


Biorational Pesticides for Pecan Insect Pests

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USDA ARS Agricultural Research Service
the in-house research arm of the U.S. Department of Agriculture

Outline

- Introduction
  - Insect targets (pecan weevil and aphids)
  - Biorational materials used (microbial derived and botanical)
- Laboratory experiments
- Field experiments

Pecan Weevil, *Curculio caryae*

- Key pest of pecan,
- Life-cycle 2-3 yrs
- Adults emerge July-October

(but mostly mid-Aug to mid-Sept)

- Most crawl or fly to the trunk
- Larvae drop to soil (late Sept to Dec), & form a soil cell at 3” to 10” depth
- About 90% of the larvae pupate after 1 yr in soil & emerge as adults the next yr
- The other 10% remain as larvae an extra yr (3 yr life-cycle)

Traps used for monitoring

Pecan Aphids

- 3 Species:

black pecan aphid, *Melanocallis caryaefoliae*
blackmargined aphid, *Monellia caryella*
yellow pecan aphid, *Monelliopsis pecanis*



- Conserve natural enemies!



- Cover crops (e.g., clover, sesbania), molasses sprays can enhance natural enemies (Bugg & Dutcher 1993, Dutcher et al. 1999).

Need for Biorationals

- The use of broad chemical insecticides can cause destruction of natural enemies, which results in outbreaks of other pests . For example, carbaryl applications for *C. caryae* control can reduce natural enemies and cause resurgence of pecan aphid populations (Dutcher and Payne 1985).
- Furthermore, excessive reliance on a narrow spectrum of chemistries for pest control can lead to resistance, e.g., resistance to imidacloprid in aphids has been observed.
- Due to these negative aspects associated with current pecan pest management, as well as other environmental and regulatory concerns, research toward the development of alternative approaches is warranted.

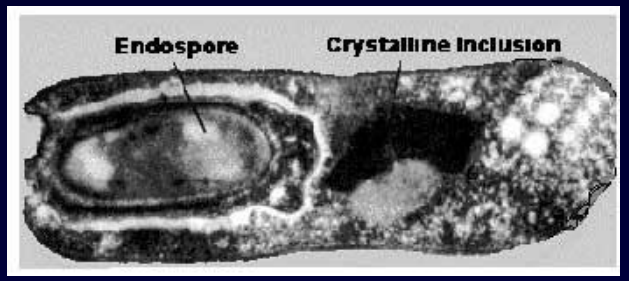
Overall Goal: Alternative Approaches to Pest Management in Pecan, Emphasis on Microbial Agents

- Focus today on:
  - Screening of a new microbial-derived insecticide
  - Screening of novel botanical-derived insecticides

Microbial Derived Insecticides

- Comprised of by-products derived from microbial organisms
- have relatively low impact on beneficial organisms and the environment compared with most broad spectrum insecticides

Bt Products



- Such as: Agree, Biobit, Crymax, Dipel, Javelin, Lipinox, Xentari
- Derived from the naturally-occurring soil bacterium, *Bacillus thuringiensis*
- Commercial preparations contain the bacteria's insecticidal crystal protein or a complex of the crystal protein and spore

Bt Products

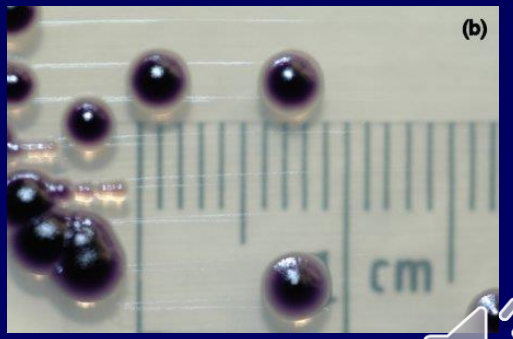
- Kill insects by disrupting their midgut membranes, and must be ingested by the insect in order to be active
- Registered as alternative pest control methods for pecan nut casebearer, fall webworm, and walnut caterpillar (von Broembsen and Mulder, 2004; Knutson and Ree, 2004)
- Compared with broad spectrum insecticides, Bt products tend to have shorter residual times, and therefore careful timing of sprays is necessary

