PEST MANAGEMENT

Integrated Pest Management

Integrated Pest Management (IPM) is the system of crop production that effectively manages pests using a combination of tools –cultural, biological or chemical – in ways that are economically and environmentally sound.

IPM programs consider both plant health care and pest management while minimizing harmful impacts on the environment. They aim to create conditions that are optimal for the crop and less favourable for pest development. Strong and healthy plants usually have the best chance to resist pests.

IPM programs develop over time. Researchers and extension specialists work to increase knowledge about how pests, plants and the environment affect one another. Farmers and pest management consultants help to create effective IPM programs for specific fields, with good observations and careful recordkeeping.

Steps in an IPM program are:

1. Identifying and understanding the pests
2. Regular monitoring
3. Deciding when to control pests
4. Choosing control methods
5. Evaluating the effectiveness of the program

Identifying and Understanding the Pests

The first step is to properly identify the pest. Use information on how the pest, crop and environment affect one another to help develop a control strategy. Find out what the pest needs to survive, what conditions promote its development and population increase, and if there are any organisms that eat or parasitize the pest.

Understand the pest's life cycle. Most pests have a developmental stage when control measures are most effective. Try to time control measures with that susceptible stage.

This production guide gives information on the most common pests found on berry crops in BC. Other resources are listed in "Useful Publications".

Regular Monitoring

Scout or monitor the crop regularly to check for potential pest problems. This is the best way to know when to apply control measures. Collect the following information:

- the pests and numbers present, and the stage of development,
- the beneficials present and their numbers,
- the crop vigour,
- an assessment of the crop damage, and
- weather conditions and other environmental conditions affecting the pests.

Each berry field should be checked as conditions vary between fields. Monitoring must be done regularly. Start monitoring fields at least once per week. Increase monitoring to twice-weekly when pests are more active. Most monitoring for berry insect and mite pests is done by counting the pests. A 10x hand lens helps to count small pests like mites. Some insects, like weevils and lady beetles, are easily counted by placing a drop sheet or "beating tray" under the plants and shaking the bushes. This disturbs the insects and they drop onto the sheet for counting. Keep good records – this is essential for making the best control decisions and evaluating their effectiveness.

Monitoring can be done by the grower, by an employee or by a hired pest management consultant. Monitoring services are available for some berry crops on a fee basis to Fraser Valley and Vancouver Island growers.

Table 1. Insect pests and damage for crop monitoring

INSECTS AND DAMAGE	Aphids	Caterpillars	Crown Borer	Leafhoppers	Lygus bugs	Spider Mites	Strawberry Mites	Sawflies	Scales	Thrips	Weevils	Slugs & Snails
Insects on undersides of leaves	✓	✓				✓		✓		✓		
Speckled damage on leaves				✓		✓				✓		
Insects move about in flowers when blown upon					✓					✓		
Insects will fall into a pan when flower stems are tapped					✓					✓		
Damaged flower buds and growing points	✓	✓			✓	✓	✓	✓		✓		
Dark fecal spots on leaves		✓						✓		✓		✓
Transparent skins on leaves	✓											
Honeydew and sooty mould	✓			✓					✓			
Insects clustered on stems	✓								✓			
Notched leaves		✓									✓	✓
Holes in leaves		✓										✓
Slime trails												✓
Skeltonized leaves		✓						✓				✓
Webbing		✓				✓						
Swelling or galls on crown			✓									
Hiding under boards and plant debris												✓
Eggs on undersides of leaves		✓	✓									

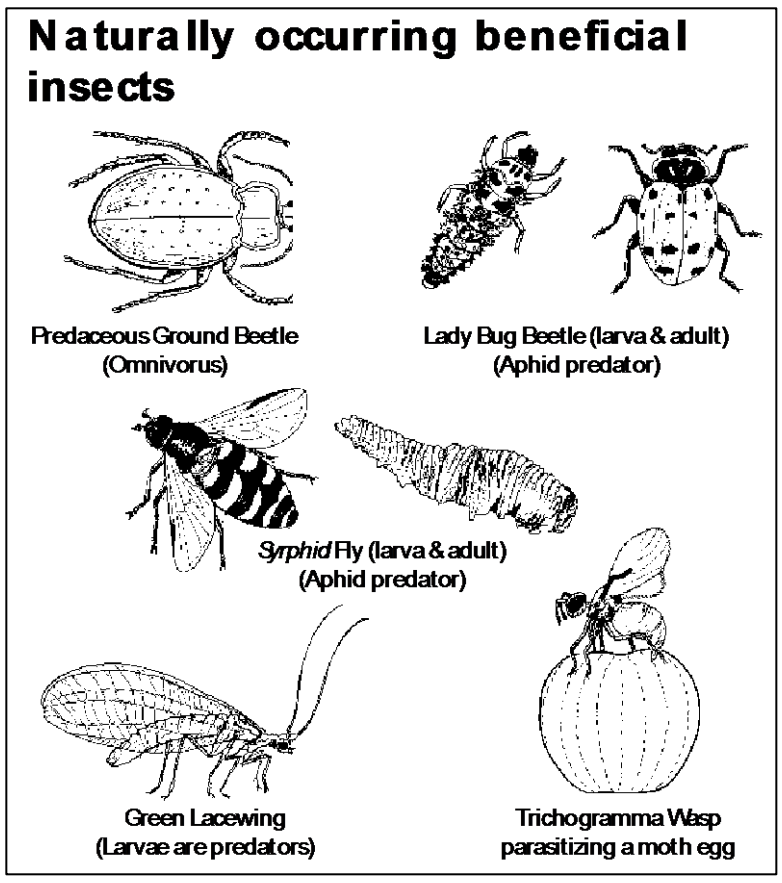
Deciding When to Control

Decide to control pests using the information collected from monitoring. Also consider the crop stage and susceptibility, pesticide restrictions and personal field knowledge.

Finally, compare the cost of controlling a pest with the economic losses if the pest is not controlled. Ideally, pests are controlled just before they reach a level that causes unacceptable economic damage (economic threshold). However, these thresholds are often site-specific and/or have not been determined for most pests attacking berry crops. In these situations, use IPM information and past experiences to make control decisions.

Choosing Control Methods

The different types of control methods used in an IPM system are cultural, biological and chemical. Good cultural and biological methods promote strong plants and provide unsuitable environments for pests. Sometimes pesticides are needed to keep crop losses low.



Cultural Control

These methods prevent pests from establishing. They include avoiding sites good for pests, selecting varieties resistant to pests, planting cover crops that shelter beneficial insects and compete with weeds, pruning to remove diseased branches and planting certified transplants. Cultural methods such as tillage, hand weeding, burning and mowing eliminate or reduce pests.

Biological Control

Biological control uses natural enemies to control pests. Natural enemies of insect pests are predators and parasites. These are also called "beneficials".

Predators eat pests. Important beneficial predators on berry crops include ladybird beetles and larvae, lacewing larvae, syrphid fly larvae and ground beetles.

