Can soybean rust fungicides impact soybean aphids?

2005 CPM Short Course

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Aphelinus albipodus

Lysiphlebus testaceipes

Photo by Zhishan Wu
Aphids are not the only insects out there

- Predators and parasites of SBA can help moderate economic damage from this insect.
- Foliar insecticide applications will reduce insect natural enemies
  - 250 SBA/plant threshold
Aphids on field pea
Epizootic - 2003

% Infection

- SBA/plant
- % Infected

Date

SBA/plant

Laboratory Procedures

Spore shower area

Transfer cadaver to water agar

Sample taken for staining
Spore ID of Entomophthorales

Spores stained with aceto-orcein

Z. radicans

P. neoaphidis

C. coronatus

C. thromboides

E. planchoniana
Entomopathogenic fungi (EF)
Mycological background

- Class Zygomycetes
- Order Entomphthorales
- Several genera
- Attack only insects - Taxa specific
- Need high humidities
- Most do better in cool conditions (70F or less)
- Density dependent to a certain extent
Generalize life cycle of an entomopathogenic fungus

1. Conidophore
2. Primary conidium
3. Secondary conidium
4. Tertiary conidium
5. Capilliconidium
6. Hyphal bodies
7. Mycelia and stroma
8. Resting spores

Drawing from Tanada & Kaya, 1993
So... Why all the fuss over fungicide applications?

• Fungi are well documented to control aphids in many crops
  – Soper 1981 (Potatoes)
  – Feng et al. 1990 (Small grain)
  – Steinkraus, et al. 1997 (Cotton)
  – Feng et al. 1990

• Fungicides control fungi
  – Moorhouse, et al. 1992

• Fungicide applications have been documented to cause higher aphid densities
  – Pickering, et al. 1990 (Pecan aphid)
  – Wells, et al. 2000 (Cotton aphid)
  – Radcliffe, et al. 2001 (GPA on Potato)
So… Why all the fuss over fungicide applications?

- Fungicide applications to soybean may increase due to Asian soybean rust (or just for the heck of it).
- Concern over the potential for field scale and larger downstream effects due to potentially large percentage of acres treated.
Fig. 4. Aphid density and prevalence of mycoses observed at Rosemount during 2005. Solid lines indicate aphid density in plots treated with fungicide at Rosemount, Minnesota 2005. Dashed line indicates prevalence of fungal-infected aphids.

Percentage of diseased aphids less than 5% even in untreated

No difference between Untreated and control
Fig. 3. Prevalence of fungal-infected aphids at Lamberton, Minnesota 2005. Down arrows indicate approximate date of the last two fungicide applications.

Pandora neoaphidis 90%
Conidiobolus thromboides 9%
Zoophthora radicans 1%

Up to 90% reduction in fungal infected aphids
All fungicide applications reduced disease
Why the difference?

- Environmental differences
  - Aphid population on decline at Rosemount when environmental conditions favorable for fungi.
  - Aphid populations building at Lamberton as temperature dropped and humidity increased
- Lower aphid densities at Rosemount site
Fig. 3. Prevalence of fungal-infected aphids at Lamberton, Minnesota 2005. Down arrows indicate approximate date of the last two fungicide applications.

Fig. 2. Aphid density in plots treated with fungicide at Lamberton, Minnesota 2005. Fungicide applications were made on 22 Jul; 5 Aug and 19 Aug for the first, second, or third application. Headline and Headline+Folicur treatments were applied on 8/05. Stratego and Bravo treatments were applied on 8/19 (colored arrows).
It doesn’t matter?

• These data probably should not be interpreted that way.
• Preliminary study to document an effect
  – Small plots and cross contamination
  – Epizootic overruns small scale treatments
• Does not address concerns on a larger scale
On the brighter side?

Limited number of applications to soybeans compared to some crops

• What is the effective life of fungicide?
• Plant surface limited, effect on soil EF unknown
• The effect may be temporary
• A slight break may be all SBA need
• EF will develop resistance
• Tank mixes effective against SBR have 2 modes of action
Infected alates may be a primary mechanism for wide dispersal of aphid–pathogenic fungi. (Feng, et. al. 2005) Infected alates can fly for hours, establish colonies and transmit disease to offspring

2 X greater chance that adult alates infected than all other Morphs. Nielsen and Hajek (2005)

-Pandora neoaphidis no known resting spores

Lagnaoui 1990
Morphs on Primary (Winter) Host = Buckthorn for SBA

Morphs on Secondary (Summer) Host

SUMMER MORPH

Fundatrix (Stem Mother)

Eggs laid by buds

Oviparae

Gynoparae - FEMALE

FALL MIGRANTS (SEXUALS)

Colonies on soybean

alatae

apterae

Drawings from Minks and Harrewijn 1987; Higley & Boethal 1994
Aphid

Environment

Entomo-pathogenic fungi

HOST

PATHOGEN
Aphid

**Direct effects**
- Temperature
- Physical disruption
- Photoperiod?

**Indirect effects**
- Plant quality
- Canopy microclimate

Environment

**Direct effects**
- Temperature
- Moisture
- Wind dispersal

**Indirect effects**
- Canopy microclimate

Fungicides

HOST

PATHOGEN

Entomo-pathogenic fungi
Aphid

HOST

Environment

Entomo-pathogenic fungi

PATHOGEN

Direct effects
Inoculum production
Movement of pathogen
Aphid

HOST

Environment

Entomo-pathogenic fungi

Direct effects
Within field SBA populations

Indirect effects
Diseased aphids into overwintering

PATHOGEN
Aphid

 HOST

 Environment

 PATHOGEN

 Entomo-pathogenic fungi
Points to Ponder

• Several species of EF are an important part of the biological system helping moderate SBA populations

• Fungicide fungicide applications to soybean can decrease the incidence of EF mycoses in SBA.

• Relationship to fungicide application and SBA aphid densities within soybean not as clear for several reasons
Points to Ponder

• Due to fewer number of applications in-field risk to soybean real but lessened.
• Treatment of large acreages may increase lower pathogen efficacy on buckthorn and change SBA population dynamics
• Treatment for non-existent fungal problems could have unintended consequences