BRITISH COLUMBIA
Ministry of
Forests, Lands and
Natural Resource Operations

Biocontrol Agent Lifecycle Schedule

April 2015

FLNRO – Invasive Plant Program

Biocontrol Agent Lifecycle Schedule

The Biocontrol Agent Lifecycle Schedule describes the months during the year that secondary and tertiary agents (see Status for definition) may be handled.
The schedule is initially broken down by alphabetically listed specific biocontrol agents and their target invasive plant (first column).
The next column describes the Activity of Interest.

First is the Life Cycle row:

The Life Cycle row contains the predicted life cycle for the agent and is based on literature sources and BCMFR field studies;
Life cycle stages are coded by colour; and

adult	egg	larva	pupa	mixed	other	all	XXXXX

White blocks with black text indicate a life cycle stage usually during a non-field season time period, e.g. overwintering larva.

Following are the Monitor and Collection rows:

The Monitor and Collection rows use the life cycle colour codes to indicate the applicable life cycle stages and may include additional information;
The preferred life cycle stage(s) to monitor or collect within are indicated in the appropriate months or part months;
When a forward slash is used, it indicates the overlap of two or more life stages i.e. adult/larva or adult/larva/pupa;
"Other" may include an acceptable form of monitoring specific to that bioagent, ie: evidence. Notes will further identify 'other';

"All stages" includes recurring or overlapping generations, common with rusts (fungus) or very short-lived insects (midges, aphids); and

Finally there is the Notes row:

The Notes row contains specific information pertaining to the agent that may be of use to the handler.

Example of use:

To determine when to monitor and collect *Agapeta zoegana:*

- Locate the *A. zoegana* bioagent information block;
- Follow the Monitor row until a colour code and life cycle stage is indicated (there may be more than one life cycle stage during which to monitor at multiple times in a year);
- In this case, it is best to monitor *A. zoegana* larva from mid-April through the end of May and again in late September and October;
- Follow the Collection row until a colour code and life cycle is indicated (there may be more than one life cycle stage during which to monitor at multiple times/year);
  In this case, it is best to collect *A. zoegana* from mid-June through all of July; and
- Refer to the Life cycle row for predictable information and how it may be adjusted for a particular situation.

Version: April 2015

Biocontrol Agent Lifecycle Schedule

Biocontrol agent ↓	Activity of interest	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
		1-15	16-31	1-15	16-28	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31
Agapeta zoegana	Life cycle	overwintering larva							larva			pupa	adult						larva			overwintering larva			
	monitor								larva										larva						
Controls	collect												adult												
Knapweeds	Notes	Larva overwinters in any instar and resumes feeding and developing the following spring.																							
Agonopterix nervosa	Life cycle	adult						egg		larva				pupa		adult									
	monitor										larva														
Controls	collect										larva														
Scotch broom & Gorse	Notes	NOT PERMITTED FOR REDISTRIBUTION																							
Aphthona cyparissiae	Life cycle	overwintering larva							pupa				adult			adult/larva			larva			overwintering larva			
	monitor												adult												
Controls	collect												adult												
Leafy spurge	Notes	*A. cyparissiae* has a longer oviposition period than *A. nigriscutis.*																							
Aphthona nigriscutis	Life cycle	overwintering larva							pupa				adult			adult/larva			larva			overwintering larva			
	monitor												adult												
Controls	collect												adult												
Leafy spurge	Notes	*A. nigriscutis* has a 1-week shorter oviposition period than *A. cyparissiae*																							
Aplocera plagiata	Life cycle	2nd generation larva								pupa		adult	adult/larva		pupa		adult 2nd gen. larva			overwintering 2nd gen. larva						
	monitor													larva			larva								
Controls	collect													larva			larva								
St. John's wort	Notes																								
Botanophila seneciella	Life cycle	overwintering pupa										adult	adult/egg/larva			larva	larva/pupa			overwintering pupa					
	monitor												adult		larva										
Controls	collect												adult		larva										
Tansy ragwort	Notes	At high elevations, larva may emerge in July.																							
Brachypterolus pulicarius	Life cycle	overwintering pupa							pupa		adult		adult/egg/larva			larva				overwintering pupa					
	monitor											adult													
Controls	collect											adult													
Toadflaxes	Notes	Adults can overwinter in climates with long growing seasons.																							

