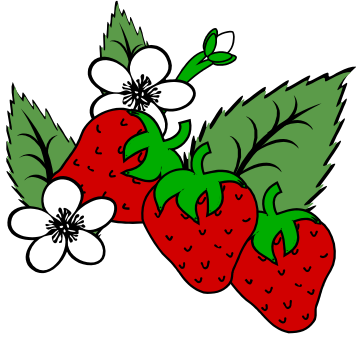


Identifying and Managing Diseases in Berry Crops

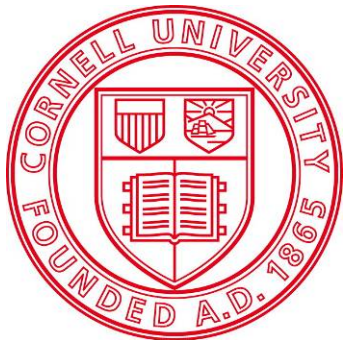


Regional Small Fruit School
Lockport NY, March 1, 2016

Kerik D. Cox

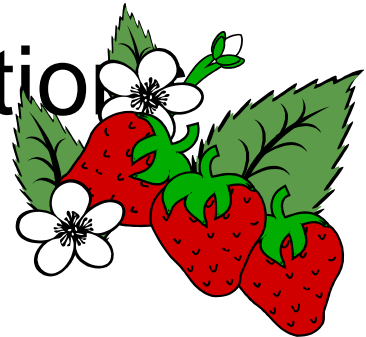
NYSAES

***Plant Pathology and Plant-Microbe Biology Section,
School of Integrative Plant Science,
Cornell University***



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



Hail < Damage > Herbicide

Disease

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

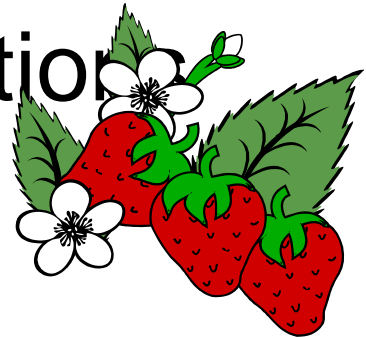


Scouting for Diseases

- 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)



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STRAWBERRIES

Variety	Days to Harvest	Yield (lb/plant)	Flavor	Color	Size	Shape	Texture	Resistance
Albion	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Chandler	40-50	1.0-1.5	Sweet	Red	Medium	Heart-shaped	Firm	High
Daystar	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Earliglow	35-45	1.0-1.5	Sweet	Red	Medium	Heart-shaped	Firm	High
Florida Sweet	40-50	1.0-1.5	Sweet	Red	Medium	Heart-shaped	Firm	High
Fortuna	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Georgia	40-50	1.0-1.5	Sweet	Red	Medium	Heart-shaped	Firm	High
Guardian	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Harvest of the South	40-50	1.0-1.5	Sweet	Red	Medium	Heart-shaped	Firm	High
Hiway	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Indigo Sweet	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Joey	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Landrum	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Loveland	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Monarch	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Neptune	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Northstar	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Parade	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Primocane	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Queen Elizabeth	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Seascape	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Sparkle	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Strawberry	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Supreme	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Triumph	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Vanessa	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Voyager	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Wentworth	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High
Yielder	45-55	1.5-2.0	Sweet	Red	Large	Heart-shaped	Firm	High

We offer over 20 varieties of both strawberry and raspberry plants & the largest selection of indexed, virus tested fruit plants available.

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



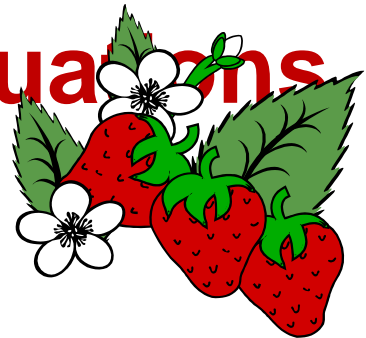
- Reduces disease inoculum and prevents spread of disease to neighboring plants

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

Outline

- Identifying disease problems
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- **Special disease diagnostic situations**
 - **Viruses**
 - **Root diseases & injury**

