2019 Cranberry Pest Management Guide

WASHINGTON STATE UNIVERSITY EXTENSION • EB0845E

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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.

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NOTE: WSU recommendations are based on the latest available information. They may occasionally differ from a label. If so, the label instructions supercede WSU instructions. Always check the label before using the chemical. This guide replaces earlier editions. Do not use after December 31, 2019.

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 descriptions 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.

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 contaminate food, feed, or water sources, and preferably in locked storage where children and animals cannot reach them.

Be certain that the pesticide label permits chemigation of cranberries before applying it through the sprinkler system.

Be especially careful not to introduce pesticides into bodies of water during the chemigation process.

Avoid contact with pesticides. If any is spilled on skin or clothing, wash it off the skin thoroughly with soap and water and change clothing immediately. Launder clothing separately from other household items.

Avoid inhaling pesticide dusts or mists.

When handling pesticides, wear clean, dry clothing and appropriate personal protective equipment listed on the label.

Wash your hands and face immediately after completing a pesticide application.

Do not eat, chew gum, smoke, or use chewing tobacco while handling pesticides. Wash hands before engaging in these activities and before using the bathroom.

To protect fish and wildlife, do not contaminate lakes, streams, or ponds with pesticide. Do not clean spraying equipment or dump excess spray material near water.

Dispose of empty pesticide containers so they do not pose a threat to human beings or the environment. Rinse empty containers at least three times and pour the rinse water into the spray tank. Unless containers can be returned 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 product 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 Safety Data Sheets (SDS) for more information. (See resources at the end of this publication for online sources of pesticide labels and SDS.)

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 has recently been updated and is available online. Compliance is mandatory.

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. For the Grayland growing area only, the WSDA has made Diazinon a restricted use pesticide (WAC 16-232-400). This product can not be used unless all drainage ditches are cribbed and covered and no open water body is exposed to pesticide contamination. Refer to WSDA for more information.

EXPORT MARKET RESTRICTIONS

Foreign countries often have lower tolerances for pesticides than the U.S. Growers producing for the export market should consult their packer/shipper to assure that the pesticides that are used will not exceed those tolerances.

In 2019 the residue tolerance of the herbicide Quinclorac will be set too low for any growers who have used this product to qualify their fruit for the export market. Similar restriction may apply for other pesticides. Consult your handler for details regarding use restrictions.

APPLICATION OF PESTICIDES THROUGH A CHEMIGATION 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 recommendations is available online or from the WSU Long Beach Research and Extension office.

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 WDG. 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.

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. Application of the fungicides Aliette WDG, Ridomil Gold, Phostrol, or Rampart have been beneficial for suppressing Phytophthora when combined with modified soil drainage. Use of these fungicides is best done prior to the conditions becoming favorable for disease development. Before using these fungicides, confirm that the Phytophthora fungus is present (check with your Extension agent). Aliette WDG and Phostrol are applied as foliar sprays. Ridomil Gold is a soil application. Rampart may be applied as either a foliar spray or soil application. Use the liquid formulation of Ridomil Gold for broadcast or chemigation treatment and the granular formulations for spot treatment. When spot treating for Phytophthora, apply fungicides 10' into healthy vines. 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.

COTTONBALL

This disease has been problematic in several beds in Washington. The fungus that causes the disease blights new upright growth in May. In June, flowers become infected, leading to a fruit rot called cottonball or hard rot. White or yellow berries at harvest filled with white mycellium 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, Indar, and Proline are the only fungicides recommended for cottonball. The level of infestation will get progressively worse without treatment.

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 number 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. Bravo or other chlorothalonil-based fungicides applied when shoots show about ½ inch of new growth in the spring is the only effective treatment.

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 fungicides when symptoms are observed and vine overgrowth is excessive. Red leaf spot can also be a significant 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.

