Bulimulus Snail Management Updates

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1

Bulimulus bonariensis Identification

- Common names:
  - Ghost snail
  - Peanut snail

- Key features:
  - Conical
  - Light brown to tan
  - Larger snails are ¾-1 inch in length

- Origin of U.S populations uncertain
  - Likely multiple introductions from several locations

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Photo credit: Paula-Moraes

2

1

B. bonariensis General Information

- Native to Central and South America and the Caribbean

- Generally referred to as "tree-dwelling" snails
  - Climb structures: barns, houses, playground equipment
  - **Climb and clog microjets!**
  - **Climb and adhere to equipment!**

- Species or species complex?
  - Can matter for management if behaviors/susceptibilities are different

Photo credit: Diepenbrock

3

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

- Uncertain how/when they first arrived/established

- First found by a shell club in Duval County, Florida

- Snails have been found attached to cargo

- Can move between fields by climbing onto farm equipment and people

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

Photo credit: Dickens, Diepenbrock

4

Basic Biology - Life Stages

- Eggs laid under the soil surface

- Juveniles born with a soft shell

- Need to consume calcium to develop hardened shells

- Shells grow with snail, but are not an indicator of age

- Adults are hermaphrodites

- Require sexual reproduction
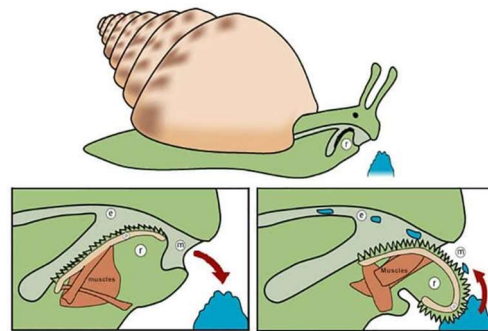
- Multiyear lifespan

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Photo credit: Paula-Moraes

5

Basic Biology - Feeding

- Most snails are considered grazers, generally feed on "films on the surface" of other things

- Thought to prefer damaged/decaying

- Attracted to moisture in agricultural settings

- Will feed on young citrus (green trunks), under damaged bark, on leaves if trapped, any damage point

How A Snail Feeds

e = eosophagus, m = mouth, o = odontophore, r = radula

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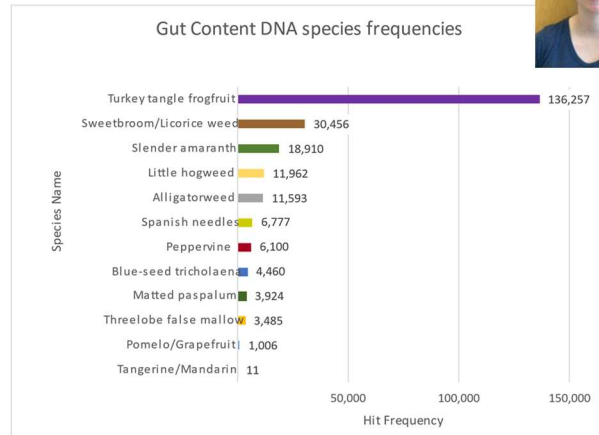Photo credit: earthlife.net/gastropod-anatomy/

6

Gut Content Data (Citrus)

- Ongoing research in Quinn Lab (UF IFAS IRREC)

- In citrus, snail gut content research shows that most of their food resources are weeds

- We plan to use these non-crop resources as areas to deploy management

Gut Content DNA species frequencies

Species Name	Hit Frequency
Turkey tangle frogfruit	136,257
Sweetbroom/Licorice weed	30,456
Slender amaranth	18,910
Little hogweed	11,962
Alligatorweed	11,593
Spanish needles	6,777
Peppervine	6,100
Blue-seed tricholaena	4,460
Matted paspalum	3,924
Threelobe false mallow	3,485
Pomelo/Grapefruit	1,006
Tangerine/Mandarin	11

Data courtesy of Dr. Nicole Quinn

7

Snail Survival Tools

- Most snails can withstand a wide array of inhospitable environments

- Snails have an epiphragm ("door"):
  - Can close off this membrane to avoid periods of drought and other unfavorable conditions

- Snails can detoxify chemistries
  - Mucus can detoxify many chemistries, making snails challenging to manage

Epiphragm

Photo credit: Paula-Moraes

8

Developing Management Plans

What you will need to know:

      1. Activity periods in your region

      2. Timing of snail daily activity

      3. What tools you have in your toolbox:

            Pesticides: molluscicides, insecticides, miticides, herbicides, fungicides

            Physical management?

