Growing Small Fruit Commercially

Beginning Farmer & Rancher Program
BF 105

Mary Concklin
Visiting Extension Educator, Fruit Production and IPM

SOLID GROUND FARMER TRAININGS
Strengthening Our Farms Across Connecticut

Visit newfarms.extension.uconn.edu/solidground for the full schedule of trainings offered in collaborations with our Agricultural Learning Partners:

• Common Ground, New Haven
• Community Farm of Simsbury, Simsbury
• Green Village Initiative, Bridgeport
• Killingly Agricultural Education Center, Killingly
• Knox-Urban Farming Incubator Program, Hartford
• Grow Windham, Willimantic, Windham
• Listo Para Iniciar Program, Bethel, Stamford, New Milford

Resources: UConn Extension

• Fruit production and IPM: Mary.Concklin@uconn.edu
• Greenhouses: Leanne.Pundt@uconn.edu, Rosa.Raudales@uconn.edu
• Food Safety: Diane.Hirsch@uconn.edu
• Business & Risk Management: Joseph.Bonelli@uconn.edu
• Pesticide Education: Candace.Bartholomew@uconn.edu
• Food Systems: Jiff.Martin@uconn.edu
• Plant Diagnostics: Joan.Allen@uconn.edu
• UConn Soils Lab: Dawn.Pettinelli@uconn.edu, Thomas.Morris@uconn.edu

Opportunities: Fruit Production & IPM

• Crop Talk: Vegetable & Small Fruit Newsletter
• UConn Fruit IPM Message via email, website
• New England Vegetable & Fruit Conference
• CT Vegetable & Small Fruit Growers’ Conference
• New England Small Fruit Production Guide
• Special Topic Workshops/Conferences/Twilight Meetings
• Beginning Farmer Training Courses
• UConn IPM Website (www.ipm.uconn.edu)/fact sheets
• Phone/email/on-farm consultations/trainings

Other Farm Resources:

• CT Agricultural Experiment Station
• USDA Natural Resource Conservation Service (NRCS)
• USDA Farm Service Industry (FSA)
• CT Department of Agriculture (CT DoAg)
• CT Department of Environmental and Energy Protection (DEEP)
• CT Farm Bureau
• CT New Farmers’ Alliance
• NE Vegetable & Berry Growers’ Association
• NE SARE
Growing Small Fruit Commercially

Pre-Plant Considerations

Advancing the Business of Farming in Connecticut in Partnership with Agriculture Learning Centers

Need To Ask Yourself

- What do you want to grow OR what does your market want you to grow
- How are you going to market the crop
- PYO insurance
- Do I have enough space for the type of market
- Do I have the capital
- Food safety plan
- Pollination options


CLiCK

Compaction

- < ½” per hour — poorly drained soil
- ½” – 1” per hour — moderately well drained
- > 1” per hour — well drained
Site Selection

- Well drained soils
- Organic matter at least 3%
- Full sun
  - Currants and Alpine strawberries will do OK in partial shade

Critical Temperatures

<table>
<thead>
<tr>
<th></th>
<th>TC</th>
<th>Early Pink</th>
<th>Late Pink</th>
<th>Bloom - PF</th>
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<tbody>
<tr>
<td>Blueberry</td>
<td>20-23</td>
<td>23-25</td>
<td>24-27</td>
<td>28</td>
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<tr>
<td>Grape</td>
<td>21</td>
<td>25</td>
<td>27</td>
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<tr>
<td>Strawberry</td>
<td>22</td>
<td>26</td>
<td>30</td>
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<tr>
<td>Bramble</td>
<td></td>
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</tbody>
</table>

Temperatures in degrees Fahrenheit

Site Selection

- Well drained soils
- OM at least 3%
- Full sun
  - Currants and Alpine strawberries will do OK in partial shade
- Topography
  - Avoid planting in sod

Existing vegetation

- Blackberry, blueberry and Black walnuts don’t go together.
**Cover Crops**

- Increase OM
- Add nitrogen
- Loosen compacted soil
- Attract beneficial insects
  - Clover, mustard flowers
- Reduce soil erosion
- Suppress weeds

