

BIOLOGICAL CONTROL OF PESTS IN FOREST NURSERIES¹

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Most major insect pests have developed resistance to the pesticides now available and new pesticides are facing increased costs and legislated restrictions. These, coupled with increased worker and consumer health concerns and possibilities of environmental contamination, have resulted in increased interest in biological pest control applications. The term biological control as used here refers to the use of living organisms to control plant pests. This is a very active and growing area and is being applied in increasing numbers of commercial applications in North America and Europe. The following programs have been developed in North America and Europe to use biological control agents to limit many common pests found in nurseries. Integrated pest management using biological control requires knowledge of the pest life cycle, careful monitoring to determine pest threshold levels, modification of spray programs to avoid harm to the biocontrol agent and a slightly different way of thinking about insect pests, parasites and predators. The rewards are better pest control, healthier plants, lower pesticide inventories, reduced health and environmental hazards and happier employees.

IMP PROGRAMS USING BIOLOGICAL CONTROL FOR NURSERY PESTS.

The programs that follow are only general guidelines that have been used with success in Canada. An IPM program must be custom designed for each different crop and greenhouse or farm situation. This should be done initially before purchasing the biocontrol products and then in ongoing consultation with the biocontrol producer, supplier or IPM advisor.

Fungus Gnats (*Bradysia sp.*)

Root damage by fungus gnats can spread disease to healthy roots and if common can cause losses of 20-40 percent of plants in early propagation stages. Excellent preventive control of fungus gnats can be obtained with early applications of the predatory mite *Hypoaspis miles*. This predator also feeds on spring tails, thrips and other small soil organisms. If fungus gnats are established on the crop and appearing in high numbers, beneficial nematodes or the new fungus gnat (Bt) may be also applied for control of the larval stages. Improve drainage and avoid over watering to limit algal growth and sites for fungus gnat and shore fly breeding. Algae may also be controlled with algacides such as Agribrom.

1. Apply *Hypoaspis* predatory mites onto all plants during early propagation. Use a general preventive rate of 30 predators per square meter of planted area. Apply weekly in the propagation area and other areas where fungus gnats are a problem.
2. Monitor plants for adult fungus gnats weekly using 1 yellow sticky trap per every 500 square meters. If adult fungus gnat counts are above 20/trap/week, treat area with parasitic nematodes or fungus gnat Bt formulations using the recommended rates. Repeat these treatments weekly until the adult fungus gnat numbers are below 20/plant. This treatment will not harm other biocontrol agents.

Spider Mite

Very good control of mites has been achieved on many species of woody ornamental shrubs in British Columbia using the predatory mite *Amblyseius fallacis*. Two new predators, the beetle *Stethorus punctillum* and midge, *Feltiella acarisuga* are also now available and are being used experimentally.

1. Apply *Amblyseius fallacis* onto all spider mite sensitive ornamental plants during propagation or when setting them out in cold frames or the field. Use a general rate of 3 predators per square meter of infested plant area repeated weekly for 3 weeks if spider mite are present.
2. Monitor these plants weekly to check spider mite levels. If mites are building up or causing webbing apply fenbutatin-oxide (Vendex™, Torque™) through a high volume sprayer. This will not harm predatory mites. Avoid the use of any other miticide or pesticide unless known to be safe for biological control agents.
3. Where there are species of plants that are very attractive to mites the new predatory beetle, *Stethorus punctillum* and the predatory midge, *Feltiella acarisuga* may be released. Release 100 adult beetles or 100 midges into each infested plant site. Make weekly introductions for 3 weeks. These biological controls can fly and feed on all stages of spider mite and will reproduce and remain in the area for more than one season. *Feltiella* will only establish if humidities are 65 percent or higher.

¹Elliott, D. 1999. Biological control of pests in forest nurseries. In: Landis, T.D.; Barnett, J.P., tech. coords. National proceedings: forest and conservation nursery associations—1998. Gen. Tech. Rep. SRS-25. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 141-143.

