A CRO Perspective of Efficacy Research Using Bio-Pesticides

Pacific Ag Group

Pacific Ag Group

- Pacific Ag Research
- Florida Ag Research
- Michigan Ag Research

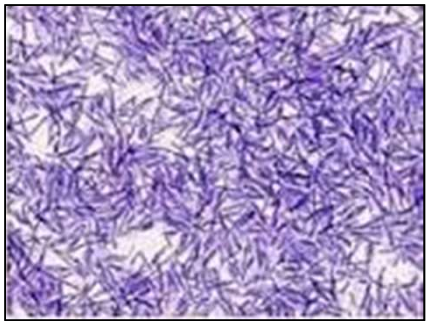
What are Biopesticides?

- EPA definition
  - Biochemical – example pheromones
  - Microbial – example Bt insecticide
  - Plant-Incorporated Protectants - example Bt corn

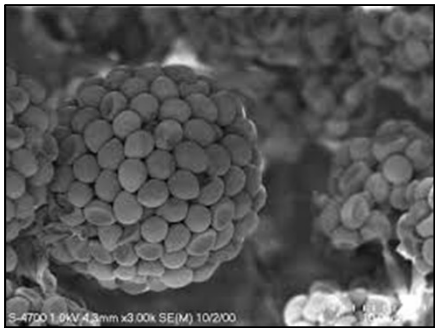
What are Biopesticides?

- **Biopesticides - *Microbial* pesticides**: EPA-registered a.i.s based on microorganisms - manage plant pathogens & diseases they cause, insects, etc.

- Generally:
  - Bacteria
  - Fungi



Bacillus sp.



Trichoderma sp.

Biopesticide and Biorational Products: Important Nuances

- Deviations from label instructions may negate product effects, more so than with conventional pesticides
- Product shelf life can be considerably shorter
- Product application timing tends to be strongly linked to efficacy
- Sometimes biopesticides cannot on their own provide complete control of pathogens or insects, but are highly effective when used along with other products

Presentation Overview

I. Handling
    I. Receipt and storage
    II. Shelf Life
    III. Mixing
II. Biology and Environmental Concerns
    I. Fungicides
        I. Foliar
        II. Soil
    II. Insecticides
III. Consequences for CRO (contract research organization)
    I. Trial size and Design
    II. Morning, evening, night applications
    III. Pitfalls
    IV. Budgeting

Overview

- Handling
  - Receipt and Storage
  - Shelf Life
  - Field
  - Mixing
    - Tank pH
    - Compatibility
    - Surfactants

Product Handling - Receipt and Storage

- Avoid product delivery for weekend
- If product arrives in cooler then it probably needs stored in refrigerator
- You may need a refrigerator

APHIS Permit

- APHIS = Animal and Plant Health Inspection Service
- Is an APHIS permit needed?
- Do you want an APHIS permit?

Product Handling – Shelf Life

BioWorks®

How You Grow Matters™

Product Shelf Life

Disease Control

Product	Frozen (below 32°F)	Refrigerated (below 40°F)	Room (70-75°F)	Outdoors (above 75°F)
BotryStop®	Do not freeze[1]	12 mo	7 days	Do not store outdoors
CEASE®	Not Needed[2]	Not Needed	3 yrs	Store cool
MilStop®	Not Needed[3]	Not Needed	2+ yrs	Store cool
PlantShield® HC[4]	8 mo	6 mo	4 mo	1 mo or less
RootShield® Granules in media	3 mo	5 mo	5 mo	2 mo or less
RootShield® Granules[4]	12 mo	9 mo	6 mo	2 mo or less
RootShield® WP[4]	8 mo	6 mo	4 mo	1 mo or less
RootShield® *PLUS*+ Granules[4] in media	3 mo	5 mo	5 mo	2 mo or less
RootShield® *PLUS*+ Granules[4]	14 mo	12 mo	6 mo	2 mo or less
RootShield® *PLUS*+ WP[4]	12 mo	10 mo	4 mo	1 mo or less
RootShield® AG[4]	8 mo	6 mo	4 mo	1 mo or less
RootShield® Home & Garden[4]	8 mo	6 mo	4 mo	1 mo or less
RootShield® Seed Treatment[4]	8 mo	6 mo	4 mo	1 mo or less
TurfShield® *PLUS*+ WP[4]	12 mo	10 mo	4 mo	1 mo or less
T-22 HC[4]	8 mo	6 mo	4 mo	1 mo or less

[1]From the time of manufacture. [2]Up to 3 freeze/thaw cycles will not harm product – check integrity of formulation if more than 3 freeze/thaw cycles occur (not tested beyond 3 cycles). [3]Freezing will not harm product. [4]From the time product leaves BioWorks' warehouse

Product Handling – Field

Product Handling
Application – Tank Mix pH?

MIXING AND HANDLING INSTRUCTIONS

Mix the required amount of Double Nickel 55 in cool water with sufficient agitation to maintain a uniform suspension in the spray or mixing tank. Tank should be cleaned prior to use. Do not use highly alkaline or highly acidic water to mix sprays. Use a buffering agent if necessary to maintain neutrality (pH 6 to 8) of water in the tank. Maintain agitation during application. Apply immediately after mixing; do not allow spray mix to stand overnight.

