Biological Control of Weeds in the Willamette Valley

Urban Pest Management Course
OSU IPPC Pesticide Recertification
February 3rd, 2016
Protecting American Agriculture

United States Department of Agriculture • Animal and Plant Health Inspection Service
Combating Pests and Diseases
Protecting the Environment
Managing Wildlife Damage
Facilitating Safe Agricultural Trade
Ensuring the Safety of Genetically Engineered Organisms
Ensuring the Humane Treatment of Animals
Leading Scientific Research and International Standards Setting
Mission:

Safeguard American agricultural & natural resources from the entry, establishment, & spread of plant pests, including plant diseases & noxious weeds.

Responsibilities:

- Pest surveillance, detection & ID
- Pest eradication & management
- Regulation & certification of plants & plant products for import & export
- Crop biosecurity & emergency response
- Regulation of biological control organisms

plant health
What is biocontrol?

reducing pest populations

with natural enemies

*natural enemy = predator

...any organism that exists by preying upon other organisms.
Biological Control

So Many KINDS!
(Thankfully.)

Such as:
Encouraging *native* predators

or

_inundative* releases...

(*rapid reduction from an artificial spike in predator populations)
**Classical Biocontrol**

Use of carefully selected predators from an invasive’s native range.

Most invaders come from other continents... *without* the organisms evolved to eat them!
Exotic Control
Agent

Exotic Pest

Predator & prey reunited ...with the goal of bringing an invasive into balance with native ecosystem
Predator & prey reunited ...with the goal of bringing an invasive into balance with native ecosystems
...with the goal of bringing an invasive into balance with native ecosystem

Source: USDA ARS, Bugwood.org, & www.invasives.org
Michigan State University study on Purple Loosestrife Biocontrol:

- Agents established in 100% of sites
- Persisted 9 yr. (study span)
- Near complete defoliation 1st occurred in 3-5 yrs.
- Weed cover reduced up to 74%
- Native species re-established (up to 90%)

Landis et al. 2003.
(Biological Control. 28 pp. 78-91)
Bring an Invasive into Balance using natural agents, without pesticides or other inputs, that work for free.*

...after a lot of research, typically taking a decade or more.
Invasive species almost always come from other continents... without the organisms evolved to eat them!
How to Ensure Safety with Classic Biocontrol Programs?

Or: “What!?!? You want to bring in more pests!?!?”

map credit: Utah State University
Careful study & review is required

Slow, expensive process...
Field research in native range

Analysis—no generalists!

Specialist?

Effects on any N.A. species?

...if so: More research!

Effective?

Submission to TAG

Approval, denial, or more study

...Introduction work may begin
How Scientists Obtain Approval to Release Organisms for Classical Biological Control of Invasive Weeds

J. Scoles, J. P. Carda and W. A. Overholt

An invasive weed is a non-native plant that exhibits rapid population growth following its arrival to a new environment where it did not evolve. The success of the weed in its new habitat is due in part to the absence of natural enemies that normally limit its reproduction and spread in its native range. Classical biological control seeks to maintain an invasive weed within one or more of its co-evolved natural enemies to provide permanent control of the weed.

Classical biological control is defined as the planned introduction and release of an entomopathogenic target-specific natural enemy (usually an arthropod, nematode or plant pathogen) from the weed’s native range to reduce the weed’s reproductive capacity, or density of the target weed in its adventive range. The term “intentional” in this definition acknowledges the fact that the arrival of a weed in a new geographical area can occur by any means (e.g., immigration), and is probably in the term “introduced,” which is restricted to actions taken by people.

Before scientists can release a natural enemy into Florida for biological control of an invasive plant, the potential agent must undergo rigorous testing to ensure that it will not harm other organisms. The candidate agent is exposed to a series of carefully chosen test plants in no-choice and multiple-choice replicated trials in order to demonstrate the natural enemy is host specific and therefore safe to release. USDA Animal and Plant Health Inspection Service, Plant Protection Quarantine unit (APHIS PPQ) controls the release approval process. (The Plant Protection Act of 2001 gives APHIS the authority to regulate “any enemy, antagonist or competitor used to control a plant pest or noxious weed.”) A voluntary multi-agency Technical Advisory Group (see test host; review information provided by the networking and communication process by seeking any recommendations to APHIS Plant Protection Quarantine concerning the release of a proposed agent. This group’s mission is to advise weed biological control researchers and provide Plant Protection Quarantine permit users with recommendations on the proposed action.

