REVISED MARCH 2024

Extension
UNIVERSITY OF WISCONSIN–MADISON

A3276

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.

Cranberry Pest Management in Wisconsin 2024

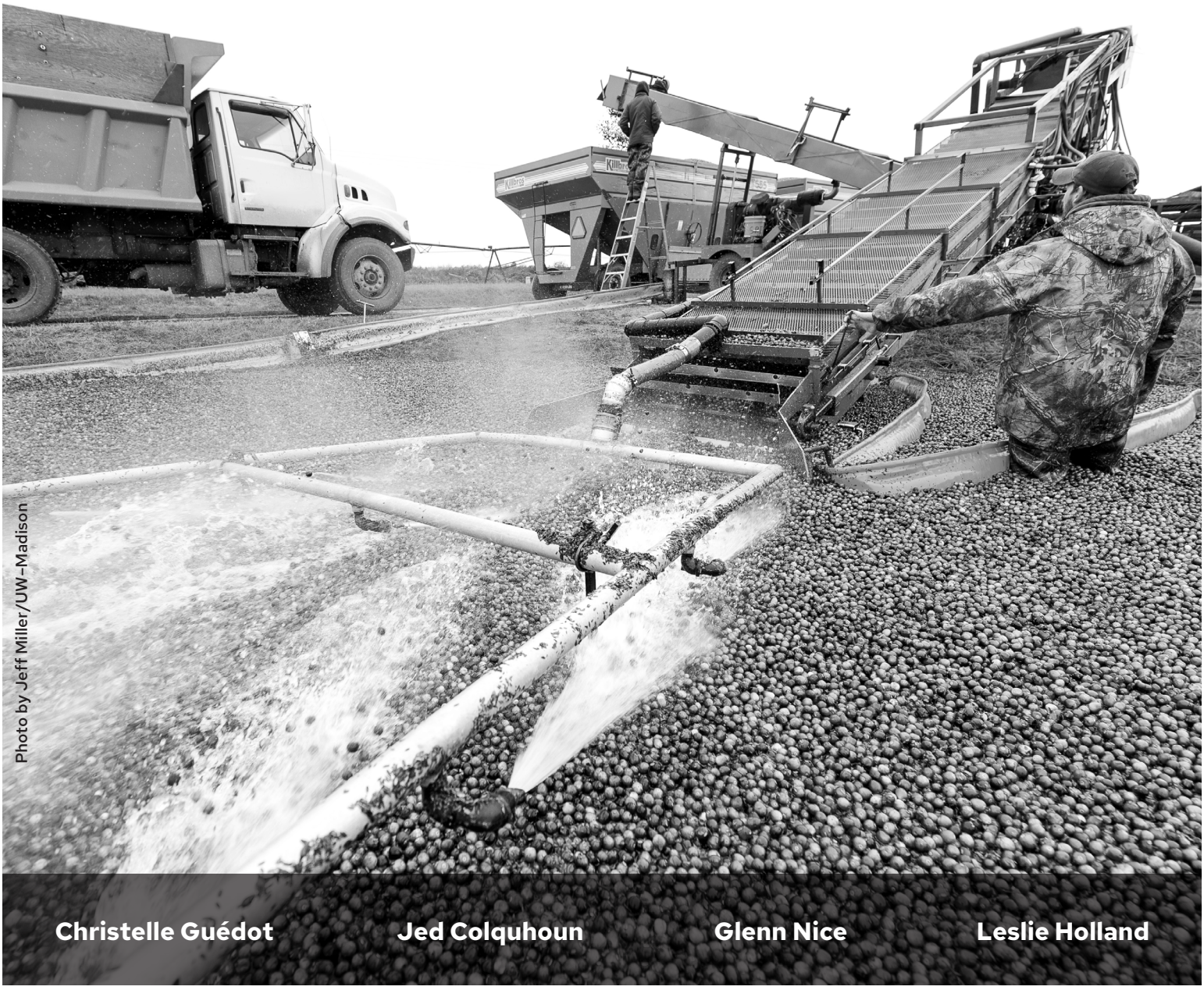


Photo by Jeff Miller/UW–Madison

Christelle Guédot Jed Colquhoun Glenn Nice Leslie Holland

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 2024 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 responsibility 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 March 18, 2024.

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 University of Wisconsin Pesticide Applicator Training (PAT) website (https://fyi.extension.wisc.edu/pat/commercial-tools-and-information) under **Government Tools**.

Wisconsin's training and certification program

In Wisconsin, responsibility for training lies with the University of Wisconsin–Madison Division of Extension 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, visit https://fyi.extension.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.

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.

Worker Protection Standard (WPS) for agricultural pesticides

The federal Worker Protection Standard (WPS) for Agricultural Pesticides took effect January 1, 1995 and was revised in 2015. 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.
- Annually 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.
- Maintain training and pesticide records for two years.
- Notify employees about pesticide applications (see below).

Pesticide handlers (including mixing/loading) who are not family members must be a minimum of 18 years of age. For more information about the WPS and the training requirements for uncertified workers and handlers, download the *How to Comply With the 2015 Revised Worker Protection Standard for Agriculture Pesticides* from the Pesticide Educational Resources Collaborative (PERC) website (http://pesticideresources.org). This website also has EPA-approved training videos for workers and handlers.

