



Agriculture and
Agri-Food Canada

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Invasive Plant Biocontrol... How it works & prospects for SK

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AAFC Lethbridge Research &
Development Centre

Canada 

Presentation Outline

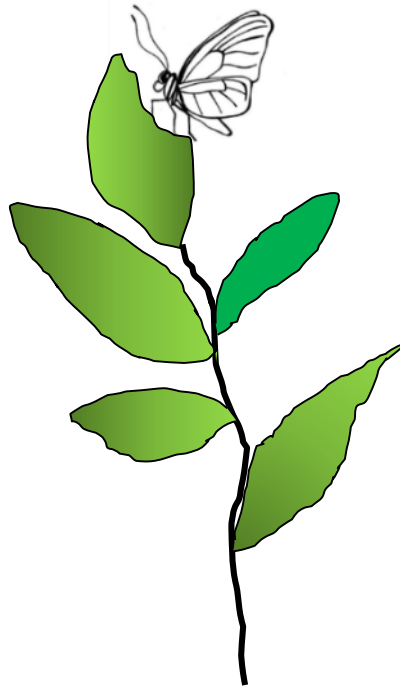
- *Overview – Canada's Weed Biocontrol Program*
- *Past successes → New & promising agents*
- *Getting good agents to stakeholders asap*



Classical Weed Biological Control

Use of an invasive plant's natural enemies (insects or pathogens) from the plant's place of origin

to reduce its populations to below damaging levels



Benefits of weed biological control



- **Host-specific**
- **Self-propagating & dispersing**
- **Can be very successful**
- **Long-term control**
- **Cost-effective (eg. 1:23 cost to benefit)**

Biological control often only option for mitigation of weeds in natural areas



Biocontrol agents released against Canada's weeds 1951-2021



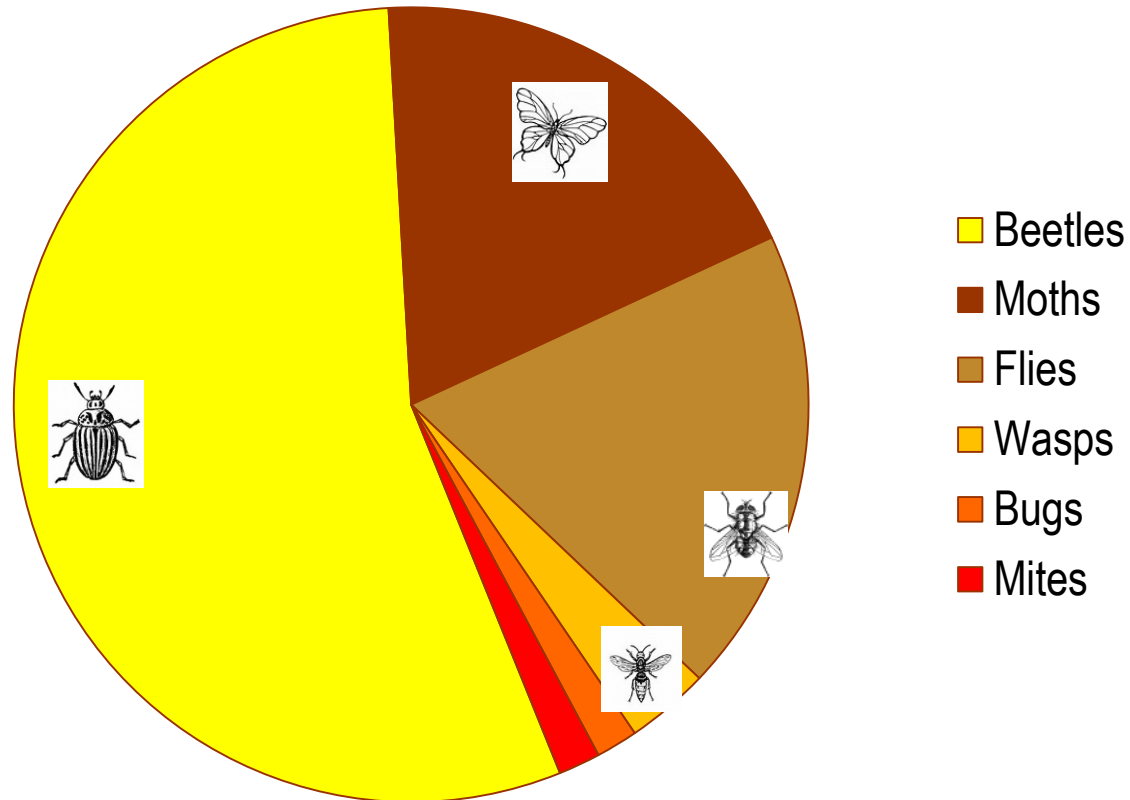
- **86 species intentionally introduced against 34 targeted invasive plant spp**
- **68% (59/86) species of released biocontrol agents are established in Canada**
- **≈46% (27/59) of established agents have some level of impact on their weed**