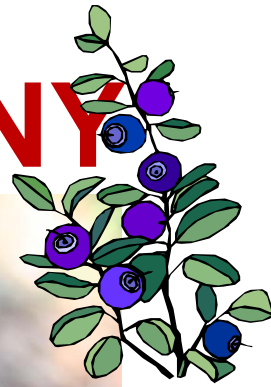


Special disease: Viruses

- 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

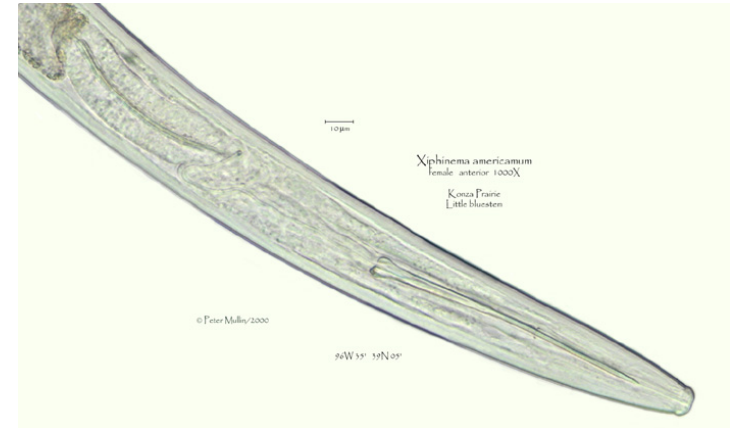
Key small fruit viruses in NY

- 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

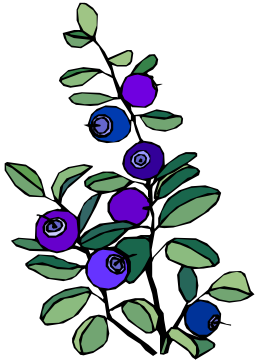


Nematode photo © Peter Mullen

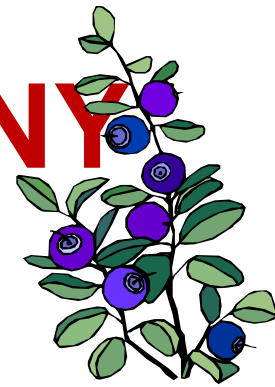


Key small fruit viruses in NY

- Blueberry Scorch Virus (BIScV) 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 (BIScV)
 - 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



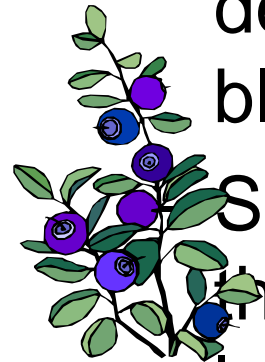
Key small fruit viruses in NY

- Blueberry Shock Ilarvirus (BIShV) Symptoms:

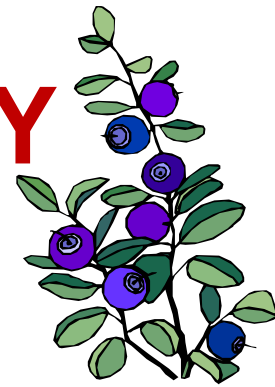
- Blight of flowers and developing leaves during bloom

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 (BIShV)
 - 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

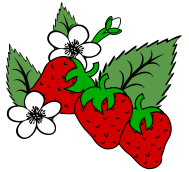
Complication: Winter Injury

- Decline in vigor and productivity (unthrifty) & even death
- Plant mortality



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

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 se



Berry Diagnostic Key

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

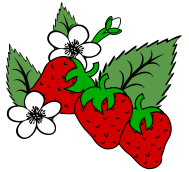


Drought Injury



- 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 a root from root system
2. If *Phytophthora* will have lateral roots
3. Cut the
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*

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

Verticillium Wilt



- Strawberries
 - See discoloration of vascular tissue (bluish) in crown
- Raspberries (black & purple)

– You can see the bluish discoloration of the vascular tissue from the base of the cane. The older canes are black and purple, but the new growth is 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



- Diagnosis:

(strawberries only)

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

Crown gall

(raspberries only)



- Vascular tumor disease:
 - Soilborne bacterial pathogen causes tumor like growth on root system



- 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

