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# Evaluation of Biological and Chemical Applications for Control of Iris Borer[1]

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## Abstract

Two species of entomopathogenic nematodes, *Steinernema carpocapsae* and *Heterorhabditis bacteriophora,* and two synthetic chemicals, Dimetheoate and Imidachloprid, were evaluated for suppression of the iris borer, *Macronoctua onusta,* on bearded iris. Field trials were conducted in prepared planting beds of bearded iris established at the Central Maryland Research and Education Center in Ellicott City, MD. Examination of larval galleries in the rhizome and number of live larvae found were used to evaluate the effectiveness of each treatment. The applications of all rates of entomopathogenic nematodes and the systemic insecticide, Imidachloprid, gave control equal to that of Dimethoate. All treatments gave significant control of iris borer compared to the control. Imidachloprid reduced borer larvae by 87% reduction; *S. carpocapsae* (all rates and aerated and none aerated) provided 100% control; *H. bacteriophora* provided 87% control; as did Dimetheoate.

**Index words:** biological control, Noctuidae moth, *Macronoctua,* entomopathogenic nematodes, systemic insecticide.

**Insecticides used in this study:** Cygon 2E (Dimetheoate); 0, 0-dimethyl S-methylcarbamoylmethyl phosphorodithioate; Marathon (Imidachloprid); 1-[(6-chloro-3-pyridinyl) methyl]-N-nitro-2-imidazolidinimine.

**Species used in this study:** bearded iris, *Iris X germanica*; *Steinernema carpocapsae* (Vector); *Heterorhabditis bacteriophora* (Lawn Patrol).

## Significance to the Nursery Industry

Bearded iris are the most popular iris species grown for landscape purposes. The iris borer, *Macronoctua onusta,* is a key pest of this herbaceous perennial. The feeding of the larvae of the iris borer causes wounds and dieback of infested plants. The number of safe, effective chemical controls for iris borer is extremely limited. This field trial demonstrates that entomopathogenic nematodes offer an viable biological control option for controlling iris borer.

## Introduction

The iris borer, *Macronoctua onusta* Grote, family Noctuidae, causes major damage to bearded iris, *Iris X germanica*. Eggs are laid on foliage in the fall. Overwintering eggs on old leaves hatch in early spring, and larvae make slender feeding channels into new leaves somewhat resembling the burrows of leafminers. The larva is white-pink with a brown head capsule. The larvae feed within leaf sheaths, in stems and flower buds, gradually moving down into the rhizomes. Fully grown larvae can be up to 5 cm (2 in) in length. They complete their growth, pupate, and emerge as dusky brown moths by late summer and early autumn (2).

Cleaning up and destroying old iris leaves and stems in late autumn is the best cultural control method (2). Unfortu-

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Table 1. Treatment and rates of insecticides and nematodes applied to *Iris X germanica*

| Treatment | Rate of application | Amount of water applied[z] |
|---|---|---|
| *Heterorhabditis bacteriophora* | 300 nematodes per 6.54 $cm^2$ (1 $in^2$) | 500 ml (.5 qt) |
| *Steinernema carpocapsae* | 500 nematodes per 6.54 $cm^2$ | 500 ml |
| *S. carpocapsae* | 1000 nematodes per 6.54 $cm^2$ | 500 ml |
| *S. carpocapsae*[y] | 1000 nematodes 6.54 $cm^2$ | 500 ml |
| Imidachloprid | 2/3 tsp per plant | applied 500 ml of water after granules applied |
| Dimetheoate | 10 ml (2 tsp) in 4000 ml (1.05 gal) of water | applied 500 ml of solution to each plant as foliar spray and allowing water to drench ground at base of plant |
| Control | Water | applied 500 ml of water per plant |

[z]All drenches applied to 30 $cm^2$ (1 $ft^2$) area around base of iris plant.
[y]These nematodes were aerated nematodes for 24 hrs before treatment.

nately, based on conversations with several growers of iris, this does not adequately prevent infestation by the iris borer. Destroying the larvae when they are feeding in the stems or rhizomes is another option for control. Until recently, the only viable chemical control option has been to apply the systemic insecticide Dimetheoate (Cygon 2E). Dimethoate is a relatively toxic material with a LD 50 of 400 (dermal). This material is normally applied when iris growth is 10–15 cm (4–6 in) in length. A relatively new, systemic chemical, Imidachloprid (Marathon), may have potential for control of iris borer. Imidacloprid is known to be effective against grubs, soft-bodied sucking insects, and some thrips species. Since the iris borer feeds inside the leaf tissue and rhizome, the systemic imidacloprid was included in the trial. Biopesticide controls that have been effective in controlling other species of lepidopterous larva borers are the entomopathogenic nematodes, *Steinernema carpocapsae* and *Heterorhabditis bacteriophora* (1, 2, 3, 4, 8).

Entomopathogenic nematodes are microscopic roundworms that attack only insects. They do not harm animals or plants; consequently, the U.S. Environmental Protection Agency has exempted them from registration and regulation requirements. The nematodes have a mutualistic association with insect-killing bacteria in the genus *Xenorhabdus (X).* The nematodes require the bacteria as food to grow and multiply. The nematodes are good searchers of insects in moist environments such as borer galleries. The hunting juvenile nematodes will search for insect larvae using carbon dioxide given off by the insect. The nematodes then enter through the spiracles, mouth or anus of the insect. Once inside the nematodes excrete the bacteria which is pathogenic to the insect. Death of the insect larvae is rapid (24–48 hours after penetration in most cases) (7). The nematodes mate and multiple within the cadaver of the insect. After an infected insect has been killed, the hunting juveniles leave the cadaver and search for other insect larvae. If suitable food is not found, the nematodes begin to die.