Distilled from Winston *et al.* (2021)

Biological Control: A World Catalogue of Agents & their Target Weeds

<https://www.ibiocontrol.org/catalog/index.cfm>

What types of agents have established?



Beetles are the Best!

- Our top 10 agents for impact are beetles
- Generally easy to rear & survive handling well

Weeds targeted for biocontrol since 1951 (with agent releases as of 2021)

- St. John's wort
- Tansy ragwort
- Field bindweed
- Hedge bindweed
- Leafy spurge
- Cypress spurge
- Canada thistle
- Bull thistle
- Nodding plumeless thistle
- Spiny plumeless thistle
- Scotch thistle
- Marsh thistle
- Perennial sowthistle
- Russian thistle
- Bladder campion
- Puncture vine
- Diffuse knapweed
- Spotted knapweed
- Meadow knapweed
- Russian knapweed
- Yellow toadflax
- Dalmatian toadflax
- Scentless chamomile
- Rush skeletonweed
- Purple loosestrife
- Houndstongue
- False cleavers
- Japanese knotweed
- Whiplash hawkweed
- Orange hawkweed
- Meadow hawkweed
- Dog-strangling vine
- Common reed
- Garlic mustard



Impact of root-feeding beetles on leafy spurge

Soon after release

- Reduced flowering stems
- Spurge plant mortality



Biocontrol of houndstongue (*Cynoglossum officinale*) by *Mogulones crucifer*



- **European import**
- **9 yrs of testing**
- **Released in Canada 1997**
- **Very successful!**



**Houndstongue plant
under heavy feeding
by weevil**

**Unattacked
houndstongue
plant**



Impact of *Mogulones crucifer* on houndstongue density



**1999: year of
release of 200
weevils**



**2001: few
houndstongue left!**

Stages in Biocontrol Agent Development



- 1. Overseas exploration**
- 2. Risk assessment studies – i.e. tests for safety**
 - ▶PETITION to CFIA for review**
- 3. Rearing for initial studies and releases**
- 4. Initial field releases**
- 5. Establishment and impact assessment**
- 6. Release strategy development (mass-rearing and distribution)**
- 7. Ecological interactions/ long-term assessment**

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Pre-release host-specificity testing overseas



- ***No-choice tests***
(what can they feed/develop on?)



- ***Multiple-choice tests***
(what do they prefer to feed on?)

