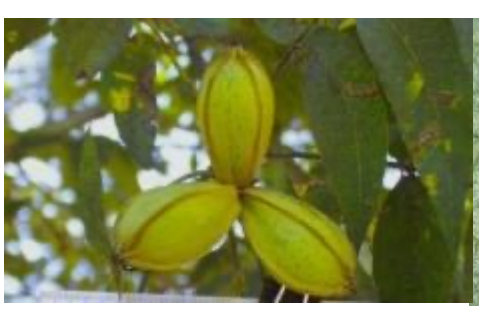




Research in Microbial Control of Pecan Pests

David Shapiro-Ilan

USDA-ARS, SE Fruit and Tree Nut Research Laboratory, 21 Dunbar Road, Byron, GA 31008

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

Projects to be Presented Today

1. Microbial control for pecan weevil (Grandevo)
2. Virus biopesticides vs. hickory shuckworm

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)

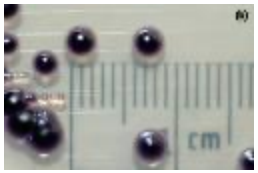
Traps used for monitoring

Grandevo®: A Novel Insecticide Based on *Chromobacterium subtsugae*

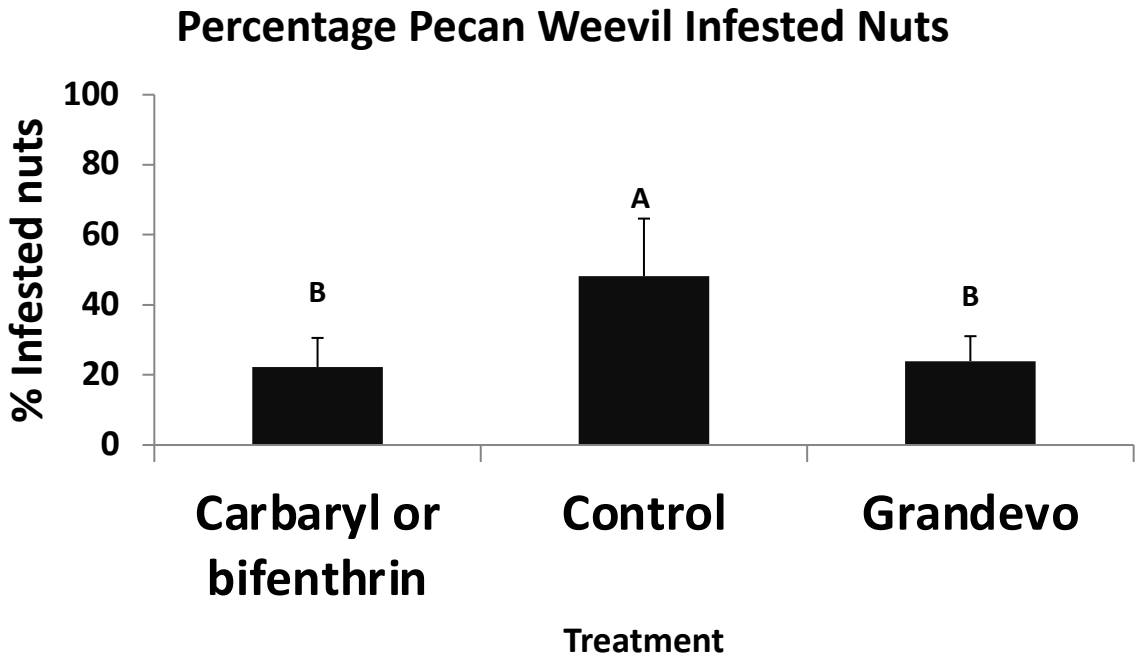
- The bacterium (*C. subtsugae*) was discovered (USDA-ARS) to produce toxins that kill Colorado potato beetle (Martin et al. 2004)
- Also found varying degrees of toxicity to gypsy moth, small hive beetle, and southern green stink bug
- Oral toxicity and effects on feeding

- Grandevo®, *C. subtsugae* shows promise in lab & field to weevils and aphids (Shapiro-Ilan et al., 2013, 2017 JEE)



