DISEASE MANAGEMENT 2014

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Sources: √ Compendium of Blueberry and Cranberry Diseases by F. L. Caruso and D. C. Ramsdell
√ Univ. of Wisconsin – Madison's "Fruit Pathology" web pages
√ UMass 2014 Cranberry Chart Book √ American Phytopathological Society (web site)

UPRIGHT DIEBACK (Fairly common – can expect infection at a few sites most years)

Upright dieback is a poorly understood disease complex that can cause significant damage to new or established beds of cranberry. It is called a "disease complex" because it can be caused by a combination of different fungi and environmental conditions that are poorly understood. The causal fungi are most likely *Diaporthe vaccinii* and its anamorph, *Phomopsis vaccinnii*—also the cause of viscid rot, along with *Synchronoblastia crypta* because they are the ones found most consistently in diseased uprights. Vines may be made more susceptible to the disease if they have been subjected to winter injury or oxygen deficiency. The disease may occur at any time during the growing season, and Howes, Early Black and Searles appear to be more susceptible to the disease than other varieties.

Favorable Conditions for the Disease (exactly how the infection occurs is not known):

- Warm temperatures (fungi grow better);
- Periods of hot and/or dry conditions that leave the vines under stress;
- Areas with heavy vine growth (disease can be especially severe in new plantings for this reason);

SYMPTOMS (easily confused with heat stress)

Symptoms first appear as a wilting—or flagging—of the tips (Figure 1), or else as a patchy (mottling) or general yellowing of the uprights. Later, if conditions don't improve, uprights will turn orange-bronze before they eventually turn brown and die. Diseased uprights are dispersed among healthy vines and may be adjacent to apparently healthy uprights on the same runner. This scattered distribution of diseased uprights coinciding with healthy uprights gives the affected area a '*salt and pepper*' appearance (Figure 2), but on some runners *every* upright may be infected.

As a general rule, *large* dead patches of uprights are not the result of upright dieback.

Figure 1. *Early stage of upright dieback in Maine*

Figure 2. *A more progressed case of upright dieback in Maine and a good example of the common 'salt and pepper' pattern of infection.*

CONTROL

Plants that are still in the early stage of infection can sometimes recover on their own if the weather turns cooler and/or more humid. Adequate irrigation and additional periodic sprinkling in July and August can also help to reduce the level of the disease. *Anything* that minimizes stress on the vines is helpful in combating the disease.

Chemical Options

√ Champ DP Dry Prill: 5.3 lb / A
√ Champ Formula 2: 5.3 pt / A
√ Champ WG: 4.2 lb / A

Must be applied pre-bloom.

Spray Timing for Upright Dieback:
April 30 – May 20 for southern Maine
May 6 – May 26 for downeast Maine

√ Bravo Weather Stik, Chloronil 720, Chlorothalonil 720 SC, & Equus 720 SST: 4 – 6.5 pt / A
√ Bravo Ultrex, Equus DF: 3.8 – 6 lb / A
√ Echo 720: 4 – 7 pt / A
√ Echo 90 DF: 3.25 – 5.75 lb / A
√ Equus 500 ZN, Initiate ZN: 5.75 – 9.25 pt / A

One pre-bloom application should be applied after the terminal bud has broken dormancy and begun to swell or has begun new growth. 50-day PHI; Up to 3 uses per season; 12-hr REI; DO NOT add spreader-sticker or mix with Dipel.

NOTE: *Bravo does not control upright dieback if applied later than early bloom*—by this time the fungus has apparently invaded shoots and is out of reach of protectant fungicides. **Fungicides will not cure upright dieback but will prevent the spread of the infection.**

FRUIT ROT

There are over 15 different fungal species responsible for causing cranberries to rot. The primary rots have been classified as **Viscid Rot, Early Rot, Black Rot,** and **End Rot**. *Phomopsis vaccinnii* is the organism responsible for Viscid Rot—considered a minor post-harvest disease—and it is also one of the two prime suspects in the cause of Upright Dieback. Early Rot is caused by *Phyllosticta vaccinii*, and can cause severe losses in the field where the growing season is typically long and warm, such as in New Jersey and Massachusetts. The fungus can attack flowers and young berries, as well as stems and leaves, but only in the berries does the damage level reach economic concern. Black Rot is caused by three separate fungi: *Allantophomopsis cytisporea*, *Allantophomopsis lycopodina*, and *Strasseria geniculata*. Black Rot is a post-harvest storage rot disease, as are Viscid Rot and, for the most part, End Rot. End Rot is caused by the fungus *Godronia cassandrae* f. *vaccinii* and occurs in all cranberry-growing regions of the country. Not unlike the case with Early Rot, End Rot can cause a twig blight and a kind of leaf spot along with its fruit-rotting ability, but it's only the latter makeup of this fungus that is economically important.

