

## Final Pre-release Investigations of the Knotweed Psyllid

### Principal Investigator

**Fritzi Grevstad**, Assistant Professor (Senior Research), Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331. Dr. Grevstad will oversee the completion of all objectives of this proposal and will provide progress and final reports.

### Cooperators and Other Participating Institutions

**Robert Bouchier** Agriculture and AgriFood Canada, Lethbridge Research Center. Dr. Bouchier will collect and send seeds of non-target plants from his region.

**Eric Coombs** will help in the planning and preparing for biocontrol agent releases and will provide space for mass rearing insects at the Oregon State Department of Agriculture Greenhouse.

**Amount Requested:** Year 1 (total): \$51,538

**Project Leveraging:** Year 1 (total): \$51,708

(sources Oregon State University, Washington State Department of Agriculture, Oregon Department of Agriculture)

**Total Project Cost:** \$103,246



*Aphalaría itadori* adults congregating on a knotweed stem.

## Project Goals and Supporting Objectives

A biological control program for the knotweed species complex (*Fallopia* spp.) in the final stages of testing and permitting. In November of 2013, the knotweed psyllid (*Aphalara itadori*) from Japan, was approved by the Technical Advisory Group for Biological Control of Weeds (TAG) for release into North America. The project is now in the regulatory hands of the USDA Animal and Plant Health Inspection Service and is posed for review by the U.S. Fish and Wildlife for compliance with the National Environmental Policy Act.

Although the knotweed psyllid was determined to be safe for release by the TAG, individual reviewers made recommendations for further studies that should be carried out prior to release. These include testing of additional varieties of buckwheat (*Fagopyrum esculentum*), an important food and cover crop plant, and additional testing to further confirm that no damage will occur on threatened and endangered species.

Currently, two biotypes of the knotweed psyllid are being maintained in the Oregon State University Quarantine. The two biotypes differ in their preference and performance on the various genetic types of knotweed. Both biotypes will be needed for the diversity of knotweed infestations that occur in North America. The northern biotype, from Hokkaido, Japan, performs best on giant knotweed (*Fallopia sachalinensis*) and is expected to be most effective as a biocontrol agent against this plant species. The southern biotype, from Kyushu, Japan, performs best on Japanese knotweed (*F. japonica*) and on hybrid knotweed (*F. x bohémica*). We will continue to maintain two large cages of each both biotypes of psyllid in the quarantine. Individual are occasionally transferred between cages of the same biotype to help maintain genetic diversity.

The overall goal of this project is to improve forest health and fish and wildlife habitat by providing an ecological, cost-effective, environmentally safe, and sustainable form of control for invasive knotweeds. The supporting objectives include:

- 1) Carry out additional feeding and development trials with both biotypes of *Aphalara itadori* on 6 North American cultivated varieties of buckwheat.
- 2) Conduct tests to quantify damage (or lack thereof) of incidental feeding or oviposition by the adult stages of the knotweed psyllid on threatened or endangered species.
- 3) Facilitate the completion of the permitting process including providing reports of supplemental results to APHIS.
- 4) Continue to maintain colonies of both biotypes of the knotweed psyllid in the Oregon State University Quarantine and when appropriate, expand rearing operations in preparation for release.

## Project Justification/Urgency

Invasive knotweeds in North America are a complex of 3 closely related species in the family Polygonaceae that were introduced from Japan during the late 19th century (Barney 2006). They include *Fallopia sachalinensis* (F. Schmidt) Ronse Decraene (giant knotweed), *F. japonica* (Houtt.) Ronse Decr. (Japanese knotweed), and the hybrid between the two *F. x bohémica* (Chrtek & Chrtková) J. P. Bailey (Bohemian or hybrid knotweed). These large herbaceous perennials have spread throughout much of North America with the greatest infestations in the Pacific Northwest (Oregon, Washington and British Columbia), the northeast of the United States, and eastern Canada. Knotweeds are present in at least 41 U.S. states and eight Canadian provinces and are classified as noxious in ten states ((USDA-NRCS 2011). Knotweeds have also invaded Europe, New Zealand, and Australia and are listed among the “world’s worst invasive species” by the World Conservation Union (Lowe et al. 2000). While capable of growing in diverse habitats, the knotweeds have become especially problematic along the banks and floodplains of rivers and streams, where they crowd out native plants and potentially affect stream nutrients and food webs (Beerling and Dawah 1993; Maerz et al. 2005; Gerber et al. 2008; Urgenson et al. 2009; McIver and Grevstad 2010). Dense knotweed thickets displace native plants through a combination of shading

(Siemens and Blossey 2007), nutrient competition, and allelopathy (Murrell et al. 2011; Urgenson et al. 2012). The inability of tree seedlings to grow along invading stream banks is potentially detrimental to fish and other stream inhabitants that benefit from the shade of trees. In restoration projects, knotweeds must be fully removed before native plantings are successful. The dense stands have no known value for wildlife.

Many federal, state, and local agencies have active control programs against knotweeds in some regions. However, the large scale of the knotweed invasion in North America, the inaccessibility of some of the infestations, and the difficulty with which the plants are killed, all suggest that complete eradication of this plant is unlikely. Classical biological control has the potential to provide widespread and sustained reduction in knotweed abundance at a very low cost. Without a biological control program, chemical and mechanical inputs are likely to be needed on a permanent basis with variable to limited success.

