# Integrated Pest Management in Cranberries: An Overview

By: Charles Armstrong
Cranberry Professional
University of Maine Cooperative Extension - 2016

# Presentation Outline:

- What *is* Integrated Pest Management (IPM)?
- Some IPM History
- Core Components of Cranberry IPM
- Cranberry Weed IPM
- Cranberry Insect IPM
- Cranberry Plant Disease IPM

# What *is* Integrated Pest Management?

"Integrated pest management (IPM) is a sound, sensible approach to dealing with pests—insects, plant diseases, weeds, and more—with methods that protect human health and the environment while saving money. IPM is ***integrated*** because it brings together, or integrates, a range of biological, organic, cultural, mechanical, and chemical options for pest problems." – *definition from the Northeastern IPM Center*
http://www.northeastipm.org/ipm-in-action/what-is-ipm/

# Some IPM History:

**1962:** Rachel Carson publishes her book Silent Spring, documenting the detrimental effects on the environment—especially on birds—of the indiscriminate use of pesticides, and it brings the issue of pesticide safety to the attention of the public:

- People start questioning and examining: *what are the adverse effects on wildlife, water quality, and human health?*
- DDT is found in milk and foods
- Resistance of pests to pesticides becomes a problem
- Response to the book eventually results in public policy changes during the 1970s

**1970s:**

- Significant research undertaken on the topic of IPM approaches to pest control
- USDA creates nationwide IPM programs at the Land Grant universities
- EPA is created and is given jurisdiction over pesticide registration & regulation
- EPA institutes pesticide education programs in the Land Grant universities (such as UMaine Orono)
- Maine Pesticide Control Act of 1975 (Title 7, Sections 601–625) gives authority to the Maine Board of Pesticides Control (BPC) to regulate pesticides in Maine (one of two statutes that gives this authority) http://www.maine.gov/dacf/php/pesticides/laws.shtml

Primary Source: M. Frazier at Penn State Extension; IPM in the Classroom 1997
http://extension.psu.edu/pests/ipm/schools-childcare/schools/educators/curriculum/contents/shorthistory

# Maine's Current IPM Policy:

**STATE POLICY; PUBLIC AND PRIVATE INITIATIVES TO MINIMIZE RELIANCE ON PESTICIDES (MRSA 22 §1471-X)**

"It is the policy of the State to work to find ways to use the minimum amount of pesticides needed to effectively control targeted pests in all areas of application. The agencies of the State involved in the regulation or use of pesticides shall promote the principles and the implementation of integrated pest management and other science-based technology to minimize reliance on pesticides while recognizing that outbreaks of disease, insects and other pests will necessitate fluctuations in pesticide use. These agencies, in cooperation with private interest groups, shall work to educate pesticide users and the general public in the proper use of pesticides and to determine other actions needed to accomplish the state policy." -- as of October, 2016.

*http://www.maine.gov/dacf/php/pesticides/laws.shtml*

# Core Components of Cranberry IPM:

- ✓ **Pest Monitoring and Correct Pest Identification**
  Monitoring involves mainly visual monitoring (on hands and knees in some cases) as well as the frequent use of a 12”-diameter sweep net
- ✓ **Insect Action Thresholds (AT)**
  Rather than relying on the calendar or one’s intuition to dictate when a spray should be applied, one should check to see what, if anything, is present (once or twice per week during the pest season), and any actions against a given pest should be based on the action threshold (AT) for that pest (given as an average per 25 sweeps with a 12”-diameter net). Past history (lessons learned) with the pest should also be considered in the decision-making process.
- ✓ **Weed ID, Priority Determinations and ‘Weed Mapping’**
  Low or High priority weed designations are based on three factors: 1) its ability to spread, 2) its ability to reduce yield, and 3) its susceptibility to control measures. Making a map of one’s weed locations and density, etc. is also advised.
- ✓ **For managing fruit rot: Bloom Stage & the Keeping Quality Forecast**
  The plant stage (specifically, the percentage of open bloom) is used in the timing of any sprays for managing rot. The Keeping Quality Forecast is a yearly prediction of rot pressure that draws on the fact that there is a strong relationship between certain weather factors (mainly temperature, precipitation, and sunshine hours) and the expected quality of the fruit.
- ✓ **Cultural Control Practices**
  Examples include seasonal and de-trash floods, pruning, sanding, mowing and burning of weeds, etc. Flooding is usually the most effective cultural control practice that cranberry growers can employ, especially against insects.