FRUIT ROT

Fungicide timing to reduce fruit rot should be made pre-infection rather than post-infection to minimize resistance development. Best fruit rot control can be obtained with fungicide targeting early to mid-bloom. This can be difficult to achieve in farms where there are mixed varieties with different bloom times under the same chemigation systems. The most effective fungicide programs include the fungicides Indar or Proline. In order to prevent fungicide resistance and preserve the effectiveness and durability of fungicides such as Abound, Indar, and Proline, it is CRITICAL to incorporate the fungicide resistance management strategies listed below:

- Follow ALL label instructions, including application interval and recommended rate. Never use less than the lowest recommended rate on the label.
- Alternate or mix fungicides with different modes of action. Use FRAC codes on labels to determine mode of action. Some FRAC codes indicate that fungicides have the same mode of action. For example, Indar and Proline have a different trade name and active ingredient, but they have the SAME mode of action and FRAC code (3). Abound has FRAC code 11.
- For best fruit rot control and fungicide resistance management, always follow up single mode-of-action fungicides applied during bloom (Abound, Indar, Proline) with a multiple mode-of-action fungicide (chlorothalonil or mancozeb) at the end of bloom or post-bloom.

INSECT AND DISEASE CONTROL IN CRANBERRIES

Time of application	Insect or disease	Materials*	Amt. formulation Per acre** Use 300 gal/acre	Tolerance in ppm	††PHI	REI	Remarks
Early dormant stage (Nov. 1 to March 1)	Black vine weevil	†Admire Pro, or	7 fl. oz.	0.05	30 days	12 hr	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.
		Alias 4F	8–16 fl. oz.	0.05	30 days	12 hr	
Bud break	Cottonball (tip blight stage)	Abound Flowable	6-15.5 fl. oz.	0.5	3 days	4 hr	See Cottonball Control text (p. 5)
		Proline 480 SC	5 fl. oz.	0.2	45 days	12 hr	
Rough neck (approx. May 1 to May 15)	Rose bloom	Kocide 2000	6 lbs.	Exempt	None listed	48 hr	See Rose Bloom Control text (p. 5)
	Upright dieback	Bravo Weather Stik or other chlorothalonil-based fungicide	See label	5.0	50 days	12 hr	
April to early May	Black vine weevil	Entomopathogenic nematodes	See label	Exempt			Use a species of nematode that is tolerant of cold soil and apply in accordance with manufacturer's directions.
	Phytophthora root rot	Ridomil Gold GR, or	20–35 lbs.	4.0	45 days	48 hr	See Phytophthora Root Rot Control (p. 5).
		Aliette WDG, or	5 lbs.	0.5	3 days	12 hr	
		Phostrol, or	5–6 pt	Exempt	3 days	4 hr	
		Phiticide, or	5–6 pt	Exempt	3 days	4 hr	Do not mix Aliette WDG or Rampart 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 WDG.
		Rampart	2–4 qt.	Exempt	0 days	4 hr	
Late hook (about May 15 ± 5 days). Avoid application of toxic insecticides after first blossoms appear. Killing bee pollinators will reduce yields.	Rose bloom	Use any fungicide at proper rate listed for the late bloom stage.					**Do not** use Bordeaux mixture in combination with any insecticide. Only Diazinon is labeled for tipworm. For the Grayland growing area, Diazinon is a state-restricted use pesticide and subject to additional restrictions per WSDA (WAC 16-232-400). Orthene: Apply no more than 1.0 lb of active ingredient per acre per crop cycle. **Do not** apply Orthene or Sevin XLR Plus during bloom.
	Blackheaded fireworm	Intrepid 2F, or	10–16 fl. oz.	0.5	14 days	4 hr	
		Diazinon 50W, or	4 lbs.	0.5	7 days	5 days	
		Orthene 97, or	1 lb.	0.5	75 days	24 hr	
		Sevin XLR Plus, or	2 pts.	3.0	7 days	12 hr	
		Success, or	4–10 fl. oz.	0.01	21 days	4 hr	
		Entrust, or	1.25–3 oz.	0.01	21 days	4 hr	
		Delegate WG, or	3–6 oz.	0.04	21 days	4 hr	
		Avaunt, or	6 oz.	1.0	30 days	12 hr	
		Altacor	3–4.5 oz.	1.0	1 day	4 hr	
	Tipworm	Sevin XLR Plus	2 pts.	3.0	7 days	12 hr	See Tipworm Control text (p. 12).