Parasites live in or on a pest. They weaken and finally kill the pest. Parasites are often too small to be seen, but are extremely important in keeping pest populations down. Important pest parasites include the Ichneumonid wasps which parasitize caterpillars and the Braconid wasps which parasitize aphids and other pests.

Some microorganisms, such as bacteria and fungi, are important in reducing populations of disease-causing organisms. Healthy soils often have strong populations of "good" microorganisms. Researchers are learning to grow and use the "good" bacteria and fungi for disease management.

Monitoring and managing beneficials is an important part of an IPM program. Beneficial insect populations can be enhanced by:

- Releasing beneficials when natural populations are low. For example, ladybird beetles can be purchased and released in blueberry fields to control aphids, or *Ambylseius* for mite control in strawberries.
- Providing shelters that attract beneficial insects. For example, building nesting sites for wild pollinators.
- Applying pesticides only when needed. Once pests are killed, the beneficials do not have a food source. The beneficials then take a longer time to build up.
- Timing pesticide applications to have the least impact on beneficial insects.
- Choosing pesticides that have little effect on beneficials and still give pest control. For example, Foray 48B (Bt) is the best control of leafrollers on blueberries because it will not harm beneficials.

Chemical Control

This includes the use of pesticides and pheromones. Pesticides are used as needed in an IPM program rather than on a calendar date. Consider the following when using pesticides:

- **Economics.** Compare the economic benefit expected from the pesticide application with the costs of control. To estimate the benefit of control, predict the crop loss if no pesticide is used. This can be difficult to determine, especially where weather conditions will affect the growth of the pest. Direct costs of a pesticide application include the pesticide, sprayer wear, and labour cost for application and clean-up. Indirect costs include potential hazards to humans and the environment.
- **Registration.** Make sure the crop and pest are listed on the pesticide label. Use the rate on the pesticide label. Field tests were done to determine the best rate.
- **Effectiveness and pest resistance.** Choose the most effective pesticide. Do not always use the same pesticide. To help prevent pest resistance, alternate pesticides. Use pesticides with different modes of action and only use pesticides when needed. Make sure the rate used kills the pest. Avoid using pesticides that persist in the environment.
- **Impact on the environment.** Pesticides can contaminate surface or groundwater. The risk of leaching is greater with pesticides that are highly soluble in water (above 30 ppm) and with pesticides that breakdown slowly in the soil.
- **Impact on non-target organisms.** Protect non-target organisms. Use pesticides with low toxicity. When natural enemies of pests are present, do not use broad spectrum insecticides unless there are no alternatives. These insecticides will kill the beneficial insects. Some fungicides are also a threat to beneficial insects. See Table 2 for pesticide toxicity to beneficials.

- **Timing pesticide applications.** For the most effective control, base application timing on crop or host plant development, susceptible pest stage, ratio of beneficials to pest, environmental conditions, and established threshold levels.
- **Application methods.** Know where the pest is and aim the pesticide application in that area. For example, some weevils can be effectively controlled by applying some pesticides only to the lower portion of the plant. Mite populations in strawberries are usually highest on the underside of lower leaves—arrange spray nozzles so sprays are directed upwards from below the canopy for effective coverage. Root rot fungi live in the soil–target fungicides at the root zone for the best effect.

Table 2. Pesticide toxicity to beneficial insects and aquatic life

Pesticide	Predatory Mites	Predatory Insects	Parasitic Insects	Bees	Aquatic Life
Admire, Alias	M	H	H	H	H
Actara	M	H	H	H	H
Actinovate	L	L	L	L	L
Agri-mek	H	M	H	H	M
Aliette	L	L	L	L	L
Allegro	-	-	-	-	L
Apollo	M	L	L	L	L
Bravo	L	L	L	L	H
Cabrio	L	L	L	L	H
Captan	L	L	L	L	H
Copper	L	L	L	L	L
Cygon	H	H	H	H	H
Decis	H	H	H	M	M
Delegate	L-H	L-H	M	M-H	M
Diazinon	M	H	H	H	M
Dibrom	H	H	H	H	H
DiPel	L	L	L	L	L
Elevate	L	L	L	L	M
Ferbam	L	L	L	L	M
Folpan	L	L	L	L	H
Foray	L	L	L	L	L
Fulfill	L	L	L	L	L-M
Funginex	M	L	L	M	L
Furadan	H	H	H	H	H
Guthion	H	H	H	H	H
Imidan	H	H	H	H	H
Insecticidal Soap	L	M	M	L	L
Kelthane	M	L	L	L	M
Lagon	H	H	H	H	H
Lance	L	L	L	L	M
Maestro	L	L	L	L	H
Malathion	H	H	H	H	H
Matador	M	H	H	M	H
Mission	L	M-H	L-M	L	M
Nova	L	L	L	L	M
Orthene	H	H	H	H	L
Pirimor	M	M	M	M	M
Pristine	L	L	L	L	H
Pyramite	H	H	H	M	M
Ridomil	M	M	M	L	L
Ripcord	H	H	H	H	M
Rovral	L	L	L	L	M
Scala	L	L	L	L	L

Senator	M	L	L	L	H
Serenade Max	L	L	L	L	L
Sevin	M	H	H	H	M
Sniper	H	H	H	H	H
Sulphur	L	L	L	L	L
Switch	M	L-H	L	L-M	H
Tanos	L-H	M-H	M-H	M-H	H
Thiodan	M	H	M	M	M
Thiram	L	L	M	L	H
Topas	L	M-H	L-M	L	M
Vydate	H	H	H	M	M
L = Low Hazard M = Moderate Hazard H = High Hazard					

For Bees:

- H = Do not apply to flowering crops or weeds
- M = Apply only during late evening or early morning
- L = can be used with few precautions with minimum injury to bees

Sources:

- *Integrated Pest Management for Strawberries*. University of California
- Applied Bionomics Ltd., Biological Technical Manual
- BCAGRI trials
- Meister Crop Protection Handbook 2005
- Biobest Biological Systems at http://www.biobest.be/ (June 2006)
- Koppert at http://www.koppert.nl/e0110.html (June 2006)
- The Pesticide Manual, 2000 (British edition)
- Product Labels

Evaluating the Effectiveness of the Program

Keep good records. They help to evaluate IPM programs. Records should include the regular monitoring records plus information gathered on pest control methods, weather, cropping practices and yields. Once the cropping season is over, review this information to decide how to improve the IPM program for the next year.

Weeds

Preventive Control

Prevent the introduction of new weeds and prevent weeds from setting seed. Many common weeds produce more than 20,000 seeds per plant. Use the following guidelines to avoid introducing weeds to berry fields:

- Use clean certified seed for cover crops. In the long run, cheap seed is usually the most expensive.
- Clean all chaff and mud from machinery.
- Use only well rotted manure.
- Practice total farm weed control by controlling weeds on fencelines, irrigation ditches, farm roads and around stockyards, buildings and equipment storage areas.

