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Cranberry pest management in Wisconsin

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Pesticide labels change often and contain information that is beyond the scope of this document. This publication is not a substitute for the label. Always read the pesticide label prior to use.

Abbreviations

D=dust

G=granules

DF=dry flowable

E or EC=emulsifiable concentrate

F=flowable

LC=liquid concentrate

S=solution or sprayable

SC= soluble concentrate

WBC=water-based concentrate

WP=wettable powder

Not all cranberry pests will be present or economically important in your planting every year. Use the enclosed information and spray schedules as a guide in planning your own pest management program to fit your specific needs for the 2016 season.

It is important to keep careful records on chemicals used, strengths, amounts applied, and application dates. These records will be useful when planning future pest control practices.

Growers who use the chemical treatments described in this publication assume full responsibil-ity for their use according to all current manufacturer label instructions. The Environmental Protection Agency (EPA) approves these instructions and their registration number appearson the label.

IN THE EVENT OF A PESTICIDE EMERGENCY, REFER TO PAGE 4.

Recommendations in this publication are current as of November 15, 2015.

Contents

Pest management and pesticides

Controlling a pest—be it a weed, an insect, or a disease—is only part of a total pest management program. Pest control is a corrective measure; you use pesticides or some other control method to reduce a damaging (or potentially damaging) pest population. Pest management, however, includes preventative measures as well.

The primary goal of a pest management program is to maintain an acceptable level of pest damage. Eradication of pests is rarely possible or feasible. In fact, our eradication attempts may create more problems (e.g., pesticide resistance, secondary pest outbreaks) than they solve. Pesticides are vital, effective tools for agriculture and for food and fiber production, but they are not a cure-all for all pest problems. Rather, they must be viewed in the context of a total pest management program.

Integrated pest management

Integrated pest management (IPM) is the coordinated use of multiple pest control methods. By becoming familiar with the crop, the pest, and all available control tactics, you can develop and implement a sound IPM program that will help you apply pesticides only when necessary.

Federal pesticide-use law

When Congress amended the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) in 1972, it included a mandate for the Environmental Protection Agency (EPA) to evaluate all new and existing pesticide products for potential harm they may cause. It also made it illegal to use, except as provided by FIFRA, any pesticide in a manner inconsistent with its labeling. Deviations from the label not recognized by FIFRA are a violation of the law.

The Food Quality Protection Act (FQPA) of 1996 strengthens the system that regulates pesticide residues on food. Recognizing that pesticide residues are present in more sources than just food, the FQPA sets limits on the total exposure from residues found in food, drinking water, and nondietary sources (such as household, landscape, and pet uses). As a result, the more uses a particular pesticide has, the greater the chance its total exposure will be met and, thus, some or all of its uses will be cancelled.

If, during the pesticide registration process, the EPA finds a product to generally cause unreasonable adverse effects on the environment—including increased risk of injury to the untrained applicator—it will be classified as restricted-use. Because restricted-use products can be used only by certified applicators, the FIFRA amendments also called for each state to develop a program for training and certifying pesticide applicators. The certification program is designed to ensure that users of restricted-use products are properly qualified to handle and apply these materials safely and efficiently. A current list of restricted-use pesticides registered for use in Wisconsin may be downloaded from the Pesticide Applicator Training (PAT) website (ipcm.wisc.edu/pat).

Wisconsin's training and certification program

In Wisconsin, responsibility for training lies with the University of Wisconsin-Extension's PAT program, while actual certification is the responsibility of the Wisconsin Department of Agriculture, Trade, and Consumer Protection (WDATCP). The Wisconsin Pesticide Law requires that all commercial applicators for hire participate in the training and certification process if they intend to use any pesticide in the state of Wisconsin, whether or not it is restricted-use.

The training prepares the applicators for the written certification exam administered by the WDATCP, which enforces Wisconsin's pesticide regulations and assures a competent understanding of the use of pesticides.

The selection, use, and potential risks of pesticides vary depending on the application method and what it is you want to protect from pests. Therefore, there is a separate training manual and certification exam for 21 pest control categories, including categories for: agricultural producers, the agricultural industry (10 categories), in and around commercial and residential buildings (6 categories), in right-of-way and surface waters (3 categories), and preserving wood. Certification is valid for 5 years, after which you can recertify by passing an exam based on a revised training manual.

The regulated community—including pesticide manufacturers, dealers, and applicators—strongly support training and certification as a way to protect people and the environment while ensuring that pesticides remain an option in pest management. We encourage all applicators to take advantage of the training and certification process, whether or not you use restricted-use pesticides. For information about the Wisconsin PAT program, contact your county Extension agent or visit ipcm.wisc.edu/pat. For information on Wisconsin's licensing and certification program, search for "pesticide certification" on datcp.state.wi.us.

Wisconsin pesticide laws and regulations

Operating under the provisions of the Wisconsin Pesticide Law and Administrative Rule, Chapter ATCP 29 (Register, April 2009), the WDATCP has primary responsibility for pesticide use and control in the state. The Wisconsin Department of Natural Resources (WDNR) has responsibility for pesticide use involving "waters of the state," the control of birds and mammals, and pesticide and container disposal. The Wisconsin Division of Emergency Management (WDEM) has responsibility for helping communities evaluate their preparedness for responding to accidental releases of hazardous compounds, including pesticides, under Title III of the EPA's Superfund Amendments and Reauthorization Act (SARA). The Wisconsin Department of Transportation (WDOT) has responsibility for regulating the transportation of pesticides listed as hazardous materials (shipping papers, vehicle placarding, etc.), and for issuing commercial driver's licenses. It is your responsibility to become familiar with all pertinent laws and regulations affecting pesticide use in Wisconsin.

Pesticides and community right-to-know

To help communities evaluate their preparedness for responding to chemical spills, Congress passed the Emergency Planning and Community Right-to-Know Act (EPCRA). This law is part of a much larger legislation called the Superfund Amendments and Reauthorization Act (SARA) and is often referred to as Title III of SARA. Title III sets forth requirements for reporting of hazardous substances stored in the community and for developing an emergency response plan.

The first step in emergency planning is to know which chemicals can cause health problems and environmental damage if accidentally released. The EPA prepared a list of extremely hazardous chemicals. These substances are subject to emergency planning and the threshold planning quantity, the smallest amount of a substance which must be reported. Some of the chemicals listed are commonly used in agricultural production (see table 1).

A complete list of EPA's extremely hazardous substances is available from the Local Emergency Planning Committee (LEPC) in your county or from the EPA website: www.epa.gov/emergency-response.

Any facility, including farms, that produces, uses, or stores any of these substances in a quantity at or greater than their threshold planning quantity must notify the WDEM and their LEPC that it is subject to the emergency planning notification requirements of Title III of SARA.

In addition to emergency planning notification, agricultural service businesses with one or more employees are subject to two community right-to-know reporting requirements: submission of safety data sheets (SDS) and submission of Tier II inventory forms. Tier II forms request specific information on each hazardous chemical stored at or above its threshold.

Table 1. Examples of agricultural chemicals subject to Title III of SARA

Active ingredient	Trade name	Threshold planning quantity (lb or gal of product)
Dimethoate	Dimethoate 4EC	125 gal
Endosulfan	Thiodan 50W	20 lb
Paraquat	Gramoxone Inteon	5 gal

Worker Protection Standard (WPS) for agricultural pesticides

The federal Worker Protection Standard (WPS) for Agricultural Pesticides took effect January 1, 1995. Its purpose is to reduce the risk of employee exposure to pesticides. You are subject to the WPS if you have at least one non-family employee who is involved in the production of agricultural plants in a nursery, greenhouse, forest, or farming operation.

The WPS requires employers to do the following:

- Display pesticide safety information in a central location.
- Train uncertified workers and handlers on general pesticide safety principles.
- Provide personal protective clothing and equipment to employees.
- Provide a decontamination site (water, soap, towels, and coveralls).
- Provide transportation to an emergency medical facility for employees who are poisoned or injured by pesticide exposure.
- Notify employees about pesticide applications (see below).

For more information about the WPS and the training requirements for uncertified workers and handlers, download the revised 2005 edition of EPA's *How To Comply* manual (www.epa.gov/pesticide-worker-safety/pesticide-worker-protection-standard-how-comply-manual).

Oral notification and posting

The WPS requires employers to give notice of pesticide applications to all workers who will be in a treated area or walk within 0.25 miles of a treated area during the pesticide application or during the restricted entry interval (described below). Notification may either be oral warnings or posting of warning signs at entrances to treated sites; both are necessary if the label requires dual (oral and posting) notification. A current list of dual-notice pesticides registered for use in Wisconsin may be downloaded

from http://ipcm.wisc.edu/pat/download/download/Dual-Notice_2014.pdf.

Wisconsin's Agriculture, Trade & Consumer Protection (ATCP) 29 posting rule is designed to protect the general public as well as workers. Thus, it requires posting of areas treated with pesticides having a dual notification statement or, for non-agricultural pesticide applications, if the label prescribes a restricted entry interval for that particular application. Refer to *On-Farm Posting of Pesticide-Treated Sites in Wisconsin* for a flow chart guiding users through a series of questions to determine when posting of treated sites is needed, what warning sign to use, and where the sign should be located. Also covered are the separate posting requirements for chemigation treatments. This publication is available from your county Extension office or online at ipcm.wisc.edu/pat/downloads. Or you can use the PAT Programs online posting tool (ipcm.wisc.edu/tools/Posting) to identify what signs must be posted and when.

Restricted entry interval (REI)

A restricted entry interval (REI) is the length of time that must expire after pesticide application before people can safely enter the treated site without using personal protective equipment. Pesticide residues on a treated crop or in a treated area may pose a significant hazard to workers or others who enter the area after treatment. Therefore, nearly all pesticides affected by the WPS (see above) have an REI (see table 3). Check the Agricultural Use Requirements section on the label for the specific REI for your product. These intervals must be strictly observed.

