Orchard disease: pathogen biology & management strategies

Eastern NY Apple IPM Training
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Outline

• Disease management principles for tree fruit

• Diseases of key importance in apples

• Apple management paradigms

Disease Management

• Exclusion - Avoidance:
  – Site selection & preparation to minimize environmental factors favoring disease
    • Proper soil fertility and pH
    • Good drainage (tiling, no clay, etc.)
    • Direct sunlight and air circulation (drying of fruits and leaves)
    • Manage weeds and plant away from wood lots:
      – Harbor pathogen populations

Disease Management
Principles

• Exclusion:
  – Prevent pathogen introduction by using certified disease-free planting stock (usually for viruses)
    • Ex: Plum pox of stone fruit
    • Ex: Apple proliferation phytoplasma

Plum pox

Neil Miles, University of Guelph
www.agf.gov.bc.ca

Apple proliferation phytoplasma

Biologische Bundesanstalt, Institut für
Pflanzenschutz im Obstbau Ar
Biologische Bundesanstalt für
Forstwirtschaft,

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

Robinson and Dominguez NYFQ 2013

www.hydrotaste.com/farm_photos.html

Managing Diseases (principles)

• Protection by minimizing factors favoring disease:
  – Remove old plant material to increase air circulation
  – 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)

- 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

Disease Management

- Eradication (pathogen destruction):
  - Sanitation: remove & destroy prunings, dead & infected shoots, infected fruit, and leaf litter
    - Infected host plants
    - Reduces overwintering / oversummering inoculum

Managing Diseases (principles)

- Chemical management: (fungicides)
  - Protection
    - Apply to plants prior to infection
    - Majority of fungicides and bactericides are protectants
  - Eradication
    - Destroys the pathogen on plant surface, or even after infection
    - Few fungicides have strong post-infection activity

Disease Management

- Chemical management: (fungicides & bactericides)
  - Key sources
    - 2015 Pest Management Guidelines for Commercial Tree-Fruit Production https://demo.cuguidelines.net/
   - Organic production guides http://nysipm.cornell.edu/organic_guide/fruit_org_guide.asp

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Apple Scab
(Monitor weather: At silver/green tip)

- Pathogen: *Venturia inaequalis*
- Symptoms:
  - Scabby lesions on fruit and leaves
- Signs: lesions contain infectious spores
- Consequences:
  - Unmarketable fruit
  - Severe infections → defoliate trees
- Host Factors: scab resistant varieties:
  - 'Liberty', 'Goldrush', 'Jonafree',

Fruit Scab

Leaf Scab
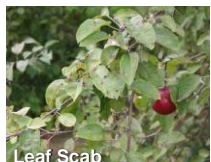
Apple Scab
(Monitor weather: At silver/green tip)

- Disease cycle:
  - Overwinters: infected leaf litter
  - Infection: ascospores from leaf litter infect leaves and fruit during warm spring rains
    - Secondary spores on infected leaves spread infection

Apple Scab
(Monitor weather: At silver/green tip)

- Cultural control:
  - Remove leaf litter: Mechanically or by Nitrogen-assisted decomposition

Apple Scab
(Monitor weather: At silver/green tip)

- Chemical control:
  - Timed fungicide applications
    - Apply prior to forecasted rain events
    - Infections occur: Green tip (ascospore maturity) to 1st Cover
  - Simple forecasting applications available
    - Ascospore maturity model
    - Mills table - infection events

Apple Scab
(Monitor weather: At silver/green tip)

- Chemical control strategy
  - Apply protectively
    - Prior to forecasted weather favoring infection
    - Half rate of Mancozeb & Captan: popular with widespread resistance
  - Save "kick-back" fungicides
    - For infections events beyond pink
    - When you are too late

Powdery Mildew
(Monitor weather: bloom to summer)

- Powdery Mildew
  - Historically not a serious disease concern in apples
  - **Highly susceptible varieties**: 'Cortland', 'Idared', 'Gingergold', 'Jonagold', others
  - Symptoms: white powdery blight of young shoots & leaves & fruit russeting
  - Consequences: reduced yields from aborted blossoms, poor return bloom, & compromised shoot growth

Managing apple powdery mildew

- Powdery Mildew management paradigm
  - Application of apple scab fungicides: infection periods and susceptible phenological stages (young leaves) overlap
  - DMI (e.g. Rally 40 WSP & Topguard) and QoI (Flint WG and Sovran) effective against both diseases: site-specific, safe, highly-effective, curative, & broad-spectrum
  - Widespread DMI and QoI use for apple scab has kept mildew in check

Fire blight
(Monitor weather: At pink)

- Pathogen: *Erwinia amylovora*
- Symptoms:
  - Spreading "burnt" blight from infected shoots/blossoms
- Signs: Ooze on cankers/fruit
- Consequences:
  - Blossom, limb, and tree death

Fire blight
(Monitor weather: At pink)

- Pathogen: *Erwinia amylovora*
- Host Factors:
  - Highly susceptible varieties
    - 'Gala', 'Gingergold', 'Honeycrisp'
  - Highly susceptible rootstock varieties
    - M.26, M.9
  - Resistant rootstocks
    - B.9 & G.series

Fire blight
(Monitor weather: At pink)

- Disease cycle:
  - Overwinters: cankers on infected shoots
  - Infection: bacterial ooze in cankers or pruning cuts:
    - Spreads to blossoms and shoots by insects, wind, and rain
    - Bacteria moves systemically from infected blossom/shoots into limbs

Fire blight
(Monitor weather: At pink)