Cultural Control

- Till to prevent seed production and deplete seed reserves in the soil and root reserves of perennial weeds.
- Hand pull small weed patches.
- Mow to prevent seed production and weaken perennial roots.
- Practice crop rotation to discourage competition by one weed type. Repeated planting of the same crop favours development of insects and diseases. This leads to weak or patchy stands which are easily invaded by weeds.
- Encourage maximum crop competition by choosing well-adapted varieties and good management of soil fertility and soil-water factors.

Chemical Control

Some herbicides are selective because of plant tolerance or sensitivity. Other herbicides are non-selective in that they kill all plants. To be effective, some are applied to the soil and others to the plant foliage. Some of the ones that are applied to the leaves kill by contact. Others kill by entering the plant tissue and upsetting growth. See "Weeds" in each crop section for specific recommendations.

Follow these guidelines for the best herbicide results:

- Use recommended crop management practices such as well-timed cultivation, good pre-plant field preparation, and appropriate fertilizing practices.
- Learn to identify weeds. Weed species determine the herbicide to use. Barnyard grass is resistant to low rates of simazine. Shepherd's-purse is resistant to Treflan (trifluralin). Choose the chemical and method most effective for the weed present in the crop concerned.
- Rotate herbicides when possible. This helps prevent the build-up of weeds that may be tolerant to one chemical.
- Control weeds at the most susceptible stage of growth. Weeds are generally most susceptible to herbicides at or near seedling emergence, or as very young seedlings in the one to three-leaf stage. Some perennial weeds, however, are better controlled at the bud stage. For this reason, with proper timing of land preparation, pre-emergence or early post-emergence herbicide application rates can be kept to the minimum specified in the recommendations.
- Apply herbicides at rates and under conditions stated on the label. Pre-emergence herbicide application rates vary, depending upon soil condition and soil type. Some herbicides (Treflan) are not effective on muck soils. Pre-emergence applied herbicides work best in warm, moist soils. Sandy loam soils require less chemical than do heavier silt or clay loam types.

Preplow Clean Up of Weeds

Quackgrass, Canada thistle, curled dock and other persistent perennial weed clean up prior to planting of most crops is recommended. Cultivation the previous season during late summer and fall is seldom adequate, even in dry weather. Experience has shown that without the use of herbicides at least one full growing season of fallowing is required to kill most perennial weeds. For best results, treat the actively growing weeds before plowing with one of the following herbicides:

- **Amitrol T** is effective on actively growing Canada thistle and quackgrass. Apply at least 10 to 14 days before plowing. Do not apply as a spring treatment prior to planting as there is some danger of residual herbicidal action. Apply Amitrol T at the rate of 16.8 to 22.4 L/ha. Read the label for additional information.
- **Roundup** (glyphosate) is very effective against quackgrass, Canada thistle and most other perennial weeds when applied as a fall or spring treatment. It is inactivated by soil contact so is not residual. Apply at least 10 to 14 days before plowing, cultivating or mowing. If used at the rate of 4.75 to 7 L/ha (1.9 to 2.8 L/acre) in 100–300 L/ha of water these products will provide control of quackgrass, Canada thistle and many other weeds, but the harder to control perennial weeds such as field bindweed, clovers and dock may require rates as high as 7 to 12 L/ha. (2.8 to 4.9 L/acre) in 100–300 L/ha of water.

Note: The above rates are based on a formulation with 356 g/L glyphosate. There are many new formulations of glyphosate on the market with varying active ingredient concentrations. Be sure to check the label for application rates.

Insects

Follow these general principles for good insect control:

- In planning the insect-control program, use the pertinent publications listed in this guide.
- When possible, apply insecticides to the young stages of insects for the best control.
- Sometimes one insecticide will control more than one insect. Choose the control for the main insect pest, then see whether or not it will control the others.
- Some of the insecticide recommendations in this guide are shown in ranges. Use the lower rates and volumes when plants are small; use the higher rates and volumes as the size of the plants increase.
- Practice crop rotation whenever possible. Growing crops that are not susceptible to the same insect pests prevents the buildup of serious pests.
- Practice sanitation (destruction of crop refuse and good weed control). This often helps prevent some insect pests from completing their life cycle or destroys their winter protection.

Diseases

Take the following measures to help control berry diseases:

- Use certified planting stock, if available.
- Rotate crops so that those susceptible to the same diseases are not planted year after year in the same field.
- Practice sanitation.
- Control insect vectors to minimize the spread of virus disease.
- Use resistant varieties
- Use fungicides when necessary to prevent foliar diseases and fruit rots.

Disease Identification

Plant samples can be sent to plant diagnostic laboratories for disease identification. Refer to the BCAGRI publication, "Resources for Berry Growers". The best diagnoses occurs with good plant samples. Use the following guidelines when submitting samples:

- Include several plants, if appropriate. Collect samples with symptoms that vary from slight to more advanced.
- Dig the sample with a hand trowel or shovel, and gently knock off the soil. Do not pull plants from the soil as this will remove infected roots that should be included with the sample.

- Keep the plant in one piece, if possible.
- Put the roots in a plastic bag and secure it at the crown. If more appropriate, put the entire sample in a plastic bag. Do not put a moist paper towel in the bag.
- Send in a box with packing material so the sample does not get crushed. Including a frozen cold pack with the sample helps to keep it fresh.
- Use a courier service to ensure fast delivery, when samples cannot be taken directly to a laboratory. Time delivery so the sample arrives during office hours, and not on a weekend.
- Use the form at the back of this guide when submitting to the BCAGRI Plant Diagnostic Laboratory at the Abbotsford Agriculture Centre, or provide laboratories with the information requested on this form.

Chemical Control

Bordeaux Mixture

Tank-mix Bordeaux is an excellent dormant fungicide and bactericide and is not easily washed off by the fall, winter and spring rains.

Bordeaux Formulas. In any Bordeaux formula, the numbers refer to pounds of ingredients and Imperial gallons of water, and are always given in the same order, with the copper sulphate first, then the hydrated lime, and the water last (e.g., Bordeaux 10-10-100 means 10 lb. of copper sulphate and 10 lb. hydrated lime in 100 gal. of water).

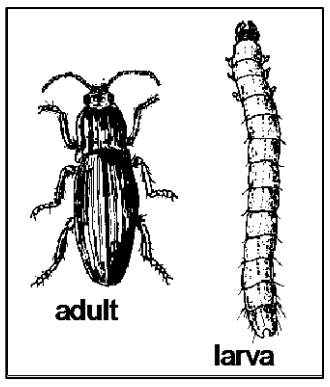
To make Bordeaux Mixture 10-10-100 using the metric formula, use 4.5 kg of both copper sulphate and hydrated lime, in 450 L water.

Making Tank-Mix Bordeaux

1. Start water flowing into spray tank.
2. When tank is about one-third full and the mechanical agitator is in operation, start washing the powdered copper sulphate into the tank through a screen with water from the supply hose. A wooden spoon is often helpful in working powdered copper sulphate through the screen. Pre-dissolving the copper sulphate in a plastic bucket of hot water will speed up the process.
3. By the time the tank is two-thirds full, all of the powdered copper sulphate should be in the tank. Then wash the lime (hydrated or builders') through the screen, using the water-supply hose, into the copper sulphate solution in the tank. The lime should be as dilute as possible before it meets the copper sulphate solution in the tank, so use lots of water to wash lime through the screen. Pre-dissolving the lime before adding to the tank may be preferred to washing powdered lime directly through screen into the tank.
4. Keep the agitator running continuously and apply the Bordeaux Mixture immediately.

