Attachment 2: Economic Threshold – Definition and Idaho Examples

Scouting, Forecasting, and Economic Threshold – Examples from Idaho

Scouting: Field examination using different techniques to classify the status of a pest population for decision-making purposes. Use scouting guidelines established for the specific pest and crop combinations. If no guidance is available, field sampling should be done randomly, with samples taken from across the entire field. Take at least 5 samples and preferably 25 – 30 samples per field.

Forecasting: Using information or data to predict pest problems early. Regional pest monitoring systems can complement scouting. Idaho's BEACON program, for instance, uses a regional monitoring network of insect traps that provides bean and sweet corn growers advanced warning of damage expected from the western bean cutworm. PNW Pest Alert system also provides current information on pest problems in the region. There are also models that have been developed, like the degree-day approach, which can help determine when scouting should begin, or when pesticide application will have the maximum control.

Economic Threshold: Guideline that helps identify when pesticide use is and is not necessary. The threshold is based on the cost of the control action vs. the cost of the yield loss that pest populations would inflict on the crop without control. It is also referred to as the action threshold. Control action is needed once this level is reached to prevent the pest population from increasing to a point where economic injury will occur.

Example 1: Root Maggot in Sugarbeets

Some sugarbeet growers in Idaho prefer to apply insecticides at planting time to kill the larval stage of the sugarbeet root maggot. But, the producer does not know at planting time if insecticides are needed because root maggot flies do not invade beet fields and lay eggs until after the seeds germinate and plants subsequently grow to the 6+ leaf stage.

The producer monitors (scouts) the fly populations with traps placed at field edges during April and May. Unless captures exceed 45 to 55 flies, insecticides are not needed.

Beet growers in one county who used traps eliminated 87% of their at-planting applications of insecticides without decreases in crop yield or quality.

Example 2: Russian Wheat Aphid in Barely and Wheat

Statewide networking provides producers with valuable aphid population information in advance of problems. Symptoms of injury include rolling of leaf edges and purple-reddish streaks in leaves. Winged aphids require 284 degree days to complete development. Severe infestations do not typically occur every year at all locations. In fall, 10% of seedlings infested is the economic threshold. Once plants begin to tiller, treatment is not required until 20% of tillers are infected. In the spring, a 5-10% infection rate warrants treatment. Following heading, treatment may be needed if 20% of tillers become infected. No treatment is needed after the soft dough stage. Note that delaying planting until late September helps avoid infestation, and planting in March reduces spring infestation.

Attachment 3: Idaho's Cooperative Weed Management Areas

***Source**: Idaho Department of Agriculture, Noxious Weed Program*
http://www.agri.state.id.us/Categories/PlantsInsects/NoxiousWeeds/cwmas.php

What is a Cooperative Weed Management Area (CWMA)?

