Use pesticides with care. Apply them only to plants, animals, or sites listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.
Insect and Disease Control

The following information lists and describes chemical control measures suggested for the more common insect pests and diseases of cranberries. The recommendations are based on research by Washington State University, the United States Department of Agriculture (USDA), and other agencies. When directions on the label are followed carefully, these materials are known to be effective.

In many cases, additional information may be desired on description of these pests, their damage, their life cycle, and their control. If your problem goes beyond the scope of this discussion, you can get additional help from your county Extension educator or cranberry specialist (e.g., Kim Patten 360-642-2031; e-mail: pattenk@wsu.edu).

PRECAUTIONS IN USING PESTICIDES

Before using any pesticide, you must have the product label in your possession. READ and FOLLOW all directions and precautions on the label. Cranberries must be listed on the label of the material you use. Occasionally they will be on the label of one brand or formulation but not on another.

If a product has recently had cranberries added to the label, you may need to obtain a supplemental label from the distributor.

Pesticides are poisonous to humans and animals. Use them only when needed and handle them with care.

Keep pesticides in their original containers. Store them in closed containers in a dry place. Avoid freezing temperatures. If a liquid product freezes and separates, contact the manufacturer before using. Store them where they will not contami-
to the manufacturer or sold to a commercial salvage firm, puncture, crush, or break them (except for aerosol cans) so they cannot be used for other purposes. They can then be taken to a sanitary landfill dump or other approved site. Contact your local solid waste program for more information. Call to verify hours and conditions first. Burning empty pesticide containers is PROHIBITED by state air quality regulations; such burning can produce toxic fumes. Dispose of pesticides no longer registered for use on cranberries. The time to do this is now. Inventory pesticides you have that fall into this category. Transfer empty pesticide containers to producers of other crops that are still on the label. (Your distributor may be able to assist in the transfer.) Return product to the manufacturer for disposal where possible. Order only the amount of pesticides that you will use during the year. Use older material first. Contact your county Extension educator for Hazardous Waste Disposal Events and other options.

**HEALTH HAZARDS**

All pesticides are poisonous; some are toxic in very small amounts and may be absorbed through the skin or inhaled in quantities that endanger the health or even the life of the operator. The degree of danger and the necessary precautions are indicated on pesticide container labels. Read the manufacturer’s label carefully and follow the instructions on it. Also refer to Material Safety Data Sheets (MSDS) for more information. (See resources at the end of this publication for online sources of pesticide labels and MSDS.)

**WORKER PROTECTION STANDARD**

The federal Worker Protection Standard (WPS) requires agricultural employers to protect their worker and handler employees from exposure to pesticides. This standard is comprehensive and complex. A Revised How to Comply (HTC) Manual developed by EPA is available from a number of sources including county Extension offices.

**REENTRY TIMES**

No one may enter a pesticide-treated field without wearing personal protective equipment specified on the label until the assigned reentry time has elapsed. Check the pesticide label for reentry times. Assigned times may range from 4 hours to several days.

**RESTRICTED USE PESTICIDES**

Certain pesticides are designated "restricted use." Only certified applicators may purchase and apply them. Check with your county Extension educator for a list of cranberry pesticides that carry restricted use designation, and ask how you can become certified.

**APPLICATION OF PESTICIDES THROUGH A CHEMI-GATION SYSTEM**

Most growers rely upon chemigation for the application of their pesticides. Several precautions must be observed for this use:

- The product must have a label allowing chemigation.
- The irrigation system should be well designed and have a uniform application rate across the entire field. Crop injury, lack of effectiveness, or illegal pesticide residues in the crop can result from uneven distribution. Conducting uniformity tests of sprinkler systems is an essential component of successful pest management.
- Apply during calm periods to avoid drift and uneven application.
- Chemigation equipment must be calibrated to inject the desired quantity of chemical. Be sure to agitate the chemical mixture in the supply tank at all times to avoid settling and uneven application.
- Growers should refer to the new state chemigation system requirements posted at the WSDA Web site at http://agr.wa.gov/PestFert/ChemFert/docs/CftapBrochure.pdf.
- Apply the right amount of water to avoid runoff, drift, or deep percolation. Pesticides must dry on the plant to be effective. The practical minimum application time is: 1) the time required for the plant surface to become covered plus, 2) the time required for the material to reach the extreme end of the system.
- Additional information on chemigation and sprinkler system uniformity testing is available from WSU Extension offices.
USING A SPREADER-STICKER

Most modern insecticides and fungicides contain a spreader-sticker. It is often inadvisable and sometimes even dangerous to add a spreader-sticker to such formulations. (Check the label.) For example, do not add wetting agents or spreader-stickers to Bravo or other products that have chlorothalonil as the active ingredient or to Aliette. Avoid using stickers with other pesticides and fertilizers applied during the period 2 weeks before to 4 weeks after the last Bravo application. If a spreader-sticker is recommended, after all other materials have been added to the spray tank, add the spreader-sticker according to directions on the spreader-sticker label, a little at a time. Test the amount by dipping cranberry tips in spray mixture. If enough spreader-sticker has been added, the leaves will wet evenly and thoroughly on both sides. If not, the spray mixture will draw up in beads and droplets. However, too much will cause the spray to run off the leaves and reduce the effectiveness of the pesticides.

Several herbicides require the addition of crop oil to the tank mix to achieve efficacy. Crop oils, applied at too high a rate during hot days, can damage cranberry leaves. To avoid damage during hot spells, reduce the amount of crop oil used in the tank mix, reduce the amount of spray applied to the plants, make the application in the early morning or late evening, and/or use a non-ionic surfactant (0.25% V/V) instead of a crop oil.