General Berry Pests

INSECTS



Wireworms

Hosts

Grasses and cereal crops are preferred hosts but will feed on most vegetable, small fruit, tree fruit or ornamental crops.

Damage

Wireworms generally build up to high levels in pasture or fields with longstanding established grass or sod. When these areas are plowed, wireworms, which live for 3 to 4 years, stay in the soil and bore into newly planted strawberry or raspberry crowns. They can kill the plants or reduce yields. Also, crows appear to know when wireworms are around, and will pull up many new strawberry plants to get to the wireworms. Wireworm damage can continue for years depending on the crops and rotational practices in the field. In strawberries, wireworms will also enter fruit that is in contact with the soil, thus contaminating fruit for fresh or processing markets. Wireworms will also affect blueberries and blackberry roots and crowns.

Identification

Wireworms are yellowish-brown, shiny, slender, hard-bodied worms 3 to 25 mm long. In the lower Fraser Valley, most of the damage is caused by two species of introduced European wireworms. They have two dark spots (like eyes) at the pointed end of the body. The adult stage of wireworms are click beetles. They are about 1 cm long and a dark brown or black color. European click beetles apparently do not fly, unlike other B.C. wireworms.

Life History

Heavy infestations occur in fields previously in sod, or surrounded by wooded or grassy areas. Wireworms can live from 3 to 4 years in the soil. The European wireworm life cycle begins with overwintered adult click beetles, which emerge from soil in March or April, and lay eggs for up to 3 months. Eggs are deposited in the soil, normally near a preferred host such as sod or cereal crops.

Within about 6 weeks, the eggs hatch into small larvae. After 3 or 4 growing seasons, these larvae become pupae and then adults, usually

in August. These adults remain in the soil over winter and emerge to deposit eggs in the following spring.

Monitoring

Before planting, use baits of whole wheat flour to find out if wireworms are present. To do this, place 30 g of flour at a depth of 10 cm in the soil using a hand corn planter or a shovel. Mark the location of each bait with a stake. Bury 30 to 50 baits per hectare (12 to 20 per acre) for an accurate reading. Four days later, dig and examine the baits for wireworms. An average of one or more wireworms per bait can cause severe damage to berry plantings.

Alternatively, dig a 12 cm diameter hole about 2.5 cm deep and evenly spread about 100 seeds of wheat, oats, barley or fall rye in the hole and cover with soil. A 12 cm diameter open coffee can pushed into the ground can be used to remove soil for planting. Locations can be marked with a flagged wire in the centre. After about one week, a 15 cm diameter coffee can can be centered over the planted area and 5-8 cm of soil removed and sorted for wireworms. If the seed has not germinated, it is too cool to obtain an accurate sample. Use 30 to 50 bait stations per hectare (12 to 20 per acre). An average of one or more wireworms per bait can cause severe damage to berry plantings.

The best time to bait in the Fraser Valley is in April and May. This is when most wireworms are near the soil surface. After May, wireworms are deeper in the soil and baits become less effective - wireworm numbers may be higher than the bait results show. In the Interior, wireworms can descend to a depth of 60 cm in the fall and not return to near the surface until the soil warms up sometime in May. Wait until this time to bait as earlier attempts may indicate a lower population than actually exists.

Baiting works best when fields are fallowed, have low green manure content and no weeds. Baiting results will be inconsistent in recently ploughed fields, or in fields with crop residues or weeds.

Management

Biological control

When fields are ploughed or disced, wireworms are often brought to the surface and eaten by birds such as crows, and seagulls. However, this does not give adequate control.

Chemical Control

Research has shown that the trap crop program outlined below is effective in significantly reducing wireworm populations. However, the product, Vitavax-Dual (lindane), has been discontinued. Work is underway to find a replacement product, but at time of printing no new insecticide has been registered for this use. Contact your supplier for the latest information.

Trap Crops

Plant rows of a cereal crop, such as wheat, before planting strawberries, raspberries or other berry crops. Wireworms are attracted to the trap crop and killed if the wheat seed is treated with an insecticide. The planting date and seeding rate of the trap crop determine its effectiveness. If done correctly, new plantings of strawberries will be protected.

Take the following steps for the best results:

Pre-plant:

1. Winter-fallow the field to be planted. Trap crops work best when there is no other green, or rotting vegetation in the field.
2. Plant trap crop in the spring (April or May), when most wireworms are near the soil surface. Wireworms are deeper in the soil in the summer, fall and winter months. The effectiveness of a trap crop is also greatly reduced under cool, wet conditions.
3. Space rows of wheat about 0.5 m apart, with 4-6 seeds per 2.5 cm in each row. Do not broadcast the seed. Trap crops will only work if they are planted in rows, since the concentration of insecticide is higher in rows than if broadcast.
4. Plant the trap crop about 10 days before planting the berry crop. If possible, plan the trap crop rows so they will be centred between the berry crop rows.
5. If time permits before planting strawberries, till the wheat under when it is about 5 to 8 cm tall and seed a second trap crop of treated wheat. The wireworms will be attracted to the new germinating wheat seed, not the newly planted strawberry plants. Thus, two treatments will both reduce wireworm populations and keep the survivors away from the strawberries.
6. Until the berry crop is well established, leave the wheat trap crops in the ground (about 1 to 2 months).

DISEASES

Nematodes

Hosts

A wide range of crops including berries.

Damage

Nematodes are particularly damaging to raspberries, blackberries and strawberries. Nematodes are seldom a problem on blueberries or cranberries. Nematodes can interfere with plant growth by sucking plant juices from the roots, migrating through the root tissue, creating infection sites for root rots and by transmitting some viruses. Damage is usually patchy in fields.

Identification

Nematodes are microscopic worms that can be seen with a microscope. Root lesion (*Pratylenchus* spp) and dagger (*Xiphinema* spp)

nematodes are the most common nematodes attacking berry crops in BC. Because they cannot be seen, poor plant vigour caused by high nematode levels is frequently blamed on other causes such as poor soil fertility, drought, insects or diseases.

Monitoring

Before planting a new crop, sample fields in late spring or summer when soil is wet but not saturated, so that fumigation can be done in late August or early September, if needed. If another crop or vegetation is present, include some samples of plant roots, as some nematodes are more abundant in roots during the summer months. Established plantings with symptoms of nematode damage can be sampled at any time. Both soil and crop roots should be included in the sample.

Nematodes tend to be very spotty in their distribution in a field. Thus, it is very difficult to collect a representative soil sample. For the best results, use the following method to sample fields.