Testing based on degrees of relatedness of plants relative to target weed

1. **Same species as weed**
2. **Other species in same**
 - **genus**
 - **tribe**
 - **family**
 - **order**
3. **Representatives of other orders and groups more distantly related**



Pre-release laboratory rearing & study of agents

AAFC - Insect Microbial Containment Facility, Lethbridge



Biocontrol agents petitioned/close to petitioning

Agent	Weed	Status 2022
<i>Aceria angustifoliae</i> (flower-galling mite)	Russian olive	Petition in review 2019-22
<i>Dichrorampha aeratana</i> (root-boring moth)	Oxeye daisy	Petition in review 2021-22; colony in quarantine (AAFC-Lethbridge)
<i>Oxyyna nebulosa</i> (root-galling fly)	Oxeye daisy	Testing near complete; colony in quarantine (AAFC-Lethbridge)
<i>Microplontus millefolii</i> (stem-boring weevil)	Common tansy	Testing near complete; insects in quarantine ready for rearing (AAFC-Lethbridge)



CABI

Aceria angustifoliae



CABI

Dichrorampha aeratana



T. Messer

Oxyyna nebulosa

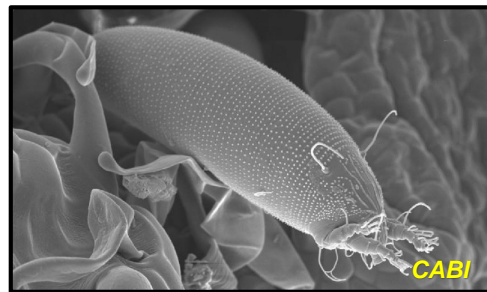


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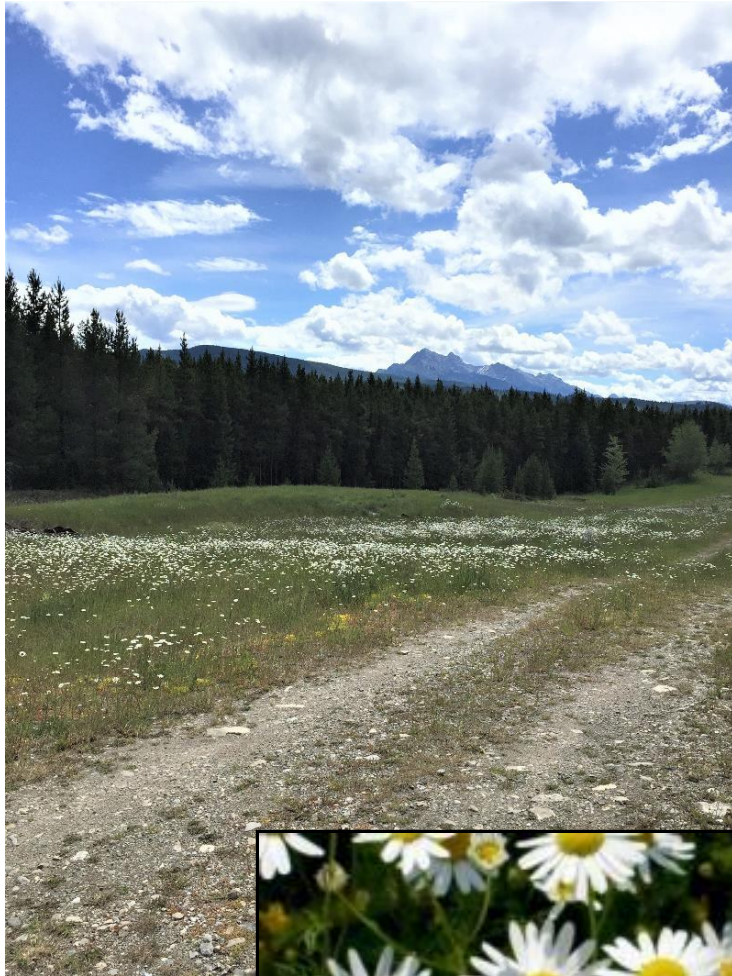
Microplontus millefolii

Russian olive gall mite (*Aceria angustifoliae*)

- **Small, plant-feeding mite**
- **Very host-specific**
- **Creates 'galls' (deformities of leaves, flowers, fruits) – reduces tree reproduction & spread**
- **Mites overwinter in buds**
- **Multiple generations / season develop in galls**
- **Can reduce fruit production by ca. 40% without reducing trees value**



