

Bulimulus snail management in citrus

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Background on *Bulimulus 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



Diepenbrock

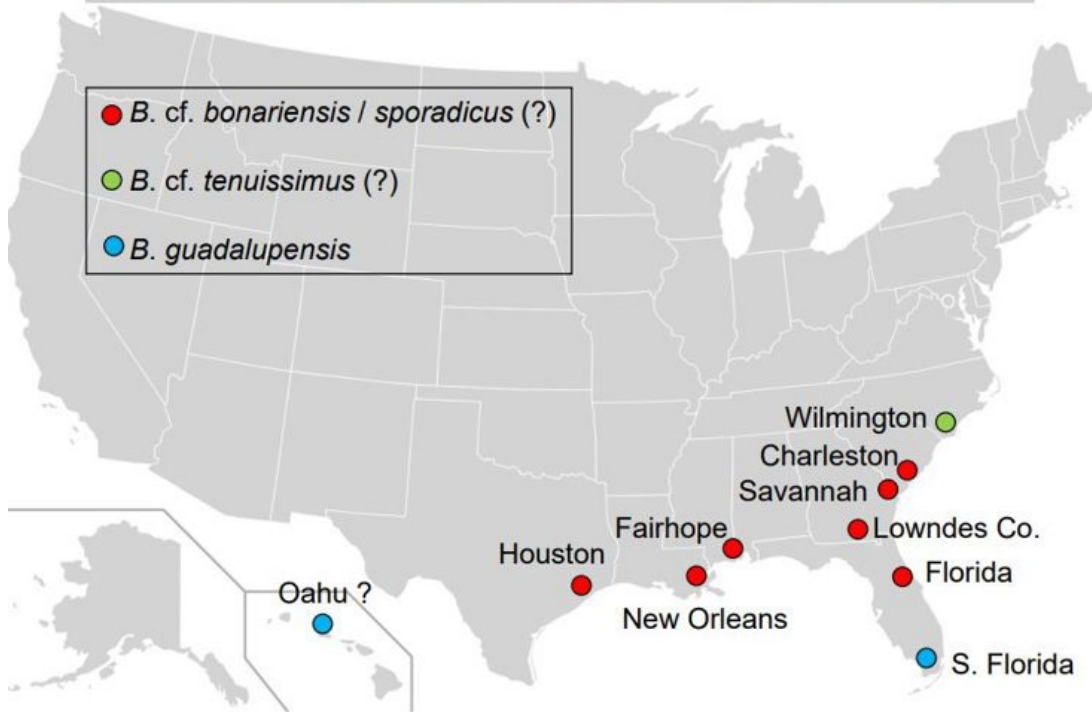
Identification

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

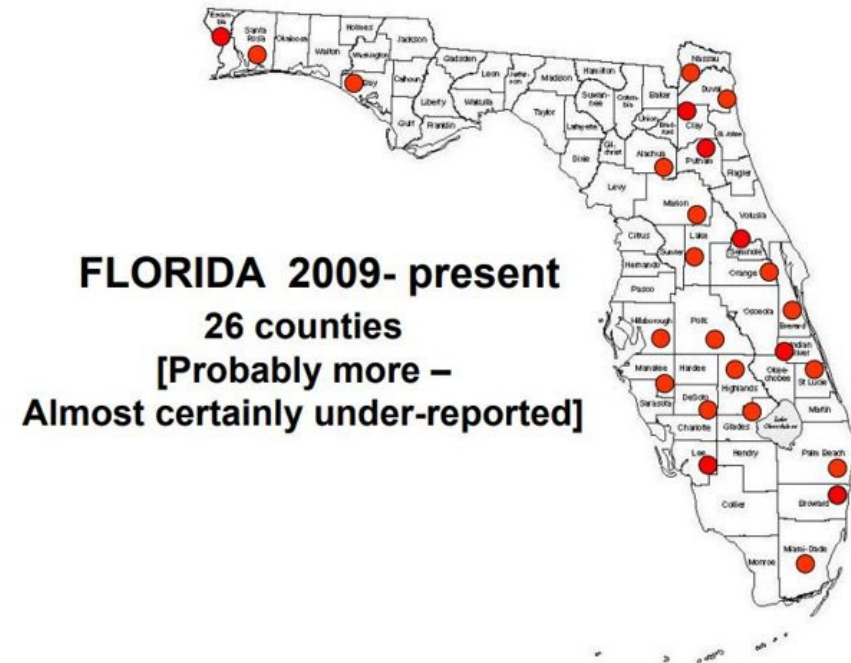


Distribution in the US/ Florida

Bulimulus spp. – Confirmed (and likely) Established



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



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

- 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, animals
- Now found in a variety of habitats: agricultural, urban, natural