Product Handling - Incompatibility

- High Rates of Copper
- Hydrogen Peroxide

Surfactants

- Obviously follow protocol/recommendations
- Make sure client understands “real world” conditions – example: brassica has a waxy surface

Product Handling
Non-Conventional Rate Units

- Beet Armyworm Killing Units
  - BAWKU/mg
- Spore counts
  - 1 x 10^9 cfu/g
- Potentially high product use rate compared to conventional chemistry

Biological and Environmental Concerns

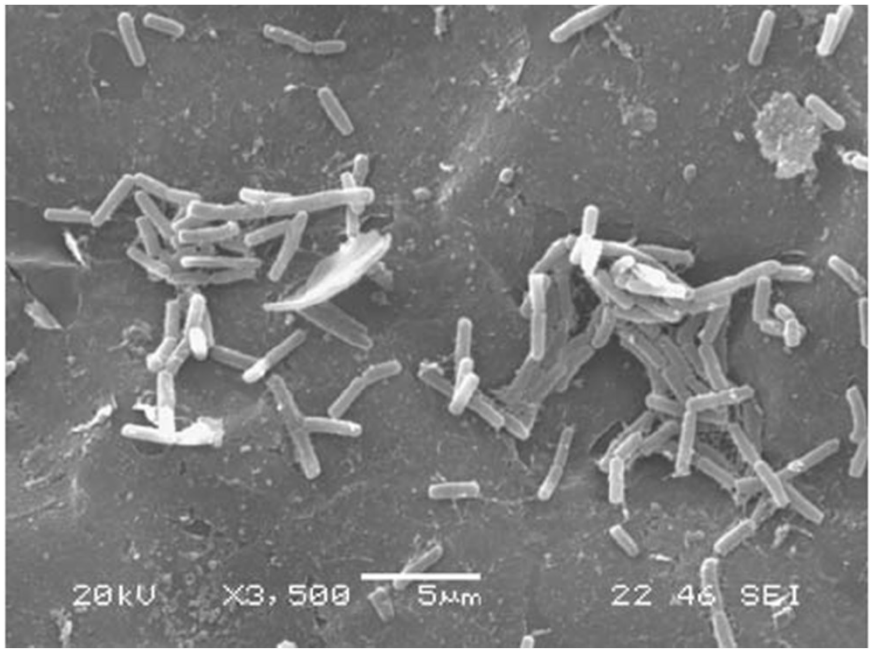
- Timing of Application
  - Fungicides
    - Foliar
    - Soil
  - Insecticides

Biology and Environment – Application Timing

- Appropriate timing will vary…what are you trying to accomplish?
- Often biological fungicides are occupying space or colonizing roots or foliage so application has to be preventative.
- However, an insect may need to be present for bio-pesticide to have an effect

Biology and Environment- Foliar Fungicide

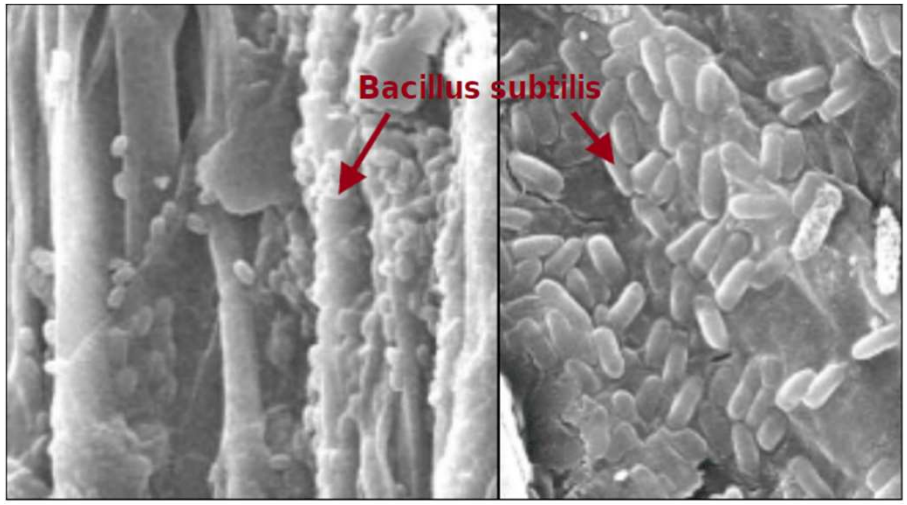
- Preventative
- Spores may arrive by wind
- May be activated by rain



Bacillus sp. isolated from biofilm. Morales, et. al. 2008. *Marine Biotechnology*.