            Biological control options?

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9

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10

Determining Activity Periods

- Like many snails, *B. bonariensis* is active in the evening and morning
  - This information is critical for management timing

- Seasonal activity patterns vary by region
  - Passive sampling can be used to determine when snails become/are active in citrus
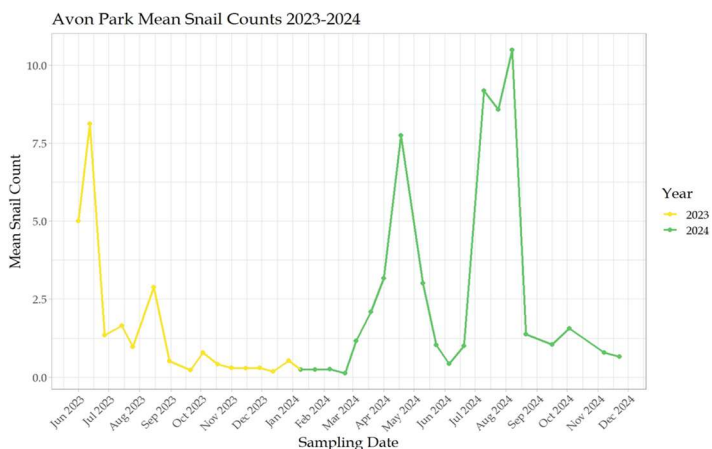
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Sampling - Tree Crops

- Field trapping with two trap styles (flat & pyramid) in groves in central FL
  - Traps checked biweekly

- Preliminary findings to date:
  - Trap type matters for detection, likely influenced by ground cover
  - Field with ground cover: flat traps attract more snails than pyramid traps
  - Field without or with minimal ground cover: pyramid traps attract more snails than flat traps
  - Ongoing research to determine which one will detect snail activity sooner in the spring

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Photo credit: Diepenbrock

Seasonal Activity: Central Florida Citrus

Avon Park Mean Snail Counts 2023-2024

- Mean snails per trap, two years
- Activity increases mid March, similar timing to flowering and flush
- Fewer caught during dry periods -> irrigation clogging during these periods
- June/July rainy period -> snails caught on traps again
- Trap capture patterns consistent with wet-dry periods
- Field observations of increased snail presence mid-late March, treatment should start at this time to reduce population early

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13

Developing Management Plans

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   Physical management?

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14

Daily Activity Patterns

- *B. bonariensis* appears to be tied to ambient temperature and moisture levels

- In central Florida, as ground temperatures rise, the snails migrate from the sandy soils to areas of higher elevation, leading to their accumulations on trees, irrigation, and equipment
  - This can be influenced by crop and within crop habitats (cover crops)

- Daily activity patterns can be important for management timing*

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15

Developing Management Plans

What you will need to know:

1. Activity periods in your region/crop

2. Timing of snail daily activity

3. What tools you have in your toolbox:

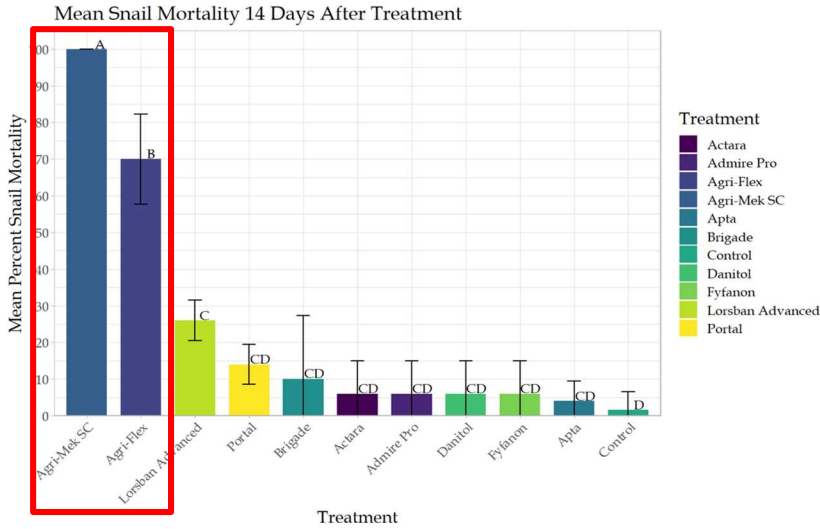Pesticides: molluscicides, insecticides, miticides, herbicides, fungicides

Physical management?

Biological control options?