Photo credit: K. Dickens, L. Diepenbrock

Basic biology – life stages

- 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

- Most snails are grazers, generally feed on “films on the surface” of other objects/plants
- Prefer dead or decaying plant material
- Attracted to moisture in agricultural settings
- Damage in citrus:
 - Secondary damage where bark is split
 - Consuming foliage when stuck in IPCs
- Damage in other crops:
 - Girdling grapevines
 - Feeding on soft-fleshed vegetables, shade grown 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



Epiphragm



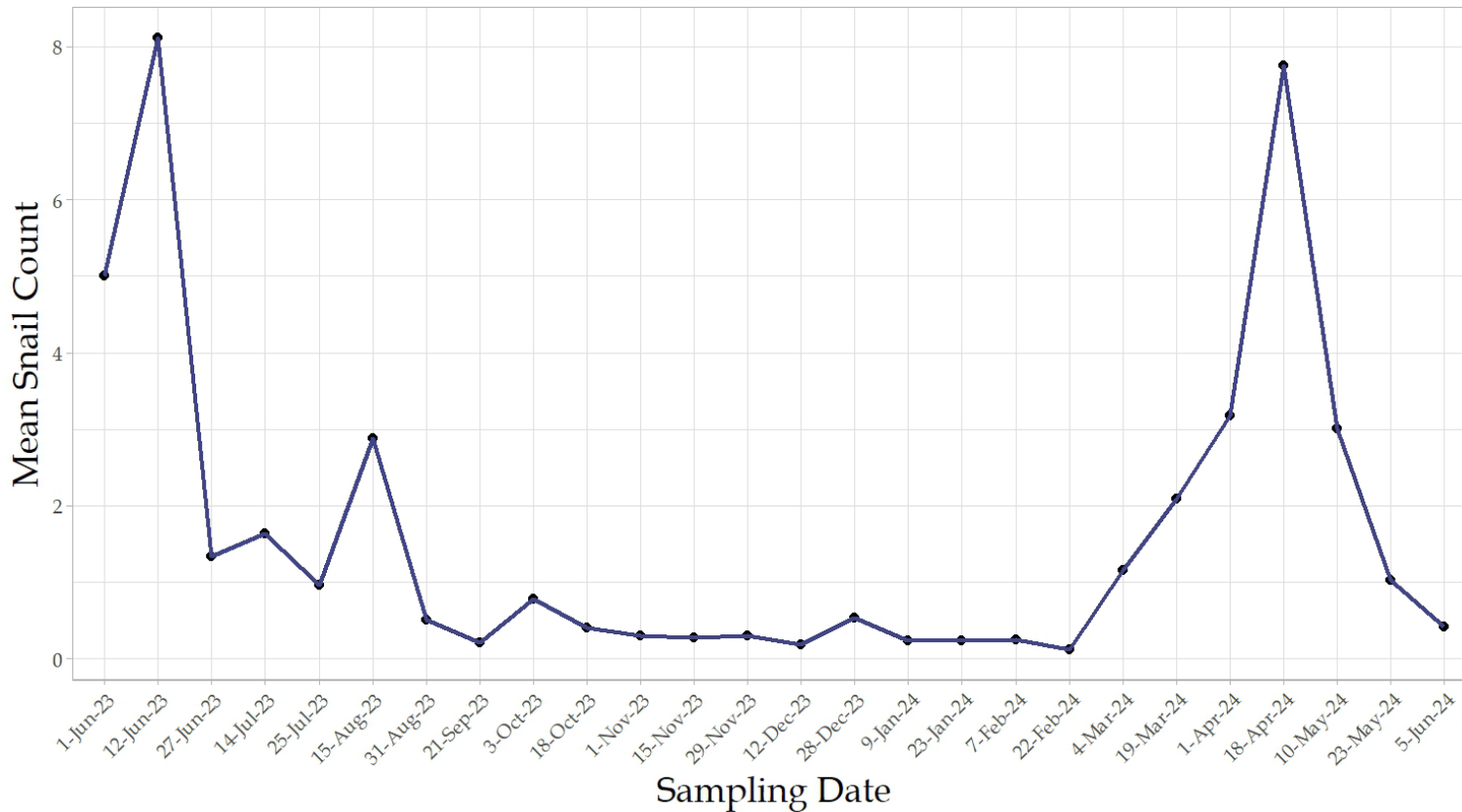
Ability of snails to withstand inhospitable environments

