4-25-2019

2019 Pesticide Safety - Water Quality

Martha Sylvia

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WATER QUALITY ISSUES

• **Surface Water**
  - Rivers, Streams, Lakes, Ponds, Springs
  - Impoundments, estuaries, wetlands, and coastal waters
    - Fish kills
    - Holding water
    - Flow through bogs

• **Groundwater**
  - Zone II
  - Well Water
  - Aquifers
RECEIVING WATER

• Fertilizers go into the receiving water and encourage algae growth.

• This causes algae blooms - or that green “pea soup” color you might have seen in Billington Sea, Monponsett Pond, Bartlett Pond, Wenham Pond, Dunham Pond, etc.

• Often this leads to a loss of oxygen in the water, causing fish kills.

• BUT we are not always the culprit.
  • Ponds with older “cottage” communities with leaking septic systems pump out much more in terms of nutrients than we do - on a continuing basis.
“That’s caused more nutrients from lawns and septic systems to go into Monponsett Pond, in addition to runoff from cranberry bogs,“ said Christine Goodyear, a scientist at the University of Massachusetts Amherst.

Stinky algal bloom in West Monponsett Pond, Halifax MA

Route 58 in Halifax, MA separates Monponsett Pond from Great Bay. Monponsett Pond is picturesque and enjoyable, but algae can pose a problem. In the summer, a gas smell coming from the pond causes locals to call the fire department to ensure there aren’t any dangerous gas leaks.

Harmful algae lurking in Bartlett Pond, Plymouth MA

Bartlett Pond, a 33-acre pond, is a part of the Great Bay estuary. The algae bloom there is harmful to wildlife and can affect the health of the Great Bay ecosystem. The Bloom Watch program helps monitor algal blooms and their impact on water quality.

Upstream Cranberry Bogs Key To Mill Pond Water Quality

Director Dr. Nate Horwitz-Willis, who manages the cranberry bog, said that the cranberry bogs help filter out nutrients and pollutants from the waterways. According to him, the cranberry bogs play a crucial role in improving water quality in Mill Pond and the Great Bay estuary.
Are you **safe** if you hold the water for the specified number of days??

But, if you have the ability to hold longer, it is **always** advisable.

A good point with many of the chemicals we are using now is that many of them do break down over time. So, the longer the better!!
HOLDING TIMES

- **14 Days**
  - Abound and Satori (azoxystrobin)
- **5 Days**
  - Lorsban (chlorpyrifos)
  - Actara (thiamethoxam)
- **3 Days**
  - Bravo, Echo, Equus (chlorothalonil)
  - Diazinon
  - Nexter (pyridaben)
- **1 Day**
  - Avaunt (indoxacarb)
- **Hold 1 Day if no required time**
# FISH

## RAINBOW TROUT

### 96 HOUR LC50

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Half-Life</th>
<th>LC50 (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nexter</td>
<td>3 day</td>
<td>0.00073</td>
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<tr>
<td>Lorsban</td>
<td>5 day</td>
<td>0.003</td>
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<td>Champ</td>
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<tr>
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<tr>
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<tr>
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<td>2.36</td>
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<td>12.6</td>
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<td>Actara</td>
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<td>&gt;100</td>
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<tr>
<td>Intrepid</td>
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<td>&gt;130</td>
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</table>
# FISH

## RAINBOW TROUT

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mg/l = ppm

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<tr>
<th>Insecticide</th>
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</tbody>
</table>
FISH
RAINBOW TROUT

96 HOUR LC50
mg/l = ppm

QUADRIS-TOP

<table>
<thead>
<tr>
<th>Difenoconazole</th>
<th>1.1 mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fenbuconazole</td>
<td>1.5 mg/l</td>
</tr>
<tr>
<td>Prothioconozole</td>
<td>1.83 mg/l</td>
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</tbody>
</table>

14 day holding time

Compare LC50 of our 3 “conazoles”
DMI fungicides
(DeMethylation Inhibitors)
FRAC code 3

<table>
<thead>
<tr>
<th>Difenoconazole</th>
<th>1.1 mg/l</th>
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</tr>
</tbody>
</table>

