Exploring Opportunities in Pecan Weevil Control

Kelly Seuhs

Associate Extension Specialist

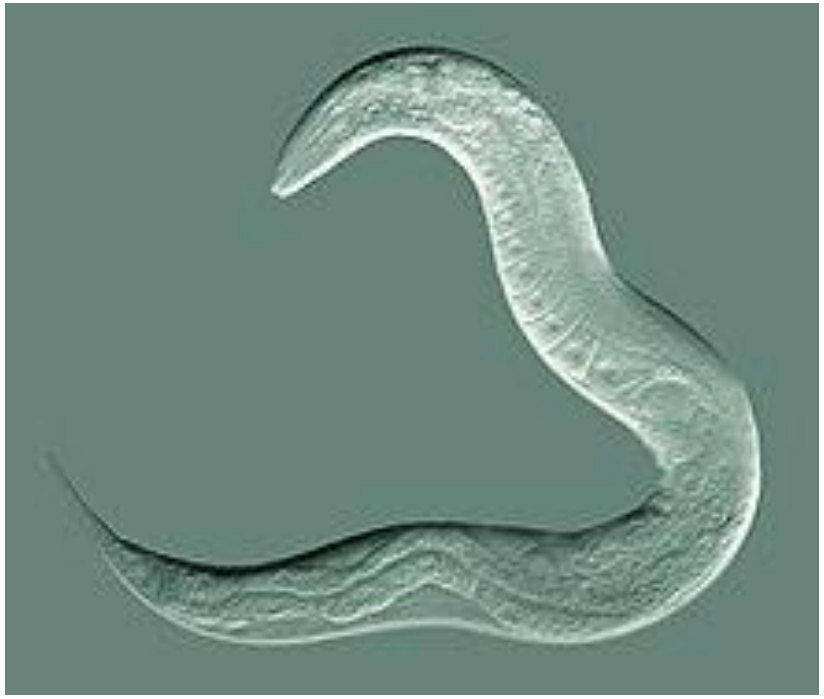
DEPARTMENT OF
ENTOMOLOGY AND
PLANT PATHOLOGY
Ferguson College of Agriculture

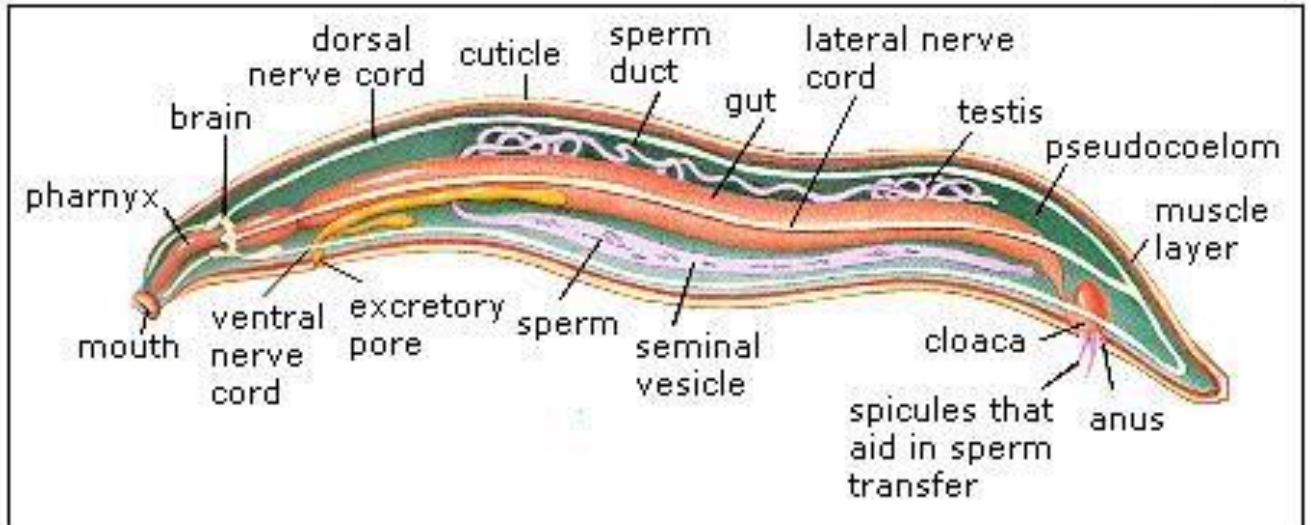
Nematodes

A diverse animal phylum.

