EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION
ORGANISATION EUROPÉENNE ET MÉDITERRANÉENNE
POUR LA PROTECTION DES PLANTES

Summary of a Pest Risk Analysis[1] for *Aphalara itadori* – Japanese knotweed psyllid

This summary presents the main features of a Pest Risk Analysis which has been conducted on the pest, *Aphalara itadori*, according to the EPPO Decision support scheme for quarantine pests, v. 08-13988.

Pest:	*Aphalara itadori* (Shinji) The Japanese knotweed psyllid. Known in Japan as Itadori madarakijirami (Japanese for "Japanese knotweed speckled psyllid").
PRA area:	Great Britain (GB).
Risk assessor:	Dr Richard Shaw, Principal Investigator, CABI Europe - UK, Egham, Surrey, UK.
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STAGE 1: INITIATION

Reason for doing PRA:	Proposed intentional release of *A. itadori* (subject to Government approval) to help control the invasive weed Japanese knotweed (*Fallopia japonica* var. *japonica*) in GB. The PRA is to assess the risk to non-target species.
Taxonomic position of pest:	Class Insecta; Order Hemiptera; Family Psyllidae; Species *Aphalara itadori.*

STAGE 2: PEST RISK ASSESSMENT

Probability of introduction

Entry

Geographical distribution: The distribution of *A. itadori* is recorded as Japan, Korea, Russia (Sakhalin and Kurile Islands). The population from which the insect intended for release is derived, originates from the Mount Aso region of Kumamoto prefecture, Kyushu Island, Southern Japan, where it was collected in 2004.

Major host plants or habitats: Natural and experimental hosts all appear to be in the genus *Fallopia* in the family Polygonaceae:

Natural hosts are:

1. Japanese knotweed: *Fallopia japonica* (Houtt.) Ronse Decraene var. *japonica* [Polygonaceae], syn. *Polygonum cuspidatum*, syn. *Reynoutria japonica.* Widespread plant in central and southern Japan. Invasive non-native species in GB where it occurs in riparian habitats and derelict land as well as along roadsides, lay-bys and railway embankments. Restricted under the Wildlife and Countryside Act 80 (1981).

2. Compact knotweed: *Fallopia japonica* var. *compacta* (Hook.f.) J.P.Bailey. Found on the upper slopes of Japanese mountains. Available in GB as a rare garden ornamental but not commonly planted.

3. Giant knotweed: *Fallopia sachalinensis* (F.Schmidt ex Maxim.) Ronse Decraene. Found in the northern part of Japan. This is a non-native pest plant in GB in similar habitats to *F. japonica* var. *japonica* where it is invasive, but to a lesser extent.

[1] The third stage of the Pest Risk Analysis is not completed; thus this is a Summary of a Pest Risk Assessment.

The psyllid has been studied extensively both in Japan as well as under containment in GB for its potential as a biological control agent for Japanese knotweed. More detail can be found in Shaw *et al.* (2009).

During surveys in Japan, the psyllid was not observed on, or to have caused any damage to co-occurring members of the Polygonaceae (outside the genus *Fallopia*) whose ranges overlap or are the same as *F. japonica* var. *japonica*. It was only found on *F. japonica* var. *japonica* and related species.

Multiple-choice egg-laying experiments were carried out to examine the behaviour of gravid females of *A. itadori*, when given a choice between *F. japonica* var. *japonica* and each of 87 non-target plant species/varieties. Three replicates of each of two test plant species were tested twice against the target host; replication was increased where non-target oviposition was detected. The results suggest that the following species are potential hosts of *A. itadori* because they were shown to be capable of receiving eggs that were able to fully develop to adult:

4. Bohemian knotweed – *Fallopia* x *bohemica* (Chrtek and Chrtková) J.P. Bailey (hybrid of *F. japonica* var. *japonica* and *F. sachalinensis*). Widespread pest plant in GB, Europe and North America.

5. Conolly's knotweed – *Fallopia conollyana* Bailey (hybrid of *F. japonica* var. *japonica* and Russian vine - *Fallopia baldshuanica*). An ornamental, not sold but it was held in the National Polygonum Collection* at the time of study. (*In Devon: http://www.thegardeningwebsite.co.uk/national-plant-collections-by-county-i4085.html). Limited distribution in GB.