Time of application	Insect or disease	Materials*	Amt. formulation Per acre** Use 300 gal/acre	Tolerance in ppm	††PHI	REI	Remarks
Bloom	Blackheaded fireworm	Pyrenone, or	See label	Exempt	0 days	12 hr	Pyrenone and Bt products only provide temporary suppression of early infestations of second generation larvae.
		Bt products, or	Rate varies by product	Exempt	0 days	4 hr	
		Intrepid 2F, or	10–16 fl. oz.	0.5	14 days	4 hr	
		Altacor	3–4.5 oz.	1.0	1 day	4 hr	
	Fruitworm	Intrepid 2F	10–16 fl. oz.	0.5	14 days	4 hr	Consult WSU first for exact timing of
	Black vine weevil	Avaunt	6 oz.	1.0	30 days	12 hr	Apply weevil adulticide at first signs of adult activity. Apply Avaunt at night to avoid risk to pollinators. Do not apply or allow drift onto blooming crops or weeds while bees are foraging. Repeat every 7 days as required until night sweeping results indicate no weevil activity. Check with WSDA for any new use restriction during bloom.
	Red leafspot***	Dithane M-45, or	3–6 lbs.	5.0	30 days	24 hr	
		Dithane DF Rainshield	3–6 lbs.	5.0	30 days	24 hr	
	Cottonball	Abound Flowable, or	6–15.5 fl. oz.	0.5	3 days	4 hr	
		Indar 2F	6–12 fl. oz.	0.5	30 days	12 hr	
	Fruit rot	Abound Flowable, or	12–15.5 fl. oz.	0.5	3 days	4 hr	Research has shown that two applications of Abound mixed with either Proline or Indar, or sequential applications of a FRAC 3 fungicide (Proline, Indar) with a FRAC 11 fungicide (Abound) starting at early bloom and repeating every 7 to 10 days during the major part of bloom has consistently increased yield and reduced fruit rot at harvest.
		Indar 2F	6–12 fl. oz.	0.5	30 days	12 hr	
		Proline 480SC	5 fl. oz.	0.2	45 days[xx]	12 hr	
Late bloom (when 80% of blossoms have dropped). To protect bee pollinators **do not** apply insecticide during blossoming. Remove bees before spraying with insecticides.	Blackheaded fireworm	Use same insecticide control as in the late hook stage, **except do not apply Orthene if it was used at late hook stage.**					Use insecticides only when necessary. Apply as soon as second generation larvae are seen (about July 5 ± 5 days).
	Fruit rot, **** or Storage rot, or Twig blight***** (Lophodermium), or Red leaf spot	Abound Flowable, or	6–15.5 fl. oz.	0.5	3 days[xx]	4 hr	See Twig Blight Control text (p. 5). 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.
		Bravo Weather Stik, or	See label	5.0	50 days[xx]	12 hr	
		Bravo Ultrex, or	See label	5.0	50 days[xx]	12 hr	
		Echo 90DF, or	3.25–5.75 lbs.	5.0	50 days[xx]	12 hr	
		Ferbam Granuflo, or	6 lbs.	4.0	50 days‡‡‡	24 hr	
		Kocide 2000, or	6 lbs.	Exempt	None listed	48 hr	Ferbam: Do not apply within 28 days after mid-bloom (equivalent to 50 days PHI).
		Dithane M-45, or	3–6 lbs.	5.0	30 days‡‡‡	24 hr	
		Dithane DF Rainshield, or	3–6 lbs.	5.0	30 days‡‡‡	24 hr	
		Dithane F-45 Rainshield, or	2.4–4.8 qts.	5.0	30 days‡‡‡	24 hr	
		ManKocide, or	7 lbs.	5.0	30 days‡‡‡	24 hr	**Do not** combine Bravo or Echo with surfactants or Dipel.
		Indar 2F	6–12 fl. oz.	0.5	30 days	12 hr	
		Proline 480SC	5 fl. oz.	0.2	45 days[xx]	12 hr	**Do not** use Kocide in combination with any insecticide.