8-8-100 BORDEAUX MIXTURE FORMULA

Ingredients. Use 8 pounds bluestone (copper sulfate) for each 100 gallons of water. Instant bluestone may be used directly from the container; crystalline bluestone must be dissolved in water first to form a stock solution. Use 8 pounds of freshly hydrated or slaked lime for each 100 gallons of water. Mix the lime with enough water to form a thin paste, and strain through a 20-mesh screen to remove lumps.

Mixing. Fill spray tank about two-thirds full with water. Then pour the bluestone slowly into the spray tank while the agitator is running. After the bluestone has dissolved, add the lime. Then add more water to fill the tank and finally add spreader-sticker. Do not combine Bordeaux mixture or Kocide with an insecticide.

PHYTOPHTHORA ROOT ROT CONTROL

This fungal disease is usually most severe in low or poorly drained areas. The disease can be controlled by improving drainage and stimulating root growth. Improve drainage by digging new lateral ditches, maintaining existing ditches, or adding drain tile or pipe. Promote new root growth by sanding and fertilizing plants, especially those at the margins of the weak areas. Soil applications of the fungicide Ridomil Gold have been beneficial when combined with modified soil drainage. Before using Ridomil Gold, confirm that the Phytophthora fungus is present (check with the Extension Agent). Use the liquid formulation of Ridomil Gold for broadcast or chemigation treatment and the granular formulations for spot treatment. When spot treating apply Ridomil Gold 10 feet into healthy vines. Apply granules when foliage is dry so granules fall through the canopy. Irrigate following application to move Ridomil Gold into the root zone. Retard spread of the pathogen by harvesting infected beds last, and by using vines free of the pathogen when planting new beds or renovating sections of established beds. Aliette fungicide is applied as a foliar spray.

COTTONBALL

This disease has been problematic in several beds in Washington. The fungus that causes the disease blights new upright growth in the spring. Later flowers become infected leading to a fruit root called Cottonball or hard rot. White or yellow berries at harvest filled with white mycelium are cottonball-infested berries. The fungus survives the winter as mummified berries. In early spring spore cups form on these berries and the spores released from the cups infect new upright growth, resulting in "tip blight." A second type of spore produced on the dead tips infects flowers. Fungicide protection is needed in early spring and again during bloom. Protection during bloom is the most critical. Abound and Indar are the only fungicides recommended for cottonball.

ROSE BLOOM CONTROL

Protect new upright and runner growth from spores produced on the surface of the pink fleshy growths (abnormal branches). Effective control will reduce disease incidence (the num-
ber of rose bloom growths) the following spring. Start fungicidal protection when the growths first begin to take on a whitish cast; this marks the onset of spore production. For 'Stevens,' 'Pilgrim,' or other hybrids, this will be in early May (rough neck stage); and for 'McFarlin' and other cultivars, about 1 to 2 weeks later. Repeat at 14-day intervals until the growths wither (shrivel/dry up), but do not make more than three applications. Chemicals applied earlier in the spring do not cause the fleshy growths to wither before spores are produced.

UPRIGHT DIEBACK

Symptoms first appear in spring with a general yellowing of leaves. This is usually followed by an orangish-brown coloration or bronzing. Eventually affected uprights turn brown and die. Infected uprights can be scattered among healthy uprights or in patches. Dying uprights often occur on the same runner as healthy uprights. Runners can also be attacked, but roots are not affected. Only one of two fungi associated with upright dieback occurs in Pacific Northwest beds. *Phomopsis vaccinii* also causes the fruit disease known as viscid rot. Recent research found that *P. vaccinii* is frequently recovered from symptomless stems of uprights and runners. Fungicides applied during the growing season reduced the frequency of recovery. At this time, it is not known if other fungi are associated with dead uprights.

RED LEAF SPOT

This disease is often found on vines having excessive growth. Controlling vigor will minimize its effect on the vines. Only young leaves are susceptible, and symptoms first appear in mid-June to early July. Red leaf spot alone is not very destructive. Damage occurs when the fungus grows from the leaf into the stem, causing shoot tips to die. The black spot fungus often overgrows red leaf spots and the two fungi in combination cause considerable damage. To minimize damage apply Dithane M-45 (or equivalent mancozeb product) or Kocide every 14 days when symptoms are observed and vine overgrowth is excessive. Red leaf spot can also be a problem on new plantings during mid- to late summer.

TWIG BLIGHT CONTROL

The onset of infection and need for fungicidal protection are linked to spore development. Timing of the first application is early July. Repeat at 14-day intervals for a total of three applications. Effective control will reduce disease incidence (the number of blighted uprights) the following spring. Protect newly planted beds when nearby established beds have diseased plants, as spores of the fungus are carried by wind currents. When new beds become infected, the reduction in vine growth delays production and promotes weed growth. For chemigated beds, additional hand spraying may be necessary to achieve control in areas where sprinkler coverage is poor. If the disease appears, contact your county Extension educator to have spore development monitored.

