

“Guardian” and “Gnat Patrol”

Beneficial Nematodes for Insect Control

By Mike Morton

The goal is to have a beautiful - productive crop. It has been estimated that each time you spray - you will suffer as much as a 1% loss in production. This loss is the combined result of the mechanical stress to the plants from the force of the spray, the blockage of the pores of the leaves from the spray material, and possibly from slight growth responses caused by the absorption of the spray material into the plant. A 1% loss does not seem to be a significant number, until you count the number of sprays that might be applied during the life of a crop.

There are several forms of biological and mechanical pest control methods available on the market today. These methods include insect barriers to help reduce the amount of pests getting to your plants. Yellow and blue sticky traps that can be used as detection methods and in many instances can actually reduce the pest population on your plants.

There are several beneficial predatory and parasitic insects available for the control of pests that become established on your crop. These include *Encarsia formosa* for control of Greenhouse whiteflies; *Phytoseiulus persimilis* for the control of spidermites; lacewings, ladybugs and several other beneficials for the control of aphids; *Amblyseius cucumeris* and Orius for control of thrips and there are several other beneficials available for control of other minor insects that can become a pest on your plants.

The one thing to point out is that all of the control methods listed above are available for **insects that live above ground - what about insects that live in the soil?** What about insects that attack the root systems of your plants? Over 90% of all insects spend all or at least part of their life cycle in the soil.

You are all familiar with earthworms. Earthworms usually indicate a healthy soil complex, one that is rich in organic matter and is properly watered. Earthworms help provide aeration and aid in the decomposition of the organic matter.

What I would like to tell you about are beneficial nematodes. These nematodes are like microscopic earthworms - with an attitude. They are specifically insect parasitic, which means they will not harm plants, people or pets. There are two varieties I would like to discuss. They are *Steinernema carpocapsae* species that I call “Guardian” and *Steinernema feltiae* species that I call “Gnat Patrol”. Beneficial nematodes are specifically exempt from E.P.A. registration. Wild strains of these

nematodes have been found to exist naturally all over the world.

Overview of how they work

“Guardian” and “Gnat Patrol” can survive in the root zone of plants for **60 - 90 days even before they find a host insect**. During this time, a cuticle that is like a tiny space suit covers them. This cuticle enables them to travel without taking anything from the surrounding area and they do not release anything into the surrounding area. While covered with this cuticle, they are resistant to environmental conditions and also resistant to most chemicals, fungicides and insecticides.

These beneficial nematodes can detect insects by either a slight increase in temperature or the release of methane gas. They can seek out insects - not just wait for them to come along. They are microscopic, but can travel about 1" per hour. Once inside the host insect - they shed their cuticle and release symbiotic bacteria into the midgut of the host insect. This bacterium then multiplies and spreads throughout the host insect. This bacterium is what actually kills the host insect.

“Guardian” and “Gnat Patrol” can reproduce very rapidly. As an example, if two of these nematodes were to enter a 3/4" host larva - within 2 to 3 weeks, the next generation could emerge with as many as 200,000 more nematodes that would then go in search of more insect hosts.

Unlike most biological controls that are very selective about the host insect that they attack, both of these species of nematodes are non-selective and have been found to be effective against a broad spectrum of insect hosts. Included in the more than 250 different insects that they are known to control are; Cutworms, Japanese beetle grubs, root weevils, corn borers, wireworms, fungus gnat larvae, thrips pupae and the list goes on. Remember, 90% of all insects spend at least part of their life cycle in the soil.

Are They Better Strains?

For several years, we have been rearing these nematodes using various selection methods. First, only those that kill the host insects the quickest are selected as potential seed stock for each successive generation. This allows us to select for those nematodes that have the best searching ability and the quickest killing ability. Then

they are cultured in such a way that allows us to collect the very first emergence of the next generation of nematodes that emerge from the host insects. This allows us to select for the most reproductive nematodes in each generation. This rearing and collection method also requires the nematodes to actually emerge and travel to a collection point. Using this method, the best "travelers" from each generation is collected. Along with other selection criteria, "**Guardian**" and "**Gnat Patrol**" are the result of several hundred generations of this selection process.

"Guardian"

Of the two varieties, "**Guardian**" is the fastest killer. Host insects are usually killed within 16 - 24 hours after the nematodes enter the host. "**Guardian**" is also the fastest reproducer. Depending on temperature, the next generation usually begins emerging from the insect host within 7 - 10 days. "**Guardian**" can survive over a wide temperature range (32° - 90° F.) and is most effective as an insect control at soil temperatures of 50° - 85°F. "**Guardian**" must enter the host insect through a natural opening; such as, mouth, anus, wounds or the spiracles. Although "**Guardian**" can be found ranging through several inches of the growing media, they prefer to live in the top 3" of the growing media. The bacteria that "**Guardian**" release is an asexual bacterium however, two nematodes must enter an insect host before reproduction can occur. The host insect killed by "**Guardian**" usually turns an off-white or slightly yellow color.

"Gnat Patrol"

Of the two varieties, "**Gnat Patrol**" is a very comparable killer. Host insects are usually killed within 16 - 28 hours after the nematodes enter the host. "**Gnat Patrol**" will reproduce at a comparable rate to "**Guardian**" within the same host. Depending on temperature, the next generation usually begins emerging from the insect host within 7 - 10 days. "**Gnat Patrol**" can survive and affective control over a wide temperature range (36° - 86°F.).

