

DISEASE MANAGEMENT 2021 - 2023
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UPRIGHT DIEBACK

Causal Agent/Pathogen: Three different fungi have been associated with this disease.

1. *Phomopsis vaccinii* (primary).
2. *Fusicoccum putrefaciens* (often).
3. *Synchronoblastia crypta* (rarely).

Factors aggravating disease incidence and severity:

- Growing seasons with prolonged periods of drought or heat stress.
- Stress weakens the vines and makes them more susceptible to infection by fungal pathogens.

Critical Phases of Infection:

- Spores of the pathogen would be produced from overwintering cranberry tissue in April and May and the emerging buds are particularly susceptible to the infection.
- Infection most probably occurs during or shortly after bud break when tissues are susceptible.
- Infection may also occur during the entire growing season.

Typical time to monitor for symptoms: Once infected, plants show symptoms (dead uprights and leaf drop) when weather-related stresses weaken the plants. There are three phases when symptoms likely appear.

1. Shortly after the winter flood has been withdrawn.
2. June and early July.
3. Late August and September.

Symptoms:

- Individual uprights that die back from the growing point toward the runner.
- Every upright may be infected on some runners, while other runners may only have one or a few infected uprights. In severe cases, the entire runner will be stressed or dying.
- Scattered uprights may be infected or whole patches of dieback may show up, particularly in newer beds.

Suspect upright dieback? Please get samples diagnosed by a plant pathology lab before applying fungicides.

Management:

- Avoid stress (by properly timing irrigation) on the plants especially through the hottest (and potentially the driest) portion of the growing season.
- Early season fungicide applications at bud break and/or early bud expansion (approximately around April 25 through May 15) are proven to give excellent control of the disease.
- Fungicides targeted for fruit rot control also provide a degree of protection against this disease during early and mid-season infection periods.

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UPRIGHT DIEBACK FUNGICIDE RECOMMENDATIONS

PESTICIDE/FORMULATION	RATE (amt/A/app)	COMMENTS/RESTRICTIONS
<u>COPPER FORMULATIONS</u>		
Champ DP Dry Prill	5.3 lb	Must be applied pre-bloom. 48-hour restricted entry interval.
Champ Formula 2 Flowable	5.33 pt	
Champ WG	4.2 lb	
<u>CHLOROTHALONIL FORMULATIONS</u>		
Bravo Ultrex, Equus DF	3.8 – 6 lb	One pre-bloom application should be applied after the terminal bud has broken dormancy (begun to swell or has begun new growth). The exact timing will depend on whether the variety is early or late-season. 12-hour restricted entry interval.
Bravo Weather Stik	4 – 6.5 pt	
Chlorothalonil 720, Equus 720 SST	4 – 6.5 pt	
Chlorothalonil Zn	5.66 – 9.25 pt	
Echo 720	4 – 7 pt	
Echo 90DF	3.25 – 5.75 lb	
Initiate ZN	5.75 – 9.25 pt	

For all above chlorothalonil formulations: Hold water for 3 days after application. In beds subject to Zone II regulations, growers must follow the required process (See Zone II section) to determine if these products may be used. As per the label, the maximum allowable number of chlorothalonil applications in a growing season is 3. **If one chlorothalonil application is used for upright dieback, only 2 applications are allowed for fruit rot.**

PHYTOPHTHORA ROOT ROT

Causal agent: *Phytophthora spp.*

Factors aggravating disease incidence and severity:

- It just takes a few infected roots (and runners) to initiate and spread the disease to a new location. However, symptoms of infection develop in only a small percentage of the exposed acreage, due to the excellent drainage and low pH values (3.0–4.5) of cranberry soils in most beds.
- Poor drainage or water-logged areas are the first places *Phytophthora* infections occur.
- High temperatures (>50 °F) facilitate the reproduction and spread of the pathogen.