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. Dual-notice pesticides can be identified on the label by checking the Agricultural Use Requirements box. This box provides instructions for oral and posting requirements. A current list of dual-notice pesticides registered for use in Wisconsin may be downloaded at https://fyi.extension.wisc.edu/pat/private-tools-and-information under **PAT Tools**.

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
Paraquat	Gramoxone Inteon	5 gal

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 nonagricultural 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 online at https://fyi.extension.wisc.edu/pat/private-tools-and-information under **PAT Tools**. Or you can use the PAT program's online posting tool (https://s3-us-west-2.amazonaws.com/pat-tools.cals.wisc.edu/tools/Posting/index.html) 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 concentrated 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 LD_{50} or "lethal dose to 50%" in milligrams of toxicant per kilogram of body weight (mg/kg). For inhalation exposure, it is expressed as the LC_{50} 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) 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.
- Discard clothes that have been saturated with pesticides—they cannot be completely cleaned.
- 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 WDNR and to your LEPC. To simplify emergency notification requirements to state agencies, call the WDNR 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 WDNR 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 the existing product in the market; always follow the product's label.

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 can request 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 annually request such notification in writing.

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 Sprayer*s from your county Extension office or download it at https://fyi.extension.wisc.edu/pat/private-tools-and-information under **PAT Tools**. 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 https://fyi.extension.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. Signal word, PPE, restricted entry, and preharvest intervals of commonly used cranberry pesticides

Trade name	Common name	Cautionary signal word	Additional requirements to the base PPE[a]	Restricted-entry interval (hours)	Preharvest interval (days)	Pesticide group[b]
Abound 2.08F	azoxystrobin	caution		4	3	(Fun) 11
Acephate	acephate	caution		24	75	(Ins) 1B
Actara[d]	thiamethoxam	caution		12	30	(Ins) 4A
Admire Pro[d]	imidacloprid	caution		12	30	(Ins) 4A
Aftershock	fluoxastrobin	caution		12	1	(Fun) 11
Agree WG	*Bacillus thuringiensis*	caution	Mixer/loaders: NIOSH with R or P filter or NIOSH powered air-purifying respirator with an HE filter	4	0	(Bio)
Alias 2F[d] Alias 4F[d]	imidacloprid	caution		12	30	(Ins) 4A
Aliette WDG	aluminum tris	warning	Protective eyewear	24	3	(Fun) 33
Altacor 35WG	chlorantraniliprole			4	1	(Ins) 28
Assail 30SG Assail 70WP	acetamiprid	caution	(30SG) Headgear for overhead exposure; (70WP) Aerial mixer/loaders NIOSH (TC-84A) with R or P filter	12	1	(Ins) 4A
Avaunt	indoxacarb	caution		12	30	Ins (22)
Bravo Ultrex Bravo Weather Stik	chlorothalonil	danger/ caution	(Ultrex) CR footwear, protective eyewear, CR headgear, CR apron for mixing/loading, NIOSH respirator (TC-21C) or approved respirator with any N, R, P, or HE filter	12	50	N/A
Callisto	mesotrione	caution		12	45	(Herb) 27
Casoron 4G	dichlobenil	caution		12	N/A	(Herb) N/A
Closer[d]	sulfoxaflor	caution		12	1	(Ins) 4C
Danitol EC[d, e]	fenpropathrin	warning	Protective eyewear	24	3	(Ins) 3A
Delegate WG	spinetoram	caution		4	21	(Ins) 5
Devrinol DF-XT	napropamide	caution		24	N/A	(Herb) 15
Diazinon 50W[d, e] Diazinon AG500[d, e] Diazinon AG600[d, e]	diazinon	caution	CR apron for mixing/loading	120	7	(Ins) 1B
Dipel DF	*Bacillus thuringiensis*	caution	Mixing/loading: NIOSH respirator N-95, R-95, or P-95	4	0	(Bio)
Dithane F-45	mancozeb	N/A		24	30	(Fun) M3
Echo 90DF Echo Zn	chlorothalonil	danger/ warning	Protective eyewear, NIOSH respirator OV or with N, R, P, or HE prefilter	12	50	(Fun) M5
Entrust SC	spinosad	N/A		4	1	(Bio)
Equus 720 SST	chlorothalonil	warning	Protective eyewear	12	50	(Fun) M5
Evital 5G	norflurazon	caution		12	N/A	(Herb) 12

Abbreviations: N/A = not applicable, CR = chemical-resistant

(continued)

[a] PPE always required (base): long-sleeved shirt, long pants, shoes, socks, and chemical-resistant gloves. See specific label for types of chemical-resistant gloves. Very few labels do not include chemical-resistant gloves.

[b] Pesticide group abbreviations: (Bact) Bactericide; (Bio) Biological; (Fun) Fungicide; (Herb) Herbicide; (Ins) Insecticide.

[c] Table 1. EPA chemical-resistant category selection chart for personal protection equipment: https://citrusindustry.net/2021/11/01/protecting-people-from-pesticide-exposure.

[d] Pollinator alert: Due to high toxicity to pollinators, additional precautions are required. Any beekeeper within 1.5 miles of an application site may annually request notification of application at least 24 hours in advance.

[e] Restricted-use pesticide.