In field experiments, it has been demonstrated that fungal infections resulting in fruit rot are concentrated around the period immediately following bloom.

SYMPTOMS

NOTE: Sometimes there is overlap among the fungi that cause field and storage fruit rots, but in general:

- *Pre-Harvest, Infecting Young Berries Still On The Vines* → probably **Early Rot** (look for round, circular, discolored splotches that take on a bull's eye pattern of alternating dark and light rings that eventually expand outwards until the entire berry is rotten) (some less common field rots are **Bitter** and **Blotch Rot**, and **Hard Rot**—the secondary stage of Cottonball disease; see page 14)
- *After Harvest (i.e. storage rots)* →
    1. Dark black color eight or more weeks after harvest, and berry is relatively firm and dry: **Black Rot**
    2. Seen first at the blossom end of the berry (typical of this rot), and the rotted tissue is soft and watery and berry is elastic to the touch and possibly floating due to gas produced during the rotting process: **End Rot** (berries with End Rot are called "poppers" because even though they are elastic, if pressed too hard they will burst)
    3. Rotting area is viscous and stringy, and berry is soft and off-color: **Viscid Rot** (the word 'viscid' describes a surface that is sticky, as though coated with a syrupy secretion) (Viscid Rot is technically a field rot, but most of the rotting occurs in storage).

CONTROL (A total of 4 fungicide applications may be needed for a bed prone to fruit rot—at least that is the case in Massachusetts; otherwise (and in Maine), just 1 or 2 applications should be adequate)

EARLY BLOOM 10%-20%:

	√ Chloronil 720, Chloro-thalonil 720 SC, Equus 720 SST, Bravo Weather Stik, Initiate 720 (NEW!)	4 – 6.5 pt / A	Use the maximum rate and 10-day schedule on beds with history of high fruit rot levels. Hold water for 3 days. 12-hr REI.
	√ Echo 720	4 – 7 pt / A	
	√ Echo 90DF	3.25 – 5.75 lb / A	
	√ Bravo Ultrex	3.8 – 6.0 lb / A	Should not use Abound more than once or twice per season, out of concerns over resistance developing if used from 3 to 6 times per year. Spray at *7 to 10-day intervals* rather than 10-14.
	√ Equus DF	3.8 – 6.0 lb / A	
	√ Equus 500 ZN	5.75 – 9.25 pt / A	
NEW!	√ Initiate ZN	5.75 – 9.25 pt / A	
	√ Abound	6.0-15.5 oz / A	
NEW!	√ Proline 480 SC	5 fl oz / A (45-day PHI; use only twice per season)	
	√ Indar 2F (30-day PHI)	6-12 oz / A	Note: Do not use more than 2 applications of Indar (resistance fears). Do not use prior to bloom. Apply at 7 to 14-day intervals.
	√ Ferbam Granuflo	6 lb / A	Note: Do not apply Ferbam more than 5 times. Apply at 14-day intervals. Rates below the recommended will be ineffective.

MID-BLOOM → Spray again at 7-10 day intervals if warranted.

√ Roper DF Rainshield (mancozeb)	3 – 6 lb / A	mancozebs; 30-day PHI; 24-hr REI; Addition of a spray adjuvant will improve the distribution and deposition of all of the mancozeb compounds; mancozebs may delay color development.
√ Dithane M-45, Manzate Pro-Stick	3 – 6 lb / A	
√ Penncozeb 80WP, Penncozeb 75DF	3 – 6 lb / A	
√ Koverall	3 – 6 lb / A	
√ Dithane F-45 Rainshield	2.4 to 4.8 qt / A	
√ ManKocide	7 lb / A	
√ Manzate Flowable, Manzate Max	2.4 to 4.8 qt / A	
√ Top Cop with Sulfur	2 qt / A (No PHI; 48-hr REI; up to 3 applications per season)	
√ Cuprofix Ultra 40 Disperss	5 lb / A (No PHI; 24-hr REI; up to 3 applications per season)	

LATE BLOOM → Spray again at 10-14 day Intervals if warranted (No PHI for these products)