# Cranberry Weed IPM

- Cranberries are perennials, so most of the weed species are also **perennials**—***plants that live for many years and produce flowers and seeds year after year.*** [Drawing a "Weed Map" is thus encouraged in order to track these weeds from year to year; *is that weed problem getting worse, or declining?*]
- **Eradication versus tolerance:** In cranberry, weed eradication is considered an unreasonable goal, so the presence of many weed populations is often tolerated – ***but, all weeds are <u>not</u> created equal!*** [Some weeds compete with cranberry significantly but many others are really only a nuisance and can therefore be safely tolerated.]

# Cranberry Weed IPM Strategies:

- **Early preventative measures** (for example, hand-weeding after planting so weeds cannot gain a foothold; adequate planting density, maintaining a low/acidic pH, mowing dikes, etc.)
- **Weed Identification**, followed by:
  - **Prioritization** (Deal first with the weeds known to be most worrisome or most destructive; lowest priority ones can perhaps be tolerated)
  - **Weed Mapping** (in order to monitor challenging or problem areas and gauge any control efforts from year to year)
- **Pre and post-emergence herbicides** (if needed)
- **Cultural Practices** (examples include 'Late Water' flood, pruning, sanding, mowing and burning of weeds)
- **Biological:** no viable choices currently

# *All weeds are not created equal!*

Massachusetts developed a **priority system** in 1995

- Weeds are put into any of four groups based on three factors: ability to spread, ability to reduce yield, and susceptibility to control measures.
  - **Priority 1 weeds are considered to pose the greatest threat to cranberry farming** (most likely with regards to cranberry **yield** in particular)!
  - **Priority 2** (Serious Weeds)
  - **Priority 3** (Weeds of less importance)
  - **Priority 4** (Weeds of little concern)

# Cranberry Weed Priorities (bad ones)

| **Priority 1: Very Damaging Weeds** | |
|---|---|
| Dewberries | Dodder |
| Poison ivy | Sawbrier |
| Wild bean (groundnut) | |

| **Priority 2: Serious Weeds** |
|---|
| Asters |
| Common sawbrier |
| Narrow-leaved goldenrod |
| Upright bramble |
| **Yellow loosestrife** *(Callisto® herbicide has helped to turn the tide against this weed in Maine)* |

Except for dodder and ‘some’ asters, these are all perennial plants.


Dodder (an especially bad “Priority 1” weed but luckily it has been *very* rare on our Maine cranberry plantings!)
Obligate parasitic weed
The host plant receives no benefit from the dodder *and* the dodder plant requires a host plant to survive.

# Cranberry Weed Priorities (lower priority ones)

| Priority 3: Weeds of less importance |
| --- |
| Black chokeberry |
| Nutsedge |
| Leatherleaf (woody, evergreen shrub) |
| Perennial sedges and grasses |
| Red maple |
| Rushes, *Juncus* sp. |
| Sheep laurel |
| White clover |

| Priority 4: Weeds of little concern |
| --- |
| annual broadleaves such as ragweed and smartweed |
| annual sedges and grasses |
| Fireweed \|\| ferns \|\| Hardhack |
| Horsetail \|\| Joe Pye Weed |
| Meadow beauty \|\| Meadowsweet |
| mosses \|\| Pitchfork \|\| Sheep sorrel |
| Sweet pepper bush \|\| White violet |

# Weeds

## 2008 Maine Cranberry Grower Survey Findings

Weeds listed by the growers as the hardest to control, and not surprisingly, also the most abundant from year to year:

**Priority 2:**

- Yellow loosestrife
- Goldenrod

**Priority 3:**

- Clover
- small trees

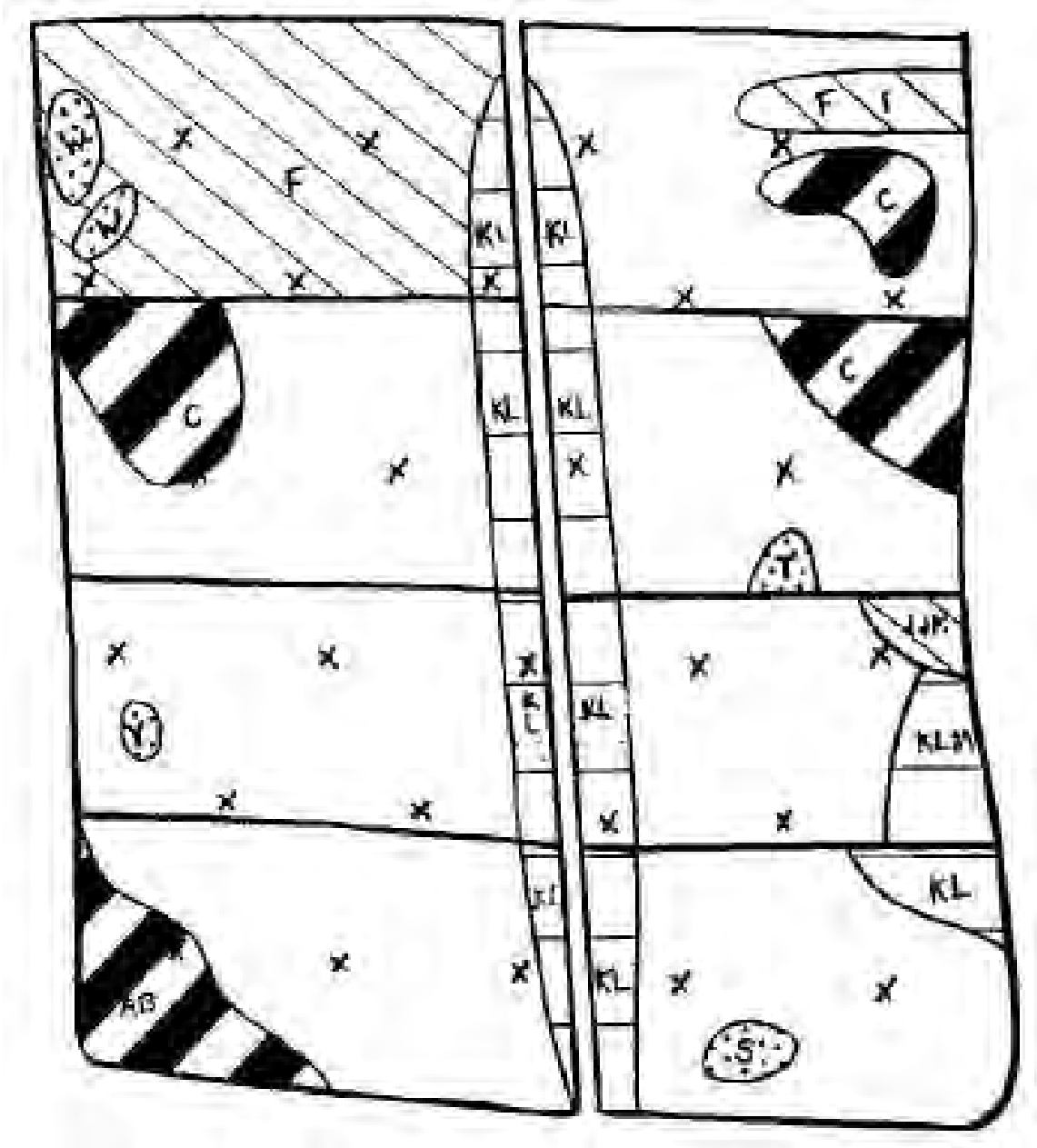
**Priority 4:**

- Horsetail
- Cattails
- Ragweed
- Grasses (*if* annuals – *otherwise* Priority 3)

# Example of a Weed Map

But you can make it however you want

x = sprinkler head



# Weed Management Herbicides (Cranberries)

**Some of the choices for cranberries:**

- Pre-emergence
  - dichlobenil (Casoron®)
  - napropamide (Devrinol®)
  - norflurazon (Evital®)
- Post-emergence
  - glyphosate (for example, RoundUp®)
  - sethoxydim (Poast®)
  - mesotrione (Callisto®)
  - clethodim (Select Max®)
  - clopyralid (Stinger®) (for clover)

# How to Help Avoid Weed Resistance:

| **Herbicide** and [active ingredient] | Resistance Management Grouping |
|---|---|
| **Callisto** [mesotrione] | **27** |
| **Casoron** [dichlobenil] | **20** |
| **Crossbow** [2,4-D] | **0** (non-bed use only) |
| **Devrinol** [napropramide] | **15** |
| **Evital** [norflurazon] | **12** |
| **Fusilade** [fluazifop-P-butyl] | **1** |
| **Intensity** [clethodim] | **1** |
| **Select Max** [clethodim] | **1** |
| **Poast** [sethoxydim] | **1** |
| **Roundup** [glyphosate] | **9** |
| **Stinger** [clopyralid] | **4** |