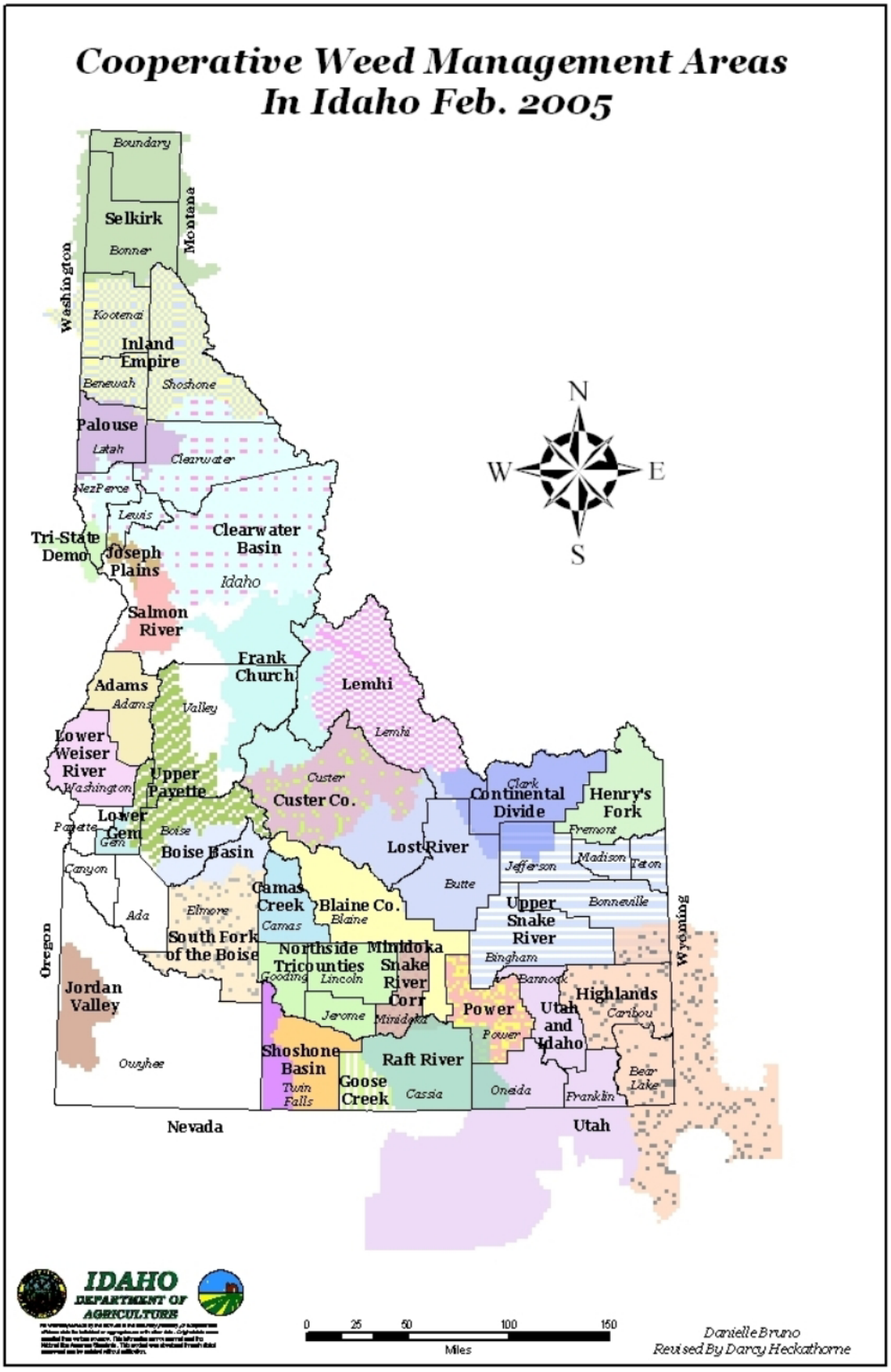
A Cooperative Weed Management Area (CWMA) is a distinguishable hydrologic, vegetative, or geographic zone based upon geography, weed infestations, climatic or human-use patterns. A CWMA may be composed of a portion of a county, a county, portions of several counties, or portions of more than one state. CWMAs are formed when the landowners and land managers of a given area come together and agree to work cooperatively to control weeds. For a CWMA to be recognized by the Idaho State Department of Agriculture (ISDA) and participate in the ISDA Cost Share Program, an Annual Operating Plan (AOP) and Integrated Weed Management Plan (IWMP) must be developed and submitted. Not all CWMAs participate in the ISDA Cost Share Program. County Weed Superintendents are often heavily involved in CWMAs and local activities.

For more information on CWMAs in your area, contact the appropriate County Weed Superintendent or the CWMA Chair.

