Microgravity effect on entomopathogenic nematodes’ ability to find and kill insects

Dr. Fatma Kaplan, Pheronym
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Dr. Edith Sampson, UF
Without pest control, Farmers would lose 30 - 80% of their crops

A 12% annual global crop loss, worth ~$157 Billion, is just due to plant parasitic nematodes.
Nematodes

The most abundant animals on earth!

- Live everywhere
- Parasitize nearly everything
- Stay dormant decades
- Difficult to control

~1020 trillion nematodes (2000/m²) estimated on earth
Nematode pheromones

Pheromone control
- Disrupt mating (Sex)
- Repel or attract
- Disperse
- Interfere development

A blend of small molecules regulates both mating and development in Caenorhabditis elegans

Interspecific Nematode Signals Regulate Dispersal Behavior

Pheromone extracts act as boosters for entomopathogenic nematodes efficacy
Pheromone stimulate dispersal behavior
Pheronym controls all nematodes with pheromones

**Bad Nematodes**

![Image of bad nematodes infecting plant root]

**PheroCoat**

- Repels nematodes from plants

**Nematode**

- Microscopic round worm

**Good Nematodes**

![Image of good nematodes infecting insect]

**Nemastim**

- Directs nematodes toward insect pests

Infect plant root

Infect insect

Pherocoat and Nemastim are trademarks of Pheronym
With pheromone treatment, EPNs disperse and encounter insects.
Improved efficacy for controlling pecan weevil

The trials conducted in the laboratory of Dr. David Shapiro-Ilan

With Nemastim treatment, more nematodes go further in the soil

The trials conducted in the laboratory of Dr. David Shapiro-Ilan

Bee friendly insect control solution with good nematodes

One product 2 beneficial nematodes controlling 25 insect pests

Nemastim™

- **S. feltiae**
- **S. carpocapsae**

Nemastim makes nematodes
- move faster
- go deeper in the soil
- infect in 3X higher numbers
- 28% to 78% more effective

**Thrips, fungus gnats**
- pecan weevil, armyworms, banana root borer, shore flies, sweetpotato weevil, leafminers, codling moth, corn earworm, borers, citrus root weevil

artichoke plume moth, **banana moth**, black cutworm, mole crickets, **corn rootworm**, billbug, **black vine weevil**, cat flea, cranberry girdler, crane fly, iris borer, large pine weevil, **navel orangeworm**, scarab grubs

Pecan weevil targets 270 plants

- Pecan
- Walnut

Citrus root weevil targets 270 plants

- Citrus
- Sugarcane

Potatoes

Strawberry
In line with NASA’s mission to colonize the Moon and Mars

Review Article

Raymond M. Wheeler*

Agriculture for Space: People and Places Paving the Way

DOI 10.1515/opag-2017-0002
Received December 14, 2016; accepted January 15, 2017

Abstract: Agricultural systems for space have been discussed since the works of Tsiolkovsky in the early 20th century. Central to the concept is the use of photosynthetic organisms and light to generate oxygen and food.

production and have a group a controlled environment and tested 1), which
Good nematodes are part of healthy soil ecosystem
One Tiny Step for a Nematode, One Big Step Toward Sustainable Agriculture in Space

Explore basic research questions

- How is pheromone production affected?
- Can EPNs find insects in microgravity?
- How does the insect immune system respond?
- Does space flight affect their infectivity?
- Would EPNs (reproduced in space) have the same microbiome?
- How does the space radiation affect nematode’s future progeny, life span, behavior, infectivity, etc?
Acknowledgement of funding and resources

Funding

- Accelerator and Angel Investment
- USDA SBIR Phase I

Incubator and Cooperative Agreement

- CRADA
- Greenhouse, orchards, lab and equipment
- Shared lab space and equipment

Leveraged grant funding, incubators and accelerators to build an investor-ready start-up
AstroNematode
Launched on December 5, 2019
on SpaceX Falcon 9 CRS-19,
Returned on Jan 7, 2020

The 1st agriculture biocontrol experiment in space

For updates:
- Go to www.astronematode.com
- Follow @astronematode