- Control:
  - Prune "strikes" (blighted shoots)
    - As they appear
    - > 12" below discoloration or 2nd year
    - If cutting into leader, rogue the tree

Fire blight
(Monitor weather: At pink)

- Chemical Control:
  - Copper application at GT: reduce inoculum
  - Timed antibiotic applications (Pink to PF)
    - Streptomycin or Kasugamycin during bloom
    - Based on accumulated heat units (degree hours) from bloom
    - Within 24hrs after hail storm

Fire blight
(Monitor weather: At pink)

- FB forecasting
  1. Cougarblight model via NEWA: http://newa.cornell.edu/

  2. Maryblyt model: http://www.caf.wvu.edu/kearneysville/Maryblyt/

Outline

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Apple disease management paradigm

- Need Precise timing of fungicides at key phenologies or weather accumulation
  - Disease forecasting with fire blight, apple scab, and fly speck sooty blotch

  - PAD counts to skip 1st applications spray season

 - Copper at silver tip for fire blight/apple scab inoculum

  - Urea on leaf litter for apple scab inoculum

Apple disease management paradigm

- Fungal diseases: apple scab, foliar leaf spots, powdery mildew
  - Urea 5% at silver tip to orchard floor

  - Silver tip: full rate copper application

  - Green tip to bloom: Captan 1/2 + mancozeb ½ + sulfur (< 7 day interval), Dodine, SDHIs, APs

  - Bloom, Petal Fall, 1st -2nd covers: DMI or QoIs for powdery mildew and summer diseases

Apple disease management paradigm

- Fungal diseases: apple scab, foliar leaf spots, powdery mildew, summer diseases
  - 3rd to 5th cover (14-21 day interval): captan full + Phosphorus acid DMI + SDHI premix

  - Final cover: QoI + SDHI or DMI + SDHI premix

  - Post harvest: drench of fludioxonil, thiabendazole, pyramethanil for *Penicililum, Botrytis, Colletotrichum, Botryosphaeria*

Questions/Concerns/Clarifications

Apple disease monitoring systems
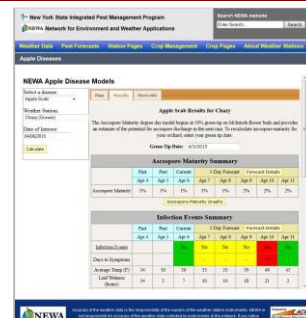
Apple disease forecasting

- Precise timing of fungicides at key phenologies, pathogen biology, or weather accumulation
- Several forecasting systems
  - RIMpro, Skybit, Orchard Radar, and **NEWA** for apple scab, fire blight, and summer disease

Apple disease forecasting

Apple scab (NEWA)

- NEWA Disease forecasting for apple scab

http://newa.cornell.edu/index.php?page=apple-diseases

- Predicts ascospore maturity and calculates infection events

- Provides warnings of possible infection events

Apple disease forecasting

Apple Scab Results for Geneva (Bejo)

The Ascospore Maturity degree day model begins at 50% green tip on McIntosh flower buds and provides an estimate of the potential for ascospore discharge in the next rain. To recalculate ascospore maturity for your orchard, enter your green tip date:

Green Tip Date: 4/17/2015

Ascospore Maturity Summary

	Past	Past	Current	5-Day Forecast			Forecast Details	
	Apr 19	Apr 20	Apr 21	Apr 22	Apr 23	Apr 24	Apr 25	Apr 26
Ascospore Maturity	2%	3%	3%	3%	4%	4%	4%	5%

Ascospore Maturity Graphs

Infection Events Summary

	Past	Past	Current	5-Day Forecast			Forecast Details	
	Apr 19	Apr 20	Apr 21	Apr 22	Apr 23	Apr 24	Apr 25	Apr 26
Infection Events			No	No	No	Yes	No	No
Days to Symptoms			-	-	-	17		
Average Temp (F)	51	53	50	45	38	37	42	42
Leaf Wetness (hours)	0	12	15	24	21	8	2	4
Rain Amount	0.00	0.68	0.08	0.21	0.08	0.01		
Rain Prob (%) Night|Day			17|77	53|67	40|42	22|30	15|20	13|13

Apple disease forecasting

Apple Scab Infection Events (March 1 – April 21)

Start Date & Time	End Date & Time	Wet Hours	Temp Avg. (F)	Rain (in.)	Days to Symptoms	Combined Event
April 20 1:01 AM	April 21 11:00 AM	17	48	0.73	17	Yes
April 17 12:01 AM	April 17 1:00 PM	13	50	0.13	16	
April 8 5:01 AM	April 10 4:00 PM	22	41	0.54	-	Yes
April 2 10:01 PM	April 4 11:00 AM	31	45	0.49	17	Yes
Dry conditions last 7 hours at download					Download Time: 4/21/2015 18:00	

Apple disease forecasting

Sooty blotch & Fungicide depletion (NEWA)

- NEWA Disease forecasting for flyspeck sooty blotch

- http://newa.cornell.edu/index.php?page=apple-diseases

- Predicts onset of epidemic

- Assists with determining timing of summer disease fungicide applications based on depletion

Apple disease forecasting

Apple disease forecasting

Apple disease forecasting

Fire Blight (NEWA)

- NEWA Disease forecasting for fire blight

- http://newa.cornell.edu/index.php?page=apple-diseases

- Uses CougarBlight 2010 logic (WSU): to identify optimal timing of antibiotic applications during bloom

- Estimates the development of trauma blight & shoot blight based on user inputs

Apple disease forecasting

Apple disease forecasting