Symptoms:

- Infected root systems are poorly developed, have few feeder roots, are reduced in mass and showing necrosis.
- Infected roots cannot uptake water and nutrients, resulting in stunting, dieback of plants and reduced drought tolerance. Other symptoms include runners rot, fewer (mostly off color) leaves per plant which may turn red prematurely in the late summer or may be delayed in turning green in the spring. If the outer layer of the underground runner is scraped off, the internal tissue will be discolored olive green to dark brown.

Suspect *Phytophthora*?

- Symptoms of *Phytophthora* are similar to those of related root disorders such as damage by root-feeding insects and nematodes, other fungal diseases such as fairy ring, or simply “wet feet.”
- Because management of each of these problems differs, it is extremely important to get an accurate diagnosis before undertaking any control measures.
- If you suspect *Phytophthora* infection, please get samples diagnosed by a plant pathology lab before applying fungicides.

Management: Adequate control can be achieved only through several integrated strategies.

- Drainage: Improve drainage (through tiles, stones, underdrains or new ditches) in low areas of the bed. Existing ditches should be maintained to the proper depth. Following rain, irrigation, or frost protection event, examine the soil surface for standing water. Problems arise where soil drainage is highly variable and it is not possible to irrigate sufficiently in well-drained areas without over-irrigating poorly drained areas.
- Irrigation Uniformity: Examine the distribution of sprinkler heads and the total capacity of irrigation system to make sure they are irrigating the bog uniformly. For irregular beds, sprinkler heads placed closer than specified in the design should be outfitted with reduced-volume nozzles. Repeated cycles of wetting and drying, especially extreme cycles, are conducive to root rot. Schedule irrigation timing to consistently maintain soil moisture near the optimum level, rather than leaving long intervals between irrigation events.
- Sanding: Apply a uniform layer of sand to the areas of dieback to get them up to grade with the remainder of the bed.
- Fungicides: After the drainage is improved, the ideal time to apply fungicides (foliar application of phosphonates or soil application of phenylamides) is when soil temperatures are conducive for root development and pathogen multiplication (May, June, July and August).
 - Spring applications (if a diagnosis is confirmed and drainage is improved) could slow down the infection.
 - If summer application can not be done, a fall application can be considered before winter hardiness. However, fall application is only effective in early harvested beds or if there is a warm, extended fall season.
 - Multiple applications per season may be needed until vine recovery is visible. These applications can revitalize the canopy by encouraging root growth and help the plant uptake water and nutrients.

Additional notes for new beds:

- New beds should aim at providing uniform drainage. Before planting, examine the bed for low points or poorly drained areas that may be vulnerable to Phytophthora development. Implementing a drainage plan during new bed construction will avoid problems down the road.
- Irrigation systems should be carefully laid out so that sprinkler heads are placed according to design specifications.
- Basamid fumigation prior to planting has been recommended for renovations that had a history of Phytophthora infestation in the soil. However, make note that current EPA regulations require an EPA fumigant training to use this chemical.
- Newly planted vines may not be able to absorb the phosphonate fungicides until sufficient shoot growth has occurred, whereas Phenylamide fungicides with a.i. mefenoxam (Ridomil Gold SL, Ultra Flourish) applied through chemigation could offer excellent root uptake.

Precautions to prevent the spread of the pathogen from infected areas/beds to healthy areas/beds:

- Machinery, equipment, footwear, etc., should be sterilized using steam, bleach (freshly prepared 10% bleach solution), or 70% alcohol. If possible, the sequence of flooding the beds during water harvest should be adjusted to flood heavily infected beds last.
- Exercise caution when purchasing/moving plant material or soil from other bogs. Be certain that they are not coming from infected beds.