Version: April 2015

Biocontrol Agent Lifecycle Schedule

Chrysolina	Life cycle	overwintering egg; larva; pupa; pupa/adult; adult; inactive adult; adult; overwintering egg
hyperici	monitor	larva; adult; adult
Controls	collect	adult
St. John's wort	Notes	*C. hyperici* normally overwinters in the egg stage, however, it may overwinter in adult and larva stages.
Chrysolina	Life cycle	overwintering egg; larva; pupa; pupa/adult; adult; inactive adult; adult; overwintering egg
quadrigemena	monitor	larva; adult; adult
Controls	collect	adult
St. John's wort	Notes	*C. quadrigemina* normally overwinters in the egg stage, however, it may overwinter in adult and larva stages in mild climates.
Chrysolina	Life cycle	overwintering egg; larva; pupa; pupa/adult; adult; inactive adult; adult; overwintering egg
varians	monitor	larva; adult; adult
Controls	collect	adult
St. John's wort	Notes	
Cochylis	Life cycle	larva; pupa; adult; larva; Larva/pupa; adult; adult/larva; larva; larva
atricapitana	monitor	larva; larva; larva
Controls	collect	larva; larva; larva
Tansy ragwort	Notes	Multiple larva/pupa found/plant root/crown. Excavate infested plants prior to larva vacating to pupate in the soil
Cyphocleonus	Life cycle	overwintering larva; larva; pupa; pupa/adult; adult; overwintering larva
achates	monitor	larva; larva/pupa; adult; larva
Controls	collect	adult
Knapweeds	Notes	Early adults yield more males, the ratio evens during peak, and near the end of the season there are more females present.
Galerucella	Life cycle	overwintering adult; adult; all stages; adult; overwintering adult
calmariensis	monitor	adult; egg/larva; adult
Controls	collect	adult; egg/larva; adult
P. loosestrife	Notes	Spring adults and F1 adults overlap one month oviposition in summer. Spring adults emerge one week earlier than *G. pusilla.*
Galerucella	Life cycle	overwintering adult; adult; all stages; adult; overwintering adult
pusilla	monitor	adult; egg/larva; adult
Controls	collect	adult; egg/larva; adult
P. loosestrife	Notes	Spring adults and F1 adults overlap one month oviposition in summer. Spring adults emerge one wk later than *G. calmariensis.*
Larinus	Life cycle	overwintering adult; adult; adult/larva; larva/pupa; adult; overwintering adult
minutus	monitor	adult; larva/pupa
Controls	collect	adult
Knapweeds	Notes	Females are more numerous than males, however, males live longer. Some adults hibernate a second year.

Version: April 2015

Biocontrol Agent Lifecycle Schedule

Larinus	Life cycle	overwintering adult; adult; adult/larva; larva/pupa; adult; overwintering adult
obtusus	monitor	adult; larva/pupa
Controls	collect	adult
Knapweeds	Notes	Females are more numerous than males, however, males live longer. Some adults hibernate a second year.
Larinus	Life cycle	overwintering adult; adult; larva/pupa; adult; overwintering adult
planus	monitor	adult; larva/pupa; adult
Controls	collect	adult; larva/pupa
Thistles	Notes	Mating and ovipositing occurs when temperatures reach 22 *C Flower buds need to be 5-7 mm for oviposition. One larva/bud.
Longitarsus	Life cycle	overwinter egg larva; adult; adult dormant; adult; adult/egg; overwinter egg/larva
gracilis	monitor	adult
Controls	collect	adult
Tansy ragwort	Notes	NOT PERMITTED FOR REDISTRIBUTION
Longitarsus	Life cycle	egg/larva; pupa; adult; inactive adult; adult; adult/egg/larva
jacobaeae (IT)	monitor	other; adult
Controls	collect	adult
Tansy ragwort	Notes	Applicable to *L. jacobaeae* (Italian) strain only. Monitor OTHER refers to feeding evidence (Aug/Sep).
Mecinus	life cycle	overwinter adult; adult; all stages; larva; larva/pupa; pupa; overwinter adult
janthinus	monitor	adult; larva/pupa; pupa
Controls	collect	dormant adult; adult
Toadflaxes	Notes	Adults reared on yellow toadflax are usually smaller. Cold climates cause mortality. Adults overwinter in cells inside stems.
Metzneria	Life cycle	overwintering larva; pupa; adult; all stages; overwintering larva
paucipunctella	monitor	larva/pupa; pupa; evidence*
Controls	collect	larva; larva
Knapweeds	Notes	*Discarded pupal casings can be observed as evidence inside seedheads long after the adult has exited.
Mogulones	Life cycle	overwinter - mixed stages; adult; all stages; adult; overwinter - mixed stages
cruciger	monitor	adult; larva; adult
Controls	collect	adult; adult
Hounds tongue	Notes	Summer emerging adults remain in their cocoon for 10 days to allow their bodies to harden.
Puccinia	Life cycle	overwintering spores; inoculation; recurring generations; overwintering spores
acrolopti	monitor	recurring generations
Controls	collect	recurring generations
Russian KW	Notes	The overwintering spores develop on dead leaves.

