



A Review of Some Biological Control Programs for Invasive Plants

**A Presentation by
W.D. McIlveen**

Biological Control Review



Native

2348 species/subspecies

Biological Control Review



Native

2348 species/subspecies



Non-native

1664 species

Biological Control Review



Native

2348 species/subspecies



Non-native

1664 species



Others (not assigned not native)

573 species

Biological Control Review



SE4 - Common exotic

48 species

Biological Control Review



SE4 - Common exotic

48 species



SE5 = Very common exotics

156 species

Biological Control Review



Steps to Becoming a Problem Invasive

1. Colonial seeds/plants become established
2. Plants are able to reproduce
3. Population increases
4. Indigenous insects, disease are ineffective in controlling plants
5. Populations reach stage where plants are considered to be invasive (ecological problem, economic problem, health issues) based on human value assessments

Biological Control Review

		Pest Agent Insect or Disease	
		Native	Introduced
Host (Plant)	Native		
	Introduced		

Biological Control Review

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Biological Control Review

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Biological Control Review

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	Introduced	Few instances but hard to recognize	

Biological Control Review

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Host (Plant)	Native	Presumed to be 'In balance'	Can have severe impact (e.g. Dutch Elm, EAB)
	Introduced	Few instances but hard to recognize	If suitable, can bring about acceptable balance

Biological Control Review – Canada Thistle



Cirsium arvense – Canada Thistle

Biological Control Review – Canada Thistle

C A P . X L .

An Act to prevent the spreading of Canada Thistles
in Upper Canada.

[Assented to 18th September, 1865.]

Preamble.

HER Majesty, by and with the advice and consent of the
Legislative Council and Assembly of Canada, enacts as
follows :

1. It shall be the duty of every occupant of land in Upper
Canada, to cut, or to cause to be cut down all the Canada
thistles growing thereon, so often in each and every year as
shall be sufficient to prevent them going to seed ; and if any
owner, possessor, or occupier of land shall knowingly suffer
any Canada thistles to grow thereon and the seed to ripen so
as to cause or endanger the spread thereof, he shall upon con-
viction be liable to a fine of not less than two nor more than
ten dollars for every such offence.

Owners of land
to cut down
thistles grow-
ing on their
lands.

Penalty.

2. It shall be the duty of the Overseers of Highways in any
Municipality to see that the provisions of this Act are carried
out within their respective highway divisions, by cutting or
causing to be cut all the Canada thistles growing on the high-
ways or road allowances within their respective divisions, and
every such overseer shall give notice in writing to the owner,
possessor, or occupier of any land within the said division
whereon Canada thistles shall be growing and in danger of
going to seed, requiring him to cause the same to be cut down

Duty of over-
seers of High-
ways under
this Act.

Biological Control Review – Canada Thistle

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An Act to prevent the spreading of Canada Thistles in Upper Canada.

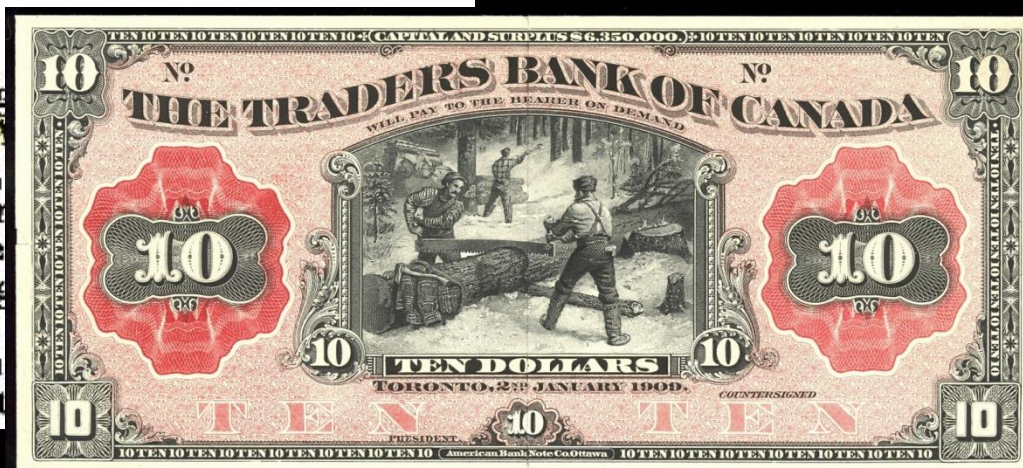
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Excerpt from Canada Thistles Act, 1865