Over the past 5 years we have been conducting field trials to evaluate the efficacy of entomopathogenic nematodes for control of clearwing moth borers. We have been successful in controlling dogwood borer, peachtree borer, and banded ash clearwing moth borer (1, 3, 5). Kaya and Brown (6) also found nematodes in the family Steinernematidae to be effective in controlling clearwing moth borer larvae in sycamore and alder trees.

## Materials and Methods

Bearded iris plants were obtained from a local grower in 1994 and planted in prepared, inground beds at the Central Maryland Research and Education Center in the first week of August. To insure that a population of the iris borer were present, larvae were removed from infested plants in early August and inserted into the plants used in our study. Two 3rd instar larvae were placed in each iris leaf fan, just above the rhizome before each rhizome was planted in the planting beds.

In this field study two nematode species were evaluated, *Steinernema carpocapsae,* and *Heterorhabditis bacteriospora. Steinernema carpocapsae* was obtained from Biosys, Inc (10150 Old Columbia Rd, Columbia, MD 21046) and the product was formulated as a water dispersible granule. The product is marketed under the trade name Vector. *Heterorhabditis bacteriospora* was obtained from Hydro-Gardens (8765 Vollmer Road, Colorado Springs, CO 80932) as Lawn patrol, and the nematodes were suspended on a sponge. Nematodes were applied as a drench to evaluate control of iris borer larvae that attempt to feed on the rhizome of the plant. Imidachloprid was applied as a granule to the soil around the rhizome, while Dimethoate was applied as a foliar spray. Table 1 provides the treatments and rates applied to *Iris X germanica*.

The spring of 1995 was drier than normal with 21.5 cm (8.5 in) less rainfall recorded by April 27, 1995. Treatments were delayed until soil temperatures reached 10C (50F) at 12.65 cm (5 in), as entomopathogenic nematodes are most active at temperatures above 10C (50F) and in moist soil conditions (7). Treatments were applied April 30 with the air temperature of 16C (61F). Rainfall over the next 7 days was recorded at 2.43 cm (0.97 in).

Two rates of *Steinernema carpocapsae* and one rate of *Heterorhabditis bacteriophora* were applied. All stock solutions of nematode treatments were applied with 500 ml (0.5 qt) of water to a 30 $cm^2$ (1 $ft^{2}$)) area around the base of each iris plant. Nematodes were aerated in water for 24 hours prior to application and applied at the rate of 1000 nematodes per 6.54 $cm^2$ (1 $in^2$). Control plants were treated with water.

Each iris planting block was a linear planting with each plant separated by 61 cm (24 in). The distance between blocks was 90 cm (35.4 in). Individual plants were used for each of the seven treatments in each planting block. The field trial was set up as 8 complete, randomized blocks.

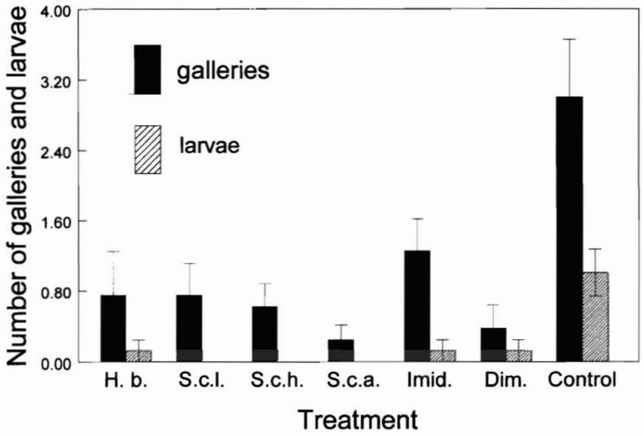


**Fig. 1.** **Effects of nematodes and conventional insecticides on the iris borer, *Macronoctua onusta*. H.b = *Heterorhabditis bacteriophora*, S.c.l. = *Steinernema carpocapsae*—low rate, S.c.h = *S. carpocapsae*—high rate, S.c.a. = *S. carpocapsae* aerated, Imd. = Imidachloprid, Dim. = Dimethoate.**

All plants in the treatment blocks were excavated on July 16, 1995. The number of live larvae present and the number of galleries detected were recorded and used to evaluate treatment efficacy (Fig. 1).

## Results and Discussion

The application of dimetheoate, imidacloprid, and all nematode species significantly reduced the number of galleries and living larvae associate with the iris rhizomes. There was not a significant block effect for either variable. Both the Student-Newman-Keuls and Scheffe's test found that all treatments levels differed from the control for both the number of galleries and number of larvae. These test did not distinguish between species or levels of nematodes or between nematodes and insecticides.

Applications of entomopathogenic nematodes, *Steinernema carpocapsae* and *Heterorhabditis bacteriophora* produced significant reductions in the number of tunnels and larvae at all of the rates used in the study. Imidachloprid reduced iris borer larvae by 87% over the control; *S. carpocapsae* (all rates, both aerated and no aerated) provided 100% control; *H. bacteriophora* gave 87% reduction; as did Dimetheoate. The results of the *S. carpocapsae* applications support previous investigations of entomopathogenic nematodes for control of clearwing moth borers (1, 3, 5).

Entomopathogenic nematodes, as a biological insecticide, have reached a level where they are both cost effective and practical for iris growers to apply for control of iris borer. These insect specific pathogens have many positive aspects for growers including their ability to kill hosts within 48 hours, ease of application, safety to humans and wildlife, and exemption from EPA regulation. Chemical pesticides may offer an advantage in that they are not susceptible to cool soil (below 10C (50F)) unlike nematodes. Multiple application of nematodes may improve control in some cases.

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