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PHYTOPHTHORA ROOT ROT FUNGICIDE RECOMMENDATIONS

	PESTICIDE/FORMULATION	RATE (amt/A)	COMMENTS/RESTRICTIONS
	Aliette WDG	5 lb	Rates are for chemigation application!
Foliar Applications (Phosphonate fungicides)	Fungi-Phite	2-4 pt	Read the label for each product to determine application interval, re-entry period, and the number of applications per season. Read label, some do not tank mix!
	ProPhyt, Reveille	4 pt	
	Reliant	2-6 pt	
	Confine Extra, Fosphite, K-Phite, Rampart	4-8 pt	
	Alude, Phiticide, Phostrol	5-6 pt	
	Oxiphos	5-10 pt	
Soil Applications (Phenylamide fungicides)*	Metastar 2EC	4-7 pt	Ground or chemigation only. No aerial application!
	Ridomil Gold SL	1-1.75 pt	
	Ultra Flourish	2-3.5 pt	
	Ridomil Gold GR	20-35 lb	Ground or air only. No chemigation!

***Soil applications** must be watered in after application. Run the sprinklers for 3 hours after application to water the fungicide into the root zone. Too much water, however, may push the chemical past the root zone. Therefore, do not apply if more than 0.5 inches of rainfall is forecasted or if sprinklers will run for more than 5 hours during the first few days after the application.

FRUIT ROT

This is the most prevalent disease problem that cranberry growers face from season to season. The disease is generally divided into two distinct categories: field rot and storage rot. The field rot phase is expressed pre-harvest and constitutes a major component of direct crop loss. Storage rots cause a reduction in the quality and shelf life of fresh, refrigerated fruit.

Causal agent:

- Fruit rot is a disease complex associated with more than 12 fungal pathogens. The most common isolated in MA are *Allantophomopsis lycopodina*, *A. cystisporia*, *Botryosphaeria vaccinii*, *Coleophoma empetri*, *Colletotrichum gloeosporioides*, *C. acutatum*, *Fusicoccum putrefaciens*, *Phomopsis vaccinii*, *Phyllosticta vaccinii* and *Physalospora vaccinii*.

Factors aggravating disease incidence and severity:

- The degree of fruit rot in different beds in a given season is dependent on many factors (weather, cultural practices, fruit rot fungal inoculum). Not all factors are completely understood.
- **Bog microclimatic factors:** Factors that leave the cranberry vine wet for long periods of time (from rain, fog, dew or irrigation) provide optimal conditions for fungal growth and increases the risk of fruit rot incidence and severity. Other factors include dense vine growth, poor air circulation, high humidity, slow drying-out of dew, and poor drainage.
- **Cultural Practices:** Any practice that promotes excessive vine growth such as excessive N fertilizer, frequent late water, holding water high in ditches, too frequent irrigation, and not cleaning the bog of berries/detached plant tissues (they could serve as sources of overwintering inoculum) from the previous cropping season could favor fruit rot development.

- Bogs planted with susceptible cultivars and with high fruit rot levels in the previous season.
- Rot develops rapidly only after the berries are detached and floating on the flood surface. Thus, the time the berries are left in the harvest floods is an important factor too.
- Not following bog sanitation: Cranberry leaves, stems, and fruit left behind after harvest (trash) are colonized by several fungi that cause field and storage rot.
- Improperly timing and improper frequency of fungicide applications: The fungicides should target the most susceptible stages of infection (bloom and early fruit set). Applying fungicides after this period will not be of use. The frequency of fungicides should be decided based on the history of fruit rot infection in the previous growing season.

Critical phases of infection:

- Flowering and fruit development are the susceptible phases of infection. Spores of the fruit rot fungi germinate from overwintering sources of inoculum and spread by wind or wind-driven rain to bloom or developing fruit. If there is a suitable layer of moisture present for 6 to 8 hours and the cultivar is susceptible, the fungi will infect these tissues.

Symptoms:

- In general, after the infection, although the fungal pathogens are multiplying with developing fruit, the fruit rot symptoms (break down of berry tissue and rot) are not apparent (latent infection) until later in the growing season or until the berries have been harvested and held in storage.