**Nutrient Deficiencies**

<table>
<thead>
<tr>
<th>Nutrient in excess</th>
<th>Induced deficiency</th>
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</thead>
<tbody>
<tr>
<td>Nitrogen (N)</td>
<td>K</td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>Cu</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>N, Ca, Mg</td>
</tr>
<tr>
<td>Sodium (Na)</td>
<td>K, Ca, Mg</td>
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<tr>
<td>Calcium (Ca)</td>
<td>Mg, B</td>
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<td>Magnesium (Mg)</td>
<td>Ca</td>
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<td>Iron (Fe)</td>
<td>Mn</td>
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<tr>
<td>Manganese (Mn)</td>
<td>Fe</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>Fe</td>
</tr>
</tbody>
</table>

**Rabbiteye**

*Vaccinium virgatum* (also known as *V. ashei*)

- Native to southern USA
- Ripen late May – late July

**Lowbush blueberry**

*Vaccinium angustifolium*

- Low spreading
- Spread by underground rhizomes
- Wooded or open areas
- Wild or managed stands
- Harvest late July - August
**Half-high blueberry**  
*Vaccinium corymbosum x V. angustifolium*

- Northcountry, Northblue, Northsky, Northland, Chippewa, Polaris
- Exceptional cold hardiness

**Highbush Blueberries**  
*Vaccinium corymbosum*

- Indigenous to North America
- 1st successful hybridization was in 1911
- Grown commercially beginning in 1930s

- Root system 6” – 12” deep
- Grows between and within soil and mulch
- Canes develop at crown
- Sensitive to changing water conditions

**How Soil pH Affects Availability of Plant Nutrients**

<table>
<thead>
<tr>
<th>pH</th>
<th>Nitrogen</th>
<th>Phosphorus</th>
<th>Potassium</th>
<th>Calcium</th>
<th>Magnesium</th>
<th>Iron</th>
<th>Manganese</th>
<th>Copper &amp; Zinc</th>
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</tbody>
</table>

**University of Connecticut Department of Plant Science**

- Soil Nutrient Analysis Laboratory, 60 Orange Street, U-101, Storrs, CT 06269-3192, USA
- Phone: 860-486-4749, Fax: 860-486-4502
- Advanced Technology Center, University of Connecticut, Storrs, CT 06269-3192

**Nutrients Extracted from Your Soil (Modified Morgan Extractable)**

<table>
<thead>
<tr>
<th>Element</th>
<th>pH</th>
<th>Soil Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boro (B)</td>
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<td>0.25</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>0.00</td>
<td>0.25</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>0.00</td>
<td>0.25</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>0.00</td>
<td>0.25</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>0.00</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Estimated Total Lead: Low, typical background levels
Amount of Sulfur in Pounds per 100 Square Feet Required to Lower Soil pH

<table>
<thead>
<tr>
<th>Present pH of soil</th>
<th>Desired pH Value of 4.5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sand</td>
</tr>
<tr>
<td>4.5</td>
<td>0.0</td>
</tr>
<tr>
<td>5.0</td>
<td>0.4</td>
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<td>5.5</td>
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<td>6.0</td>
<td>1.2</td>
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<td>6.5</td>
<td>1.5</td>
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<tr>
<td>7.0</td>
<td>1.9</td>
</tr>
<tr>
<td>7.5</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Nitrogen deficiency
Or
Iron deficiency?

