Identifying and Managing Diseases in Berry Crops

Regional Small Fruit School
Lockport NY, March 1, 2016

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Outline

• Identifying disease problems
  – Damage, pathogens, & symptoms
  – Tips for differentiating disease from injury
  – Disease scouting

• Principles of disease management
  – Avoidance, Protection, Eradication, & Chemical management

• Special disease diagnostic situations
  – Viruses
  – Root diseases & injury
Identifying Disease Problems

• Disease = change in physiology caused by microbial attack
  – Examples: rots, spots, lesions, & discoloration
  – Giveaways: signs of the pathogen

• Damage = trauma caused by force, energy & chemicals
  – Examples: hail, animals, herbicides, & heat
  – Giveaways: insects, hail storm, baseball bat, & heat/sun
Identifying disease problems

• Symptoms: observable physiological reactions resulting from pathogen infection

• Examples:
  – Discoloration
  – Lesion: wound
  – Wilt
  – Chlorosis: yellowing of tissue
  – Necrosis: Darkening and death of tissue
Identifying disease problems

• Symptoms: Examples?
  – Blight: general rapid death of several plant organs
  – Rot: necrosis and maceration of fleshy tissue

• Pathogen: organism capable of inciting disease (physiological change)
  – Parasite: feeds off, can vector, but does not incite disease

• Signs: pathogen, its parts, or products on the host
Identifying disease problems

• Indications based on symptom distribution
  – Patchy vs. Uniform distribution symptoms over plants/plantings
    • Biotic diseases usually have patchy distribution
    • Abiotic injury usually uniform distribution

– Soilborne disease aggregate across plantings
  • Patches of pathogen populations
  • Coincident with wet spots
  • Dry fields = abiotic/Injury
Identifying disease problems

- Disease is self-replicating: symptoms developing over time/other plants?
- When a producer has a disease problem that merits treatment, the whole planting should look fairly symptomatic
Scouting for Diseases

• Problems with scouting and diseases
  – You can’t see the pathogens or trap pathogens until after infection has occurred
  – Many management practices & most chemical applications protect against infection
  – Once you see symptoms or the pathogen it’s usually TOO LATE!

• We scout for symptoms of diseases
  – Benefits:
    • Prevent spread of new infections
    • Be prepared for next year
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Managing Diseases (principles)

• Avoidance: practices that avoid sources of disease
  – Select & prepare site to avoid pathogen presence, and minimize environmental factors favoring pathogen presence
  – DO NOT expose system to house plants or outside plant material
Managing Diseases (principles)

• Avoidance: practices that avoid sources of disease
  – Prevent pathogen introduction by using certified disease-free planting stock (usually for viruses)
Managing Diseases (principles)

- Protection: protect plants by avoiding factors that favor disease:
  - Covered production - avoids external sources of inoculum: (soil, wind, rain, weeds)
  - Hydroponic avoids soilborne inoculum, but favorable for aquatic pathogens and ↑ RH
Managing Diseases (principles)

- Protect plants by minimizing factors favoring disease:
  - Avoid overhead irrigation or excessive watering
  - Avoid excessive nitrogen fertilization
    - Succulent tissues encourage GH & HT diseases
    - Dense foliage increases drying times
  - Harvest/Post-harvest:
    - Avoid practices that may injure fruit or flowers
Managing Diseases (principles)

• Protect plants by minimizing factors favoring disease:
  – Optimize plant or pot spacing to ensure good air circulation (drying of fruit, flowers, and leaves)
  – Remove old plant material to increase air circulation
Managing Diseases (principles)

• Eradication (pathogen destruction):
  – Sanitation: remove & destroy infected fruit or plants, leaf litter, and dead plant material

• Reduces disease inoculum and prevents spread of disease to neighboring plants
Managing Diseases (principles)

• Chemical management: (fungicides)
  – Protection
    • Apply to plants prior to infection
    • Majority of fungicides are protectants, but few protectants labeled for greenhouse use
  – Eradication
    • Destroys the pathogen on plant surface, or even after infection
    • Few fungicides have strong post-infection activity
  – Chemical management resources
    • Cornell Pest Management Guidelines (Print only)
      http://ipmguidelines.org/
    • Organic production guides
      http://nysipm.cornell.edu/organic_guide/fruit_org_guide.asp
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Special disease: Viruses

