NATURAL ENEMIES OF JAPANESE HONEYSUCKLE, *LONICERA JAPONICA*, IN NEW ZEALAND

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ABSTRACT

Japanese honeysuckle is rapidly increasing as a weed throughout most of the North Island and northern South Island of New Zealand. A classical biological control programme was initiated in 2004–2005 with a survey of the natural invertebrate fauna and pathogens associated with the weed in New Zealand. The honeysuckle was being attacked by a diverse range of native and introduced invertebrates. But overall the damage was minimal and none of the herbivore niches on the weed were well utilised implying that exotic agents may have a chance of inflicting additional damage that might be sufficient to control the species. Most damage was caused by foliage feeders, such as lepidopterous larvae and thrips, but this affected less than 5% of total plant biomass. Primary and secondary foliar pathogens, such as *Pseudocercospora lonicerae, Colletotrichum gloeosporioides, Insolibasidium deformans* and *Phoma* spp., were frequently recorded. Potential use of these natural enemies for weed biocontrol is discussed.

Keywords: Environmental weed, mycoherbicide, honeysuckle blight, parasitoid, predators.

INTRODUCTION

Japanese honeysuckle, *Lonicera japonica* (Thunb.) Caprifoliaceae, is a weed of native forest remnants, wetlands, pine plantations, shrubland and transit corridors throughout many regions of New Zealand (Standish 2002). It is a perennial climbing and twining woody vine that spreads by seeds, rhizomes and above-ground runners. In New Zealand the plant blooms from September through May with sweetly fragrant white-yellow flowers. The fruit, a many-seeded, black pulpy berry, matures in autumn. The plant grows rapidly, can create dense tangled thickets that can smother trees, and is regarded as a threat to native plants (Standish 2002).

Japanese honeysuckle is native to temperate eastern Asia (Japan, Korea) but has naturalised in Australia, North and South America, Hawaii and parts of Europe (Williams et al. 2001). It was first recorded as being naturalised in New Zealand in 1926 (Webb et al. 1988) but is known to have been cultivated here as an ornamental since 1872.

Once introduced to a site, Japanese honeysuckle quickly builds up a mass of vegetative material using host plants and its own stems for support (Williams & Timmins 1999). It is a hardy plant, tolerant of cold winter temperatures and a wide range of soil types, including poorly draining soils and those high in salts or heavy metals (Williams et al. 2001).

Biological control was proposed as a potential management tool (Standish 2002) because it may offer some advantages over current control methods such as a reduction of non-target chemical herbicide impacts on desirable flora. Biological control also offers continuous action and self-dispersal that current control methods do not offer (Barton et al. 2007). There are no biological control programmes for Japanese honeysuckle elsewhere

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in the world (Waipara et al. 2005). As part of the proposed classical biological control programme a survey of the invertebrate fauna and plant pathogens on the plant in New Zealand was undertaken. Such surveys are routinely conducted on a target weed across its introduced range (Balciunas 2004), firstly, to ensure potential biological control agents from the native range are not already present, and secondly, to identify pathogens that are potential candidates for inundative biological control.

MATERIALS AND METHODS

Survey of invertebrates on Japanese honeysuckle

The herbivorous invertebrate fauna of Japanese honeysuckle was surveyed at 33 sites in New Zealand between November 2004 and December 2005. At each site, 10 collection locations were randomly selected. Methods outlined previously to sample moth plant (Waipara et al. 2006) were used to collect invertebrates present on Japanese honeysuckle. A collecting tray (80 x 80 cm) was placed under suitable parts of selected plants, and the foliage above the tray was hit five times with a solid stick. Invertebrates that fell onto the tray were collected with an aspirator for identification. Immature life stages were collected for rearing to adults. Foliage, growing points, intact and cut stems were also inspected for signs of invertebrates, which were then collected for identification and a visual estimate was made of the amount of herbivore-related damage at each site. The invertebrates collected were identified to species or genus level. They were then ranked on a scale of abundance according to the total number of individuals collected, and the number of sites at which they were present. They were classed as rare, occasional, common or abundant according to the definitions below:

rare: fewer than 5 individuals collected across all 33 sites
occasional: 5–24 individuals collected, **or** present at fewer than five sites
common: 25+ individuals collected **and** present at five or more sites
abundant: 200+ individuals collected **and** present at ten or more sites.