FRESH FRUIT KEEPING QUALITY

Fungicide use is only a part of the program to assure good keeping quality. Fungicide applied late in the growing season provides little additional keeping quality. Control of weeds and vine overgrowth, careful handling of the fruit, avoiding irrigation during mid-day, and excess nitrogen fertilizer are also essential.
## INSECT AND DISEASE CONTROL IN CRANBERRIES

<table>
<thead>
<tr>
<th>Time of application</th>
<th>Insect or disease</th>
<th>Materials*</th>
<th>Amt. formulation Per acre**</th>
<th>Tolerance in ppm</th>
<th>PHI</th>
<th>REI</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early dormant stage (Nov. 1 to March 1)</td>
<td>Black vine weevil</td>
<td>†Admire Pro, or Alias 4F</td>
<td>Use 300 gal/acre 7 fl. oz.</td>
<td>0.05</td>
<td>30 days</td>
<td>12 hr</td>
<td>Apply with 600-1000 gallons of water/acre and immediately incorporate with ample rain or irrigation. Special Local Needs registration is WA-050013 for Admire Pro.</td>
</tr>
<tr>
<td>Late dormant stage till buds break dormancy (March 1 to 15)</td>
<td>Upright dieback</td>
<td>Bordeaux mixture 8-8-100, or Champ Formula 2</td>
<td>24 lbs 2/3 gal.</td>
<td>Exempt</td>
<td>None</td>
<td>48 hr</td>
<td>Do not use Bordeaux mixture in combination with any insecticide.</td>
</tr>
<tr>
<td>Bud break</td>
<td>Cottonball (tip blight stage)</td>
<td>Bordeaux mixture 8-8-100, or Abound Flowable</td>
<td>24 lbs 6–15.4 fl. oz.</td>
<td>Exempt</td>
<td>0.5</td>
<td>3 days</td>
<td>See cottonball control text (p. 5)</td>
</tr>
<tr>
<td>Rough neck (approx. May 1)</td>
<td>Rose bloom</td>
<td>Bordeaux mixture 8-8-100, or Kocide 2000</td>
<td>24 lbs 6 lbs.</td>
<td>Exempt</td>
<td>None listed</td>
<td>48 hr</td>
<td>See rose bloom control text (p. 5)</td>
</tr>
<tr>
<td>April to early May</td>
<td>Black vine weevil</td>
<td>Entomopathogenic nematodes</td>
<td>See label</td>
<td>Exempt</td>
<td>None listed</td>
<td>48 hr</td>
<td>Use a species of nematode that is tolerant of cold soil and apply in accordance with manufacturer’s directions.</td>
</tr>
<tr>
<td>Phytophthora root rot</td>
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<td></td>
<td>See phytophthora root rot control (p. 5).</td>
</tr>
<tr>
<td>Late hook (about May 15 ± 5 days). Avoid application of toxic insecticides after first blossoms appear. Killing bee pollinators will reduce yields.</td>
<td>Rose bloom</td>
<td>Use any fungicide at proper rate listed for the late dormant stage.</td>
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<td></td>
<td></td>
<td>Do not use Bordeaux mixture in combination with any insecticide. Apply Diazinon as soon as worms are found in vines or tips. Only Diazinon is labeled for tipworm. Lorsban may only be applied two times per year. Orthene: Apply no more than 1.0 lb of active ingredient per acre per crop cycle; Special Local Needs registration is WA-000021B. Do not apply Orthene or Sevin XLR Plus during bloom.</td>
</tr>
<tr>
<td>Black headed fireworm, or Tipworm (Tipworm is not present on all farms; consult WSU or OceanSpray for recommendations.)</td>
<td>Intrepid 2F, or Dazinon 50W, or Lorsban 4 EC, or †Orthene 97, or Sevin XLR Plus, or Success, or Delegate WG, or Avaunt, or Assail 30SG, or Altacor</td>
<td></td>
<td>10–16 fl. oz. 4 lbs. 3 pts. 1 lb. 2 pts. 4–10 fl. oz. 3–6 oz. 3–6 oz. 4–6.9 oz. 3–4.5 oz.</td>
<td>0.5 0.5 1.0 0.5 0.01 0.04 0.9 0.6 1.0</td>
<td>14 days 7 days 60 days 75 days 21 days 21 days 7 days 1 day 1 day</td>
<td>4 hr 5 days 24 hr 24 hr 4 hr 21 days 4 hr 12 hr 12 hr</td>
<td></td>
</tr>
<tr>
<td>Do not mix Aliette with any product containing copper. Do not apply to plants previously treated with a product containing copper. Spray adjuvants are not recommended for use with Aliette.</td>
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</tbody>
</table>