Pesticide tolerance levels

In Public Law 518, the Food and Drug Administration (FDA), a division of the U.S. Department of Health and Human Services, warns "Food shipments bearing residues of pesticide chemicals in excess of established tolerances will be contraband and subject to seizures as adulterated." This applies to both raw and processed foods.

The amount of pesticide residue in or on a food material at harvest must fall into established tolerances, expressed in parts per million (ppm). The actual amount of pesticide chemical found in a food at harvest depends in part on the amount applied to the crop and the length of time since the last application. Therefore, growers are responsible for strictly following label information with regard to maximum spray dosage and the interval between the final pesticide application and harvest. The FDA advises pesticide users to follow directions on recently registered labels, so they don't exceed the residue tolerances for the specific materials. Use table 3 as a guide to the interval between the last pesticide application and harvest. The pre-harvest intervals refer to pesticide use on cranberries only; other crops may have different intervals. The pesticide label also lists this information.

Pesticide toxicity

Pesticides enter the human body in four common ways: through the skin (dermal), the mouth (oral), the lungs (inhalation), and the eyes. Agricultural workers are most often poisoned by absorbing the pesticides through the skin.

Perhaps the greatest hazard for the applicator is in loading and mixing the pesticide concentrate, which presents a significant risk of exposure to the chemical in its most toxic form. Although hazards associated with the actual application are frequently much less severe, they can still be substantial, especially if there is significant drift or if appropriate precautions are ignored. A pesticide may be toxic as a result of exposure to a single dose (acute toxicity) or repeated exposures over time (chronic toxicity).

Acute toxicities are normally expressed as the amount of pesticide required to kill 50% of a population of test animals (usually rats or rabbits). For oral and dermal exposure, this is referred to as the LD50 or "lethal dose to 50%" in milligrams of toxicant per kilogram of body weight (mg/kg). For inhalation exposure, it is expressed as the LC50 or "lethal concentration to 50%" in parts per million (ppm) of toxicant in the total volume of air when the toxicant is a gas or vapor, and in milligrams per liter (mg/l) of air or water when the toxicant is a dust or mist. **Pesticides with greater acute toxicities have lower LD_{50} and/or LC_{50} values; that is, it takes less of the chemical to kill 50% of the test population**.

Labels indicate the relative level of acute toxicity through the use of signal words and symbols that reflect general categories of toxicity (see table 2). The toxicity category is assigned on the basis of the highest measured toxicity, be it oral, dermal, or inhalation; effects on the eyes and external injury to the skin are also considered.

Table 2. Toxicity categories of pesticides

	Toxicity category			
Measure of toxicity	I High toxicity	II Moderate toxicity	III Slight toxicity	IV Low toxicity
Oral LD_{50} (mg/kg)	0–50	50–500	500–5,000	>5,000
Dermal LD_{50} (mg/kg)	0–200	200–2,000	2,000–20,000	>20,000
Inhalation LC_{50} gas/vapor (ppm) dust/mist (mg/l)	 0–200 0–0.2	 200–2,000 0.2–2	 2,000–20,000 2–20	 >20,000 >20
Eye effects	corrosive	irritation persists for 7 days	irritation reversible within 7 days	no irritation
Skin effects	corrosive	severe irritation	moderate irritation	mild irritation
Signal word	DANGER[a]	WARNING	CAUTION	CAUTION

mg/kg = milligrams per kilogram **ppm** = parts per million **mg/l** = milligrams per liter
< = less than **>** = greater than

[a] Products assigned to Category I due to oral, inhalation, or dermal toxicity (as distinct from eye and skin local effects) also must have the word "poison" and the "skull and crossbones" symbol on the label.

Human poisoning

In the event of human pesticide poisoning, the pesticide label is your first source of first-aid information. Always bear in mind, however, that first-aid response to pesticide exposure is not a substitute for professional medical help. Seek medical attention promptly and always be sure to give the label or labeled container to the doctor. The product's Safety Data Sheet (SDS, formerly known as MSDS) is a more technical document than the label, and it often contains additional treatment instructions for the attending medical professional.

Poison Control Center (1-800-222-1222). You may call the Poison Control Center at any hour for information regarding proper treatment of pesticide poisoning. While hospitals and medical facilities may have some information, the Poison Control Center has the most complete and current files, and their personnel are specifically trained to deal with poison cases.

Pesticide safety

Before you handle pesticides, **stop and read the label**. Labels contain human safety precaution statements and list the specific protective clothing and equipment that you need to wear. Some of the following may be label requirements; others are common-sense guidelines that will help minimize pesticide exposure to you, your co-workers, and your family and neighbors.

- Wear a long-sleeved shirt, long trousers, shoes, and socks when handling pesticides.
- Wear coveralls (fabric or chemical-resistant) over your work clothes for an added layer of protection.
- Unless the label states otherwise, always wear chemical-resistant gloves whenever you work with pesticides.
- Wear chemical-resistant footwear, gloves, eyewear, and a respirator (if the label requires one) when mixing, loading, or applying pesticides.
- If you wear fabric coveralls, also wear a chemical-resistant apron when mixing and loading pesticides.
- Stand in the crosswind when mixing or loading pesticides.
- Never apply pesticides when there is the likelihood of significant drift.
- Never leave a spray tank containing a pesticide unattended.
- Avoid back-siphoning into the water source.
- Never eat, drink, or smoke when handling pesticides.
- Wash hands thoroughly after handling pesticides.
- If you splash pesticide on yourself, remove contaminated clothing immediately and wash yourself thoroughly.
- Wash contaminated clothes separately from other household laundry.
- Keep pesticides in original containers.
- Store and lock pesticides out of the reach of children.
- Observe restricted entry intervals on a treated crop or area.

Pesticide accidents

Pesticide spills. Regardless of the magnitude of a spill, the objectives of a proper response are the same—you must **control** the spill, you must **contain** it, and you must **clean it up**. A thorough knowledge of appropriate procedures will allow you to minimize the potential for adverse effects.

Report spills of any compound to the WDNR. However, you do not need to report the spill if it is completely confined within an impervious secondary containment and the spilled amount can be recovered with no discharge to the environment. On the other hand, a spill of any amount is reportable if it occurred outside of secondary containment and it harmed, or threatens to harm, human health or the environment (e.g., back siphoning). The spill is exempt from the WDNR reporting requirements if you deem the spill will not harm, or threaten to harm, human health or the environment and the amount spilled would cover less than 1 acre if applied at labeled rates and, if a SARA pesticide, is less than the reportable quantity. If unsure, err on the side of caution. You will not get into trouble for reporting a spill that does not need to be reported, but you can get into trouble if you don't report a spill that needs to be reported.

Reportable spills involving SARA substances (see "Pesticides and Community Right-to-Know," page 2) are also to be reported to the WDEM and to your LEPC. To simplify emergency notification requirements to state agencies, call the WDEM 24-hour spill hotline (1-800-943-0003) whenever a spill of any compound occurs. Calling this hotline will not, however, remove your responsibility of notifying your LEPC.

Spills of some compounds may require that you notify federal authorities by calling the National Response Center (1-800-424-8802). Your call to the WDEM spill hotline should provide you with assistance in determining whether federal authorities need to be notified.

Pesticide fires. In the event of a fire, call the fire department, isolate the area, and clear all personnel to a safe distance **upwind** from smoke and fumes. Always inform the fire department of the nature of the pesticides involved and of any specific information that may help them fight the fire and protect themselves and others from injury. For information on cleanup and decontamination, contact the WDEM and the pesticide manufacturer(s).

Livestock poisoning. When you suspect animal poisoning by pesticides, first call your veterinarian. If the cause of poisoning cannot be determined, call the WDATCP's Animal Toxic Response Team at 608-224-4500.

Wildlife poisoning or water contamination. Contact the WDNR district office. District offices are located in Spooner, Rhinelander, Eau Claire, Green Bay, Milwaukee, and Fitchburg.

Pesticides and endangered species

Endangered and threatened species are the most vulnerable plants and animals in our natural communities. These species are either in danger of extinction or likely to become endangered in the foreseeable future. Starting in 2010, the EPA's Endangered Species Protection Program (ESPP) will provide applicators with county-specific bulletins containing pesticide limitations designed to better protect listed species and their habitat.

The first product to carry label text directing users to view a bulletin is methoxyfenozide (Intrepid 2F), to protect the endangered Karner blue butterfly and Hine's emerald dragonfly. It may take several years for products with the new label to replace existing product in the market. As always, users should follow the label on the product they are using.

When using pesticides whose label statements instruct you to follow the measures contained in the ESPP Bulletin, you must either access the EPA's Bulletins Live! website or call their toll-free number (800-447-3813) within 6 months before using the product. The bulletin will show which counties or portions of counties are affected and the use limitations for that particular product. You must use the bulletin that is valid for the month and year in which you will apply the product.

Go to epa.gov/endangered-species for general information on the ESPP. The WDNR is responsible for implementing ESPP for our state. For more information about protected plants, animals, and natural communities in Wisconsin, see http://dnr.wi.gov/topic/endangeredresources/biodiversity.html.

Pesticide drift

It is impossible to totally eliminate pesticide drift. Drift occurs because of unforeseen wind variations and other factors, many of which are beyond the applicator's control. People living in areas subject to pesticide drift worry about the acute and chronic effects of exposure to pesticides. State rules governing pesticide drift attempt to strike a balance between the intended benefits of pesticide use and the potential risks to those exposed to drift.

According to state law, people living adjacent to land that is aerially sprayed with pesticides can request to be notified at least 24 hours before application. Beekeepers also are entitled to notification of applications that occur within a 1.5-mile radius of their honeybee colonies. Both ground and aerial pesticide applications are subject to advance notification requirements to beekeepers who request such notification.

For ground applications, you can minimize drift by following these recommendations:

- Follow all label precautions for specific drift-reduction measures.
- Spray when wind speed is low.
- Use the maximum nozzle orifice without sacrificing pest control activity.
- Keep pressure at the lowest setting possible without distorting spray pattern and distribution.
- Use drift-control agents when permitted by product label.
- Consider using nozzles specifically designed to reduce drift.
- Leave an untreated border strip next to adjacent property.

