Integrated Management of Strawberry Diseases

A program that INTEGRATES the use of:

• Disease Resistance
• Cultural Practices
• Biological Control
• Minimal Fungicide Use
• A knowledge of Disease Biology
Knowledge of Pathogen Biology and Disease Epidemiology

This knowledge is critical to the development of effective management strategies.
How can we effectively “Manage” a plant disease without basic knowledge on pathogen ecology and disease epidemiology?
Epidemiology and control of Strawberry Fruit Rots

To demonstrate the importance of having knowledge about the disease, we will take a close look at the major strawberry fruit rot diseases.
STRAWBERRY FRUIT ROTS

Botrytis (Gray Mold)
Leather Rot
Anthracnose
Botrytis Fruit Rot
“Gray Mold”
Of Strawberry

Caused by the fungus:
Botrytis cinerea
Fifteen years ago growers in the Midwest and Eastern U.S. sprayed fungicides for Botrytis control from early spring (pre bloom) through harvest.

Could result in 4 to 6 applications or more per year.
Let’s look at how increasing our knowledge about this disease has greatly increased our ability to control it effectively.
The fungus overwinters in symptomless infected leaves
Quiescent (latent) Infections in apparently Healthy strawberry leaves
Almost all of the primary inoculum comes from sporulation on old dead leaf residue within the row.
Most fruit infections actually occur during bloom.

The fungus colonizes old dead flower parts and gets established in the young green fruit.
The fungus develops latent infections in the young green fruit. The fungus cannot colonize the immature fruit tissue.
This immature fruit was inoculated with Botrytis and has a latent infection.
When the fruit begins to mature (ripen), the fungus becomes active and fruit rot develops.
The fruit rot you see develop at harvest time was actually infected during bloom.

Spraying during harvest is not effective in controlling the disease that is developing from latent infections.
FOR CONTROL OF BOTRYTIS (GRAY MOLD) APPLICATIONS OF FUNGICIDE DURING BLOOM ARE CRITICAL.
Bloom in our perennial matted row systems usually last about 2 to 3 weeks.

Protecting the flowers with fungicides during bloom only results in 2 or at the most 3 fungicide applications compared to up to 6 applications in the past.
Fungicides for Botrytis (Gray Mold) on Caneberries

**Excellent**
- Pristine
- Rovral
- Switch
- Elevate
- Captevate

**Suppression**
- Cabrio
- A bound
Fungicides for Control Of Botrytis Gray Mold On Strawberry

- Switch
- or
- Elevate (tank mixed with) Captan
- Pristine
- Scala
Fungicide Resistance Management

• No more than 2 applications of Topsin M, Switch, Elevate, Pristine or Scala should be made without alternating to another fungicide with different chemistry.

• Resistance development is a serious threat to our continued use of these materials.
Use of Cultural Practices

The use of any cultural practice that provides an environment within the planting that is less conducive to disease development and spread should be employed.
Weed Control

• Weeds prevent air circulation and result in fruit and foliage staying wet for longer periods.
• Gray mold, in particular, is generally more severe in plantings with poor weed control.
1) Should be based on soil and foliar analysis.
2) Use of excessive fertilizer, especially Nitrogen, should be avoided.
# Effect of Cultural Practices on Gray Mold

(Wilcox and Pritts, Cornell Univ.)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>% Gray Mold</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Allstar</td>
<td>Honeyoye</td>
<td></td>
</tr>
<tr>
<td>Flat bed, matted row</td>
<td>17</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Flat bed, matted row, 30 lbs N</td>
<td>27</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Flat bed, matted row, 60 lbs N</td>
<td>39</td>
<td>35</td>
<td></td>
</tr>
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</table>
Harvesting Procedures

Important Considerations:

a) Pick fruit frequently
b) Handle berries with care
c) Train pickers to avoid diseased fruit
d) If possible, remove disease and damaged berries from the field
Anthracnose Fruit Rot of Strawberry

Caused by the fungus: Colletotrichum acutatum
Anthracnose is generally thought of as a warm weather or southern disease of strawberry.
Anthracnose fruit not caused by *Colletotrichum acutatum* was epidemic for the first time in Ohio in 1991.