Sampling method. Root-lesion nematode populations are highest from mid-September to October when soils are moist. However, sampling for nematodes may be done anytime as long as results are interpreted with respect to the sample collection date. Use a soil-probe or small trowel to collect samples. A clean plastic pail works well for holding the sample. To obtain a representative sample from a field, collect 20 to 25 sub-samples for every 2 hectares (5 acres). Walk in a "W" pattern through the field, stopping to collect approximately every 22 m (75 ft) at a maximum. Thoroughly mix the subsamples together in the pail to make one sample. If raspberry plants are present, collect fine, fibrous roots as well as soil. Keep the sample cool until it arrives at the lab.

Sample areas with different soil types separately.

Management

Cultural Control

- Use only certified planting stock free of nematodes.
- Keeping land bare of weeds and vegetation between crops will help to reduce nematode populations, however soils subject to wind or water erosion should have an over-winter cover crop.

Chemical Control

The chemicals used to control nematodes are called nematicides. Most nematicides are fumigants and are applied to the soil before planting. The object of nematode control is to reduce the population level sufficiently to enable normal crop establishment.

Pre-plant. Treat the soil with:

- **Vapam** at 450 to 900 L/ha (180 to 360 L/acre using the higher rates on heavier soils, high organic matter soils or where control of soil diseases and weeds are wanted. Vapam may be injected and/or rotovated into the soil and sealed by rolling.

For best results, follow these guidelines:

- Before fumigation, be sure the soil is loose and friable to a depth of 20 cm, and free of sod, lumps and crop debris.
- Do not apply under windy conditions or to extremely wet soils.
- If the soil is dry, irrigate prior to treatment. The soil must be near "field capacity" for acceptable control.
- Use Vapam only when soils are between 5° and 20°C at the 15 cm depth. Fumigation should be done from late summer to early fall for early spring plantings. Late fall and early spring fumigation is unreliable because soils are often too cold and wet for fumigants to be effective.
- Organic matter reduces the effectiveness of Vapam. Therefore, if manures are to be used, apply in the spring after fumigation, prior to planting.
- Rotovate Vapam into high organic matter soils, to improve effectiveness.

Vapam should provide control of existing vegetation and will suppress nematodes and many soil borne diseases when applied with water or the "rotovate and roll" method, especially if applied at higher rates.

In order for Vapam to lower nematode populations sufficiently, do not aerate the soil until 14 days after treatment. Aerate by shallow disking and leave for a further week before planting. Since Vapam can damage plant roots, be certain that all trace of the chemical is out of the soil before planting. Test the soil by taking one soil sample from the treated zone and another sample from an untreated zone, and placing them in separate jars. Place a few lettuce seeds on the soil surfaces and seal the jars. Compare germination of the seeds in a few days. If seeds in the treated soil do not germinate (but did in the untreated sample) the Vapam chemical is still active in the soil. Aerate again, wait a week and re-test until it is safe to plant.

- **Basamid Granular** (dazomet) at 325 to 500 kg/ha (130 to 200 kg/acre). Apply evenly and immediately incorporate into the soil to a depth of 15-20 cm using a rotary cultivator or rototiller. Soon after incorporation, soil needs to be sealed through rolling, flooding, or tarping as described on the label.

For best results, soil to be treated should be well worked and free of clods. Soil moisture level must be suitable for seed germination for a 5-7 day period prior to treatment. Water the soil to achieve and maintain this level.

The treatment time before aerating the soil will vary depending upon the temperature of the soil. For example, if the temperature at a depth of 10 cm in the soil is over 18°C, aeration may begin 5-7 days after application and planting may begin 10-12 days after initial treatment. Soil temperatures of 6-8°C require as long as 40 days after treatment before planting may begin.

A few days following aeration of the soil, a soil safety germination test should be performed to determine if the chemical has dissipated from the soil so that plants will not be damaged by residual fumigant. Refer to the label for more information.

Established plantings. Vydate L can be used on established raspberries to help reduce nematode populations. However, it is not a replacement for pre-plant fumigation. Refer to "Nematodes" in the raspberry section for application information.

VERTEBRATES

Beavers

Beavers occasionally cause serious feeding damage to blueberry bushes and their dams can result in flooded berry fields. Removal or partial removal of beaver dams may be an effective temporary solution to lower the water level in fields. But the solution is not permanent

until the beavers abandon the area or are trapped out.

Management

For further information, refer to the leaflet "Beaver Damage Control in agricultural areas of British Columbia", available from BC Ministry of Environment or BCAGRI offices. Contact a local conservation officer at the BC Ministry of Environment for a listing of licensed trappers.

Birds

Hosts

All berry crops

Damage, Identification

Starlings and other birds such as crows, robins, sparrows and finches may damage berry crops. Starlings usually cause the most problems in Fraser Valley fields. Birds can cause considerable losses, particularly in blueberries. The berries are eaten whole, or "pecked" and left on the bushes.

Starling Feeding Patterns

Starlings are flocking birds. Their numbers increase tremendously over the summer because of the relatively large number of juveniles produced and the movement of starlings into an area from locations as far as 100 km away. The feeding pressure on berry fields increases as the flocks build and the birds switch from eating insects to eating fruit.

Once starlings establish a feeding pattern in a field it is difficult to scare them away. Thus it is important to begin your bird control program at the first sign of birds feeding on the berries. The number of starlings may grow through the season as more birds discover your field or as other food sources diminish. Towards the end of the blueberry season, large flocks of migrating starlings may also be present. The large flocks can cause a lot of damage in a short period of time.

The heaviest feeding periods tend to be early in the morning and again in the late afternoon to dusk. But some birds may be present in the field throughout the day. Starlings prefer to feed from an exposed roosting site—such as a lone tree, overhead wires or a roof ridge—where they can watch for predators. The flocks fly down to the bushes, feed for a short period of time, and return to the roosting site. This pattern is repeated throughout the feeding period. At dusk, they flock to protected roosting sites where they spend the night—often a large stand of trees.

Management

Bird control should minimize crop losses while minimizing disturbance to neighbours and harm to non-target species.

The *Farm Practices Protection (Right to Farm) Act* protects farmers from nuisance actions by persons or local governments if farmers are following normal farm practice. Under the Act, "normal farm practice" is typically determined by the Farm Industry Review Board under site specific circumstances. Several local governments have noise bylaws dealing with audible bird scare devices including Delta, Pitt Meadows and Surrey. Audible scare devices use noise to scare birds. These bylaws generally follow the BCAGRI's Wildlife Damage Control guidelines which outline practices which farmers should follow in their bird control programs.

Several types of control are available (Refer to the BCAGRI publications, "Integrated Bird Management" and "Bird Control Suppliers and Equipment for BC Growers").

- Netting
- Visual scaring devices
- Noise scaring devices
- Falcons
- Population control

Netting

Netting is the most effective way to keep birds out of the fields and it is usually acceptable to neighbours. It is installed on a structure of poles and wires above the bushes. Overhead netting can be erected to accommodate mechanical harvesting. However, bird netting is not always cost-effective. Use the BCAGRI publication, "Netting for Bird Control in Blueberries-—A Decision Making Guide", to determine if nets are cost-effective for a specific field. Also refer to the BCAGRI publication, "Installation of Bird Proof Netting for Horticultural Crops".