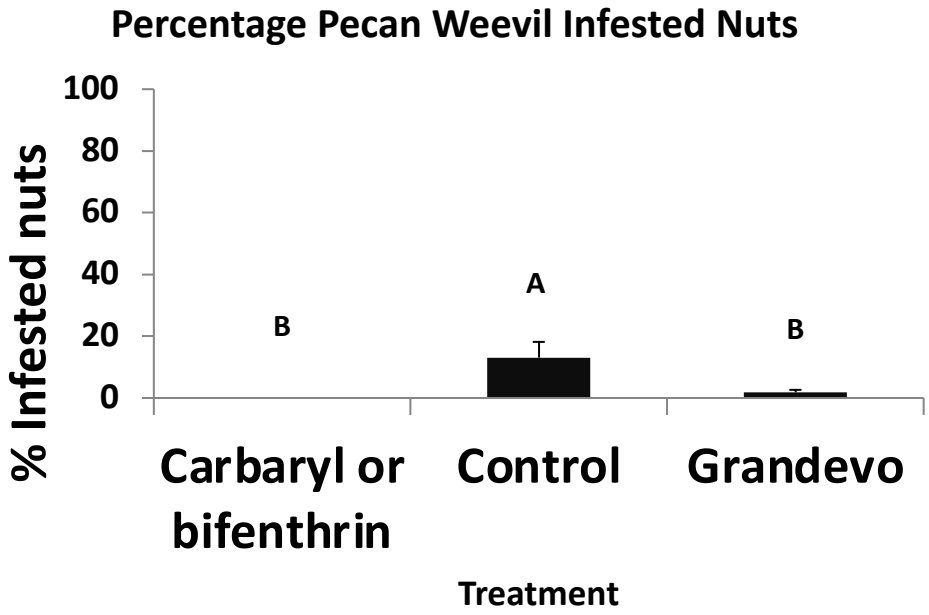


Results: 2014



- High level of infestation
- Grandevo (3 lbs per A) produced results similar to the chemical standards

Results: 2015



- Lower level of infestation than 2014
- Grandevo produced results similar to the chemical standards at 3 lbs per A

Shapiro-Ilan et al. 2017, Environmental Entomology

Pecan Aphids

- 3 Species:

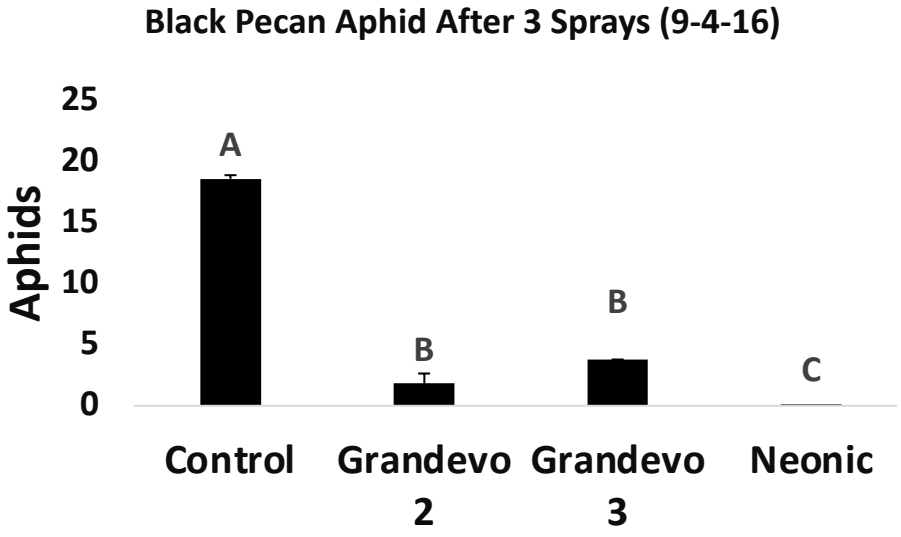
black pecan aphid, *Melanocallis caryaefoliae*

