



# Developing management for *Bulimulus bonariensis*, an emerging snail pest in Florida citrus

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# Background on *B. bonariensis*

- This group of snails is native to Central and South America and the Caribbean
- Generally referred to as “tree-dwelling” snails
  - Climb and clog microjets
  - Climb any structure: barns, houses, playground equipment
  - **Climb and adhere to equipment!**
- Uncertain if there is just one species or a complex
  - Does this matter? It can for management if behaviors/susceptibilities are different



# Identification

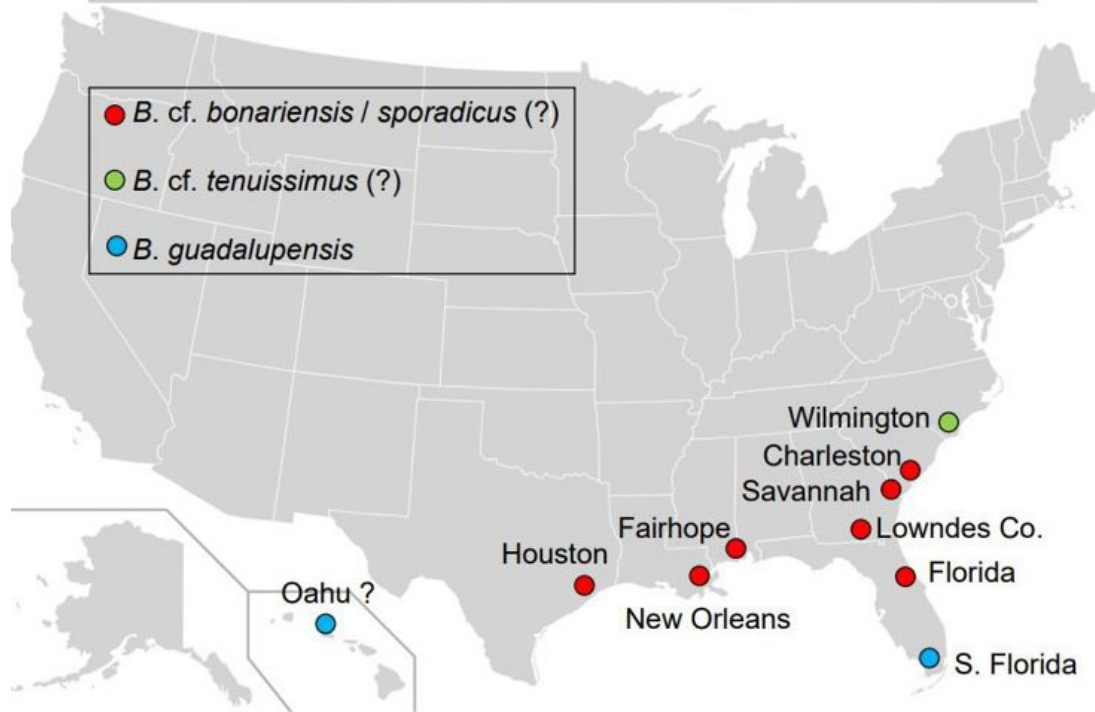
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- Common names
  - Ghost snail
  - Peanut snail (need to get rid of this one)
- Key features
  - Larger snails are  $\frac{3}{4}$ -1 inch
  - Conical
  - Light brown to tan
  - Display aggregation behavior
- Origin of US populations uncertain
  - Native to South America
  - Likely multiple introductions from several locations