Time of application	Insect or disease	Materials*	Amt. formulation Per acre** Use 300 gal/acre	Tolerance in ppm	††PHI	REI	Remarks
July 1 to 15	Fruit rot, **** or Storage rot, Twig blight***** (Lophodermium) Red leaf spot	Any fungicide and its rate listed for late bloom					See Twig blight control text.
	Cranberry fruitworm	Altacor	3–4.5 oz.	1.0	1 day	4 hr	See Fruitworm Control text (p. 14).
		Intrepid	10–16 fl. oz.	0.5	14 days	4 hr	
	Greedy scale	Diazinon 50W	4 lbs	0.5	7 days	5 days	Do not apply if bees are still present.
	Cranberry girdler	Entomopathogenic nematodes Best to apply nematodes no earlier than 14 days following peak moth flight. Follow manufacturer's recommendations for application rates, timing, and irrigation requirements	See label	Exempt			See Cranberry Girdler Control text. (p. 12).
	Adult weevils	Avaunt	6 oz.	1.0	30 days	12 hr	Monitor for adults by sweeping at night.
	Tipworm	Movento	8–10 fl. oz.	0.3	7 days	24 hr	Do not apply until after petal fall.
July 25 to August 10	Storage rot or Twig blight (Lophodermium)	Any fungicide at proper rate listed for late bloom.					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. Spray for fireworm only if third generation larvae are seen.
	Fireworm	Use any insecticide, except Orthene 97 (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.					
	Phytophthora root rot	See April to early May.					
	Vaccinium berry fruit worm	Altacor	3–4.5 oz.	1.0	1 day	4 hr	See Vaccinium berry fruitworm text (p. 12).
		Intrepid 2F	10–16 fl. oz.	0.5	14 days	4 hr	

Time of application	Insect or disease	Materials*	Amt. formulation Per acre** Use 300 gal/acre	Tolerance in ppm	††PHI	REI	Remarks
July 25 to August 10	Black vine weevil	†Admire Pro Alias 4F	7 fl. oz. 8–16 fl. oz.	0.05 0.05	30 days 30 days	12 hr 12 hr	If high adult populations were observed with sweeping, then apply Admire or Alias in this time period to control young larvae, incorporating with several hours of irrigation. Special Local Needs registration is WA-050013 for Admire Pro.
Late July to early September	Black vine weevil	Entomopathogenic nematodes					Apply in accordance with manufacturer's directions regarding irrigation requirements and when soil temperatures exceed 53°F. It is critical to keep soil very moist for several days immediately after applications. Make a single application in spring or fall when larvae are present.
October	Root weevils	See remarks on flood-water control for weevils under root weevil section.					
	Phytophthora root rot	See April to early May					

*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. Minimal control of field rot can be expected if fungicides are applied after blossoms have dropped.
*****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).
xxExport restrictions apply. Consult handler before use.
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.

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.

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 for at least 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 post-bloom and post-harvest application of Admire Pro or Alias 4F, 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 larvae control on peat soils has been poor. Determine the need for adult control by night sweeping. The threshold is 1 adult per 25 sweeps. For adult control apply Avaunt at night at the first indication of peak adult emergence, usually in early to mid-June. Apply Avaunt at night to avoid risk to pollinators. Do not apply or allow drift onto blooming crops or weeds while bees are foraging. Repeat the applications every 10 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.

BLACKHEADED 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.

There are two generations of fireworm per year. The first generation hatch occurs early to mid-May. The second generation hatch occurs mid-June to early-July. The first generation larvae are much easier to target and control than the second generation larvae. 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 and Altacor are most effective against the early instar (<1/8" long) larvae, but large larvae are also controlled. Two applications at 10-day intervals may be required to account for uneven hatch. Intrepid provides 10–14 days control and Altacor provides 14–21 days control.

If the majority of larvae have reached the 1/2"-long stage, applications of softer insecticides like Pyrenone and *Bt* products are unlikely to provide adquate control. Consider the use of other insecticides instead. 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 insecticides 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. The relationship between trap catch numbers and infestation levels is weak, but growers with consistent high counts (>100 moths/trap/week) are likely to have severe infestations of larvae during the second generation. Two insecticide applications at 10- to 14-day intervals may be required to control heavy infestations of second generation larvae. Registered insecticides vary in their retreatment intervals, so it may be necessary to choose two different products for the two applications. *Bt*-based compounds and Pyrenone are sensitive to ultra-violet sunlight and should be applied in mix with a sticker at dusk.

*These pests are not on the label; however, this use is legal when label directions and precautions are followed.

Altacor, Intrepid, *Bt*-based materials, and are not toxic to bees and can be applied during pollination. Failure to obtain control of fireworm with reduced risk insecticides, like Intrepid and Altacor, can be expected when products are applied through sprinkler systems with poor uniformity and/or when wash-off time is too long.

CRANBERRY GIRDLER

There are no effective pesticides registered for cranberry girdler control. Feedback from other growing areas suggest, however, that growers have had some success with Altacor 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 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 recently become a serious pest on several cranberry beds in Washington. It can cause serious crop damage and by the time it is noticed it is too late to provide effective control. Moths start flying and laying eggs in June. They target small pea size fruit to lay their eggs on. There is one generation a year. Best control results from an application of long residual insecticide, like Altacor, when fruit are the size of small green peas. Two applications may be necessary if there is a large persistent population of adults. If you miss this timing you could experience significant crop damage.