Spinosad

- Is the active ingredient in Spin Tor, & is derived during fermentation of the naturally occurring soil bacterium, *Saccharopolyspora spinosa*
- Kills insects by modulating the nervous system (acetylcholine receptors)
- Is effective in controlling pecan nut casebearer and hickory shuckworm (Dutcher and Hudson, 2003)
- Is also registered for use against the fall webworm and walnut caterpillar

A Novel Insecticide Based on *Chromobacterium subtsugae*

- Relatively new bacterium (*C. subtsugae*) was discovered (USDA-ARS) to produce toxins that kill Colorado potato beetle (Martin et al. 2004)
- Also found varying degrees of toxicity to gypsy moth, small hive beetle, and southern green stink bug
- Oral toxicity and effects on feeding
- Commercially available “Grandevo®”



Botanical Insecticides

- Plant material or extracts
- Often have lower toxicity to non-targets and reduced environmental persistence compared with broad-spectrum synthetic chemicals (exceptions exist)
- Examples: pyrethrins, neem-based insecticides
- Materials we tested: eucalyptus extract (MBI-205), citrus extract-8.92% (Vintre®) and citrus extract-19.4% (ORSA-003)
- Target pests: pecan weevil and pecan aphids

Aphid Tests – Lab
Black pecan aphid, *Melanocallis caryaefoliae*

- Treatments applied in a Potter spray tower to Petri dishes containing aphids (20) on leaf discs (based on Shapiro-Ilan et al. 2008)
- 3 reps per treatments with 2 consecutive trials
- Checked mortality four days post-treatment

Pecan Weevil, *Curculio caryae* Lab Tests

- Fresh cut nut clusters, wash & place in 500 ml flask with water. 12 clusters per treatment.
- Two consecutive trials.

<u>Apply (spray)</u>:

  - Chromobacterium at 2.24% with 0.01% tween
  - MB205 (eucalyptus) at 3%
  - Control, 0.01% tween

- Add 3 male & 3 female adult weevils (in cages)
- Determine # of damage sites (feeding or oviposition) per nut

Field Test vs. Aphids (2010 & 2011)

- Spray treatments onto terminals (Caddo 2010; Stuart 2011)

  - MB205 (eucalyptus) – 10%

  - *Isaria fumosorosea* fungus (IFR) 8.5 x 10^8 blastospores per ml (with silwet 0.02%)

  - Combination of fungus & MB205 (eucalyptus)

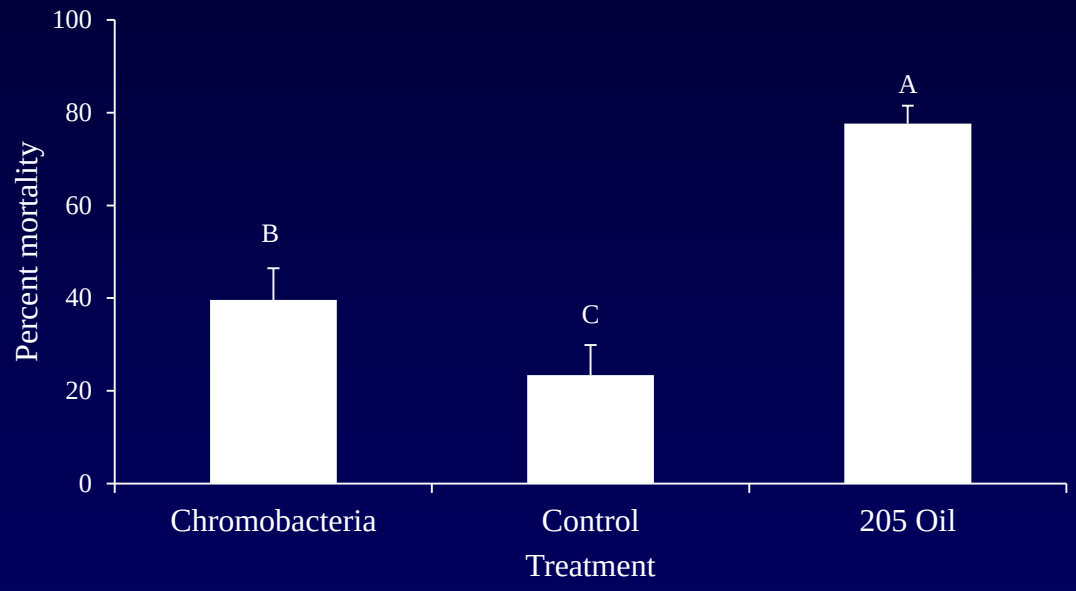
  - Control (water with silwet)

