

## **BioNem WP: a unique tool for nematode control**

**Daphna Blachinsky, Jana Antonov, Amir Bercovitz, Beny El-ad, Katya Feldman, Alice Husid, Michael Lazare, Nathaly Marcov, Idan Shamai, Mordechai Keren-Zur**

Agrogreen Minrav Group - Kiryat Minrav Hi-Tech Park, P.O.Box 153, Ashdod 77101, Israel.  
email: [dafna@agrogreen.co.il](mailto:dafna@agrogreen.co.il)

**Abstract:** Pre-plant application of nematicides is strongly recommended for effective control of nematodes. In certain situations, mainly in perennial crops, or in long season vegetables, nematodes emerge from deep soil layers and thus diminish the effect of the pre-plant treatment. The use of pesticides for post-planting control is limited due to their toxicity to plants and humans. BioNem WP is a biological nematicide, based on a unique strain of *Bacillus firmus*. It is conveniently applied in commercial fields through irrigation systems. BioNem WP is effective against phytopathogenic nematodes, and is registered in Israel for the control of root knot nematodes in vegetable crops (cucumber, tomatoes, pepper, eggplant and herbs) and in perennial crops (peaches, olives, ornamentals). Long term suppression of nematode population was observed following single application of BioNem WP, either pre or post-planting. This feature may be attributed to activity in deep soil layers and to persistent nematicidal activity in the treated soil, which was observed even under water recirculation. The long term activity of BioNem WP combined with its safety makes it a unique tool for nematode control in perennials, during harvest of edible crops, and under chronic infestation with nematodes.

### **Introduction**

The effectiveness of Methyl Bromide in nematode control made the development of new effective nematicides seem unnecessary. As Methyl Bromide is being phased out, the market is facing the need for an effective nematicide.

BioNem WP is a biological nematicide, based on a unique strain of *Bacillus firmus*. It is effective against phytopathogenic nematodes, and is conveniently applied in commercial fields through irrigation systems. The product is commercially used in Israel for the control of root knot nematodes (*Meloidogyne spp.*, RKN) in vegetables (cucumber, tomatoes, pepper, eggplant and herbs) and in perennial crops (ornamentals and stone-fruits).

Field performance results presented here, combined with its safety and ease of use prove BioNem WP to be an effective and unique tool for nematode control. In these studies, BioNem WP was found especially advantageous for nematode control in perennials, during harvest of edible crops, and under chronic nematode infestation.

### **Materials and Methods**

BioNem WP – A wettable powder formulation containing the bacteria *Bacillus firmus* and additives, Manufactured by Agro-Green, the Biological Div. of Minrav, Ashdod, Israel.

Field Trials - All trials were done in commercial plots. Treated plots were replicated at least 4 times (at least 10 m<sup>2</sup> per plot) randomly distributed. An aqueous suspension of BioNem WP was injected with a pressure sprayer or fertilizer pump into the irrigation line leading to treated plots. Following application the field received 20 mm of irrigation.

Disease Assessment - Soil nematode population: Soil from a depth of up to 15 cm was sampled from 8 random locations within the plot. RKN were counted using the Baerman funnel method. Field assessment of nematode damage: 6- 10 plants per plot were uprooted and the galling index scored on a severity scale of 0 (clean roots) to 5 (over 75% of the root surface covered with galls). Galling of roots is the measurable damage caused by root-knot nematodes. Damage to the roots is presented as the distribution of galling severity.

## Results

### Long term suppression of nematodes

Nematode control is best achieved by pre-plant application. When BioNem WP was applied pre-plant in Hypericum (ornamental crop), reduced nematode population was observed over a period of 10 months. The standard chemical (Cadusafos) provided partial control only, even though it was applied twice (Figure 1A). The reduced population was reflected also in a greatly reduced damage to the Hypericum roots as assessed 11 months after planting (Figure 1B). Similar results were seen in pepper, eggplant, and tomato (not shown). Due to the long term effect, only one application was necessary in most annual vegetables.

In perennial crops, the pre-plant treatment cannot provide nematode control which will last the entire life span of the crop. To complement the effect of the pre-plant treatment, annual spring treatments are currently recommended. Treating a peach orchard with BioNem WP in February resulted in some suppression of nematode population (Figure 2 dotted line). However, earlier application in November that relied on the long term effect of BioNem WP abolished the burst of active nematodes in the following spring (Figure 2). Such early treatment using conventional nematicides is not considered feasible due to their short term effect.