Azoxystrobin 0.47 mg/L
### FISH

- **RAINBOW TROUT**

<table>
<thead>
<tr>
<th></th>
<th>Echo 720</th>
<th>Bravo Ultrex</th>
<th>Bravo weatherstik</th>
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</thead>
<tbody>
<tr>
<td>mg/l = ppm</td>
<td>0.012</td>
<td>0.012</td>
<td>0.012</td>
</tr>
<tr>
<td>96 HOUR LC50</td>
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<tr>
<td>Flowthrough</td>
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<td>Semi-static</td>
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<td>0.0076</td>
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**CHLOROTHALONIL**
### Aquatic Invertebrate (Daphnia Magna) Water Flea

**48 Hour EC50**

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Concentration (mg/l)</th>
<th>Time</th>
<th>Concentration (ppm)</th>
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<tbody>
<tr>
<td>Nexter</td>
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<td>Sevin</td>
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<tr>
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### AQUATIC INVERTEBRATE

**Daphnia Magna**

**Water Flea**

#### 48 HOUR EC50

<table>
<thead>
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<th>CHLOROTHALONIL RANGE</th>
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<tbody>
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<td>Echo 720</td>
<td>0.0342 - 0.143 mg/l</td>
</tr>
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</table>
• If you have a flow through bog and it is tough to hold for even as long as the label suggests...

• You can:
  • make sure your water is as low as possible before application;
  • talk with your upstream neighbor. Maybe they can help by holding water even one plank higher...
  • Build a tailwater recovery
  • Make sure your flumes are tight
  • Be aware of specific gravity, to release from top of board or bottom of boards...
For environmental stewardship, adopt pesticide best management practices. The following practices will reduce the potential for pesticide contamination of groundwater and surface water.

- Practice Integrated Pest Management (IPM)
- Select pesticides that are labeled for the intended application site
- Consider application site characteristics (soil texture, slope, organic matter)
- Consider location and conditions of wells
- Make sure your water supply is adequate for cranberry production
- Use tailwater recovery
BMP’S TO PROTECT WATER RESOURCES

• Mix and load carefully
• Prevent backsiphoning and spills
• Use protective equipment and clothing
• Consider impact of weather and irrigation
• Store pesticides safely and securely
• Dispose of wastes safely
• Leave buffer zones around sensitive areas
• Reduce off-target drift
WATER SAMPLING

• Pesticides are widespread in groundwater and surface water

• 95% of stream samples and 50% of well samples contained at least one pesticide

• Most samples taken contained at least one pesticide
PESTICIDE ISSUES
GROUNDWATER ISSUES

• Even correctly applied pesticides can move downward with rain and irrigation
  • non-point source pollution
• Pesticides can move from surface water to groundwater
• Once a pesticide is in groundwater it breaks down more slowly because of less light, heat and oxygen
COMPOUNDS ARE NOT ALL THE SAME

• Read supplemental labels, they have specifics for cranberry
• Actara – leaches into the ground more than all other compounds we have
• **Actara** and **Intrepid** and **Princep** are Zone II compounds

GROUNDWATER PROTECTION LIST

• Why do some compounds get added and others do not???
OVERALL ENVIRONMENTAL FATE

- Know the Chemical Characteristics of Pesticides
- Sum of various processes that take place with pesticides
  - Chemical Characteristics
  - Pesticide Movement
  - Degradation
  - Environmental Impact

Soluble + Persistent

Leaching + Runoff

Low Degradation

Water Contamination
MA GROUNDWATER PROTECTION LIST

• Potential Groundwater Contaminants based on:
  • Leaching potential
  • Toxicological concerns

• If it is on the Groundwater Protection List then it is on the Massachusetts Restricted Use Products List
LEACHING POTENTIAL

- **Leaching potential criteria** as set in the State Regulations 333 CMR 12.00
- Leaching potential refers to a pesticide which meets or exceeds the following criteria based upon the most conservative data and information published in the US EPA Environmental Fate and Groundwater Branch Pesticide Fate One Line Summaries:
  - Water solubility greater than or equal to 3 ppm
  - Koc less than or equal to 1900
  - Kd less than or equal to 20 in the absence of a reported Koc value
  - Soil half life greater than or equal to seven days
TWO MOST IMPORTANT PROCESSES

• **Sorption**
  • Describes the tendency of a pesticide to bind to the soil (organic matter)
    • “Sticking” of pesticides to soil particles
  • Depends on organic carbon content of soil
  • Often represented by $K_{oc}$ number
  • Decreases the leaching and runoff potential

• **Degradation**
  • Microbial or chemical reaction
  • Aerobic and Anaerobic conditions
  • Half-life
PESTICIDE CHARACTERISTICS