- Cover pecan terminals in netted sleeves; 3 trees with 2 sleeves per treatments.
- Count live/dead aphids on terminal 5 d post-treatment
- Combined count black pecan aphid, blackmargined aphid (*Monellia caryella*) & yellow pecan aphid (*Monelliopsis pecanis*)

Field Test: *C. subtsugae* (Grandevo) *vs.* Pecan Weevil

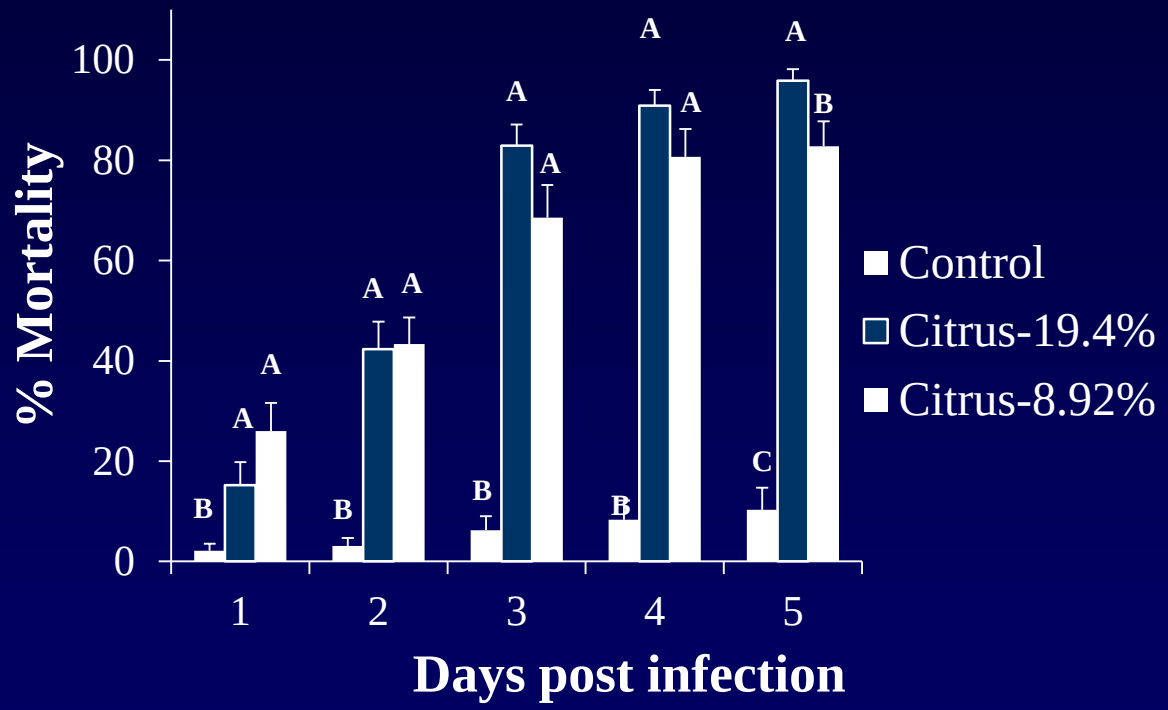
- Treatments: Grandevo vs untreated control
- ½ trees receive treatment, ½ control
- ½ trees with caged weevils (3-4 pairs)
- Determine # damage sites (feeding or oviposition) 3 & 7 days post-treatment
- Weevil mortality determined in cages
- Four replicate trees for each treatment-cage combination.
- The experiment was repeated 1X