Predatory and parasitoid species that may also inhibit biological control agents introduced in the future were also recorded.

Survey of plant pathogens on Japanese honeysuckle

Plants at each of the 33 collection points were also inspected for signs of pathogen damage. Any diseased leaves, leaf petioles, stems, flowers, flower petioles or pods found were collected for processing. A dissecting microscope was used to search necrotic areas for diagnostic reproductive structures of fungi. Methods outlined previously (Waipara et al. 2006) were used to isolate fungi from diseased tissues. Small pieces of tissue (469 in total) were cut from the leading edge of diseased areas and surface sterilised. The pieces were plated on potato dextrose agar (Difco Labs, Detroit, MI, USA) with 0.02% streptomycin (Sigma, St Louis, MI, USA), contained in 9 cm Petri dishes. Plates were incubated under near-ultraviolet and white light at 18°C. Microcolonies that were initiated from tissue fragments were sub-cultured for further identification. Basidiocarps of *Chondrostereum purpureum* were collected from the base of a vine at a single site (Waipu Gorge, Northland). To isolate this fungus in pure culture, tissues of the basidiocarp, as well as the infected vine wood where the fruiting body was attached, were dissected out with a scalpel, surface sterilised (as described above), plated onto Nobles agar amended with 0.02% streptomycin, and incubated in the dark at 18°C.

RESULTS

Survey of invertebrates on Japanese honeysuckle

A total of 108 herbivorous invertebrate species was recorded during this survey. In addition, 12 groups of taxonomically related herbivorous species were recorded (identification of these groups to species level was not feasible). Two herbivorous species, *Scolypopa australis* (the passionvine hopper) and *Siphanta acuta*, were classed as 'abundant' (Table 1), a further 16 herbivorous species or taxonomic groupings were classed as 'common', 30 were classed as 'occasional', and 74 were classed as 'rare'. At many sites more than 25% of the Japanese honeysuckle leaves examined showed signs

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of invertebrate herbivory but damage was minor. Leaves that were >20% consumed were rare, and the overall amount of foliage that appeared to have been consumed or damaged by herbivores was estimated to be <5%.

The most obvious foliage damage was caused by a range of moth larvae, especially from the families Tortricidae (leafrollers) and to a lesser extent Noctuidae. Little invertebrate damage was observed on flowers or fruit apart from that caused by the New Zealand flower thrips, *Thrips obscuratus* (Thripidae), which may cause considerable damage to flowers (Mound & Walker 1982), and four species of sap-feeding shield bugs (Pentatomidae) that are known to feed on the fruit of other plants (Larivière 1995). Omnivorous European earwigs, *Forficula auricularia* (Forficulidae), were 'common' in the survey and are known to damage the flowers and fruit of many plant species.

TABLE 1: Herbivorous invertebrates collected from Japanese honeysuckle in New Zealand during 2004–2005[1].