For more information about drift—what it is, how it occurs, and drift management principles—ask for *Managing Pesticide Drift in Wisconsin: Field Sprayers* from your county Extension office or download it at ipcm.wisc.edu/pat/downloads. This publication also describes the critical role the pesticide applicator plays in deciding whether to spray at the site.

Pesticides and groundwater

Trace amounts of pesticides are appearing in our nation's groundwater. To minimize further contamination, many pesticide labels contain precautionary statements either advising against or prohibiting use in areas vulnerable to groundwater contamination. A summary of these precautionary statements is included under "Remarks" for each pesticide in this publication.

To protect our state's water resources, Wisconsin's groundwater law (Act 310) created two guidelines to limit the presence of fertilizer and pesticides in groundwater: **enforcement standards** are maximum chemical levels allowed in groundwater and **preventive action limits** are set at a percentage of the enforcement standard. When contamination approaches preventive action limits, the responsible party must implement corrective measures to prevent further contamination. To get a list of fertilizers and pesticides and their enforcement standards and preventive action limits, see NR 140 (docs.legis.wisconsin.gov/code/admin_code/nr/100/140).

Through groundwater monitoring studies, the most commonly found pesticide is atrazine. Consequently, Wisconsin implemented Chapter ATCP 30 to help minimize further contamination of our groundwater by atrazine. Under this rule, statewide rate restrictions have been implemented and, in some areas, the use of atrazine is prohibited.

Mixing and loading pesticides. Mixing and loading pesticides pose a high risk of point source contamination of ground and surface water because of the concentration, quantity, and type of pesticides that are usually handled at a mixing and loading site. To minimize this risk of environmental contamination, Wisconsin requires that certain mixing and loading sites have secondary containment.

Both private and commercial applicators are required to have a mixing and loading pad if more than 1,500 pounds of pesticide active ingredient are mixed or loaded at any one site in a calendar year or if mixing and loading occurs within 100 feet of a well or surface water. In-field mixing is exempt from the pad requirements provided mixing or loading at the site of application occurs 100 feet or more from a well or surface water.

Agricultural Chemical Cleanup Program. Cleanup of contaminated soil or of contaminated groundwater itself is costly. The Agricultural Chemical Cleanup Program (ACCP) helps ease the financial burden for facilities and farms by reimbursing them for eligible costs associated with the cleanup of sites contaminated with pesticides or fertilizers. For more information, contact the WDATCP at 608-224-4518.

Calibrating pesticide equipment

Accurate and uniform pesticide application is basic to satisfactory pest control. Too frequently a grower does not know exactly how much pesticide has been used until the application is completed. This can lead to substantial monetary losses due to unnecessary pesticide and labor costs, unsatisfactory pest control resulting in reduced yields, and crop damage. Good pesticide application begins with accurate sprayer or granular applicator calibration. One method of calibration is contained in the *Training Manual for the Private Pesticide Applicator* and the *Training Manual for the Private and Commercial Pesticide Applicator: Fruit Crops*. These are available at ipcm.wisc.edu/pat.

Cleaning pesticide sprayers

Thorough sprayer cleaning is necessary when switching from one pesticide type to another. This is especially important when herbicides are applied with the same equipment as fungicides or insecticides. If you apply significant quantities of different types of pesticides, reserve one sprayer for herbicides only and another for insecticides and fungicides.

Check the label for specific cleaning instructions. If none are listed, follow the guidelines listed below:

1. Park the sprayer on a wash pad and flush the tank, lines, and booms thoroughly with clean water and apply the pesticide-contaminated rinsate to sites listed on label. Simpler still, mount a clean water source on your sprayer and flush the system while in the field.
2. Select the appropriate cleaning solution for the pesticide used:
   Hormone-type herbicides (e.g., 2,4–D, Banvel). Fill the sprayer with sufficient water to operate, adding 1 quart household ammonia for every 25 gallons of water. Circulate the ammonia solution through the sprayer system for 15–20 minutes and then discharge a small amount through the boom and nozzles. Let the solution stand for several hours, preferably overnight. (Please note: household ammonia will corrode aluminum sprayer parts.)

   Other herbicides, insecticides, and fungicides. Fill the sprayer with sufficient water to operate adding 0.25–2 pounds powder detergent (liquid detergent may be substituted for powder at a rate to make a sudsy solution) for every 25–40 gallons of water. Circulate the detergent solution through the sprayer system for 5–10 minutes and then discharge a small amount through the boom and nozzles. Let the solution stand for several hours, preferably overnight.
3. Flush the solution out of the spray tank and through the boom.
4. Remove the nozzles, screens, and strainers and flush the system twice with clean water.
5. Scrub all accessible parts with a stiff bristle brush.

Preparing pesticide sprayers for storage

Before storing the sprayer at the end of the season:

1. Clean the sprayer per label instructions or as specified above.
2. Fill the sprayer with sufficient water to operate, adding 1–5 gallons of lightweight emulsifiable oil, depending upon the size of the tank. Circulate the oil/water solution through the sprayer system for 5–10 minutes.
3. Flush the solution out of the spray tank and through the boom; the oil will leave a protective coating on the inside of the tank, pump, and plumbing.
4. Remove the nozzles, screens, and strainers and place them in diesel fuel or kerosene to prevent corrosion. Cover the nozzle openings in the boom to prevent dirt from entering.
5. As an added precaution to protect pumps, pour 1 tablespoon of radiator rust-inhibitor antifreeze in each of the inlet and outlet ports. Rotate the pump several revolutions to completely coat the interior surfaces.

Pesticide disposal

It is the legal responsibility of all pesticide users to properly dispose of pesticide waste in an environmentally acceptable manner (it is illegal to bury or burn any pesticide containers in Wisconsin). Disposal is the final act of safe and judicious pesticide use.

Some pesticides are considered "hazardous" by the EPA. Disposing waste or excess resulting from use of these pesticides comes under stringent regulations of the Resource Conservation Recovery Act (RCRA). This federal law and the accompanying state law (NR 600) regulate generators of hazardous waste, including those disposing of hazardous pesticides.

The simplest way to avoid becoming a hazardous-waste generator is to triple- rinse all pesticide containers and apply rinsates to labeled sites. If you must generate hazardous waste, disposal procedures may differ depending on the volume of waste generated and its characteristics.

You can reduce the amount of pesticide waste (hazardous or not) by following these guidelines:

- Determine whether the pesticide you intend to use is considered hazardous by the EPA. A list of these pesticides is available from your WDNR regional office. If listed, check for alternative pesticides that are not hazardous and will provide equivalent pest control.
- Mix only the amount of pesticide needed and calibrate equipment so all solution is applied.
- Attach a clean water supply to the sprayer unit so the tank can be rinsed and the rinsate applied to the labeled site while still in the field.
- Triple-rinse all pesticide containers. Even if the pesticides were hazardous, a triple-rinsed container is not hazardous waste, and you can dispose of it in a sanitary landfill.
- Don't mix hazardous waste with other pesticide waste. This will result in the entire mixture being considered hazardous.

Wisconsin Clean Sweep program. The Wisconsin Clean Sweep program, sponsored by the WDATCP and individual counties, offers a way to dispose of most kinds of pesticide waste including liquids, dry formulations, and hazardous waste. For details on when a site will be held in your area, check with your county Extension office or visit the WDATCP website (datcp.state.wi.us) and search for "clean sweep." Wisconsin Clean Sweep has two components: an agriculture program and a household program.

Recycling plastic pesticide containers. Your local recycling program might recycle plastic pesticide containers. First, be sure to clean the containers in accordance with the pesticide label. Once the containers are properly cleaned, contact your municipality to determine if it will recycle plastic pesticide containers. Each municipality decides whether or not it will accept plastic pesticide containers.

Be aware that Wisconsin law prohibits the burning of pesticide containers regardless of the label's directions.

Contact your pesticide supply dealer for additional container recycling options.

A final word

Chemical pesticides help make disease, insect, and weed management programs successful. However, pesticides present hazards to agricultural workers, the general public, and the environment. Therefore, they should be used wisely, safely, and only when needed. Proper crop management can lessen the need for pesticide use, because a well-maintained planting is less susceptible to disease, insect, and weed pests.

Note: When applying a pesticide, always follow the directions on the label. Label information changes from time to time. The current pesticide label is the final authority for safety and legality.

Table 3. Toxicity information, restricted-entry & preharvest intervals of commonly used cranberry pesticides