Adaptable to a broad range of environments.

They are ubiquitous in freshwater, marine, and terrestrial environments.




dorsal nerve cord
cuticle
sperm duct
lateral nerve cord
brain
gut
testis
pseudocoelom
pharnyx
muscle layer
ventral nerve cord
excretory pore
sperm
seminal vesicle
cloaca
mouth
spicules that aid in sperm transfer
anus

Feed on Variety of Materials

- Some can be microscopic, while others can reach as much as 5 cm (2 in) or larger.
- Free-living species.
- Feed on materials as varied as bacteria, algae, fungi, small animals, fecal matter, dead organisms, and living tissues.

Importance to Agriculture and Horticulture

- Depending on its species, a nematode may be beneficial or detrimental to plant health.

- Pest (Plants), such as the root-knot nematode, which attack plants.

- Plant-parasitic nematodes cause crop losses of 10% or more worldwide every year.

- Predatory (insect)

Entomopathogenic Nematodes

- A group of nematodes that cause death to insects.
- Entomopathogenic nematodes (EPNs) live parasitically inside the infected insect host, and so they are termed as *endoparasitic*.
- They infect many different types of insects living in the soil like the larval forms of moths, butterflies, flies and beetles as well as adult forms of beetles, grasshoppers and crickets.
- The most commonly studied entomopathogenic nematodes are those that can be used in the biological control of harmful insects. Most of these species come from two families: Steinernematidae and Heterorhabditidae (Gaugler 2006).

Research

- USDA-ARS Fruit and Tree Nut Research Lab (Byron, Georgia)
- Collaborations with various University Extension and Research specialist
- Shapiro-Ilan, D. and Gardner, W.A., 2012. Improved control of Curculio caryae (Coleoptera: Curculionidae) through multi-stage pre-emergence applications of Steinernema carpocapsae. *Journal of Entomological Science* 47: 27-34.

Application Timing

- *Steinernema carpocapsae* nematodes.
  (In soil, under tree canopy) (2yr)

- Three successive applications before PW emergence.
  Early May (first application)
  Early June (second application)
  Late June (third application)

- Rate of 1 billion per/acre/application.

- Reduced population 49 to 81%

How Does it Work?

- When the *Steinernema carpocapsae* nematodes are applied to the soil surface, they enter into the soil and search for grub and/or pupal stages of small pecan weevils.
- Once they locate either grub or pupa, they enter into their body cavities via natural openings.
- Once in the body cavity, nematodes release symbiotic bacteria called *Xenorhabdus* spp. from their gut in the blood of grub or pupae.
- In the blood, these bacteria multiply quickly and cause septicemia that kills, usually within 48 h after infection.
- Suppressed the emerging populations of pecan weevil adults in late July through August.

How Are They Applied

- Can be applied with most horticulture or equipment including pressurized sprayers, mist blowers, and small backpack sprayers.
- In general, large diameter nozzles allowing high volumes are recommended. Filters and screens should be removed and proper agitation maintained. High pressure should be avoided.
- As nematodes need a film of water for their movement to seek their hosts, soil moisture is crucial.
- This allows nematodes will move freely in the soil profile to seek both grubs and pupae of pecan weevils.

Recent Work

- Shapiro-Ilan et al, 2017. Control of Pecan Weevil With Microbial Biopesticides, *Environmental Entomology*, Volume 46, Issue 6, December 2017, Pages 1299–1304

Experiment 1: Integrated Use of Microbial Biopesticides (2 yr. study)

The pest management regime consisted of the three different microbial biopesticides applied at different times during the season (*S. carpocapsae*, Grandevo, and *B. bassiana*).

- *S. carpocapsae* was applied to soil surrounding the dripline. One trial (2 sites). One application per year.
- Grandevo was applied three times to the canopy during the weevil emergence period (at 2-wk intervals beginning 7 August 2014 and 17 September 2015) at the highest recommended label rate.
- *B. bassiana (soil fungus)* was applied to soil around the dripline of the tree on 28 August 2014 and 15 September 2015.
- Soil treatments were applied using a boom sprayer AWD ATV, and an 8-foot boom with 7 spray nozzles, and screens removed.
- Canopy spray treatments were applied using an air blast sprayer, with an approximate volume of 100gpa.