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Aphids (Many Species)

There has been excellent success treating aphid infestations in nurseries with biological control agents. In fact, if biological control agents are introduced in open screen houses and field settings, it is usually unnecessary to apply pesticides for most species of aphids. Unfortunately, protected or gall forming aphids are not controlled by biological control agents that are presently available from commercial suppliers.

1. At the first sign of aphids, apply the *Aphidoletes* aphid predatory midge at the rate of 2 predators per square meter of infested area, repeated weekly for 3 weeks. These biocontrols can fly and feed on all stages of most species of aphids and will reproduce and often overwinter and remain in the area providing control for more than one season.
2. At the first sign of aphids, apply the aphid parasite, *Aphidius* at a rate of 1 parasite for every 2 square meters of infested area, repeated weekly for 3 weeks. Three weeks after release look for signs of parasites in the form of parasitized aphid mummies attached to the leaves.
3. If aphid hot spots are building up apply the Ladybeetle, *Harmonia axyridis* at the rate of 1 per plant in the infested area repeat this treatment in 2 weeks.
4. Monitor plants weekly, if aphid hot spots continue to develop and there is plant damage, spot spray with pirimocarb (Pirimore™) or Insecticidal Soap. This will cause minimal harm to the biologicals. Avoid the use of other pesticides unless determined to be safe for biological control agents.

Caterpillars (Lepidopteran larvae)

Caterpillar damage may be controlled by releasing the commercially available moth egg parasite *Trichogramma* spp. or sprays containing the spores and insecticidal crystals of strains of *Bacillus thuringiensis* (Bt). A new larval parasite, *Cotesia marginiventris*, is also available for experimental use. *Cotesia* attacks a wide range of hosts and is a natural enemy of 21 different Lepidopteran species.

1. Monitor planted area for adult moths using pheromone traps or ultra violet light traps.
2. Release *Trichogramma* egg parasites as soon as adult pest moths are detected at rates of 50,000-100,000/acre or as advised by the supplier.
3. Release *Cotesia* parasites as soon as larvae are found on plants at weekly rates of 1 parasites per square meter of infested area. If there is more than 1 caterpillar for every 10 plants apply Bt sprays as well.
4. Bt is usually applied as a high volume spray at first sign of larval damage. Follow the formulators recommendations for rates.

Vine Weevil (*Otlorhynchus sulcatus*)

The vine weevil can cause serious harm to nursery plant roots and the adult also feeds on leaves. Unfortunately root weevils are all female do not require mating and can lay up to 1000 eggs each! Adults are also flightless, are most active at night and they can walk as far as 1000 metres per day. Adults lay eggs in the root ball and both larvae and adults continue feeding at temperatures as low as 2°C. As many as 400 weevils have been found in a single 2 gal. container root ball. A nematode is available as a biological control agent of this pest. Nematodes are most effective when applied into potted plants under warmer growing conditions in greenhouses or when soil temperatures are greater than 12°C. Nematodes are mixed with water and applied as a drench. Nematodes in the *Heterorhabditis* group have been found more effective than other types against vine weevil.

1. Monitor plants weekly for damaged leaves and check the root ball of wilting plants for weevil larvae causing root damage.
2. Apply nematodes to the root zone following label recommendations. Apply 2-3 treatments at weekly intervals. Spring and Fall applications are best as most adult weevils are in the soil at this time. Treated plants should be watered before treatment and kept moist as the nematodes can only move through moist substrates. Do not overwater treated plants as this will wash away nematode larvae. Nematode biocontrols are resistant to Orthene and it may be applied as well where necessary.

Biocontrol of *Lygus* Bug?

At the moment there is no commercially available biocontrol for *Lygus* Bug and the only control method is excluding by screening vent openings or use of pesticides. Entomologists at Agriculture Canada are investigating the use of parasites for biological control of *Lygus*. Cornell University is experimenting with the fungus, *Beauveria bassiana*, a microbial biocontrol that is now available in the USA. Work is also being done at Simon Fraser University on *Lygus* attraction or mating disruption pheromones and this may have direct application to nursery IPM.