Oxeye daisy ***(Leucanthemum vulgare)***



- **Introduced to Canada 1800s**
- **Invader of managed & native pastures**
- **Listed noxious weed seed (fed Seeds Act) – contaminates forage seed crops**
- **Noxious weed (BC, AB, SK, MB)**
- **Avoided by grazing cattle**
- **Shallow roots promote soil erosion**

Oxeye daisy root-boring moth (*Dichrorampha aeratana*)



- European & Asian origin
- Adventive in eastern (not western) Canada
- Adults emerge in spring, eggs laid on leaves/stems, larvae move into roots & base of stems where feed until winter, pupate in early spring
- Successful rearing in quarantine (Leth) since 2018

Testing of oxeye daisy root moth on a native plant species (Arctic daisy) collected from the Yukon (2018)



Petition for Canadian release of 1st oxeye daisy agent → submitted to CFIA, November 2021

Petition for field release of *Dichrorampha aeratana* (Pierce and Metcalfe, 1915) (Lepidoptera, Tortricidae) as a biological control agent for oxeye daisy, *Leucanthemum vulgare* Lam., in the USA and Canada



Key results:

- Lab no-choice tests – could develop on 11/74 test plant spp.
- Outdoor choice tests – larvae only found on Shasta and creeping daisy
- **But no impact on growth and reproduction of Shasta daisy (vs oxeye daisy)**

Oxeye daisy root-galling fly (*Oxyna nebulosa*)



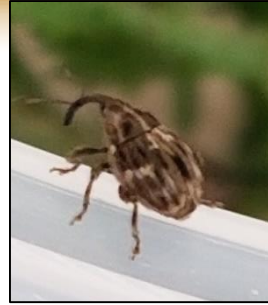
- Wide distribution Europe & western Asia
- Adults emerge throughout summer, eggs laid in leaves, larvae move to crown & roots where initiate their small, round, clustered galls, larvae develop and pupate in galls
- Successful rearing in quarantine (Leth) since 2019
- Used lab colony to test Arctic daisy – no galling
- Fly host-specific

Common tansy (Tanacetum vulgare)



- **Aromatic perennial introduced to NA from Europe in 1600s**
- **Occurs in all provinces/territories except Nunavut**
- **Invades native & managed pastures, forests & riparian habitats**
- **Toxic to humans & livestock, but cattle avoid**
- **Listed noxious BC, AB, SK, MB**

Common tansy stem-boring weevil (*Microplontus millefolii*)



- Occurs W Europe to SE Siberia
- Adults emerge in summer, eggs laid on shoots, larvae develop to adults in stems.
- Narrow host range demonstrated
- Received only a few from Russia Oct 2021 (via CABI), in quarantine cold storage (Leth) & will attempt rearing 2022