Biological Control Review – Canada Thistle

Name	Agent	Release Year
<i>Altica carduorum</i>	Foliar-feeding beetle	1964
<i>Hadroplontus litura</i>	Stem, root crown-feeding weevil	1975
<i>Larinus planus</i>	Seed-feeding weevil	1988 adventive
<i>Puccinia punctiformis</i>	Rust	2002
<i>Rhinocyllus conicus</i>	Seed-feeding weevil	1979
<i>Terellia ruficauda</i>	Seed-feeding fly	1931 adventive
<i>Urophora cardui</i>	Stem gall-forming fly	1974
<i>Lema cyanella</i>	Foliar-feeding beetle	1993 adventive
<i>Cassida rubiginosa</i>	Foliar-feeding beetle	1902 adventive
<i>Cleonis pigra</i>	Root crown weevil	2003 adventive
<i>Dasineura gibsoni</i>	Seed hairs midge	2003 adventive
<i>Vanessa cardui</i>	Painted Lady	Native

Biological control agents for Canada Thistle

Biological Control Review – Canada Thistle



Altica carduorum Canada Thistle Fleabeetle

Biological Control Review – Canada Thistle



Hadroplontus litura



Larinus planus



Terellia ruficauda



Cassida rubiginosa

Biological Control Review – Canada Thistle



Uphora cardui – Thistle Stem Gall

Biological Control Review – Canada Thistle



Puccinia punctiformis – Thistle Rust



Painted Lady – Native species

Biological Control Review - St. John's Wort



Hypericum perforatum

St. John's Wort or Klamath Weed

Designated as noxious weed in 20 countries

Invasive and toxic causing photosensitization
in cattle



Biological Control Review - St. John's Wort



Chrysolina hypericis



Chrysolina quadrigemina

All three species were released in Ontario to control St. John's Wort



Aplocera plagiata

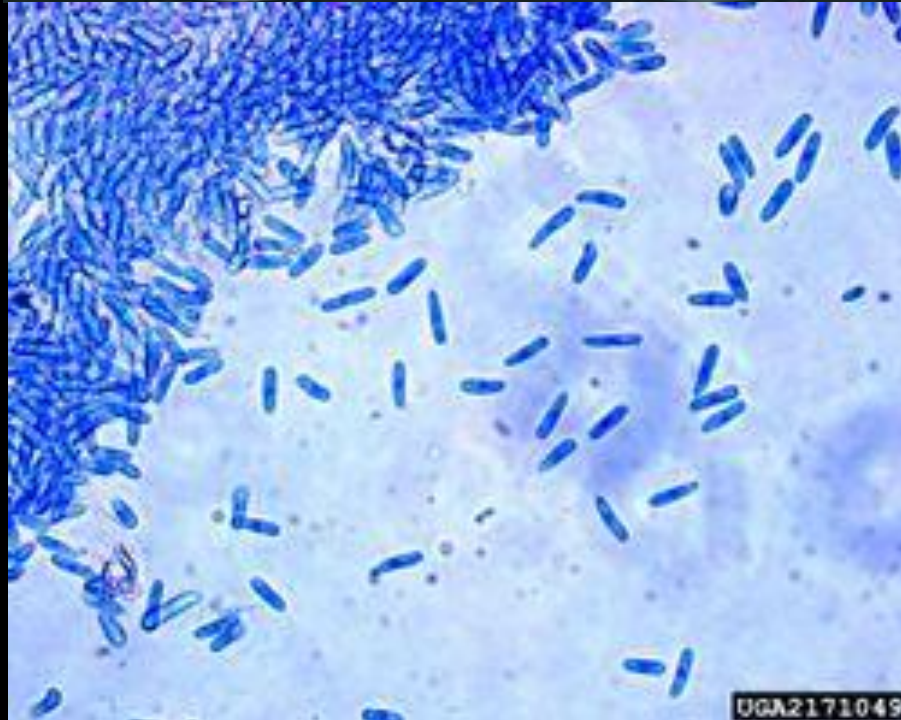
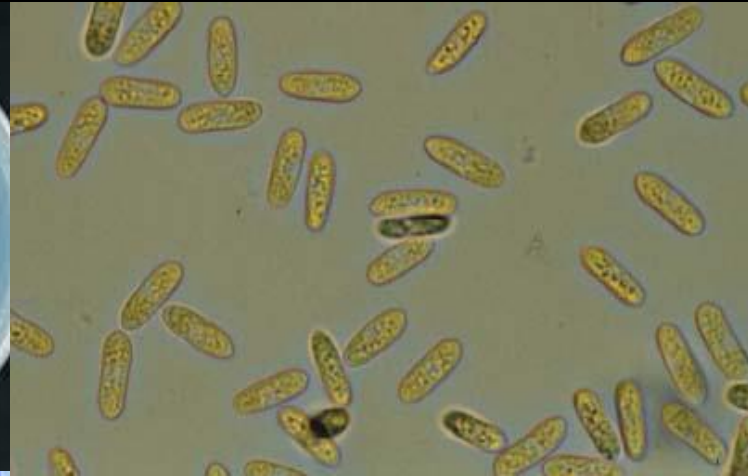
Biological Control Review - St. John's Wort