Taxon	Common name	Feeding niche	Frequency (no. sites out of 33)	Origin
Cercopidae	**spittlebugs**			
Philaenus spumarius	meadow spittle bug	sap feeder	common (14)	exotic
Flatidae	**planthoppers**			
Siphanta acuta	green planthopper	sap feeder	abundant (22)	exotic
Ricaniidae				
Scolypopa australis	passionvine hopper	sap feeder	abundant (16)	exotic
Tortricidae	**leaf rollers**			
Ctenopseustis obliquana or *C. herana*		foliage	common (17)	native
Epalxiphora axenana	sharp-tipped bell moth	foliage	occasional (3)	native
Epiphyas postvittana	light-brown apple moth	foliage	occasional (8)	exotic
Planotortrix excessana or *P.octo*		foliage	occasional (10)	native
Chrysomelidae	**leaf beetles**			
Eucolaspis sp.	bronze beetle	foliage	common (10)	native
Curculionidae	**weevils**			
Asynonychus cervinus	Fuller's rose weevil	foliage	common (7)	exotic
Catoptes spp.		foliage	common (7)	native
Irenimus sp.		foliage	common (11)	native
Elateridae	**click beetles**			
Conoderus exsul	pasture wireworm	foliage	common (8)	exotic
Tettigoniidae	**long-horned grasshoppers**			
Caedicia simplex	katydid	foliage	common (18)	native
Gastropoda	**slugs/snails**			
Cantareus aspersa		foliage	abundant (26)	exotic
Thysanoptera	**thrips**			
Thrips obscuratus	NZ flower thrips	flowers	common (15)	native

[1]A complete appendix of all invertebrates identified from this survey Japanese honeysuckle in New Zealand has been previously reported (Waipara et al. 2005).

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Over 40 different predator and 10 parasitoid species were identified. Most common were spiders and the Australian leafroller tachinid (*Trigonospila brevifacies*) respectively.

Survey of plant pathogens on Japanese honeysuckle

A low level of disease was observed on all plants sampled across all sites. Symptoms in the field were usually sporadic and superficial leaf necrosis did not impact severely on the aggressive vegetative growth or flower/fruit/seed production of the weed. A total of 38 fungal species was identified from these symptoms and most were secondary pathogens or saprophytes. The most common leaf spot was caused by *Pseudocercospora lonicerae,* which was observed on samples from 29 of the 33 sites surveyed (Table 2). Its initial symptom was a characteristic brown circular spot at the leaf edge, which as the disease progressed, increased in size spreading from the leaf margin, becoming irregularly shaped, and turning the leaf yellow. The most frequently encountered taxon group was the Coelomycetous fungi (Table 2). Most were secondary pathogens as they were isolated from leaf spots caused by the primary infection of either *P. lonicerae* or *Phoma* spp.

Basidiocarps of *Chondrostereum purpureum* were collected once from the basal stem of a vine at Waipu Gorge, Northland. There were no visible signs that infection by this pathogen had reduced the growth or health of this plant at the time of collection. Despite multiple attempts to isolate it onto Nobles agar, no cultures were obtained. Samples exhibiting leaf blight symptoms were identified as *Insolibasidium deformans*, which is commonly known as honeysuckle blight.

Disease damage observed on flower tissues was minimal, mainly comprising discolouration and browning along with the appearance of tiny speckled lesions. A total of 20 diseased flower tissues was plated from three sites. The fungi isolated from diseased flowers at two sites were saprophytic species (*Alternaria alternata, Aureobasidium pullulans, Epicoccum purpureum, Penicillium* spp., Yeasts). At the third site there was a minor disease complex comprising weak/secondary pathogens already described from minor leaf spots (*Fusarium, Phoma, Phomopsis*). It was likely that most of these minor symptoms were not due to infections by primary pathogens but rather due to natural senescence of the delicate flower tissues.

TABLE 2: Primary pathogens observed damaging Japanese honeysuckle in New Zealand during 2004-2005.

Fungi	No. collection sites	No. isolates	Symptoms
Pseudocercospora lonicerae[1]	29	29	leaf spot
Phomopsis[1] (2)[2]	22	49	leaf and flower spots
Phoma[1] (7)[2]	16	58	leaf and flower spots/tip dieback
Colletotrichum gloeosporioides[1]	15	24	leaf spot
Fusarium (6)[2]	14	26	leaf and flower spots
Microsphaeropsis[1]	8	11	leaf spot
Pestalotiopsis[1]	4	9	leaf spot
Chondrostereum purpureum	1	1	wood pathogen
Gyoerffiella rotula	1	2	leaf spot
Insolibasidium deformans	1	2	honeysuckle leaf blight
other Coelomycete spp.	26	79	leaf spot/tip dieback

[1]Coelomycetous pathogens.
[2](n) = number of species identified.