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



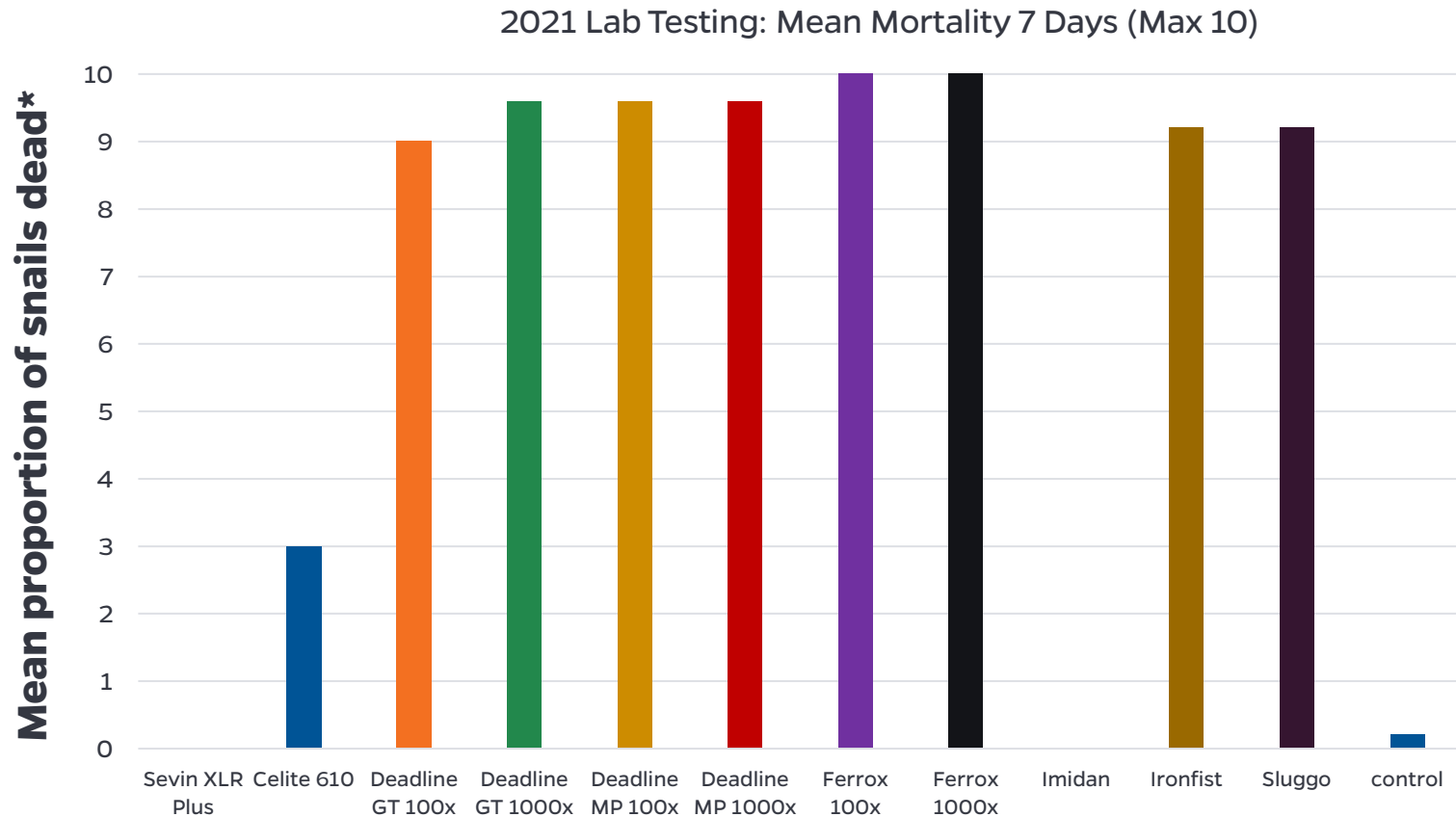
Seasonal activity as monitored by traps

Mean snail captures across all traps- Site 1



- Numbers of snails varied by site
- Habitat within sites vary
 - Site 1: mostly sand
 - Site 2: partial sand, some weeds
 - Site 3: full ground cover in row middles
- All have decreased captures September- late February
 - Are they present?
Active?
 - Where are they?