**Use 300 gal/acre.**
<table>
<thead>
<tr>
<th>Time of application</th>
<th>Insect or disease</th>
<th>Materials*</th>
<th>Amt. formulation and Tolerance</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bloom</td>
<td>Black headed fireworm</td>
<td>Pyrenone, or Bt products, or Intrepid 2F</td>
<td>Use 300 gal/acre</td>
<td>Pyrenone and Bt products only provide temporary suppression of early infestations of second generation larvae.</td>
</tr>
<tr>
<td></td>
<td>Fruitworm</td>
<td>Intrepid 2F</td>
<td>10–16 fl. oz. 0.5 14 days 4 hr</td>
<td>Consult WSU first for exact timing of fruitworm spray.</td>
</tr>
<tr>
<td></td>
<td>Black vine weevil</td>
<td>Avaunt</td>
<td>6 oz. 0.9 7 days 12 hr</td>
<td>Apply weevil adulticide at first signs of adult activity. Apply Avaunt at night to avoid risk to pollinators. Repeat every 5–7 days as required until night sweeping results indicate no weevil activity.</td>
</tr>
<tr>
<td></td>
<td>Fruitworm</td>
<td>Intrepid 2F</td>
<td>10–16 fl. oz. 0.5 14 days 4 hr</td>
<td>Consult WSU first for exact timing of fruitworm spray.</td>
</tr>
<tr>
<td></td>
<td>Black headed fireworm, or Fruitworm</td>
<td>Pyrenone, or Bt products, or Intrepid 2F</td>
<td>See label Rate varies by product 0.5 14 days 4 hr</td>
<td>These fungicides help to reduce fruit rot plus protect vines from twig blight. Repeat at 10- to 14-day intervals. Do not apply Bravo products more than three times per season.</td>
</tr>
<tr>
<td></td>
<td>Fruit rot, Storage rot, or Twig blight</td>
<td>Abound Flowable or Bravo Weather Stik, or Bravo Ultrex, or Echo 90DF, or Ferbam Granulfo, or Kocide DF, or Kocide LF, or Kocide 2000, or Dithane M-45, or Dithane DF Rainshield, or Dithane F-45 Rainshield, or ManKocide, or Maneb 80 WP/75 DF, or Indar 2F</td>
<td>See label See label See label 6 lbs. 10.6 pts. 6 lbs. 3–6 lbs. 3–6 lbs. 2.4–4.8 qts. 7 lbs. 4.8–6 lbs. 6–12 fl. oz. 0.5 3 days 4 hr</td>
<td>Use insecticides only when necessary. Apply as soon as second generation larvae are seen (about July 5 ± 5 days).</td>
</tr>
<tr>
<td></td>
<td>Red leaf spot</td>
<td>Dithane M-45, or Dithane DF Rainshield</td>
<td>3–6 lbs. 7.0 30 days 24 hr</td>
<td>See Twig Blight Control text on page 5.</td>
</tr>
</tbody>
</table>

Late bloom (when 80% of blossoms have dropped). To protect bee pollinators do not apply insecticide during blossoming. Remove bees before spraying with insecticides.

Use same insecticide control as in the late hook stage, except do not apply Orthene if it was used at late hook stage.

These fungicides help to reduce fruit rot plus protect vines from twig blight. Repeat at 10- to 14-day intervals. Do not apply Bravo products more than three times per season.

Ferbam: Do not apply within 28 days after mid-bloom (equivalent to 50 days PHI).

Do not combine Bravo or Echo with surfactants or Dipel.

Do not use Kocide in combination with any insecticide.
<table>
<thead>
<tr>
<th>Time of application</th>
<th>Insect or disease</th>
<th>Materials*</th>
<th>Amt. formulation Per acre**</th>
<th>Tolerance in ppm</th>
<th>PHI</th>
<th>REI</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 1–15</td>
<td>Fruit rot, Storage rot, Twig blight (Lophodermium) Red leaf spot</td>
<td>Any fungicide and its rate listed for late bloom</td>
<td>Use 300 gal/acre</td>
<td>°°PHI</td>
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<tr>
<td></td>
<td>(Approximately)</td>
<td>Cranberry girdler</td>
<td>Entomopathogenic nematodes</td>
<td>See label</td>
<td>Exempt</td>
<td></td>
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<tr>
<td>July 1–7</td>
<td></td>
<td>Best to apply nematodes no earlier than 14 days following peak moth flight. Follow manufacturer's recommendations for application rates, timing, and irrigation requirements</td>
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<tr>
<td>Adult weevils</td>
<td>Avaut</td>
<td>6 oz.</td>
<td>0.9</td>
<td>7 days</td>
<td>12 hr</td>
<td></td>
<td>Monitor for adults by sweeping at night,</td>
</tr>
<tr>
<td>July 25 to August 10</td>
<td>Fruit rot, or Storage rot, or Twig blight (Lophodermium) Fireworm, or Fruitworm, or Lecanium scale</td>
<td>Any fungicide at proper rate listed for late bloom.</td>
<td>Use any insecticide, except °Orthene (unless you have not used it during the current season) at proper rate listed for the late hook stage. Only one application of Orthene is allowed per growing season. Use Lorsban only if it will be applied at least 60 days before harvest.</td>
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<td></td>
<td></td>
<td>Insecticides may be combined with fungicides if insect control is necessary. It is not advisable to use more than one of each in the tank at any given time. Check the label of each product to be combined for special mixing instructions. Use Diazinon if scale insects are a problem. Spray for fireworm only if third generation larvae are seen.</td>
</tr>
<tr>
<td>Phytophthora root rot</td>
<td>See April to early May.</td>
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<td></td>
</tr>
<tr>
<td>Time of application</td>
<td>Insect or disease</td>
<td>Materials*</td>
<td>Amt. formulation</td>
<td>Tolerance in ppm</td>
<td>††PHI</td>
<td>REI</td>
<td>Remarks</td>
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<tr>
<td>July 25 to August 10</td>
<td>Black vine weevil</td>
<td>†Admire Pro</td>
<td>Use 300 gal/acre</td>
<td>7 fl. oz.</td>
<td>0.05</td>
<td>30 days</td>
<td>12 hr</td>
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<tr>
<td></td>
<td></td>
<td>Alias 4F</td>
<td></td>
<td>8–16 fl. oz.</td>
<td>0.05</td>
<td>30 days</td>
<td>12 hr</td>
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<tr>
<td></td>
<td></td>
<td>Belay</td>
<td></td>
<td>12 fl. oz.</td>
<td>0.01</td>
<td>21 days</td>
<td>12 hr</td>
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<tr>
<td>August 20–25</td>
<td>Fruit rot, or Storage rot, or</td>
<td>Any fungicide at proper rate</td>
<td></td>
<td></td>
<td>See label</td>
<td></td>
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<tr>
<td></td>
<td>Twig blight (Lophodermium)</td>
<td>listed for late bloom except Bravo and Ferbam Granuflo.</td>
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<tr>
<td>Late July to early</td>
<td>Black vine weevil</td>
<td>Entomopathogenic nematodes</td>
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<tr>
<td>September</td>
<td></td>
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<tr>
<td>October</td>
<td>Root weevils</td>
<td>See remarks on flood-water control for weevils under root weevil section.</td>
<td></td>
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<tr>
<td></td>
<td>Phytophthora root rot</td>
<td>See April to early May</td>
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</tbody>
</table>