"**Gnat Patrol**" can be found ranging through several inches of growing media. In outdoor applications, they prefer to live in the top 3" - 5" of the growing media. At this depth, survival of "**Gnat Patrol**" will probably be much better and there is less chance of them dying from extreme drought or temperatures. The bacteria that "**Gnat Patrol**" release is an asexual bacterium however, two nematodes must enter an insect host before reproduction can occur. The host insect killed by "**Gnat Patrol**" will turn a whitish color.

"**Gnat Patrol**" can enter a host insect through the same natural openings as "**Guardian**", but with their smaller size they can infest smaller insects at a better rate.

In most instances, it may be an advantage to release a combination of both varieties. They both are non-selective when it comes to finding an insect host. They both are able to survive for 60 - 90 days while searching for an insect host. They tend to work at different depths within the growing media. And while "**Guardian**" may kill slightly quicker, "**Gnat Patrol**" may be able to penetrate some insect hosts that "**Guardian**" cannot. For instance, "**Gnat Patrol**" has been found to be much more effective in controlling Gnats and Shore Flies than "**Guardian**".

Easy to Release

Both of these varieties are shipped via "2nd day air". They will arrive on a damp sponge inside a zip lock plastic bag. This bag will be inside a styrofoam case and an ice pack will be included as a "heat sink". This ice pack is not frozen, but rather is serving to stabilize the temperature within the styrofoam case and aids in preventing temperature extremes.

It is best to apply the nematodes during the evening or during periods of cloudy, cool weather. If you think of these nematodes as microscopic earthworms, you will realize that they must be allowed time to enter the growing media before they dry out. You would not release earthworms on hot, dry ground and expect them to survive. Attempting to apply the nematodes during periods of hot, dry weather may prevent many of them from surviving the transfer into your growing media. "Watering in" with additional water will help insure they have been carried into your growing media.

Releasing 1 million of these nematodes over 2,000 ft² works out to approximately 500 nematodes per ft². As a preventative, they should be applied every 60 days to greenhouse crops. For outdoor applications, usually they should be applied in the early Spring as soon as the frost has gone out of the ground. Since they can survive for 60 - 90 days before finding a host, they will be in place as the insect activity increases with warmer temperatures.

Since Guardian / Gnat Patrol are reared for Gnat and Fly control, it might be better suited to release once or twice per month. They should be applied again in the late Summer once the possibility of soil temperatures above 90° F. has past. Many insects return to lay their eggs in the soil in the late Summer. These eggs develop and usually have a stage capable of wintering over in the soil.

“Guardian” and **“Gnat Patrol”** require similar moisture levels to plants. They can survive in the root zone of any plants that receive adequate moisture and at temperatures that support proper plant growth. They are effective in greenhouse crops (even NFT systems), lawns, golf courses, gardens, flowerbeds, houseplants, and interiorscapes, orchards and have even been used against tree borers. They can be mixed into your growing media - even before you plant. There is no smell, no unsightly appearance and no customer complaints. They are safe to people, pets, plants and the environment.

“Guardian” and **“Gnat Patrol”** are usually rinsed from the sponge into a small amount of water, which then becomes a concentrated solution of the nematodes. They can withstand pressures up to 300 PSI, therefore you can apply them using an injector system, or dilute them with more water and use a pump sprayer, hose-end sprayer, watering can or pail. However, they will gradually settle in standing water, so constant agitation is necessary as you apply them.

This is a biocontrol method that works - even if you are using chemical sprays to control other insects. Unless you are using a material that specifically states it will kill nematodes - it's probably not going to harm the nematodes.

Research continues on other varieties of biological controls that may be introduced in the future. This industry is gaining momentum as we move into the new millennium. The market for “insecticide free” and “pesticide free” products are growing. Many growers are beginning to capitalize on this. The ever changing laws and regulations the grower will face during the years ahead will have a discouraging effect on those who continue to use chemical sprays as a first line of defense against pests. The use of chemical pesticides is becoming more of a liability to the grower.

The goal is to have a beautiful - productive crop. Without filling out a ton of paperwork. The use of biological control can delay, and in many cases actually eliminate the need for chemical sprays. Some growers will not be totally successful with bio-control on their first attempt. However, they may be able to postpone the use of insecticides and will probably find these insecticides to be more effective when they actually have to use them, because the insect pests have not developed a resistance to them.

There are biological controls available today for nearly every insect pest that is a problem in the greenhouse. In the very near future, this will also extend into the control of several fungus and waterborne diseases. It will extend to other beneficial organisms; including beneficial bacteria and beneficial fungi. Some growers make regular, periodic releases of beneficials into their greenhouse – much the same as some growers spray on a regular basis. Other growers will monitor their pest populations and make releases only after a pest has been detected.

Timing is very important. Those who wait until they have a serious problem will usually not be successful using bio-control. Releasing biological pest control items into your greenhouse is much like hiring very tiny workers for you crop. These workers have a specific duty to perform. They don't take days off, they don't want vacations – and – they are willing to work for “room & board”.

In summary, it is very important to keep good records and to learn from your successes and your failures. Each time you try, you will get better!!

Mike Morton
Hydro-Gardens

Mike Morton has been with Hydro-Gardens since 1972. During that period, he has worked in nearly every facet of the greenhouse business. He has managed greenhouse complexes, and has supervised the construction of greenhouses across the United States, the Caribbean, and Saudi Arabia. He has grown nearly every type of vegetable and has also grown several million tree seedlings under contract for the Forest Service. Since 1985, he has devoted more time to biological pest control. He currently serves as President of Hydro-Gardens and provides technical service and support for growers around the world.