After identifying a candidate biological control agent, scientists ordinarily submit a proposed host specificity test plant list to the Technical Advisory Group. At this early stage of the approval process, the Technical Advisory Group will make recommendations on the target weed choice and comment on the proposed test plant list.

To import a potential weed biological control organism into the United States for host specificity testing, scientists must submit a permit application to APHIS PPQ. It takes 4 to 6 weeks from submission of the application to receive a permit. Approved biological control agents must go to an adequate high-security containment facility upon entry into the United States. The state of Florida currently has three

From: How Scientists Obtain Approval to Release Organisms for Classical Biological Control of Invasive Weeds by J. Scoles et al.
University of Florida, IFAS Extension
CUMULATIVE NEW WEEDS

YEAR

NUMBERS NEW SPECIES

(This slide by: Eric Coombs, Biocontrol Entomologist, Oregon Department of Agriculture.)
Where To Use Biocontrol?

- Established, relatively large weed infestations
- Remote, inaccessible, less disturbed areas
- Areas not controlled by other means
- Environmentally sensitive sites
Where **NOT** To Use Biocontrol?

- Small or new infestations
- Highly disturbed areas
- Roads or traveled paths
  - site specific, acceptable for some sites
- Sites where using incompatible weed management tools
- On weeds with no approved agents
  - avoid moving insects that have not undergone testing for environmental safety
Integrated Weed Management

• Biological
  – grazing, insect feeding, pathogen damage

• Physical/Mechanical
  – tilling, hand-pulling, mulching, burning, mowing

• Chemical
  – herbicide

• Cultural
  – reseeding/revegetation, fertilization
Using Biocontrol in an IWM Strategy

- Use biocontrol & herbicide/physical control INDIRECTLY
  - release biocontrol in largest weed patch
  - spray/mow/dig satellite patches & weed edges to control spread
  - using physical/herbicide methods directly on the weed will likely kill the biocontrol agents

- Use biocontrol & cultural methods DIRECTLY
  - when biocontrol agents have started to reduce weed infestation, use cultural methods to increase plant competition
Integrated Weed Control Project

Combating Weeds with Integrated Controls

WHAT WE DO
The Integrated Weed Control Project promotes a comprehensive approach to weed management, including biological control, throughout Washington State. Learn more about us here.

WHERE TO START
If you would like biological control insects to help control weeds on your property, visit the Control Agents page to learn about weed-specific control strategies.

HOW TO LEARN MORE
This website is growing all the time. Please be sure to visit the content areas for specific questions. One-on-one contact us! We would love to work with you.

Biological Control Insects Feeding On Diffuse Knapweed

IWM Slides by:

Jennifer Andreas
Integrated Weed Control Project
jandreas@wsu.edu

More info at: www.invasives.wsu.edu

Complete Presentation Available Here →
Weed #2 becomes #1, #3 becomes #2 &...
We need to look at the whole picture!

Success?

(This slide by: Eric Coombs, Biocontrol Entomologist, Oregon Department of Agriculture.)
## Potential Considerations:

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...can be a weapon of last resort for otherwise intractable pests
Biological control of weeds in Oregon

- **Insects (71)**
  - beetles (41)
  - flies (15)
  - moths (14)
  - wasp (1)
- **Mites (3)**
- **Nematode (1)**
- **Pathogens (2)**

77 biocontrol agents since 1947

(Slide Credit: Eric Coombs, Biocontrol Entomologist, Oregon Department of Agriculture.)
BIOLICAL CONTROL OF WEEDS

(Slide Credit: Eric Coombs, Biocontrol Entomologist, Oregon Department of Agriculture.)
BIOLOGICAL CONTROL OF WEEDS

New BCAs and Weeds by Decade

(Slide Credit: Eric Coombs, Biocontrol Entomologist, Oregon Department of Agriculture.)
Practical info on 52 agents targeting 23 noxious weeds in a map-sized brochure.
Biological Control of Weeds in the Willamette V.
Most Effective Current Programs:

- St. Johnswort (*Hypericum perforatum*)
- Tansy Ragwort (*Senecio jacobaea*)
- Purple Loosestrife (*Lythrum salicaria*)
- Scotch Broom (*Cytisus scoparius*)
Biological Control of Weeds in the Willamette V.
Other (Less Effective/Common) Current Programs:

Field Bindweed
(Convolvulus arvensis)

Thistles- Bull & Canada
(Cirsium & Carduus spp.)