- Pay attention to the R**esistance Management Grouping <u>number</u>** (assigned based on how the chemical works, or its 'mode of action'; products with the same number have the same or a very similar mode of action).
- Avoid repeatedly using compounds that fall within the same chemical group!
- Good resistance management includes **<u>alternating products</u>** that have different mode of actions, and/or limiting or reducing the total **<u>number of applications per season</u>** of the same herbicide or herbicides having the same "Resistance Management Grouping" number.

# Cranberry Insect IPM

- ✓ Correct ID is essential!
- ✓ About 24 insects and 1 mite are known to be of economic importance in cranberry.
- ✓ When scouting/searching for pests, try not to be distracted or alarmed by non-pest insects.
- ✓ Probably the four most threatening/destructive cranberry insect pests in Maine are:
  1. **Blackheaded Fireworm** (2 to 3 generations per year)
  2. **Cranberry Fruitworm** (single generation per year)
  3. **Cranberry Tipworm** (3 to 5 generations per year)
  4. **Cranberry Weevil** (2 generations per year)

# Cranberry Insect IPM

- ✓ Scouting / Looking for pest insects:
  - Visual monitoring on hands and knees (only your hands and eyes for tools)
  - Sweep net sampling (aka “sweeping”)

  *Both activities are important and both should be used!*
- ✓ Sweeping (weekly, *and at least until bloom*):
  - Use a 12”-diameter net (pest capture threshold values are based on this size net)
  - One 180° arc swath with the net (in one direction) = 1 sweep
  - 25 sweeps = 1 sweep set

| Size of Acreage | Number of sweep sets |
|---|---|
| 1 – 10 acres | 1 sweep set / acre |
| 10 – 20 acres | At least 10 sweep sets |
| > 20 acres | 1 sweep set per 2 acres |

# Cranberry Insect IPM

**Treatment** for an insect pest should be based on scouting (and comparing counts with action thresholds) but should take into account other factors as well, such as:

- crop value
- dollar cost of the action or treatment

  **[the thresholds in cranberry are not economic thresholds but just experience-based levels at which you should be 'concerned']**
- effects on pollinators and other beneficials
- potential water issues (if relevant)
- weather
- neighbors
- chemical resistance management

# Cranberry Insect IPM

- ✓ Pheromone Traps (*usefulness in Maine is questionable!*)
  - Trap captures are not paired with an action threshold level (used for application timing only);

    [Depending on control product to be used, either the start of significant flight, peak trap capture, or end of flight will be the trap information needed.]
  - One trap per 10 acres; place on the upwind side of the bed; change lure every 3 weeks unless otherwise noted; NOTE: a lot of non-target (non-pest) moths are sometimes drawn to the same lures, and can clutter up or even fill up the trap surface area.
- ✓ Behavioral Control: Mating Disruption (not widely used, so very patchy availability of products, *if any!*)
- ✓ Cultural Control: primarily floods and sanding (Certain floods are often extremely effective against some of the species of cranberry insects!)

# Cranberry Insecticides:

## Carbamates & Organophosphates (broad spectrum)

- Include Sevin®, Diazinon®, Orthene® and Lorsban®;
- Include the conventional active ingredients used for many years that are often toxic to bees and natural enemies, and often have high human toxicity;
- Target the nervous system;
- Most are being reduced in usage or phased out;

## Insect Growth Regulators (IGRs) e.g. Rimon®, Confirm®, Intrepid®

- This group interferes with molting or metamorphosis;
- Confirm® and Intrepid® are caterpillar-specific and have low human toxicity; most effective when applied multiple times and in low gallonage against small caterpillars (may take 7 or more days before they die, but they stop feeding long before they die)

# Cranberry Insecticides:

Spinosyns (*e.g.* spinosad, spinetoram) [e.g. Delegate®, Entrust®]

- Target the nervous system, interfering with the insect's normal functioning at the synapse, causing paralysis and death;
- Work via contact and ingestion;
- Low non-target impact;

Neonicotinoids [e.g. Actara®, Assail®, Admire®, and Alias®]