Common name	Trade name	Cautionary signal word	Oral LD50[a] (mg/kg)	Dermal LD_{50}[a] (mg/kg)	Restricted-entry interval (hours)	Preharvest interval[b] & limitations (days)
acephate	Orthene	caution	866–945	>10,250	24	75–90[c]
acetamiprid	Assail	caution	866–1,064	>2,000	12	1
azoxystrobin	Abound	caution	>5,000	>4,000	4	3
carbaryl	Sevin	caution/warning	406–699	>4,000	12	7
chlorantraniliprole	Altacor	—	>5,000	>5,000	4	1
chlorothalonil	Bravo, Echo, Equus	warning/danger	9,000	>5,000	12	50
chlorpyrifos	Lorsban	warning	380	>2,000	24	60
clethodim	Select Max	caution	3,610	>5,000	24	30
clopyralid	Stinger	caution	>5,000	>5,000	12	50
clothianidin	Belay	caution	3,044	>5,000	12	24
copper ammonium carbonate	Copper-Count-N	caution	—	—	12	exempt[d]
copper hydroxide	Kocide, Champ, Champion	caution/danger	varies[e]	varies[e]	48	exempt[d]
copper sulfate (basic)	Cuprofix Ultra Disperss	caution	300–960	—	48	exempt[d]
diazinon	Diazinon	caution or warning	66	379	120[e]	15
dichlobenil	Casoron	caution	3,160	—	12	NA
fenbuconazole	Indar	caution	4,000	>2,000	12	30
fluoxastrobin	Evito	caution	>5000	>5000	12	1
fosetyl-aluminum	Aliette	caution	2,860	>2,000f	12	3
glyphosate	Roundup and others	caution or warning	>5,000	>5,000	varies by label[e]	30–180
imidacloprid	Admire, Alias, Widow	caution	>4,000	>2,000[f]	12	30
indoxacarb	Avaunt	caution	687–1,867	>5,000	12	30
mancozeb	Dithane, Manzate, Penncozeb	caution	>5,000	>5,000	24	30
mancozeb + copper hydroxide	ManKocide	danger	2,535	>5,000	48	30
mefenoxam	Ridomil Gold	caution	1,172	>2,020	48	45
mesotrione	Callisto	caution	>5,000	>5,000	12	45
methoxyfenozide	Intrepid	caution	>5,000	>2,000	4	7
napropamide	Devrinol	caution	5,000	—	24	NA
norflurazon	Evital	caution	>5,000	>2,000	12	NA
phosmet	Imidan	warning	275	>2,000	72	14
phosphorous acid	Phostrol, Prophyt	caution	>5,000	>4,000	4	0–3[e]
polyoxin D zinc salt	Oso, Tavano	caution	>5,000	>5,050	4	0
propiconazole	Orbit, PropiMax, Tilt, Topaz	warning	1,310	>5,000	12	45
prothioconazole	Proline	caution	>2000–<5,000	>5000	12	7
pyriproxyfen	Knack	caution	3,773-4,733	>2,000	12	7
quinclorac	QuinStar 4L	caution	>3,500	>2,000	12	60
extract of *Reynoutria sachalinensis*	Regalia	caution	>5,000	>5,000	4	0
sethoxydim	Poast	warning	2,676–3,125	>4,000	12	60
spinetoram	Delegate	caution	>5,000	>5,000	4	21
spinosad	Entrust, SpinTor	caution	>5,000	>2,000	4	21
tebufenozide	Confirm	caution	>5,000	>5,000	4	30
thiamethoxam	Actara	caution	>5,000	>2,000	12	30

Abbreviations: L = little or no reaction; **NA** = not applicable; — = unknown. [a] LD50 values are based on male rats except where noted.
[b] Days between final spray and harvest. [c] Maximum of one application per season. Valent products have a 75-day preharvest interval, products of other registrants have a 90-day preharvest interval. [d] Exempt from tolerance—Fixed copper materials are exempt from the requirement of a tolerance when applied to growing crops in accordance with good agricultural practice. Under USDA labeling information, all fixed (basic) copper fungicides labeled for use on cranberries may be used on a "no time limitation" basis. [e] Varies with manufacturer; check the label. [f] Dermal LD50 based on rabbits.

Disease management

The most numerous and widespread cranberry diseases are caused by fungi. In Wisconsin, most diseases do not cause enough yield loss to warrant the use of fungicides. However, over the past decade the fruit rot disease complex has become more important, especially in plantings of high-yielding, newer cultivars. Cottonball remains a problem on some marshes, especially in older beds. Brown, dying uprights in mid- to late summer are very common, but only rarely are they linked to pathogenic fungi.

For effective disease management, you must identify the problem before beginning treatment. The Plant Disease Diagnostic Clinic at University of Wisconsin–Madison provides diagnoses for a modest charge (labs.russell.wisc.edu/pddc). Several UW-Extension publications offer more complete information on many of the more important cranberry diseases (learningstore.uwex.edu). Another resource is the *Compendium of Blueberry and Cranberry Diseases*, available from APS Press (www.apsnet.org/apsstore/shopapspress/pagearchive/41736.aspx).

Fungicide update

Before using fungicides, growers should check with their crop handler for individual restrictions on certain active ingredients. Chlorothalonil (Bravo, Echo, Equus) and mancozeb (Dithane, Manzate, Penncozeb) are broad-spectrum fungicides that have been used for fruit rot control for decades but are not effective for cottonball control. The two other main classes of fungicides used on cranberries are the sterol demethylation inhibitors (Indar, Orbit/Tilt/Propimax/Topaz, Proline) and the strobilurins (Abound, Evito). The Fungicide Resistance Action Committee (FRAC) codes for sterol demethylation inhibitors and strobilurins are 3 and 11, respectively. To prevent selecting for strains of pathogens resistant to fungicides, growers should not apply more than two sprays of fungicides with the same FRAC code per growing season. An exception, however, is that growers who are trying to regain control of cottonball the year after a severe outbreak should apply four sprays of a sterol demethylation inhibitor—two during shoot elongation and two during bloom.

Two newer "soft" fungicides are now labeled for use on cranberries. The active ingredient in Oso (formerly Tavano) is polyoxin D zinc salt, which inhibits the formation of chitin, a building block of fungal cell walls. Although it is a natural fermentation product of a bacterium, Oso is not currently permitted for use in organic production. The active ingredient in Regalia is an extract of giant knotweed (*Reynoutria sachalinensis*), which is believed to induce a plant's natural defense mechanisms. Regalia is permitted for use in organic production. In Wisconsin trials, Oso and Regalia have been inconsistent in their level of control for both fruit rot and cottonball. In most trials they suppress disease, but they are usually less effective than the sterol demethylation inhibitors and strobilurin fungicides.

Disease notes

Fruit rot

Fruit rot diseases have become troublesome for several growers, especially in central Wisconsin. The fungus *Colletotrichum*, which causes bitter rot, has been identified at many sites where more than 20% of fruit were rotted at the time of harvest. This fungus apparently produces spores and can infect cranberry for several weeks throughout the summer, making control difficult. Minimizing the time that fruit and foliage are wet (e.g., by irrigating in the morning rather than evening) should create an environment less favorable for disease development.

Early rot, caused by *Phyllosticta vaccinii*, is often a problem in younger (less than three years old) plantings. Research suggests that Indar is highly effective when applied to younger plantings at the time that established plantings are in bloom. Especially in warmer years, early rot causes significant leaf spotting and premature defoliation in younger beds. It generally does not kill plants, however, and its severity decreases as plantings mature.

The key time to apply any fungicide for fruit rot control is during bloom and early fruit set. However, chlorothalonil can be phytotoxic, causing fruit scarring and reduced fruit set if applied during bloom, especially if applied in lower spray volumes (e.g., less than 50 gal/a). If spray volume is low, consider using Proline, Abound, or Evito during early to mid-bloom, followed by chlorothalonil during late bloom and/or fruit set. Copper hydroxide is not effective in controlling fruit rot in Wisconsin. Other forms of copper have not been tested recently.

Refrigerate cranberries immediately after harvest and during storage to delay development of storage rots. Be aware, however, that these diseases can develop at low temperatures and eventually cause rotting even at near-freezing temperatures. Store fruit at 38–40°F; infected berries break down rapidly at temperatures above 55°F.

Cottonball

On many Wisconsin marshes, cottonball occurs so infrequently that it does not require special control measures. However, on certain marshes the disease causes economic damage in the form of fruit rot and costs of removing rotten fruit.

The fungus that causes cottonball, *Monilinia oxycocci*, overwinters as sclerotia (mummies) in previous seasons' infected berries. In spring, at the same time as budbreak, sclerotia germinate to produce small cup-like apothecia that release ascospores. The airborne ascospores infect tender young uprights that have recently emerged and cause the tip blight stage of the cottonball disease. Infected uprights turn tan and wilt from the tip back shortly before bloom. At the base of newly infected leaves is an inverted "V" pattern of tan diseased tissue characteristic of tip blight. In severely infested beds, ascospores of *M. oxycocci* also may infect and kill unopened flowers, causing a flower blight symptom. Eventually, wilted shoots become covered with a white mantle of fungal spores. These spores invade flowers through stigmata (pollen-receptive surfaces of flowers). The fungus does not kill the flower but grows inside the

developing berry. These infected berries or "cottonballs" do not become noticeable until late in the season when they fail to turn red; instead, they turn yellowish and sometimes are marked with brown stripes. Removing "trash" after harvest may reduce the number of diseased fruit remaining in the bed and thereby reduce disease the following season. Cottonball can be managed with well-timed fungicide treatments applied properly.

Upright dieback

Upright dieback is characterized by yellow mottling and chlorosis of leaves, followed by bronzing and death of the entire upright. In young plantings (1–3 years old), large patches of uprights can be affected; in older plantings affected uprights are generally scattered among healthy uprights. Upright dieback seems to be worse under hot, dry conditions that are stressful to the cranberry plant. The exact cause of upright dieback is not well understood, but the fungus *Phomopsis vaccinii* has been isolated from affected plants. Several other fungi can also be isolated from plants with symptoms, but their roles in the upright dieback syndrome are not understood. Conditions that favor vigorous, but not excessive, vine growth should help vines tolerate or resist fungal infections. To help prevent upright dieback, provide adequate moisture and cool beds by sprinkling with water during hot, dry periods. Infection probably occurs during the spring as shoots are elongating, so fungicide application at this time is likely more effective than applications made later after the fungus has invaded the plant tissue.

Phytophthora root and runner rot

Several species of the soil-inhabiting fungus-like organism *Phytophthora* have been found in Wisconsin. The species causing root rot of cranberry in Massachusetts and New Jersey, *Phytophthora cinnamomi*, has **not** been isolated in Wisconsin during surveys taken in the late 1980s and in 1997 and in sporadic sampling since then. On affected plants, typical symptoms above ground include small leaves, stunted uprights, reduced flower and fruit production, and premature reddening of the foliage. Below ground, small feeder roots frequently are lacking, and runners may exhibit bluish-gray discoloration under the bark.

These symptoms occur most often on plants located in areas of a bed that are poorly drained and occasionally have standing water. Often, affected plants die and leave large areas of the bed devoid of cranberry vines. Replanting in these void areas usually is unsuccessful; instead, weeds rapidly become established and proliferate.