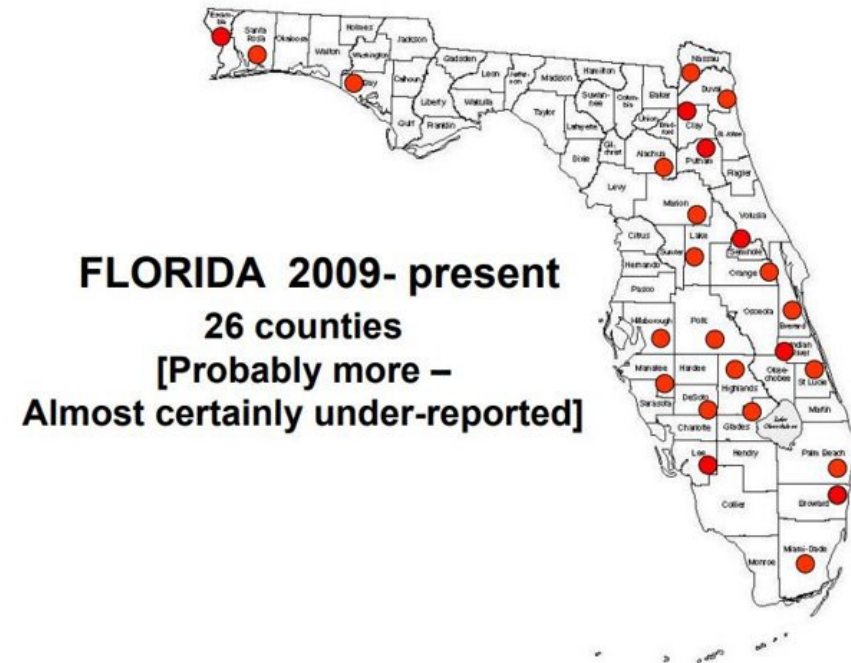


# Distribution in the US/ Florida

**Bulimulus spp. – Confirmed (and likely) Established**



**Bulimulus sp. “sporadicus” [cf bonariensis & sporadicus]**



# How did they get here and how do they get around?

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- Uncertain how/when they first arrived or established
- First found by a shell club in Duval County, Florida
- Specimens have been found moving on cargo
- Move into farm equipment and can be moved when equipment moves field to field
- Can move on people
- Now found in a variety of habitats: agricultural, urban, natural



Photo credit: K. Dickens, L. Diepenbrock

# Basic biology – life stages

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- Eggs buried under the soil surface
- Juveniles born with a soft shell
- Need to consume calcium to grow hardened shells
- Shells grow with snail, but are not an indicator of age
- Adults are hermaphrodites
- Require sexual reproduction
- Multiyear lifespan



Photo credit: S. Paula-Moraes

# Basic biology- feeding

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- Most snails are grazers, generally feed on “films on the surface” of other things
- Prefer dead or decaying plant material
- Attracted to moisture in agricultural settings
- Thought to not directly feed on citrus trees until spring of 2021
- Damage in other crops:
  - Girdling grapevines
  - Feeding on soft-fleshed vegetables
  - Impeding peanut harvest



# Challenges in developing management

1. Ability of snails to withstand inhospitable environments
2. Limited availability of effective chemistries
  - Baits CAN work IF snails encounter them, and many are expensive
3. Lack of knowledge regarding WHEN to manage
4. Lack of understanding of how they use the grove/surrounding habitats



