

GROWERTALKS

Pest Management

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Do-It-Yourself, Insect-killing Nematodes

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Applications of insect-killing nematodes have become increasingly popular among greenhouse growers for managing soil-dwelling pests such as fungus gnats, shore flies and the pupal stage of Western flower thrips. The tiny infective stage of the nematodes, called infective juveniles (IJs), enter susceptible insects through body openings. Once inside, they release bacteria that kills the insect and provides food for the nematodes. After reproducing within the insect, the new IJs are released and are capable of infecting more insects. The most commonly used nematodes in greenhouses are *Steinernema feltiae* followed by *S. carpocapsae*. These and other nematodes are readily available from several companies.

Some growers have asked us about rearing their own nematodes in order to save on costs. Doug Mead, Head Grower at Dickman Farms in Auburn, New York, has been successfully using nematodes for several years, but with current nematode purchasing costs, it was only cost-effective to treat half his acreage. After viewing online videos, Doug, who is an innovator, asked us about rearing his own nematodes, which he figured could cut his costs in half and enable him to apply nematodes biweekly to all 400,000 sq. ft. of his production area. Most of Doug's nematodes are applied via boom irrigation at a biweekly rate of 35 million nematodes per 1,000 sq. ft. Both *S. feltiae* and *S. carpocapsae* are used.

Doug checks for nematode viability at several points during his rearing process to be sure that things are going well. Using a hand lens or dissecting scope, he checks several drops of nematode-containing water to look for curled, wriggling nematodes, as opposed to dead ones that appear needle-straight and stiff. He'll readily admit that rearing your own nematodes isn't for every grower, even given the cost-savings. It takes a commitment and dedication to understanding the process and making it work. But he's been pleased with the results, especially because he can now treat his entire operation. It should be noted that Doug uses nematodes in combination with a full line of other biocontrol organisms in his pest management program.

Here's an introduction to how you can raise your own insect-killing nematodes. For more information, a fact sheet can be found at www.greenhouse.cornell.edu/pests/index.htm.

Protocol for rearing nematodes

The protocol begins with ordering waxworm fishing bait cups from a supplier (see Figures 1 and 2). Waxworms are used as a nematode host to propagate the nematodes. This step should be initiated three to six weeks prior to a planned nematode application. Once you've determined how many waxworm cups are

needed, they may be ordered from the listed bait suppliers (see list below).

If you're doing this for the first time, you should plan on starting six weeks in advance of the planned application and initially inoculating two to four cups with each desired nematode species, referred to as starter cups. These starter cups will be used to collect emerging nematodes, which will then be used to inoculate the required number of cups that will produce the number of nematodes needed for the application. Once starter cups have been inoculated, emergence of new infective IJs will be seen after 12 to 14 days. The nematode life stage that infects insects is called the infective juvenile.

After arrival of the waxworm cups, the next step is to collect/harvest IJs from the starter cups. The number of IJs needed for an application will determine the number of waxworm cups for mass-rearing that will be inoculated in this rearing cycle. Each cup should produce a minimum of 10 to 15 million IJs. The number of IJs needed to initially inoculate each cup is 15,000.

To collect IJs for inoculating the mass-rearing cups, use a fine tip paint brush or small rinse bottle filled with non-chlorinated water to collect emerging IJs from the side and lid of your starter cup(s) (see Figure 7). The amount of liquid you collect can be adjusted based on your need. For example, a single rearing cup can provide a gallon of nematode stock water, which can then be used to infect 100 waxworm cups.



Figure 1. Waxworm cups from a fishing bait supplier. Figure 2. Waxworm cup prior to nematode inoculation.



*Figures 3 and 4. Waxworm cup with all waxworms infected by *Steinernema carpocapsae*. Note the darker color of the one on the right.*

Figure 5. A yellow film of nematodes observed 12 to 14 days after cups were inoculated.



Figure 6. Use a 1-oz. coffee scoop to apply the nematode solution in a circular pattern to the surface of each waxworm cup. Try to evenly cover the surface and all the waxworms.

Figure 7. Use a fine tip paint brush or small rinse bottle filled with non-chlorinated water to collect emerging IJs from the side and lid of your starter cup(s).

Once you've collected your IJs and have your nematode stock liquid, use a 1-oz. coffee scoop to apply the nematodes in a circular pattern to the surface of each waxworm cup (see Figure 6). Try to evenly cover the surface and all the waxworms. Once cups have been dosed, label the lids with the species and inoculation date and store them for 12 to 14 days. The storage area for the inoculated nematode cups should be dark and at a temperature of 65 to 75F (18 to 23C) and have good air circulation to provide oxygen to the developing nematodes. (Do not tightly pack the containers. A single layer of containers on shelves allows good air circulation.) Check for 90% to 100% waxworm death (see Figures 3 and 4) inside the cups approximately three days after inoculation and then periodically check for moisture levels (spray water to the surface with a spray bottle if needed; the surface should stay moist, but not wet) until IJ emergence is visible (Figure 5).

The date of inoculation provides the estimated date of when to harvest the new IJs from the cups. Once the yellowish film of emerging IJs on the side or lid of a few cups is observed (Figure 5), the cups are ready to harvest. The cups should be harvested within three to seven days for best viability against the targeted pest.

Harvesting IJs from the cups involves dumping the contents from a set number of cups onto a mesh screen and rinsing the debris vigorously to separate the new IJs from the other material in the cups into a collection container (e.g., a clean 30-gal. trash can). Each cup should yield at least 10 million and probably 15 to 20 million nematodes. Mesh screens (No. 20 mesh and No. 40 mesh) can be purchased and adapted to fit over the collection container.

The collected nematode water can now be applied within the greenhouse using application equipment for distributing nematodes, such as a fertilizer injector. Remember to keep spray solution gently agitated to keep the nematodes in suspension. Nematodes need to be applied within one hour after being rinsed out of the mass-rearing cups. **GT**

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Waxworm suppliers

Best Bet Inc.

bestbetinc@aol.com

(218) 659-4202

Grubco

grubco.com

(800) 222-3563

Knutson's

tom@knutsondecoys.com

(800) 248-9318

Speedy Worm

www.speedyworm.com

sales@speedyworm.com

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