CWMA	Chair	County Weed Superintendent	Contact Number
Adams	Julie Burkhardt	Ray McKinney Adams County	256-4437
Blaine	Sarah Michael	John Cenarrusa Blaine County	823-4017
Boise Basin	Mike Bottoms	Mike Bottoms Boise County	392-6636
Camas Creek	Carl Rey	Terry Lee Camas County	764-3512
Clearwater Basin	Leonard Lake	Denny Williams Clearwater County	476-4918
Continental Divide	Keith Bramwell	Mitch Whitmill Clark County	374-5121
Custer	Gary Chamberlain	Jim Hawkins Custer County	879-2344
Frank Church	Howard Lyman	Carl Crabtree - Idaho Mike Overaker - Lemhi John Johann - Valley Jim Hawkins - Custer	983-2667 756-2824 382-7199 879-2344

IDAHO

Henry's Fork	Bradford Orme	Dave Rydalch Fremont County	624-7442
Highlands	Farrel Hoopes	Paul Jenkins Caribou County	547-4483
Inland Empire	Nina Eckberg	Leslee Stanley Shoshone County	753-5475
Jordan Valley	Dennis Stanford	Bruce Sibert Owyhee County	337-5696
Joseph Plains	Carl Crabtree	Carl Crabtree Idaho County	983-2667
Lemhi	Mike Overacker	Mike Overacker Lemhi County	756-2824
Lost Rivers	Randy Purser	Brad Gamett Butte County	527-8587
Lower Gem	Jake Wyant	Jake Wyant Gem County	365-4201
Lower Weiser River	Dave Springer	Bonnie Davis Washington County	414-1950
Minidoka Snake River Corridor	Reid Smith	Reid Smith Minidoka County	438-8195
Northside TriCounties	Terry Ruby	Terry Ruby Gooding/ Jerome/ Lincoln Counties	934-5569
Palouse	Alan Martinson	Alan Martinson Latah County	883-7210
Power	Vince Fehringer	Curtis Munk Power County	226-7627
Salmon River	Carl Crabtree	Carl Crabtree Idaho County	983-2667
Selkirk	Sharon Sorby	Brad Bluemer Bonner County	263-3175
Shoshone Basin	Tom Williams	Kali Ruiz Twin Falls County	734-9000
South Fork of the Boise	Stacie Prow	Stacie Prow Elmore County	587-2136
Tri-State Demo.	Lynn Danley	Hugh Jacobs Nezperce County	799-3060
Upper Payette	John Johann	John Johann Valley County	382-7199
Upper Snake	Greg Hanson	Jeffery Pettingill Bonneville County	529-1397
Utah-Idaho	Jerry Hobson	David Hallinan Bannock County	234-4139


Cooperative Weed Management Areas
In Idaho Feb. 2005
Boundary
Selkirk
Bonner
Montana
Washington
Kootenai
Inland Empire
Benewah
Shoshone
Palouse
Latah
Clearwater
NezPerce
Lewis
Tri-State Demo
Joseph Plains
Clearwater Basin
Idaho
Salmon River
Frank Church
Lemhi
Adams
Valley
Lower Weiser River
Washington
Upper Payette
Custer
Custer Co.
Clark
Continental Divide
Henry's Fork
Fremont
Payette
Gem
Boise
Boise Basin
Lost River
Madison
Teton
Canyon
Jefferson
Butte
Camas Creek
Blaine Co.
Camas
Blaine
Upper Snake River
Bonneville
Ada
Elmore
South Fork of the Boise
Northside Tricounties
Gooding
Lincoln
Minidoka
Snake River Corr
Bingham
Bannock
Oregon
Jordan Valley
Jerome
Minidoka
Power
Utah and Idaho
Highlands
Caribou
Owyhee
Shoshone Basin
Twin Falls
Raft River
Goose Creek
Cassia
Oneida
Franklin
Bear Lake
Nevada
Utah
Wyoming
N
W
E
S
IDAHO
DEPARTMENT OF AGRICULTURE
0 25 50 100 150
Miles
Danielle Bruno
Revised By Darcy Heckathorne