Practices aimed at soil water management, such as avoiding over-irrigation and improving soil drainage, are critical for managing Phytophthora root and runner rot. Low spots should be filled in with sand. Although mefenoxam (Ridomil) and phosphorous acid (Aliette, Phostrol, Prophyt, Rampart) are registered for control of Phytophthora root and runner rot, these products have not been tested in the field in Wisconsin. Growers have reported variable degrees of success with Ridomil, and there are too few reports from growers on phosphorous acid products to judge their efficacy. Tests in the laboratory and greenhouse indicate that many of the *Phytophthora* species found in Wisconsin are not sensitive to Ridomil. Although not tested specifically on cranberry, the phosphorous acid products are effective on a wide range of *Phytophthora* species in other crops. Because Ridomil is taken up through roots, it is most effective in spring as plants resume growth. Because the phosphorous acid products are taken up by leaves and transported to roots, they are most effective after some shoot elongation and leaf expansion has occurred.

Leaf and stem diseases

Three leaf diseases occasionally cause significant damage to cranberry plants in Wisconsin. Two are Protoventuria (Gibbera) leaf spot and Cladosporium leaf spot. Characteristic gray to white centers of Cladosporium leaf spots distinguish them from Protoventuria spots, which are small and red. Although no fungicide is registered specifically for controlling these two diseases, the same fungicides used for storage rots ordinarily control them.

The third leaf disease—red leaf spot—is marked by large, circular, bright red spots on the upper surface of leaves and paler red spots on the undersurface. In severe infestations, shoot tips may become infected and killed. Young plantings of 'Ben Lear' and 'Stevens' appear most susceptible, but any cultivar may develop the disease if vine growth is luxuriant. Red leaf spot is usually so sporadic and unpredictable that we do not recommend routine spraying to control it. If it does occur, the spray program for storage rots should adequately control red leaf spot.

Stem gall, sometimes called "canker," girdles stems and kills uprights. Large portions of beds can be damaged and put out of normal production for 2–3 years. The cause of stem gall is probably bacteria that produce a plant growth hormone. Stem gall seems to be worst in areas where plants have been damaged by beaters, tires, or cold injury. The bacteria infect through wounds. There are no chemical controls for these bacteria. The best management strategy is to minimize plant injury at harvest, during the winter, and in early spring.

Virus diseases

Two viruses, tobacco streak virus (TSV) and blueberry shock virus (BlShV) are associated with fruit scarring on several varieties at several locations in Wisconsin. Both viruses are carried on pollen, and bloom may be a key time for infection. The role of insect vectors is not yet known, and therefore, spraying insecticides to control these virus diseases is not recommended. Watch industry newsletters for updates on TSV and BlShV.

Cranberry disease management recommendations

Always read the label before using any pesticide even if you have used the product before. Information on labels changes. The information presented in table 4 is only a guide and should be used in conjunction with specific label recommendations.

Apply fungicides in sufficient water to provide adequate coverage. Most can be applied as either dilute (usually 100–300 gal/a water) or concentrate (usually 20–50 gal/a water) spray mixtures by ground equipment, by aircraft (at least 5 gal/a water), or through sprinkler irrigation systems, if permitted. Concentrate applications initially do not cover fruit and foliage as thoroughly as dilute applications, but dew, rain, or sprinkler water redistribute the fungicide so that coverage becomes comparable to that of dilute applications.

The risk of phytotoxicity is greater with concentrate applications. Most cranberry fungicides are toxic to fish. Exercise caution.

Table 4. Fungicide application schedule for cranberry diseases

Disease	Application timing	Fungicide, rate/acre[a]	Comments and restrictions
Cottonball	Budbreak (when majority of shoots show ½-inch new growth) and 14 days later 10–15% bloom and again at full bloom	Indar 2F, 6.0–12.0 fl oz PropiMax EC, 4.0–6.0 fl oz Tilt 41.8EC, 4.0–6.0 fl oz Topaz EC, 4.0–6.0 fl oz	Although sprays during budbreak may be beneficial where cottonball incidence is high, the most important sprays are during bloom. Do not apply Tilt, Indar, Topaz, or PropiMax more than four times per year combined. Note that Topaz EC (propiconazole), distributed by WinField Solutions, is labeled for cottonball control. Topaz fungicide, distributed by Agriliance LLC, is phosphorous acid, and although permitted on cranberry, has not been tested for cottonball control.
	10–15% bloom and again at full bloom	Abound 2.08F, 6.0–15.5 fl oz	Applications of Abound are not permitted before bloom. See the label for specific use restrictions.
Upright dieback	Prior to bloom when shoots begin growth	Bravo WeatherStik, 4.0–6.5 pt; or Echo 720, 4.0–7.0 pt; or Echo Zn, 6.0–10.0 pt; or Equus 720 SST, 4.0–6.5 pt; or Equus 500 ZN, 5.75–9.25 pt	Chlorothalonil-based fungicides may not be used more than three times per year, and irrigation water must be held for at least 3 days following application.
Fruit rots	Early to late bloom, then at 10–14-day intervals	Bravo WeatherStik, 4.0–6.5 pt; or Bravo Ultrex, 4.8–6.0 lb; or Echo 720, 4.0–7.0 pt; or Echo Zn, 6.0–10.0 pt; or Equus 720 SST, 4.0–6.5 pt; or Equus 500 ZN, 5.75–9.25 pt	The lower rate is sufficient in most years. All chlorothalonil products have a 12-hour restricted entry interval and a 50-day preharvest interval.
	Early to late bloom, then at 7–10-day intervals	Abound 2.08F, 6.0–15.5 fl oz	See the label for specific use restrictions, especially related to aquatic wildlife. Do not apply more than two sprays of Abound before alternating with an unrelated fungicide.
		Dithane DF, 3.0–6.0 lb; or Dithane F-45, 2.4–4.8 qt; or Mankocide DF, 10.5 lb; or Penncozeb 80WP, 3.0–6.0 lb; or Penncozeb 75DF, 3.0–6.0 lb; or Penncozeb 4FL, 2.4–4.8 qt	Mancozeb is sold under various trade names. Be sure that cranberries are on the label. Mancozeb may cause some delay in coloring of fruit in the fall.
	Early bloom to early fruit set	Aftershock, 2.0–5.7 fl oz Evito 480SC, 2.0–5.7 fl oz	See the label for specific use restrictions. Because of the 14- to 21-day use interval, it may be practical to use Evito or Aftershock just once per season for fruit rot control.
	Early to late bloom, and 7–10 days later	Proline 480SC, 5.7 fl oz	A maximum of two applications of Proline is permitted per season.
Phytophthora root and runner rot	Early shoot elongation, then at labeled intervals	Aliette WDG, 5 lb; or Prophyt, 4 pt ; or Phostrol, 5-6 pt	These products vary in their use intervals and number of applications permitted; refer to labels for details on restrictions and compatibility with other pesticides. Also see comments on page 10.
	Budbreak, then up to 45 days before harvest, then post-harvest	Ridomil Gold SL, 1.0-1.75 pt; or Ridomil Gold GR, 20-35 lb	See comments on page 10.

[a]Pesticide active ingredients are listed in table 3.

Insect management

Blackheaded fireworm, cranberry fruitworm, and sparganothis fruitworm are the most important insect pests of cranberries in Wisconsin. Virtually every marsh is susceptible to attack, and economic damage can occur if controls are not adequate. Of secondary importance are spanworms and cranberry girdler. These normally occur at low levels, but if environmental conditions favor an outbreak and you don't take appropriate controls, losses can be serious. Cranberry tipworm, white grub, cranberry weevil, sparganothis fruitworm, flea beetle, and dearness scale are more spotty in distribution but can also be damaging. Other insects occasionally cause problems.

Insect monitoring and identification

The benefits of a pest monitoring program include more rapid and dependable detection of major and minor pests, improved timing of controls, greater flexibility in choice of control approaches, and reduced usage of pesticides when pests are absent. Delays in chemical applications will often result in increased damage. Do not rely on calendar timing of sprays—this approach may work four years out of five, but unusual weather patterns or abnormally heavy pest pressures will occasionally produce unexpected damage. Be especially vigilant early in spring for hatch of first-generation blackheaded fireworm larvae. Early warm spring weather can lead to early hatch. Sex pheromone traps are commercially available to monitor adult flight periods of blackheaded fireworm, cranberry girdler, sparganothis fruitworm, and cranberry fruitworm.

Proper pest identification also plays a role in achieving control. Although cranberry fruitworm and blackheaded fireworm are still our most serious fruit pests, we occasionally see significant damage from sparganothis fruitworm. Sparganothis fruitworm feeds on the foliage and surface of the fruit (like blackheaded fireworm), and also within the fruit (like cranberry fruitworm). Although similar in appearance to the blackheaded fireworm, sparganothis fruitworm is identified by its yellow head. Paired pale spots along the body and a more ragged chewing hole in fruit further distinguish sparganothis fruitworm from cranberry fruitworm. Sparganothis fruitworm may also cause damage to adjacent leaves, and its feeding activity can continue into the early harvest period.

Occasional pests

In addition to our most serious pests, several less-common insects can feed on cranberry plants and fruit. Although natural environmental factors often control these "occasional pests," they can occur in sufficient numbers to cause injury. Crop consultants, IPM scouts, and growers have increasingly reported cases of unusual insects causing damage. This does not necessarily indicate an increased number of actual cases. Rather, as more people are trained in pest management and as routine IPM scouting becomes common, pest situations that were previously overlooked or misdiagnosed are recognized as caused by occasional pests. IPM practices also have led to the overall reduction in pesticide use, which sometimes allows these normally uncommon insects to increase to damaging numbers.

The occurrence of such insects is often spotty, even being confined to part of an individual bed. This emphasizes the need for monitoring all beds. Although intensive monitoring such as trapping and sweep-sampling is not necessary for all beds, they all should at least be routinely inspected visually. Further, the spotty distribution of occasional pests makes large-scale pesticide applications unnecessary and probably disruptive to natural controls. Instead, localized outbreaks should be controlled with spot treatments of the areas.