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16

Chemical Management Updates: Foliar

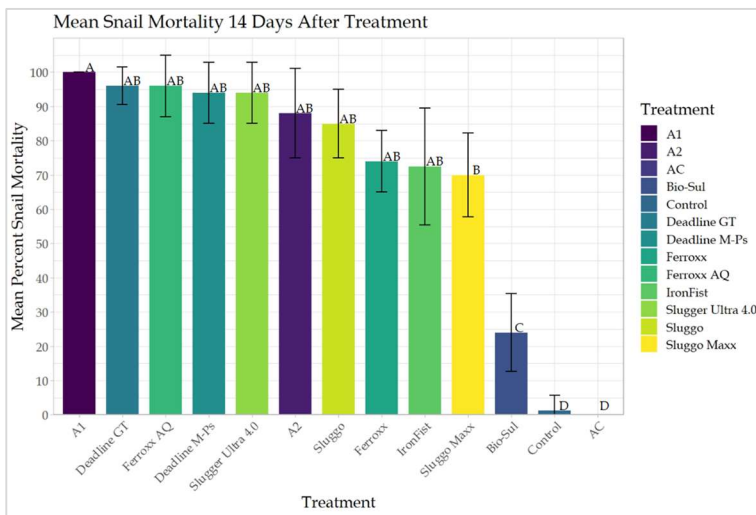Mean Snail Mortality 14 Days After Treatment

- Spray assay designed to capture greatest potential activity of materials
- Snails, fresh leaves, and sand lightly sprayed with water to ensure snail bodies are exposed to pesticide
- Chemistries with abamectin have the greatest CONTACT mortality
  - **To work in the field, this material MUST make contact with the snail's body**
  - No residual activity of abamectin

17

Chemical Management Updates: Foliar

Mean Snail Mortality 14 Days After Treatment

- Commercially available baits tested at 10x maximum rate
- Evaluating new bait active ingredients, labelled:
  - "A1" & "A2" from Apex Bait Technologies
- New product appears to be as effective as the most effective commercially available bait chemistries, but with fewer potential non-target effects
- Stay tuned for more data on this product!

18

9

General Management Takeaways

- Management recommendations are far from complete, but pieces are available:
  - Passive trapping to determine seasonality
  - Daily activity patterns
  - Chemistries

- Researchers from academia and industry are invested and working together to develop solutions

19

Acknowledgements

Dr. Nicole Quinn
Noah Barguez-Arias
Lena Craft
Diana Estrada
Rejoice Muruge
Haley Martini
Tracy Liesenfelt
Bennett Farrar
Chelsea Chamara
Dr. Silvana Paula-Moraes

Thank you to our growers and industry colleagues for working with us on this research and providing helpful input throughout!

CRDF Citrus Research and Development Foundation, Inc.

20

10

Questions?

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Insecticides	Active Ingredient	Max Rate	Application Rate (mL/L)
Actara	Thiamethoxam 25.0%	5.5 oz/a	0.43
Admire Pro	Imidacloprid 42.8%	7.0 oz/a	0.55
Agri-Flex	TMX 13.9%+ Abamectin 3.0%	8.5 oz/a	0.66
Agri-Mek SC	Abamectin 8.0%	4.25 oz/a	0.33
Apta	Tolfenpyrad 15.0%	27 oz/a	2.12
Brigade 2 EC	Bifenthrin 25.1%	32 oz/a	2.5
Danitol 2.4 EC	Fenpropathrin 30.9%	21.33 oz/a	1.67
Fyfanon	Malathion 57.0%	4.5 pt/a	6.76
Lorsban Advanced	Chlorpyrifos 40.2%	80 oz/a	6.25
Portal	Fenpyroximate 5.0%	64 oz/a	5

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Baits*	Active Ingredient	Max Rate	Application (grams)
Bio-Sul	Sulfur 1.0%	44 lbs/a	2
Deadline GT	Metaldehyde 3.0%	33.3 lbs/a	1.5
Deadline M-Ps	Metaldehyde 4.0%	25 lbs/a	1.2
Ferroxx	Sodium Ferric EDTA 5.0%	20 lbs/a	0.92
Ferroxx AQ	Iron phosphate 3.0%	25 lbs/a	1.2
IronFist	Sodium Ferric EDTA 2.0%	40 lbs/a	1.8
Slugger Ultra 4.0	Metaldehyde 4.0%	25 lbs/a	1.2
Sluggo	Iron phosphate 1.0%	43.56 lbs/a	2
Sluggo Maxx	Iron phosphate 3.0%	25 lbs/a	1.2

*For baits, 10x the max rate was applied to provide sufficient coverage and increase encounter rate

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23