Economic damage was not observed prior to this date.
OVERWINTER SURVIVAL UNDER NORTHERN CONDITIONS

The disease was new to Ohio so we needed to determine if the fungus could overwinter in Ohio.
The big question was:

How was the disease introduced into the planting?
Anthracnose is probably introduced into a field on infected transplants.
Research conducted at Iowa State University in Dr. Mark Gleason’s Laboratory showed that anthracnose could move from one location to another on apparently healthy plants.
Fungicides For Control Of Anthracnose Fruit Rot

Captan and Thiram
A bound, Cabrio and Pristine
Switch
Fungicide Resistance Management

- No more than 2 applications of Cabrio, Quadris or Pristine should be made without alternating to a fungicide with different chemistry.

- Captan or Thiram

- Switch

- “Fungicide resistance is a real threat to our most effective anthracnose fungicides.”
Leather rot of Strawberry

Caused by the oomycete: Phytophthora cactorum
Disease cycle of leather rot of strawberry caused by Phytophthora cactorum
For Leather Rot control, cultural practices are critical

- Good Soil Drainage (no standing water)
- Straw Mulch
Good Drainage is Extremely Important

Standing water (saturated soil) promotes disease development
For Leather Rot control, cultural practices are critical

- Good Soil Drainage (no standing water)
- Straw Mulch
Mulch

Bare soil between the rows should be avoided.

A good layer of straw mulch is beneficial for controlling fruit rots, especially leather rot.
<table>
<thead>
<tr>
<th>Treatment</th>
<th>% Leather Rot</th>
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<tbody>
<tr>
<td>Aliette 80WG 2.5lb</td>
<td>3.9</td>
</tr>
<tr>
<td>Ridomil 2E 2qt</td>
<td>3.6</td>
</tr>
<tr>
<td>Straw Mulch Only</td>
<td>2.5</td>
</tr>
<tr>
<td>Check</td>
<td>65.9</td>
</tr>
</tbody>
</table>
I took the slides I am going to show next just last week in a commercial strawberry field near our research station.
Fungicides for Control of Leather Rot

Old Protectants
Captan and Thiram

Newer Systemic Materials
Mefenoxam – Ridomil Gold
Fosetyl-Al - Aliette
Phosphoruous Acid

Strobilurins
Azoxystrobin – Abound
Pyraclostrobin – Cabrio
Pristine
Phosphorous Acid

- Phosphorous acid has essentially the same active ingredient as Aliette.
- Several phosphorous acid fungicides are currently being registered for use on strawberry.
- Pro Phyt, Agri Fos, there will be several others
The Strobilurin fungicides are very important tools for disease control in strawberry.
Pristine 38WG

- Outstanding Material
- Combination of Cabrio plus Boscalid
- Controls all fruit rots (Botrytis, Anthracnose and leather rot)
- Good control of leaf spot diseases
- Good control of Powdery Mildew
- Good Post harvest control of Botrytis
Abound 2.08f and Cabrio 20EG

- Best for anthracnose fruit rot
- Excellent for powdery mildew
- Good activity against leaf spot diseases
- Very effective for control of leather rot
- Some suppression of Botrytis
STRAWBERRY LEAF DISEASES

- Leaf Spot
- Leaf Scorch
- Leaf B light
- Powdery Mildew
- Angular Leaf Spot
LEAF SPOT

Caused by the fungus: Mycosphaerella fragariae
LEAF SCORCH

Caused by the fungus: Diplocarpon earliana
LEAF BLIGHT

Caused by the fungus: Phomopsis obscurans
POWDERY MILDEW

Caused by the fungus: Sphaerotheca macularis
Control of Strawberry Leaf Diseases

- Use Disease resistant Varieties
- This is the most practical means of control
- Use effective Fungicides.
- I do not like to recommend fungicides for control of foliar diseases on strawberry.
Fungicides for Control Of Strawberry Leaf Diseases