Attachment 4: Beneficial Insects found in Idaho

***Source*: PNW Insect Management Handbook (http://pnwpest.org/pnw/insects)**

Target Pests and Commercially-Available Beneficial Organisms

Target pests	**Commercially-available beneficial organisms**	**Scientific name**
Aphids *See also* soft-bodied arthropods.)	predatory midge parasitoid wasps big-eyed bugs ladybird beetles (“ladybugs”) lacewings minute pirate bugs	*Aphidoletes aphidimyza* *Aphidius ervi, A. matricariae, A. colemani* *Aphelinus abdominalis* *Lysiphlebus testaceipes* *Trioxys pallidus* *Geocoris spp.* *Hippodamia convergens* *Harmonia axyridis* *Coleomegilla maculata* *Chrysopa spp.*, *Chrysoperla spp.* *Orius spp.*
Armyworms *See also* Butterfly and moth.)	Braconid parasitoid wasp	*Chelonus texanus*
Black fly larvae	bacterial endotoxins *Bti*	*Bacillus thuringiensis* var. *israelensis* (e.g., Bactimos, Teknar, Vectobac)
Brown garden snails/slugs (Mollusca)	predatory decollate snail	*Ruminia decollata*

Butterfly and moth larvae and eggs of beetle pests in stored grain products, such as: almond moth Indian meal moth grain weevil	parasitoid wasps warehouse pirate bug	*Bracon hebeter* *Cotesia plutellae* *Xylocoris favipes*
Butterfly and moth eggs and young larvae: cabbage looper imported cabbage worm diamondback moth corn earworm beet armyworm cutworm tomato fruitworm gypsy moth codling moth and other orchard moths pink bollworm sod webworm tobacco budworm	viral pathogen bacterial endotoxins *Btk, Bta* parasitoid wasps of eggs	Nuclear *polyhedrosis* virus (NPV) *Bacillus thuringiensis* *var. *kurstaki* (e.g., Dipel, Javelin, Attack, Thuricide, Bactospeine, Safer's Caterpillar Killer) *var. *aizawai* (e.g., Certan) *Trichogramma minutum, T. bactrae* *Trichogramma platne, T. brassicae* *Trichogramma pretiosum* *Trichogramma platneri*
Cockroach egg case (ootheca)	Eulophid parasitoid wasp	*Tetrastichoides spp.*
Codling moth larvae	granulosis virus pathogen	*Baculovirus carpocapsae*
Fire ants	parasitic mite	*Pyemotes tritici*
Fleas	parasitic nematodes	*Steinernema carpocapsae, S. feltiae*
Flies (garbage- and manure-breeding)	parasitoids of puparia Histerid beetle predator	*Tachinaephagus zealandicus* *Sphegigaster spp.* *Spalangia cameroni, S. endius* *Muscidifurax raptor* *Muscidifurax zaraptor* *Muscidifurax raptorellus* *Nasonia vitripennis* *Pachcrepoideus vindemiae* *Carcinops pumilio*
Fungus gnat (larvae)	predatory mite parasitic nematodes bacterial endotoxin *Bti*	*Hypoaspis miles, H. aculiser* *Heterorhabditis megidis, H. spp.* *Steinernema carpocapsae* *S. feltiae, S. spp.* *Bacillus thuringiensis* var. *israelensis*
General pests in the garden	praying mantid predator	*Tenodera spp.*