Version: April 2015

Biocontrol Agent Lifecycle Schedule

Agent	Row	Schedule (left to right)
Puccinia chondrillinia Controls R. skeletonweed	Life cycle	overwintering spores · inoculation · recurring generations · overwintering spores
	monitor	recurring generations
	collect	recurring generations
	Notes	NOT PERMITTED FOR REDISTRIBUTION. In cold climates the overwintering spores require germination to initiate further development.
Puccinia jaceae Controls Knapweeds	Life cycle	overwintering spores · inoculation · recurring generations · overwintering spores
	monitor	recurring generations
	collect	recurring generations
	Notes	NOT PERMITTED FOR REDISTRIBUTION. In dry climates, *P. jaceae* may overwinter as mycelium on rosettes or as sexual reproductive spores on alternative plants.
Puccinia punctiformis Controls Canada thistle	Life cycle	overwintering spores · inoculation · recurring generations · overwintering spores
	monitor	recurring generations
	collect	recurring generations
	Notes	NOT PERMITTED FOR COLLECTION OR REDISTRIBUTION
Rhinusa antirrhini Controls Toadflaxes	Life cycle	overwintering adult · adult · adult/larva · all stages · adult · overwintering adult
	monitor	adult · adult
	collect	adult · adult
	Notes	The life cycle for both strains of *R. antirrhini* are the same.
Rhinusa neta Controls Toadflaxes	Life cycle	overwintering adult · adult · adult/larva · all stages · adult · overwintering adult
	monitor	adult · larva/pupa · adult
	collect	adult · adult
	Notes	Spring emerging adults live until September and may mix with new adults emerging in September.
Rhinocyllus conicus Controls Thistles	Life cycle	overwintering adult · adult · larva · pupa · adult · overwintering adult
	monitor	adult · egg/larva · pupa · adult
	collect	larva/pupa · adult
	Notes	Summer adults remain in seedheads until their bodies harden.
Sphenoptera jugoslavica Controls Knapweeds	Life cycle	overwintering larva · pupa/adult · adult · larva · overwintering larva
	monitor	larva · pupa · adult · larva
	collect	adult
		Males emerge 1 wk earlier than females. Immature larva going into winter will resume feeding in the spring before they pupate
Tyria jacobaeae Controls Tansy ragwort	Life cycle	pupa · adult · adult/larva · larva · pupa
	monitor	adult · larva · other
	collect	larva
	Notes	Monitor OTHER indicates the opportunity to monitor for presence only, extensive foliar feeding is typical of T. jacobaeae

Version: April 2015

Biocontrol Agent Lifecycle Schedule

Urophora	Life cycle	overwintering larva								pupa		adult		adult/larva		larva/pupa		adult/larva		overwintering larva					
affinis	monitor								larva/pupa			adult			larva	larva/pupa									
Controls	collect											adult					larva								
Knapweeds	Notes	Only the earliest emerging larva will pupate in summer which go on to produce the second generation overwintering larva.																							
Urophora	Life cycle	larva								pupa		adult		egg/larva				larva							
cardui	monitor							larva				adult						larva							
Controls	collect							larva												larva					
Canada thistle	Notes	Larva overwinter in woody galls. Galls are collected and released intact to allow the pupa to develop.																							
Urophora	Life cycle	overwintering larva								pupa		pupa/adult		adult/larva		larva/adult		larva			overwintering larva				
quadrifasciata	monitor					larva				pupa			adult	all stages					larva						
Controls	collect							larva/pupa					adult				adult		larva						
Knapweeds	Notes	Diffuse knapweed offers better floral development for the chance of a second generation.																							
Urophora	Life cycle	overwintering larva							larva		pupa	pupa/adult		adult			larva			overwintering larva					
stylata	monitor																larva								
Controls	collect																larva								
Bull thistle	Notes	Overwinters in the third larva instar.																							

The biological control agent lifecycle schedule was developed by using British Columbia field studies and available literature sources.

Seasonal temperatures, climate change and unique habitats may alter the biological control agents' schedule.

Complete details regarding the biological control agents and their host plants can be found at: https://www.for.gov.bc.ca/hra/Plants/Agent-Plant_Matrix.htm

Version: April 2015