• Captan, Thiram, Syllit, or Topsin

• Nova or Procure

• Strobilurin Fungicides:
  A bound, Cabrio or Pristine
ROOT DISEASES

• Red Stele
• Verticillium Wilt
• Black Root Rot
RED STELE ROOT ROT

caused by the oomycete: Phytophthora fragariae
VERTICILLIUM WILT

Caused by the fungus: Verticillium dahliae
Disease Resistant Varieties should be the primary method for control of soil borne root diseases:

- Verticillium Wilt
- Red Stele Root Rot
BLACK ROOT ROT

(Physiological disorder)
Black Root Rot

- Is a Physiological Disorder
- Exact cause not understood
- No current control recommendation other than maintaining good production practices
Integrated Management of Strawberry Diseases

A program that INTEGRATES the use of:

- A knowledge of Disease Biology
- Disease Resistance
- Cultural Practices
- Biological Control
- Minimal Fungicide Use
Disease Resistance

The First Line of Defense
USE DISEASE RESISTANT VARIETIES

If disease resistant varieties are not available, we should at least **AVOID** highly susceptible varieties.
Disease Resistant Varieties should be the primary method for control of soil borne root diseases:

- Verticillium Wilt
- Red Stele Root Rot
STRAWBERRY VARIETIES WITH RESISTANCE TO THE FOLLOWING DISEASE ARE AVAILABLE:

- Red Stele
- Verticillium Wilt
- Leaf Spot
- Leaf Scorch
- Powdery Mildew
<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Leaf Spot</th>
<th>Leaf Scorch</th>
<th>Red Stele</th>
<th>Verticillium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delight</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
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<tr>
<td>Earliglow</td>
<td>R</td>
<td>R</td>
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<tr>
<td>Honeoye</td>
<td>T</td>
<td>T</td>
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</tr>
<tr>
<td>Raritan</td>
<td>S</td>
<td>S</td>
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<tr>
<td>Surecorp</td>
<td>R</td>
<td>R</td>
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</tr>
</tbody>
</table>

*R = Resistant
*S = Susceptible
*T = Tolerant*
Unfortunately, we do not have good resistance to the fruit fungal pathogens:

- Botrytis Fruit Rot
- Anthracnose
- Leather Rot
Due to the lack of resistance to the major strawberry fruit rots, fungicides will remain an important component of the disease management program.
However, their minimal use within integrated disease management programs will be emphasized.
The End
ANGULAR LEAF SPOT (BACTERIAL BLIGHT)

Caused by the bacterium: Xanthomonas fragariae
Chemical Control of Angular Leaf Spot (Bacterial Blight)

• Many copper fungicides are labeled

• OxiDate (Hydrogen Dioxide 27%)
Copper for Bacterial Blight on Strawberries

- I have the following information from a grower in Michigan. He claims to have good success in controlling angular leaf spot (browning of the caylex).
- Copper fungicide (Kocide 2000) at 3 lbs/Acre

Timing

- When flower buds show in the spring, applied with Captan
- Once more before Bloom
- If very wet weather or if abrasions occur on leaves (high winds with blowing sand or excessive water), maybe a third spray
- Never applies after initiation of bloom
Kocide 101  
( Copper Hydroxide )

- Use at 2 to 3 lbs / A cer
- Begin application when plants are established and continue on a weekly schedule throughout the season.
- Use higher rates when conditions favor disease.
- Discontinue if signs of crop injury appear.
Oxidate
( Hydrogen Dioxide )

Use 1 gallon (128 ounces) per 100 gallons of water = 1:100 dilution

• Curative – Spray diseased plants using the 1:100 dilution rate for three consecutive days and continue on 5 to 7-day interval.
**OxiDate**

( **Hydrogen Dioxide** )

**Preventative** - Begin when plants are small. Apply the first three treatments at 1:100, for 5-day intervals. Reduce rate to 1:300 after completion of the third treatment and maintain 5-day interval spray cycle until harvest.