



Using Beneficial Nematodes for Grub Control

Nematode Biology

Nematodes are microscopic, non-segmented worms which occur naturally in soil all over the world. Thousands of strains exist with different lifestyles. Beneficial nematodes attack only soil-dwelling insects and leave plants alone. Beneficial nematodes and the bacteria they spread are not known to be harmful to humans, animals, plants, earthworms or other non-target organisms, but they do aggressively pursue insects like grubs. When they sense the temperature and carbon dioxide emissions of soilborne insects, beneficial nematodes move toward their prey and enter the pest through its body openings. The nematodes carry an associated bacterium (*Photorhabdus* species) that kills insects fast (within 48 hours). Several generations of nematodes may live and breed within the dead pest; they emerge and seek more pests in the soil. Beneficial nematodes have been shown to be as much as 96% effective against Japanese beetle grubs in field studies.

Nematode Use Guide

Although many species of beneficial nematodes are available, *Heterorhabditis bacteriophora* (Hb) nematodes are most effective against Japanese beetles, European chafers and other grubs that are lawn pests. They are more efficient than the *Steinernema* species. Hb nematodes work better because they are cruiser nematodes that burrow down in the soil searching for deep soil-dwelling pests. They also have a special “tooth” that helps them get into the grub.

Nematodes are shipped in the infectious juvenile stage of their life cycle and can be stored in the refrigerator for up to 2–3 weeks. They may come on a sponge, in gels, granules or liquids.

The best time to apply nematodes is when grubs are present and actively feeding in late July to mid-September. Nematodes are neutralized by exposure to strong sunlight, so they must be applied in heavily overcast or rainy conditions; at dusk or during rainfall is an ideal time. Nematodes prefer a moist environment. If the ground is very dry, it helps to pre-irrigate the area with at least 0.5 inches of water.

Follow the mixing instructions carefully. To treat a 2000 sq. ft. lawn area, mix 1 million nematodes in at least 4 gallons of water that is under 86° F. Carefully pour the nematodes into a hand sprayer, hose-end sprayer or pressurized backpack sprayer and use the spray solution immediately. The sprayer nozzle opening should be at least 0.02 inches and any screens should be removed. Evenly spread the solution over the area to be treated. Continuous mixing should take place to prevent the nematodes from sinking to the bottom. After application apply 0.25 inches of water to wash the nematodes off the grass blades, and then keep the soil moist for at least two weeks to help them get established.

OVER

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After treatment, monitor the lawn carefully. If grub damage continues, apply nematodes a second time. Infected grubs take on a brown appearance (see below).



Where to Purchase Beneficial Nematodes

| Company Name | Company Location | Contact Information |
|--|--|--|
| The Green Spot Ltd. | 93 Priest Rd, Nottingham, NH 03290-6204 | 603-942-8925 www.greenmethods.com |
| O'Donal's Nursery | 6 County Road, RFD #4, Gorham, ME 04038 | 207-839-4262 www.odonalsnurseries.com |
| North Country Organics | P.O. Box 372, Depot Street, Bradford, VT 05033 | 802-222-4277 www.norganics.com |
| Skillin's Greenhouses | 89 Foreside Road, Falmouth, ME 04105 | 207-781-3860 www.skillins.com |
| Fedco Seeds | PO Box 520, Waterville, ME 04903 | 207-873-7333 www.fedcoseeds.com/ogs.htm |
| Hydro-Gardens | P.O. Box 25845, Colorado Springs, CO 80936-5845 | 888-693-0578 www.hydro-gardens.com |
| Griffin's Greenhouse & Nursery Supplies | 50 West Gray Road, Gray, ME 04039 | 207-657-5442 www.griffins.com |



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Insect Parasitic Nematodes for Turfgrass Pest Management



The lack of efficacy and inappropriate applications are common problems associated with the use of any pesticides. However, success with biological control agents requires a more educated end user. The following information is designed to help you increase the effectiveness of nematode applications for insect control in **turfgrass**.

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Selection of a nematode product

Insect-parasitic nematodes can be used to control larval stages of several turfgrass insect pests. They are also the most effective biological control option for curative control of insects. However, no single nematode species can control all turfgrass pests. Different nematode species carry different bacteria (the insect killing agent), use different hunting tactics, and have different temperature activity ranges.

Therefore, the selection of an appropriate nematode species or product for a specific target pest is very important. A list of nematode species together with the specific target pests is given in the table at right.

