DOSE–RESPONSE PROFILES OF FLUOPYRAM AND GARLIC-DERIVED DIALLYL POLYSULFIDES AGAINST *BELONOLAIMUS LONGICAUDATUS*

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Background

Sting Nematode Management in Florida Strawberries

Sting nematode (*Belonolaimus longicaudatus*) is one of the most damaging plant-parasitic nematodes in Florida sandy soils, particularly in high-value crops such as strawberry and vegetables. Feeding by sting nematodes causes severe root damage, leading to reduced plant vigor, stand loss, and significant yield losses. Management has historically relied on soil fumigation; however, increasing regulatory restrictions and production costs have driven the adoption of non-fumigant nematicides. Fluopyram (Velum®), a succinate dehydrogenase inhibitor (SDHI), is currently the primary post-plant option in Florida strawberry systems. Continued reliance on a single mode of action raises concerns about reduced sensitivity and highlights the need for alternative tools. This study evaluates the biological activity of garlic-derived diallyl polysulfides (DAPS; NEMguard™) relative to fluopyram to better understand their potential role in integrated nematode management programs.

Fig 1 . Typical sting nematode (*Belonolaimus longicaudatus*) damage on strawberry: aboveground stunting (left) and severe root pruning (center, right)..

Hypothesis

- The hypothesis of this study is that garlic-derived diallyl polysulfides and fluopyram will produce distinct dose–response profiles against sting nematode, reflecting differences in mode of action, exposure concentration, and effects on motility and mortality.

Objective

- Evaluate the effects of fluopyram (Velum®) and DAPS (NEMguard™) on sting nematode motility and mortality.
- Characterize dose–response relationships across relevant concentration ranges.
- Assess their potential role in integrated nematode management programs.

Materials and Methods

Nematode Source

- Sting nematodes (Belonolaimus longicaudatus) were extracted from field soil using a modified Baermann method.
- Nematode suspensions were standardized prior to assay setup.

Experimental Design

- Assays conducted in 48-well plates (1 mL per well)
- 500 µL nematode suspension + 500 µL 2X treatment solution
- Products tested:
  - Fluopyram (Velum®): 1–1,000 ppm
  - DAPS (NEMguard™): 100–10,000 ppm
- Exposure times: 6, 24, 48, and 96 h One independent run per product with multiple replicates per treatment.

Motility and Mortality Evaluations

- Motility: nematodes classified as active, affected, or immobile under microscope
- Mortality: assessed using 1 N NaOH stimulus
  - Live nematodes respond to stimulus
  - Dead nematodes do not respond
- Responses expressed as proportion affected + immobile (motility) or dead (mortality)

Materials and Methods

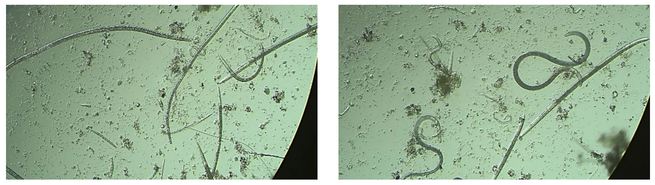

Fig 2 . Nematodes following NaOH stimulus used for mortality assessment; live individuals respond to the stimulus, whereas dead nematodes remain immobile.

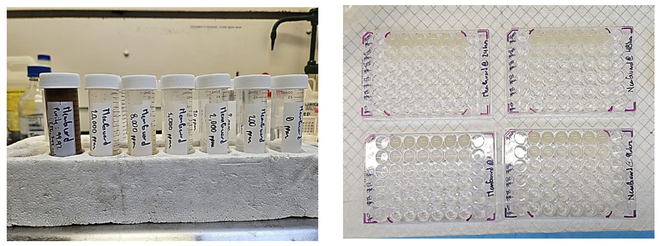

Fig 3 . Preparation of nematicide solutions through serial dilution and setup of exposure treatments in 48-well plates.

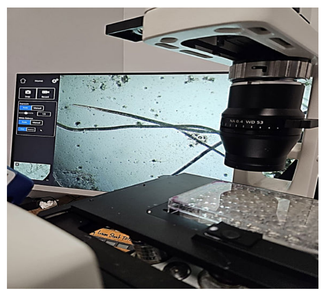

Fig 4 . Inverted microscope used to evaluate nematode motility and mortality following exposure.

Results

Control Response - Motility (0 ppm)

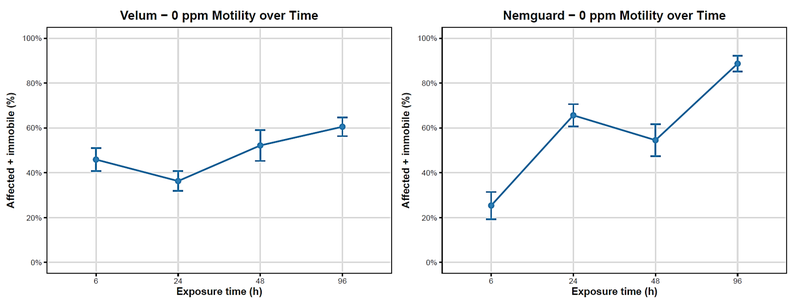

Fig 5 . Control response (0 ppm): motility of *Belonolaimus longicaudatus* over time, showing baseline levels of affected and immobile nematodes in the absence of treatment..