Table 3. Signal word, PPE, restricted entry, and preharvest intervals of commonly used cranberry pesticides *(cont.)*

Trade name	Common name	Cautionary signal word	Additional requirements to the base PPE[a]	Restricted-entry interval (hours)	Preharvest interval (days)	Pesticide group[b]
Exirel SE[d]	cyantraniliprole	caution		12	3	(Ins) 28
Fanfare ES[d, e] Fanfare EC[d, e]	bifenthrin	warning	CR gloves, protective eyewear	12	30	(Ins) 3
Grandevo WDG	*Chromobacterium subtsugae* strain PRAA4-1	caution	Protective eyewear, NIOSH respirator with R or P filter (TC-84A), or powered air purifying respirator with an HE filter (TC-21C)	4	0	(Bio)
Imidan 70W[d]	phosmet	warning	Mixing/loading with handheld equipment or nozzles: CR apron; Open cab: CR headgear for overhead exposure, chemical resistant apron if exposed to concentrate and a respirator with OV cartridge (TC-23C or TC-14G) or N, R, P, or HE prefilter	72	14	(Ins) 1B
Indar 2F	fenbuconazole	caution	CR headgear for overhead exposure	12	30	(Fun) 3
Intrepid 2F	methoxyfenozide	caution		4	7	(Ins) 18
Mankocide DF	mancozeb + copper hydroxide + manganese + zinc + ethylenebisdithio-carbamate	danger	Protective eyewear	48, 24 if certain conditions are met, see label	30	(Fun) M1 + (Bact) M3
Movento	spirotetramat	caution		24	7	(Ins) 23
Orthene 97[d]	acephate	caution	Hand wand applications: NIOSH TC-21C or a respirator with N, R, P, or HE filter	24	75	(Ins) 1B
Phostrol	mono- and dibasic sodium, potassium, and ammonium phosphites	caution	Protective eyewear	4	3	(Fun) 33
Poast	sethoxydim	warning	CR footwear, protective eyewear, CR headgear for overhead exposure, mixing/loading and cleaning CR apron	12	60	(Herb) 1
PropiMax	propiconazole	warning	Goggles or face shield	12	45	(Fun) 3
Pyganic[d]	pyrethrins	caution	CR gloves	12	0	(Ins) 3A
Quadris Top	azoxystrobin + difenoconazole	caution		12	30	(Fun) 11 + (Fun) 3

Abbreviations: N/A = not applicable, CR = chemical-resistant *(continued)*

[a] PPE always required (base): long-sleeved shirt, long pants, shoes, socks, and chemical-resistant gloves. See specific label for types of chemical-resistant gloves. Very few labels do not include chemical-resistant gloves.

[b] Pesticide group abbreviations: (Bact) Bactericide; (Bio) Biological; (Fun) Fungicide; (Herb) Herbicide; (Ins) Insecticide.

[c] Table 1. EPA chemical-resistant category selection chart for personal protection equipment: https://citrusindustry.net/2021/11/01/protecting-people-from-pesticide-exposure.

[d] Pollinator alert: Due to high toxicity to pollinators, additional precautions are required. Any beekeeper within 1.5 miles of an application site may annually request notification of application at least 24 hours in advance.

[e] Restricted-use pesticide.

Table 3. Signal word, PPE, restricted entry, and preharvest intervals of commonly used cranberry pesticides *(cont.)*

Trade name	Common name	Cautionary signal word	Additional requirements to the base PPE[a]	Restricted-entry interval (hours)	Preharvest interval (days)	Pesticide group[b]
Quilt Xcel	azoxystrobin + propiconazole	warning		12	45	(Fun) 11 + (Fun) 3
QuinStar 4L	quinclorac	caution		12	60	(Herb) 4
Ridomil Gold GR Ridomil Gold SL	mefenoxam	caution		48	45	(Fun) 4
Rimon EC	novaluron	warning	Protective eyewear	12	1	(Ins) 15
Select Max	clethodim	caution	Protective eyewear	24	30	(Herb) 1
Sevin 4F[d] Sevin XLR Plus[d]	carbaryl	caution	CR footwear, headgear, NIOSH (TC-21C) respirator with N, R, P, or HE filter; (XLR Plus) Mixer/loader CR apron	12	7	(Ins) 3A
Spear-Lep	GS-omega/kappa	caution	Protective eyewear	4	0	(Ins) 32
Stinger	clopyralid	caution	Protective eyewear	12	50	(Herb) 4
Tilt	propiconazole	warning	Goggles or face shield	24	45	(Fun) 3
Topaz EC	propiconazole	warning	Protective eyewear, goggles, or face shield	12	45	(Fun) 3
Venerate XC	*Burkholderia* spp. strain A396	caution	Protective eyewear; NIOSH (TC-84A) respirator with a HE filter (TC-021C) in repeated exposure	4	0	(Ins) biological
Venom[d]	dinotefuran	caution		12	7	(Ins) 4A
Verdepryn SL[d]	cyclaniliprole	caution	Protective eyewear	4	1	(Ins) 28
Weedar 64	2,4-D	danger	Mixing/loading: CR apron; protective eyewear	48	30	(Herb) 4
Widow[d]	imidacloprid	caution		12	30	(Ins) 4

Abbreviations: N/A = not applicable, CR = chemical-resistant *(continued)*

[a] PPE always required (base): long-sleeved shirt, long pants, shoes, socks, and chemical-resistant gloves. See specific label for types of chemical-resistant gloves. Very few labels do not include chemical-resistant gloves.

[b] Pesticide group abbreviations: (Bact) Bactericide; (Bio) Biological; (Fun) Fungicide; (Herb) Herbicide; (Ins) Insecticide.