Operculum





# Ability of snails to withstand inhospitable environments

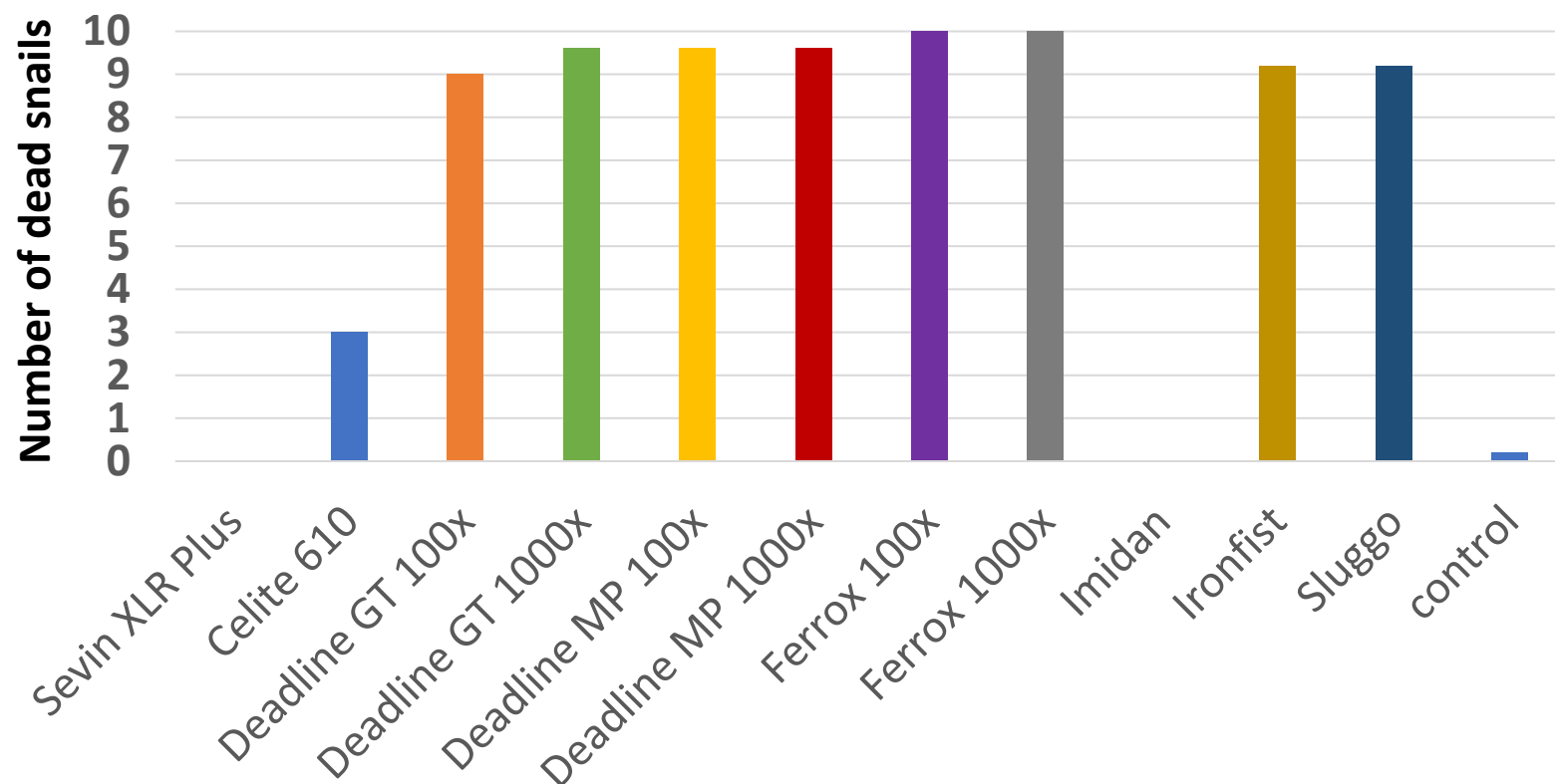
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- Snails are not active:
  - Dry periods
  - Too hot (t.b.d.) -> climb structures
  - Too cold (t.b.d.) -> burrow into soil
- Snails are active:
  - Temperate
  - Moist
- Vulnerable periods for management:
  - Target periods of activity- dawn/dusk after irrigation runs or after a rain



# Limited availability of effective chemistries

Lab Testing: Mean Mortality 7 Days (Max 10)



- Several baits are available, but efficacy is inconsistent in groves
- What if pesticides we currently use have an added benefit towards snail management?

# Field testing baits and insecticides



Arenas sunk adjacent to trees where microjets could supply some moisture, water added if needed



Treatments applied at field rates



Portion of snails returned to “optimal” lab conditions.