√ Kocide 2000	6 lb / A
√ Kocide 3000	3.5 lb / A
√ Copper-Count-N	4 to 8 qt / A
√ Nu-Cop 3L	4.33 – 5.67 pints / A
√ MasterCop	3 pints / A
√ Nu-Cop HB	4.2 lb / A
√ Kocide DF, Champion WP	8 lb / A
√ Nordox [24-hr REI]	8 lb / A
√ Nordox 75WG [12-hr REI]	5 lb / A
√ 3lb copper flowable	10.67 pints / A
√ Champ Formula 2 flowable	5.33 pints / A
√ Champ DP Dry Prill	5.6 lb / A
√ Champ WG, Nu-Cop 50DF	4.2 lb / A
√ Badge SC	7 pints / A
√ Badge X2	3.5 lb / A
√ Kentan DF	4 to 5.25 lb / A

Do not combine with any insecticide, as any other product could alter the fungicide, making it phytotoxic to the cranberry plants.

Coppers - Starting late bloom. Then repeat sprays as warranted at 10-14 day intervals.

FRUIT ROT CULTURAL NOTES

- Howes and Stevens varieties have good fruit rot resistance.
- Trash Removal: Cranberry leaves, stems, and fruits left behind after harvest are colonized by several fungi that can cause field and storage rot. This fungi-filled trash serves as a reservoir for fungal infections in subsequent growing seasons. Translation: *trash piles should not be left next to the bed but should instead be deposited at least a quarter mile from the bed if possible.* If a bed is dry-harvested, trash should be removed from a post-harvest flood in the fall or from the winter flood before it is withdrawn.
    - Self-pollinated seeds: Self-pollinated seeds in berries that are left in the beds can germinate in the soil and often times go on to produce plants that are described as 'mongrels,' and most mongrels are known to produce primarily vegetative, non-fruiting uprights. Over time, the worry is that mongrel type genotypes may take over an entire bed. Reportedly, this has happened in other cranberry-growing regions, and when growers see it or suspect that it is happening, many will scalp the beds bare and totally re-plant.
- Lush Vines: Where fertilizer has been heavy, vines will tend to become very overgrown. Besides making them more attractive to cranberry tipworm, which has an easier time feeding on the soft and lush tissues, overgrown vines will lead to a situation of poor air circulation, retention of high

humidity, and slow drying-out of heavy dew. These conditions encourage infection by both fruit-rot fungi and red leaf spot fungi. When growth is excessive, pruning is recommended in order to promote better air circulation throughout the vine canopy.

- Sanding: Lowers the incidence of field fruit rot (such as Early Rot) by covering the cranberry litter upon which the fungal fruiting bodies overwinter.
- Late Water: Late-holding the winter flood helps reduce field rot by disrupting the life cycles of the fungi. During late-water years, fungicides can be reduced (their rates and/or the number of applications) without any sacrifice in fruit quality. This fungicide reduction can also be carried on through the first year after late-water, but by two years after the late-water flood, the fungal inoculum will begin to build up again.
- Irrigation: Run sprinklers in the early morning rather than in the evening, during which the vines remain wet for a long time, thereby 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 for 1 to 2 hours in the late morning or early afternoon to cool the vines and berries in order to prevent injury. Scalded berries can resemble rotten berries, but without the reddish border as seen in Early Rot. After a week or more has passed, however, a scalded berry will be hard to discern from a fruit-rot berry, since fungi will colonize a scalded berry by that time.
- End Rot may be made worse by excessive use of nitrogen fertilizer during the growing season, prolonged periods of flooding, and bruising of berries during harvest, but chemical control is usually necessary *only* on berries destined for long-term storage or for fresh market sale.

OTHER DISEASES

FAIRY RING [Maine cranberries: rare occurrence, or unobserved from year to year]

We have *perhaps* had this disease in Maine, but not knowingly to any significant extent. It is a root disease that is sporadic in occurrence in Massachusetts and New Jersey, and the severity of the symptoms varies from year to year. It can be spread from one bed to another through uprooted vines during wet or dry harvest and their subsequent dislodgement in the next harvested bed. Picking machines should be freed of vines before moving to the next bed. Damage is usually worst during periods of drought, so keep vines well-irrigated. On a positive note*, the disease does not cause significant losses*. **Symptoms:** A small area of dead or weak vines, where the plants quickly turn yellow to rust-colored before dying, and the uprights usually die from the tip downward, sometimes leading to the misdiagnosis of Upright Dieback. If berries are present, they wither as though suffering from drought stress, which in fact they are—the pathogen produces a dense mat of mycelium around the roots, which physically prevents water from reaching the root system, resulting in drought-like conditions. The disease "ring" can expand outward in all directions at a rate of 12 to 18 inches per year, and when the affected area reaches a diameter of about 6½ feet, the middle often will revive and fill in with healthy plants (either weeds or cranberry vines, or both). **Control:** Control is difficult. Removal of the entire infected area eliminates the pathogen. Water should be kept in the ditches, especially during the hottest and driest times of the summer in order to minimize the drought-induced effect of the pathogen. Application of lime, Sul-Po-Mag (0N-0P-19K-11Mg), and urea helps to rejuvenate any affected vines. **See page 7 for fungicide choices.**