[c] Table 1. EPA chemical-resistant category selection chart for personal protection equipment: https://citrusindustry.net/2021/11/01/protecting-people-from-pesticide-exposure.

[d] Pollinator alert: Due to high toxicity to pollinators, additional precautions are required. Any beekeeper within 1.5 miles of an application site may annually request notification of application at least 24 hours in advance.

[e] Restricted-use pesticide.

Disease management

The most numerous and widespread cranberry diseases are caused by fungi. While disease pressure for fungal diseases is traditionally low and disease epidemics in Wisconsin marshes are sporadic, losses can be significant in years of high disease pressure. This is especially true for the fruit rot disease complex which continues to be an increasing concern in plantings of high-yielding newer varieties.

The Plant Disease Diagnostic Clinic at University of Wisconsin–Madison provides diagnoses for a modest charge (pddc.wisc.edu). Several Extension publications offer more complete information on many of the more important cranberry diseases (learningstore.extension.wisc.edu). Another resource is the *Compendium of Blueberry, Cranberry, and Lingonberry Diseases and Pests, Second Edition*, available from APS Press at https://apsjournals.apsnet.org/doi/book/10.1094/9780890545386.

Fungicides

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 can be used by some growers for fruit rot control but are not effective for cottonball control. However, as Maximum Residue Limits (MRLs) for chlorothalonil and mancozeb continue to become more stringent in certain countries, pay close attention to handler guidelines for rule changes and restrictions as these products may not be allowable at key management windows for the fruit rot complex. 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, Satori, Aframe). 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.

Quadris Top and Quilt Xcel are premixed combinations of fungicides. Quadris Top is a premixed combination of the active ingredient in Abound (azoxystrobin) and difenoconazole, a fungicide new to cranberry. In recent trials, Quadris Top has been very effective in controlling both fruit rot and cottonball. Quilt Xcel is a premixed combination of the active ingredients of Abound (azoxystrobin) and Orbit/Tilt (propiconazole). It also has been very effective in controlling cottonball in field trials. Although the Quilt Xcel label lists fruit rots, it is not as efficacious for fruit rots compared to the other registered conventional materials. Therefore, Quilt Xcel should be considered a cottonball fungicide rather than general fruit rot fungicide. While these products are newer to cranberry, the fungicide modes of action are not. Both Quadris Top and Quilt Xcel are combinations of group 3 and group 11 fungicides. Note that because they both contain azoxystrobin, they have a 14-day water holding restriction after application.

Two newer "soft" fungicides are labeled for use on cranberries, and both are permitted for use in organic production. The active ingredient in Oso is polyoxin D zinc salt, which inhibits the formation of chitin, a building block of fungal cell walls. The active ingredient in Regalia is an extract of giant knotweed (*Reynoutria sachalinensis*), which is believed to induce a plant's natural defense mechanisms. In Wisconsin trials, Oso and Regalia have been inconsistent in their level of control for both fruit rot and cottonball. In some trials they suppress disease, but they are usually less effective than the sterol demethylation inhibitor and strobilurin fungicides.

Fungicide resistance

For decades, fungicide resistance management in cranberry was centered on the use of multisite fungicide chemistries, in particular, mancozeb and chlorothalonil. These multisite fungicides are considered "low risk" for fungicide resistance development due to their ability to target a fungus at different sites, making it harder for the fungus to overcome. However, due to increasing restrictions in the export market, these multisite chemistries are no longer relied on for fruit rot management in Wisconsin. Due to the limited number of modes of action (FRAC groups 3 and 11) available for fruit rot disease control in cranberry, there may be increased opportunities for fungicide resistance development. Fungicide resistance as defined by the Fungicide Resistance Action Committee (FRAC) is "an acquired, heritable reduction in sensitivity of a fungus to a specific fungicide." Fungicide resistance is a problem observed with single-site fungicides, which are at increased risks for being overcome by the fungus. The single-site fungicide classes used in cranberry are FRAC 3 and FRAC 11. Some commonly used fungicides in FRAC 3 include Indar (fenbuconazole), Proline (prothioconazole), and the group 3 chemistries found in premix products Quadris Top and Quilt Xcel, difenoconazole and propiconazole, respectively. Fungicides in FRAC group 3 are considered "medium risk" for fungicide resistance development, and while they can be applied solo (e.g., Proline) applications are often made with another single-site fungicide (i.e., FRAC 11) to offer two modes of action instead of one to control fungal pathogens. On the other hand, the FRAC 11 fungicide Abound (azoxystrobin) is classified as "high risk" for fungicide resistance development. This means that FRAC 11 fungicides should never be applied solo (i.e., no solo applications of Abound). To minimize the risk for fungicide resistance development, Abound is tank mixed with a FRAC 3 chemistry (e.g., Indar). The active ingredient, azoxystrobin, is also found as the FRAC 11 component in the premix fungicides Quadris Top and Quilt Xcel. While we have several compounds within FRAC 3 for disease control in cranberry, we rely on the azoxystrobin in Abound and both premixture products. Over reliance on this active ingredient may eventually result in decreased sensitivity by the fungus and ultimately fungicide resistance.