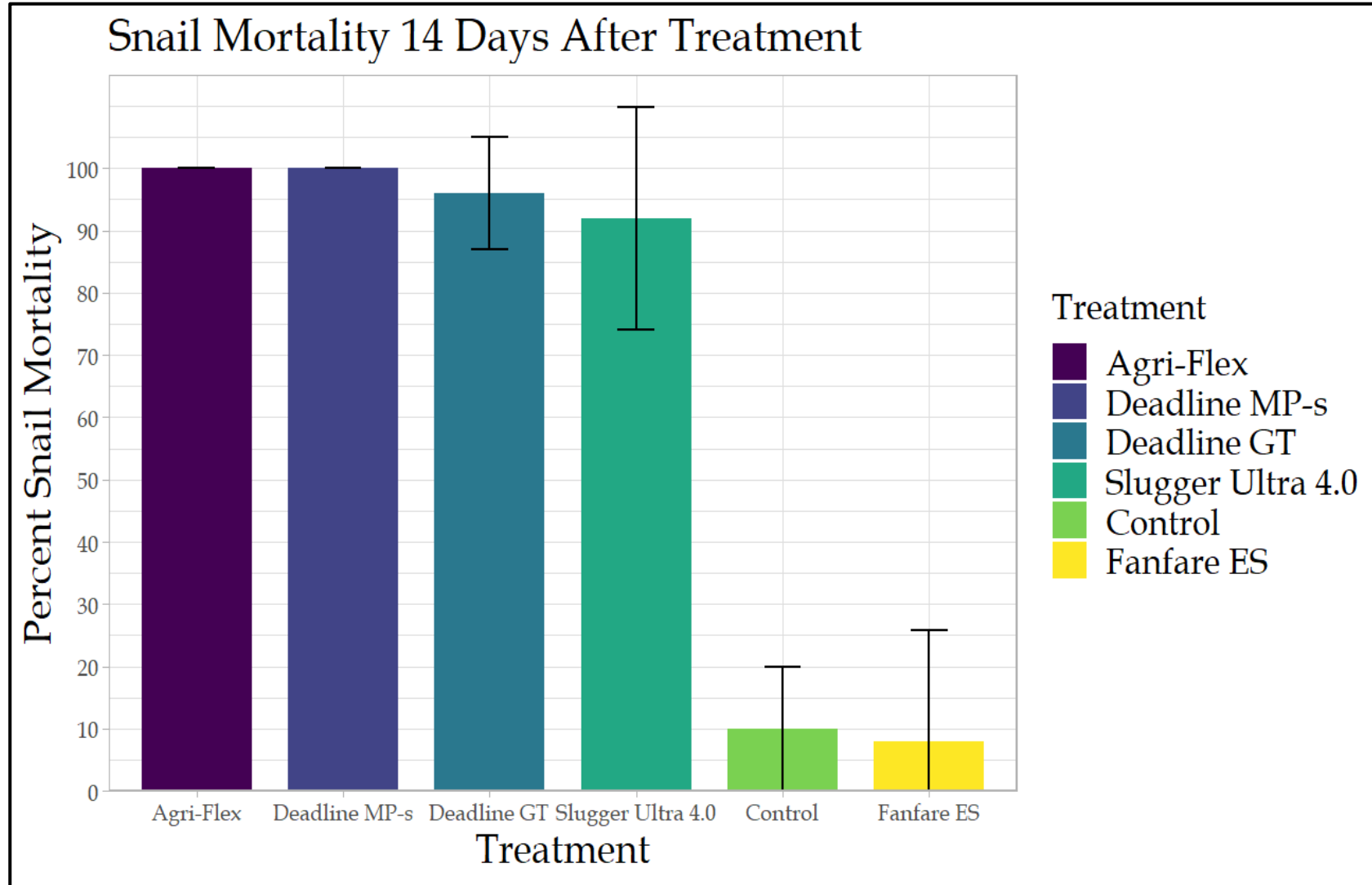
# Materials tested SO FAR

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Product	Application Rate	Active Ingredient
Deadline M-Ps <sup>1</sup>	250 lb/acre	Metaldehyde
Deadline GT <sup>1</sup>	333 lb/acre	Metaldehyde
Slugger Ultra 4.0 <sup>1</sup>	250 lb/acre	Metaldehyde
Agri-Flex <sup>2</sup>	8 oz/acre	Abamectin + Thiamethoxam
Fanfare ES <sup>2</sup>	16 oz/acre	Bifenthrin
Control (Water)	N/A	N/A

<sup>1</sup>10 times the max rate was used to provide adequate coverage of arenas

<sup>2</sup>Agri-Flex and Bifenthrin are NOT registered for snail control



## Preliminary data

- Some insecticides used for OTHER pests may provide some benefit for snail management
- No mortality in containers of snails brought back to the lab
- **None of the insecticides tested are currently labeled for use on snails**

# When should we manage snails?

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- Need to know WHEN snails are active and have a good tool to determine activity (trap)
- Evaluation of 2 traps in 3 groves