Insecticide update

Burholderia spp. cells (Venerate XC) is a biological insecticide and miticide available from Marrone© Bio Innovations. It is now included in table 5. Venerate contains killed cells and fermentation solids of *Burholderia* spp. cells that control insects by enzymatic degradation of the exoskeleton and disruption of the molting process. Venerate acts by contact or ingestion, resulting in death of the insect. Venerate is OMRI approved.

Chromobacterium subtsugae (Grandevo), a biological insecticide/miticide is now included in table 5. Grandevo is available from Marrone© Bio Innovations. It is a bacterium commonly known as Achromacil™ that functions primarily as a stomach poison. Grandevo is OMRI-approved.

Dinotefuran (Venom), a neonicotinoid insecticide is now included in table 5. Venom is available from Valent® as a 70SG formulation. It controls insects through contact and ingestion.

The EPA cancelled the registration of sulfoxaflor-containing products effective immediately. If you own sulfoxaflor-containing products (such as Closer), you may use your remaining stock according to the label instructions.

Valent will be discontinuing the use of Belay on cranberry. Belay will still be available for use in 2016 and 2017. The company will not be pursuing re-registration on cranberry once the label expires in 2018.

Table 5 reviews the major insecticide registrations on cranberry. The labels for each product contain additional important, specific information. Carefully read the pesticide labels to choose materials that best fit your needs and to fully understand application procedures and precautions.

Table 5. Currently registered insecticides for cranberries[a]

Insecticide and formulation	Labeled insects	Remarks[b]
acephate (Orthene): 97	fireworms, spanworms, sparganothis	Maximum of one application per year. Water soluble; should not be used with more than the recommended amount of water or wash-off may occur, particularly with sprinkler application.
acetamiprid (Assail): 30 SG, 70 WP	cranberry fruitworm, flea beetle, fireworm (suppression), spanworms, sparganothis,tipworm	Maximum of two applications per year. Minimum of 7 days between applications.
Bacillus thuringiensis (Bt) Dipel: ES, DS	cranberry fruitworm, fireworms, spanworms, sparganothis	The percent active ingredient in Biobit is about half that of Dipel; check labels for specific rates. Must have good coverage of leaf surfaces; a spreader/sticker may improve effectiveness. Most effective against young larvae. Two to three successive applications at 3- to 5-day intervals may be necessary.
Burholderia spp. cells (Venerate): XC	armyworms, fireworms, leafrollers, loopers, sparganothis fruitworm, aphids (suppression), cranberry blossom weevil (suppression), mites (suppression), thrips (suppression)	May be applied by ground or aerial equipment. No preharvest interval. Reapply every 3–10 days. Optimal results when targeting newly hatched larvae, nymphs, or immatures. Do not apply while bees are foraging.
carbaryl (Sevin): XLR Plus, 4F, 80 Solupak	fireworms, flea beetle, fruitworm, sparganothis	Maximum of 10 quarts (XLR or 4F) or 12.5 lb (80 Solupak) per acre per year.
chlorantraniliprole (Altacor): 35 WG	fruitworm, sparganothis, fireworm, spanworms	Begin applications when treatment thresholds have been reached. Thorough coverage is required. One-day preharvest interval. Do not apply more than once every 7 days. No more than three applications per season. Do not exceed 9 oz per acre per season.
chlorpyrifos (Lorsban): 4E, 75 WG, Advanced	cranberry weevil, fireworms, fruitworm, spanworms, sparganothis	Maximum of two applications per year.
Chromobacterium subtsugae (Grandevo)	aphids, armyworms, brown spanworm, cranberry blossom weevil, cranberry fruitworm, cutworms, fireworms, leafrollers, loopers, mites, sparganothis fruitworm, thrips	Do not apply to flooded fields. May be applied as a foliar spray by ground or aerial equipment and by chemigation. Most effective against newly hatched larvae. Thorough coverage is required, the use of an adjuvant is recommended to maximize effectiveness. It has a residual activity of about 7 days and no limit on the number of applications. No preharvest interval.
clothianidin (Belay)	blackheaded fireworm, cranberry fruitworm, cranberry tipworm, cranberry weevil, flea beetle, sparganothis fruitworm	May be applied by ground equipment and chemigation, but not by air. Soil applications must be watered in. Apply no more than 12 oz/a per season. Wait at least 7 days between applications. Product cannot be combined with an adjuvant.
diazinon (D•Z•N): 50W, AG500, AG600WBC	blackheaded fireworm, fruitworm, tipworm	Current labels of some products require a minimum of 400 gal/a of finished spray, which precludes usage of low-volume spray equipment. Maximum of six applications per year and a minimum period between applications of 14 days. All formulations are very hazardous to birds.
dinotefuran (Venom): 70 SG	blackheaded fireworm (suppression), cranberry fruitworm (suppression), cranberry weevil (suppression), flea beetles, leafhoppers, spanworm (suppression), sparganothis fruitworm (suppression), stink bugs, and tipworm (suppression).	May be applied as a foliar spray with air or ground equipment. Thorough coverage is required. Minimum of 14 days between applications. Seven-day preharvest interval. Do not apply more than 8 oz/a per season. Use of this product may result in groundwater contamination.
imidacloprid (Admire Pro, Alias 2F, Alias 4F, Widow)	root grubs, rootworms	For soil application only; must be watered in. In Wisconsin, primarily for control of flea beetle larvae. Apply no more than 0.5 lb ai/acre per season.
indoxacarb (Avaunt)	blackheaded fireworm, cranberry weevil, spanworms	Eye irritant. May be applied by chemigation. Hold water for 1 day after application. Apply no more than 24 oz/a per season. Wait at least 7 days between treatments.

[a]Refer to table 3 for restricted entry intervals and preharvest intervals; refer to table 7 for insecticide rates.
[b]Refer to table 6 on page 15 for relative toxicity of insecticides to honeybees.

Table 5. Currently registered insecticides for cranberries[a] *(continued)*

Insecticide and formulation	Labeled insects	Remarks[b]
methoxyfenozide (Intrepid): 2F	blackheaded fireworm, gypsy moth, spanworms, sparganothis	Very selective to Lepidoptera and therefore protects natural enemies important in IPM programs. Is an insect growth regulator so death may occur a few days after application, but feeding and damage stop shortly after ingestion. Maximum of 64 fl oz per acre per year (four applications at maximum label rate). Be aware of application restrictions in sandy regions where the endangered Karner blue butterfly is known to occur.
novaluron (RimOn): 0.83 EC	blossomworm, fireworms, flea beetle, fruitworms, gypsy moth, spanworm, sparganothis, tipworm	Maximum of three applications of 36 fl oz per acre per year. Cannot be used with surfactants or adjuvants. Wait at least 7 days between applications.
phosmet (Imidan): 70W	blossomworm, cranberry tipworm midge, cranberry weevil, cutworms, false armyworm, fireworms, fruitworm, gypsy moth, spanworms, sparganothis	Maximum of 15.6 lb per season. Minimum of 10 days between successive applications. Reduced activity in alkaline spray waters, which should be buffered. Available in water-soluble bags.
pyriproxyfen (Knack)	cranberry fruitworm	Maximum of two applications per year totaling 32 fl oz per year. Minimum of 14 days between applications. Is an insect growth regulator so death may occur a few days after application. May not be applied by chemigation.
spinetoram (Delegate): WG	armyworms, currant fruitfly (suppression), fireworms, gypsy moth, leafrollers, loopers (spanworms), sparganothis, thrips (suppression)	May be applied by chemigation. Soft on beneficial insects and therefore good in IPM programs. For resistance management, do not rotate with products containing spinosad. Do not apply more than 19.5 oz/a per season, or six applications per year. Do not apply within 21 days of harvest. Do not make more than two consecutive applications. Do not make applications less than seven days apart.
spinosad (Entrust SC)	armyworms, currant fruitfly, fireworms, leafrollers, light brown apple moth, loopers (spanworms), sparganothis, thrips	For pest suppression; may not provide acceptable results against high population numbers. Best timed against hatching eggs and young larvae. Entrust is USDA-approved for the National Organic Program. For resistance management, do not rotate with products containing spinetoram. Do not apply within 21 days of harvest. Do not make more than two consecutive applications. Do not make applications less than seven days apart. Do not apply more than a total of 29 fl oz (0.45 lb ai) spinosad per year. Do not make more than six applications per year.
tebufenozide (Confirm): 2F	blossomworm, false armyworm, fireworms, fruitworms, gypsy moth, sparganothis, spanworms	Maximum of 64 fl oz (four applications) per acre per year. Allow at least 30 days from final applications until harvest.
thiamethoxam (Actara)	aphids, cranberry flea beetle, cranberry weevil, Japanese beetle, leafhoppers	Maximum of 12 oz per acre per year.

[a]Refer to table 3 for restricted entry intervals and preharvest intervals; refer to table 7 for insecticide rates.
[b]Refer to table 6 on page 15 for relative toxicity of insecticides to honeybees.

Pheromone-mediated mating disruption

To our knowledge, there no longer are any products registered for mating disruption of either blackheaded fireworm or sparganothis fruitworm. Dow AgroSciences has discontinued the sprayable formulations originally developed by 3M Canada, and MSTRS Technologies have dropped their EPA and OMRI registrations for their metered release "baggies." In both cases, the products were discontinued because of a lack of a viable market.

Insecticides and pollination

Insects are important for cranberry pollination. Active pollinators improve fruit set. Honey bees are not the only pollinators; native bees, including bumble bees and other wild insects, play an important role in pollinating cranberry. Whenever possible, do not apply insecticides when 2% or more of the flower buds are open or you may kill a significant number of pollinators. Similarly, do not introduce honey bees to a marsh until 10% of the flowers have opened. Remove bees immediately after pollination.