Management: Adequate control can be achieved only through several integrated strategies.

- Canopy Management: Practices that increase air circulation such as pruning will reduce disease pressure. Sanding of bogs can also reduce disease pressure by burying excess runners and improving airflow, as well as burying sources of disease inoculum.
- Late Water: Holding late water (flooding from mid-April to mid-May) once in three years will improve berry quality by disrupting the life cycles of fruit rot fungi and increase fungicide application efficacy by synchronizing bloom. In the year late water is used and also in the following year, the number of fungicide applications can be reduced in beds with a history of low fruit rot pressure. The fungicides should not be eliminated completely or vine diseases may be a problem the following growing season. Fungicide regimes should be brought back to normal in the second year after late water.
- Trash Removal: Remove trash from water-harvested beds during harvest, or as soon after as possible. If the bed was dry-harvested, trash should be removed from the bed with a post-harvest flood in the fall or from the winter flood before it is withdrawn. Trash piles should not be left next to the bed, and should be deposited at least a quarter-mile from the bed if possible. Self-pollinated seeds in berries left behind on the bog may germinate in the soil and possibly produce plants that are the typical "mongrels". These genotypes may produce much vegetation but few berries, and in worst-case scenarios, may take over the productive vines in the bed.
- Irrigation: When irrigation is necessary, sprinkler systems should be run in the early morning, and not in the early evening. Morning watering allows vines to be watered with minimal evaporation, and the surface of the vines can then dry out in the sun's heat. When watering is done in the early evening, the vines are kept wet for an extended period, thus creating favorable conditions for infection by the fruit rot fungi. On days with excessive temperatures (>100°F on the bed), particularly in newly planted or recently sanded beds, sprinklers should be run in the late morning or early afternoon to cool the vines and berries and may prevent injury. Sprinklers should be run to prevent scalding of the fruit when all of the following conditions persist: (1) dewpoints of 55°F

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or less during midday and afternoon hours, (2) high temperatures of 80°F or more, (3) clear or scattered sky conditions during the day, (4) bed soil moisture is low, (5) wind speeds average greater than 11 mph, and (6) no rainfall has occurred during the last 48 hours. This "forecast" is based on research performed in New Jersey. Scalded berries are typically browned on one side, with a clear demarcation between the brown area and the green (usually) area of the fruit. The rotted area in a berry affected with fruit rot typically has an area of anthocyanin production (reddish border) adjacent to the affected area. After 7 days, a scalded berry will be hard to discern from a rotted berry, particularly since fungi will colonize the stressed scalded berry.

- **Resistant Varieties:** When replanting bogs or planting new bogs, varying levels of disease resistance against fruit rot among varieties should be considered. A summary chart with some of the most common cultivars and their relative field rot resistance (highest-moderate-low) is presented below.

Highest field rot resistance	Moderate field rot resistance	Lowest field rot resistance
Scarlet Knight, Mullica Queen, Howes, Haines, Black Veil	Stevens, Crimson Queen, Demoranville, Early Black	Ben Lear

- **Fungicides:** For adequate control, fungicide applications should have good coverage and take place before fungi infect plant tissues. Most fruit rot infections occur during the bloom period and early fruit set before berries start to size up. Applications typically should begin during early bloom (mid-June, before 50% of flowers have opened). Once the fruit has set and begun to increase in size (mid-late July), fungicides are no longer necessary or effective. Fungicide decisions such as the choice, frequency and interval between fungicide applications are dependent on the individual bed, its history of fruit rot severity, products allowed by respective fruit handlers and Keeping Quality Forecast (KQF) found on the Cranberry Station's website. If the KQF forecast is good to excellent, consider fewer applications and/or longer application intervals. Cranberry beds prone to fruit rot may need up to 4 fungicide applications. One or two fungicide applications may be adequate for a bed with very little fruit rot in previous growing seasons. Storage rot is usually not a concern for berries that are water harvested, as these berries will immediately be frozen in most cases. If in doubt, call the Extension Plant Pathologist.
- **Note for newly planted beds:** One or two fungicide applications during the first two years after planting will help reduce fungal inoculum and may reduce fruit rot in subsequent years.

