The fundamentals of biocontrol of fungal and bacterial diseases

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Biologicals = microbe vs. microbe

Fungal hyphae (filaments)
Fungus in the growing medium

Fungus on flowers, stems or leaves
**BioControl in the Greenhouse**

**January 30, 2015**

**RUSTS**
- Chrysanthemum brown rust (see urediospores and teliospores below)
- Geranium rust
- Snapdragon rust

**Bacteria**
- Pseudomonas leaf spot on chrysanthemum
- Bacterial leaf spot of zinnia
- Xanthomonas leaf spot on English ivy
Ralstonia solanacearum – cause of a vascular wilt disease of many plants

Biological control is sending your team in to protect against fungi and bacteria that cause disease

Biologicals = Microbe vs Microbe

Unlike biocontrol of insects, Biocontrols for disease mgt are regulated by EPA

Biopesticides – derived from natural materials: animals, plants, fungi, bacteria + certain minerals

EPA Biopesticide Categories:

1. Microbial – beneficial bacteria and fungi included here
2. PIPs – plant incorporated bioprotectants (e.g. Bt)
3. Biochemical pesticides (like pheromones) – no such tricks for disease management
Biologicals for Disease Management

- Use **preventively**
- Using them is **NOT** like using a chemical
- Different from using insect parasites and parasitoids

**Different Modes of Action:**
- Competitive exclusion
  - "First come, first served"
- Predation
- Antagonistic metabolites
- Nutrient competition
- Stimulate plant defense

Thus not prone to triggering resistance!

**Common Biocontrol Organisms**

**Fungi**
- *Trichoderma* species

**Bacteria**
- *Bacillus* species
- *Streptomyces* species

**Prey for the Biocontrols . . .**

*(the diseases you want to prevent!)*

**Fortés of Bioantagonists:**
- *Trichoderma* vs. fungi
- *Streptomyces* vs. fungi
- *Bacillus* vs bacteria and fungi

**ESPECIALLY GOOD against PM**

*Gerbera leaf coated with powdery mildew fungus*
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FOLIAR BIOCONTROL PRODUCTS
Mycostop - Streptomyces griseoviridis K61 – AgBio OMRI
Actinovate – S. lydicus – Nat’l Industries OMRI

Cease - Bacillus subtilis QST713 – Bioworks OMRI
Companion Biological Fungicide (2-3-2 L)– B. subtilis
GB03 - Growth Products ISR, antibiotic + auxin-like metabolites 0-4 hr REI Growth Products (not OMRI)
DoubleNickel 55 Biofungicide (B. amyloliquefaciens D747) Certis OMRI

Also tackle SOILBORNE PROBLEMS:
Rhizoctonia solani

Phytophthora cryptogea
making ZOOSPORES

SOILBORNE PROBLEMS:
e.g. Phytophthora on lavender

SOILBORNE PROBLEMS:  e.g.
Thielaviopsis basicola on calibrachoa

BIOCONTROL PRODUCTS For DRENCH/MIX
RootShield G, WP – Trichoderma harzianum T-22 and
RootShield Plus – T. harzianum + T. virens – Bioworks OMRI
BIO-TAM – T. asperellum + T. gamsii – AgraQuest (not OMRI)

Mycostop - Streptomyces griseoviridis K61 – AgBio OMRI
Actinovate, Actino-Iron – S. lydicus – Nat’l Industries OMRI

Cease - Bacillus subtilis QST713 – Bioworks OMRI
Companion Biological Fungicide – B. subtilis GB03 - Growth Products (not OMRI)
DoubleNickel 55 Biofungicide (B. amyloliquefaciens D747)
Certis OMRI
Pro-Mix with Biofungicide (B. pumilis GHA-180)– Certis (not OMRI)
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Pro-Mix BX/HP Biofungicide + Mycorrhizae [BRK, BRK20 & LP15]
(B. pumilis GHA-180 + Glomus intraradices)
Premier (not OMRI listed)
Targets: Pythium, Fusarium, Rhizoctonia etc.
Root biostimulant & ISR generator, toxins

ISR=
Induced Systemic Resistance

SOILBORNE PROBLEMS:
e.g. Pythium irregulare

Uneven effect typical in biocontrol tests
... But we inoculate

Tools Available For Biological Control In Greenhouses

...But we inoculate
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Harzianum Hamatum, Virens, Asperellum and Gamai

(Trichoderma species developed as biocontrols)

Trichoderma species

RootShield G, WP - root 0 hr REI OMRI
Trichoderma harzianum T-22

Targets:
Pythium, Rhizoctonia, Fusarium, Thielaviopsis, Cylindrocladium

RootShield Plus+ - G & WP OMRI
Trichoderma harzianum T-22
Trichoderma virens G-41

Targets:
Pythium, Rhizoc, Fusarium, Thielaviopsis, Cylindrocladium
Suppression of P. aphanidermatum
More benefit against Phytophthora