Careful monitoring of pest populations early in the season will help you plan insecticide applications to avoid the period when plants have blossoms. If you don't monitor populations, pest outbreaks that should have been controlled may occur during blossom. In this situation, growers must decide if losses from the pest or from the lack of pollinators will be greater. If you must use an insecticide during blossom time, use those that are least toxic to bees and apply them in the evening after bees stop foraging. The next morning use sprinkler irrigation to wash off the pesticide and discourage bee foraging. Table 6 lists the relative bee toxicity of commonly used cranberry insecticides.

Wisconsin law allows beekeepers the right to request notification of pesticide application if their hives are within 1.5 miles of an application site. If someone makes such a request, you must notify them at least 24 hours prior to application.

Cranberry insect management recommendations

Table 7 is a guide to insecticide usage on cranberries. Insecticides and rates listed reflect labeling that was accurate when this publication went to press. The grower/applicator is responsible for confirming that the intended use of a pesticide is legal. People who use information in this publication assume all responsibility for personal injury or property damage.

Table 6. Relative toxicity of certain cranberry insecticides to honey bees

Toxicity to bees	Insecticide	Comments
Highly toxic	acephate acetamprid carbaryl chlorpyrifos clothianidin diazinon dinotefuran imidacloprid indoxacarb phosmet spinetoram thiamethoxam	Use of these pesticides at any time of day or night during blossom may result in severe bee losses. For maximum bee protection, do not use them within 7 days of blossom.
Moderately toxic	novaluron spinosad	
Relatively nontoxic	*Bacillus thuringiensis* Chromobacterium subtsugae chlorantraniliprole methoxyfenozide pyriproxyfen tebufenozide	These products will cause a minimum amount of injury to bees.

Table 7. Spray schedules for cranberry insects (Where several pesticides and formulations are listed for the control of a pest, apply only one pesticide.)

Timing of spray	Insect	Pesticide, rate/acre[a]	Comments and restrictions
Delayed dormant (½ inch new growth)	cranberry weevil	*Burholderia* spp. cells, 1–8 qt. chlorpyrifos 4E, 3.0 pt; or 75 WG, 2.0 lb *Chromobacterium subtsugae*, 2.0–3.0 lb clothianidin, 4.0 fl oz indoxacarb, 6.0 fl oz	Fireworm treatments normally also control weevils.
	fireworm, sparganothis fruitworm	acephate 75S, 1.33 lb; or 97, 1.0 lb *Burholderia* spp. cells, 1–8 qt. carbaryl 4 lb/gal, 4.0 pt; or 50WP, 6.0 lb; or 80WSP, 2.5 lb chlorantraniliprole 35WG, 3.0–4.5 oz chlorpyrifos 4E, 3.0 pt; or 75 WG, 2.0 lb *Chromobacterium subtsugae*, 2.0–3.0 lb clothianidin, 4.0 fl oz *diazinon 50WP, 4.0–6.0 lb; or AG500, 2.0–3.0 qt; or AG600WBC, 51.0-76.5 fl oz indoxacarb, 6.0 fl oz phosmet 70W, 1.3–4.0 lb spinetoram WG, 3.0–6.0 oz tebufenozide 2F, 16.0 fl oz	Acephate is now restricted to a single application per year. Indoxacarb is not registered for sparganothis.
	flea beetle	acetamiprid, 4.0–6.9 oz clothianidin, 4.0 fl oz dinotefuran 70SG, 2.0–4.0 oz novaluron, 12.0 oz thiamethoxam, 2.0–4.0 oz	
	June beetle (grubs)	carbaryl XLR, 1.0–2.0 qt imidacloprid, 16.0–32.0 fl oz	
	spanworm	acephate 75S, 1.33 lb; or 97, 1.0 lb *Bacillus thuringiensis* ** chlorantraniliprole 35WG, 3.0–4.5 oz chlorpyrifos 4E, 3.0 pt; or 75 WG, 2.0 lb *Chromobacterium subtsugae*, 2.0–3.0 lb indoxacarb, 6.0 fl oz methoxyfenozide, 10–16 fl oz phosmet 70W, 1.3–4.0 lb spinetoram WG, 3.0–6.0 oz tebufenozide 2F, 16.0 fl oz	You can control spanworms with fireworm treatments if the treatments coincide with the youngest larval stages of spanworms. Acephate is now restricted to a single application per year. In Karner blue butterfly habitat, methoxyfenozide (Intrepid) must be used in such a way as to minimize spray drift. Refer to the Endangered Species portion of the Intrepid label to access appropriate guidelines.
	tipworm	clothianidin, 4.0 fl oz *diazinon 50WP, 4.0–6.0 lb; or AG500, 2.0–3.0 qt; or AG600WBC, 51.0–76.5 fl oz	Diazinon has a maximum of six applications per year; allow at least 14 days between treatments.
June 7–21	dearness scale (crawler stage)	No materials registered	Applying chlorpyrifos for fireworm control during this period may control scale.
	flea beetle	acetamiprid, 4.0–6.9 oz clothianidin, 4.0 fl oz dinotefuran 70SG, 2.0–4.0 oz novaluron, 12.0 oz thiamethoxam, 2.0–4.0 oz	

* Restricted-use pesticide. ** see product labels for rates. [a]Pesticide trade names are listed in table 3.

Table 7. Spray schedules for cranberry insects, *continued* (Where several pesticides and formulations are listed for the control of a pest, apply only one pesticide.)

Timing of spray	Insect	Pesticide, rate/acre[a]	Comments and restrictions
Hook stage to start of blossom	cranberry weevil, fireworm, spanworm, sparganothis fruitworm, tipworm		Use materials, formulations, and rates listed above that are labeled for your target pests. Do not apply broad-spectrum insecticides once flowers have started to open.
Blossom	**Protect pollinating insects! Do not use insecticides during blossom period!**		
After blossom (mid- to late July)	fireworm, spanworm, sparganothis fruitworm, tipworm		Use materials and rates as listed above. *Chromobacterium subtsugae* and *Burholderia* spp. are not registered for tipworm.
	cranberry fruitworm	acephate 75S, 1.33 lb acetamiprid 30 SG, 4.0-6.9 oz; or 70 WP, 1.7-3.0 oz carbaryl 4 lb/gal, 4.0 pt; or 50WP, 6.0 lb; or 80WSP, 2.5 lb chlorantraniliprole 35WG, 3.0–4.5 oz chlorpyrifos 4E, 3.0 pt; or 75 WG, 2.0 lb *Chromobacterium subtsugae*, 2.0–3.0 lb clothianidin, 4.0 fl oz *diazinon 50WP, 4.0–6.0 lb; or AG500, 2.0–3.0 qt; or AG600WBC, 51.0–76.5 fl oz phosmet 70W, 1.3–4.0 lb pyriproxyfen, 16.0 fl oz	Acephate is now restricted to a single application per year. **Note:** Rate of diazinon is higher than for other insects. Two to four applications at 7- to 10-day intervals may be needed for serious infestations. Chlorpyrifos has a 60-day preharvest interval. The phosmet label recommends using higher label rates for cranberry fruitworm.
	flea beetle	acetamiprid, 4.0–6.9 oz clothianidin, 4.0 fl oz dinotefuran 70SG, 2.0–4.0 oz novaluron, 12.0 oz thiamethoxam, 2.0–4.0 oz	

* Restricted-use pesticide. ** see product labels for rates. [a]Pesticide trade names are listed in table 3.

Weed management

Weeds compete with cranberry vines for light, water, and nutrients. Tall weeds shade vines, reduce cranberry photosynthesis and nitrogen uptake, discourage pollinating insects, and slow the drying of rainfall, irrigation, and dew from vines. The slow drying of cranberry vines favors disease development and may impede pollen shedding. Heavy stands of weeds slow harvesting and can cause damage to fruit skin during harvest. In short, weeds reduce cranberry yield and quality. An effective cranberry weed management program uses both cultural and chemical controls.

Cultural control

Improving drainage of wet areas helps control wiregrass sedge, arrowhead, and other weeds. Increasing soil moisture reduces ragweed and goldenrod. Heavy nitrogen fertilization in June encourages barnyardgrass and other annual weeds. Too little fertilization may produce weak vines and open areas for weed invasion. Fertilization, water management, and other cultural practices that maximize cranberry growth encourage a solid canopy of cranberry vines, which will compete with weeds and reduce their density.

Soil pH. If soil pH is above 5.5, growth of some upland weeds may be reduced by lowering soil pH. Elemental sulfur is the most efficient way to reduce soil pH. Apply the sulfur in split applications of 50–100 pounds each per acre during the year when beds are dry and water is not puddled. Do not apply over 500 pounds of sulfur per acre per year. Sulfur pellets are preferred. Change in pH takes time, don't expect immediate results. No direct pH response results from application of sulfate salts such as ammonium sulfate or potassium sulfate.

Chemical control

Before using an herbicide, read and follow the label directions! Use only registered materials. The inclusion of product names in the tables is not an endorsement of a particular manufacturer's brand.

Preemergence herbicides are only effective before weeds germinate or produce significant growth. Make applications as early as the label allows. Poor performance and vine damage caused by some preemergence herbicides can be traced to making applications too late. Where this type of control is not possible, use postemergence herbicide or wiper applications.

When more than one herbicide is available, rotate among available materials to prevent weed resistance and potential build-up of residues in the soil. Herbicides must be applied evenly for effective weed control. Calibrate application equipment frequently and avoid overlap where possible.

Preemergence herbicides

Casoron is widely used to control germinating weeds in Wisconsin cranberry beds. While Casoron is effective, at high rates it can damage vines and reduce yields. Use the lowest effective rate possible. Do not apply more than 100 lb/a (4 lb ai) in any 12-month period.

Grass control

Two herbicides designed specifically for grass control are now labeled for cranberry: Poast and Select Max. Both are labeled for bearing beds. See label for adjuvant requirements. Timing is critical; read the product label carefully and be sure to apply when grasses are at the correct stage for maximum effect. Multiple applications may be necessary for control. Vine injury may result when applied during the heat of the day. For better results, spray in the evening when air temperatures are cool. These herbicides do not control sedges. To distinguish between grasses and sedges, roll a stem between your thumb and fingers. A grass will roll smoothly, a sedge will not.