Disease notes

Fruit rot

Fruit rot diseases have become troublesome for many 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 produces spores which infect cranberry during bloom in June and July in Wisconsin. The ripe rot pathogen *Coleophoma* is also prevalent in Wisconsin marshes, and constitutes one of the most common fungal species identified from rotted fruits at harvest. 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. While this disease does not typically kill plants it can significantly reduce growth in a new planting and can limit the ability of the plantings to fill in properly. As plantings mature, the severity of this disease decreases.

The key time to apply any fungicide for fruit rot control is during bloom. However, chlorothalonil can be phytotoxic, causing fruit scarring and reduced fruit set if applied during bloom, especially if applied in lower spray volumes. If spray volume is low, consider using Proline, Quadris Top, 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.

If fruit is being harvested for fresh market sales, refrigerate cranberries immediately after harvest and during storage to delay development of storage rots. Be aware, however, that fruit rot can develop at low temperatures and eventually cause rotting even at near-freezing temperatures. Store fresh fruit at 38–40°F; infected berries break down rapidly at temperatures above 55°F.

Cottonball

Cottonball occurs so infrequently on Wisconsin marshes 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 appears to be variable, but the fungus *Phomopsis vaccinii* has been isolated from some affected plants. Several other fungi can also be isolated from plants with symptoms, but their roles in the upright dieback syndrome are not understood. The cause of upright dieback in Wisconsin seems to be physiological rather than due to specific fungal pathogens. In some cases, pathogens may be secondary to any physiological issue with the plant. In cases where *Phomopsis vaccinii* is consistently isolated from affected uprights, fungicide applications the following spring may be warranted. Conditions that favor vigorous, but not excessive, vine growth should help vines tolerate or resist fungal infections. Infection occurs during the spring as shoots are elongating, so fungicide application at this time is more effective than applications made later after the fungus has invaded the plant tissue. If *Phomopsis vaccinii* is isolated from shoots exhibiting upright dieback, applications of chlorothalonil during the earliest stages of bud elongation (¼–½ inch green) the following spring are most effective. No treatment options are available for upright dieback symptoms in the season that they occur.

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. 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, and installation of drain tile should be considered in beds with consistent drainage issues. 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. There is limited data on the efficacy of Ridomil products and phosphorous acid products in Wisconsin. Once *Phytophthora* issues have been detected proper drainage should be prioritized. Lab tests and field applications indicate that many of the *Phytophthora* species found in Wisconsin are not sensitive to Ridomil.

Leaf 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 the cranberry fruit rot complex 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. 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 the cranberry fruit rot complex should adequately control red leaf spot.

Bacterial diseases

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 are bacteria that produce a plant growth hormone. Stem gall seems to be worst in areas where plants have been damaged by harrow tires or cold injury. The bacteria can only infect through mechanical wounds caused by outside sources, therefore managing bacterial stem gall focuses on avoiding wounding the plant. Minimizing plant injury at harvest, during the winter, and in early spring is the best preventative management strategy. During harvest, avoid turning the harrow around at the end of the bed whenever possible (ramping in and out is preferable in mitigating crushing damage) and ensure harvest speed is slow enough that no track slippage occurs. This type of mechanical damage at harvest causes grinding on the vines by spinning tracks and creates wounds that the stem gall bacteria can infect. In early winter, a deep flood when making ice can help ensure that ice sheeting does not form in the canopy of the vines, as subsequent expansion and contraction of ice in winter and spring can injure vines and provide entry sites for stem gall bacteria. Lifting the ice gently down on vines as it melts by reflowing in late winter and early spring also helps to minimize the damage associated with ice crushing down on vines, thus reducing the likelihood of injury from stem gall. There are no chemical control options for these bacteria. If stem gall infections are detected, best management practice includes sanding the bed (at least ½ inch is preferable) during the winter following the injury. The sand will bury the infected stems and allow the vines to form new roots ahead of the gall-damaged section, and restore proper flow of water and nutrients to growing uprights and reduce symptoms.

False blossom disease is caused by a phytoplasma which is an obligate bacterium. This disease reemerged in Wisconsin in 2018 and results in yield losses. Infected vines do not recover and can no longer bear fruit. The blunt-nosed leafhopper (BNLH) is the only known insect vector of the false blossom phytoplasma. In places where false blossom occurs, the BNLH should be managed. To prevent introduction of the disease it is recommended to plant pathogen-free nursery stock and vines. See Extension publication ***Cranberry False Blossom*** (A4169) for more information.

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. See Extension publications ***Tobacco Streak Virus in Cranberry*** (A4110) and ***Blueberry Shock Virus in Cranberry*** (A4147) for more information.

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 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 (100–300 gal/a water) or concentrate (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.

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 Quilt Xcel, 14.0–21.0 fl oz Tilt EC, 4.0–6.0 fl oz Topaz EC, 4.0–6.0 fl oz	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. For Quilt Xcel, consult label for use restrictions, including 14-day water holding requirement.
	10–15% bloom and again at full bloom	Abound 2.08F, 6.0–15.5 fl oz Quadris Top, 10.0–14.0 fl oz	Applications of Abound are not permitted before bloom. Consult Abound label for specific use restrictions. Consult Quadris Top label for use restrictions, including 14-day water holding requirement.
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	Applications at 20% in-bloom and 80% in-bloom	Bravo WeatherStik, 4.0–6.5 pt; or Bravo Ultrex, 3.8–6.0 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.
		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, 7.0 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.
		Aftershock, 2.0–5.7 fl oz Evito 480SC, 2.0–5.7 fl oz	See the label for specific use restrictions. Do not apply more than two sprays of Aftershock or Evito before alternating with an unrelated fungicide.
		Proline 480SC, 5.0 fl oz	A maximum of two applications of Proline is permitted per season.
		Quadris Top, 10.0–14.0 fl oz	Consult Quadris Top label for use restrictions, including 14-day water holding requirement.
Phytophthora root and runner rot	Early shoot elongation, then at labeled intervals	Aliette WDG, 5 lb; or Prophyt, 4.0 pt ; or Phostrol, 5.0–6.0 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 12.
	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 12.