- Targets the nervous system in a way similar to the natural insecticide, nicotine – causes excitation of the nerves, paralysis and death;
- Have systemic activity in the plant;

# Cranberry Insecticides:

## Microbial Disruptors of Midgut Membranes

- *Bacillus thuringiensis* (B.t.) products that work as a stomach poison (*Bt* subspecies Kurstaki, or *Bt-k*, is toxic only to caterpillars);
- Must be eaten by the insect to have any effect;
- Applications must be well-timed against small larvae, and be applied in low gallonage;
- Have not been widely adopted in cranberry, largely because other reduced-risk options perform better;

# Cranberry Insecticides (as of 2016)

The table shown here provides an overview of many of our cranberry insecticides. They have been grouped by insecticide class (or Group). ***As with all pesticides, when rotating insecticides to avoid insecticide resistance, it is best to rotate between different chemical groups so pay attention to the Group number of any products you choose to use.***

| Chemical Group | Product Common Name | Example brand name | Spectrum | IPM fit | Mammalian toxicity (oral) |
|---|---|---|---|---|---|
| **Anthranilic diamides (Group 28) (sustained muscle contraction / paralysis)** | chlorantraniliprole | Altacor® | very narrow | very good | **very low (no acute toxicity)** |
| **Tetronic acid derivatives (Group 23) (lipid synthesis inhibitors)** | spirotetramat | Movento® (hoping for 2017) | narrow | very good | **very low (no acute toxicity)** |
| **Oxadiazines (Group 22) [nervous system] (sodium channel blockers)** | indoxacarb | Avaunt® | fairly narrow | good | **moderate** |
| **Organophosphates (Group 1B) [nervous system] (cholinesterase inhibitors)** | acephate | Orthene® | broad | poor | **slight** |
| | chlorpyrifos | Lorsban® | broad | poor | **moderate** |
| | diazinon | Diazinon® | broad | poor | **slight** |
| | phosmet | Imidan® | broad | poor | **moderate** |
| **Carbamates (Group 1A) [nervous system] (cholinesterase inhibitors)** | carbaryl | Sevin® | broad | poor | **slight** |
| **Neonicotinoids (Group 4A) [nervous system] acetylcholine agonists (mimics) (most are highly toxic to bees)** | thiamethoxam | Actara® | narrow | ok | **low** |
| | imidacloprid | Admire® | narrow | ok | **moderate** |
| | imidacloprid | Alias® | narrow | ok | **moderate** |
| | acetamiprid | Assail® | narrow | good | **very low** |
| | clothianidin | Belay® | narrow | so-so | **very low** |
| | dinotefuran | Scorpion® | narrow | medium | **low** |
| | dinotefuran | Venom® | narrow | medium | **low** |
| **Insect Growth Regulators (Group 18A)** | tebufenozide | Confirm® | very narrow | good | **low** |
| | methoxyfenozide | Intrepid® | very narrow | good | **low** |
| **[ecdysone mimics]** | **Disruptors or mimics of the insect hormone ecdysone, which induces premature molting and metamorphosis.** | | | | |
| **Insect Growth Regulators (Group 15) [chitin inhibitors]** | novaluron | Rimon® | very narrow | good | **low** |
| **Bacillus thuringiensis (Group 11B2)** | Bt | DiPel® | very narrow | good | **Essentially non-toxic** |
| **Spinosyns (Group 5) (Naturalytes)** | **spinosad spinetoram** | **Entrust® Delegate®** | **very narrow** | **good (but toxic to bees when wet)** | **low** |

# Cranberry IPM Disease Management

## Major Cranberry Diseases

- **Fruit Rot**
- ***Phytophthora* Root Rot**
- **Upright & Runner Dieback**
- **Cottonball** (Wisconsin & some in the Pacific Northwest)
- **Fairy Ring**