- Viruses: abiotic infectious particles
  - Nucleic acids and proteins that disrupt cellular physiology
- Viruses infection = loss of plant & planting?
- Virus problems look similar to subtle horticultural problems – Why?
  - Virus infection primarily upsets the plant physiology in ways similar to a nutrient deficiency or toxicity
- Virus infections can be asymptomatic for many years until titers build sufficiently
  - Asymptomatic infections are transmissible
Key small fruit viruses in NY

- Tobacco and Tomato ringspot virus (ToRSV & TRSV)
  - Symptoms: Asymptomatic with consequences, and malformed leaves with chlorotic & necrotic spots
  - It may take more than 10 years before symptoms become apparent
  - Consequences: poor growth, poor or absent fruit production, plant death
Key small fruit viruses in NY

- Tobacco and Tomato ringspot virus (TRSV & ToRSV)
  - Vector: Dagger nematode
    - Thrives in sandier soils
    - Doesn’t move far
    - Numerous weeds can host the nematode – widely distributed throughout a planting

- Management
  - Should remove and replant elsewhere with healthy stock
  - Plant to non-host or leave fallow
Key small fruit viruses in NY

- Blueberry Scorch Virus (BlScV) Symptoms:
  - Blight and necrosis of developing leaves and flowers during bloom (start brown, bleach gray)
  - May look like frost injury and may kill young twigs
  - Cultivar-specific chlorosis and marginal necrosis patterns
Key small fruit viruses in NY

- **Blueberry Scorch Virus (BlScV)**
  - Consequences: poor growth, poor or absent fruit production, plant death
  - Vector: Aphids
    - Quickly move throughout a planting, and to neighboring fields
    - Not more than 0.5 miles
Key small fruit viruses in NY

- Blueberry Shock Ilarvirus (BlShV) Symptoms:
  - Blight of flowers and developing leaves during bloom
  - Second flush of growth in the summer and bushes look normal, but have no fruit
  - Have symptoms for only 1-4 years and then infections become quiescent
Key small fruit viruses in NY

- Blueberry Shock Ilarvirus (BlShV)
  - Consequences:Bushes lose productivity, but can recover with good yields in a perfect operation
  - Vector: Transmitted in pollen spread by bees.
    - Can quickly spread within a field and to neighboring fields
    - Quiescent infections are still transmissible
Distinguishing viruses from other problems

1. Number of shoots and leaves expressing virus-like symptoms (when symptomatic, virus symptoms often systemic)
   - Don’t be alarmed by a few crumbly berries, or oddly chlorotic leaves on a cane or bush

2. Intensity of virus-like symptoms
   - Although infected plants can be asymptomatic, poor fruit production, or lack thereof is not reason to suspect a virus
Distinguishing viruses from other problems

3. Timing of symptom appearance
   - Virus tissue titers during peak biomass production in spring - virus symptoms most apparent in spring
   - Sudden appearance of bizarre symptoms - end of the summer during the beginning of senescence - not likely a virus

4. Symptom distribution
   - Usually patchy distributions - due to restricted movement and habitation patterns of the virus vector
   - Varieties vary in susceptibility and symptom expression - Uniform distribution across blocks and varieties are likely abiotic causes (like nutrition)
Special: Root diseases

- Root diseases are frustrating in established operations:
  - Most effective management practices – prior to planting
  - Root diseases only become apparent after planting is established
  - Post planting management practices – less effective, slow spread only, & don’t cure affected plants
Special: Root diseases

- Root diseases are frustrating to identify/diagnose:
  - Pathogens are soilborne – protected and hidden in the soil
  - Diagnostic symptoms are below ground – prevents recognition during the time when action could save the planting
  - Once dead = fungal decay free for all
Complication: Winter Injury

• Decline from winter injury: plants not well insulated or protected from spring freezes.
  – Plants stressed from disease or abiotic factors
  – More predisposed to winter injury

• Symptoms:
  – Reduced vigor and productivity (unthrifty) & even death

Sparse straw cover & few dead plants lying around
Winter Injury

• Diagnosis: cut through crown of **dying** plants
  – Cortex of crown brown (dead) & vascular tissue white and healthy
  – Most root disease pathogens prefer vascular tissue, secondary decay microbes rot cortex
Winter Injury

• Diagnostic symptoms:
  – As temperatures warm floricanes appear to wilt and die, while primocanes remain healthy
  – Buds on affected canes will break, but floricanes wilt due to damaged vascular connections
  – Injury will be most severe at the growing tips
Winter Injury

- Diagnostic symptoms:
  - Canes can be killed to the ground (variety-specific)
    - Buds primarily are affected
  - Winter injured plants will send up new primocanes that stay healthy
    - Plants suffering from a root disease will continue declining throughout the season
Drought Injury