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

Insect management

Cranberry fruitworm and sparganothis fruitworm are the most important insect pests of cranberry in Wisconsin. Most Central Wisconsin marshes are susceptible to attack from both species and economic damage can occur if controls are not adequate. Blackheaded fireworm presence and abundance have decreased in recent years and has not represented a widespread threat to cranberry production lately in Wisconsin. It is more of a sporadic and localized pest which can reach damaging levels and thus should still be monitored and managed accordingly. The red-headed flea beetle (also known as cranberry flea beetle) has become a pest of concern for many growers. It is important to monitor for the presence of red-headed flea beetle adults and associated damage from adults feeding on leaves and fruit. Of secondary importance are spanworms and cranberry girdler. These normally occur at low levels, but if environmental conditions favor an outbreak and appropriate controls are not undertaken, losses can be serious. Cranberry tipworm, white grub, cranberry weevil, and dearness scale are more spotty in distribution but can also be damaging. Other insects may 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. 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.

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. Recently, some marshes have reported higher than usual numbers of leafhoppers. Leafhoppers have piercing-sucking mouthparts and can cause noticeable feeding injury on vines when high densities are allowed to flourish. In addition, the resurgence of blunt-nosed leafhopper is raising concerns over their ability to vector and spread the phytoplasma responsible for false blossom disease. Special attention should be paid for the presence of blunt-nosed leafhopper nymphs in the spring, in particular at the marshes that saw higher than usual populations of leafhoppers in previous years, and at marshes that have identified false blossom symptoms on cranberry vines.

Insecticide update

The inseticide Confirm which contains the active ingredient tebufenozide is no longer being manufactured by Gowan and is no longer registered with DATCP. Please discontinue use of Confirm.

The Environmental Protection Agency (EPA) performs registration reviews to reevaluate pesticides every 15 years to assess environmental and occupational risk. During the review process of Diazinon, the EPA reached an early agreement with pesticide registrants to develop voluntary mitigation measures. Diazinon is available in three formulations: 50W, AG500 and AG600. Adama is the registrant for Diazinon 50W and AG500, and has decided to continue the production of AG500 into 2024 and to cease production of Diazinon 50W. For AG500, new labeling that will contain occupational risk mitigation measures and endangered species language are expected to be approved by the end of 2023. As for AG600, manufactured by Loveland Products, the production of Diazinon AG600 seem to have ceased as well. Once stocks of Diazinon 50W and AG600 run out, Diazinon will only be produced and available from Adama in the AG500 formulation. It is expected that the EPA will announce the notice of the agreed upon mitigation measures later this year. You are still allowed to use any of the formulations of Diazinon until the EPA completes the registration review process.

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): 30SG, 70WP	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, Agree: WG	cranberry fruitworm, fireworms, spanworms, sparganothis	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.
bifenthrin (Fanfare): EC, ES	cranberry fruitworm, fireworms, spanworms, tipworm, flea beetle, leafhoppers, sparganothis fruitworm, white grub adult	Extremely toxic to fish and aquatic invertebrates, use care when applying near any body of water. Recommended primarily to control leafhoppers prebloom. One application per year recommended. 3-day water holding highly recommended to reduce movement of the product in water system.
Burkholderia 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	fireworms, flea beetle, fruitworm, sparganothis	Maximum of 10 quarts (XLR or 4F) or 12.5 lb (80 Solupak) per acre per year.
chlorantraniliprole (Altacor): 35WG	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.
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.
cyantraniliprole (Exirel): 10SE	fruitworm, sparganothis, blackheaded fireworm, spanworms	Make no more than two applications within a single generation of target pest. Minimum of 5 days between applications. Do not exceed more than 62 fl oz per acre per year.
cyclaniliprole (Verdepryn): 100SL	cranberry fruitworm	Do not apply during bloom. Make no more than 3 applications per year. Minimum interval between applications is 5 days. Apply no more than 33 fl oz per acre per year.
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 three 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.

[a]Refer to table 3 for restricted entry intervals and preharvest intervals; refer to table 7 for insecticide rates. *(continued)*
[b]Refer to table 6 on page 18 for relative toxicity of insecticides to honeybees.