FUNGICIDE RESISTANCE MANAGEMENT FOR FRUIT ROT

Fungicide resistance, defined as reduced fungicide sensitivity in fungal populations, is a real and serious threat to the cranberry industry. It could severely impact the efficacy of fungicides used against fruit rot pathogens. The Fungicide Resistance Action Committee (FRAC) developed a code of numbers and letters that can be used to distinguish the different fungicide groups based on their mode of action. Repeated and ineffective use of fungicides from the same FRAC group can accelerate the development of resistant pathogen populations and once this occurs, fungicide applications will provide very little or no disease control.

In recent years, two of the key groups of fungicides employed in fruit rot management (Mancozeb/EDBCs since 1960, Chlorothalonils since 1985), have been subjected to revised Maximum Residue Limits (MRLs) by international export markets. This prompted the cranberry processing industry to impose new regulations on the use and prompting growers to rely more on the newer, single-

site mode of action fungicides from FRAC Group 3 and 11. These newer fungicides (eg., Abound, Indar, Proline and Quadris Top) can be equally effective in controlling fruit rot fungi and are perceived to be less harmful to human and environmental health when compared to the older, multi-site mode of action chemicals (chlorothalonil and EBDCs/Mancozebs). However, newer fungicides are at higher risk of selecting for fungicide-resistant pathogens than older fungicides. To preserve the effectiveness and durability of the few effective registered fungicides we have available, it is **CRITICAL** to incorporate the fungicide resistance management strategies listed below:

- Follow ALL label instructions, including application interval and recommended rate. Never use less than the lowest recommended rate on the label.
- Alternate or mix fungicides with different modes of action.
 - Use FRAC codes on labels to determine the mode of action. The same FRAC codes indicate that fungicides have the same mode of action. For example, Indar and Proline have different trade names and active ingredients, but they have the SAME mode of action and FRAC code (3).
- For best control and fungicide resistance management, mix Abound with Indar or Proline, or use Quadris Top.

FRUIT ROT FUNGICIDE RECOMMENDATIONS

TIMING – Begin early to mid-bloom (10-50%), then at 7-14 day intervals.

Read the label for each product to determine application interval, re-entry period, and number of applications per season.

NEWER CHEMISTRIES

RATE (amount/A)

Abound AFrame Satori <i>azoxystrobin</i>	FRAC Group 11	6.0-15.5 fl oz	No more than 2 sequential apps. See Resistance Management notes below and in Resistance Management chapter. Hold water for 14 days. Avoid drift if the bed is next to a McIntosh apple orchard, as the fungicide is highly phytotoxic to this cultivar.
Indar 2F <i>fenbuconazole</i>	FRAC Group 3	6.0-12 fl oz	No more than 2 apps due to resistance concerns. Do not use prior to bloom. 30-day PHI.
Proline 480SC <i>prothioconazole</i>		5 fl oz	No more than 2 apps. 45-day PHI.
Quadris Top <i>difenconazole</i> and <i>azoxystrobin</i>	FRAC Group 3+11	10-14 fl oz	No more than 2 sequential apps due to resistance concerns. Do not use prior to bloom. 30-day PHI. 14-day water holding.

