Update on microbial control of arthropod pests of strawberries

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Available microbial pesticides

• *Beauveria bassiana* strain GHA
  • BotaniGard 22 WP (2X10^{13} viable conidia/lb)
  • BotaniGard ES (2X10^{13} viable conidia/qrt)
  • Mycotrol-O ES (2X10^{10} viable conidia/g of ai)

• Soilborne fungus and pathogenic to several arthropod pests

• Can be used alone or in combination with other pesticides

• *Metarhizium anisopliae* strain F52 will be available in the near future
Objective

• Integrating microbial control with other pest management options to
  • i) improve the pest management potential,
  • ii) reduce the usage of chemical pesticides and
  • iii) extend the life of available pesticides
Experiments conducted

• Endophytic colonization of *Beauveria bassiana* (strains GHA and SfBb1) and *Metarhizium anisopliae* (strains GmMa1 and F52) in greenhouse studies

• Using *B. bassiana* with reduced rates of chemical pesticides for lygus control in laboratory assays

• Field evaluation of *B. bassiana* for lygus, whitefly, thrips and aphid control
Endophytic colonization—B. bassiana

• Objectives
  • What is an ideal method of inoculation?
  • Does B. bassiana colonize strawberry plants?
  • If it does, how long does it persist in the plant?
  • Does the colonized fungus protect the plant from herbivore damage?
Endophytic colonization- *B. bassiana*

- **First experiment: Inoculation methods**
  - Mix $1 \times 10^7$ viable conidia/gram of vermiculite
  - Dip roots in a suspension of $10^7$ conidia/ml
  - Apply a 100 ml suspension of $10^7$ conidia/ml at the plant base

- **Fungal isolates**
  - Commercial isolate, GHA
  - California isolate, SfBb1

- **Sampling**
  - 1, 3 and 6 weeks after inoculation
Endophytic colonization - *B. bassiana*

- Rinsed, surface-sterilized and rinsed the plant material
- Plated plant tissue on selective medium
- Plated rinsate on medium to verify contamination
Endophytic colonization - *B. bassiana*

Emergence of colonized *B. bassiana* from treated plant tissue

No *B. bassiana* detected in controls
Endophytic colonization-

*B. bassiana*

*Petioles include pedicels and leaf lamina includes sepals*
Endophytic colonization - *B. bassiana*

- **Second experiment: Different concentrations**
  - 200 ml suspension of $1 \times 10^9$, $1 \times 10^{10}$ or $1 \times 10^{11}$ conidia by applying at the plant base

- **Fungal isolates**
  - Commercial isolate, GHA
  - California isolate, SfBb1

- **Sampling**
  - 1, 3, 6 and 9 weeks after inoculation
Endophytic colonization- *B. bassiana*

**Diagram:**
- **Proportion colonized by fungus**

**Axes:**
- **Y-axis:** Proportion colonized by fungus
- **X-axis:** Various time points (1 WAT, 3 WAT, 6 WAT, 9 WAT, 10^9, 10^10, 10^11 Conidia/ml, 10^9, 10^10, 10^11 SfBb1)

**Legend:**
- Blue: Root
- Red: Petiole *
- Green: Leaf lamina *

*Petioles include pedicels and leaf lamina includes sepals*
• Conclusions
  • *B. bassiana* successfully colonized various strawberry plant parts especially those preferred by lygus bug for feeding and oviposition.

• Persistence of colonized fungus in the plant for 9 weeks after inoculation has a good potential for pest management.
• **Conclusions**
  
  • It could not be detected in the strawberry plant tissue.
  
  • *M. anisopliae*- treated plants appeared to withstand spider mite damage to some extent.
Endophytic colonization- *M. anisopliae*

**M. anisopliae**-treated plants

10 DAT: 44% damage
14 DAT: 56% damage

**Untreated control plants**

10 DAT: 59% damage
14 DAT: 65% damage
**Objectives**
- Improve the efficacy of *B. bassiana*
- Reduce the usage of chemicals

**Treatments**
- 0.19 lb/ac or $1 \times 10^7$ conidia/ml of BotaniGard 22 WP (label rate 1/2-2 lb/acre)
- 1/5 the label rate of
  - Actara (1 pt/ac),
  - Aza-Direct (2 qrt/ac),
  - Danitol (11 oz/ac) and
  - Dibrom (1 pt/ac)
Synergy: fungus-chemicals vs. Lygus
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Cumulative mortality (%)