In addition, during the oviposition choice experiments there were twelve non-target species on which eggs were laid (<17 per plant compared to an average of 434 eggs per plant for *F. japonica* var. *japonica*). These eggs failed to develop to adult so these are not considered to be potential hosts.

Nymphs, which develop from the eggs, are the main feeding and damaging stage and are largely sedentary. Because of this, it is unlikely that nymphs would move from the adults' choice of oviposition host to non-target species. Nevertheless, the potential for nymphs to damage non-target species was investigated. First instar nymphs were forcibly placed on most of the plant species that received eggs in the oviposition choice experiments (*F. japonica* var. *japonica* and thirteen non-target species). Results showed that five species were able to support development of *A. itadori* beyond third instar; *F. japonica* var. *japonica* and its hybrid *F. conollyana* as well as *Fallopia dumetorum* (copse bindweed; native, protected species in GB, restricted largely to copse habitat requirement); *F. baldshuanica* Russian vine (non-native horticultural plant but invasive) and, *Muehlenbeckia complexa* (wire plant; non-native ornamental and occasionally invasive). Only *F. conollyana* and *M. complexa* supported the development through to adult in this study in 48% and 7% of cases respectively vs. 66% for *F. japonica* var. *japonica*. When given a choice between *F. japonica* var. *japonica* and these species, gravid females laid an average of 434 eggs per plant compared to 58 for *F. conollyana* and 15 for *M. complexa*. Combining these results, there is a low probability that any of the species used in this test will be damaged by the psyllid.

Adult survival studies on *Fallopia* spp. known to occur in the UK plus buckwheat,

Fagopyrum esculentum, (selected because there is an unpublished report of the related *Aphalara polygoni* damaging this crop plant in Hokkaido, Japan in 1983) show that survival was severely compromised on anything but *F. japonica* var. *japonica*, which suggests that adult feeding is highly restricted too. However, *F. dumetorum* supported survival of *ca*. one-quarter of the number of adults that survived on *F. japonica* var. *japonica* over the study period. This suggests that some adult feeding had taken place on this species. However, *F. dumetorum* did not support the development of eggs to adults in the oviposition choice experiments, although it did receive eggs. Nevertheless it is rarely sympatric with invasive knotweeds, preferring copse habitats which are not commonly invaded by knotweed.

Based on these data it would appear that with the exception of two other invasive knotweeds and two rarely-grown ornamental *Fallopia* spp., the psyllid, *A. itadori*, would pose no threat to any non-target test plants were it to establish and spread in GB, following an intentional release.

The psyllid overwinters on the bark of conifers in Japan; this is thought to be for shelter only with no significant damage inflicted as a result. It is not known how it would overwinter in the PRA area but it is likely to be on conifereous trees and no feeding damage is envisaged.

Which pathway(s) is the pest likely to be introduced on:

This is a proposed intentional release.

Establishment

Plants or habitats at risk in the PRA area:

The target host is *F. japonica* var. *japonica*. Two other invasive weeds that may become affected by the psyllid are *F. sachalinensis* and *F. bohemica*. Two rarely planted ornamental plants may also be at risk: *F. japonica* var. *compacta* and *F. conollyana*.

Climatic similarity of present distribution with PRA area (or parts thereof):

Japan's eco-climatic conditions are not directly comparable with those of GB. Kyushu Island, Japan (origin of the psyllid culture) is more sub-tropical. However, there are higher altitude sites that are comparable to GB, with similar temperatures at similar times of year. The psyllid culture under consideration for release in GB was collected from *F. japonica* var. *japonica* in the Mount Aso region of Japan's Kumamoto Prefecture. The winters in the psyllid's native range in Japan are harsher than the UK with much more snowfall. The summers can be very hot and dry. So, in general, climatic extremes are greater in its native range in Japan, compared to GB. It is not known whether the psyllid actually requires these extremes, but populations of *A. itadori* can be found from the coast to the mountaintops (>1,500 metres above sea level) where conditions contrast markedly. Studies of its thermal tolerance showed that it did not develop at 10ºC and very little development took place at 12ºC. Species with a 10ºC minimum threshold have been considered to be marginal for GB. An estimation of its degree-day requirements, based on development studies at various temperatures suggests that, based upon temperature alone, *A. itadori* would establish successfully across most of GB. It would only be excluded from parts of Scotland and the Lake District where temperatures across the year would be too low.