Use the following guidelines to select and maintain nets:

- Use a mesh size of 25 x 25 mm or smaller. Larger mesh may result in birds becoming tangled in the netting, or allow small song birds to enter the netted area.
- Install netting tightly to prevent trapping birds.
- Replace or repair damaged netting. Remove trapped birds as soon as possible.
- Recycle unusable, damaged netting or dispose of it at a municipal incinerator or landfill. Do not bury or burn it on the farm site.

Visual Scaring Devices

These are only effective when used with noise scaring devices. Used this way, they provide visual cues to the birds. The birds will make a connection between the visual cues and the noise devices. The visual cues then help to keep the birds away during times when the noise device is silent.

- **Flash tapes and streamers.** String between poles above the berries or on top of the bushes. Twist tapes or streamers every 3 m and attached to poles 12 m apart.
- **Scarecrows and predator models.** Examples are hawk-shaped kites, mechanical hawk models, predator-eyes, owls. Suspend above the crop where they will move freely in the wind.
- **Wild predator birds.** Attract birds of prey by installing nest boxes. This may be effective even if the raptorial birds attracted do not feed on the pest birds.

Noise Scaring Devices

Noise devices, especially propane-fired cannons, can be annoying to neighbours. Contact BCAGRI or the BC Blueberry Council to obtain the latest information on BCAGRI's Wildlife Damage Control guidelines. Also check with your local government to determine if they regulate bird scare devices through noise or other bylaws. To date Delta, Pitt Meadows and Surrey are known to have bylaws addressing this issue. Types available include:

- Propane cannons and orchard pistols. Propane-fired cannons or exploders are commonly used to scare birds with automated shot gun like noises. Different options are available in firing frequency and supporting tripods. Better models have randomized firing on a tripod that elevates the cannon above the crop and allows the device to rotate. Orchard pistols or other shell launchers are used with cracker or whistler shells.
- Bird calls. Amplified distress calls and predator calls are often effective in repelling problem birds. In newer systems, the calls are digital recordings on interchangeable microchips and can be adjusted for time and frequency. The bird call recordings should be carried out regionally to ensure that they are effective.
- Other noise devices. Speaker systems are also used to broadcast other noises to scare birds. People riding motorbikes, banging pails or sticks or clapping their hands will also scare birds.

Using Noise Scaring Devices

Farmers are expected to consider the impact of any noise scaring devices they use has on their neighbours. Farmers should also consider using bird scaring techniques other than noise. The BC Blueberry Council has hired a Grower Liaison Officer to assist growers to develop an integrated bird management plan. Growers are encouraged to take advantage of this assistance. As a minimum, farmers should follow the up-to-date BCAGRI Wildlife Damage Control guidelines. The following are the current guidelines for South Coastal BC only:

Audible bird scare devices are divided into two main categories.

Category 'A' bird scare devices create an impulse sound. Impulse sound is from impacts or explosions. Propane-fueled exploders or cannons are an example of Category 'A' devices. Firearms and shell launchers such as orchard pistols are not included.

Category 'B' bird scare devices are any other stationary device, not in Category 'A', which generate sounds to scare or disturb birds. Examples are devices that broadcast birdcalls or other sounds through loudspeakers. Firearms are not included.

Guidelines applying to both Category A and B devices are as follows:

Farmers are responsible for the strategic management of devices, and must take due measures to minimize noise impact on neighbours. To achieve this, farmers:

- should ensure that a Bird Predation Management Plan is completed before the first use of devices in each growing season and that the plan is kept up to date throughout the season. A Bird Predation Management Plan requires that producers monitor bird populations and activity on their properties, utilize a range of approaches or techniques to prevent bird damage, and undertake strategies to minimize both device use and bird habituation to devices;
- should assign an individual who will be responsible for:
    - being familiar with the Bird Management Plan and the terms it establishes for the use of devices;
    - making regular visits to the sites to ensure that devices are functioning properly and that bird pressure is sufficient to justify propane cannon use;
    - ensuring that devices are not operated outside of the hours permitted within the guidelines, and responding promptly should out-of-hours operation be reported.
- should provide the contact information for that individual to the BC Blueberry Council, and, where their local governments maintain a registry of devices, with their local governments.

With respect to the operation of devices, farms:

- should operate devices only between 6:30 a.m. and 8:00 p.m. local time or dawn to dusk, whichever is of lesser duration;
- should operate as few as possible devices on a given farm site up to a maximum of one device per two hectares of cropland at any one time. If multiple devices are used on a larger field, they should be placed at a distance from each other so that they are not concentrated within the field and so they do not exceed the permitted density;
- should alternate or relocate devices being used on a farm operation at least every 4 days;
- should point directional devices away from the nearest neighbouring residence or facility and away from nearby roads;
- should maintain devices, including timing mechanisms, to ensure they operate properly and not outside the permitted hours of operation;
- should use devices only when required for the protection of a crop during periods when that crop is vulnerable to bird predation;
- should use devices only as outlined in the Bird Predation Management Plan.

Guidelines applying only to Category A devices are as follows:

Farmers:

- should operate devices with a firing frequency of no more than one firing per 5 minutes for single shot devices and no more than 11 activations or maximum of 33 shots in any hour for a multiple-shot device. Multiple shots from a device are considered as one activation if they occur in less than a 30-second period;
- should maintain a 200 meter separation distance between a device and a neighbouring residence. Where written permission from the owner of a neighbouring residence is obtained, the separation distance can be waived.
- should not operate devices between noon and 3pm.

Guidelines applying only to Category B devices are as follows:

Farmers:

- should maintain a 100 meter separation distance between a device and a neighbouring residence. Where written permission from the owner of a neighbouring residence is obtained, the separation distance can be waived.

Guidelines for shell launchers (orchard pistols) :

Farmers:

- should operate shell launchers following guidelines for Category A devices except for the guidelines on number of devices per hectare, firing frequency and mid-day break.
- should not operate "bear bangers" as a bird scare device.

To prolong the effectiveness of scaring devices, and to minimize disturbances to neighbours, also do the following:

- Start scaring birds when they first begin feeding in a field. Do not delay. Once birds get used to a field, it is very difficult to change their behaviour.
- Do not always use the same scare device. The first response of birds to an unexpected object is to flee. As the birds get used to the object, they start to explore it, then finally the birds ignore the object.
- Random, unpredictable sounds are more effective than repetitive sounds. Start propane cannons with infrequent firings. Increase the firing frequency as the feeding pressure increases—usually as the harvest season progresses.
- Locate sound devices for the best effect. Speakers and cannons should be located above the canopy and pointed into the field, not towards neighbours or work areas.
- Use a number of different scare devices. Include visual and noise devices in the strategy.
- Move scare devices around and do not leave in one place for the entire harvest season. They should be moved at least once a week, preferably every 2–3 days.
- Remove visual scare devices as soon as they appear to lose effectiveness.
- Reinforce the scaring effect of the device by occasionally shooting crackers or whistler shells into the vicinity of the birds. Do not fire shotguns into the crop (danger of lead shots in the fruit).
- Maintain noise devices, including proper functioning of timer, to prevent off-hour firing.
- If possible, remove roosting sites used for feeding, such as lone trees, or make them less attractive. For example, place strips of spikes along roof ridges.