Knapweeds- Meadow & Spotted
(Centaurea spp.)
Garlic Mustard (*Alliaria petiolata*)

Knotweeds (3 *Fallopia* spp.)

Hawkweeds (*Pilosella* spp.)

*A-list weeds, E.D.R.R.*
BIOLOGICAL CONTROL OF
ST. JOHN'S WORT
Hypericum perforatum

OREGON DEPARTMENT OF AGRICULTURE
NOXIOUS WEED CONTROL PROGRAM

ERIC M. COOMBS
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BIOLOGICAL CONTROL OF
ST. JOHNSWORT

Hypericum perforatum
BIOLOGICAL CONTROL OF
ST. JOHNSWORT

Chrysolina hyperici – leaf beetle
BIological control of
Tansy Ragwort
Senecio jacobaea = (Jacobea vulgaris)

Oregon Department of Agriculture
Noxious Weed Control Program

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BIOLOGICAL CONTROL OF TANSY RAGWORT

*Senecio jacobaea = (Jacobea vulgaris)*
BIOLOGICAL CONTROL OF TANSY RAGWORT

*Senecio jacobaea = (Jacobea vulgaris)*
BIological control of 
Tansy Ragwort

Tyria jacobaeae – cinnabar moth
BIological control of Tansy Kangwort

Tyria jacobaeae – cinnabar moth
BIOLOGICAL CONTROL OF
TANSY RAGWORT

*Tyria jacobaeae* – cinnabar moth
BIOLOGICAL CONTROL OF TANSY RAGWORT

*Longitarsus jacobaeae* – flea beetle
BIological control of tansy ragwort

*Longitarsus jacobaeae* – flea beetle
BIOLOGICAL CONTROL OF TANSY RAGWORT

*Longitarsus jacobaeae* – flea beetle
BIOLOGICAL CONTROL OF TANSY RAGWORT

*Longitarsus jacobaeae* – flea beetle

1978

1987
BIOLOGICAL CONTROL OF SCOTCH BROOM

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BIOLOGICAL CONTROL OF
SCOTCH BROOM

Cytisus scoparius
BIOLOGICAL CONTROL OF SCOTCH BROOM

*Exapion fuscirostre* – seed weevil
BIOLOGICAL CONTROL OF SCOTCH BROOM

*Exapion fuscirostre* – seed weevil
BIOLOGICAL CONTROL OF SCOTCH BROOM

*Bruchidius villosus* – seed beetle
BIOLOGICAL CONTROL OF SCOTCH BROOM

Bruchidius villosus – seed beetle
BIOLOGICAL CONTROL OF
SCOTCH BROOM

Bruchidius villosus – seed beetle
Bruchidius - 2009 and 2014

Paired t-test:
$t=7.31$, $df=26$
$p<0.0001$

Average increase per site:
134 adults, or 1024%
BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

*Lythrum salicaria*

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Oregon Department of Agriculture
Noxious Weed Control Program

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BIOLOGICAL CONTROL OF
PURPLE LOOSESTRIFE

Lythrum salicaria
BIOLOGICAL CONTROL OF
PURPLE LOOSESTRIFE

*Lythrum salicaria*
BIOLOGICAL CONTROL OF
PURPLE LOOSESTRIFE

*Lythrum salicaria*
BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

*Nanophyes marmoratus* – seed capsule weevil
BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

*Nanophyes marmoratus* – seed capsule weevil
BIOLOGICAL CONTROL OF
PURPLE LOOSESTRIFE

*Hylobius transversovittatus* – root weevil
BIOLOGICAL CONTROL OF
PURPLE LOOSESTRIFE

*Hylobius transversovittatus* – root weevil
BIOLOGICAL CONTROL OF
PURPLE LOOSESTRIFE

Galerucella pusilla – leaf beetle
BIOLOGICAL CONTROL OF
PURPLE LOOSESTRIFE

Galerucella pusilla – leaf beetle
BIOLOGICAL CONTROL OF
PURPLE LOOSESTRIFE

Galerucella calmariensis & pusilla leaf beetles
BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

Galerucella calmariensis leaf beetle

July  Sept  July
BIOLOGICAL CONTROL OF
PURPLE LOOSESTRIFE

Galerucella calmariensis

Oaks Bottom, Sellwood neighborhood  KPTV 8-10-2015:
http://www.kptv.com/story/29752985/beetles-swarm-se-portland-neighborhood
BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