POLYOXIN-D ZINC SALT

Oso	FRAC Group 19	3.75-13 fl oz	No more than 6 apps of Oso or 3 apps of Ph-D when using maximum rate. Limited research on efficacy. For best results alternate or incorporate into a program with other fungicides for fruit rot.
Ph-D		6.2 oz	

FRUIT ROT FUNGICIDE RECOMMENDATIONS

TIMING – Begin early to mid-bloom (10-50%), then at 7 - 10 day intervalsCHLOROTHALONIL FORMULATIONS*

Bravo Ultrex		3.8-6.0 lb	Restricted use!! Handler restrictions!! Check before using!
Bravo Weather Stik		4-6.5 pt	
Chloronil 720, Initiate 720		4-6.5 pt	Use the maximum rate in beds with high rot incidence on a 10-day schedule. Zone II restricted.
Chlorothalonil 720 SC		4-6.5 pt	
Echo 720	All FRAC	4-7 pt	3 apps per season, 12-hr REI (6.5-day eye irritant). Hold water for 3 days after application.
Echo 90DF	Group M5	3.25-5.75 lb	
Equus DF		3.8-6.0 lb	50-day PHI
Equus 500 ZN		5.75-9.25 pt	
Equus 720 SST		4-6.5 pt	
Initiate ZN		5.75-9.25 pt	

* For all chlorothalonil formulations: Before use on beds subject to Zone II regulations, growers must follow the required process to determine if these products may be used. See Zone II Section. The maximum allowable number of chlorothalonil applications is 3. If 1 Bravo application was used for upright dieback control, only 2 fruit rot applications are allowed. Do not mix with Dipel.

Ferbam Granuflo	FRAC Group M3	6 lb	Do not apply more than 5 times. Apply at 14-day intervals. Using rates below recommended rate will be ineffective. 50-day PHI, 24-hr REI.
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MANCOZEBS

Dithane F-45 Rainshield		2.4-4.8 qt	Handler restrictions!! Check before using!
Dithane M-45		3-6 lb	
Penncozeb 75DF		3-6 lb	Addition of spray adjuvants will improve distribution and deposition for all of the mancozeb compounds.
Penncozeb 80WP		3-6 lb	
Koverall	All FRAC	3-6 lb	May delay color development in some varieties!
Roper DF Rainshield	Group M3	3-6 lb	
ManKocide		7 lb	
Manzate Flowable		2.4-4.8 qt	30-day PHI.
Manzate Max		2.4-4.8 qt	All 24-hr REI, except ManKocide 48-hr REI.
Manzate Pro-Stick		3-6 lb	

TIMING- Begin at late-bloom (>50%), then at 7-14 day intervalsCOPPERS (See page 2 for full list of copper products)

Mastercop		3 pt	Make first application in late bloom. Apply one or two additional applications at 10-14 day intervals or as needed depending on disease severity.
Badge X2	FRAC Group	3.5 lbs	
Kocide 3000	M1	3.5 lbs	Make first application in late bloom. Apply one or two additional applications at 7-14 day intervals or as needed depending on disease severity.
Champ		4.2 lbs	

Do not mix copper fungicides with insecticides. Do not tank mix with Aliette or phosphites unless spray solution has been buffered first. Call Extension specialist for information on buffering.

FRUIT ROT FUNGICIDE ADDITIONAL NOTES

Fungicides	Trade Names	Resistance Risk	Comments
Chlorothalonils	Bravo, Echo, Equus, etc.	Low	Check with handlers for market restrictions.
Mancozebs	Dithane, Manzate, Penncozeb, etc.	Low	Check with handlers for market restrictions. Anecdotally believed to have a negative effect on fruit color. In 2019 trials, we did not observe any negative effects on color in Stevens.
Coppers	Mastercop Badge X2 Champ Kocide 3000, etc.	Low	Limited research data available. Coppers could serve as resistant management tools while efficiently managing fruit rot if used as part of a fungicide program with other fungicides. More effective if used later in the season (late bloom).
Difenoconazole + Azoxystrobin	Quadris Top	Medium	
Prothioconazole Fenbuconazole	Proline Indar	Medium	For best results and resistance management, use during bloom and combine with azoxystrobin.
Azoxystrobin	Abound, AFrame, Satori	High	For best results combine with prothioconazole or fenbuconazole.
Polyoxin-D zinc salt	Oso and Ph-D	Medium	Limited research data available. For best results alternate or incorporate into a program with other fungicides for fruit rot.
SDHI, plant extracts	Kenja, Regalia, etc.		Limited research data available.