*Pesticides are listed in alphabetical order and not necessarily in order of effectiveness. Products having the same active ingredient may be available under other trade names.

**Do not exceed the amount indicated on product label.

***This pest is not on the label; however, use of this product is legal when label directions and precautions are followed.

****Including hard rot stage of cottonball.

††If twig blight is present, Bravo or Mancozeb are recommended over other products.

†A Special Local Needs registration has been granted for this use under Section 24(c), FIFRA.

††PHI stands for pre-harvest interval or the minimum number of days from last application to harvest.

‡‡‡Certain processors are requesting that growers voluntarily maintain a 60-day pre-harvest interval for EBDC fungicides (for example, mancozeb and ferbam).

REI = restricted-entry interval.

Abbreviations: WP—wettable powder; EC—emulsifiable concentrate; G—granules; F—flowable; S—soluble powder; DG—dispersible granules; WDG—water dispersible granules; WSP—water soluble pouches.
ROOT WEEVIL AND GRUB CONTROL

Strawberry Root* and Black Vine Weevil Control.

Mature larvae may be suppressed during April to mid-May or August to September using entomopathogenic nematodes. For spring applications use nematodes that are tolerant of cold soils. Follow the producer’s instructions as to the recommended species, rates, and methods. Root weevils usually are not a problem in water-harvested beds. If they do occur there, hold the flood water 4–7 days after harvest. Mid-winter flooding is not effective. If damage has been severe, vigorous control of both larvae and adults will be required to prevent loss of the bed. Once larvae are present, they can be suppressed with a mid-summer and post-harvest application of Admire Pro, Alias 4F, or Belay, and/or mid-summer application of nematodes. Consider spot treatment with nematodes if cost savings are a consideration. Control with both Admire Pro and nematodes will be compromised if the product has not been immediately incorporated with 1-inch of water through rain or irrigation. The efficacy of Admire Pro for weevil control on peat soils has been spotty. Determine the need for continued adult control by night sweeping. For adult control apply Avaunt at night at the first indication of adult emergence, usually in early to mid-June. Repeat the applications every 10–14-days until adults are no longer obtained by night sweeping. Spot sanding of affected areas in the spring can be done to help ameliorate damage.

BLACK HEADED FIREWORM CONTROL

Insecticides should target recently hatched larvae before they become enclosed in the developing bud. Timing for this can only be done by visual inspection or sweeping.

The first generation hatch occurs early to mid-May. If a hatch occurs prior to bud elongation, the newly hatched larvae fail to survive and an application of an insecticide should be delayed. Timing of a spray for fireworm control is dependent on the type of insecticide. IGR products like Intrepid are most effective against the early instar (<1/8” long) larvae. Two applications at 10-day intervals are usually required to account for uneven hatch.

If the majority of larvae have reached the 1/2”-long stage, applications of traditional insecticides or Delegate are required to obtain adequate control. Applications made against larvae that are 1/4” long result in poor control, while traditional insecticides are effective against larger larvae. Sweep samples and visual inspection of hot spots are the only effective means to monitor for hatch and stage of larvae development. If a severe infestation of fireworm has occurred in the previous year, then two applications of a traditional insecticide or Delegate 10–14-days apart during the first generation hatch in May will be needed to suppress the population during the current year. Control of the second generation is essential to prevent damage to vines and the crop. Pheromone trap catches should be used to predict emergence of second generation larvae, but sweep samples should be taken to confirm larval abundance and the stage of development. Two applications at 10- to 14-day intervals may be required to control heavy infestations of second generation larvae.

Pyrenone and Bt-based materials, like Intrepid, are not toxic to bees and can be applied during pollination. Bt-based compounds and Pyrenone are sensitive to ultra-violet sunlight and should be applied in mix with a sticker at dusk. Failure to obtain control of fireworm with reduced risk insecticides, like Intrepid, can be expected when products are applied through sprinkler systems with poor uniformity and/or wash-off time is too long.

CRANBERRY GIRDLER

There are no effective pesticides registered for cranberry girdler control. Feedback from IPM scouts in Wisconsin suggest, however, that growers have had some success with Belay in suppressing larvae populations of girdler (see application window for weevils). Pheromone traps indicate adult emergence and predict larval development, but estimate abundance only roughly. Temporary flooding (24- to 48-hours) during late July to late August may suppress recently hatched larvae, but may need to be repeated several times. To prevent

*These pests are not on the label; however, this use is legal when label directions and precautions are followed.
fruit scald, start flooding at night to be above the tips by midmorning. Entomopathogenic nematodes can be effective if applied during early to mid-August. Two applications at 14-day intervals may be required for heavy infestations. Severely infested patches should be sanded or renovated, but at least 1- to 2-inches of sand is needed to prevent damage. Sanding should occur in the spring when damage is first noticed. Caution: flooding at these times may increase the incidence of fruit rot and lower the keeping quality of fresh fruit. A 4- to 5-week flood after harvest also may help to suppress girdler.