- Self-pollination discouraged
- Cross pollination strongly recommended
- Native sonicating bees best
- Bloom period of 7-20 days

Ripen 2-3 months after bloom
Increase in size by ~35% AFTER fruit turn blue
Sugar content ~ doubles
Ripe fruit are 85% H₂O
Don’t pick early and put on shelf to ripen

Plant Selection
- Early season
  - Duke, Patriot
- Mid-season
  - Reka, Northland, Blueray
  - Bluecrop, Bluegold
- Late mid-season
  - Chandler, Darrow
- Late season
  - Nelson, Jersey
- Very late
  - Elliot
- At least 2 varieties
  - Highbush + lowbush + half-high

Planting & Care
- Planting time
  - Bare root or container
  - Spring in northeast
  - Soak roots before or water immediately
  - Root pruning - NO
- Apply 4 - 6 inches mulch, flat top
- Between rows
  - mulch, sod

3 years old plant
Pruning Blueberries

- **Timing**
- 1st 2 – 3 years remove
  - Flower buds
  - Dead wood
  - Broken wood
  - Diseased wood
  - Weak wood

- Year 3 onward
- 2 – 3 canes per year of growth
- No canes older than 6 years
- Remove dead, low, weak canes
Rejuvenation

Brambles

*Rubus*

- *R. idaeus* – red and yellow raspberry
- *R. occidentalis* – black raspberry
- *R. neglectus* – purple raspberry
- *R. fructicosus* – blackberries

Other Brambles

- **Dewberry**: *Rubus trivialis*
  - Trailing habit, related to blackberry
- **Boysenberry**: *Rubus ursinus x idaeus*
  - Cross between raspberry, blackberry & loganberry

Other Brambles

- **Loganberry**: *Rubus x loganobaccus*
  - Accidental cross between blackberry & red raspberry
- **Tayberry**: *Rubus fructicosus x idaeus*
  - Cross between black raspberry & Loganberry
Planting & Care

- Canes are hardy
  - reds to -30°F
  - Others to -10°F
- Self-fruitful
- Full sun

DON’T plant brambles or strawberries where . . .

★ Tomatoes, potato, eggplant in past 4-5 years: Verticillium Wilt

Fertility

Avoid potassium chloride fertilizer

Remove Weeds

Pruning Floricane Fruiting Raspberry

Summer reds
- Tipping
- Timing
- Remove spent fruiting canes, weak canes
- Reduce row width to 1’
- 4-5 canes/linear ft of row
Pruning Floricane Fruiting Black & Purple Raspberry & Blackberry

- Tipping early summer
  - 3”-4” when canes at the wire

Pruning Floricane Fruiting Black & Purple Raspberry & Blackberry

- Remove spent fruiting canes, weak canes
- Leave 4-8 strong canes/crown
- Winter tipping
- Stiles shift trellis
  - For semi-erect & trailing blackberries

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Fall Fruiting Brambles
aka - Everbearing

- Annual fruit production
- Primocane bearing
- Red & yellow raspberries
- Blackberries

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Fall bearing Brambles

- **Red raspberries**
  - Heritage, Autumn Britton, Caroline, Josephine, Polana, Himbo Top, Nantahala, Polka, Jaclyn, Joan J, Prelude
- **Blackberries**
  - Prime Jan, Prime Jim, Prime Ark 45, Prime Ark Freedom
- **Black raspberries**
  - Niwot
- **Yellow raspberries**
  - Anne, Kiwigold, Fall Gold

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Pruning Fall bearing Brambles

- After harvest, once plants are dormant
- Don’t leave long stubs
Double Cropping

- New canes grow after the first summer.
- Prune tip of cane opposite last set of leaves.
- Do not tip.
- First summer
- Fall
- Winter
- Spring
- Early second summer
- After harvested

Strawberries

*Fragaria ananassa*

- *Alpine, Fragaria vesca*
  - Red, white, yellow fruit
  - Full sun to partial shade

Site Selection & Preparation

- Avoid frost pockets
Types of Strawberries

- **June bearers**
  - Early season: Chandler, Earliglow, Cavendish, Honeoye, Northeaster, L’amour
  - Mid-season: Allstar, Darselect, Jewel, Seneca, Ovation, Sparkle
  - Late season: AC Valley Sunset, Record
- **Everbearers or Day Neutrals**
  - Everest, Tribute, Tristar, Seascape, Mara Des Bois, Evie 2