Control Response - Mortality (0 ppm)

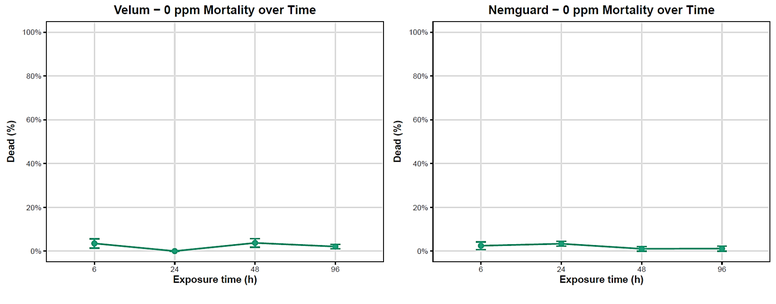

Fig 6 . Control response (0 ppm): mortality of Belonolaimus longicaudatus over time, confirming low baseline mortality in untreated conditions.

Results

Motility Response (EC_{50})

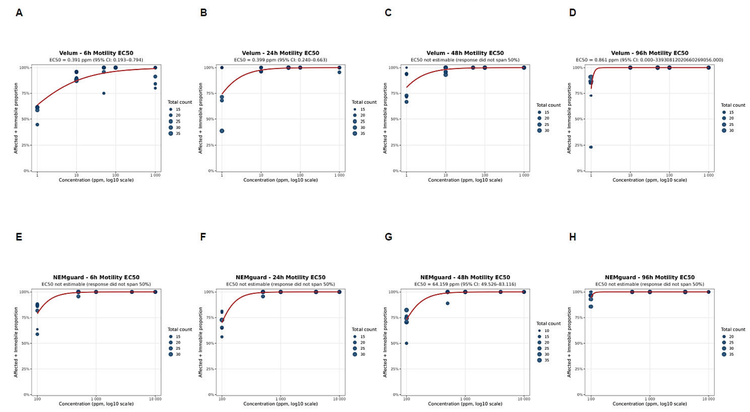

Fig 7 . Motility dose–response curves (EC_{50}) for fluopyram (Velum®) and DAPS (NEMguard™), showing strong low-ppm activity for fluopyram and responses exceeding 50% across the tested range for DAPS.

Mortality Response (LC_{50})

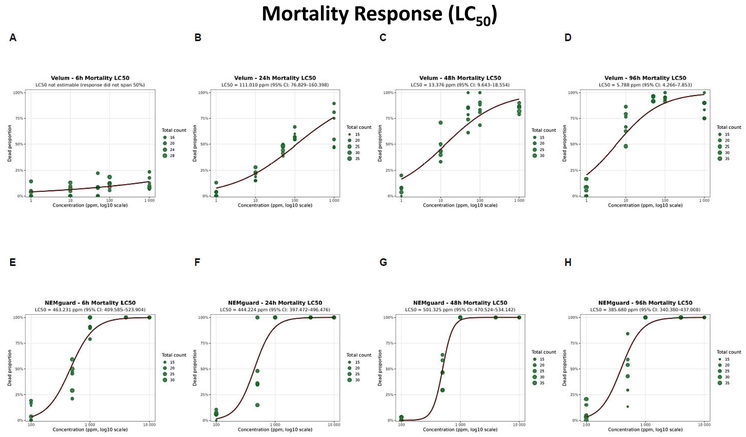

Fig 8 . Mortality dose–response curves (LC_{50}) for fluopyram (Velum®) and DAPS (NEMguard™) across exposure times, showing time-dependent mortality for fluopyram and rapid, concentration-dependent mortality for DAPS.

Table 1. Summary of EC_{50} (motility) and LC_{50} (mortality) values for fluopyram (Velum®) and garlic-derived diallyl polysulfides (DAPS; NEMguard™) against *Belonolaimus longicaudatus*.

Product	Time (h)	EC_{50} (ppm)	LC_{50} (ppm)
Velum®	6	**0.39**	Not estimable (>1,000)
Velum®	24	**0.40**	111.01
Velum®	48	Not estimable (<1)	13.38
Velum®	96	**0.86**	**5.79**
NEMguard™	6	Not estimable (<100)	**463.23**
NEMguard™	24	Not estimable (<100)	**444.22**
NEMguard™	48	**64.16**	**501.32**
NEMguard™	96	Not estimable (<100)	**385.68**

EC_{50} or LC_{50} values were considered not estimable when responses did not span the 50% threshold across the tested concentration range.

Conclusions

- **Fluopyram (Velum®)**, at concentrations relevant to soil water (~1–10 ppm), showed strong motility inhibition, with mortality increasing over time, indicating time- and concentration-dependent activity.
- **DAPS (NEMguard™)** showed nematistatic effects at lower concentrations (EC_{50} not estimable) and transitioned to nematicidal activity at higher concentrations (LC_{50} ~385–500 ppm), achieving ~50% mortality, with near-complete mortality approaching ~1,000 ppm.
- These results highlight **distinct response patterns under controlled conditions**; ongoing field studies are evaluating whether DAPS can be integrated with fluopyram to improve nematode management programs and provide an additional rotational tool alongside non-fumigant nematicides.

Acknowledgements

- We thank Ecospray Ltd and the members of the University of Florida's Vegetable and Fruit Nematology Laboratory for their support.

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