• Decline from drought injury: plants not well irrigated during summer drought
  – Plant stressed from a lack of water

• Symptoms:
  – Plants wilt and developing leaves and fruit shrivel

• Susceptible to chemical injury
Drought Injury

- Diagnosis: remove plant from soil and cut through crown
  - Soils hard and dry?
  - Rainfall for last two weeks?
  - Fine roots present, dry and sinewy?
  - Cortex of crown hard to cut & vascular tissue white
**Phytophthora Root Rot**

- *Phytophthora* root rot and red stele
- Aquatic pathogen: wet soils, low-lying areas, & heavy rains
- Symptoms:
  - Initial: shoot stunting, chlorosis, leaf scorching
  - Wilt and death of plants in patches (as soil warms)
Phytophthora Root Rot

Diagnosis:

1. Select wilting plant (not dead), remove soil, & look “rattail” root system
2. Remove brown epidermis from crown and major roots
3. If white underneath, healthy. If reddish brown, then Phytophthora
**Phytophthora Root Rot**

Diagnosis:

1. Select wilting plant (not dead) & remove soil from root system.
2. If *Phytophthora*, many of the fine roots and lateral roots will have rotted away.
3. Cut through the crown and large roots.
4. If white underneath, healthy. If lower sections of the root system are reddish/chocolate brown, and are next to sharply delineated sections of white tissue, suspect *Phytophthora*. 

Berry Diagnostic Key
Verticillium Wilt

Strawberries
- Decline more slowly than other root diseases
- Older outer leaves wilt first, while young leaves become stunted
- Severe infections: bluish streaks on runners & petioles

http://plant-disease.ippc.orst.edu/image.cfm?RecordID=362
Verticillium Wilt

- Strawberries
  - See discoloration of vascular tissue (bluish) in crown

- Raspberries (black & purple)
  - Youngest canes wilt first from base to tip: petioles attached, oldest leaves scorched, youngest leaves often still green
  - Bluish streaks/cast in severely infected canes
Verticillium Wilt

• Management (cultural): pathogen survive in soils after weeds and vegetables
  – Wait three years after: tomato, eggplant, peppers, pigweed, horse nettle, stone fruit trees
  – Use only Verticillium free planting stock
  – No complete resistance in any host: red raspberries less susceptible

• Management (chemical): fumigation only
  – Impractical
Black Root Rot
(strawberries only)

- Disease complex resulting from: soilborne pathogens, lesion nematodes, compaction, wet soils working in concert

- *Phythium*: aquatic pathogen similar to *Phytophthora*
  - Shows up wet spots or areas w/ poor drainage
  - *Phytophthora* management practices can help

- Symptoms: (primarily occurs in establishment year)
  - Reduced vigor and productivity, stunting, & even death
Black Root Rot
(strawberries only)

• Diagnosis:
  1. Select a young declining plant, and remove soil from the root system
  2. Look for rattail root system: loss of fine and lateral roots
  3. Black coalescing patches/lesions on main fleshy roots
  4. Vascular tissue in crown initially white and healthy
Black Root Rot
(strawberries only)

• Do not confuse black root rot with natural blackening occurring with age
  – Older roots have a dark epidermal coloring – looks black
  – Inside these will be white and not covered with dark lesions
Black Root Rot
(strawberries only)

• Disease Development:
  – Occurs gradually when subjected to cold injury, herbicides, compaction, & excessive water

• Control:
  – Plant material with healthy white root systems
  – Prior to replanting, rotate out of strawberries 2-3 years
  – Promote water drainage in planting
  – Minimize soil compaction
  – *Phytophthora* control measures will also help
• Vascular tumor disease:
  – Soilborne bacterial pathogen causes tumor like growth on root system
  – Disrupts vascular function

• Symptoms and diagnosis:
  – Stunting & wilt of leaves (disrupted vascular function) → predisposed for winter injury
  – Search base of the canes & crowns
  – Tumor like growths on crowns, lower stems, and roots (wounded sites in contact w/soil)
Crown gall
(raspberries only)

• Considerations:
  – Galls disintegrate → release bacteria
  – Common stone fruit and grape disease

• Management (cultural)
  – Never plant stock with galls or odd growths
  – Take care when planting after stone fruit and grapes
  – Avoid practices that injure the crown and roots
    • Winter injury and insects can wound sufficiently
Questions

New York State Berry Growers’ Association