**Pollination**

- Self-fruitful

**Fertility**

<table>
<thead>
<tr>
<th>Nutrients Extracted from Your Soil</th>
<th>Recommended Fertilizer Extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pH</strong></td>
<td>6.2</td>
</tr>
<tr>
<td>Calcium</td>
<td>200 ppm</td>
</tr>
<tr>
<td>Magnesium</td>
<td>30 ppm</td>
</tr>
<tr>
<td>Potassium</td>
<td>2 ppm</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>2 ppm</td>
</tr>
<tr>
<td>Lime</td>
<td>3 oz tsp</td>
</tr>
<tr>
<td>Bone meal</td>
<td>5 oz tsp</td>
</tr>
<tr>
<td>Super Sulfate</td>
<td>4 oz tsp</td>
</tr>
<tr>
<td>Organic Matter</td>
<td>8 oz tsp</td>
</tr>
</tbody>
</table>

**Parts of the Plant**

- Leaf
- Crown
- Runner (stolon)
- Runner (daughter) plants
- Roots

**Matted Row Planting System**

- **June Bearers**
  - 12”-18” x 3’-4’
- **Day Neutral**
  - 6’-9” x 9” between staggered rows, x 4’
- **Flower removal**
Renovation

- Mow off the plants
- Remove diseased leaves
- Thin plants
- Improve sunlight penetration
- 4 - 6# 10-10-10/100' of row after harvest
- Add soil by root crown for root development

No Renovation Done

Winter care

- 20°F crown damage
Currants & Gooseberries

Ribes
- R. sativum, R. rubrum (red)
- R. petraeum (white)
- R. nigrum (black)
- R. odoratum (native)
- R. hirtellum (American)
- R. grossularia var. uva-crispa (European)

Varieties
- Black Currants
  - Consort
  - Titania*
  - Crusader
  - Ben Sarek
- Red Currants
  - Rovada
  - Jonkheer Van Tets
  - Cascade
  - Red Lake
- White Currants
  - Blanca
  - Pink Champagne
- Native Currant
  - Crandall

Varieties
- Red Gooseberries
  - Hinnonmaki Red
  - Tixia
  - Captivator
  - Foxwell
  - Poorman
- Green Gooseberries
  - Invicta

Jostaberry
- Cross between gooseberry and black currant
- Fruit similar to gooseberry
- Thornless
- Resistant to White pine blister rust
- Varieties
  - Jostaki, Josta, Jostagrande

Site Selection & Preparation
- Full sun to partial shade
- Well drained soils
- OM at least 3%
- Soil pH 6.0 - 6.5
- Tolerate -22 to -31°F
Fibrous root system
- Raised bed/container option
- Mulch 2” - 4”
- Avoid potassium chloride
- No fruit 1st year
- Harvest in July

Pruning
- Dormant
- Year 1: 6 - 8 canes
- Year 2: 4 - 5 canes
- Year 3: 3 - 4 canes
- Mature plants 9-12 stems
- Prune out all wood over 3 years old

Grapes

V. vinifera - European
V. labrusca - American
V. rotundifolia - Muscadine
V. Vinifera cultivars X disease resistant wild American species – French hybrids

Plant Selection

Table grapes
- Concord - black
- Thompson seedless – white*
- Thomcord – black*
- Canadice – red*
- Himrod – white*
- Reliance – red*
- Seneca – white
- Steuben – black

Wine: Red
- Delaware
- Catawba
- Frontenac
- Marquette
- Chambourcin
- Cabernet
- Merlot

Wine: White
- Niagara
- Cayuga White
- Frontenac Gris
- Seyval Blanc
- Vidal Blanc
- Edelweiss
- Aurora

The Plant
- Deep roots
- 3-in-1 buds
- Cordon, shoots, tendril
Planting & Care

- pH 5.5 – 7.0
  - American: 5.5-6.0
  - French/European: 6.5-7.0
  - French/American: 6.0-6.5
- No fertilizer at planting
- Grow tubes
- Remove flower buds 1st year

Pruning & Training

- Stake and tie 1st year
- Remove lateral shoots on trunk
- Choose training system