CRANBERRY FRUITWORM

Cranberry fruitworm, Acrobasis vaccinii (Riley), has been noted occasionally on cranberry beds in Washington. It is not as voracious as the fireworm and feeds only on the berries. Generally the worms are through feeding well ahead of harvest, but in late, cool seasons larvae may still be in the berries at harvest time. Larvae brought to the warehouse in the berries will continue to feed, often webbing berries together. (See page 8 for management guidelines.) Treatment must be applied when the fruits are near pea size to be effective.

SPOTTED WING FIREWORM

Spotted wing fireworm has recently been discovered in cranberry beds in Washington. Second generation larvae will damage fruit near harvest. Consult your Extension specialist for recommendations on scouting and control.

FROST AND SCALD CONTROL

Frost. Sprinkle during every frost period after buds have started to swell. Overuse of sprinkler irrigation for frost protection too early in the season, prior to bud swell, can result in reduced control of weeds with pre-emergent herbicides. During severe freezes, occasional sprinkling may not give complete protection. Coating with ice will help prevent desiccation. Do not turn off sprinklers until ice on the vines has melted, or the temperature is well above freezing. To avoid frost damage, it is critical that the temperature sensor is exposed to open sky and located at the lowest elevation in the bed at the tip.

Scald. Sprinkle during periods of high temperatures and low relative humidity. Turn sprinklers on before the temperature reaches 80° to 85°F. Beds with weak vines (e.g., herbicide, weevil, or disease-damaged) on sandy sites are most susceptible to scald damage.

Weed Control

Herbicide use in cranberry beds is often more difficult than in other crops and cropping situations. The root system of cranberries consists of a mass of fine, fibrous roots. Most of the roots are in the upper 4- to 6-inches of soil, making herbicide injury more likely. Furthermore, cranberry beds are acidic and usually high in organic matter; both soil characteristics affect herbicide action. If higher herbicide rates are used to gain weed control, chances for cranberry injury are increased. Under most conditions, the chemical weed control practices outlined have proved to be effective and selective to cranberries when carefully used according to directions. Soil pH management can be an important tool in controlling weeds. Soil pH's above 5.0 will encourage some species of weeds. Gradually lowering pH with elemental sulfur, when combined with a good herbicide program, is an effective means of controlling some leguminous weeds. Avoid use of any elemental sulfur in areas that are poorly drained.

SWAB TREATMENTS

Tall Weeds on Beds

- **Glyphosate (Roundup)**—Use solutions as directed by product label, swabbed on weeds extending at least 6 inches above cranberry vines.

  Do not allow solution to drip or touch cranberry vines. Apply no later than 30 days before harvest. Repeat treatment may be necessary; wipe in both directions to improve results; use a recommended dye to observe coverage patterns. Do not use, mix, or store in galvanized pipe or container. Rainfall or irrigation occurring within 6 hours after application may reduce effectiveness. Poor growing conditions such as stress, disease, or insect damage also may reduce effectiveness. Adding 2,4-D to Roundup may improve control against some broadleaf weeds. Do not mix these two products together without diluting one first, or they may solidify.
Roundup (50% to 100% solution) also may be applied as a stump treatment or injection and as a frill application. Use for woody brush control in and around cranberry beds. Apply after fruit set and no later than 30 days before harvest.

- Clopyralid (Stinger)—use a 2% wiper solution as directed by product label on susceptible weed species that extend well above the cranberry canopy. The only Stinger formulation registered for this use is Special Local Needs label WA-030006. The label must be in the grower’s possession at the time of application.

POST-HARVEST SPOT TREATMENT OF WEEDS

- Sethoxydim (Poast) or clethodim (Select)—apply to susceptible grass species that remain actively growing during the winter.

- Clopyralid (Stinger)—apply after harvest to clover and lotus using a hand-held sprayer. Follow label precautions regarding use near standing water. Use of Stinger after bud swell in spring will result in crop damage. Follow label for precautions on timing.

- Check with an Extension educator to see if a section 18 exists for an effective post-emergent herbicide.

NEW PLANTING PREPARATION

Pre-plant weed eradication of perennial weeds prior to planting is critical. Fumigation or multiple spraying of new and established weeds with Roundup in the summer prior to planting a new bed or renovating a weedy bed is highly recommended. If sand is used on new plantings, make sure it is free of weed seeds. Sand 3- to 4-inches deep is needed to prevent weeds from emerging through the layer. To avoid introducing new weed seeds, use vines that are taken from weed-free beds. Purchase and use of fumigants in Washington requires applicators have a fumigant endorsement.

Pre-emergent Weed Control

- Norflurazon (Evital 5G) at 1 to 2.5 lb active ingredient per acre (20-50 lb product). Use lower rates (15-20 lb. product) on 'Stevens,' 'Grygleski 1,' 'Crimson Queen,' 'Mullica Queen,' or 'Pilgrim' varieties or on sandy soils. Injury may occur in areas where water puddles. Plants that are not true grasses resist treatment. For fescues and annual bluegrass control use clethodim (Select). Some growers have reported slight phytotoxicity from the crop oil concentrate used with grass herbicides. Damage is avoidable if products are not applied to point of runoff.