Examples of water solubilities:

- Roundup (glyphosate): 12000 mg/L
- Actara (thiamethoxam): 4100 mg/L
- Devrinol (napropamide): 0.75 mg/L

- **Solubility**: The ability of a pesticide to dissolve in a solvent, such as water
- **Water-soluble pesticides** are more susceptible to:
  - Surface runoff
  - Leaching toward groundwater

Leaching criterion for Groundwater Protection:
- Water solubility greater than 3 ppm
LEACHING POTENTIAL

Koc <= 1900
Soil ½ life >= 7 days
Water solubility >= 3 ppm

Highly Mobile
• Actara
  Thiamethoxam
  • Koc 70 ml/g
    (low adsorption potential)
  • Half lives:
    Soil: 385 days
  • Solubility: 4000 ppm
    (highly soluble in water)

Slightly mobile
• Kerb
  Pronamide
  • Koc 889 ml/g
  • Half lives:
    • Hydrolysis: 42 days
    • Soil: 392 days
    • Anaerobic: 762 days
  • Solubility: 15 ppm
**LEACHING POTENTIAL**

Koc <= 1900  
Soil ½ life >= 7 days  
Water solubility >= 3 ppm

---

**moderately mobile**  
- **Intrepid**  
  Methoxyfenozide  
  - Koc 490 ml/g  
  - Half life in soil:  
    - 336-1100 days  
  - Solubility: 3.3 ppm

---

**relatively immobile**  
- **Diazinon**  
  - Koc 1000 ml/g  
  (higher adsorption potential)  
  - Half Live in soil:  
    - 40 days  
  - Solubility: 60 ppm
LEACHING POTENTIAL

Koc \leq 1900

Soil ½ life \geq 7 days

Water solubility \geq 3 \text{ ppm}

**low mobility**

- Roundup glyphosate
  - Koc 2600-4900 ml/g. highly adsorbed
  - Half life in soil:
    - 47 days
    (2-200 range)
  - Solubility: 12,000 mg/l

**relatively immobile**

- Bravo chlorothalonil
  - Koc 900-1400 ml/g really high
  - Strongly adsorbs to soil
  - low to no mobility in soil
  - Half lives: moderately persistent
    - Soil: 12-19 days
    - The field dissipation half-life of chlorothalonil was 48 days
  - Solubility: insoluble in water, low water soluble
GROUNDWATER RULES

Potential Groundwater Contaminant refers to a pesticide which meets the definitions of toxicological concern and leaching potential

• Lifetime Maximum Contaminant Level, Proposed Maximum Contaminant Level, or Health Advisory Level HAL less than or equal to 20 ppb or

• US EPA classification as a known or probable human carcinogen, categories A, B1 or B2
TOXICOLOGICAL CONCERN

KERB
• Pronamide had a toxicological classification as a probable human carcinogen (B2).

ACTARA
• Thiamethoxam has a toxicological classification as a likely human carcinogen

BRAVO
• Chlorothalonil has a toxicological classification as a probable human carcinogen (B2).
PESTICIDES IN CRANBERRY BOG SYSTEMS

• Monitoring for pesticides on Groundwater Protection List
• Targeted monitoring based on Notifications
• 2018: Three bog systems; Sampling of bog ditches

<table>
<thead>
<tr>
<th>Pesticide</th>
<th>Highest Detection (ppb)</th>
<th>Human Health Standard (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorothalonil</td>
<td>0.022 (1 of 4)</td>
<td>500</td>
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<tr>
<td>Methoxyfenozide</td>
<td>3.54 (4 of 4)</td>
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</tr>
<tr>
<td>Thiamethoxam</td>
<td>0.044 (2 of 4)</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>methoxyfenozide</td>
<td>chlorothalonil</td>
</tr>
<tr>
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<td>---------------</td>
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<tr>
<td></td>
<td>Intrepid</td>
<td>Bravo</td>
</tr>
<tr>
<td>South Carver</td>
<td>.892 ppb</td>
<td>ND</td>
</tr>
<tr>
<td></td>
<td>no app</td>
<td>collection 7/30</td>
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<tr>
<td>South Carver</td>
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<td>ND</td>
</tr>
<tr>
<td></td>
<td>App on 7/27</td>
<td>App of Actara in May</td>
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<tr>
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<td>collection 7/30</td>
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<tr>
<td>Rochester</td>
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<td>collection 7/30</td>
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<tr>
<td>benchmark</td>
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<tr>
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<td></td>
<td>chronic</td>
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Editorial blaming Cranberry and Makepeace for poisoning the wareham water supply