Grasshoppers (nymphs and adults)	protozoan	*Nosema locustae*
Gypsy moth larvae	Braconid parasitoids of the larvae viral pathogen bacterial endotoxins *Btk* and *Bta*	*Cotesia marginiventris* *Casinaria arjuna* *Nucleopolyhedrosis* virus *Bacillus thuringiensis*
Larvae and grubs that pupate in the soil: wireworms root weevils flea beetles cucumber beetles dampwood termites	parasitic nematodes of larvae	*Steinernema feltia, S. riobravis* *S. carpocapsae* *Heterorhabditis heliothidis,* *H. megidis, H. spp.* *H. bacteriophora*
Leafminers	Braconid parasitoid of larvae Chalcid parasitoid of larvae	*Dacnusa sibirica* *Diglyphus isaea*
Mealybugs: citrus citrophilus longtailed and other mealybugs other soft-bodied insects, all stages	ladybird beetle (“mealybug destroyer”) parasitoid wasp	*Cryptolaemus montrouzieri* *Leptomastix spp.*
Mites: twospotted mite *Tetranychus urticae*	predatory mites predatory six-spotted thrips minute pirate bugs big-eyed bug	*Neoseiulus californicus, N. fallacis* *Amblyseius hibisci* *Phytoseiulus persimilis, P. macrophililis, P. longipes* *Metaseiulus) Galendromus occidentalis* *Scolothrips sexmaculatus* *Orius spp.* *Geocoris*
Mosquitos (that breed in water)	predatory fish bacterial endotoxin *Bti*	*Gambusia affinis spp.* *Bacillus thuringiensis* var. *israelensis* (e.g., Dunks, Bactimos, Vectobac, Teknar)
Navel orangeworm *Paramyelois transitella* in almonds and walnuts	parasitoid wasp of larvae parasitoid wasp of eggs	*Goniozus legner* *Pentalitomastrix plethoricus*
Pink bollworm larvae	Braconid larval wasp parasite	*Microchelonus blackburni*
Scales: citrus red scale citrus yellow scale armored scale oleander scale San Jose scale ivy scale	Chalcid parasitoid wasps ladybird beetles	*Aphytis melinus* *Aphytis lingnanensis* *Comperiella bifasciata* *Chilocorus nigritus* *Lindorus lophathae*

Soft scales: citrus black scale black/brown hemispherical nigra scales *See also* soft-bodied arthropods.)	parasitoid wasp ladybird beetle	*Metaphycus helvolus* *Lindorus lopanthae*
Soft-bodied arthropods: thrips scales aphids spider mites whiteflies eggs of harmful pests	lacewing larva (in larval stage) fungal pathogen ladybird beetles minute pirate bugs	*Chrysopa carnea* (green lacewing) *Beauveria bassiana* *Chilocorus nigritus, C. baileyii* *Hippodamia convergens* *Harmonia axyridis* *Orius spp./Xylocoris flavipes*
Thrips larvae *See also* soft-bodied arthropods.)	predatory mites lacewings minute pirate bugs	*Amblyseius cucumeris, A. mckenziei, A. barkeri, A. degenerens* *Chrysoperla spp.*, *Chrysopa spp.* *Orius spp.*
Wax moth larvae (in honeycombs)	bacterial endotoxin *Bta*	*Bacillus thuringiensis* var. *aizawai* (e.g., Certan)
Weevils in landscape plants	parasitoid wasps of larvae parasitic nematodes	*Anisopteromalus calandrae* *Steinernema carpocapsae, S. feltiae, S. riobravis* *Heterorhabditis heliothidis, H. megidis*
Whitefly nymphs *See also* soft-bodied arthropods.)	parasitoid wasps of eggs ladybird beetles	*Encarsia formosa* *Eretmocerus eremicus* *Delphastus pusillus*