Days after treatment

- Control
- Actara
- Aza-Direct
- BotaniGard 22 WP
- Danitol
- Dibrom
- Actara+BotaniGard
- Aza-Direct+BotaniGard
- Danitol+BotaniGard
- Dibrom+BotaniGard
Synergy: fungus-chemicals vs. TSSM

• Collaborative study conducted by Dr. Jeong Jun Kim at the National Academy of Agriculture Science in South Korea

• Synergy between chemical *B. bassiana* and some miticides against twospotted spider mite on strawberries

• **Treatments**
  
  • *B. bassiana* 1X10^8 conidia/ml
  • Label rate and 1/5 the label rate of
    ▫ Abamectin
    ▫ Acrinathrin
    ▫ Bifenthrin+Imidaclorpid
    ▫ Dinotefuran
    ▫ Indoxacarb
  • 1/5 of the label rate of miticides + *B. bassiana*
Synergy: fungus-chemicals vs. TSSM

Bifenthrin+Imidacloprid

Mortality (%)

Days after treatments

Control
GHA
0.2X P
1X P
0.2X P + GHA

D0 D1 D2 D3 D4

25 50 75 100
Indoxacarb

- Control
- GHA
- 0.2X P
- 1X P
- 0.2X P + GHA

Mortality (%) vs. Days after treatments

Synergy: fungus-chemicals vs. TSSM
• **Conclusions**
  
  • Laboratory studies indicate that there is a synergy between *B. bassiana* and certain chemical pesticides.

  • Right combination can effectively manage pest populations and reduce chemical pesticide usage.
Field efficacy of *B. bassiana*

- **Treatments applied weekly for 4 weeks**
  - Untreated control
  - Mycotrol-O at 1 qrt/acre
  - Mycotrol-O at 2 qrt/acre

- **Sampling**
  - Untreated control – 40 plants from the middle 4 beds
  - Mycotrol-O at 1 qrt/acre – 40 plants from the middle 10 beds
  - Mycotrol-O at 2 qrt/acre – 40 plants from the middle 10 beds
Field efficacy of *B. bassiana*-Lygus

**1-3 instar nymphs on strawberries**

![Graph showing the average number of 1-3 instar nymphs per plant on strawberries before and after treatment with different treatments.](image)

**4-5 instar nymphs on strawberries**

![Graph showing the average number of 4-5 instar nymphs per plant on strawberries before and after treatment with different treatments.](image)

**Adults on strawberries**

![Graph showing the average number of adults per plant on strawberries before and after treatment with different treatments.](image)

**On flowering hosts**

![Graph showing the average number of nymphs and adults on flowering hosts before and after treatment with different treatments.](image)

**Treatments**

1st – 8/20
2nd – 8/27
3rd – 9/2
4th – 9/9
Field efficacy of *B. bassiana*

### Graphs

#### Aphids

- **X-axis**: Days before or after treatment
- **Y-axis**: Average number per plant
- **Treatments**:
  - Untreated
  - Mycotrol-O Low
  - Mycotrol-O High

#### Whiteflies

- **X-axis**: Days before or after treatment
- **Y-axis**: Average number per plant
- **Treatments**:
  - Untreated
  - Mycotrol-O Low
  - Mycotrol-O High

#### Thrips

- **X-axis**: Days before or after treatment
- **Y-axis**: Average number per plant
- **Treatments**:
  - Untreated
  - Mycotrol-O Low
  - Mycotrol-O High

### Treatments

- 1st – 8/20
- 2nd – 8/27
- 3rd – 9/2
- 4th – 9/9
Field efficacy of *B. bassiana*

• **Observations**
  • Mobility of lygus adults
  • Strawberry canopy environmental conditions on inoculum persistence
  • Seemed to be a reduction in lygus adults, whiteflies and thrips from *B. bassiana* treatment
Experiments planned

• Use *B. bassiana* and Rimon for controlling adult and immature lygus

• Use *B. bassiana* and reduced rates of chemical pesticides

• Evaluate arthropod pest control potential with endophytically colonized *B. bassiana*

• Evaluate plant pathogen control with *B. bassiana* colonization
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Questions?

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