REI=0 hr for G&WP; 4 hr if dip or dust WP

BIO-TAM — AgraQuest (not OMRI)
Trichoderma asperellum ICC 012
Trichoderma gamsii G-41 ICC 080

Targets: soilborne diseases
Fusarium, Phytophthora, Pythium, Rhizoc, Sclerotinia, Sclerotium rolfsii, Thielaviopsis, Verticillium, Rosellinia, Armillaria
Can pre-germinate with 24-36 hr pre-trt soak
May pose a risk to beneficial beetles: blocked in some counties
Not OMRI certified
REI=1 hr

Streptomyces species

Sounds like something I took last week...
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**Streptomyces griseoviridis**

- **Mycostop OMRI**
  - *Streptomyces griseoviridis* K-61
  - Targets:
    - *Fusarium, Alternaria & Phomopsis*  
      (Seed rot, root rot, stem rot & wilt)
  - Also suppression of *Botrytis, Pythium, Phytophthora & Rhizoc*
  - Use with thiophanate-methyl, metalaxyl, vinclozolin, fosetyl-Al & propamocarb - same day
  - (Don’t treat seeds of dusty miller or melons)
  - REI=0-4 hrs

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**Streptomyces lydicus**

- **Actinovate SP T&O OMRI**
  - *Streptomyces lydicus* WYEC 108 Natl Industries
  - Targets include:
    - *Pythium, Phytophthora, Rhizoctonia, Verticillium, Fusarium, Sclerotinia, Botrytis, Alternaria, Anthracnose, Erwinia, Xanthomonas, Pseudomonas, PM and DM*
  - Soil and foliar treatments; 7-14 days
  - REI=0-1 hr  
    Ornamentals, veg & herbs - 1 tsp/gal

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**Powdery Mildew on Poinsettia**

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**e-GRO**

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### Powdery Mildew Control on Poinsettia

![Graph showing the effectiveness of various Bacillus species against powdery mildew on Poinsettia](chart)

**Bacillus species**

**Double Nickel 55 OMRI**  
*Bacillus amyloliquefaciens* D747  
WDG  0-4 hr REI  
Targets include:  
PM, DM, leaf spots, bacterial diseases, and rusts. Herbs on label.  
Root disease treatments also.  
0.25-3.0 lb/100 gal  
3-28 day interval

**Bacillus amyloliquefaciens**

**Bacillus subtilis**  
Companion Cease

**Companion Biological Fungicide 2-3-2L**  
*Bacillus subtilis* GBO3 Growth Products  
(Not OMRI listed)  
Effect: ISR, antibiotic + auxin-like metabolites  
**Some Targets:** Rhizoctonia, Pythium, Fusarium wilt; Alternaria, Botrytis, PM, Sclerotinia, Xanthomonas campestris  
REI: 0-4 hr  
1. Liquid Biological Fungicide for Turf & Landscape Use  
2. Liquid Biological Fungicide for Ghse, Nurs & Ornam Crops

**syngenta®**  
1/27/2015
Cease
*Bacillus subtilis* QST-713 strain – Bioworks (OMRI listed)

**Some Targets:**
Rhizoc, Fusarium, Pythium, Phytophthora
Alternaria, Anthracnose, Botrytis, Cercospora,
Myrothecium, DM, PM, rust, Sclerotinia,
Xanthomonas, Erwinia, Pseudomonas

REI: 0-4 hr.
You could pit a *Bacillus* species vs. *Erysiphe polygoni* (To manage PM)

*Streptomyces* and *Bacillus* against PM

Rose Powdery Mildew

You could pit a *Streptomyces* against *Podosphaera pannosa*

Verbena PM

You could pit a *Bacillus* or *Streptomyces* vs. *Podosphaera xanthii*

Bacteria too???
Biorationals = Materials with natural origin, considered environmentally benign
(includes botanical extracts)

Nogoya Rose Kale IR-4 report, C. Becker, 2009  
* Bacillus subtilis (Cease) reduced Xanthomonas leaf spots at 1% and 2% (but wasn’t as good as a copper fungicide treatment)

Trilogy (Neem oil)  
* Use at 1%  
* 7-14 day interval  
* Landscape and nursery ornamentals  
* Watch out for open flowers  
* Have good evaporation conditions

Regalia Biofungicide Concentrate  
* Gerbera Disease severity reduced from 79% in controls to 2% with Regalia 1%  
* Per Villavicencio 2011  
* PDMR 5:OT020
ArmicarbO, MilStop & Kaligreen
Potassium bicarbonate

For foliar disease control
Especially powdery mildew
Weekly application
Good as a rotational partner

Why Use Biocontrols for Disease?
- Plant safety (but check on this each time)
- OMRI labeling (often) for organic growers
- Help with resistance management (rotation partners)
- Reduce chemical use
- Enjoy low REIs
- See plant health promotion side effects
- Effectiveness against pathogens

Coming Up Next:
3:00 to 3:25 Eastern
Case Studies of Using Biocontrol for Disease Control in Greenhouse Crops
Matthew Krause