H. helix is of major importance in horticulture in much of the temperate zone both for private planting and community landscaping (Moriarty, 2001), as a popular ornamental and groundcover in residential, commercial and public landscaping, and has been used to control erosion in many parts of the USA (Reichard, 2000; Moriarty, 2001). It does provide a complete ground cover; however, its shallow rooting does not prevent landslides when the soils are saturated following periods of heavy rainfall (Moriarty, 2001). Historically, extracts from the foliage were used medicinally to treat wounds and ulcerative sores, combat lice and fleas, as a narcotic to soothe toothaches, against arthritis and rheumatism and recently it has been shown to be effective against bronchitis (Büechi and Bolli, 2003). Bees readily visit flowers and the resulting honey is a fine pale amber colour with an excellent flavour and there seems to be no record of toxins being transferred to the honey (Jordan, 1976; Schepens, 1997). Currently, plant extracts have only limited use as ingredients in some cosmetics, shampoos and medicines (Schepens, 1997).

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:
Ceroplastes japonicus (tortoise wax scale), *Hercinothrips femoralis* (banded greenhouse thrips), *Pseudococcus calceolariae* (scarlet mealybug)

Minor host of:
Armillaria mellea (armillaria root rot), *Aspidiotus nerii* (aucuba scale), *Ceroplastes rusci* (fig wax scale), *Dialeurodes citri* (citrus whitefly), *Icerya purchasi* (cottony cushion scale), *Nectria haematococca* (dry rot of potato), *Otiorhynchus armadillo* (armadillo weevil), *Phytonemus pallidus* (strawberry mite), *Pratylenchus penetrans* (nematode, northern root lesion), *Pratylenchus vulnus* (walnut root lesion nematode), *Pseudomonas cichorii* (bacterial blight of endive), *Trichoplusia ni* (cabbage looper)

Wild host of:

Arabis mosaic virus (hop bare-bine), *Ceroplastes rubens* (red wax scale), *Eutypa lata* (Eutypa dieback), *Lobesia botrana* (grape berry moth)

Associated with (not a host):
Aonidiella citrina (yellow scale)

Host of (source - data mining):
Dynaspidiotus britannicus (bay-tree, scale), *Siphoninus immaculatus* , *Tetranychus urticae* (two-spotted spider mite), *Xanthomonas hortorum* pv. *hederae* (bacterial: ivy leaf spot)

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IMAGES

Picture	Caption	Copyright
	Large deciduous trees with trunks covered by *H. helix*.	Pierre Binggeli
	Large coastal plant with a stout trunk (ca 10 cm diameter) growing over a small cliff.	Pierre Binggeli

Flower buds, flowers and young fruits. Pierre Binggeli

Fully grown but immature fruits and immature fruits with simple leaves. Pierre Binggeli