VACCINIUM BERRY FRUIT WORM

Vaccinium berry fruit worm (*Lotisma trigonana*) can be a troublesome late season pest for fresh fruit growers. Larvae and moths have been noted to emerge from packaged fruit in the market. Two applications of Altacor or Intrepid in mid-July and mid-August are likely to provide good suppression. It has not been a problem pest for the past decade.

CRANBERRY TIPWORM

Cranberry tipworm has become increasingly more problematic in recent years, and can be found in most all beds in Washington. When infestation rates become too high, there can be significant decline in fruiting uprights in the year after infestation, and reduced production in the year of infestation. Obtaining good insecticide efficacy requires application timings at egg laying and early larva stage. This can be difficult to achieve once generations start to overlap. Good first generation control is required to suppress the tipworm populations. Research trials indicate that multiple applications of Sevin XLR Plus provides some control. Apply when the first signs of tip cupping are noticed in the warm spots on the bed, or when frequent visual inspections of tips with a hand lens indicates eggs or first generation larvae. This is generally around mid-May on most beds. Movento has recently been registered for use after bloom. It provides excellent control. Two applications may be required if the infestation is severe. Check to see if other new insecticides have become available for tipworm 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 and delay spring growth. The tender new upright growth is more sensitive to frost damage than flowers are. During severe frost events, on-off sprinkling may not provide complete protection. 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. All 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 PowerMAX or several other products with this active ingredient)—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.

  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.

  Some glyphosate products have recently added dormant season spot broadcast treatment of weeds on cranberry beds. Do not exceed a 0.5% (v/v) solution. Do not apply after mid February. Make sure this use pattern is on the glyphosate label you are using. Do not use on any of the new hybrid varieties.

- 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 or several other products with this active ingredient)—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 WSU Long Beach REU 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 glyphosate 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 New Plantings

- 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.
- Napropamide (Devrinol 50DF) at 3 lb active ingredient per acre (6 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.
- Callisto at 4–8 oz per acre applied prior to weed emergence.

Post-emergent Grass Control New Plantings

- 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.
- Clethodim (Intensity and Intensity One) may be applied by chemigation (Special Local Needs labels WA-180004 and WA-180005) for control of grass weeds in new plantings. See SLN for label rates and recommendations.

  Plants that are not true grasses are not controlled by sethoxydim or clethodim. 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.

  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.
- Calisto at 4 to 8 fl. oz. per acre. Should be applied at very 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 New Planting

- 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 0.25% v/v NIS or crop oil.
- Chlorimuron (Curio). Apply at 0.5 to 1 oz per acre. See SLN label for details. The registrant is planning to withdraw support of the label in 2016.
- Quinclorac (Quinstar 4L) at 8 oz/ac will control a wide range of annual grasses, broadleaf weeds, rushs, and sedges with minimal risk to new plantings. When broadcasting always use with a 0.25% v/v nonionic surfactant.
- Check with WSU Long Beach REU to see if any new Section 3 or Section 18 exists for post-emergent broadleaf weed control.

GRASS CONTROL 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.
- Clethodim (Intensity and Intensity One). See SLN for chemigation recommendations.
- Callisto at 8 fl. oz. per acre plus 0.25 to 0.5% v/v crop oil. Apply to early post emergent.

PERENNIAL BROADLEAF CONTROL 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 0.5 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.
- Quinclorac (Quinstar) at 8 oz per acre applied twice, first at late pre-emergence or early post-emergences and again in 30 days with or without Callisto (8 oz per acre) will provide control of numerous herbaceous perennial weeds, including yellow loosestrife. Treatment of bearing beds with Quinstar will affect the export sales of fruit from that bed. Consult your handlers for more information.

POLLINATOR PROTECTION AND 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.

The EPA has proposed restrictions on the use of pesticides that are acutely toxic to bees. This includes the insecticides Diazinon, Orthene, Pyrenone, Sevin, Entrust, Success, Delegate, Admire, Alias, and Avaunt. The restrictions would prohibit application of these materials during bloom when commercial pollinators (honey bees) are present and under contract for pollination services. Carefully read the label of your product for pollinator protection restrictions and hazards. For more information and a full listing of impacted active ingredients, see the EPA's policy document, *Policy To Mitigate The Acute Risk To Bees From Pesticide Products*. See PNW591, *How to Reduce Bee Poisoning from Pesticides*, to determine the toxicity status of any particular product.