## Flat trap

Retains moisture, likely provides good habitat for snails to aggregate



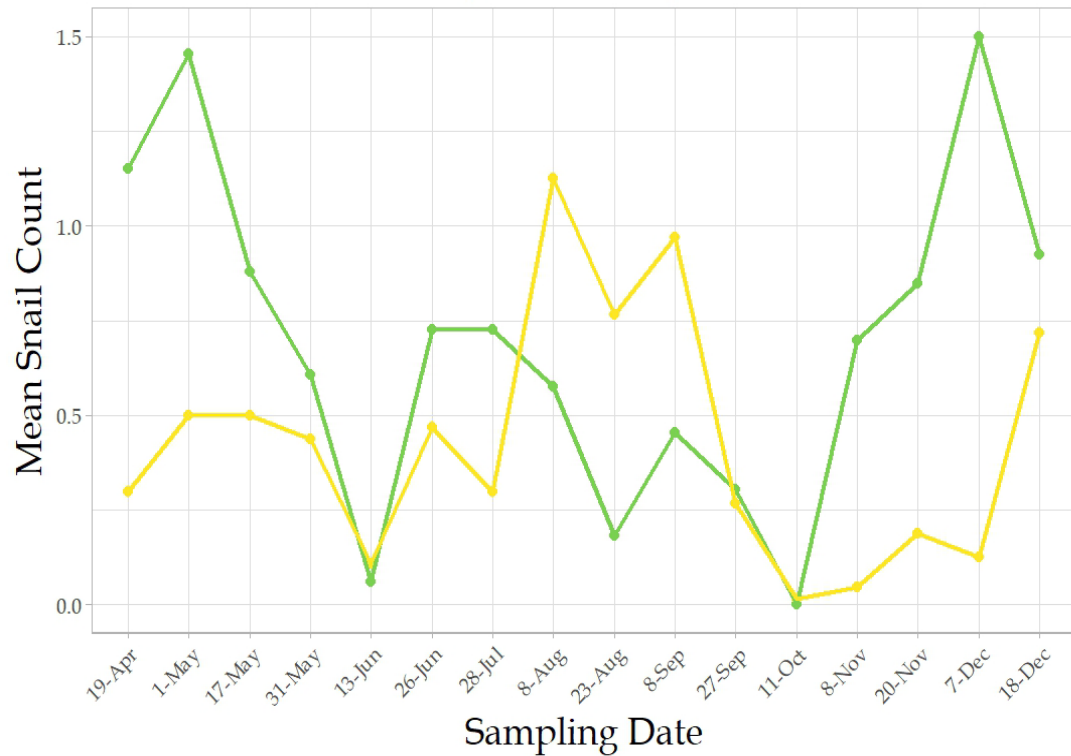
## Pyramid trap

Provides structure for snails to climb

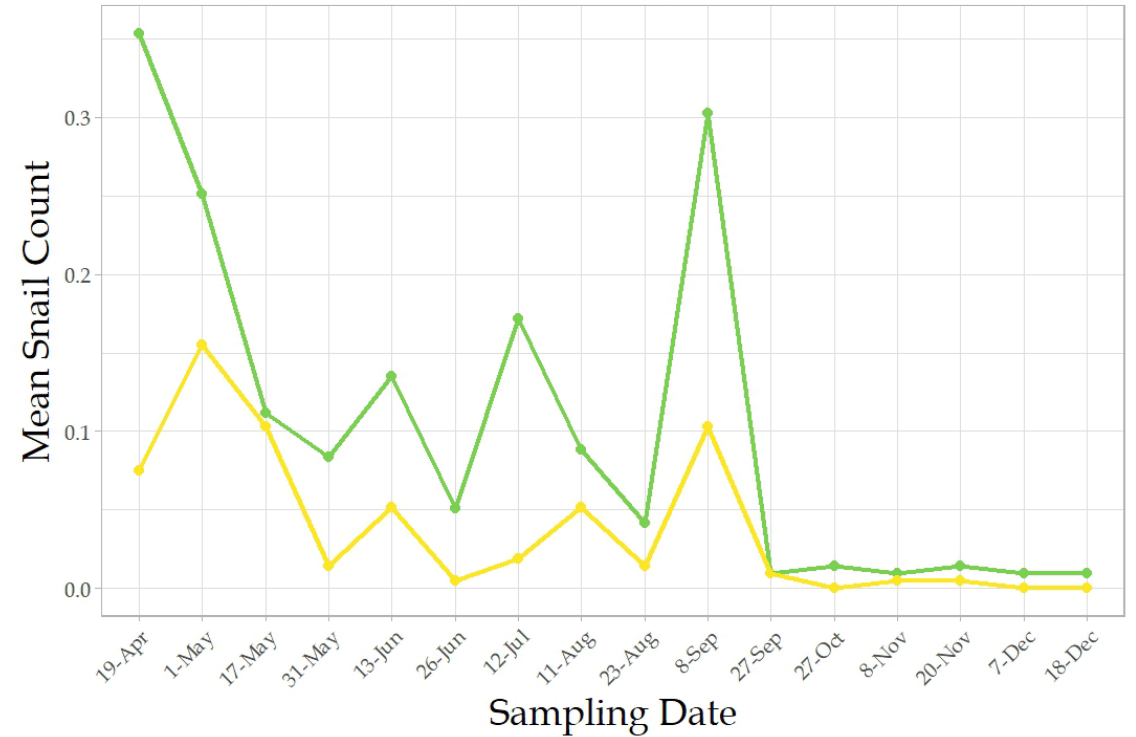
# Mean trap captures

## April 2022-Dec 2022, 2 sites

Lake Alfred Flat vs Pyramid Trap Mean Snail Counts 2023