Galerucella calmariensis

Photos – M. Peters

2007

Oaks Bottom

2015
BIOLOGICAL CONTROL OF
PURPLE LOOSESTRIFE

Galerucella calmariensis

Timeline

Aug 7  5:18 PM Reports of GACA flying all over
Aug 8  Agencies notified, PDX, APHIS
Aug 9  History of site given – no problem before
Aug 10 News stations pick up story KPTV & ODA
       APHIS responds to homeowners,
       ODA
       gets blame, “Perfect Storm”
Aug 13 Town hall forum agencies, die-off noticed
Aug 14 Beetles dying en masse
Aug 17 Few beetles observed, last complaint on
       crape myrtle, last news story
Aug 24 Monitoring ends
BIOLOGICAL CONTROL OF
PURPLE LOOSESTRIFE

Galerucella calmariensis – Oaks Bottom
BIOLOGICAL CONTROL OF
PURPLE LOOSESTRIFE

Galerucella calmariensis

Oaks Bottom – Salix, Polygonum, Solanum
BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

Galerucella calmariensis – nontarget impact

willow  spiraea  oak
BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

Galerucella calmariensis - nontarget impacts
BIOLOGICAL CONTROL OF
PURPLE LOOSESTRIFE

Galerucella calmariensis
Predator & prey reunited ...with the goal of bringing an invasive into balance with native ecosystems
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Biological control of Bull thistle

*Cirsium vulgaris*
BIOLOGICAL CONTROL OF CANADA THISTLE

*Cirsium arvensis*
BIOLOGICAL CONTROL OF
BULL THISTLE

*Urophora stylata* – seed head gall fly
BIOLOGICAL CONTROL OF BULL THISTLE

Urophora stylata – seed head gall fly
BIOLOGICAL CONTROL OF CANADA THISTLE

*Urophora cardui* – stem gall fly
BIOLOGICAL CONTROL OF CANADA THISTLE

Urophora cardui – stem gall fly
BIOLOGICAL CONTROL OF CANADA THISTLE

*Rhinocyllus conicus* – seed head weevil
BIOLOGICAL CONTROL OF SPOTTED KNAPWEED

*Centaurea stoebe (maculosa)*
BIOLOGICAL CONTROL OF MEADOW Knapweed

Centaurea pratensis (jacea x nigra)
BIOLOGICAL CONTROL OF
SPOTTED & MEADOW KNAPWEED

*Larinus obtusus* – seed head weevil
BIOLOGICAL CONTROL OF SPOTTED & MEADOW Knapweed

Larinus obtusus – seed head weevil
BIOLOGICAL CONTROL OF
FIELD BINDWEED
Convolvulus arvense

OREGON DEPARTMENT OF AGRICULTURE
NOXIOUS WEED CONTROL PROGRAM

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BIOLOGICAL CONTROL OF
FIELD BINDWEEED

Tyta luctuosa – defoliating moth
BIOLOGICAL CONTROL OF FIELD BINDWEEED

Tyta luctuosa – defoliating moth

Releases -2011  Catches 2012
BIOLOGICAL CONTROL OF JAPANESE KNOTWEED

*Fallopia japonica*
BIOLOGICAL CONTROL OF
BOHEMIAN KNOTWEED
Perisicaria bohemica
BIOLOGICAL CONTROL OF JAPANESE KNOTWEED

Fallopia japonica
BIOLOGICAL CONTROL OF JAPANESE KNOTWEED

Fallopia japonica
Knotweed: Potential Agent

- 3 species in North America & Europe
  - *Fallopia japonica*
  - *Fallopia sachalinensis*
  - *Fallopia x bohemica*

- *Aphalara itadori*
  - northern & southern strain – attack different biotypes
  - petition should be or has been submitted in 2012
  - looking for pre-release monitoring sites
Garlic Mustard: Potential Agents

• *Alliaria petiolata*

• *Ceutorhynchus scrobicollis*
  ~ root-crown weevil
  ~ petition submitted to TAG in 2008
  ~ additional tests conducted in 2010-2011 to address TAG’s concerns
  ~ response to TAG submitted in September 2011
  ~ if TAG recommends, will begin USDA APHIS approval process

• Additional testing on: *C. alliariae, C. roberti, C. constrictus*