Limited availability of effective chemistries

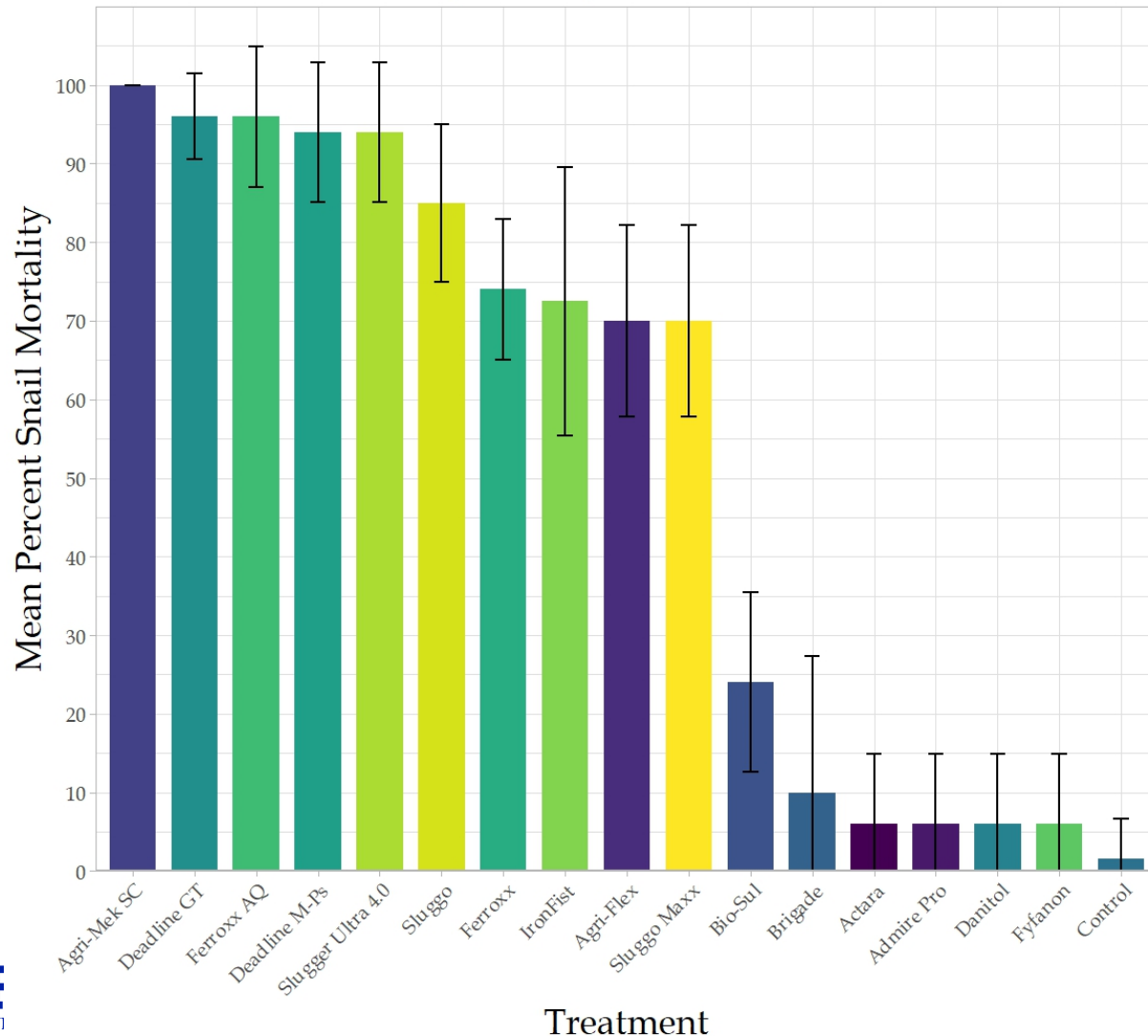


*10 = 100% mortality

- Several baits are available, but efficacy is inconsistent in groves
 - Rates tested are 100 or 1000 times the maximum application rate
- What if pesticides we currently use have an added benefit towards snail management?