Balanced pruning
- 30 + 10 system
- Remove 70-90% of last year’s wood
Cranberry
Vaccinium macrocarpon

- Native to northeast
- Heath family
- Wetland plant but...
- Trailing plant
- Rhizomes grow couple feet/yr
- Uprights bear fruit

- Plant fall or early spring
- pH 4.0-5.0
- Shallow fibrous root system

Varieties
- Early Black - MA
- Howes - MA
- McFarlin - MA
- Stevens - NJ
- Ben Lear - WI
- Searles - WI

- Harvest in fall
  - Plants 2-3 years old
  - Dry, wet
  - Add thin layer of sand after harvest every 2-3 years
  - Mulch late fall
  - Prune runners not uprights
Elderberry
*Sambucus nigra*

- Denmark Series
  - Samdal, Samyl
- NY Series
  - Adams No. 1 & No. 2, York
- Nova Scotia series
  - Johns, Kent, Nova, Scotia, Victoria
- Missouri series
  - Bob Gordon, Wyldewood

- Hardy to zone 4, some lower
- Soil pH 6.0-6.8
- Shallow rooted
  - Don’t allow to dry out year 1
- Weed management is critical
- Flower in June

Ripen in August-Sept

Prune in dormant season

Small Fruit IPM

Principles of Integrated Pest Management

- 97% of insects that you see in your yard are beneficial or innocent bystanders and are not damaging plants.
- Plants can tolerate some damage from pests.
- Beneficials do not eat all pests, instead, pest and beneficial arthropod populations are kept in balance.
IPM Tools You Will Need

- Understanding of key pests & diseases
- Magnifier
- Picture guides
- Method for keeping track of observations
- Knife
- Traps and lures

Abiotic Disorders

- Sunburn
- Hail
- Nutritional
- Chemical

Birds

- Biggest problem in blueberries
- 37 species of birds are attracted to blueberries
- No threshold

IPM Management: Birds

- Auditory scare tactics
IPM Management: Birds

- Auditory scare tactics
- Visual scare tactics

Physical Barriers

Deer and Rodents

- Girdle canes
- Eat buds, foliage, fruit
- IPM management
  - Exclusion
  - Repellents
  - Predators
  - Traps

Spotted Wing Drosophila

*Drosophila suzukii*

- Feed on wide range of fruit
- Female ID
  - Serrated ovipositor
  - Egg laying: over 300 eggs/female
- Male ID
  - Wings

Spotted Wing Drosophila IPM

- Many alternate hosts
- 8-12 generations/year
Spotted Wing Drosophila IPM

- Sanitation
- Traps
- Insecticides
- Ongoing research

Brown Marmorated Stink Bug

Life Cycle
- Overwinters as adults
- Female lays up to 250 eggs into the summer
  - Clustered 25-30

Damage
- Suck juices from fruit
- Inject yeast, bacteria

Life Cycle
- 5 nymphal stages
- 1-2 generations/year

Monitoring

Tedder traps + pheromone lure
- Not for trapping out
- Modify top

Placement
- Border vegetation
- Orchard/vineyard border row
- Orchard/vineyard center

Threshold
- Established for apples only so far
Management
- Insecticides along border
- Insecticides alternate middles
- Insecticides whole block
- Biological control
  - *Trissolcus japonicas*
  - Other parasitoids

Cane Borers
- Raspberry Cane Borer, *Oberea bimaculata*
- Red Necked Cane Borer, *Agrilus ruficollis*
- Currant Cane Borer, *Synanthedon tipuliformis*

Raspberry Cane Borer
- 2 year life cycle
- 2 rings of punctures ½ “ apart, 6” below growing tip
- Hatch July
- Larvae burrows down cane to crown first year
- Second year feed on crowns
- Adults emerge following later spring-early summer

Raspberry Cane Borer IPM
- Management
  - Remove wilted tip below the rings - destroy
  - No biological control

Rednecked Cane Borer
- Adults feed on foliage through summer
- Eggs inserted 10” from ground in summer
- Larvae tunnel into cane in fall
- Swelling
- Adults emerge following late spring
- Cane weakened