RED LEAF SPOT [*As seen in the cover photo*] [Minor disease for Maine cranberries]

Red leaf spot is somewhat common in Maine (varies from year to year in terms of how widespread it is) and easily recognized by the presence of circular, bright red spots on the upper sides of leaves and occasionally on young green berries. The undersides of the leaf spots are paler and eventually become covered with a dense, white, powdery deposit. When several spots develop on a single leaf, they often grow together. Infected leaves are usually shed prematurely. Leaf infections may spread through the petiole (leaf stem) to the young growing vine, causing reddening and eventually death of the stem. The part of the vine above the infected area may continue its normal growth or wither and die, depending on the amount of distortion of the stem tissue**. High nitrogen use will favor the onset of this disease.** Ben Lear variety is especially prone to this disease, whereas Stevens is very resistant to it. **Control:** The early stage of this disease is no cause for panic, and generally sprays for fruit rot will also control this disease. Copper compounds will offer protection against further infection. Injured plants will not be cured, but the infection will be prevented from spreading.

COTTONBALL [Maine cranberries: not yet verified but could be present as it occurs in our wild blueberries fairly commonly under the name of *mummyberry*]

Monolinia oxycoccus - This is the most important disease affecting cranberries *during the growing season* in Wisconsin. There are two phases—a tip blight phase, and a berry-rot phase. The tip blight phase is usually economically insignificant, but the resulting fruit rot phase can reach epidemic levels, as high as 90% of berries lost due to rot. **Symptoms:** Tip blight symptoms appear about three weeks after budbreak and include tan to brown discoloration and wilting or crooking of succulent shoot tips, and a V-shaped pattern of tan discoloration at the base of leaves along the mid-vein. The V-pattern is a good way of distinguishing Cottonball from Upright Dieback disease while in the field. Infected berries fail to ripen. Brown, necrotic bands appear lengthwise on the berry and spread until the entire berry is yellowish-brown. The interior of the berry is filled with white, cottony fungal mycelia (see photo below), but the berry remains firm (hard rot). Some infected berries turn dark brown and shriveled, and are referred to as 'mummies'. **Control:** Cranberry beds should be picked clean to reduce as much as possible the number of mummified fruit left behind, since it is within the 'mummies' that the Cottonball fungus overwinters. For fungicide options, Abound (and OMNI-approved Serenade) can be used. When spraying during bloom—which targets the secondary stage of the infection—Abound appears to do an adequate job. In Wisconsin, they recommend spraying *only* during bloom, and not trying to spray during the tip blight phase of the disease because even when that phase is controlled really well, secondary infection still occurs.

V-shaped pattern of leaf necrosis

A cranberry with the characteristic white, cottony cottonball fungal mycelia inside.

Phytophthora ROOT ROT [Maine cranberries: rare and minor – just 1 known case since 1996]

In other cranberry-growing regions where this disease has sometimes been severe (*e.g.* Massachusetts, New Jersey, Wisconsin, Oregon and Washington), crop loss can be significant. It occurs most ofen in beds or portions of beds that have poor drainage or that experience prolonged periods of saturation or standing water during the growing season. **Symptoms:** Above-ground symptoms are easy to see; namely, the absence of vines in discrete areas (often low spots). Uprights in the affected spots are stunted, and the leaves are small and few in number. Few blossoms can be found as well. Below ground, the absence or lack of the small and fibrous feeder roots is a tell-tale sign of this disease, coupled with the fact that diseased vines are consequently easy to pull out from the soil. **Control:** The first line of defense is to manage soil water. Excessive irrigation should be avoided and drainage should be improved. Drainage can be enhanced by sanding and installing drains, digging deeper side ditches, etc. Aliette, Ridomil, Rampart, Metastar, Helena ProPhyt (phosphites) and Phostrol are some of the fungicide choices for use against *Phytophthora.*

ORGANIC OPTIONS
FOR FIGHTING CRANBERRY DISEASES

DISEASE	ORGANIC CONTROL OPTIONS
Cranberry Fruit Rot (over 15 species of fungi play a part)	Kocide®, Late Water (pp 45-47), Trash Flooding, Sanding, Avoiding too much fertilizer, Pruning: so vines dry faster, Irrigating mornings vs. evenings.
Upright Dieback	Adequate irrigation (and avoiding oxygen deficiency situations during the winter), Minimize excessive vine growth.
Red Leaf Spot	Kocide®, Trash Flooding, Avoiding excessive nitrogen.
Phytophthora Root Rot	Sanding, Trash Flooding, Improving drainage, Fixing low spots.
Fairy Ring	Removal of the entire infected area eliminates the pathogen. Keep water in the ditches, especially when it's really hot and dry.