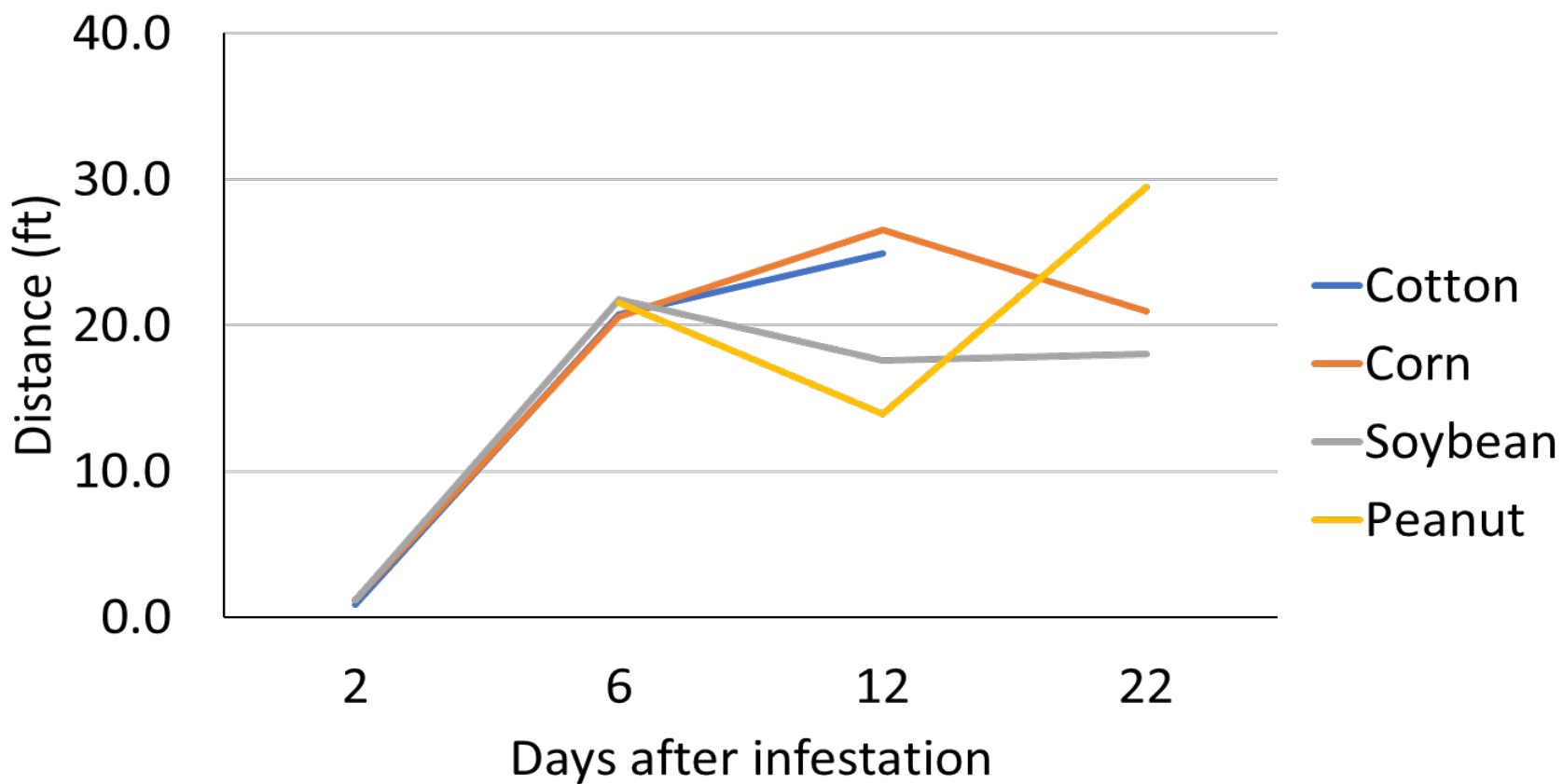


Polk City Flat vs Pyramid Trap Mean Snail Counts 2023



Trap  
Flat  
Pyramid

# How do snails navigate the habitat/grove?



Studies from agricultural sites

**Traveled distance: 30ft**

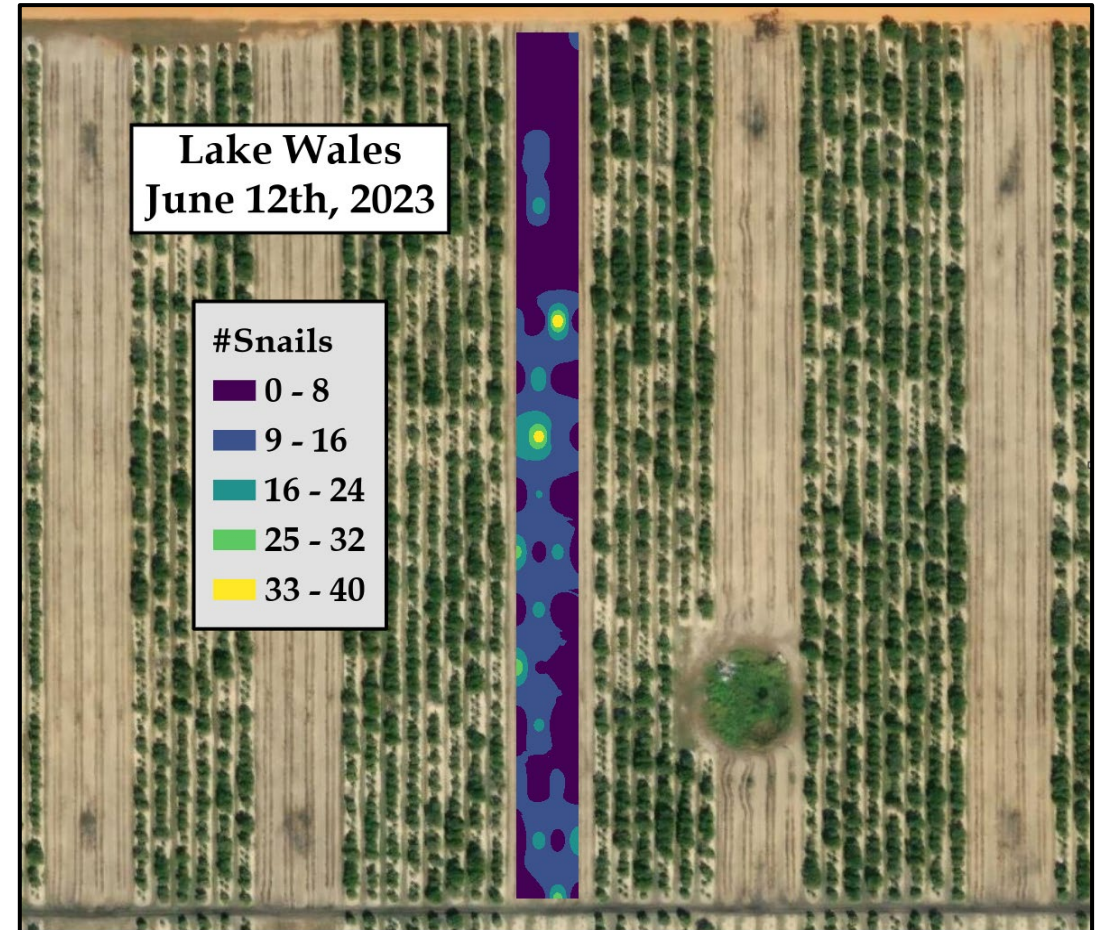
**Maximum distance: 80ft**

Rabelo et al. 2022  
Paula-Moraes lab, NFREC



# No pattern to within-field distribution

- Means from weekly snail trapping are being overlaid on field maps to determine if there are spatial patterns to their population
- Reproductive populations are likely established in groves, with some migration into/out of fields
- Will need to treat whole grove for snails