Biology and Environment - Soil Fungicide

- Well the disease is already in soil at some life stage
- Root dips/drenches
- Seed treatment
- *Bacillus subtillus* will grow with roots
- Point is don’t wait too long



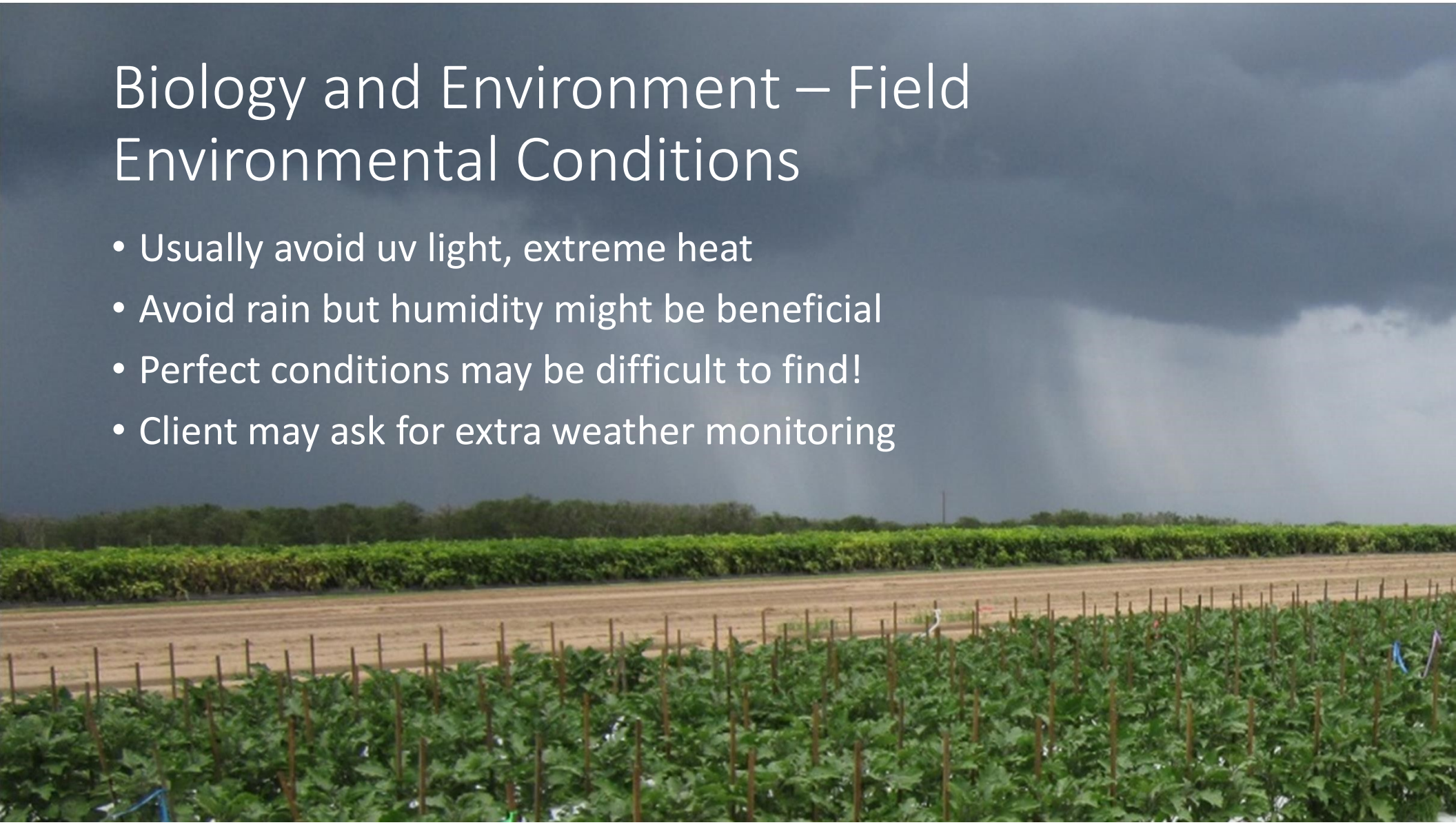
Pea root micrograph colonized by *B. subtilis*; Humboldt University Berlin

Biology and Environment - Application Timing - Entomopathogenic insecticide

- Obviously insect need to be present!

Biology and Environment – Field Environmental Conditions

- Usually avoid uv light, extreme heat
- Avoid rain but humidity might be beneficial
- Perfect conditions may be difficult to find!
- Client may ask for extra weather monitoring



Consequences for CRO

- Trial size and Design
- Morning, evening, night applications
- Pitfalls
- Budgeting

Consequences - Should trial size be adjusted?

- Larger plot size?
- More replication?

Consequences – Application Difficulty

- May have to apply to avoid extreme conditions
  - UV
  - Heat
  - Too wet or dry
- Application coverage is very important
  - Smaller droplet size to improve coverage?
  - Therefore you may have to avoid wind

Consequences for CRO

- Probably more applications
- More difficult applications (strange time of day, good coverage so no wind)
- Will have to more closely monitor pest populations

Consequences for CRO

- Probably more difficult evaluations
- Probably more likely to have to re-do (if product completely preventative then you may completely miss pest)
- How much to charge?

Consequences - Chemical standard

- Include conventional standard if possible