Klamath Beetle - *Chrysolina quadrigemina*

Beetles are prey to Carabid beetles when they enter soil to pupate or as adults

Biological Control Review - St. John's Wort



The fungus *Colletotrichum gloeosporioides* causes stem lesions on St. John's Wort

Infections caused dieback and mortality of the host plant

Disease was considered useful as a biocontrol agent

Fungus is spread by *Chrysolina* Beetles

Biological Control Review - St. John's Wort



Oil from flowers works as a topical treatment for bruises, joint problems, inflammation and/or neurological problems

Wildly sold as a herbal remedy against mild depression

Nicknamed the "Herb of Happiness"



Biological Control Review - St. John's Wort

HortScience 49(1):31–34, 2014.

A Rapid Greenhouse Screening Method to Identify St. John's Wort (*Hypericum perforatum*) Accessions Resistant to *Colletotrichum gloeosporioides*

Vincent V. Michel¹

Agroscope, CH-1964 Conthey, Switzerland

Nicole Debrunner and Xavier Simonnet

Médiplant, CH-1964 Conthey, Switzerland

Additional index words. anthracnose, disease, *Hypericum perforatum*, resistance breeding

Abstract. Anthracnose is a major production constraint for st. john's wort (*Hypericum perforatum* L.) caused by the fungus *Colletotrichum gloeosporioides* (Penz.). A greenhouse screening method based on mortality was developed to eliminate accessions susceptible to anthracnose in the early stage of breeding for resistant cultivars. The mortality of 22 accessions of st. john's wort artificially inoculated with a strain of *C. gloeosporioides* was highly correlated between three greenhouse experiments ($r = 0.799$ to 0.923), even when done at two different places. The response of the greenhouse screening was equally highly correlated to the mortality in the field tested at two sites naturally infested with *C. gloeosporioides* ($r = 0.700$ to 0.865) but less well correlated with the mortality at a third field site ($r = 0.495$ to 0.672). Yield of st. john's wort was highly correlated with mortality ($r = -0.747$ to -0.846) at all three field sites, but a significant interaction between accession and site was observed. Therefore, an improvement of anthracnose resistance of st. john's wort should be based on a greenhouse screening of seedlings followed by multiple-site field testing of adult plants.

