Greenhouse Disease Management: Powdery & Downy Mildews, Botrytis, and more

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Cultural controls for disease prevention:

- Sanitation, sanitation, sanitation
    - weeding, removing dead plant material and soil decreases the amount of disease lurking in the greenhouse
- Grow resistant cultivars when available
- Crop diversification
- Maintain plant health
    - Proper fertility, proper planting depth, etc.
- Keep foliage dry: avoid condensation/dew formation- spacing of plants
    - Most fungi need wet leaves to infect- decrease the duration of leaf wetness
- Improve air circulation/decrease humidity (<80%)
    - Most fungi need high humidity to produce spores

When you spray…

- Proper diagnosis is crucial
- Consider your product options
- Conventional vs biological/biorational
    - Biologicals are based on organisms, eg. Cease (*Bacillus subtilis*)
    - Biorationals are "softer" chemicals, eg. Kaligreen (potassium chloride)
    - These are often labeled organic, but not always- read the label
    - Lack of efficacy data for these products- results are often inconsistent
    - Efficacy of bio products is much more sensitive to environmental conditions than that of conventionals
- When trying out a new product, do a trial run first to test for phytotoxicity
- Always follow the label instructions
- Use the recommended dosage- using lower rates can encourage resistance development
- Resistance management
    - Tank mixing- prevent reproduction of resistant strains
    - Product rotation- prevent selection of resistant strains

Fungicides: Protectants vs. Systemics

Protectant:

- Does not enter plant- good coverage essential
- Most have broad spectrum activity (multisite)
- Resistance development less likely

Systemic:

- Enter plant to some degree- coverage less crucial
    - Some enter leaves but not leaf veins- these are not moved to other parts of the plant
    - Some enter leaf veins and move upward to other parts of the plant
    - Few (phosphonates, fosetyl-Al) move up and down in the plant

- Some have protectant qualities (eg, strobilurins)
- Often have narrow spectrum (single site)
- Resistance development more likely

Powdery mildews

- Usually on upper leaf surface, sometimes lower also
- 68-86°F temperature optimum
- Encouraged by low light, shade
- Unlike other fungi, spores do not need free moisture to germinate
- Does need RH >95% for spore production
- Host specific

Powdery mildew management

- Protectant fungicides:
    - Stylet oil, neem oil, potassium bicarbonate (Kaligreen, Armicarb, MilStop)work best
    - AQ-10 and Serenade (*Bacillus subtilis*) may provide some protection
    - Milsana, Regalia helpful when tank mixed with other products
- Caveats:
    - Preventative only- good coverage is imperative
    - Biologicals work best under low disease pressure
- Systemic fungicides:
    - QoI (strobilurins)(Quadris, Heritage, Compass)
    - DMI (Folicur, Eagle, Terraguard)
    - Polyoxin D (Veranda O)
- Most have single-site mode of action- risk of resistance development (Polyoxin D is multisite)
- Product combinations and rotation important

Downy mildews

- Different from powdery mildew
- Needs ≥6 hours leaf wetness for infection (PM needs 0)
- Usually on lower leaf surface, sometimes upper also
- May be white or gray/black
- 45-70°F temperature optimum (depends on species)
- RH ≥ 85% for sporulation and disease development
- Host specific

Downy mildew of impatiens

- Jewelweed is also a host
- Easily spread by wind and splashing water
- Oospores may allow it to survive in soil
- Fungicides can protect plants, but can **not** cure DM on impatiens

Downy mildew of basil

- Doesn’t overwinter outdoors in the northeast but can persist in year-round greenhouse operations

Downy mildew of coleus

- Different species from DM of basil
- Some CVs more resistant than others

Downy mildew control

- Tolerant/resistant varieties
    - Impatiens: Bounce, Big Bounce
    - Coleus: some CVs less susceptible than others; for a complete list, go to http://msue.anr.msu.edu/news/coleus_downy_mildew
    - Basil: Genovese most susceptible; Eleonora is somewhat less susceptible; boutique varieties (lemon, cinnamon, etc.)are generally less susceptible
- Fungicides for Ornamentals
    - Metalaxyl (Subdue MAXX)
        - Resistance in FL, MI
    - Fluopicolide (Adorn)
    - Dimethomorph (Stature)
    - QoI (eg. Heritage, Disarm, Insignia, etc.)
    - Mancozeb (eg. Protect DF)
- Fungicides for Basil
    - Cyazofamid (Ranman)
    - Mandipropamid (Revus)
    - Phosphonates (Fosphite, Alude, Vital)
    - Potassium bicarbonate (Armicarb, MilStop)*
    - Hydrogen peroxide (OxiDate) *
    - *Streptomyces lydicus* (Actinovate)*
    - *Bacillus subtilis* (Cease, Rhapsody, Serenade)*

      *phosphonates work well in clinical trials; other biological/biorational products may offer some disease control but not at an acceptable level
- New product on the horizon: Oxathiapiprolin (Orondis)- may be released by Syngenta in 2016

Botrytis gray mold

- Spores abundant and ubiquitous
- Not host specific
- Begins in tender, senescent, or injured tissues
- 55-75°F, ≥85% humidity optimum
- 8-12 hrs. leaf wetness needed for germination and infection

Botrytis control

- Prevention is key!
- Cultural controls first and foremost: sanitation, spacing, decrease plant density
- Decrease RH and leaf wetness
    - Ventilate 5-10 minutes- cool air in, warm air out
    - As cool air warms, RH drops
    - May need to do this repeatedly

- Numerous choices for chemical control: see fact sheet for complete list:
    - https://ag.umass.edu/fact-sheets/botrytis-blight-of-greenhouse-crops
- However… fungicide resistance can be a problem, especially with the following:
    - Benzimidazoles (FRAC group 1)
    - Dicarboximides (FRAC group 2)
    - QoI (FRAC group 11)
- Chlorothalonil, mancozeb, copper recommended by Penn State researchers
- Results from clinical trials with biological/biorational products:
    - Cease + Milstop combination moderate success in GH tomatoes 3 consecutive years
    - Serenade (Cease) worked well in one other study
    - Rhapsody worked well on geranium and lisianthus in one study
    - PlantShield and SoilGard not very effective on geranium in one study
    - Phyton not effective on poinsettia in one study

Phytotoxicity

- Burning, spotting of foliage
- Sometimes resembles disease

Avoiding phytotoxicity

- Read the label
- New product? Spray a few plants before treating entire crop
- Avoid temperatures >80°F and high humidity- these conditions increase chances of phytotox.
- Don't spray stressed plants
- Be careful with oils

Use the UMass Extension Plant Diagnostic Lab!

- Go to http://ag.umass.edu/diagnostics and choose Vegetable and Floriculture Diagnostics from the menu on the left for information on sample submission and downloading the submission form
- Thank you