Black Pecan Aphid – Lab Results



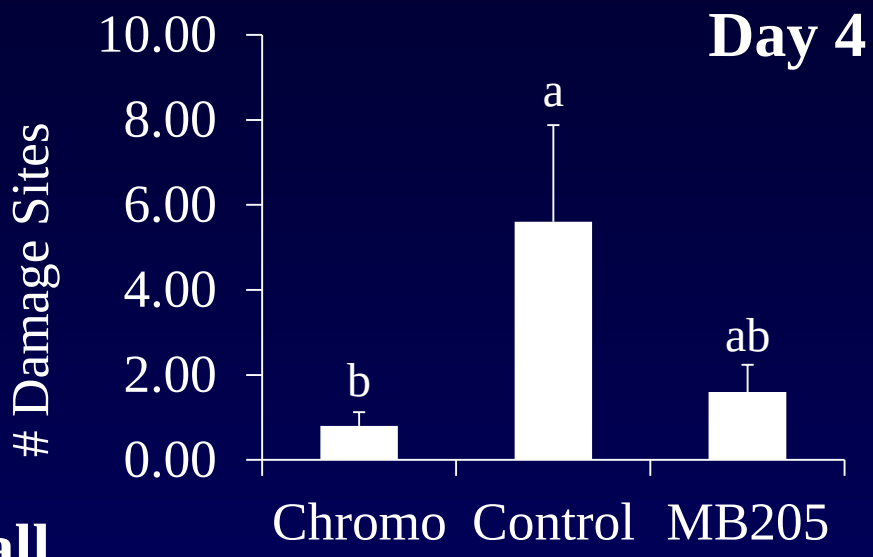
- Both materials were active though MB205 (eucalyptus) was more active