“Some of the cranberry pesticides in our drinking water are banned in dozens of countries”

“Has been scientifically identified as the primary source of the pesticides in our drinking water supply”

Wareham Water Department does have 15 years of data

Yes, they did detect cranberry pesticides but none were at high levels
BAM (ppb) 0.14 - 2.60
Sevin (ppb) ND - 0.72
Bravo (ppb) ND - 1.70
Casoron (ppb) ND - 0.19
Intrepid (ppb) ND - 0.69
Devrinol (ppb) ND - 3.70
Evital (ppb) ND - 1.00
<table>
<thead>
<tr>
<th>Secondary Contaminants</th>
<th>Trade Name</th>
<th>Sampling dates</th>
<th>Range Detected</th>
<th>ORSG*</th>
<th>Possible Source</th>
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<tr>
<td>2,6 Dichlorobenzamide</td>
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<td>Azinphos-methyl</td>
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<tr>
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<td>Bravo (ppb)</td>
<td>2000 to 2014, 2017</td>
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<tr>
<td>Chlorpyrifos</td>
<td>Lorsban (ppb)</td>
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<td>Dichlobenil</td>
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</tr>
<tr>
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<td>2000 to 2014, 2017</td>
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<tr>
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<td>Norflurazon</td>
<td>Evital (ppb)</td>
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<td>ND - 1.00</td>
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<td>Agricultural Chemical</td>
</tr>
<tr>
<td>Propyzamide</td>
<td>Kerb (ppb)</td>
<td>2000 to 2014, 2017</td>
<td>ND</td>
<td>None</td>
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<tr>
<td>Thiamethoxam</td>
<td>Actara (ppb)</td>
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<td>Indoxacarb</td>
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</tr>
<tr>
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MASSGIS ONLINE DATA VIEWER

- https://maps.massgis.state.ma.us/map_ol/oliver.php
REVIEW

- Are you using a product on the Groundwater Protection List?
- Are you in a regulated primary recharge area?
- What do you do next?

Requirements

- There must be no viable alternative to the use of the product
- The applicator must be using an IPM Program from a Department approved source

Chlorothalonil
Methoxyfenozide
Thiamethoxam
Simazine
Dinotefuran
ONLINE NOTIFICATION

• MDAR website: Pesticides and Water Supply Protection

Groundwater Protection Program Notification Form

You must notify us when you apply a pesticide product which is listed on the groundwater protection list. Notifications must be made within ten days of the end of the calendar month. Please submit one form per site.

Fields marked with an * are required.

Name: 

First Name

CONTACT

Hotze Wijnja

Phone

617-626-1771

Tell us what you think
WHAT’S UP NEXT?

Water quality → More for Less

EQUITY: GROWING MORE FOR LESS
DO NOT BE A SPENDTHRIFT
BE A SKINFLINT

• Cost of each application, make it count
  • Do you really need it
  • Adjuvant $5 more
  • Generic, cheaper but works fine

• Application (cheapest, most effective)
  • aerial, ground, chemigation, spot treat, mist blow

• Injection, is it actually getting there
  • Dye test
COSTS MONEY TO HAVE PROPERTY

- Property Taxes
- Personal Property Tax
- Road upkeep, repair
- Pumphouses, screenhouses
- Roof replacement
- Water rights, DEP
- Water clearing
- Ditch cleaning

Costs money to crop

- Frost
- Irrigation
- Flooding
- Sprays
  - 3 insecticides
  - 3 fungicides
  - 3 herbicides
- $4/bbl to harvest
- $1/bbl to truck
- Hired help
HOW LOW CAN YOU GO?

• **INSECTS:** You must manage:
  • **CFW and Spag** - direct fruit pests
  • **Weevils:** destroy flower pods
  • **BHF:** destroy the plant
  • **Winter moths** eat flower buds

• Sweep 1x or 2x in the spring:
  • if weevil/Spag/BHF are problems

• Walk your acreage early and late

• Calculate % out-of-bloom

• Correctly time CFW spray!
WHAT INSECTS WILL TAKE YOU OUT??

- CFW
- Spag
- Weevil

- Sweep, sweep again
- Think about the thresholds
- How much damage is there?
- Is mist blowing an option
- Back-pack treating an area
- Late Water
- 24-48 hour spring reflow?
WHAT INSECTS WILL TAKE YOU OUT??