Testing a broader range of chemistries

Mean Snail Mortality 14 Days After Treatment

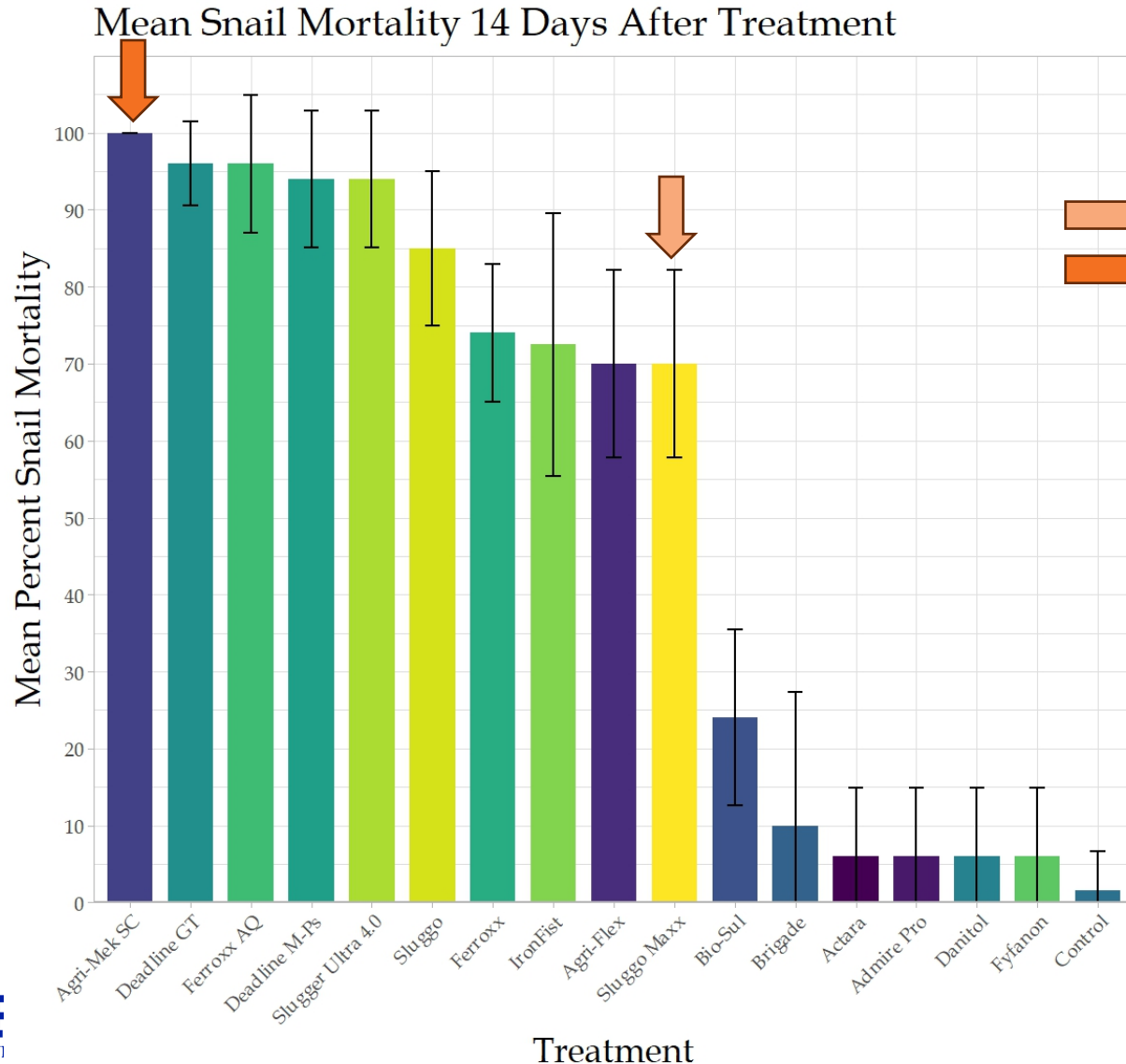


Insecticides	Active Ingredient	Max Rate
Actara	Thiamethoxam 25.0%	5.5 oz/a
Admire Pro	Imidacloprid 42.8%	7.0 oz/a
Agri-Flex	TMX 13.9%+Abamectin 3.0%	8.5 oz/a
Agri-Mek SC	Abamectin 8.0%	4.25 oz/a
Brigade 2 EC	Bifenthrin 25.1%	32 oz/a
Danitol 2.4 EC	Fenpropathrin 30.9%	21.33 oz/a
Fyfanon	Malathion 57.0%	4.5 pt/a
Baits*	Active Ingredient	Max Rate
Bio-Sul	Sulfur 1.0%	44 lbs/a
Deadline GT	Metaldehyde 3.0%	33.3 lbs/a
Deadline M-Ps	Metaldehyde 4.0%	25 lbs/a
Ferroxx	Sodium Ferric EDTA 5.0%	20 lbs/a
Ferroxx AQ	Iron phosphate 3.0%	25 lbs/a
IronFist	Sodium Ferric EDTA 2.0%	40 lbs/a
Slugger Ultra 4.0	Metaldehyde 4.0%	25 lbs/a
Sluggo	Iron phosphate 1.0%	43.56 lbs/a
Sluggo Maxx	Iron phosphate 3.0%	25 lbs/a

*Baits tested at 10x

Most insecticides are NOT labelled for snails!

Insecticides labelled for use in citrus (more in progress!)