Because of crop values for medicine, attempts to grow disease resistant St. John's Wort are underway

Biological Control Review - St. John's Wort



Hypericum frondosum
Sunburst St. John's Wort



Hypericum hookerianum
Hooker's St. John's Wort

Horticultural *Hypericum* species

Biological Control Review - St. John's Wort



Hypericum gentianoides
False St. John's-wort or Orange-grass



Hypericum sphaerocarpum
Round-fruited St. John's-wort

Rare species of *Hypericum* in Ontario

Biological Control Review – Knapweeds



Centaurea infestation

Knapweed Species

Centaurea benedicta
Centaurea callitrapa
Centaurea diffusa
Centaurea jacea
Centaurea nigra
Centaurea nigrescens
Centaurea paniculata
Centaurea scabiosa
Centaurea solstitialis
Centaurea stoebe
Centaurea X moncktonii
Centaurea X psammogena



Biological Control Review – Knapweeds

Species	Common Name	Year Release
<i>Urophora quadrifasciata</i>	Seed-head Gall Fly	1970
<i>Urophora affinis</i>	Seed-head Gall Fly	1972
<i>Metzneria paucipunctella</i>	Seed-head Moth	1973
<i>Sphenoptera jugoslavica</i>	Root Gall Beetle	1976
<i>Agapeta zoegana</i>	Root Moth	1982
<i>Pelochrista medulla</i>	Root Moth	1982
<i>Pterolonche inspersa</i>	Root Moth	1986
<i>Cyphocleonus achates</i>	Root Weevil	1987
<i>Puccinia centaureae</i>	Knapweed Rust Disease	1988
<i>Larinus obtusus</i>	Seed-head Weevil	1993
<i>Bangastermis fausti</i>	Seed-head Weevil	1992 USA only
<i>Aceria centaureae</i>	Leaf Gall Mite	1993 USA only
<i>Isoculus minutus</i>	Seed-head Gall Wasp	Under evaluation

Biological Control Review – Knapweeds



Urophora quadrifasciata



Urophora affinis



Metzneria paucipunctella



Sphenoptera jugoslavica



Agapeta zoegana



Pelochrista medulla



Pterolonche inspersa



Cyphocleonus achates



Puccinia centaureae

Biological Control Review – Knapweeds



Centaurea cyaneus



Centaurea macrocephala



Centaurea montana

Biological Control Review – Purple Loosestrife



Purple Loosestrife – *Lythrum salicaria*

Poster plant for invasive species

Desirable as nectar plant for Honey Bees and for horticultural purposes

Biological Control Review – Purple Loosestrife



Neogalerucella californiensis
Released in Ontario 1992



Neogalerucella pusilla
Released in Ontario 1992



Hylobius transversovittatus
Released in Ontario 1992

Biological Control Review – Purple Loosestrife



Neogalerucella californiensis
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Neogalerucella pusilla
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Hylobius transversovittatus
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Nanophyes marmoratus
Released New York and Minnesota 1994
Adventive to Ontario, 2012

Biological Control Review – Purple Loosestrife



Neogalerucella californiensis
Released in Ontario 1992



Neogalerucella pusilla
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Hylobius transversovittatus
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Nanophyes marmoratus
Released New York and Minnesota 1994
Adventive to Ontario, 2012



Nanophyes brevis
Approved for release but withheld
due to a nematode infection

Biological Control Review – Purple Loosestrife



Four-lined Plant Bug - *Poecilocapsus lineatus*

Biological Control Review – Purple Loosestrife



Small Engrailed –
Ectropis crepuscularia



Loosestrife Aphid
Myzus lythri
Aphid from Europe, ca 1930

Other insects feeding on Purple Loosestrife

Biological Control Review - Docks



Rumex crispus – Curled Dock

Biological Control Review - Docks

Species	Action
<i>Apion frumentarium</i>	Herbivore
<i>Apion violaceum</i>	Herbivore
<i>Bembecia chrysisiformis</i>	Stems/Roots
<i>Chamaesphecia doryliformis</i>	Stems/Roots
<i>Gastrophysa viridula</i>	Herbivore
<i>Hypera rumicis</i>	Herbivore
<i>Lixomorphus ocularis</i>	Roots
<i>Pegomya solennis</i>	Blotch Leaf Miner
<i>Ramularia rubella</i>	Pathogen Leaves
<i>Uromyces rumicis</i>	Pathogen Leaves

List of biological agents used to control *Rumex* species

Biological Control Review - Docks



Hypera rumicis

Biological Control Review - Docks



Ramularia rubella



Uromyces rumicis – Dock Rust

Biological Control Review - Docks



Apion frumentarium



Apion violaceum



Lixomorphus ocularis



Pegomya solennis – Dock Leaf Blotch Miner

Biological Control Review