WEED CONTROL IN CRANBERRIES

Time of application	Weed[Δ]	Materials*	Amt. formulation Per acre**	Tolerance in ppm	Remarks
Dormant stage early spring	Catsear* or false dandelion, spikerush*, oniongrass*, cottontop*, rush*, broadleaf weeds	Riverdale 2,4-D Granules (2,4-D)	20 lbs	0.5	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. Riverdale 2,4-D is limited to one application per dormant season. Max rate is 20 pounds/acre per application.
February to late April	Birdsfoot trefoil (lotus), buttercup*	Devrinol 10G (napropamide)	60–90 lbs.	0.1	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.
	Rice cutgrass, poverty-grass, smokegrass, barnyard grass, needle-grass, spikerush, nutsedge	Evital 5G (norflurazon)	50–160 lbs.	0.1	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.
	Annual broadleaf weeds, purple aster, loosestrife, rush, sedge, grass, field horsetail, silverleaf	Casoron 4G (dichlobenil)	40–100 lbs.	0.1	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.
	Multiple species—severe infestation	Casoron 4G (dichlobenil)	30–50 lbs.	0.1	Better 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.
		plus			
		Riverdale 2,4-D Granules (2,4-D)	5–15 lbs.	0.5	
March 1 to late April	Creeping Buttercup Tussock[Δ]	†Curio (chlorimuron ethyl)	0.5–1 oz.	0.02	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.
Late April to August	Multiple species	Callisto (mesotrione)	8 fl. oz.	0.02	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.
November to late April and July to August	Birdsfoot trefoil (lotus), purple aster, clovers	†Stinger (clopyralid)	0.6 pt.	4.0	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.
Late April to July	Yellow loosestrife	††Quinstar (quinclorac)	8 fl oz.	1.5	Most effective when applied to new growth in spring. Do not exceed 16.8 fl oz. of product per year.

[Δ]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.
††Export restrictions apply. Consult handler before use.

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.

	Sevin	Orthene	mancozeb	Kocide	ferbam	diazinon	Bravo*	Ridomil Gold	Abound**	Aliette WDG
*Bravo									?	
diazinon		C		†				?	?	
ferbam				C				?	?	
Kocide	†	†	C		C	†		?	?	X
mancozeb				C					?	
Orthene				†		C		?	?	
Sevin				†				?	?	
Ridomil Gold	?	?		?	?	?			?	
**Abound	?	?	?	?	?	?	?	?		
Aliette WDG				X						

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:

Polashock, J.J, F.L. Caruso, A.L. Averill, A.C. Schilder. 2017. *Compendium of Blueberry and Cranberry Diseases*. 2nd Edition. 231 pages. APS Press, 3340 Pilot Knob Road, St. Paul, MN 55121-2097. 1-800-328-7560. http://www.APSnet.org

Pacific Northwest Insect Management Handbook. MISC0047. Revised annually. Available through Washington State University Extension, Pullman; or Oregon State University Extension Service, Corvallis.

Pacific Northwest Plant Disease Management Handbook. MISC0048. Revised annually. Available through Washington State University Extension, Pullman; or Oregon State University Extension Service, Corvallis.

Pacific Northwest Weed Management Handbook. MISC0049. Revised annually. Available through Washington State University Extension, Pullman; or Oregon State University Extension Service, Corvallis.

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 SDS Sheets
http://www.greenbook.net/
http://www.cdms.net/

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

National Ag. Safety Database
http://www.nasdonline.org/

Online Pest Management Handbooks
http://pnwhandbooks.org/plantdisease/
http://pnwhandbooks.org/insect
http://pnwhandbooks.org/weed/
http://longbeach.wsu.edu/cranberries/

Pollinator protection:
EPA Pollinator Protection
https://www.epa.gov/pollinator-protection

PNW591, *How to Reduce Bee Poisoning from Pesticides*
http://pubs.wsu.edu/ItemDetail.aspx?ProductID=14994&SeriesCode=&CategoryID=&Keyword=pnw591
OR
https://tinyurl.com/y7kummk2

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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