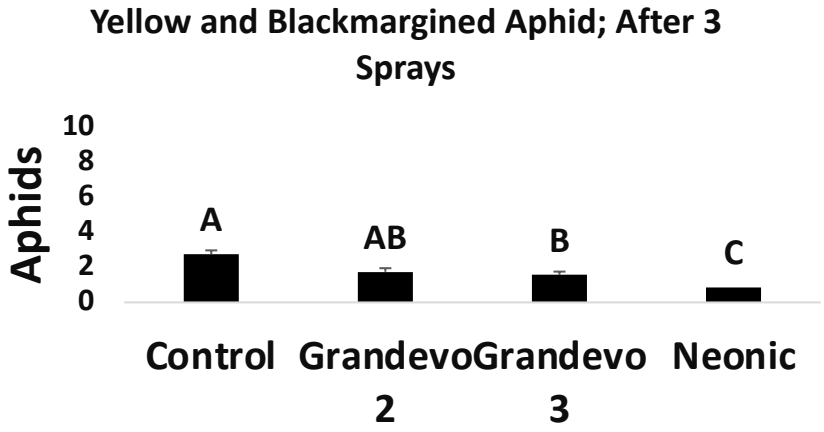
blackmargined aphid, *Monellia caryella*

yellow pecan aphid, *Monelliopsis pecanis*

- Natural enemies:

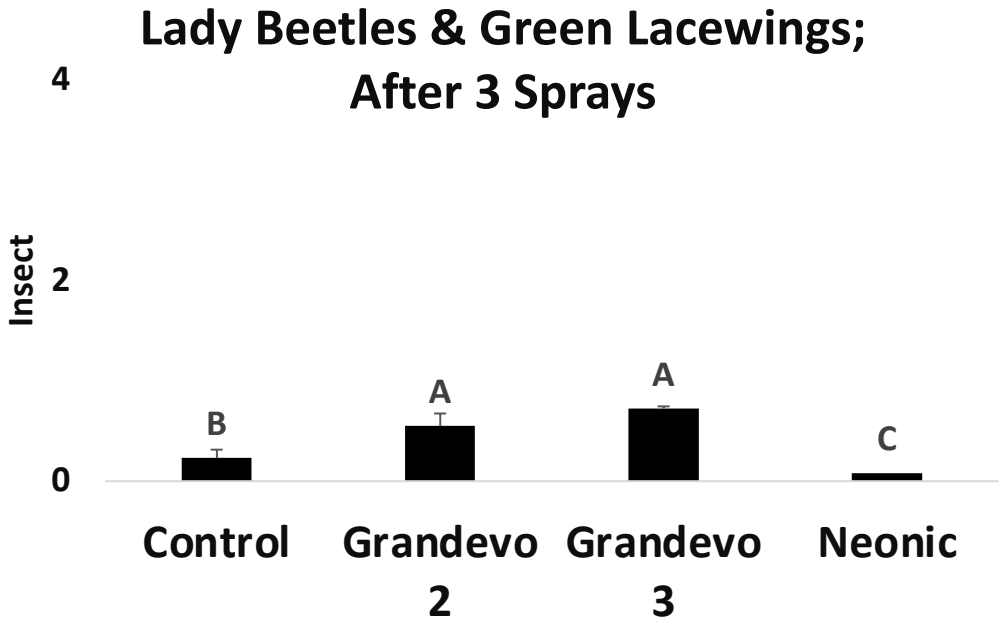
Results: Aphid control with Grandevo





- Grandevo kills aphids though not as well as standards
- Nonetheless this is an added benefit in addition to pecan weevil control

Results: Two vs Three Lbs. Grandevo Natural Enemies



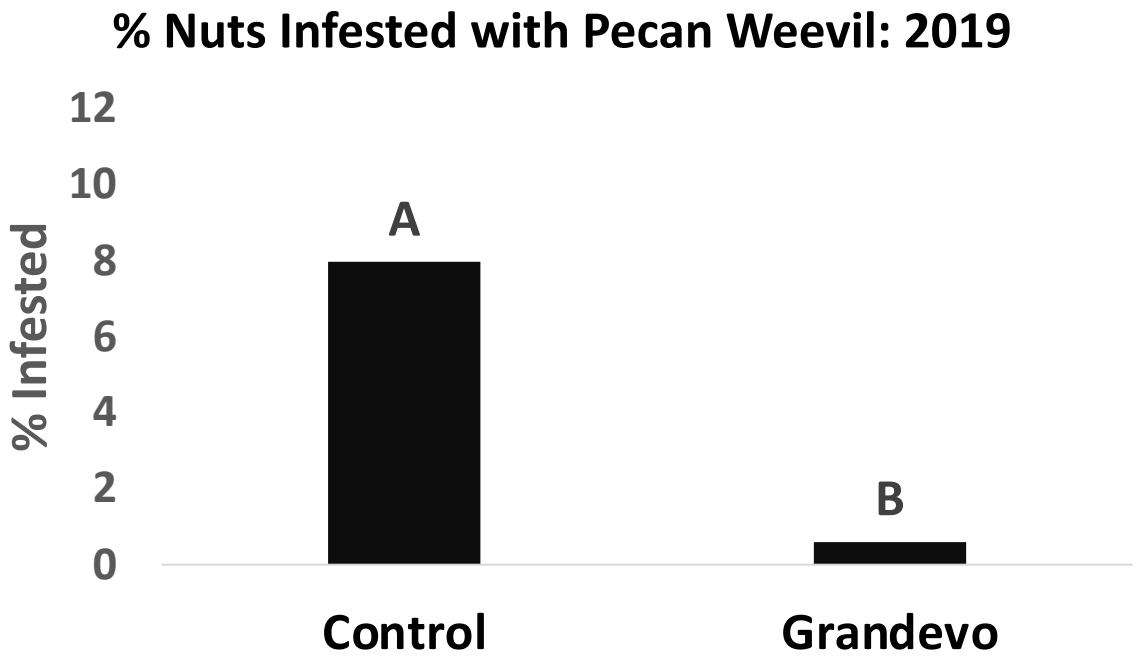
Thus, for Grandevo Tests:

- Grandevo at the 3 lb. rate provides pecan weevil control equal to chemical standard (previous research)
- Grandevo contributed to aphid control and preservation of natural enemies (note other weevil control sprays can result in increased aphid/mite populations)

Can We Use a Lower Rate: 2 lbs or quarts per Acre?

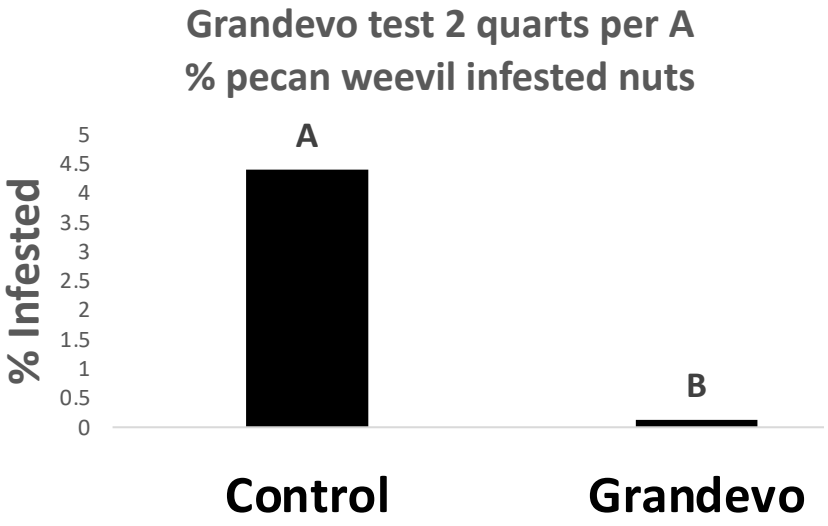
- 2.5 acre blocks x 4 blocks per treatment (USDA-ARS, Byron, GA)
- Treatments:
  - Grandevo Applied 4X
  - Untreated control
    - 2019 granular Grandevo (2 lbs.); 2020 liquid formulation
- Nuts in the canopy were randomly assessed for pecan weevil infestation (approximately 100 nuts per block)

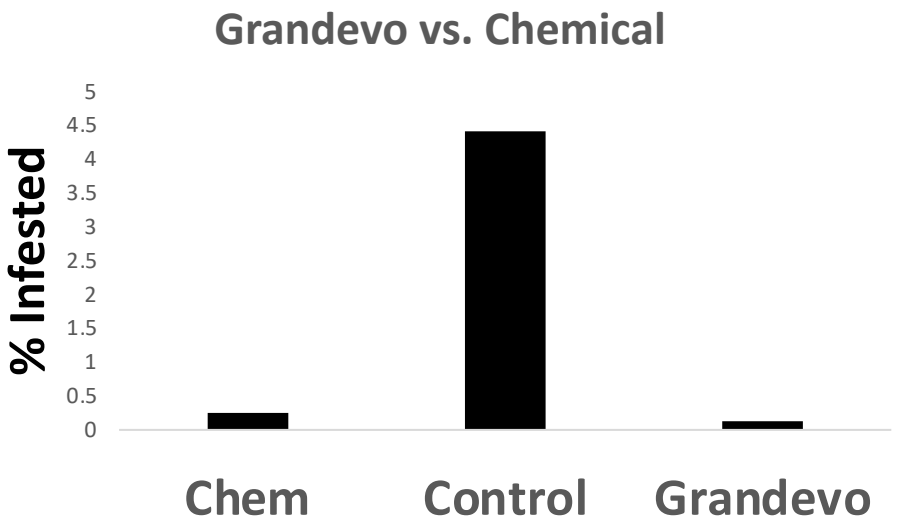
2019 Results: 2 Lbs per Acre (Granular)