Stages in Biocontrol Agent Development



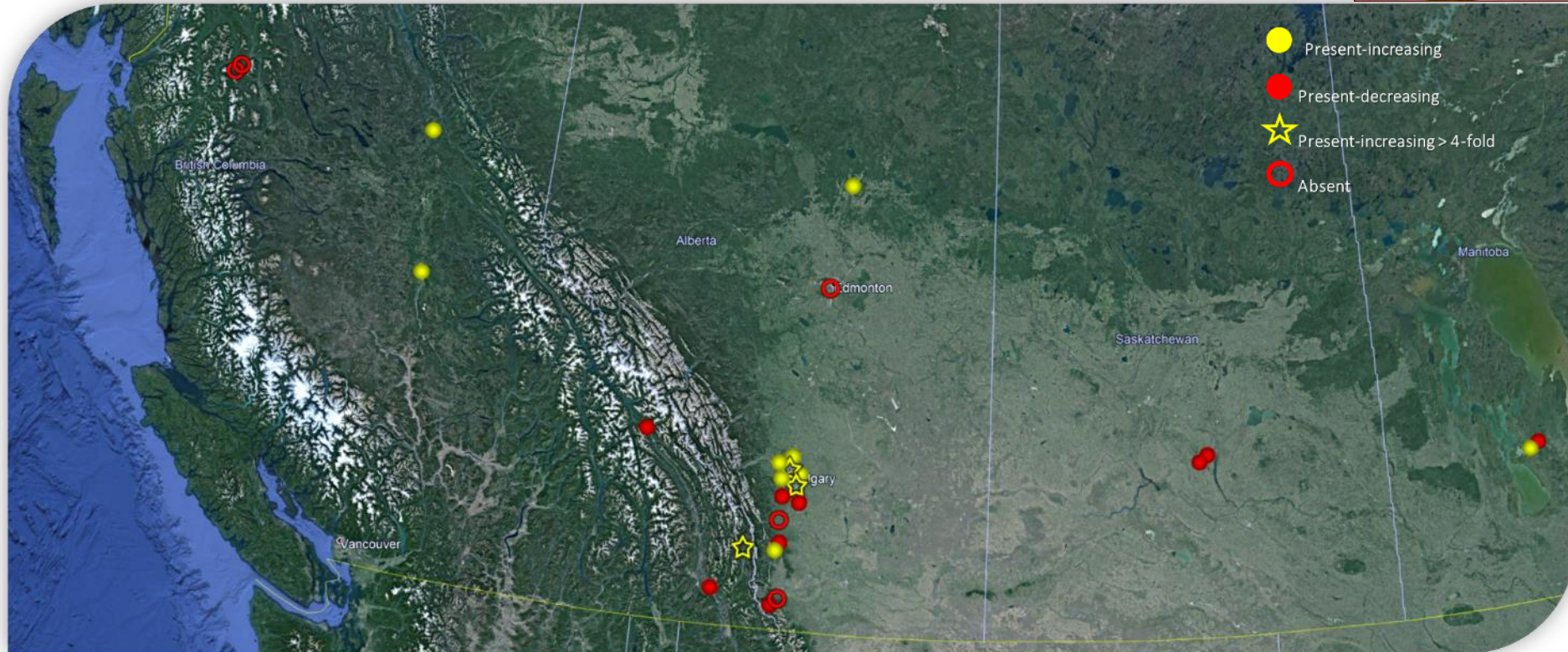
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Yellow toadflax stem-galling weevil (Rhinusa pilosa)