Characteristics (other than

Other than temperature, establishment of the psyllid is only likely to be limited by the availability of its intended host plant. The target host, *F. japonica* var.

climatic) of the PRA area that would favour establishment:

japonica, and the experimentally-susceptible hybrid *F. bohemica* are widespread invasive weeds throughout GB, from Cornwall to northern Scotland. The other possible host, *F. sachalinensis,* is also invasive and fairly widespread. Their widespread presence will favour establishment.

The reproductive strategy of *A. itadori* should enable at least one generation to be produced per year in GB.

The intended host plant *F. japonica* var. *japonica*, supports almost no phytophagous (plant feeding) arthropods in its invasive range in GB, so it is unlikely that the psyllid will be out-competed.

The likelihood of significant attack by GB native parasitoids on *A. itadori* is low. A limited study of generalist predators showed a clear preference by most predators tested for the normal prey (aphids) over the psyllid when a choice was available, so it seems unlikely that *A. itadori* will be predated.

There are no existing pest management practices on *F. japonica* var. *japonica* that would affect the establishment of *A. itadori*.

Which part of the PRA area is the endangered area:

The "endangered" area is all of the areas of GB where the target invasive weed *F. japonica* var. *japonica* is distributed i.e. most riparian and transport corridors as well as many ruderal habitats from the tip of Cornwall to the lowlands of Scotland. Only the Lake District and Scottish Highlands, areas which are largely devoid of Japanese knotweed or have a very low abundance of the plant, would not be suitable for *A. itadori'*s developmental requirements. It is likely that establishment and spread will be more successful in warmer climes. Areas where the two other invasive *Fallopia* species are distributed are also "endangered", as described above. Areas where two rarely-planted ornamental *Fallopia* species occur are unlikely to become affected: there are few suppliers of *F. japonica* var. *compacta* and so it is rarely planted; *F. conollyana* has limited distribution in GB and is only held in the National Polygonum Collection and not sold.

POTENTIAL ECONOMIC CONSEQUENCES

How much economic impact does the pest have in its present distribution:

There are no economically-important (or environmentally-important) hosts that are affected by *A. itadori* in its current area of distribution. It is not a vector of any plant pathogens. It is not thought to damage the conifer species on which it is presumed to shelter over winter in Japan. *Aphalara* spp. are, in the main, restricted to the Polygonaceae and are not recognised crop pests. However, a related psyllid, the congeneric, *Aphalara polygoni,* was recorded in one unpublished report as damaging buckwheat (*F. esculentum*) in Hokkaido, Japan in 1983. This plant species did receive eggs in the *A. itadori* oviposition choice experiments (17 per plant compared to 434 for the target species) but none developed to adult.

Describe damage to potential hosts in PRA area:

In the field in Japan, *A. itadori* nymphs have been observed causing significant damage to large plants of *F. japonica* var. *japonica,* stunting growth and limiting leaf expansion. In GB, nymphs of *A. itadori* should cause similar damage, reducing the vigour of its intended target. The psyllid may also feed on two other invasive *Fallopia* species. Even if it behaves as the congener *A. polygoni* which is reported to have damaged buckwheat in Japan, this is a minor crop in GB and so the potential for economic damage is extremely small.

How much economic impact

Based on its narrow natural and potential host-range, which has been shown to be restricted to invasive *Fallopia* species, *A. itadori* will not cause direct economic

would the pest have in the PRA area:

damage to any crop species grown in the PRA area. It will also not affect consumer demand or export markets for GB.

The intention of this proposed release is to reduce the costs of control of the invasive weed, *F. japonica* var. *japonica*. In 2003, the British Government's Non-Native Species Policy Review Working Group gave an estimate of the costs of control countrywide by conventional methods of £1.56 billion, were it to be attempted (http://www.nonnativespecies.org/documents/Review_of_non-native_species_policy.pdf).