- Grandevo caused approximately 93% control

2020: 2 quart per Acre (liquid)





- Similar results (ca. 93% control)
- 2 lbs/quarts per Acre works well!

A Virus for Control of Hickory Shuckworm

David Shapiro-Ilan[1], Ted Cottrell[1], Angel Acebes[2]

[1] USDA-ARS, Byron, GA

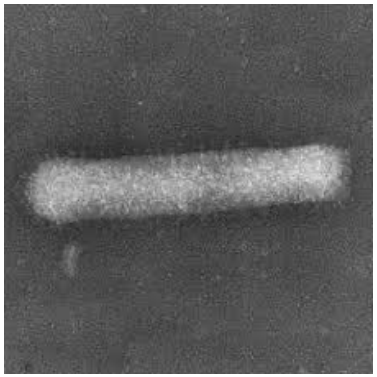
[2] University of Georgia, Tifton, GA

Hickory Shuckworm (*Cydia caryana*)

- Larval tunneling into developing nutlets prior to shell hardening causes nutlets to fall.
- After shell hardening, larvae tunnel in the shuck, which interferes with nut development
- Heavily infested pecans may not open properly in the fall, resulting in “sticktights”
- Shuckworms overwinter as mature larvae in the shucks on the orchard floor or on the tree
- Three-five generations per year depending on location
- Chemical control is used widely for suppressing shuckworm populations (such as chlorpyrifos and pyrethroids); some of these materials can flare aphid populations

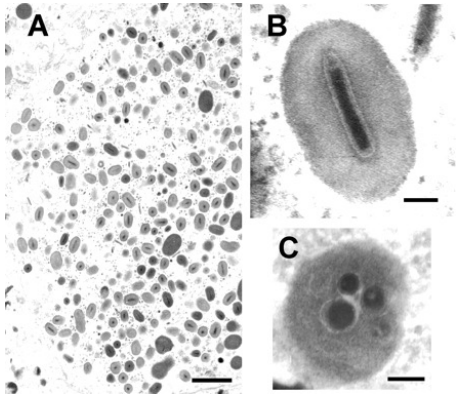
Alternative Methods of Control: An insect virus?

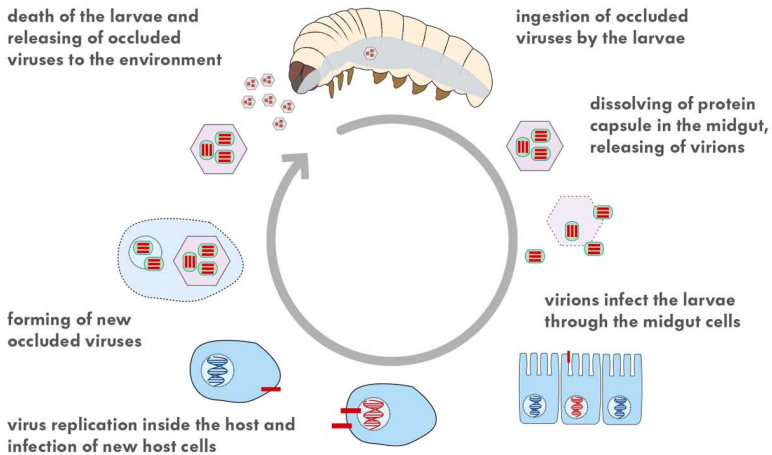
- More than two dozen viruses in the family Baculoviridae have been commercialized
- They are highly specific and safe to humans and nontargets
- One type, a granulovirus, is used to kill codling moth, *Cydia pomonella* (same genus as shuckworm)