FAIRY RING

This disease is sporadic in occurrence and the severity of symptoms varies from year to year.

Causal Agent/Pathogen:

- Some fungi such as *Psilocybe agrariella* var. *vaccinii*, *Helicobasidium* sp. (anamorph *Thanatophytum* sp.), *Rhizoctonia*-like fungi, *Pezicula*, *Dermea*, *Crytosporiopsis* and *Neofabrea* have been associated with this disease. However, the role of these fungi in fairy ring disease is not completely characterized.

Factors aggravating disease incidence and severity:

- Damage caused by this disease is usually worse during growing seasons with limited rainfall (drought) and hotter than normal temperatures. Excessively dry soils could promote this disease.
- Stevens, Ben Lear and Howes are highly susceptible, while Early Black is less susceptible but not resistant.

Symptoms:

- Initially, a small area of weak or dead vines occurs, usually in higher spots in the bog or near the ditches.
- When environmental conditions are favorable for disease spread, the area of dead vines expands outward in all directions and opens the canopy for weed invasion.
- The outside edge of the necrotic zone is sometimes bordered by a ring of cranberry vine overgrowth which are unproductive. In heavily infested beds, numerous rings will be present and they may overlap or combine, resulting in whole sections that are devastated by the disease.
- Reduces yield 50-60%. Increases fruit rot incidence.
- Increases the need for replanting.

Precautions to prevent the spread of fairy ring from infested areas/beds to healthy areas/beds:

- The mechanism of dissemination of this disease is unknown. It is possible that movement of vines, during harvest or any other means, could spread the disease from infested areas to healthy areas of bog or even among various bogs.

Management:

- Control strategies for this disease have still not been worked out thoroughly.
- During those summers with low rainfall, plants should be properly irrigated.
- Sprinklers should be run for several hours in the early morning hours, when there is little evaporation, to ensure that the root systems are properly watered.
- Raising the water level in the ditches can help in this regard. This can be a problem, however, if there are low areas in the same bed where *Phytophthora* root rot may also be present. Beds should be properly graded.

FAIRY RING FUNGICIDE RECOMMENDATIONS

TIMING	PESTICIDE/ FORMULATION	RATE (amt/A)	COMMENTS/RESTRICTIONS
MAY	Abound/AFrame and Indar	15.5 fl oz/30-100 gal <hr/> 12 fl oz/30-100 gal	Make the first app at budbreak. Irrigate for 1-2 hours before and following application. Repeat 2-4 weeks later if necessary. Make sure to have Indar supplemental label. <i>See below for drench instructions.*</i>
JUNE - JULY	Ferbam Granuflo	9 lb/100 gal	Apply 1 gal of this mixture to 1 sq ft area. Treat the area 3 feet beyond the advancing line of dying vines and 2 feet within the line. Do not apply after July 31. Only 1 app!
MID-AUGUST THROUGH OCTOBER	Sul-Po-Mag Or K-Mag 0-0-22	4000 lb/A or 1.5 oz/sq. ft.	Follow-up applications may be necessary. This may help vines out-compete the fungus.

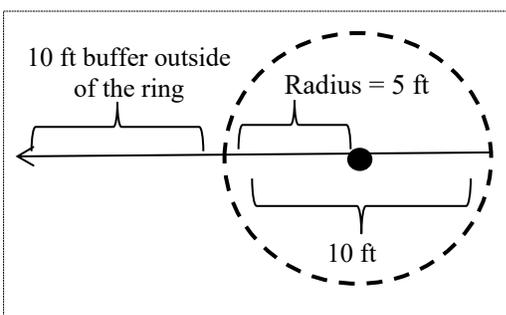
* Indar and Abound soil drench. Using a drench method, one can treat up to a tenth of each acre while remaining within the label restrictions (one-tenth of an acre is approximately 4,300 ft²).