# Does anything eat them? Camera trapping

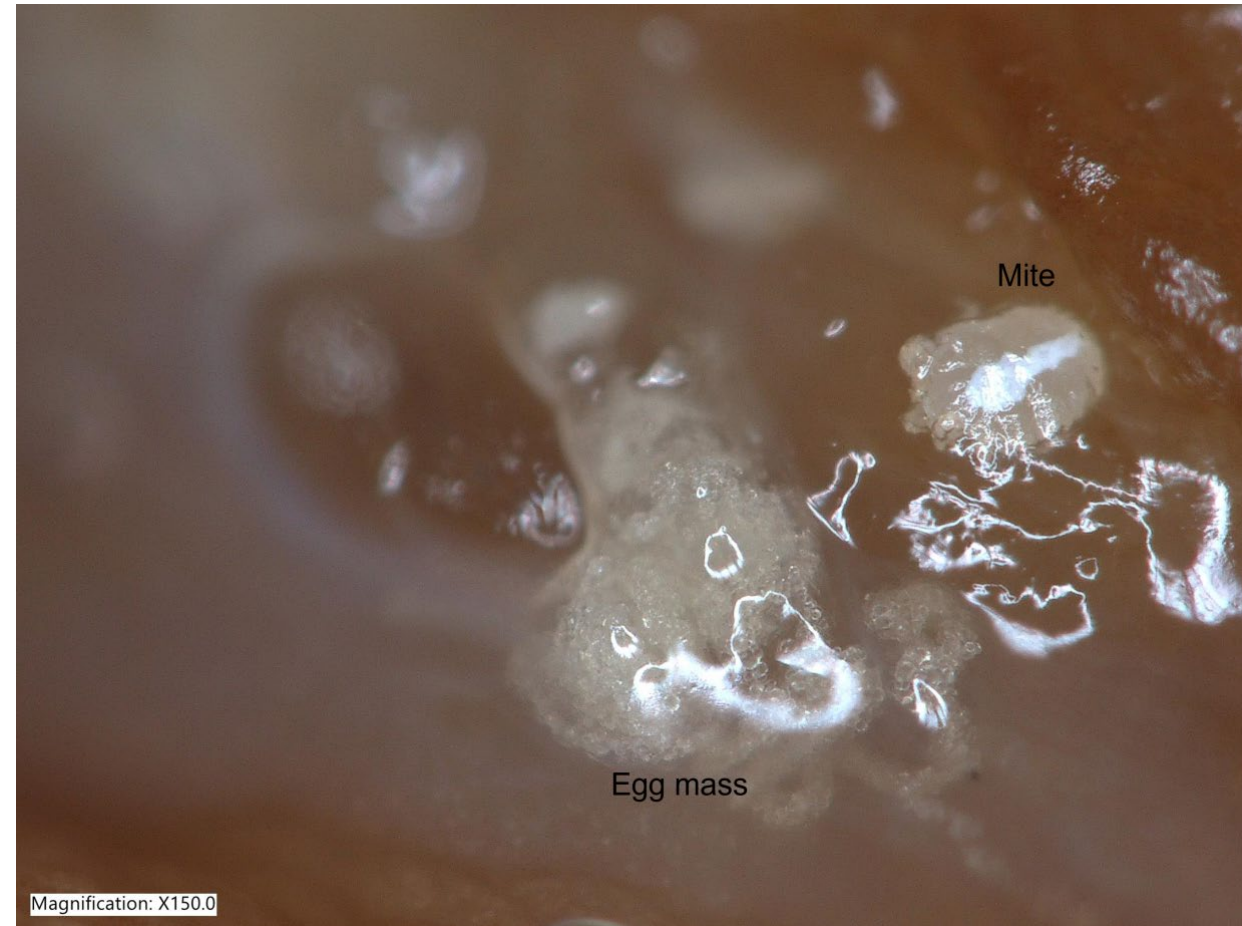


Collaboration with Dr. Quinn, IRREC

# Predatory mites

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- Predatory mite has been found embedded in snail lungs
- Impacts of mite on this snail currently being documented
- Heavy mite loads have been found in research collections that suddenly die and snail bodies liquify
- Could this be used towards management?



# General management take-aways

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- Still under development for most crops
- Need a better understanding of their ecology within the agricultural system, interactions with available chemistries, and potential impacts of predators to make informed recommendations
- Stay tuned- multi state working group in the Southeast meets regularly and is seeking management funding to assist specific commodities!



# Acknowledgements

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