- Treatment effects were assessed after harvest by percentage of nuts infested with pecan weevil.
- Harvested at similar times each year. Nuts randomly sampled per plot (100 to 200).

- **Experiment 2**: Small Plot Test Comparing Soil Applied Microbial Agents

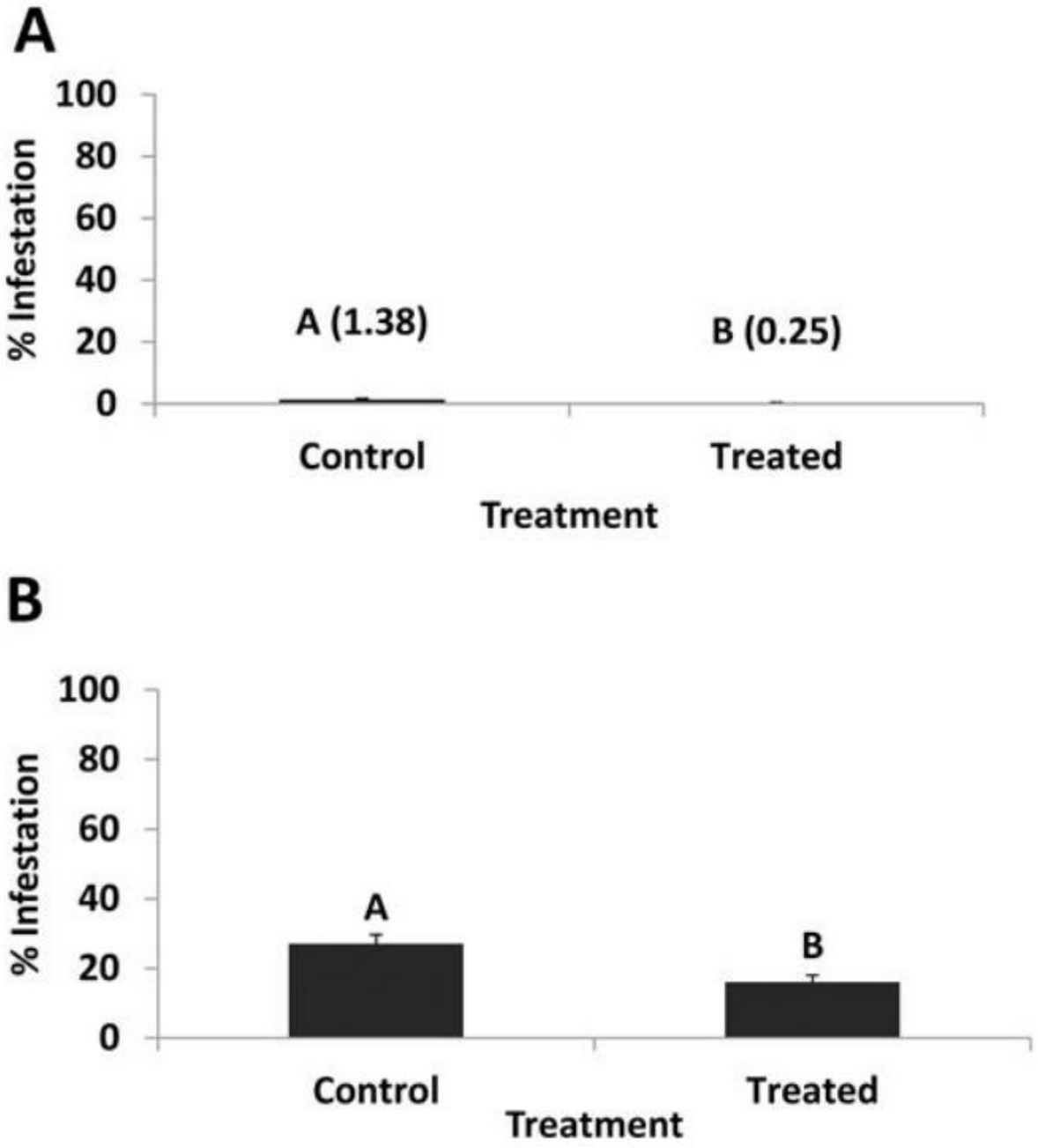
    - Combinations all soil applied

- **Experiment 3**: Comparison of Biopesticide and Chemical Insecticide Canopy Sprays

    - Three treatments consisting of Grandevo, Carbaryl/Bifenthrin, and a check.