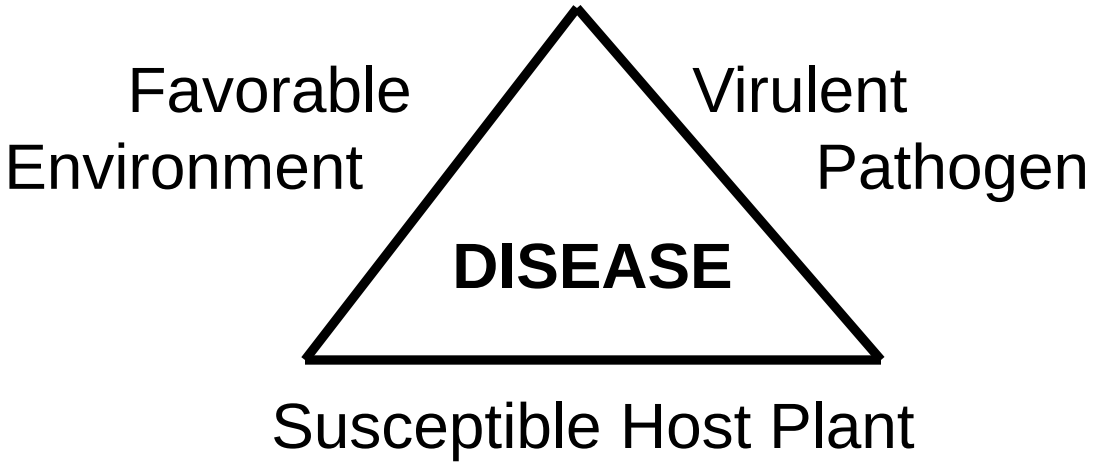
## Minor Cranberry Diseases

- ***Protoventuria & Pyreno-botrys* leaf spots**
- **Red Leaf Spot**
- **Rosebloom**
- **Ringspot**

**False Blossom: Major problem in the early 20th century and may be making a comeback in Massachusetts and New Jersey.**

# Cranberry IPM Disease Management

## ‘Disease Triangle’ (need all 3)



# Cranberry IPM Disease Management

## *Weather Factors are Key!*

- Temperature: If a pathogen encounters a favorable temperature at every turn, a serious disease outbreak can occur.
- Precipitation: drought or excess moisture stresses a cranberry plant and lowers its defenses *(drought favors Upright dieback and Fairy ring; wetness favors Phytophthora)*
- Humidity: Fungal pathogens require a film of moisture on plant surfaces for the spores to germinate and enter their host plant.
- Sunshine: Provides ‘drying power’ *and* the cranberry plant will be operating at maximum efficiency with full sunshine.

# Cranberry IPM Disease Management

## Some Key Fruit Rot Factors:

- **Weather** is probably the most important factor that affects fruit rot levels.
- Several different pathogens capable of causing different kinds of rot (12+ fungal species creating 9+ types of rot)
- Fruit rot fungal population levels will **vary** from year to year in any given bog (sometimes some of the species of fungi may not even be present in a given year)
- **Vine density** (vines stay wet longer the denser they are)
- **Drainage** (poor drainage favors fruit rot infection)
- **High water level in ditches** (favorable to rot)

# Cranberry IPM Disease Management

## Fruit Rot Factors (Continued):

- For many of the various fruit rot pathogens, even though they infect the flowers, they remain latent until the subsequent berry reaches a certain stage of maturity, at which point they will ‘get busy’ and visible symptoms will appear.
- *Symptoms may not be visible* until late in the season; sometimes not until after the berries have been harvested and are being held in storage.
- Some fungi are solely responsible for rot occurring in the field, while others are solely responsible for rot occurring in storage.

# Cranberry IPM Disease Management

## Fruit Rot Management:

- Fungicides (beginning in early bloom)
- De-trash floods (to remove sources of fungal spores)
- Trash pile removal after harvest
- Sanding
- Vine pruning and proper fertilizer scheduling
- “Late Water” flood
- Variety selection (Stevens is very resistant to fruit rot)

# Cranberry IPM Disease Management

## A few notes on some of the other Diseases:

- **Leaf spot diseases** are usually held in check via a normal fruit rot fungicide program.
- **Red Leaf Spot** is usually a sign of over-fertilization.

- **Upright Dieback** – more common following long periods of either drought or heat stress.
- **False Blossom** – causal agent is a phytoplasm (similar to a virus); have to control its vector, *i.e.* the blunt-nosed leafhopper (seems to be making a comeback in MA and NJ)

THE UNIVERSITY OF MAINE
Cooperative Extension

# For Further Information:

**Check out the Maine Cranberry IPM Guide available at**
**https://extension.umaine.edu/cranberries/grower-services/cranberry-ipm-guide/**

**University of Maine Cooperative Extension**
**Pest Management Unit**

17 Godfrey Drive
Orono, ME 04473
207.581.3880 • charles.armstrong@maine.edu
https://extension.umaine.edu/ipm/