A. *Estimate the area to be treated:*

1. Measure across the center of the fairy ring (this gives you the diameter).
2. Divide by 2 to get the radius.
3. Add 10 ft to the radius to include a buffer around the fairy ring.
4. Use the formula
Area = $r^2 \times \pi$. (r is radius, π is ~ 3.14)

The fairy ring in this example has a 5 ft radius + 10 ft buffer = 15 ft.

$$\text{Area to be treated} = 15 \times 15 \times 3.14 = 706.5 \text{ ft}^2$$



B. *Calculate the rates of Indar and Abound for your fungicide mix.*

The rate for Indar will be equal to the fairy ring area (ft²) multiplied by 0.0028 fl oz.

The rate for Abound is equal to the fairy ring area (ft²) multiplied by 0.004 fl oz.

For every ft² to be treated, use 0.1 to 0.2 gallons of water. Apply the tank mix evenly over the affected area (entire ring area plus the 10 ft outer margin). If you need assistance in managing the fairy ring or calculating fungicide rates or if the area is larger than one-tenth of each acre, please contact the Extension Plant Pathologist at the Cranberry Station.

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DISEASE MANAGEMENT NOTES

1. Read and follow label instructions. Always check the label for variations in restricted entry intervals and worker protection standards.
2. Make all pesticide applications in a manner to prevent contamination of streams, ponds and public ways. Impound water (as per label) for as long as possible after applying.
3. RESISTANCE DEVELOPMENT to Abound, Indar, Proline, and Quadris Top by the fruit rot fungi is a very real and serious threat. Applications of the fungicide should be made pre-infection rather than post-infection to minimize resistance development. See Resistance Management section.

These products are most effective when applied during early to mid-bloom (20-50%) and it is highly recommended to mix Abound with Indar or Proline. The number of fungicide applications should be based on the label instructions and the Keeping Quality Forecast.
4. When applying half-rates, the maximum number of applications (not material applied) must not be exceeded. It is not recommended to use a rate below the lowest recommended rate on the label.
5. Use Abound very carefully and avoid drift if the bed is next to a McIntosh apple orchard, as the fungicide is highly phytotoxic to this cultivar. See Resistance Management section.
6. PRE-MIX fungicides with a small amount of water until a smooth suspension is obtained before final dilution. Use immediately. Blossom injury may occur with concentrate sprays especially when sprayed by air when the temperature on the bog is above 85°F. Do not combine any copper fungicide with an insecticide. Do not tank mix copper compounds with Aliette or any of the phosphites for Phytophthora unless appropriate precautions have been taken to buffer the spray solution or severe phytotoxicity will result. Call plant pathologist for information on buffering.
7. Consider delaying harvest to obtain acceptable color in thick vines or when mancozeb is used.
8. SANDING and FERTILIZING. Frequent sanding and fertilizing help reclaim beds infected with false blossom disease. Regular uniform sanding most likely helps to reduce inoculum of the fungi that cause fruit rot. Sanding should not be done during the same year late water is to be held.
9. SPREADER STICKERS are contained in most fungicides. The addition of wetting agents or spreader stickers to Bravo, Echo, or Equus may cause phytotoxicity damage. Please check the fungicide label. NOTE: the addition of spray adjuvants will improve the distribution and deposition of all mancozeb chemicals.
10. STORED PESTICIDES may deteriorate. Avoid freezing liquid formulations. It is not advisable to use old materials in opened containers. Follow Pesticide Bureau regulations for disposing of pesticides and their containers.
11. Review the Disease Management BMP in the UMass Best Management Practices Guide: ag.umass.edu/cranberry/publications-resources/best-management-practices
12. Organic Options. Some fungicides are certified organic for disease management in cranberry. They include many of the coppers, but check with OMRI (www.omri.org) or your certifier for approved products.