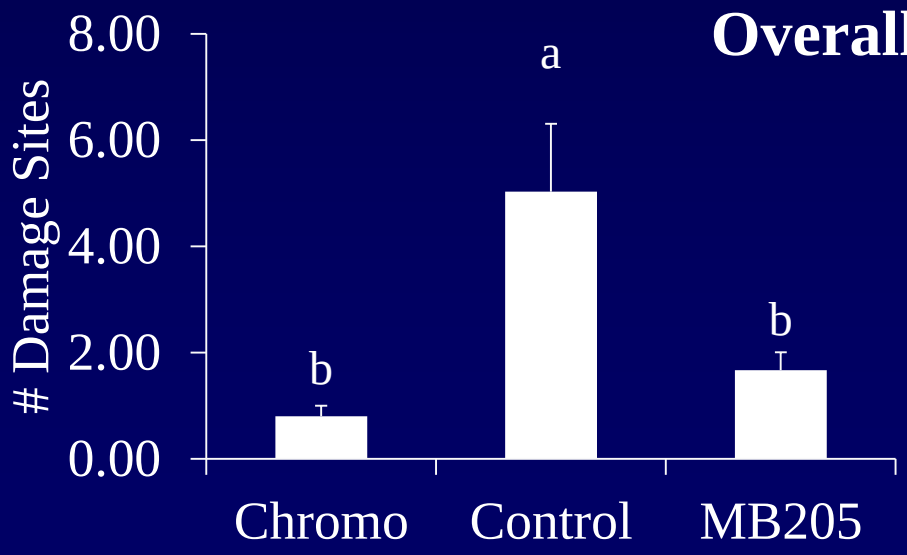
Black Pecan Aphid – Lab Results



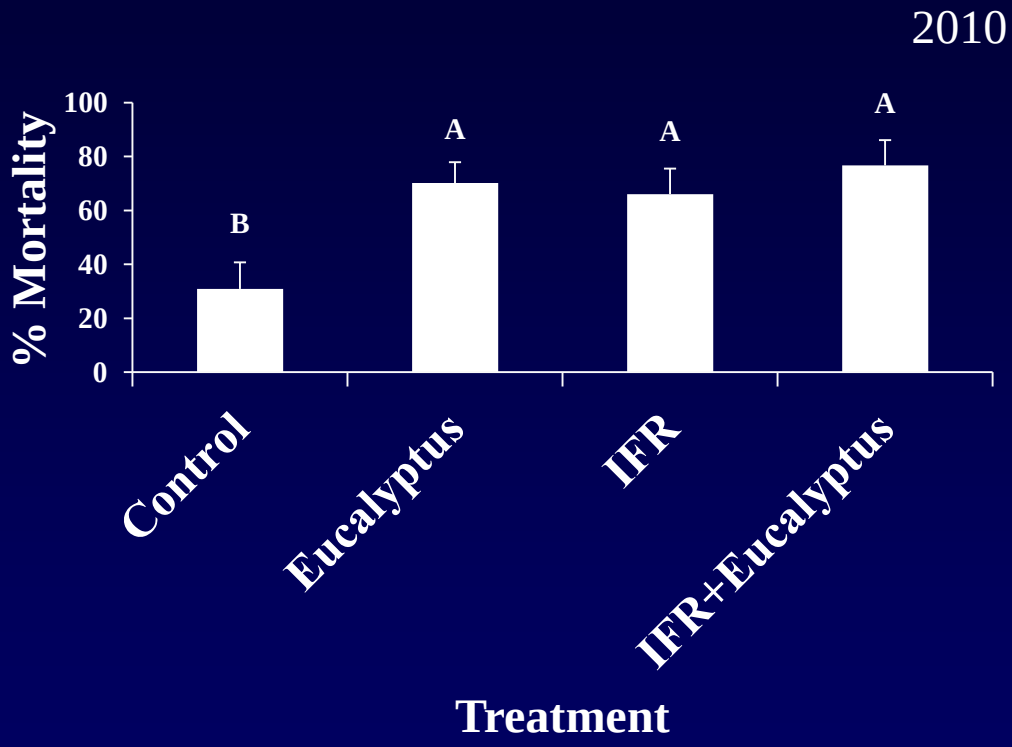
- Both materials were active though Citrus-19.4% (ORSA-003) was more active