A reduction in the range and dominance of *F. japonica* var. *japonica* is anticipated as a result of the activities of the psyllid. This should take place slowly and allow native species to re-establish. However, in some riparian habitats, other weeds such as Himalayan balsam (*Impatiens glandulifera*) and/or giant hogweed (*Heracleum mantegazzianum*) may become replacement weeds. Nevertheless, these species should be easier to control than Japanese knotweed.

Some vertebrate species, e.g. grass snakes (*Natrix natrix*) and otter (*Lutra lutra*), may have established an association with *F. japonica* var. *japonica*. It is assumed that *A. itadori* will have a negative impact on the dominance of this invasive weed and that those plants that succeed it will provide similar habitats for such species.

There is a small workforce of weed control specialists which has co-evolved with the expansion in the range of *F. japonica* var. *japonica* in GB. If *A. itadori* is highly successful in reducing the vigour of this invasive weed it is possible that some individuals may lose income. If approved for intentional release the psyllid is likely to become part of an integrated control programme. Thus, there will be business opportunities for those who are able to adapt conventional control methods to work alongside biological control.

If as a result of the introduction of *A. itadori* the target host plant ceases to be a damaging invader of riparian habitats, contracted work directly associated with the plant's ability to compound the risk of flooding, i.e. flood recovery, would be reduced, but this would be offset by reduced insurance claims and premiums. Any reduction in the threat to development sites posed by *F. japonica* var. *japonica* will result in large savings to the construction and infrastructure industry

CONCLUSIONS OF PEST RISK ASSESSMENT

Summarize the major factors that influence the acceptability of the risk from this pest:

A. itadori is a non-native plant pest whose natural and potential host range appears limited to species of *Fallopia* which are invasive weeds in GB. These include Japanese knotweed (*F. japonica* var. *japonica*), Giant knotweed (*F. sachalinensis*) and Bohemian knotweed (*F. bohemica*).

Only two non-invasive species have potential to be damaged by *A. itadori*; these are Compact knotweed (*F. japonica* var. *compacta*) and Conollys knotweed (*F. conollyana*). These species are rare garden ornamentals and so any economic damage that may be caused by *A. itadori* is negligible.

There are no significant economic or environmental impacts that would be expected to occur should release of *A. itadori* be authorised in GB.

The benefits of release should be a reduction in the vigour of Japanese knotweed and the other invasive knotweeds in GB reducing the direct negative impacts that

these plants cause and reducing the costs of their control.

The risks associated with release of *A. itadori* should be minimal compared to the anticipated benefits.

Estimate the probability of entry:

This is a proposed intentional release and so entry is certain if permission is granted.

Estimate the probability of establishment:

It is highly likely that *A. itadori* will establish and spread in habitats where *F. japonica* var. *japonica* and possibly other invasive *Fallopia* species occur, throughout GB, provided it is released during the growing season of its intended host. There are some parts of Scotland and the Lake District where temperatures may not be adequate for the developmental of the psyllid and therefore it may not establish in these locations. Also, the absence of host plants or their sparse distribution in these and other areas would not favour establishment.

Estimate the potential economic impact:

The potential economic impact is that there will be a reduction in the current impact and substantial costs of control of *F. japonica* var. *japonica.* Other invasive species of *Fallopia* may be similarly affected. Long-term there may be some loss of income/employment for weed control companies that specialise in the control of these particular invasive species but conversely there will be commercial opportunities for integrated approaches to knotweed control for some of these businesses. It is most unlikely for there to be an economic impact on crop plants, consumer demand or export markets. As control of *F. japonica* var. *japonica* progresses, it may be replaced by other weed species or other native species of plant. Costs associated with control of replacement weed species are likely to be significantly less. Habitats will change as plant succession occurs. There will be effects on vertebrate species that co-exist with *F. japonica* var. *japonica* but these are not thought to be negative.

Degree of uncertainty

<u>Establishment and spread</u>

<u>Host range testing</u>: This has been carried out using established techniques and an extensive test plant list of 87 species/varieties. However, it is not possible to test all of the plant species that occur in the PRA area. It is possible that *A. itadori* will behave differently in the field than the laboratory but it is highly likely that the predicted hosts will be *Fallopia* spp. Threats to non-target species that were unable to support development to adult are presumed to be low, but if the knotweed host is severely damaged or eradicated there is a risk of some "spill-over" damage in the short term.