## **Approach**

### **Objective 1: Additional tests on buckwheat**

In previous host specificity testing, we thoroughly tested the psyllids ability to oviposit and develop on one common variety of buckwheat (*Fagopyrum esculentum*). We used no-choice tests, choice oviposition tests, multiple generation tests, observations in Japan, and field tests in the UK. All suggested that the risk to buckwheat is near zero. However, TAG reviewers still expressed some reservation based on the fact that we only tested one buckwheat variety. Thus, in the current project, we will test an additional 6 distinct varieties of buckwheat that are used in field cultivation in the United States and Canada. These varieties include Manor, Mancan, Winsor Royal, Giant American, Tempest, and Pennquad, all obtainable from the USDA-ARS National Plant Germplasm System.

No-choice tests will be carried out using the same methods used for the full host range testing. Potted plants (6 replicates of each buckwheat variety and knotweed controls) will be caged individually with 5 pairs of reproductive adult psyllids. After 5 days of exposure, the adults will be removed and the number of eggs on the plants will be recorded. The plants will be maintained for 50 additional days, sufficient for development to the adult stage if it occurs. At this point, the plants will be thoroughly searched for the presence of psyllid adults and nymphs.

### **Objective 2: Assessing damage on T and E species**

Although our prior testing of closely related surrogate species indicated that reproduction on threatened and endangered species was highly unlikely, one TAG reviewer was concerned about the possibility that the plants could incur damage from adult feeding and oviposition, even if the psyllids don't successfully develop on the plants. The APHIS regulatory official in charge of permitting also indicated that this level of testing was likely to be needed to pass the NEPA review based on outcomes of other recent biocontrol proposals. We will obtain and grow at least 3 *Polygonum* spp., two *Polygonella* species, and 4-5 *Eriogonoid* species that will serve as surrogates to the threatened and endangered species in the Polygonaceae. Pairs of similarly sized plants will be caged with and without psyllids for a period of 2 weeks or until the psyllids die. Plants measurements and observations of damage will be made before and after exposure.

### **Objective 3: Facilitate the permit process**

The P.I. has already applied for a permit to release the psyllid which initiated APHIS action toward reviewing the proposed release. She will continue to maintain communication with permit officials and encourage progress in the review process. Following completion of objectives 1 and 2, a report of results will be written up and

submitted to APHIS which can then be incorporated into the document that will be reviewed under NEPA.

#### **Objective 4: Colony maintenance and expansion**

Throughout the project period, we will maintain healthy colonies of both biotypes of the psyllid. This requires maintaining a steady supply of knotweed plants--field collection of knotweed rhizomes, potting up the plants, watering, and controlling greenhouse pests. The plants are transferred into the quarantine colonies where they support development of one to two generations of psyllids. Dead or depleted plants are removed from the cages as needed and disposed through the autoclave.

In anticipation of releases, we will begin to increase our rearing operations in the quarantine. The goal will be to maintain 10,000-20,000 psyllids (as can be accomplished in the limited greenhouse space in the quarantine) through spring months so that releases can be made soon after permits are issued. Once permits are issued, depending on timing, we will make initial field releases into Oregon and Washington field sites and provide insects to East Coast collaborators where further rearing/releases will occur. At this point we will also transfer populations to a larger, non-quarantine greenhouse at the Oregon Department of Agriculture in Salem, Oregon where rearing can occur on a much larger scale.

#### **Expected Products and Outcomes**

Upon completion of this work, the knotweed psyllid will be very thoroughly tested for host specificity leaving no questions open for regulators. If approved for release, the knotweed psyllid will be an extremely valuable control tool that will eventually be available for release into all locations where in North America where knotweeds are a problem. At best, the psyllid populations will expand to reach high densities wherever knotweed occurs, causing a substantial decline in its abundance and impacts. In the least, the psyllid provide an added stress to the plant that will reduce its aggressiveness, slow its rate of spread, and make it easier to eliminate using integrated control tools. Either way the psyllid is likely to provide large economic and environmental benefits.

#### **References**

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**Budget**

Project Period: May 1, 2015 -- April 30, 2016

<b>Cost Elements</b>	<b>Details</b>	<b>Forest Service Contribution</b>
<b>Direct Costs</b>		
<b>Salaries</b>		
Principle investigator	36% FTE for 12 months	\$28,702
<b>Fringe benefits</b>		
Principle investigator	OSU benefits rate = 49% of salary	\$14,064
	<b>Total salaries and benefits</b>	<b>\$42,766</b>
<b>Travel</b>	Travel costs for the P.I. to attend one national meeting	\$1,600
	Driving costs for collecting plants from field sites and attending meetings in Pacific Northwest (~1200 miles x \$0.56/mile)	\$672
	<b>Total travel</b>	<b>\$2,272</b>
<b>Supplies (expendable)</b>	Supplies for growing plants and rearing insects: pots, soil, fertilizer, cage material	\$500
<b>Other direct expenses</b>	Quarantine costs: 40 weeks @ \$150 week	\$6,000
<b>Total requested</b>		<b>\$51,538</b>

**Matching Contributions**

<b>Source</b>	<b>Details</b>	<b>Amount</b>
Oregon State University	Unrecovered indirect expenses (46% of requested total)	\$23,708
Washington State Department of Agriculture	\$3,000 committed for months of May - June 2015. \$20,000 anticipated for July 2015 - April 2015.	\$23,000
Oregon State Department of Agriculture	In-kind participation by state entomologist, Eric Combs. Salary/benefits and travel costs	\$5,000
<b>Total match</b>		<b>\$51,708</b>