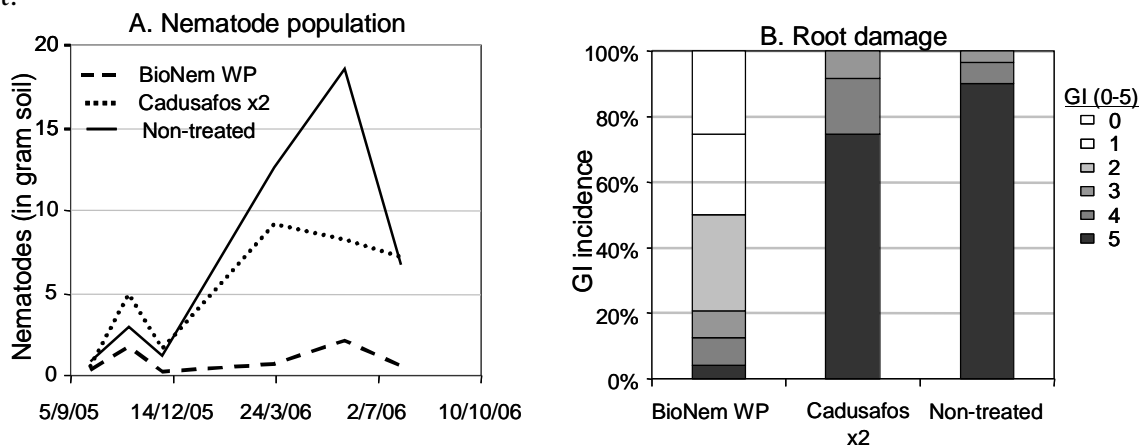


Figure 1. Long-term suppression of nematodes in Hypericum

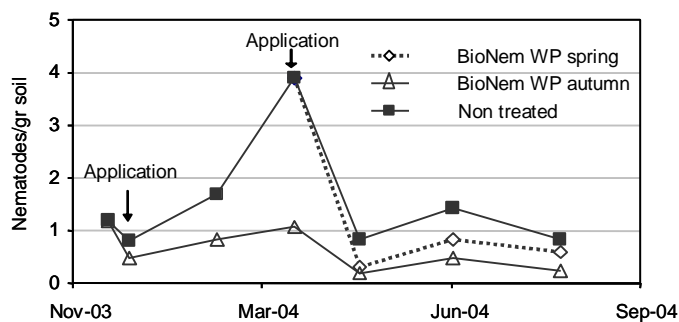


Figure 2. Effect of application timing on nematode control in peaches.

### Mid-season application

The effect of pre-plant treatment diminishes with time due to reinfestation of the field. Mid-season application of chemicals is restricted due to their toxic effects, especially during harvesting of edible crops. BioNem WP is non-toxic, non-phytotoxic and is allowed for use during harvesting of edible crops. These safety features coupled with easy application make BioNem WP the preferred candidate for mid-season uses. Application of BioNem WP in Sweet basil (3 months old) infested with RKN, resulted in a decrease in nematode population while a dramatic increase in nematode population was observed in the untreated plots (Figure 3A). The benefit of this population reduction was evidenced also by the reduction in the galling of the crop roots. (Figure 3B). Similar results were obtained in pepper, cucumber, eggplant and tomato (not shown).

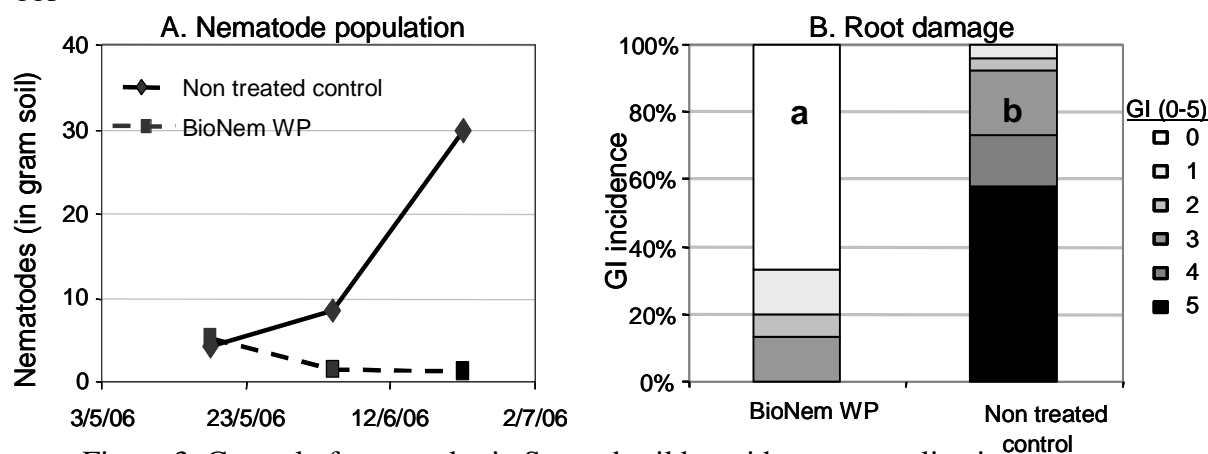


Figure 3. Control of nematodes in Sweet-basil by mid-season application

### Persistent nematode control

Soil fumigants eradicate nematodes within hours, after which they vaporize. In contrast, BioNem WP only reduces the nematode population in the soil. Low but measurable numbers of active nematodes can still be found following BioNem WP treatment (1). Despite this incomplete killing, the effect of reduced nematode population lasted for months (Figures 1-3). This phenomenon might be explained by persistent control activity.