- Napropamide (Devrinol 10G) at 3 lb active ingredient per acre (30 lb product). Use split applications of lower rates on sandy soils. Combinations of both Devrinol and Evital at low rates may improve weed control on new plantings.

**Post-emergent Grass Control**

- Sethoxydim (Poast) at 0.5 to 1.5% solution (4 tsp to 4 tbsp and 8 tsp crop oil/gal water).

- Clethodim (Select 2EC) or (Select Max). See label for spot treatment rate. Apply to actively growing grasses listed on label at the 4- to 5-leaf stage (6- to 12-inches tall). Apply to obtain thorough coverage but not to runoff. Repeat treatment if necessary as often as three times (June, July, and August). Erratic results occur when grasses are stressed from lack of vigor, drought, high temperature, low fertility, mature grass stage of growth, and unknown environmental factors. New cranberry growth is sensitive to crop oil applied at high rates (>1%) with high spray volumes on hot days.

- Callisto at 4 to 8 fl. oz. per acre. Should be applied at early post-emergence for best control. Does not work across all grass species. Can be applied through chemigation or broadcast with 1/4 v/v NIS or crop oil.

**Post-emergent Broadleaf Control**

- Callisto at 4 to 8 fl. oz. per acre. Should be applied at early post-emergence for best control. Can be applied through chemigation or broadcast with 1/4 v/v NIS or crop oil.

**GRASS CONTROL ON BEARING BEDS**

- Sethoxydim (Poast) at 0.5% to 1.5% solution (4 tsp to 4 tbsp and 8 tsp crop oil/gal water). Use the higher rates for perennial grass control.
Repeated applications may also be necessary. Do not exceed 5 pints per acre per season. Do not apply within 60 days of harvest.

- Clethodim (Select 2EC) or (Select Max). See label for spot treatment recommendations. Do not apply within 30 days of harvest.

- Callisto at 8 fl. oz. per acre plus 1/4 to 1/2% v/v crop oil. Apply to newly emergent and young grass.

PERENNIAL BROADLEAF CONTROL ON BEARING BEDS

Some of the worst perennial weeds, such as silverleaf, purple aster, and lotus, can be controlled or suppressed with two applications of Callisto. The first timings should correspond to when the plants have full emergence and have adequate canopy to treat, usually early May. The second timing should aim at any regrowth that has occurred, usually mid-June. Several years of treatment may be necessary to achieve permanent control. Pre-emergent herbicides like Casoron may also be required if other weed species, like horsetail, begin to dominate. Prolonged annual use of pre-emergent herbicides, like Casoron, will result in a significant decline in bed productivity. This may be partially mitigated by frequent sanding.

- Curio at 1/2 to 1 oz. per acre can be applied from March up to 60 days PHI to control creeping buttercup and some other broadleaf weeds. Use lower rate when cranberries are rapidly growing.

ACUTE TOXICITY OF INSECTICIDES TO BEES

Insecticides vary in their impact on bees. Many cannot be applied on blooming crops or weeds. If they were, the results would be devastating to the bees. There are also some that can be applied to bloom but are restricted to late evening, night, or early in the morning. Also, pay attention to weather conditions. If temperatures are unusually low following treatment, residues on the crop may remain toxic to bees up to twice as long as during reasonably warm weather. Conversely, if abnormally high temperatures occur during late evening or early morning, bees may actively forage on the treated crop during these times. Finally, there are a number of insecticides and miticides that can be applied at any time with reasonable safety to bees. See PNW0591, *How to Reduce Bee Poisoning from Pesticides*, to determine the toxicity status of any particular product.
<table>
<thead>
<tr>
<th>Time of application</th>
<th>Weed*</th>
<th>Materials*</th>
<th>Amt. formulation Per acre**</th>
<th>Tolerance in ppm</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dormant stage</td>
<td>Catsear* or false dandelion, spikerush*, oniongrass*, cottontop*, rush*, broadleaf weeds</td>
<td>Riverdale 2,4-D Granules (2,4-D)</td>
<td>20 lbs</td>
<td>0.5</td>
<td>Apply 2,4-D before weed emergence, while cranberries are completely dormant and dry. Only use granular formulation registered for cranberries. Do not use products with significant amounts of fine powder. 2,4-D provides only limited residual weed control.</td>
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<td>February to late April</td>
<td>Birdsfoot trefoil (lotus), buttercup*</td>
<td>Devrinol 10G (napropamide)</td>
<td>60–90 lbs.</td>
<td>0.1</td>
<td>Apply Devrinol at 90 lbs. before start of spring growth to dry vines to suppress Lotus. Rain or sprinkler irrigation of at least 1/4-inch after application is essential for weed control. Devrinol may lose effectiveness if repeatedly used at high rates in the same field for several years. Do not apply after bud opening or more than once per year. Use lower rates on 'Stevens' or 'Pilgrim' varieties, on sand beds, or on beds having weak vines.</td>
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<tr>
<td>Rice cutgrass, poverty-grass*, smokegrass, barnyard grass, needle-grass, spikerush, nutsedge</td>
<td>Evital 5G (norflurazon)</td>
<td>50–160 lbs.</td>
<td>0.1</td>
<td>Better weed control can be achieved by using two equal applications in the spring (50 lbs. each). Make second application 3- to 6-weeks after first. Do not apply at or after popcorn stage. Do not exceed 100 lbs. of product per year on producing beds. Higher rates or continued annual use of Casoron will result in reduced yields and bed decline. Avoid over-application, which may result from overlapping during treatment period.</td>
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<tr>
<td>Annual broadleaf weeds, purple aster, loosestrife, rush, sedge, grass, field horsetail, silverleaf</td>
<td>Casoron 4G (dichlobenil)</td>
<td>40–100 lbs.</td>
<td>0.1</td>
<td>Best control of hard-to-kill weeds may be obtained by using these two herbicides in combination. Use granular formulations of these herbicides and follow all precautions and restrictions as given for each herbicide when used alone (see above). Do not apply at or beyond popcorn stage. May be used as a split application in late February and early to mid-April for more effective weed control.</td>
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<tr>
<td>Multiple species—severe infestation</td>
<td>Casoron 4G (dichlobenil) plus Riverdale 2,4-D Granules (2,4-D)</td>
<td>30–50 lbs.</td>
<td>0.1</td>
<td>Timing will vary by species. Better control of hard-to-control species will require two applications. Do not exceed 16 fl. oz. of product per year. Damage to vines is minimal when label instructions are followed. (Chemigation Special Local Needs registration is WA-1100001.)</td>
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<tr>
<td>March 1 to late April</td>
<td>Creeping Buttercup</td>
<td>†Curio (chlorimuron ethyl)</td>
<td>0.5–1 oz.</td>
<td>0.02</td>
<td>Spring application is the preferred timing for Curio. Use lower rate when applying between May and early July. Do not apply more than one application per season. Special Local Need registration is WA-100004.</td>
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<tr>
<td>Late April to August</td>
<td>Multiple species</td>
<td>†Callisto (mesotrione)</td>
<td>8 fl. oz.</td>
<td>0.01</td>
<td>Timing will vary by species. Better control of hard-to-control species will require two applications. Do not exceed 16 fl. oz. of product per year. Damage to vines is minimal when label instructions are followed. (Chemigation Special Local Needs registration is WA-1100001.)</td>
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<tr>
<td>November to late April and July to August</td>
<td>Birdsfoot trefoil (lotus), purple aster, clovers</td>
<td>†Stinger (cloparylad)</td>
<td>0.6 pt.</td>
<td>4.0</td>
<td>Application should be made post-emergent when weeds are clearly visible, but before they become too large. Timing will vary by species. Special Local Needs registration is WA-030006.</td>
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</table>