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

Insecticide and formulation	Labeled insects	Remarks[b]
fenpropathrin (Danitol): 2.4 EC	cranberry fruitworm, cranberry weevil, leafhoppers, sparganothis fruitworm, tipworm,	Do not apply more than 32 fl oz per acre per year. Minimum of 14 days between applications.
GS-omega/kappa (Spear-Lep)	cranberry fruitworm, leafrollers, loopers, spanworms, sparganothis fruitworm	Must be tank mixed with low label rate of Bt to have any efficacy. Apply 1–2 pt/a.
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.
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.
pyrethrins (Pyganic): 1.4 EC, 5.0 EC	flea beetle, fruitworms, leafhoppers	Hold water for 24 hrs. Degrades in sunlight. Should be buffered to 5.5–7.0 pH. USDA-OMRI approved for organic production.
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.
spirotetramat (Movento)	leafhoppers, thrips, tipworm	Do not apply until after petal fall. Maximum of 30 fl oz per acre per year. Do not make applications less than seven days apart. Check with handler on preharvest interval; see **Insecticide update** for details.
sulfoxaflor (Closer): 21.8SC	leafhoppers (suppression), Lygus bugs, thrips (suppression)	Maximum of 2–3 applications depending on species. Do not make applications less than 7 days apart. Do not apply at any time between 3 days before bloom until after petal fall.
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 18 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. Research is ongoing to develop mating disruption technologies to add to our cranberry pest management toolbox.

Insecticides and pollination

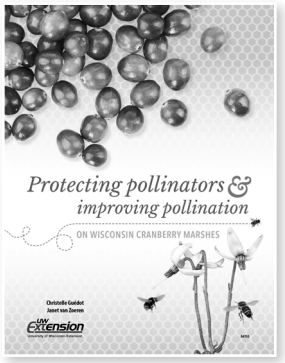
Insects are important for cranberry pollination and improve fruit set. Honey bees are not the only pollinators; native bees, including bumble bees and other wild insects, play an important role in pollinating cranberry. Whenever possible, do not apply insecticides when 2% or more of the flower buds are 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 (table 6) and apply them in the evening after bees stop 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.

Refer to extension publication A4155, *Protecting Pollinators and Improving Pollination on Wisconsin Cranberry Marshes* for detailed information on pollination.



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 however, it is essential to always check the label before applying a pesticide. 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 acetamiprid bifenthrin carbaryl cyantraniliprole cyclaniliprole diazinon dinotefuran fenpropathrin imidacloprid indoxacarb phosmet pyrethrins spinetoram sulfoxaflor 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 spirotetramat spinosad	
Relatively nontoxic	*Bacillus thuringiensis* *Burkholderia* spp. cells *Chromobacterium subtsugae* chlorantraniliprole GS-omega/kappa methoxyfenozide	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	*Burkholderia* spp. cells, 1.0–4.0 qt. *Chromobacterium subtsugae*, 2.0–3.0 lb indoxacarb, 6.0 fl oz	Fireworm treatments normally also control weevils.
	fireworm, sparganothis fruitworm	acephate 97, 1.0 lb bifenthrin, 6.4 fl oz *Burkholderia* spp. cells, 1–8 qt. carbaryl XLR Plus or 4F, 1.5–2.0 qt chlorantraniliprole 35WG, 3.0–4.5 oz *Chromobacterium subtsugae*, 2.0–3.0 lb cyantraniliprole 10SE, 10.0–20.5 fl oz *diazinon 50WP, 4.0–6.0 lb; or AG500, 2.0–3.0 qt; or AG600WBC, 51.0–76.5 fl oz GS-omega/kappa, 1–2 pt + *Bacillus thuringiensis*** indoxacarb, 6.0 fl oz phosmet 70W, 1.3–4.0 lb pyrethrins 16–64 fl oz spinetoram WG, 3.0–6.0 oz	Acephate is now restricted to a single application per year. Indoxacarb is not registered for sparganothis.
	June beetle (grubs)	carbaryl XLR 2.0 qt imidacloprid, 7.0–14.0 fl oz	
	leafhoppers	acephate 97, 1.0 lb bifenthrin, 6.4 fl oz carbaryl XLR Plus or 4F, 1.0–2.0 qt *diazinon 50WP, 4.0–6.0 lb; or AG500, 2.0–3.0 qt; or AG600WBC, 51.0–76.5 fl oz fenpropathrin 10.67–16 fl oz sulfoxaflor 2.75–5.75 fl oz phosmet 70W, 1.3–4.0 lb pyrethrins 16–64 fl oz	
	spanworm	acephate 75S, 1.33 lb; or 97, 1.0 lb *Bacillus thuringiensis*** bifenthrin, 6.4 fl oz chlorantraniliprole 35WG, 3.0–4.5 oz *Chromobacterium subtsugae*, 2.0–3.0 lb cyantraniliprole 10SE, 10.0–20.5 fl oz indoxacarb, 6.0 fl oz methoxyfenozide, 10–16 fl oz phosmet 70W, 1.3–4.0 lb spinetoram WG, 3.0–6.0 oz	You can control spanworms with fireworm treatments if the treatments coincide with the youngest larval stages of spanworms. Acephate is 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	bifenthrin, 6.4 fl oz *diazinon 50WP, 4.0–6.0 lb; or AG500, 2.0–3.0 qt; or AG600WBC, 51.0–76.5 fl oz spirotetramat 8.0–10.0 fl oz	Diazinon has a maximum of three applications per year; allow at least 14 days between treatments.
June 7–21	dearness scale (crawler stage)	No materials registered	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.
Hook stage to start of blossom	cranberry weevil, fireworm, spanworm, sparganothis fruitworm, tipworm		

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

(continued)