Flowering Plants that Attract Beneficial Insects

Common name (botanical name)	Natural enemies*
Apiaceae (Carrot Family)	
Angelica *Angelica*	ladybird beetles ("ladybugs"), lacewings
Anise *Pimpinella anisum*	parasitoid wasps
Blue Lace *Trachymene caerulea*	parasitoid wasps
Caraway *Carum caryi*	hoverflies, minute pirate bugs and big-eyed bugs, lacewings, parasitoid wasps
Chervil *Anthriscus cerefolium*	parasitoid wasps
Coriander *Coriandrum sativum*	hoverflies, parasitoid wasps, parasitoid tachinid flies
Dill *Anethum graveolens*	hoverflies, ladybird beetles, parasitoid wasps
Fennel *Foeniculum vulgare*	hoverflies, parasitoid wasps, parasitoid tachinid flies
Lovage *Lovisticum officinale*	parasitoid wasps
White Lace Flower *Ammi majus*	hoverflies, predatory bugs, ladybird beetles, parasitoid wasps, parasitoid tachinid flies
Wild Carrot *Daucus carota*	hoverflies, predatory bugs, ladybird beetles, lacewings, parasitoid wasps
Asteraceae (Daisy Family)	
Blazing Star, Gayfeather *Liatrus sp.*)	minute pirate bugs, big-eyed bugs, parasitoid wasps
Chamomile *Anthemis nobilis*	ladybird beetles
Cosmos *Cosmos bipinnatus*	hoverflies, lacewings, minute pirate bugs
Golden Marguerite *Anthemis tinctoria*	ladybird beetles, parasitoid wasps, parasitoid tachinid flies
Goldenrod *Solidago altissima*	soldier beetles, predatory bugs, ladybird beetles, parasitoid wasps
Marigolds, signet *Tagetes tenuifolia*	minute pirate bugs, parasitoid wasps
Mexican sunflower *Tithonia tagetifolia*	hoverflies, minute pirate bugs
Sunflower *Helianthus annuus* and *H. debilis*	hoverflies, ladybird beetles, parasitoid wasps
Tansy *Tanecetum*	hoverflies, ladybird beetle larvae, parasitoid wasps
Yarrow, milfoil *Achillea millefolium*	hoverflies, parasitoid wasps
Yarrows *Macrophylla, taygetea,* etc.)	hoverflies, parasitoid wasps
Common name (botanical name)	**Natural enemies***

Brassicaceae (Cabbage Family)	
Broccoli *Brassica oleracea*	hoverflies, parasitoid wasps
Sweet alyssum *Lobularia maritima*	hoverflies, parasitoid wasps, parasitoid tachinid flies
Candytuft *Iberis umbellata*	hoverflies
Mustards *Brassica hirta* and *B. juncea*	hoverflies, minute pirate bugs, big-eyed bugs
Dipsaceae (Scabiosa Family)	
Cephalaria *Cephalaria giganitica*	hoverflies, parasitoid wasps
Dipsacus *Dipsacus spp.*)	hoverflies
Pincushion flower *Scabiosa caucasica*	hoverflies, parasitoid wasps
Scabiosa *Scabiosa atropurpurea*	hoverflies
Fabaceae (Legume Family)	
Alfalfa *Medicago sativa*	bees, predatory bugs, lacewings, ladybird beetles, parasitoid wasps
Clover *Trifolium spp.*)	bees, predatory bugs, lacewings, ladybird beetles
Vetch *Vicia spp.*)	bees, predatory bugs, lacewings, ladybird beetles
Hydrophyllaceae (Waterleaf Family)	
Fiddleneck/Phacelia *Phacelia tanacetifolia*	bees, predatory bugs, hoverflies
Polygonaceae (Buckwheat Family)	
Buckwheat *Eriogonum spp.* and *Fagopyrum spp.*)	hoverflies

* - Ladybird beetles include many species in the Family Coccinellidae, Order Coleoptera.
- Lacewings include many species in the Families Chrysopidae and Hemerobiidae, Order Neuroptera.
- Parasitoid wasps include a large number of species in Families such as Aphelinidae, Aphidiidae, Braconidae, Chalcidae, Encyrtidae, Eulophidae, Ichneumonidae, Mymaridae, Pteromalidae, Scelionidae, and Trichogrammatidae, Order Hymenoptera.
- Hoverflies include many species in the Family Syrphidae, Order Diptera.
- Predatory bugs include many species in Families such as Anthocoridae, Lygaeidae, Nabidae, Pentatomidae, and Reduviidae, Order Hemiptera.
- Minute pirate bugs include many species in the Family Anthocoridae, Order Hemiptera.
- Big-eyed bugs include many species in the Family Lygaeidae, Order Hemiptera.
- Parasitoid tachinid flies include many species in the Family Tachinidae, Order Diptera.
- Bees include many species in Families such as Anthophoridae, Apidae, Halictidae, and Megachilidae, Order Hymenoptera.