Pecan Weevil Lab Results



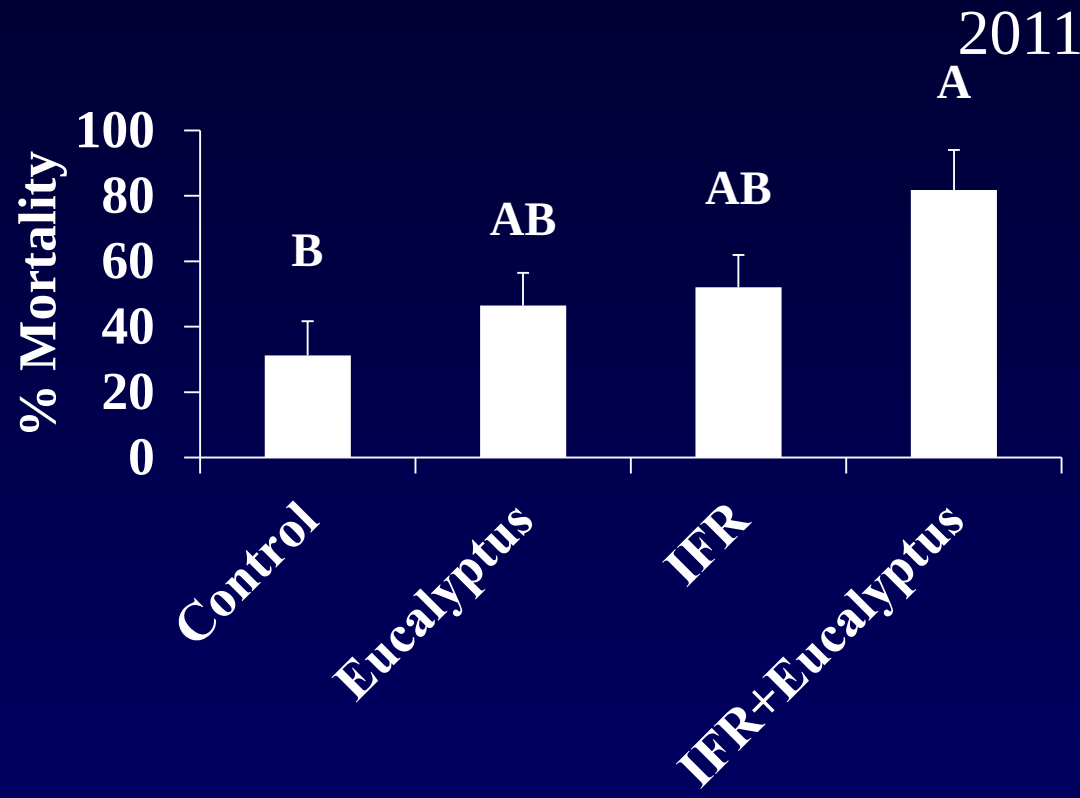


Results: Field Test Vs. Aphids



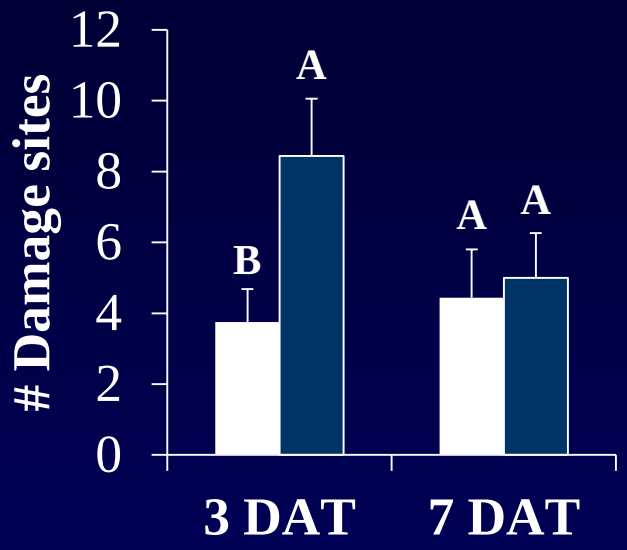
- All treatments (fungus & MB205) > control

Results: Field Test Vs. Aphids

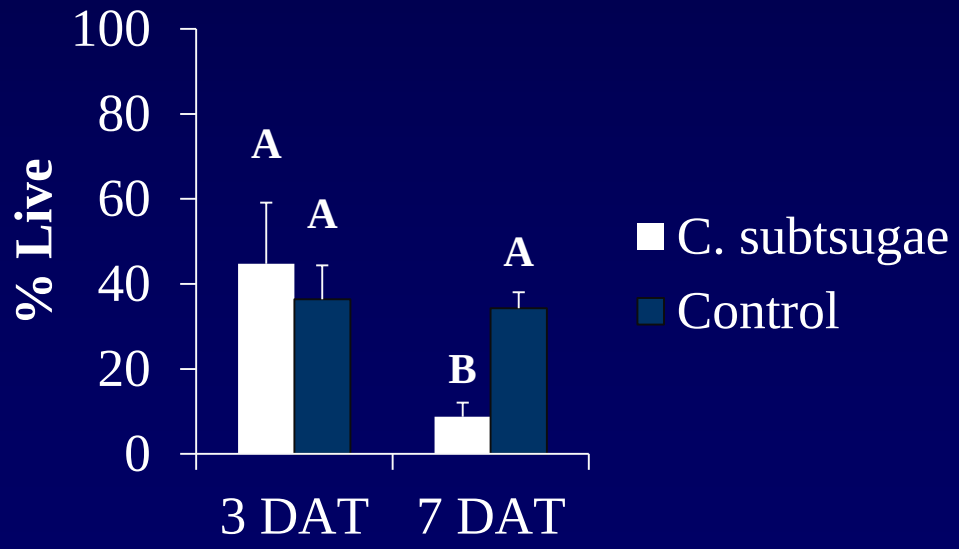


- Only fungus + eucalyptus > control

Results: Field Test Vs. Pecan Weevil



Reduced damage by 55% within the first 3 d



Caused 74.5% corrected mortality at 7 d

- Suppressed feeding at 3 d, caused mortality at 7 d

Summary/Conclusions

- *C. subtsugae* (Grandevo) shows promise vs. pecan weevil; large scale field tests needed
- Activity of MB205 eucalyptus + Ifr fungus shows potential vs. aphids
- Citrus (Vintre & ORSA-003) shows potential vs. aphids
- Future: additional field tests and screening of these and other materials

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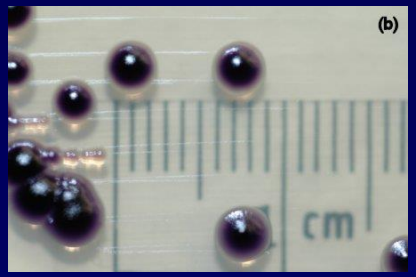

Mention of a proprietary product name does not imply USDA's approval of the product to the exclusion of others that may be suitable