Three species on the proposed list were unavailable for testing: *Polygonum boreale, Persicaria mitis* and *Persicaria minor*. These species are very distinct from the normal host, and thus unlikely to support feeding, oviposition and development of *A. itadori.* They are, like *Fallopia* spp., members of the Polygonaceae. CABI are trying to source these plants and hope to be in a position to test them prior to any authorised release.

<u>Over-wintering</u>: The exact over-wintering behaviour of *A. itadori* is uncertain but is likely to be sheltering, without feeding on or causing damage to, evergreen trees. Part of the recommended post-release monitoring programme would be focussed on assessing any impact, on these potential overwintering hosts.

Climate: The climatic predictions supporting the determination of the establishment risk of *A. itadori* are preliminary and carry uncertainty but this will not increase the unacceptability of the risks associated with release.

Natural enemies: The potential for predation or for parasitism to affect establishment of *A. itadori* is low but carries some uncertainty.

Adaptability: The psyllid appears highly adaptable with respect to climate and habitats with medium uncertainty. It is believed to have low adaptability to host plants outside of the genus *Fallopia*.

Delimiting spread/human spread:
It is not certain that *A. itadori* could be contained or eradicated once it has spread beyond a limited release area but the contingency plan for post-release monitoring should manage any unpredicted risks in the early stages. Spread by human assistance is possible but has medium uncertainty. There is a low risk of unaided spread to mainland Europe. However, it can be anticipated that the psyllid will be spread intentionally and perhaps accidentally, by human activities. Thus it is likely that it will be introduced to mainland Europe.

Impacts

It is difficult to predict any secondary, tertiary etc. effects on the rest of the food chain. The likely lack of specialist, native natural enemies of the psyllid should mean that these risks are minimised, but some indirect effect resulting from the presence of a new organism in a habitat can never be ruled-out. The main effect of any unanticipated predation will be to limit the effectiveness of the psyllid. The potential for *A. itadori* to act as a vector of plant pathogens in GB has not been tested but is highly unlikely given that these relationships are normally highly specialised in psyllids and that there are no records of *A. itadori* acting as a plant pathogen vector. This is reinforced since *F. japonica* in GB is not known to carry any psyllid-transmissible pathogens though a new phytoplasma has recently been isolated and identified as not belonging to a transmissible group. Other diseases may be present but not identified. The potential for hybridisation with other native UK psyllid species is not known, but it is unlikely, given that such species do not readily interbreed. There is potential for other weed species to replace Japanese knotweed following successful attack by *A. itadori*, but this is uncertain. Impacts arising from control of the target host on vertebrate species that currently co-exist with *F. japonica* var. *japonica* are likely to be low but this is not certain. Costs and benefits arising from introduction of *A. itadori* have not been evaluated.

OVERALL CONCLUSIONS

The studies that have been undertaken by CABI to determine the host-specificity of *A. itadori*, as well as observations of its behaviour in Japan, indicate that its closest relationship is with Japanese knotweed - *F. japonica* var. *japonica*, its intended target, and other invasive *Fallopia* species in GB. Mated females of *A. itadori* are not likely to lay eggs on non-target plants and if they do this will be in locations close to invasive knotweeds on a very narrow range of plants. These eggs have a very low probability of developing to the feeding stage (nymphs) and an even lower probability of developing to adults.

Overall *A. itadori* should not be considered to be a problematic pest so no risk management should be required. It is likely that the huge potential benefits of its proposed release in terms of aiding control of invasive knotweeds and reducing the damage they cause, outweighs the very low risks associated with the introduction of such a specialist natural enemy as a biocontrol agent. However, to answer this question fully, a cost-benefit analysis would be needed.

Despite the high likelihood of introduction and establishment *A. itadori* can be considered a "beneficial pest" and as such the pest risk is low.

STAGE 3: PEST RISK MANAGEMENT

A post-release monitoring and contingency plan has been developed.

Reference

Shaw RH, Bryner S, Tanner RA, 2009. The life history and host range of the Japanese knotweed psyllid, *Aphalara itadori* Shinji: Potentially the first classical biological weed control agent for the European Union. *Biological Control*, **49**, 105-113.