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DISCUSSION

Many native and introduced invertebrates are associated with Japanese honeysuckle in New Zealand but no specialised Japanese honeysuckle feeding invertebrates were found during this survey, and damage caused to Japanese honeysuckle by invertebrate herbivory could not be regarded as serious. Foliage feeders (most noticeably lepidopterous larvae, molluscs and thrips) appear to be the most damaging invertebrates currently feeding on the weed in New Zealand.

The total amount of Japanese honeysuckle foliage that appeared to have been consumed or damaged by herbivorous invertebrates at our survey sites was estimated to be <5%. Specialised Japanese honeysuckle biocontrol agents are unlikely to meet with any significant competition from resident herbivores as none of the 'herbivore niches' on Japanese honeysuckle are well utilised in New Zealand, and some (e.g. leaf mining) do not appear to be utilised at all. Therefore there is considerable scope for the introduction of host-specific invertebrate biocontrol agents that could markedly reduce the vigour of Japanese honeysuckle in New Zealand. However, the combined effect of generalist predators, such as spiders, earwigs, ants and praying mantids, could inhibit the effectiveness of some potential invertebrate biological control agents for Japanese honeysuckle, while the parasitoids identified could particularly affect some potential lepidopteron biological control agents.

Although foliar pathogens were widespread in distribution, leaf damage to Japanese honeysuckle infestations was also limited and did not reduce plant health to any useful extent. Biocontrol potential of these leaf spots is therefore considered to be low. *Pseudocercospora lonicerae* (synonym *Cercospora lonicerae*) was previously recorded as a leaf spot pathogen of Japanese honeysuckle in North America, and as a potential candidate for classical biocontrol before this survey (Standish 2002). However, as the strain(s) currently in New Zealand appear to be only weakly pathogenic, surveys in the native range are needed to find more aggressive pathotypes to augment the low virulent strains already present on the host.

The occurrence of *C. purpureum* on Japanese honeysuckle is a new host record for this fungus in New Zealand, and possibly also a new international record. The pathogen has been reported on other *Lonicera* species (Setcliff 2002), including the shrubby relative *L. tatarica* in New Zealand (Pennycook 1989). This fungus is a widespread wound pathogen, commonly known as silver leaf disease, and is a plurivorous horticultural disease of economic importance. However, its broad host range has enabled successful mycoherbicide development against woody weeds in North America, South Africa and Europe, as well as against gorse in New Zealand (Bourdôt et al. 2006). The use of *C. purpureum* for inundative biocontrol of Japanese honeysuckle may be limited, as its pathogenicity is restricted to woody tissues and therefore ineffective against rapid invasion by the herbaceous vines.

The observation of honeysuckle leaf blight was expected as it has a worldwide distribution and most species of *Lonicera* are susceptible hosts (Beales et al. 2004). It has been recorded three times previously on the weed in New Zealand as well as on *Lonicera tatarica* (Pennycook 1989), and recently in Australia on *Lonicera nitida* (Cunnington & Pascoe 2003). The blight is totally reliant on climatic conditions being both cool and wet, since infection only occurs when relative humidity is near or at 100 percent for sustained periods of at least 2 days, and where the leaves are less than 20 days old. It therefore has no biocontrol potential because its attack would be sporadic under a relatively narrow set of climatic conditions.

In light of the conclusion that both invertebrate herbivore and pathogen damage to Japanese honeysuckle in New Zealand are not serious, the biocontrol programme will shortly begin surveying the natural enemies of the plant in its native Asian range.

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