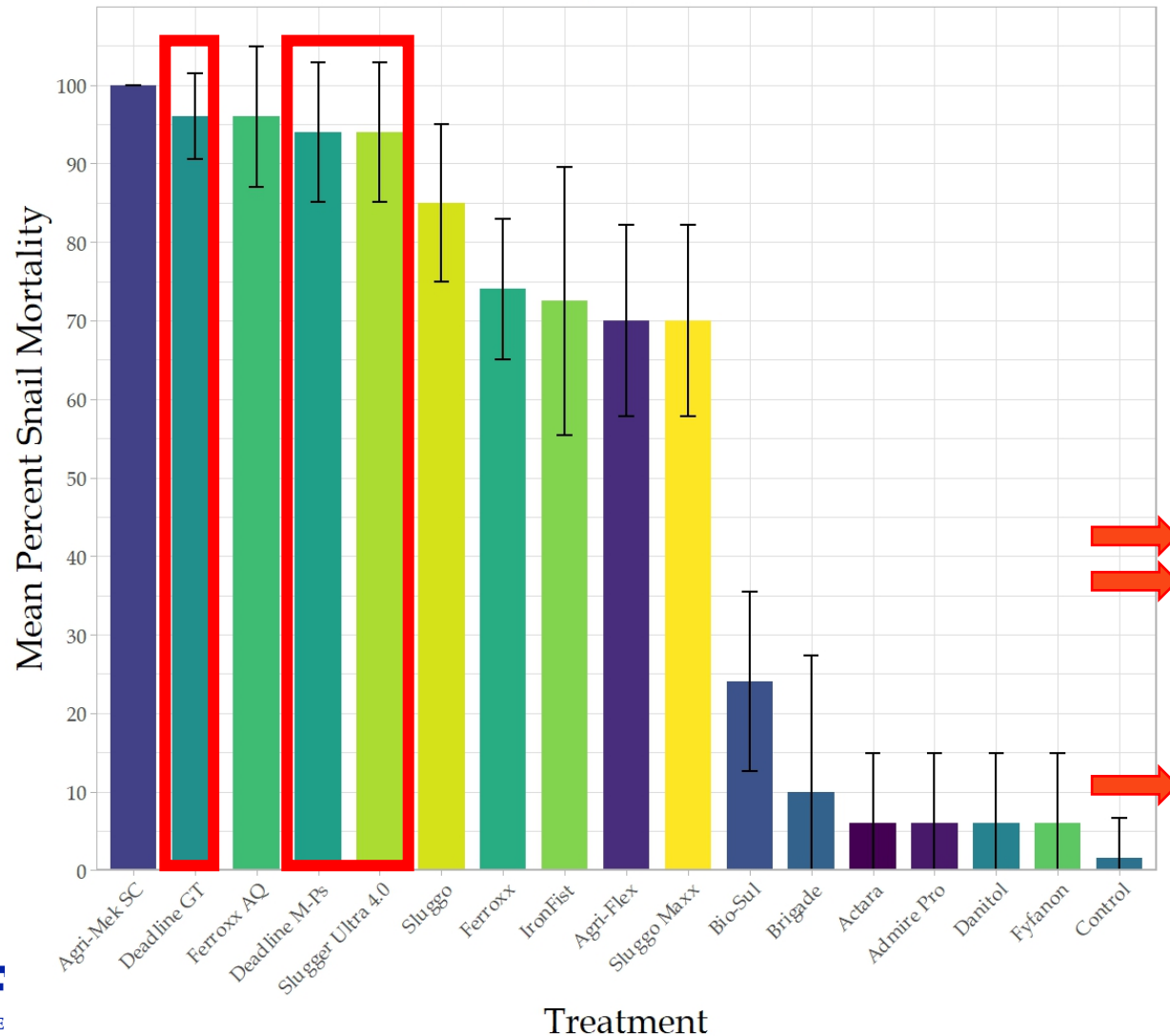


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Metaldehyde baits