Falcons (Birds of prey)

Farmers may be able to contract companies to provide birds of prey and handlers to patrol their berry fields during the crop protection season. Generally larger blocks of crop in one place are required for this bird control option to be considered cost-effective. Companies offering this service will require contracts to cover the costs of acquiring trained birds and handlers.

Population Control

Eliminating bird populations from the farm is a last resort. Some birds, although causing damage during the harvest period, may help eliminate destructive insect pests at other times of the year.

If absolutely necessary, starlings, crows, magpies, English sparrows and rock doves can be killed without a special permit. Killing any other species of birds is illegal without a permit. Check the local government or law enforcement agencies about any restrictions on discharging firearms.

Traps. Starlings may be captured using a large baited trap. It is questionable if trapping is an effective means of reducing large starling populations, especially when trapping is done late in the summer. Broods are produced in March to April, June and August. (One pair of starlings is capable of producing 20 juveniles in one season.) The most effective time for trapping is just before breeding starts in the spring. At this time, starlings are usually found around feedlots and dairy barns. Maintaining traps can be problematic during the busy harvest time. Trap plans are available from the BCAGRI.

Deer

Deer occasionally cause serious damage to berry plantings, especially strawberries and raspberries. They eat the leaves and new growth, thus, weakening plants and reducing yields. Since permits to kill deer are very rarely issued by the BC Ministry of Environment, prevention of damage is based upon using repellants and fencing.

Management

Deer Repellants. Apply repellants as soon as damage is noticed and when temperatures are above freezing. Spray plants and the fence line to a height of 2 m using:

- **Hinder** (ammonia and fatty acids) at 3 to 5 L/100 L in a full coverage spray. In summer, apply every 10 to 14 days or as required to protect new growth. In fall and winter, apply every 2 to 3 months depending upon deer pressure and weather conditions. Hinder will also repel rabbits. Do not use within 14 days of harvest; or
- **Deer Away** (putrescent whole egg solids) in full coverage spray. Repeat every 2 to 3 months, as required. Apply before flowering and leafing out and after harvest.

Deer Fencing. If deer damage is severe or frequent, fencing may be the most cost-effective control method. Use electric fences or woven wire fences. Electric fencing is much less expensive but may not be 100% effective.

In south coastal BC, an electric deer fence should be 1.8 m high with at least 7 strands of high-tensile, smooth wire spaced 20 to 30 cm apart. Use a high voltage energizer. Woven wire fences are usually 2.1 m high.

For further information on deer fencing, refer to the “Electric Fencing Manual and Deer Exclusion Fencing for Orchards—Woven Wire” available from all BCAGRI offices.

Field Mice (Voles)

Hosts

Blueberry bushes, strawberry and raspberry plants and occasionally cranberry vines

Damage

Field mice numbers can fluctuate widely, but when numerous they can cause severe damage. Mice injury is usually associated with high grass and weed growth within or beside berry plantings. Injury usually occurs in the winter under a protective snow cover. In blueberries, field mice can cause damage by gnawing the stems and roots. Below the ground injury may be extensive but not visible from the surface until the plants fall-over or fail to leaf-out normally.

Identification

Field mice, also known as voles, are small rodents (about 13 to 23 cm long) with small, furry ears and relatively short tails.

Do not confuse field mice or voles with moles. Moles are not rodents but are burrowing mammals that eat mainly insects and earth worms, not plants. Mole activity can be recognized by the earth mounds that they leave in lawns and pastures.

Monitoring

Watch for holes in the soil near plants. These are signs of field mouse activity.

Management

Chemical Control

Remove tall weeds and grasses, brush piles and other trash from around plants, from ditches, fields, along fence rows, around buildings and other places where mice congregate. These provide protection and are breeding sites for mice. Removing this material helps keep mice out of the area and prevent their numbers from increasing.

Herbicides and/or frequent close mowing does as much or more to keep mice under control as poison baits. Therefore, preventive control is the primary method of control.

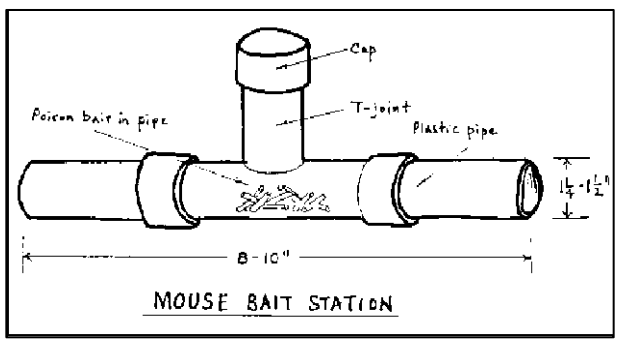
Trapping of field mice is seldom effective.

Chemical Control

Poison Baits. If preventive control measures alone are not adequate, poison baits (rodenticides) may be necessary. Use covered "bait stations" to both protect the bait from the weather and to prevent accidental poisoning of other animals. Bait stations can easily be built (from pieces of plastic pipe or wood, etc.) or may be purchased commercially. Place bait stations in areas where mice are likely to be found, e.g. near bushes, fences, brush piles and high grass.

Use one of the following materials according to label directions:

- chlorophacinone N **(Rozol)** is a multiple-dose anticoagulant rodenticide available in pellet bait formulations. Place in bait stations.
- Zinc phosphide (**Rodent Pellets, ZP Rodent Bait**) is a single-dose rodenticide available in cracked corn or pellet bait formulations. Place in bait stations.



Moles (Coast and Lower Mainland)

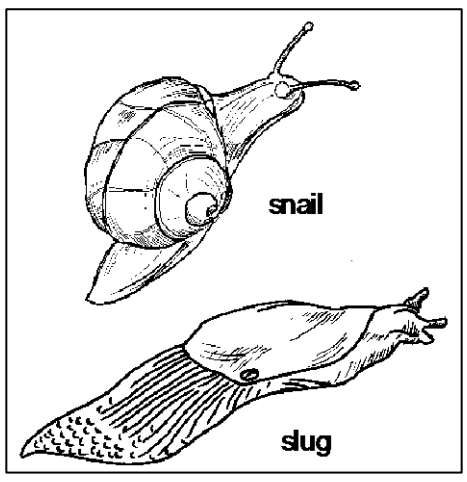
Identification

Moles are small greyish mammals up to 20 cm long. They burrow underground and leave hills of dirt. Mole activity in berry fields may indicate the presence of root weevils.

Management

Trapping with English scissor traps is the best control method. Trapping is best done from November to March but it can be done throughout the year. Trap only in runways that are in use. To find out if runways are in use, stamp down on the mounds and runways and check if they are re-established.

Miscellaneous Pests



Slugs and Snails

Hosts

Many weeds, shrubs, trees.

Damage

Slugs are usually only a problem in wet seasons. Occasionally they climb up into the plants and feed on berries and leaves.