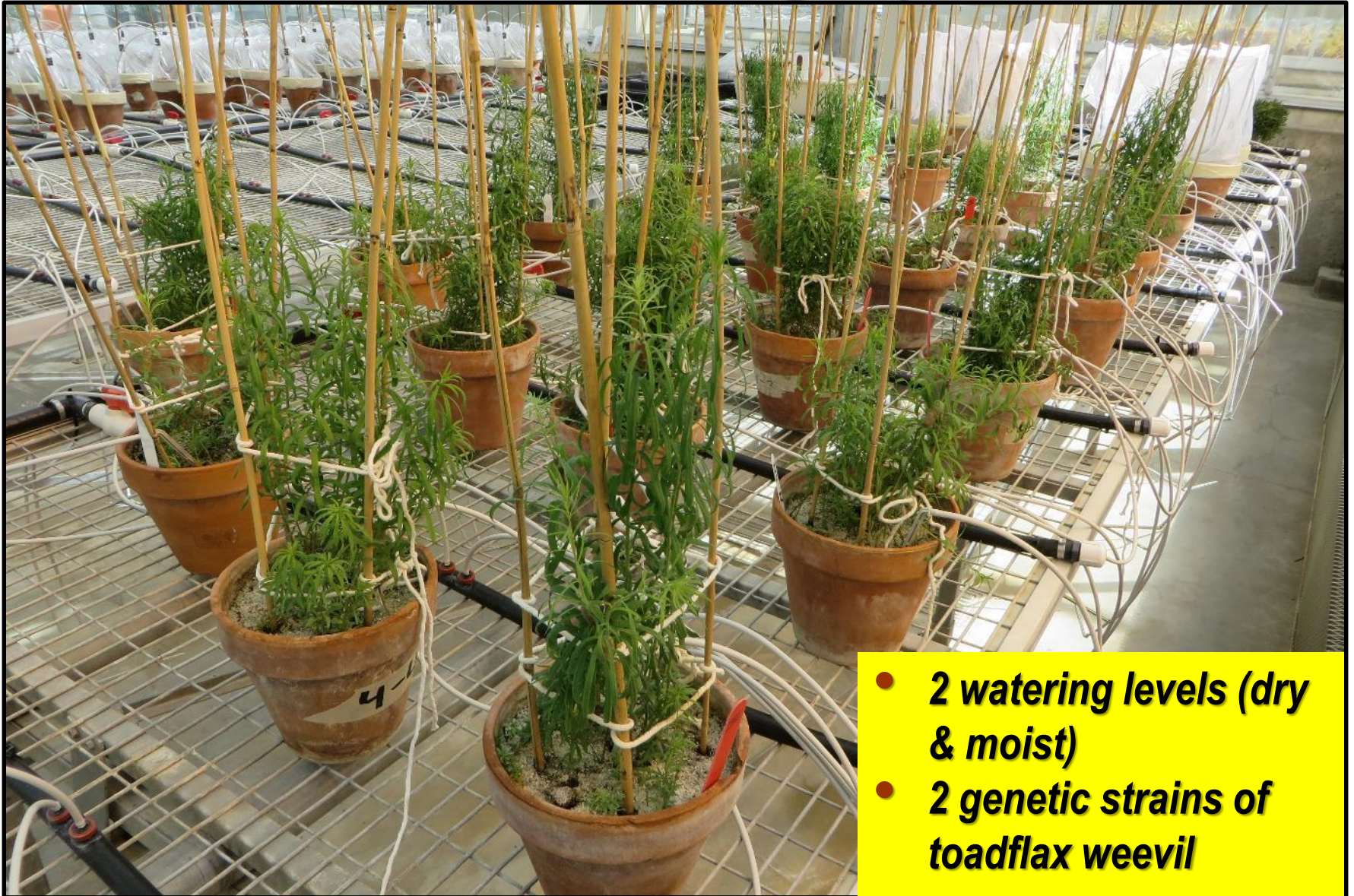
- ***Introduced from Serbia – very host-specific & good impact***
- ***Adults emerge in spring, eggs laid in young shoots, larvae complete development to adult in galls, overwinter in litter/soil***
- ***First releases in Canada 2014-2016 (AB, BC, SK, MB, ON, PEI, NS)***

Early assessment of *Rhinusa pilosa* establishment on yellow toadflax in Canada



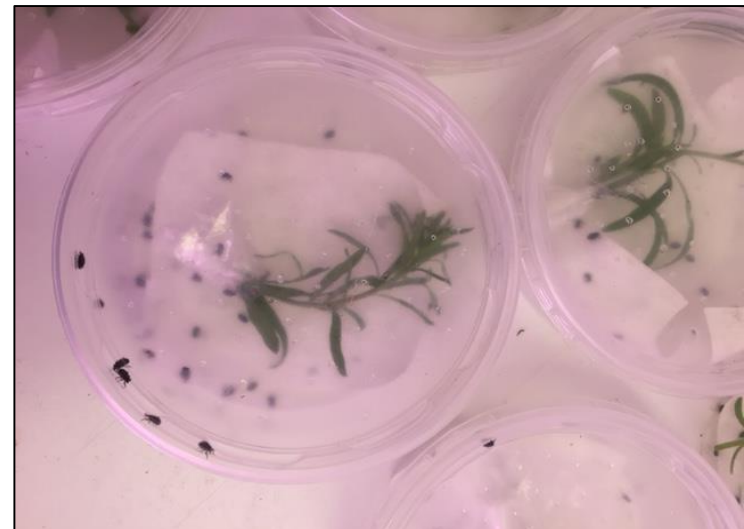
➤ **Based on 2019 monitoring, some weevil populations were thriving and others disappearing 3-5 yrs after first releases (2014-2016).**