Kocide® 2000 / 3000

- Helps prevent cranberry fruit rot (starting late bloom);
- Helps stop the spread of red leaf spot;
- No time limitation for Pre-Harvest Interval;
- Maximum of 3 applications per season; Restricted Entry Interval of 24 hours;

OxiDate® (128 fl oz per 100 gallons of water; apply 25-100 gal/solution per treated acre)

Serenade® ASO or MAX (biofungicide labeled for mummyberry/cottonball, botrytis, and bacterial canker at 2-6 qts./A.)

Late-Water (LW) Flood

Late Water means—if conditions allow—pulling the winter flood in late March and reflooding for 2 to 3 weeks, usually from late April to early May (pp 45-47). Do NOT hold LW if the winter has been severely cold and long, oxygen deficiency conditions are suspected, or if the bed has been sanded the preceding fall or current spring. **Be cautious about using LW if the winter has been very mild as well due to lack of dormancy.** Avoid using LW more than two consecutive years as plants may be stressed to a dangerous degree.

- Helps control fruit rot by disrupting the life cycles of the various rot-inducing fungi that attack cranberry; [Fungal inoculum will begin to build up again during the 2nd year after LW, or *sometimes* during the 1st year after LW if the use of LW is the *only step* taken to try to control fruit rot fungi]
- Remove the LW flood if air temperatures are unseasonably warm and/or the water temperature climbs too high (no more than 65˚F)

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Maine Cranberry Keeping Quality Forecast Table

[Compiled from forecasts taken from past UMass Cranberry Station Newsletters]

Points Awarded MAXIMUM POSSIBLE POINTS = 16	**Keeping Quality** (In other words, the 'expected' keeping quality of the fruit)	**Interpretation** (What to do)
0 to 2	VERY POOR	If you take no steps to manage fruit rot, you could suffer a high level of fruit rot at harvest and particularly during storage. Inoculum produced during the current growing season might exponentially increase during the following year, meaning that more fungicide applications will be required to reduce the inoculum load for subsequent crops. Be particularly cautious in a fresh-fruit situation, as fruit quality will be sacrificed if you reduce your fungicide sprays. Be especially conservative in any beds that were not sprayed with fungicide the previous year, or that had significant rot or scald.
3 or 4	POOR	You should use full recommended rates and numbers of applications for fruit rot fungicides. However, if you held Late Water, fungicide inputs 'may' be reduced.
5 or 6	FAIR TO GOOD	You should *probably not* reduce your fungicide rates and/or the number of fungicide applications. (If Late Water was held, you can reduce your fungicide inputs in that situation.)
7 or 8	GOOD	Can '*probably*' reduce your fungicide applications (*definitely* reduce if you used a Late Water flood)
9 to 11	VERY GOOD TO EXCELLENT	Can '*probably*' reduce or eliminate your fungicide applications (*definitely* eliminate if you used a Late Water flood)
12 to 16	EXCEPTIONAL	Can '*probably*' eliminate your fungicide applications (*definitely* eliminate if you used a Late Water flood)

Notes to keep in mind:

- ★ Anytime you have a bed that had excessive rot or a very large crop the previous year, suffered severe drought stress during either of the previous *two* years, or had leaf drop in the spring of the current year, then you should *not* reduce your fungicide sprays, regardless of a 'FAIR' or 'GOOD' forecast model.
- ★ *In general, 'cool and dry' work to the crop's advantage with regards to fruit rot levels (fruit rot fungi like it 'hot and humid'), but if there's a drought, the plants will be stressed such that they are more vulnerable to rot.*
- ★ "From 1948 through 2007, the keeping quality forecasts issued by the UMass Cranberry Station had an 87.9% success rate, with quality no worse than predicted. In only 13 years (12%) was the quality poorer than predicted, while in 21 years (20%) the quality was better than forecasted." – page 36 of UMass's book: Cranberry Production: A Guide for Massachusetts