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Attachment 5: Biological Control Agents Used in Idaho

***Source*: USDA-ARS**
http://www.ars.usda.gov/SP2UserFiles/Place/53254300/Reports/USA-BCW(forpdf)v5.pdf

Biological Control Agents

Weeds – Approved Biological Agents tested in Idaho

Invasive Weed	Biological Agent	Type	Result
Bachelor's button	Chaetarellia australis	Seed head fly	Widespread over host range
Scotch broom	Bruchidius villosus	Seed beetle	Released, unknown coverage
Halogeton	Coleophora parthenica	Stem boring moth	Failed
Brown knapweed	Urophora quadrifasciata	Seed head gall fly	Released, unknown coverage
Diffuse knapweed	Bangastermus fausti	Seed head weevil	Released, unknown coverage
	Pterlonche inspirsa	Root boring moth	Failed
	Sphenoptera jugoslavica	Root boring beetle	Widespread over host range
	Urophora offinus	Seed head gall fly	Widespread over host range
	Urophora quadrifasciata	Seed head gall fly	Widespread over host range
Spotted knapweed	Agapeta zoegana	Root boring moth	Limited coverage over host range
	Bangesternus fausti	Seed head weevil	Released, unknown coverage

	Cyphocleonus achates	Root boring weevil	Established over host range
	Larinus minutus	Seed head weevil	Limited coverage over host range
	Larinus obtusus	Seed head weevil	Released, unknown
	Metzneria paucipunctella	Seed head moth	Widespread over host range
	Urophora affinus	Seed head gall fly	Widespread over host range
	Urophora quadrifasciata	Seed head gall fly	Widespread over host range
Purple loosestrife	Galerucella calmariensis	Defoliating beetle	Limited coverage over host range
	Galerucella pusilla	Defoliating beetle	Limited coverage over host range
	Hylobius transversovittatus	Root weevil	Released, unknown
	Nanophyes marmoratus	Flower bud weevil	Established over host range
Puncture vine	Microlarinun lareynii	Stem boring weevil	Failed
	Microlarinun lypriformis	Seed weevil	Failed
Mediterranean sage	Phrydiuchus tau	Crown/root weevil	Widespread over host range
St. Johnswort	Agrilus hyperici	Root boring beetle	Widespread over host range
	Aplocera plaginata	Defoliating moth	Widespread over host range
	Chrysolina hyperici	Defoliating beetle	Widespread over host range
	Chrysolina quadrigemina	Defoliating beetle	Widespread over host range
	Chrysolina varians	Defoliating beetle	Failed
	Zeuxidplosis giardia	Bud gall midge	Failed
Rush skeleton weed	Bradyrrhoa gilveolella	Root boring moth	Released, unknown
	Cystiphora schmidti	Stem/leaf gall midge	Widespread over host range
	Eriophyes chondrillae	Bud gall mite	Widespread over host range
	Puccinia chondrillae	Leaf rust fungus	Widespread over

			host range
Leafy spurge	Aphthona cyparissiae	Root/defoliating beetle	Limited coverage over host range
	Aphthona czwalinae	Root/defoliating beetle	Limited coverage over host range
	Aphthona flava	Root/defoliating beetle	Limited coverage over host range
	Aphthona faceitosa	Root/defoliating beetle	Limited coverage over host range
	Aphthona nigriscutis	Root/defoliating beetle	Limited coverage over host range
	Chamaesphecia crassicornis	Root boring moth	Failed
	Chamaesphecia empiformis	Root boring moth	Failed
	Chamaesphecia tenthrediniformis	Root boring moth	Failed
	Hyles euphorbiae	Defoliating moth	Established over host range
	Oberea erythrocephala	Root boring beetle	Released, unknown
	Spurgia esulae	Shoot tip gall midge	Limited coverage over host range
Yellow starthistle	Bangesternus orientallis	Seed head weevil	Widespread over host range
	Chaeforeillia australis	Seed head fly	Widespread over host range
	Eustenopus villosus	Seed head weevil	Widespread over host range
	Larinus curtus	Seed head weevil	Widespread over host range
	Urophora jaculata	Seed head gall fly	Failed
	Urophora sirunaseva	Seed head gall fly	Widespread over host range
Canada thistle	Altica carduroum	Defoliating beetle	Failed
	Ceutorhynchus litura	Crown/root weevil	Limited coverage over host range