2,4-D

Most 2,4-D labels do not allow use on cranberry. Only certain granular applications of 2,4-D are allowed preemergence in Wisconsin. Granular 2,4 D must be applied before bud break to avoid herbicide injury. Liquid sprays are not legal.

Glyphosate

Glyphosate is the active ingredient in herbicides sold under many trade names, but only a few are registered in cranberry. Consult the label prior to use. Glyphosate is a nonselective herbicide without residual action. Plants absorb the chemical through leaves and stems, and transport it throughout the plant through the vascular system. Glyphosate acts through the root system, so weeds may take several weeks to die. Patiently wait for results.

During the production period, glyphosate is registered for wiper application only, which is effective for weeds taller than the canopy. Weeds may be wiped with glyphosate during the season up to 30 days before harvest.

After the initial treatment, spot treatment with the wiper will eliminate weeds missed or those requiring a repeat application. A repeat application may be necessary where weeds were initially dense. Consult label for surfactant requirements.

Wiper application. Wipers should deposit herbicide on as much foliage as possible while not contacting or dripping onto the vines. The degree of control is proportional to the amount of foliage wiped. Using a food-safe dye in your wiping equipment will make it easier to see where you have and have not wiped. See details on label.

Timing is important for wiper applications. Annual weeds that are about to flower are most susceptible to control with glyphosate. Applications to young, rapidly growing plants will kill tops before the herbicide has had time to move throughout the plant for a complete kill. For most perennial weeds, July and August treatments are most effective.

Note: glyphosate cannot be applied within 30 days before harvest. Many glyphosate products do not allow surfactant additions when using wiper applications. Consult label for details. If weeds are still actively growing after harvest, a post-harvest wiping may help. Don't clip weeds prior to wiping. Clipping removes foliage that could be wiped with glyphosate. Woody perennial weeds may require two to three applications per year for 2 years for complete control.

Precautions: Do not allow glyphosate to contact or drip on cranberry plants or the vines will die. Wear non-permeable rubber or plastic boots when applying glyphosate. If footwear becomes contaminated with herbicide, wash them thoroughly before walking on lawns or other desirable foliage. Mixing glyphosate with hard water that is high in calcium, iron, manganese or zinc, or with dirty water containing organic matter will reduce activity. Be sure to clean equipment thoroughly both before and after treatment.

Stinger (clopyralid)

Stinger is a postemergence phenoxy-type herbicide. It is very active and will damage any vines it comes in contact with. You must have a valid Stinger 24(c) label in your possession at the time of application.

Callisto (mesotrione)

Callisto may be applied to bearing or nonbearing cranberry beds for control of rushes, sedges, and several other common cranberry weeds. Callisto has both preemergent and postemergent activity.

QuinStar 4L (quinclorac)

QuinStar 4L is a systemic herbicide that is taken up by roots and foliage. For perennial weeds, symptoms may not appear for several weeks and full effect may take up to six months. Younger weeds (especially dodder) are easier to manage than older, established weeds. QuinStar 4L controls several weed species common in cranberries, including yellow loosestrife. **MRL concerns exist; check with applicable handlers prior to use.**

Table 8. Cranberry weed control—Bearing vines

Application timing	Weeds	Commercial product, rate/acre	Active ingredient, rate/acre	Comments and restrictions
After harvest and before winter	wiregrass sedge	Casoron 4G, 100.0 lb	dichlobenil, 4.0 lb	Some injury may develop on vines. Use granular formulation. Do not use on young beds, newly sanded beds, or prior to or immediately after mowing vines. Use lower rates on sandy soil or weak vines.
	clover, goldenrod	Stinger 3EC	clopyralid	You must have a valid Stinger 24(c) label for cranberries in Wisconsin in your possession at application. See label for application details.
Spring	loosestrife, northern St. Johnswort, ragweeds, smartweed, sticktites, tearthumb	see label for rate	2,4-D	Several granular 2,4-D formulations exist; however, most are not registered for cranberry. Ensure the product you use is registered for cranberry. See the package label for use rates and precautions. Store 2,4 D away from other pesticides and fertilizers. The volatile 2,4-D can be absorbed by other products and may result in plant injury.
	annual broadleaf weeds, cinquefoil, perennial grasses, sedges, dodder	Casoron 4G, 35.0–100.0 lb	dichlobenil, 1.4–4.0 lb	Apply pre-budbreak. Some injury may develop on vines. Irrigate soon after application. Do not apply more than 100 lb/a per 12-month period. Do not use on young beds, newly sanded beds, or prior to or immediately after mowing vines. Use lower rates on sandy soil or weak vines.
	annual grasses, bluejoint, creeping sedge, sicklegrass, turkeyfoot	Evital 5G, 80.0–160.0 lb	norflurazon, 4.0–8.0 lb	Use lower rates on sandy soils, weak vines, and 'Stevens' and 'McFarlin' cultivars. Expect some vine injury. Can only be applied once per year (12 months).
	sticktites	Devrinol DF-XT, 8.0–12.0 lb Devrinol 2-XT, 8.0–12.0 qt	napropamide, 4.0–6.0 lb	Apply before spring growth begins. Apply as sticktites germinate. Irrigate within 24 hours after application or product will decompose with ultraviolet light. Controls a narrow range of weeds. Avoid applying when beds may be reflowed for spring frost protection or when soils are water-soaked.
	grasses	Poast, 0.5–2.5 pt/a	sethoxydim, 0.09–0.469 lb	Apply to actively growing grass weeds before extensive tillering or seedhead formation. See label for adjuvant requirements. Use no closer than 60 days before harvest.
	annual grasses	Select Max, 9.0–16.0 fl oz	clethodim, 0.068–0.121 lb	Apply to actively growing weeds. Always include nonionic surfactant at 0.25% v/v. Do not exceed 16 oz per application. If needed, wait at least 14 days before second appli-cation. Do not apply between hook and full fruit set. Treat at least 30 days before harvest.
	perennial grasses	Select Max 12.0–16.0 fl oz	clethodim 0.091–0.121 lb	
	dodder, yellow loosestrife, and select other broadleaf and grass weeds	QuinStar 4L, up to 8.4 fl oz	quinclorac, up to 0.25 lb	Apply up to 8.4 fl oz/a of QuinStar 4L herbicide as a foliar application. A second application may be made at least 30 days after the first application. A crop oil concentrate at a rate of 2 pints/a may be included in the spray mixture. Do not apply more than a total of 16.8 fl oz/a of QuinStar 4L per calendar year and do not make more than 2 applications per year. Do not apply within 60 days of harvest. Do not apply to crops subjected to stress conditions such as hail damage, flooding, drought, injury from other herbicides, or widely fluctuating temperatures, as crop injury may result. **Export MRL concerns exist; check with applicable handlers prior to use**.

Table 8. Cranberry weed control—Bearing vines *(continued)*

Application timing	Weeds	Commercial product, rate/acre	Active ingredient, rate/acre	Comments and restrictions
Spring through mid-August	broadleaf weeds, brush, grasses, sedges	See label for rate	glyphosate	Wiper application only. Wipe weeds above the cranberries with appropriate equipment. Do not apply glyphosate within 30 days of harvest. Many glyphosate products do not allow surfactant additions when using wiper applications. Consult label for details.
Late June through July	clover, goldenrod	Stinger 3EC	clopyralid	Do not apply Stinger from one week prior to bloom until one week after bloom. You must have a valid Stinger 24(c) label for cranberries in Wisconsin in your possession at application. See label for application details. Do not apply within 50 days of harvest.
After budbreak, but not less than 45 days prior to flooding or harvest	rushes, sedges, and several other common weeds	Callisto, up to 8 fl oz	mesotrione, up to 0.25 lb	Pre- and postemergent activity. Apply no more than two applications per crop year and not more than 16 fl oz/a total Callisto product per year. If two applications are made they must be made no closer than 14 days apart. See label for adjuvant recommendations and other restrictions.

Table 9. Cranberry weed control—Nonbearing vines

Application timing	Weeds	Commercial product, rate/acre	Active ingredient, rate/acre	Comments and restrictions
After planting	germinating grasses, sedges, etc.	Devrinol DF-XT, 6.0 lb Devrinol 2-XT, 6.0 qt	napropamide, 3.0 lb	Must be watered into the soil within 24 hours or it decomposes with ultraviolet light.
		Evital 5G, 40.0–80.0 lb	norflurazon, 2.0–4.0 lb	Irrigate immediately after application. Some vine injury may occur. Can only be applied once per year (12 months).
	annual grasses	Select Max, 9.0–16.0 fl oz	clethodim, 0.068–0.121 lb	Apply to actively growing weeds. Always include nonionic surfactant at 0.25% v/v. Do not exceed 16 oz per application. If needed, wait at least 14 days before second application. Do not apply between hook and full fruit set.
	perennial grasses	Select Max, 12.0–16.0 fl oz	clethodim, 0.091–0.121 lb	
After budbreak, but not less than 45 days prior to flooding in fall or winter	rushes, sedges, and several other common weeds	Callisto, up to 8 fl oz	mesotrione, up to 0.25 lb	Pre- and postemergent activity. Apply no more than two applications per crop year and not more than 16 fl oz/a total Callisto product per year. If two applications are made they must be made no closer than 14 days apart. See label for adjuvant recommendations and other restrictions.

More information

For detailed information about cranberry diseases, see the following Extension publications:

Cottonball Disease of Cranberry (A3194)

Cranberry Fruit Rot Diseases in Wisconsin (A3745)

Cranberry Stem Gall (A3795)

Fungal Leaf Spot Diseases of Cranberry in Wisconsin (A3711)

References to pesticide products in this publication are for your convenience and are not an endorsement of one product over other similar products. You are responsible for using pesticides according to the manufacturer's current label directions. Follow directions exactly to protect the environment and people from pesticide exposure. Failure to do so violates the law.

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