Rednecked Cane Borer IPM
- Management
  - Sanitation: remove infested canes before June 1
  - Sanitation: proper pruning and disposal of old canes
  - No biological control
Mummy Berry
Monilinia vaccinii-corymbosi

- Fungus overwinters in mummified berries
- Blooming forsythia
- Spring infections
- Primary & secondary stages
- Blueray highly susceptible

Disease cycle

- Fungus overwinters in mummified fruit
- Cool rainy weather, 50-62 degrees F
- Spring: spores released, move by bees, wind, rain
- 6-12 hours leaf wetness at 59 degrees
- Infect young tissue, then to petioles

Mummy Berry IPM

- Management
  - Forsythia & mummy cups
  - Sanitation
  - Avoid susceptible varieties
    - Bluecrop, Blueray, Collins, Earlblue, Weymouth, Jersey, Berkeley
  - Cover mummies 1” mulch
  - Fungicides

Leather Rot
Phytophthora cactorum

Red Stele
Phytophthora fragariae
Phytophthora spp.; Phytophthora cinnamomi

- Soil borne
- Causes fruit & crown rot
- Rain splashed from soil to fruit
- Management
  - Avoid fruit - soil contact
  - Avoid water puddling
  - Mulch plants
  - Raised beds

Red Stele Life Cycle

- Wet soils → fungal spores released
- Favor soil temps of 44-60 degrees F
- Infect root tip
- Fungus grows into the root
Cultural management

- Plant resistant varieties
  - AC Wendy, Annapolis, Early Glow, Cavendish, Allstar, Flavorfest, etc.
- Certified disease-free plants
- Good soil drainage
- Raised beds
- Sanitation: remove all of the infected plants’ parts

Gray Mold – Bunch Rot
*Botrytis cinerea*

- Wet cool weather, high RH
- Stone fruit, berries, grapes
- Life cycle
  - OW in infected foliage, twigs, soil organic matter
  - Moves to healthy tissue, flowers, fruit
  - Picked fruit
  - Moves on new plants, cuttings

Grape Berry Moth
*Endopiza vitana*

- 2 - 3 generations per year
- OW in debris, woodlots as pupae
- Adults emerge spring
- 1st generation lay eggs on blossom clusters, stems
- Larvae feed on flowers, fruit clusters
- 2nd generation lays eggs on berries
- Larvae feed internally
- 3rd generation in late July

Cultural Management

- Keep fruit off soil
- Promote good air circulation
- Avoid too much nitrogen
- Avoid overhead watering
- Plant disease free plants
- Sanitation
- No 2 fruit touching

Grape Berry Moth IPM

- Management
  - Remove wild grapes
  - Look for OW larvae
  - Monitor with GBM traps
  - Monitor clusters - threshold ~3% infested clusters
  - Sanitation: rake & dispose of leaves
### Grape Berry Moth IPM

- **Management**
  - Insecticides
  - Kaolin clay repellent
  - Biological control minimal with *Trichogramma minutum*

### Black Rot

**Guignardia bidwellii**

- **Life cycle**
  - Over-winter in mummies
  - Spring rains release spores
  - Bud break – veraison
  - Young plant tissue more susceptible

<table>
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<tr>
<th>Temperature</th>
<th>Hrs of leaf wetness</th>
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<tr>
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- **Duration of continuous leaf wetness necessary for infection by *Guignardia bidwellii* at different temperatures**

- **Period of susceptibility**
  - Foliage until finish expansion
  - Fruit 3-5 weeks after bloom
  - *V. vinifera* most susceptible

- **Symptoms**
  - Fruit symptoms appear within 2 weeks
  - Infections near veraison show symptoms 3-5 weeks later
  - Foliage: lesion center becomes reddish brown

### Black Rot IPM

- **Management**
  - Sanitation – remove & destroy all mummies
  - Mulch
  - Good air circulation
  - Leaf removal during season
  - Fungicides

### Questions?

Photo credits, unless otherwise specified:
Mary Concklin