Storage and handling

Storage recommendations vary according to the product, and should be followed strictly. However, nematodes must be stored in a cool and dry location out of the direct sunlight. Most products require refrigerated storage. Do not expose to extreme temperature for long periods of time. Nematodes must not be frozen. Do not open bottles until ready to use. Do not store diluted product.

| Nematode | Target Pest |
|--------------------------------------|--|
| <i>Steinernema carpocapsae</i> | Annual bluegrass weevil Bluegrass billbug Hunting billbug Black cutworm Dog/cat flea larvae European crane fly Armyworms Sod webworms |
| <i>Steinernema riobravae</i> | Tawny mole cricket |
| <i>Steinernema scapterisci</i> | Southern mole cricket |
| <i>Heterorhabditis bacteriophora</i> | Black turfgrass ateniensis European chafer Green June beetle Japanese beetle May/June beetles |

No. masked chafer
So. masked chafer
SW. masked chafer
West. masked chafer

Application

Nematodes could be applied like most other conventional pesticides using backpack sprayers, pull-behind tank sprayers or fertigation systems. Dosage rates could vary according to the pest or product, but normally about 2.5 billion nematodes are applied to one hectare area. Following important points should be followed while applying nematodes:

1. Nematodes must be applied during early morning or late evening when intensity of lethal sun light is minimal.
2. Nematodes should not be applied to hot and dry soil. If the soil is dry and hot, apply irrigation of at least 0.1 inch of water before applying the nematodes.
3. Carrier volume should be 2-5 gallons of water per 1000 sq. ft. of treatment area.
4. Agitation must be provided in the spray tank to ensure proper mixing and dispersion of the product during spraying.
5. Sprayer screen sizing must be 50 mesh or coarser or screens can be removed to prevent clogging
6. The application should be followed by irrigation of at least 0.1 inch of water within 30 minutes of treatment if environmental conditions are warm and dry; within 2 hours if conditions are cool and moist. Post-application irrigation prevents drying of the nematodes on the foliage.

If nematodes are to be applied by **fertigation equipment** following additional precautions should be followed:

1. Lightly water (syringe) area to be treated to moisten turf surface and cool irrigation lines.
2. Pre-mix the required amount of product in sufficient water to uniformly inject the entire irrigation system.
3. Inject nematodes during the second watering. Add nematodes to a clean feeder tank. Suspension must be continuously agitated during injection to prevent nematodes from settling. After injection, rinse feeder tank with clean water and inject into system to purge nematodes from fertigation system.
4. After application, immediately irrigate treated area with a minimum of 0.1 inch of water.

Disposal

Product and container waste resulting from the use of nematode products may be disposed of on site or at any approved waste disposal facility in accordance with federal and local regulations.

Compatibility with chemical pesticides

Although nematodes can be applied together with some chemicals used for turf maintenance, but they are not compatible with all chemicals. Therefore, instructions on the label must be followed prior to mixing the product with any other chemical. If there are no instructions on the label, the manufacturer of the product should be contacted. Most failures of nematode applications can be attributed to their incompatibility with other chemicals. *Steinernema carposapsae* is generally less influenced by most chemicals as compared to the

other nematodes such as *Steinernema riobravae* and *Heterorhabditis bacteriophora*. Table 2 (below) lists chemicals that have been found to reduce nematode efficacy when exposed directly. These chemicals should not be tank mixed with nematodes. To obtain best results, nematode applications should be made 1-2 weeks before or after application of these chemicals.

Expected results

If properly applied and environmental conditions are favorable, most nematode products will provide insect control comparable to most insecticides. However, nematodes take 2-5 days to kill most insects and the speed to kill depends on soil temperature. While high soil temperatures (above 90°F) could be lethal, low soil temperatures (below 50°F) will slow nematode activity.

Suppliers

Refer to the Insect Parasitic Nematode Retail Suppliers page!

Table 2. Chemicals that should not be tank mixed with insect parasitic nematodes.

| Chemical | Trade name | Chemical | Trade Name |
|----------------|------------|-------------------|----------------------|
| Anilazine | Dyrene | Fipronil | Chipco Choice |
| Azadirachtin | Azatin | Insecticidal Soap | Various |
| Azinphosmethyl | Guthion | Isazophos | Triumph |
| Bendiocarb | Turcam | Methomyl | Lannate |
| Carbofuran | Furadon | Oxamyl | Vydate |
| Carbaryl | Sevin | 2-4-D | Various |
| Chlorpyrifos | Dursban | Trichlorfon | Dylox |
| Ethoprop | Mocap | Triclorpyr | Turflon, Confront |
| Fenamiphos | Nemacur | | |

[Dr. Parwinder Grewal](#) is a Turfgrass Entomologist with a split research and extension appointment at the Ohio State University. He specializes in biological and microbial control.

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Maine and On-line Vendors of Biocontrols

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|---|---|--|
| Fedco Seeds | PO Box 520, Waterville, ME 04903 | 207-873-7333, www.fedcoseeds.com/ogs.htm |
| Griffin's Greenhouse & Nursery Supplies | 50 West Gray Road, Gray, ME 04039 | 207-657-5442, www.griffins.com |
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