Objectives

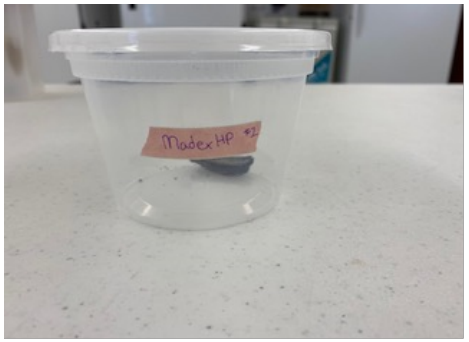
- Compare the virulence of the two commercial Cydia pomonella granulovirus strains to hickory shuckworm under laboratory conditions (<u>can the virus kill shuckworm</u>?)
- Determine the efficacy of the two Cydia pomonella granulovirus strains for control of hickory shuckworm under field conditions



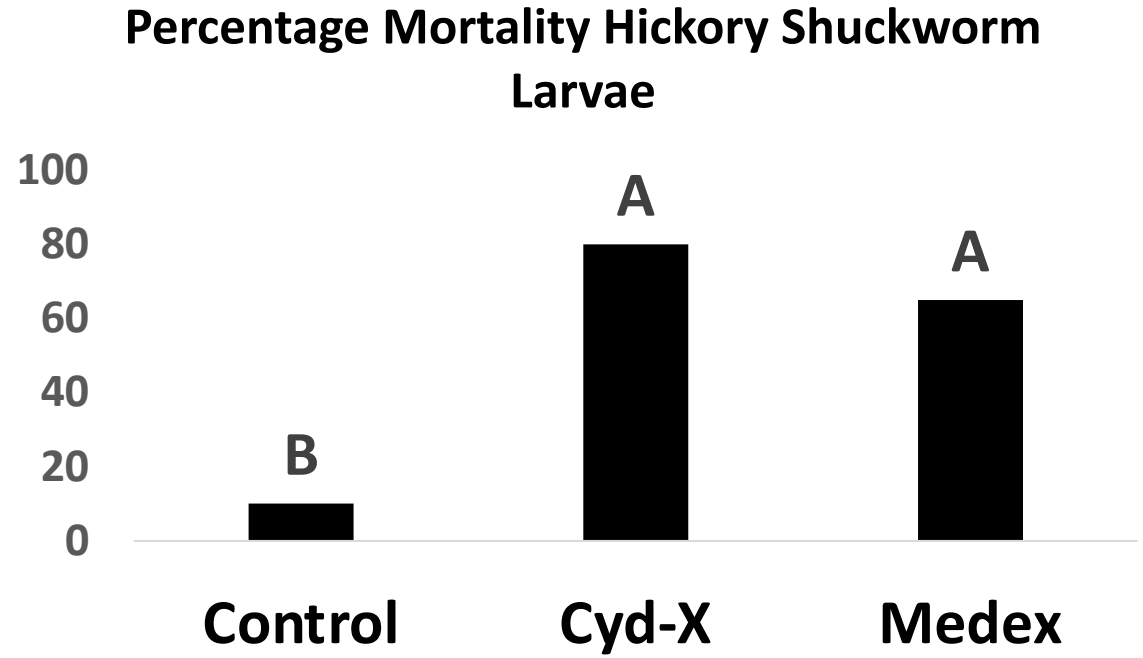


Methods: Lab Experiment

- Infested shucks collected from orchards (USDA-ARS, Byron, GA)
- Two granulovirus treatments (two commercial products) and a non-treated control were tested
- One shuck containing one shuckworm was placed into a 16oz plastic cup. 1mL of CYD-X or Madex-HP was pipetted into 9mL of distilled water
- Four replicates of five insects per treatment
- Analysis: ANOVA and Tukey's test



Results: Lab Experiment



- Both virus products killed shuckworm larvae
- Impressive because:

1. Larvae were mature (not neonates that are the target)
2. We did not expect much feeding

Next step: Field tests in August 2021

Conclusions

- Grandevo, at the 2 lb/quart rate, controlled pecan weevil (93%)
- Grandevo also contributes to pecan aphid suppression and conserves natural enemies
- Granulovirus is pathogenic to hickory shuckworm and thus shows promise for control

Acknowledgments

- **Technical assistance**: Kate Anderson, Stacy Byrd, Shardaya Weems
- **Co-Investigators**: Ted Cottrell, Angel Acebes, Lenny Wells, Russ Mizell, Camila Hofman
- **Funding**: GA Agricultural Commodity Commission




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