Snails climb up into the plants and feed on algae and lichens on the branches (blueberries). Occasionally they feed on leaves and berries. Their protective shell enables them to remain in the bushes during the day. Snails can end up with the picked berries, especially when machine harvesting.

Identification

Slugs and snails are related to one another. Slugs are slow-moving, soft-bodied, slimy, legless creatures. They are black, grey, brown or olive green in colour, and do not have a shell. Slugs are 3 to 4 mm when hatched and grow to 10 cm in length.

Snails have a protective shell. It can be up to 2 cm in diameter and usually has alternating yellow and brown concentric rings.

Life History

Both snails and slugs overwinter in protected places, in all life stages — eggs, immatures and matures. Immatures and matures can freeze to death in severely cold winters. They become active in early spring. Slugs are usually active only at night and on rainy days. During warm days, they hide in cool, shady places such as cracks in the soil, among dead leaves on the ground, and in sawdust mulch around plants. Snails can remain on plants during the day but will withdraw into their shells on hot, dry days.

Monitoring

Watch for activity to begin in spring — usually in April or May. To find out when activity starts, mark 10 to 20 plants or weed patches and put 1 tablespoonful of slug bait on the ground. Slime trails and dead or dying slugs and snails will be seen in 1 to 4 days if they are present and active.

Management

Chemical Control

Control weeds and keep cover crops mowed as tall grasses and weeds provide protection and may attract these pests.

Chemical Control
If present in large numbers, control snails or slugs in the spring before they climb into the plants. When the pests are active and conditions dry, apply in the evening at the base of plants or to the headlands.

- **Deadline MP (4% metaldehyde)** at 25 kg/ha (10 kg/acre).

Do not apply to blueberry and raspberry fields after fruit has formed. Do not apply to strawberry and blackberry fields within 6 days of harvest. Do not allow slug bait to come into contact with the fruit.

Note: metaldehyde is toxic to dogs, birds and other wildlife. Clean-up or bury any spilled product.

- **Sluggo or Ferramol** (0.76% ferric phosphate) slug and snail bait at 25 to 50 kg/ha (10 to 20 kg/acre) scattered by hand or granular applicator between the rows and near the base of the plants when slugs are detected. Apply the highest rate if infestation is severe. Reapply at least every two weeks if slugs and snails continue to be a problem. Do not place in piles.

Note: ferric phosphate is not harmful to pets, birds or wildlife.

Invasive Alien Pests

The BC berry industry risks losses in production and market access by the presence or threat of invasive alien species.

Invasive alien species are species of plants, mammals, arthropods (insects, mites), plant pathogens (bacteria, fungi, viruses, nematodes) that are introduced to a country or region deliberately or accidentally outside their natural habitats. Once introduced, they can quickly establish themselves and spread if suitable food hosts and environmental conditions are present. The lack of natural enemies, which regulate their abundance in their home range, may also aid in their establishment and spread. Not only are invasive alien species a threat to cultivated crops, ornamental plants, rangelands, and forests, but they also threaten native plants and animals (biodiversity) by competing for available space and food or by directly attacking native species.

Economic Impact and Challenges

The economic consequences of new pests may be direct due to a decrease in marketable yield or quality, or indirect such as quarantine restrictions and market closures. Some invasive alien pests threaten more than one plant-based sector (agriculture, forestry, horticulture). Therefore it is essential that affected sectors work together to minimize risks of introduction, establishment and spread.

Challenges in minimizing the risks from invasive alien species include:

- Expanding global movement of crops (in particular, fruit, nursery and floriculture), vehicles and people.
- Increasing annual average temperatures making our climate more suitable for survival.
- Limited resources to maintain adequate surveillance for early detection of introductions and timely application of remedial measures.

Surveillance and Regulation

In many cases, remedial measures to prevent the establishment and spread of newly introduced invasive pests are unavailable; therefore, the strict application of quarantine regulations and surveillance programs are essential. The Canadian Food Inspection Agency (CFIA) has the lead role in maintaining vigilance for specified invasive alien species to prevent their introduction into Canada and their spread

between provinces. The CFIA conducts Pest Risk Assessments of new pests and regulates many pests (see their web site http://www.inspection.gc.ca/english/plaveg/ protect/listpespare.shtml#R for a list of pests regulated by Canada). The Agency maintains annual surveillance programs within Canada to document the absence of selected pests as well as to detect the presence of new invasive alien species arriving in Canada.

The BC Ministry of Agriculture (BCAGRI) administers the Plant Protection Act, the Weed Control Act and the Animal Diseases Control Act to help prevent the spread of pests, weeds and plant and animal diseases. Information on these and other Acts administered by the Ministry are available at http://www.agf.gov.bc.ca/fsq/legislation.htm.

Environment Canada, the CFIA and other federal and provincial departments and agencies and industry associations, are jointly preparing a National Action Plan for Addressing the Threat of Invasive Alien Plants and Plant Pests. The strategic goals of this Action Plan are those of Canada's National Strategy for Addressing the Threat of Invasive Alien Species, namely: prevention, early detection, and rapid response to new invasive alien species, and control and management of existing alien invasive species

All growers have a responsibility to prevent the introduction of invasive alien pests, whether on business or on vacation. Anyone importing plants, seeds/propagative material, produce or processed plant products should be aware of and comply with import regulations. For more information, visit the CFIA web site on Plant Imports http://www.inspection.gc.ca/english/toc/travoye.shtml#veg.

Growers can also aid in the detection of newly introduced alien species by reporting any unusual plants, plant diseases, insects or mites to their nearest BCAGRI or CFIA office. Early detection and identification will greatly improve chances of eradicating the pest or slowing its spread and damage. The BCAGRI web site contains pictures and information on some invasive alien species of immediate concern to BC. (www.agf.gov.bc.ca/cropprot/nonnativepests.htm).

Newly Introduced and Potential Invasive Alien Pests of Berry Crops

The following lists recently introduced pests affecting berry crops in BC and pests that pose a high risk of introduction from outside BC.

Recent Invasive Alien Pest Introductions into BC

Pest	Distribution	Hosts	Suspected Year of Introduction or Detection	Control Products Registered
Blueberry scorch virus	South Coast, South Vancouver Island, Okanagan Valley	Blueberry, Cranberry	2000	No
Blueberry shock virus	South Coast	Blueberry	2000	No
Blueberry Fruit Drop	South Coast	Blueberry	2001	No
Blueberry Midge, Cranberry tipworm	South Coast	Blueberry, Cranberry	1998	No
European Wireworms	South Coast	Most crops	1980's	No
Yellow Nutsedge	South Coast		Early 1990's	Yes

Potential Invasive Alien Pest Introductions

Pest	Nearest Infestation	Hosts	Damage	Control Products Registered?
Blueberry Maggot	Ontario, Eastern USA	Blueberry	Fruit	Yes
Cranberry Fruitworm	Washington	Blueberry, Cranberry	Fruit	No
Reversion Disease / Gall Mites	Europe	Currants, gooseberries	Plant	No