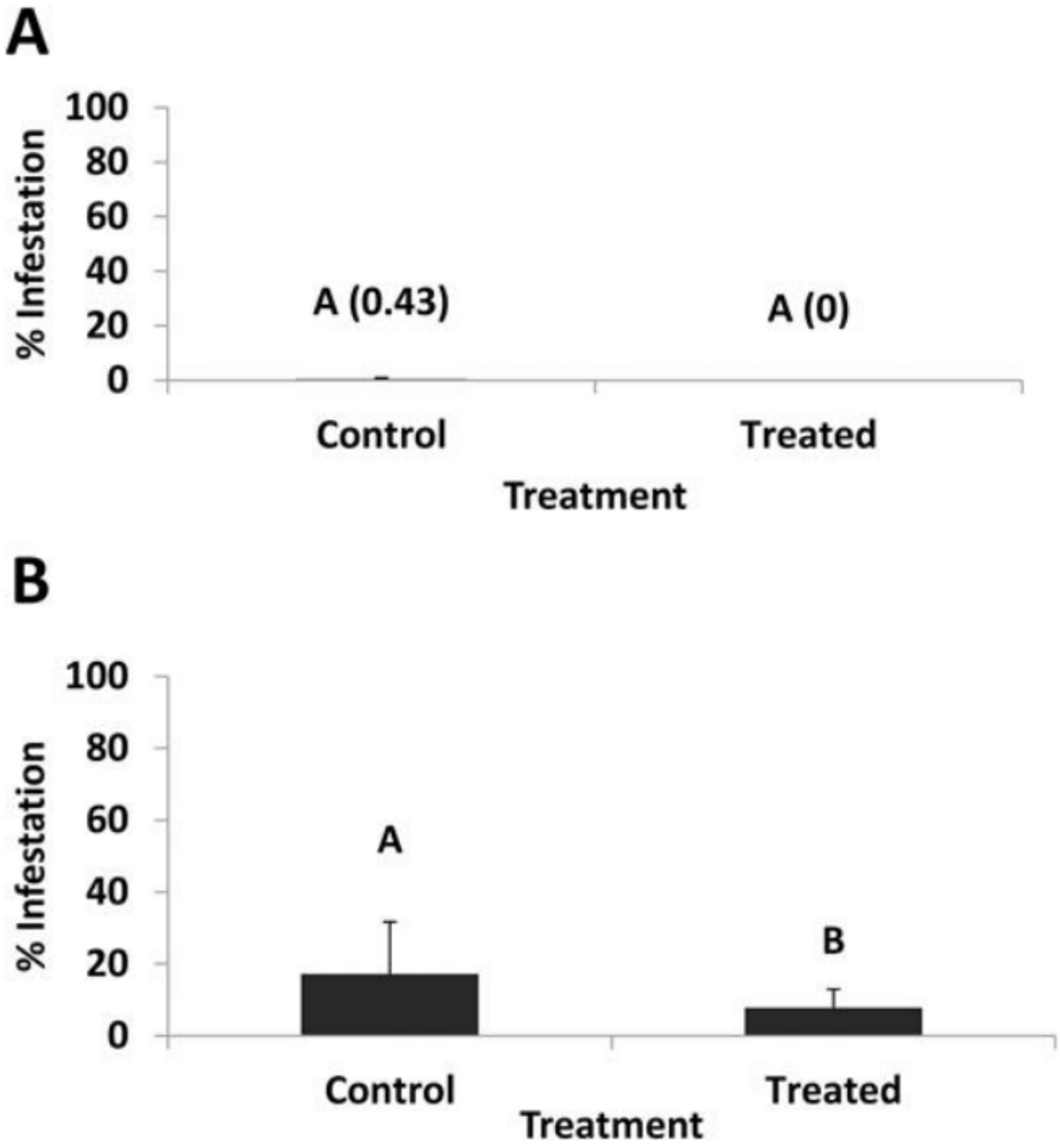
Experiment 1.

Fig. 1.