Greenhouse watering experiment



- **2 watering levels (dry & moist)**
- **2 genetic strains of toadflax weevil**

Rearing *Rhinusa pilosa* for field release



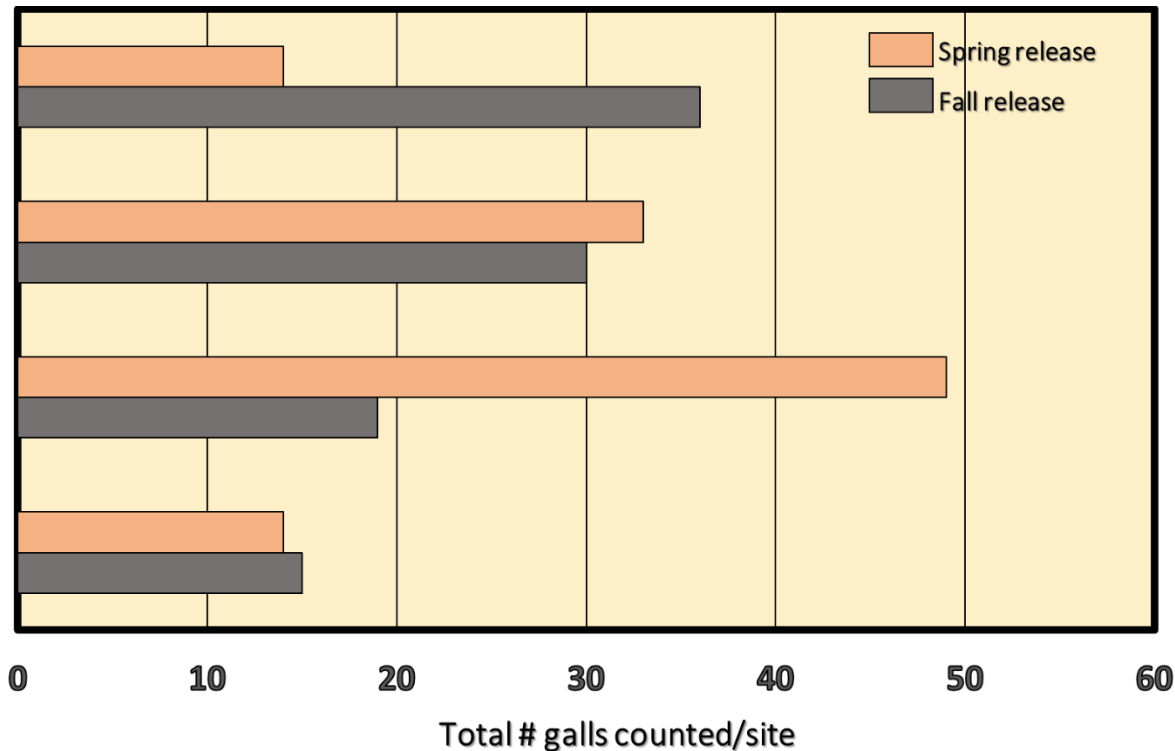
'Farming' the Houndstongue Weevil 2002-2005



Establishment of nursery sites for mass-production of *Rhinusa pilosa*?



Season to release *Rhinusa pilosa*?



- **Can release either in spring or fall to get establishment.**
- **Recommendation for redistribution – move galls with adults to new toadflax patches in fall**

A BIG THANKS to all those who make **our science possible!**

- Collaborators from home & abroad
- Students (undergraduate and graduate)
- LeRDC Staff (Technicians, Support)
- Funders (AAFC, Provinces/States, Industry)



Questions Anyone?