*Weeds not on product label; some suggested uses of pesticides in this publication are for weeds not listed on the label. These are indicated by the symbol*. Such uses comply with the federal law (FIFRA) which says a use is consistent with label instructions provided the crop or site is on the label and directions concerning rates and interval before harvest are followed.

†A Special Local Needs registration has been granted for this use under Section 24 (c), FIFRA.
**SPRAY COMPATIBILITY (ABILITY TO MIX) CHART FOR FUNGICIDES AND INSECTICIDES**

**Combining Chemicals**

It may be to your advantage to control several problems with a single spray application by combining several chemicals. Read the label and follow the manufacturer's directions when making these mixtures. This compatibility chart is provided to help you in preliminary planning only. Compatibilities can vary from those indicated on this chart because of change in solvents and emulsifying agents, etc. It is a good idea before making a tank mixture to perform a "jar test." Mix the chemicals in a jar of water at approximately the recommended dilution rate. After thorough shaking, let stand for 20 minutes. If the combination remains mixed, or can be remixed readily, the mixture is physically compatible. Some mixtures may be phytotoxic (cause plant injury). To determine if a combination is phytotoxic, spray a small area and then evaluate 3 to 7 days later for visual effects. Agitation is recommended when mixing and using mixtures of pesticides.

When preparing mixtures, add wettable powder or water-dispersible granules to the tank first, followed by flowable products. Add emulsifiable concentrate products last. Again, be sure to provide adequate agitation in the tank while mixing and spraying.

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<th>Sevin</th>
<th>Orthene</th>
<th>mancozeb</th>
<th>Lorsban</th>
<th>Kocide</th>
<th>ferbam</th>
<th>diazinon</th>
<th>Bravo*</th>
<th>Bordeaux</th>
<th>Ridomil Gold</th>
<th>Abound**</th>
<th>Aliette</th>
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Blank = Normally compatible; however, most recent compatibility charts suggest not to mix unless approved by manufacturer.

C = Caution, may be incompatible or compatibility unknown.

X = Incompatible.

† = Do not combine Bordeaux mixture or Kocide with an insecticide.

? = Compatibility profile unknown.

* Do not use a spreader-sticker with Bravo.

**Abound flowable is compatible with many commonly used pesticides, liquid fertilizers, and biological control products. Nonetheless, performing a "jar test" is still recommended.
RESOURCES

Hard copy:


*Cranberry Production in the Pacific Northwest.* PNW0247.

*Laundering Pesticide Contaminated Clothing.* NEHEG8115.


Online:

WSU Urban IPM and Pesticide Safety Education Program Home Page
http://pep.wsu.edu

Other useful Internet sites:

Washington State Pest Management Resource Service
http://wsprs.wsu.edu

Pesticide labels and MSDS Sheets
http://www.greenbook.net/
http://www.cdms.net/

WSU Extension publications
http://pubs.wsu.edu

National Ag. Safety Database
http://www.cdc.gov/niosh/nasd.html

Online Pest Management Handbooks
http://plant-disease.ippc.orst.edu/
http://pnwpest.org/pnw/insects
http://weeds.ippc.orst.edu/pnw/weeds
Use pesticides with care. Apply them only to plants, animals, or sites as listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

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