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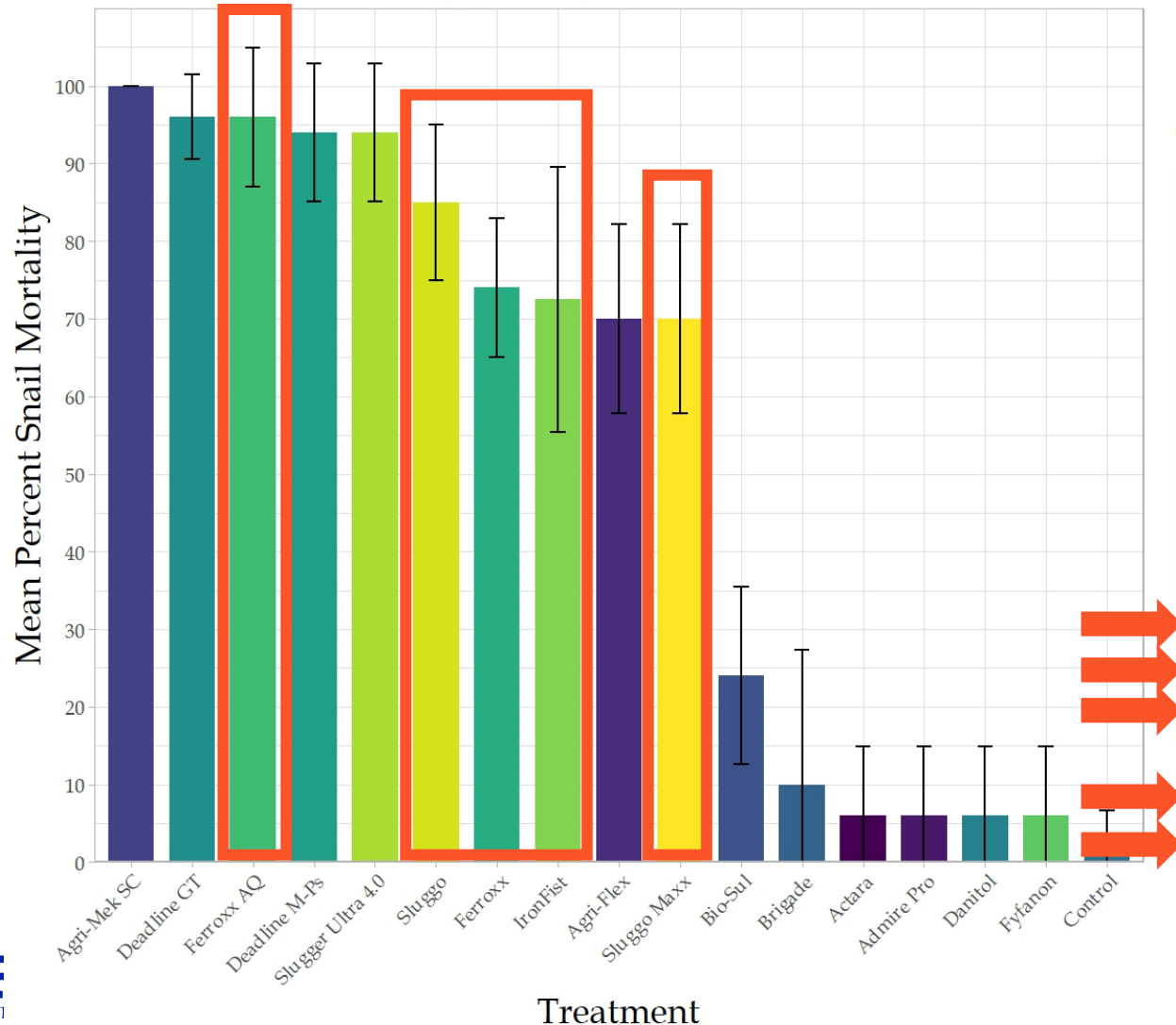