Tomato seedlings were planted in soil from BioNem WP treated field that was mixed with freshly infested soil. Roots of these plants had less galling as compared with plants grown similarly in untreated soil (Fig 4). This effect lasted for 140 days following BioNem WP field application and is the manifestation of persistent nematode control activity in BioNem WP treated soil. None of the chemical nematicides possess this feature, which enable BioNem WP to outperform in certain situations.

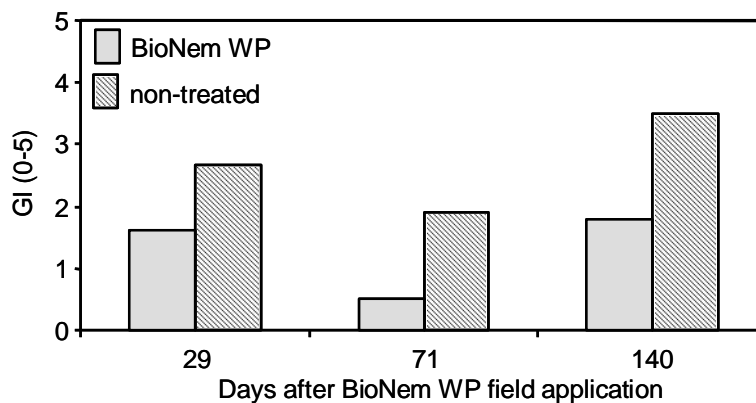


Figure 4. Persistent nematode control by BioNem WP

### Control of chronic infestations

Cropping on detached substrates is supposed to avoid nematode damage. However, once infested, the nematodes spread throughout the plot. Spreading is facilitated by recirculation of water. Chemical control under these conditions is difficult due to leaching. Frequent applications intended to compensate for the short term effect might result in damage to the environment and in reduced efficacy of the pesticides. An example of such situation was found in roses grown on detached substrate (Tuff) and irrigated by water recirculation. These roses were infested with *Meloidogyne hapla*. Repeated applications of chemical nematicides did not prevent the proliferation of these nematodes. BioNem WP was applied to two rows in the green house. The results in Fig 5 show an increase in active nematode population in the untreated rows, while no active nematodes were detected in the BioNem WP treated rows over a period of 12 weeks after application. It is suggested that the persistent nematode control achieved by BioNem WP suppressed nematodes in the treated substrate despite the continuous infestation by the irrigation water.

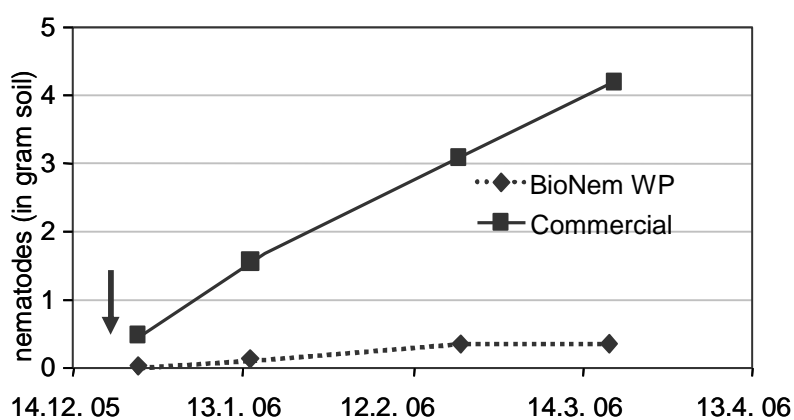


Figure 5. Control of chronic infestation in roses

### Conclusions

The results presented here show that BioNem WP provides effective nematode control that favorably compares with current chemical nematicides. Due to the persistent nematode control, BioNem WP was more effective than the chemical nematicides in certain situations. A single pre-plant application of BioNem WP was sufficient for the entire season in annual crops and may be comparable with several chemical nematicide applications per season. A new nematode control regime in perennial crops was demonstrated by autumn application of BioNem WP that enabled nematode control up to and beyond the following spring. A single BioNem WP application controlled nematodes in a plot irrigated by water recirculation. This demonstrates the unique ability of BioNem WP to control chronic infestations. Safety and phytosafety become a major concern when nematode control is needed during the harvesting of edible crop. BioNem WP provided the needed efficacy along with the required safety.

### References

Keren-Zur, M., Antonov, J., Bercovitz, A., Feldman, K., Husid, A., Kenan, G., Markov, N., Rebhun, M., 2000: *Bacillus firmus* formulations for the safe control of root-knot nematodes. In: Proceedings of the Brighton Crop Protection Conference on Pests and Diseases. 2A: 47–52.