

Commercial testing of BioNem and BioSafe, two bionematicides for the control of root-knot nematodes (*Meloidogyne* spp.)



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Background

BioNem and BioSafe are two biological nematicides based on an isolate of the bacteria *Bacillus firmus*. The products have been registered as microbial nematicides in Israel and registration in other countries is in an advanced stage. In extensive commercial testing on vegetable crops (tomato, cucumber and pepper) and herb (basil) BioNem and BioSafe pre-plant applications significantly reduced the nematode populations and the root infestation (galling index), and induced an overall increase in yield comparable to that obtained with the current chemical standards. Toxicological studies show no adverse effects on non-target organisms. The combination of BioNem with soil fumigation (dazomet) or soil solarization provided an enhanced nematode control, when compared to each treatment alone. BioNem and BioSafe thus have a unique profile as microbial bionematicides, offering a new option for integrated management of nematode pests.

Products Description

Trade Name: BioNem and BioSafe.
Use: Bionematicide for root-knot nematodes (*Meloidogyne* spp.) control.
Crops: Tomato, cucumber, pepper, basil.
Formulation: Granulated powder for preplant application.
Active Ingredient: *Bacillus firmus*.
Mode of action: Reduces viable nematode population.
Composition: *Bacillus firmus* spores and materials of plant and animal origin. No toxic materials are included.
Shelf life: Over two years at ambient conditions.
BioNem is registered in Israel for tomato and cucumber crops.
BioSafe is registered in Israel for all vegetable crops.

Material and methods

Field trials were carried out throughout several growing seasons in commercial greenhouses naturally infested with root-knot nematodes (primarily *Meloidogyne javanica*). A randomized block design was used with 6-8 replicates. BioNem or BioSafe were applied (2 to 7 days before planting) onto the planting row (70 or 140 g/linear meter; approximately 500 or 1000 kg ha⁻¹, respectively). Cucumber, tomato, pepper or basil seedlings were transplanted and cropped according to recommendations for commercial production. Methyl bromide (MB), dazomet (DAZ), cadusaphos (Rugby), 1,3-dichloropropene (1,3-D) were applied according to manufacturer instructions. Root-knot infestation was determined by uprooting 5-10 plants from each plot and assigning a galling index (GI) ranging from 0 (i.e. no galls) to 5 (i.e. entire root covered with galls). Nematode population in soil was determined periodically by the Baerman funnel test.

Results

BioNem application to soil infested with root-knot nematodes resulted in a fast decline of larval population (Fig. 1). In a field trial the suppression of nematode population was evident throughout a 7 months period (Fig. 2).

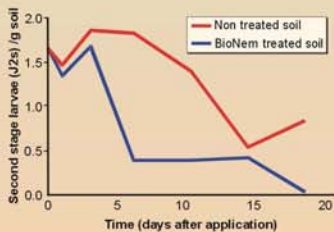


Fig. 1. Rapid decline in juvenile populations of *Meloidogyne* sp. in soil sample treated with BioNem (Laboratory study).

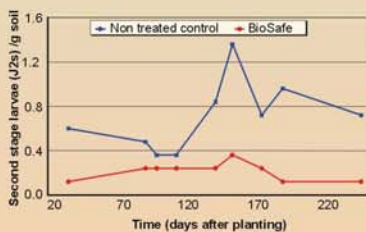


Fig. 2. Population dynamic of *Meloidogyne* sp. in soil treated with BioSafe (Field study).

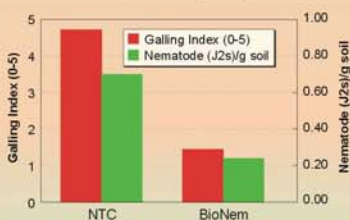


Fig. 3. Control of root-knot nematodes (*Meloidogyne* sp.) by BioNem on cucumber (Jat, 2001).



Fig. 4. Effect of BioNem on cucumber yield in soil infested by root-knot nematodes (*Meloidogyne* sp.) (Jat, 2001).



Effect of BioNem on cucumber plants grown on soil infested with nematodes (Jat, 2001).

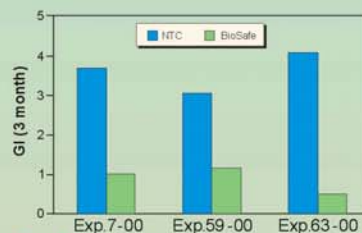


Fig. 6. Control of root-knot nematodes (*Meloidogyne* sp.) by BioSafe on organically grown basil.

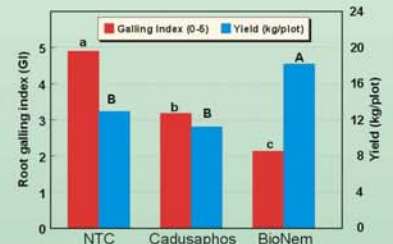


Fig. 5. Control of root-knot nematodes (*Meloidogyne* sp.) by BioNem on tomato (Kadima, 1998).



Effect of BioSafe on tomato plants grown on soil infested with nematodes (Kadima, 1998).

Soil treatment with BioNem or BioSafe reduced nematode population and root damages (galling index) on cucumber, tomato and basil (Fig. 3, 4, 5 and 6). BioSafe and BioName also induced an increase in yield performance when compared to the non treated control (NTC) (Fig. 4 and 5).

Implementation of BioNem in IPM programs

BioNem applied as a stand alone treatment significantly reduced nematode infestation when compared to the non treated control (Fig. 7 and 8). The combined treatment with Dazomet enhanced BioNem nematicidal activity, despite the fact that Dazomet alone had very little effect on nematode infestation (Fig. 7). Control of nematodes by the BioNem-Dazomet combination was as effective as that by methyl bromide. The application of nematodes by the BioNem-Dazomet combination was as effective as that by methyl bromide. The application of nematodes by the BioNem-Dazomet combination was as effective as that by methyl bromide. The application of nematodes by the BioNem-Dazomet combination was as effective as that by methyl bromide.

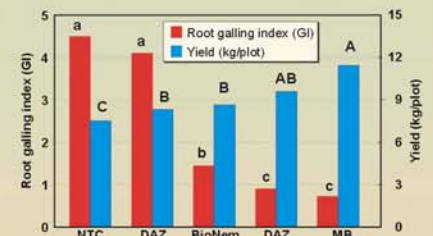


Fig. 7. Integrated management of root-knot nematode (*Meloidogyne* sp.) on cucumber crop (Yad Natan, 1999).



Effect of BioNem on pepper grown on soil infested with root-knot nematodes (Tzrufa, 1999).

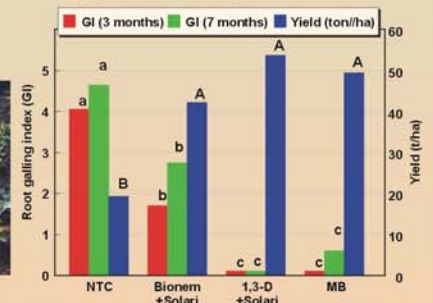


Fig. 8. Integrated management of root-knot nematodes (*Meloidogyne* sp.) on pepper crop (Tzrufa, 1999).

Conclusions

- BioNem and BioSafe (as stand alone treatments) are effective in controlling root-knot nematodes on several vegetable crops.
- The combination of BioNem with soil solarization or soil fumigants provides an additional strategy for root-knot nematode control.
- BioNem can be implemented effectively in IPM programs designed to replace methyl bromide.