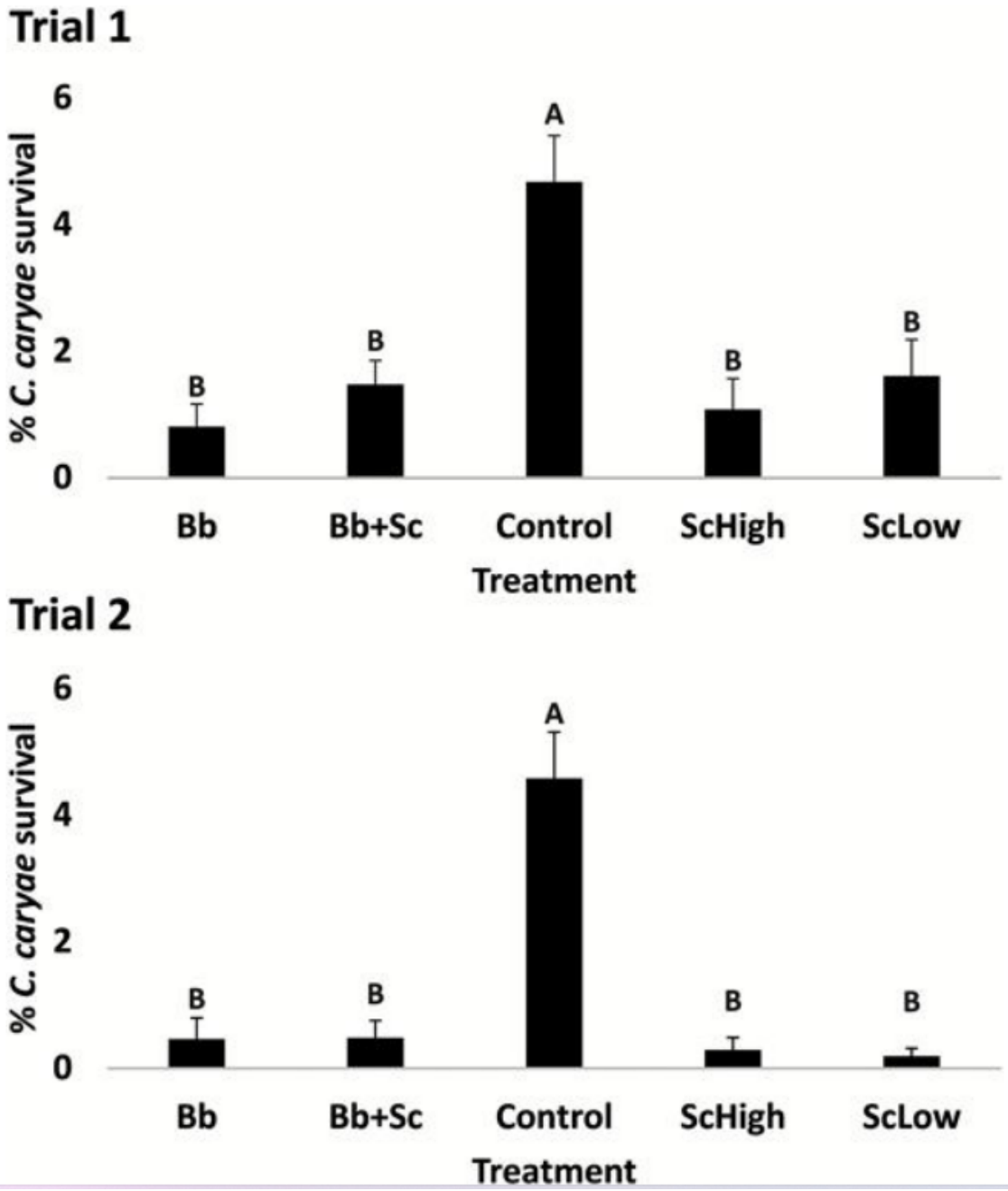
Experiment 1. (Year 2)

Fig. 2.