IPM SUMMARY FOR NURSERY PESTS

Fungus Gnats	Yellow sticky traps	Use 1 trap/500m ² for monitoring adults	Aphids (many species)	<i>Aphidoletes aphidimiza</i>	Preventative and curative 2 predators/m ² of infested area repeated weekly for 3 weeks
	<i>Hypoaspis miles</i>	Apply once at planting or transplanting or if fly trap counts are below 20/trap/week 15,000/100m ² or 30/pot (1tsp)		<i>Aphidius</i> spp.	Preventative and curative 1 parasite/2m ² of ingested area repeated weekly for 3 weeks
	<i>Steirnernema feltiae</i> (Microkil™)	Apply at least 2X at 2 week intervals if fly trap counts are above 20/ trap/week rate- 50,000,000/250m ² or as recommended		<i>Harmonia axyridis</i>	1/plant in infested area repeated in 2 weeks
	<i>Bacillus thuringiensis israelensis</i> (Vectobac™)	Apply weekly if fly trap counts are above 20/ trap/week rate- 4-8 litres/1000 litres of water		Pirimicarb (Pirliss™ 50DF)	500g Pirliss 50DF/1000 litres water or as directed moderately harmful to biologicals so apply at low rate to tops of plants only or use only in hot spots
	Bromide(Agribrom™)	Apply with irrigation to control algae 10-15 ppm bromine or as directed		Insecticidal soap (Safer's Soap™)	1part soap/100 parts water of use low rate moderately harmful to biologicals so apply to tops of plants only or use only in hot spots
Spider Mite (<i>T.urticae</i>)	<i>Amblyseius fallacis</i>	Preventative and low curative 3 predators/m ² repeated weekly for three weeks when mites are detected	SOURCES OF BIOLOGICAL CONTROL PRODUCTS: The following is a partial list of biological control and IPM product suppliers. There are now more than 130 different species of beneficial organisms for sale in North America. An electronic data base of suppliers with information on IPM may be accessed through the internet at: http://www.cdpr.ca.gov/docs/dprdocs/goodbug/organism.htm		
	<i>Stethorus Punctillum</i>	Preventative and low curative 100/infested site/weekly for 3 weeks	Canada		
	<i>Feltiella acarisuga</i>	Preventative and low curative (requires Rh+65) 100/infested site/weekly for 3 weeks	Westgro Sales Inc. 7333 Progress Way, Delta, B.C. (604) 940-0290		
	fenbutatin oxide (Vendex 50W™)	500g-1Kg Vendex 50W/ 1000 litres water	Plant Products Co. Ltd. 314 Orenda Road, Brampton, On. (905) 793-7000		
Vine Weevil	<i>Heterorhabditis megidis</i> (Nemasys™)	Soil temperature must be 12°C or greater most effective in pot or container culture apply as a soil drench as directed (eg.) 50,000,000/250m ²	Plant Product Quebec 3370 Le Corbusier, Laval, Que. (450) 682-6110		
Caterpillars (many species)	Pheromone traps Ultraviolet light traps	Use 1 trap/50000m ² for monitoring adults	U.S.A.		
	<i>Trichogramma brassiere</i>	Egg parasites should be released as soon as pest adult moths are detected, release 50,000-100,000 parasites/acre weekly for 3 weeks or as advised by supplier	The Green Spot Ltd. 93 Priest Road, Nottingham, N.H. (603) 942-8925		
	<i>Bacillus thuringiensis var.kurstaki</i> (Dipel™)	Apply as a high volume spray at first sign of larval damage at recommended rates (eg.) 1.2Kg. Dipel/1000 liters of water.	Rincon Vitova Inc. 3891 North Ventura Ave., Ventura, Ca. (805) 643-5407		
			I.P.M. Laboratories Inc. Main Street, Locke, N.Y. (315) 497-2063		
			Evergreen Growers Supply 17492 S. Eaden Rd., Oregon City, Or. (503) 631-7954		