- CFW ➔ Altacor $55
- Spag ➔ Delegate $50
- Weevil ➔ Avaunt $37
- Scale ➔ Actara $15
- BHF ➔ Intrepid $29
- YHF ➔ Diazinon $30

What is the cost of sweeping?
INSECTICIDES 2019

- Altacor – chlorantraniliprole $55
- Avaunt – indoxacarb $37
- Delegate – spinetoram $50
- Diazinon post resp eye $35-40
- Intrepid – methoxyfenozide Restricted $29
- Sevin – carbaryl resp $25
- Actara – thiamethoxam Restricted *GW $15
- Admire – imidacloprid
- Orthene – acephate
- Nexter – pyridaben resp eye
- Lorsban – chlorpyrifos Restricted resp eye
- Exirel – cyantraniliprole $70
- Assail – acetamiprid
- Imidan – phosmet resp
- Rimon – novaluron eye
INSECTICIDES 2019

- **Altacor** – *chlorantraniliprole* $55
- **Avaunt** – *indoxacarb* $37
- **Delegate** – *spinetoram* $50
- **Diazinon** - *post* resp eye
- **Intrepid** – *methoxyfenozide* Restricted
- **Sevin** – *carbaryl* resp
- **Actara** – *thiamethoxam* Restricted *GW
- **Admire** – *imidacloprid*
- **Orthene** – *acephate*
- **Nexter** – *pyridaben* resp eye
- **Lorsban** – *chlorpyrifos* Restricted resp eye
- **Assail** – *acetamiprid*
- **Imidan** – *phosmet* resp
- **Exirel** – *cyantraniliprole* $70
- **Rimon** – *novaluron* eye
- **Cormoran** – *novaluron/acetamiprid*
- **Safari/Venom** – *dinotefuran*
- **Closer** – *sulfoxaflor*
- **Beleaf** - *flonicamid*
- **Movento** - *spirotetramat*
HOW LOW CAN YOU GO?

• **DISEASES:** You must manage:
  * **Fruit Rot:** Time your sprays (% bloom)
  * **Phytophthora:** Improve drainage; modify irrigation to avoid standing water.

• **WEEDS:** You must manage:
  * **Dodder:** Prevent seed formation. POST treatments can be more targeted than PRE applications.
  * **Dewberries:** Will kill cranberry vines. Control the perimeters; prevent exponential growth.
FUNGICIDES 2019

• **Bravo – Chlorothalonils**
  • Bravo Ultrex  **post**  resp  **eye** *(restricted use)*GW
  ■ Chloronil 720, Echo 720 **eye**
  • Equus 720, Initiate 720 **eye**
  • Bravo Weatherstik  **eye for workers**

• **Proline – prothiaconazole**  
  • **$35-40**

• **Indar – fenbuconazole**  
  • **$22**

• **QuadrisTop – difenconazole/azoxystrobin**  
  • Abound – azoxystrobin  **$24/15**
  • Manzate – EDBC’s  resp  **$24/40**

• Champ – coppers  **post**  **eye**
• Phostrol – phosphites
• Aliette WDG – fosetyl-al
• Ridomil – mefenoxam  **post**
• Ferbam Granuflo  resp  **21c**
• Callisto – mesotrione
• Intensity, Select – clethodim eye
• Roundup – glyphosate  (MRL issues)
• QuinStar - quinclorac
• Casoron – dichlobenil
• Devrinol – napropamidine
• Kerb – pronamidine  (MRL issues)  (restricted use)
• 2,4-D granular, weedar 64 post eye  (restricted use)
• Poast – sethoxydim
• Stinger – clopyralid eye
• Evital – norflurazon
COST OF CONTROLLING WEEDS

- Devrinol 2XT...... $130-$200/A (12-18 qt/A)
- Evital.................. $370-$740/A (80-160 lb/A)
- Casoron............... $75-$250/A (30-100 lb/A)
- Callisto.............. $32/A (8 oz/A)
  • Syngenta generic: Explorer, even less
- Intensity One..... $11/A (16 oz/A)
- Poast................... $60/A (using 40 GPA spot)
- Handweeding...... $12-18/hr/person
COST OF PRODUCTION...

• Cost is driven by the needs of the bog

• Spending is driven by cash available

• You spend based on the income available