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
Blossom	cranberry fruitworm, sparganothis fruitworm	*Burkholderia* spp. cells, 1–8 qt. chlorantraniliprole 35WG, 3.0–4.5 oz *Chromobacterium subtsugae*, 2.0–3.0 lb GS-omega/kappa, 1–2 pt + *Bacillus thuringiensis*** methoxyfenozide, 10.0–16.0 fl oz	
After blossom (mid- to late July)	fireworm, spanworm, sparganothis fruitworm, tipworm	Use materials and rates as listed above for all insects. spirotetramat, 8.0–10.0 fl oz for tipworm only	*Chromobacterium subtsugae* and *Burkholderia* spp. are not registered for tipworm. Spirotetramat is registered for tipworm only (check with handler on preharvest interval).
	cranberry fruitworm	acephate 75S, 1.33 lb acetamiprid 30SG 4.5–5.3 oz; or 70WP 1.9–2.3 oz carbaryl XLR Plus or 4F, 1.5–2.0 qt chlorantraniliprole 35WG, 3.0–4.5 oz *Chromobacterium subtsugae*, 2.0–3.0 lb cyantraniliprole 10SE, 10.0–20.5 fl oz cyclaniliprole 100 SL, 8.2–11.0 fl oz *diazinon 50WP, 4.0–6.0 lb; or AG500, 2.0–3.0 qt; or AG600WBC, 51.0–76.5 fl oz GS-omega/kappa, 1–2 pt + *Bacillus thuringiensis*** phosmet 70W, 1.3–4.0 lb pyrethrins 16–64 fl oz spinosad 4.0–6.0 fl oz	Acephate is restricted to a single application per year. Diazinon has a maximum of three applications per year; allow at least 14 days between treatments. The phosmet label recommends using higher label rates for cranberry fruitworm.
	flea beetle	acetamiprid, 30SG 4.5–5.3 oz; or 70WP 1.9–2.3 oz *diazinon 50WP, 4.0–6.0 lb; or AG500, 2.0–3.0 qt; or AG600WBC, 51.0–76.5 fl oz dinotefuran 70SG, 2.0–4.0 oz phosmet 70W, 1.3–4.0 lb pyrethrins 16–64 fl 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. 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 moss, 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.

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; in many cases generic options are also available, but make sure that cranberry is included on the label.

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 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. Clethodim, the active ingredient in Select Max, is sold under many trade names. Be sure that the product you use is labeled for cranberry and double-check application rates—they vary among products.

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. Weedar 64 is allowed for wiper application only. Do not allow Weedar 64 to contact cranberry vines.

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. The current Stinger 24(c) label for Wisconsin expires December 31, 2027. You must have a valid Stinger 24(c) label in your possession at the time of application.

Callisto (mesotrione)

Mesotrione is now available in several trade names; be sure the product you choose is labeled for use on cranberry. 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. **Maximum residue limit 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, up to 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	clopyralid	You must have a valid Stinger 24(c) label for cranberries in Wisconsin in your possession at application. The current Stinger 24(c) label for Wisconsin expires December 31, 2027. Check the DATCP special pesticide registrations for label updates.
Spring	loosestrife, northern St. Johnswort, ragweeds, smartweed, sticktites, tearthumb	see label for rate	granular 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, up to 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 application. 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	

(continued)

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

Application timing	Weeds	Commercial product, rate/acre	Active ingredient, rate/acre	Comments and restrictions
Spring *(cont.)*	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**.
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	clopyralid	You must have a valid Stinger 24(c) label for cranberries in Wisconsin in your possession at application. The current Stinger 24(c) label for Wisconsin expires December 31, 2027. Check the DATCP special pesticide registrations for label updates.
	tall broadleaf weeds	Weedar 64, 2.4 pt/a	2,4-D, 1.2 lb/a	**Wiper application only.** Wipe weeds above the cranberries with appropriate equipment as listed on the label. Do not allow the solution to touch or drip onto vines. Apply in a 33% solution (one part Weedar 64 to two parts water). The preharvest interval is 30 days. Limited to two applications per year.
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

View detailed publications about cranberries at the UW–Madison Division of Extension Learning Store (learningstore.extension.wisc.edu):

Blueberry Shock Virus in Cranberry (A4147)

Cranberry False Blossom (A4169)

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)

Tobacco Streak Virus in Cranberry (A4110)

Protecting Pollinators and Improving Pollination on Wisconsin Cranberry Marshes (A4155)

REVISED MARCH 2024

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.

Extension
UNIVERSITY OF WISCONSIN–MADISON

Authors: Christelle Guédot is associate professor of entomology, Jed Colquhoun is professor of horticulture, Glenn Nice is Pesticide Applicator Training (PAT) manager, and Leslie Holland is assistant professor and Extension specialist, College of Agricultural and Life Sciences and Division of Extension, University of Wisconsin–Madison.

Cover photo by Jeff Miller, University of Wisconsin–Madison.

University of Wisconsin–Madison Division of Extension, in cooperation with the U.S. Department of Agriculture and Wisconsin counties, publishes this information to further the purpose of the May 8 and June 30, 1914, Acts of Congress. An EEO/AA employer, University of Wisconsin–Madison Division of Extension provides equal opportunities in employment and programming, including Title VI, Title IX, the Americans with Disabilities Act (ADA), and Section 504 of the Rehabilitation Act requirements. For communicative accommodations in languages other than English, please contact oaic@extension.wisc.edu. Persons with disabilities who require alternative means for communication of program information (braille, large print, audiotape, etc.) should contact Heather Lipinski Stelljes at heather.stelljes@wisc.edu.

Cranberry Pest Management in Wisconsin–2024 (A3276) R-04-24