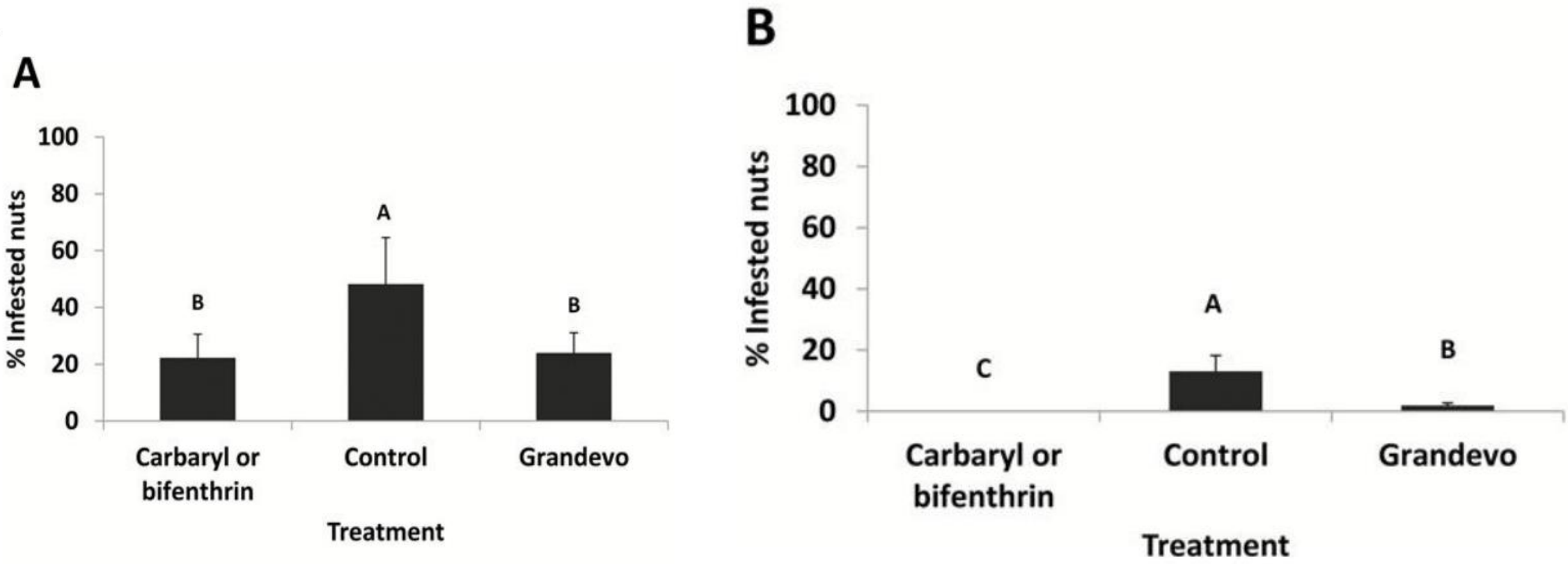
Experiment 2.

Fig. 3.



Experiment 3.

Fig. 4.



Discussion

- The integrated approach using multiple biopesticides was successful in reducing damage caused by *C. caryae*.
- Percent infestation???.
- Next step is to identify if reduced rates are still effective.
- Yearly applications???.
- Cost efficiency yet to be determined.
- Research ongoing!!!

Challenges!!!

- Cost
- Environmental Conditions (Moisture, UV exposure, or desiccation)
- Consistency in field performance
- Expanding knowledge
- Strain improvement
    - -Production
    - -Formulation
    - -Application techniques

Plans for This Season

- Grandevo
- Experimental liquid formulation
- New Strain
- Peptides???

Table 1. Evaluations of Insecticide Performance for Control of Pecan Weevil and Hickory Shuckworm

		Percentage infested nuts	
Treatment	**Rate product/acre**	**Pecan weevil[a]**	**Hickory shuckworm[a]**
Untreated check		4.2	3.0
Minecto Pro	8.0 fl oz	4.8	3.3
Warrior II w/zeon	1.28 fl oz	2.2	1.7
Grandevo WDG	2.0 lb	1.5	2.2
Minnecto Pro	12.0 fl oz	2.2	2.1
Warrior II w/zeon	2.56 fl oz	2.8	3.2
Grandevo WDG	3.0 lb	1.8	1.3
P-value		0.4032	0.4519

[a]Means within columns, were not significantly different ($P \geq 0.05$).

DEPARTMENT OF
ENTOMOLOGY AND
PLANT PATHOLOGY
Ferguson College of Agriculture

THANKS

Kelly Seuhs
Associate Extension Specialist
Department of Entomology and Plant Pathology
Oklahoma State University
127 NRC
Stillwater, Ok 74078
405-744-6456
k.seuhs@okstate.edu