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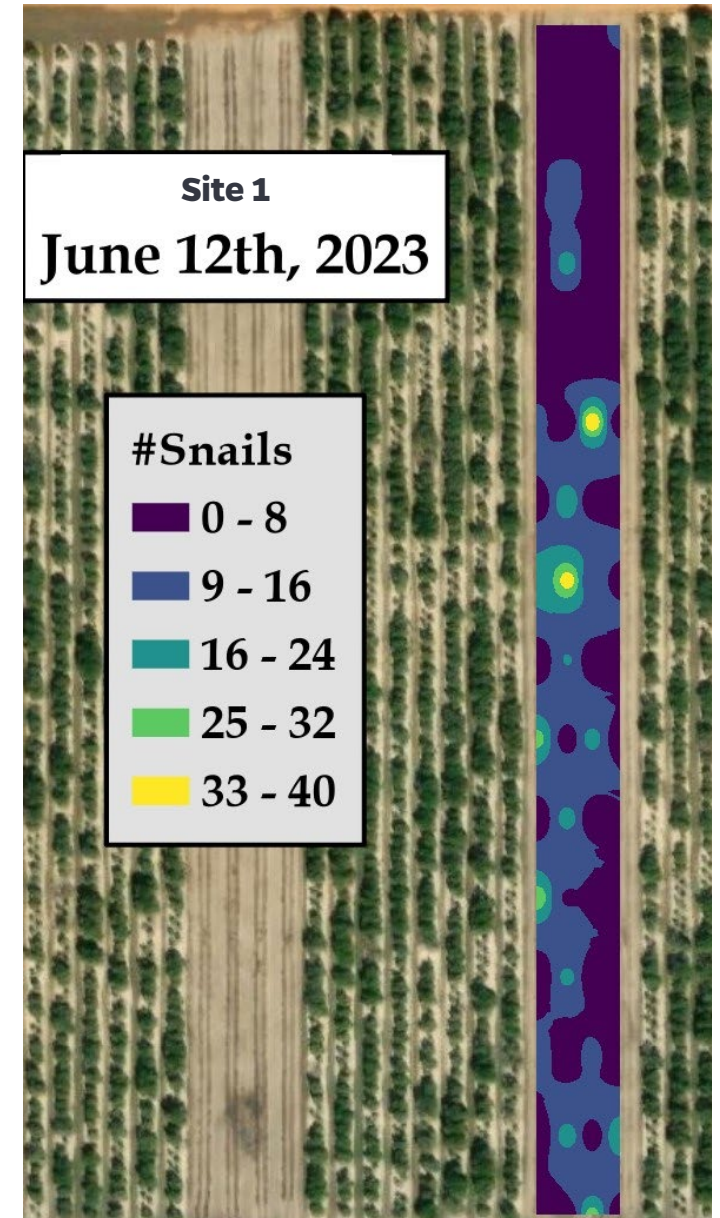
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Baits are expensive- can we target where snails are located within a grove?



Within grove snail distribution

- Biweekly trapping in 3 sites
- Snail density in traps mapped to location of traps within fields
- Similar outcomes in all sites:
 - Distribution is not uniform
 - No clear trends to edges or within site variables
 - Few snails trapped in field margins
- Management will have to be distributed throughout the grove to reduce the population



Ongoing work

- Chemical evaluations
 - Evaluations will continue until snails reduce populations in field (early October), and resume in mid spring 2025 concurrent with activity
 - Testing: Insecticides, fungicides, herbicides
- Trapping
 - Biweekly until fall 2025- describe seasonal cycles with multiple years of data
- Mark-recapture
 - Preliminary mark-recapture with painted snails- look for activity patterns
 - RFID tracking of snails within sites to determine 3-dimensional movement patterns (start spring 2025)
- Looking for predators
 - Performed in collaboration with Dr. Nicole Quinn UF-IFAS IRREC

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Questions?

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