	Rhinocyllus conicus	Seed head weevil	Limited coverage over host range
	Urophora cardui	Stem gall fly	Released, unknown
Musk thistle	Rhinocyllus conicus	Seed head weevil	Widespread over host range
	Trichosirocalus horridus	Crown/root weevil	Widespread over host range
Plumeless thistle	Rhinocyllus conicus	Seed head weevil	Widespread over host range
Russian thistle	Colephora klimeschiella	Leaf mining moth	Widespread over host range
	Colephora parthenica	Stem boring moth	Widespread over host range
Dalmatian toadflax	Brachypterolus pulicarius	Flower beetle	
	Calophasia lunula	Defoliating moth	
	Mecinus janthinus	Stem boring weevil	

Typical Biological Control Agents for Insects – "Beneficials"

Parasitoid
- Certain types of wasps
- Certain types of flies

Predators
- Lady beetles, various types
- Lacewings
- Bigeyed bug
- Pirate bug
- Soldier bug
- Certain midges
- Certain mites

Pathogens
- Various bacteria, fungi, viruses, nematodes

Attachment 6: Integrated Pest Management – Idaho Example

Source: University of Idaho Extension, *The Role of Integrated Pest Management,* E. J. Bechinski, R. L. Mahler, and H. W. Homan

http://www.uidaho.edu/wq/wqpubs/cis938.html

Russian Wheat Aphids

Pest management for Russian wheat aphids starts at planting time with cultural methods. Idaho farmers break the aphid infestation cycle by planting fall-seeded wheat and barley as late as feasible. This tactic allows the crop to escape pest colonization by avoiding incoming flights of aphids that occur when summer crops are harvested. The reverse (plant as early as possible) is true for spring-seeded crops. Early plantings allow wheat and barley plants to develop beyond the highly susceptible seedling stage before aphids arrive.

Field selection also can contribute to Russian wheat aphid suppression. Here the idea is to avoid planting cereal crops in fields immediately adjacent to rangeland or large grassy expanses. These areas can serve as reservoirs where aphids survive and multiply during the summer dry season from crop harvest until the next crop is planted.

Aphid-resistant wheat and barley varieties are still in the research and development phase. In addition, work is continuing on the importation and release of exotic parasitic wasps and lady beetles for Russian wheat aphid control and on use of aphid-killing fungi as a biological insecticide.

Insecticides for Russian wheat aphid control can be applied according to two strategies; by incorporating insecticides into the soil at planting time or by spraying them over the top of rows later during the growing season. Rather than automatically apply pesticides, Idaho wheat and barley growers use scouting and forecasting to decide if pesticides really are needed. The need for insecticides at planting time can be gauged from a statewide network of traps that monitor aphid flights. Use of insecticides at planting is recommended only if aphid flights are heavy and planting dates cannot be changed to avoid incoming aphids.

Later during the growing season farmers can scout fields using a system of decision cards (fig. 4) that quickly and accurately identify fields requiring treatment. Because Russian wheat aphid infestations often begin at field edges, spot-spraying a 50-foot-wide strip along the fencerow (versus broadcast application over the entire field) may be all that is required. Spot spraying has the added benefit of allowing biological control agents to survive in unsprayed portion of the field.