Meloidogyne incognita on Society Garlic and Its Control

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ABSTRACT

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Society garlic (*Tulbaghia violacea*) was heavily parasitized by the root-knot nematode *Meloidogyne incognita*. Few galls were apparent on infested plants, but numerous mature egg masses were evident throughout the root system. Immersion of rhizomes and roots in a hot water bath at 25, 47.5, 50, 52.5, 55, or 57.5 C for 2.5, 5, 7.5, 10, or 15 min was investigated as a control measure. All treatments at 50 C or higher and intervals of 5, 7.5, and 15 min at 47.5 C eliminated recovery of *M. incognita*. Excellent recovery was obtained from the controls at 25 C. Severe plant damage occurred at 52.5 C or higher or with 15-min exposures at 50 C. Optimum nematode control with minimum plant damage was achieved with exposure at 50 C for 2.5 min or at 47.5 C for 15 min.

Society garlic (*Tulbaghia violacea* Harv.: Alliaceae) is an attractive ornamental groundcover for tropical and subtropical regions. Recently in Florida, stunting and chlorosis were observed in nursery plants heavily infested by root-knot nematodes. Although few galls were found on infested root systems, numerous orange-brown egg masses of *Meloidogyne incognita* (Kofoid & White) Chitwood were visible on the white roots. Occurrence of *M. incognita* on this plant can be a serious problem because propagation is by rhizome division, and therefore, infested planting material could initiate root-knot infestations in new planting sites.

Hot water treatment has been recommended as a control measure for nematodes in bulbs and other planting material (1–3), and early work on the subject has been reviewed briefly (1). This method of treatment has been successful for caladium (5) and other Florida ornamentals (1). *M. incognita* larvae in glass vials were killed by exposure to a temperature of 50 C for only 4 min, and a high degree of control of this nematode was achieved when infested root systems of various ornamentals were immersed for 10 min at that temperature (1). The degree of control varied with the plant species used, and *T. violacea* was not among the plants tested. When cloves of garlic (*Allium sativum* L.), a closely related species, were immersed in hot water, plant injury occurred at 51.1 C (124 F) and the cloves tolerated temperatures of 48.9 C (120 F) for 25 min or 50 C (122 F) for 20 min (4).

This experiment was conducted to determine the efficacy of hot water treatment for various temperature/time combinations on survival of *M. incognita* on society garlic and on the mortality of the plant.

MATERIALS AND METHODS

A total of 180 young plants of *T. violacea* infested with *M. incognita* were used in this study. Individual plants contained from three to 10 shoots each and rhizomes were about 7.5 cm long by 2.5 cm wide. Plants were treated on 19 January 1983 and divided into two lots of 90 plants each. One lot was used for determining nematode survival and the other for plant growth measurements. The experimental design was a 6 × 5 factorial replicated three times, with six temperatures (25.0, 47.5, 50.0, 52.5, 55.0, and 57.5 C) and five exposure intervals (2.5, 5.0, 7.5, 10.0, and 15.0 min). Treatments were carried out by immersing the roots, rhizome, and lower stems in a water bath for the desired time interval. The bath consisted of 10 L of water in a plastic container maintained at various desired temperatures (±0.25 C) by a circulating heater (Thermomix II, Bronwill Scientific Division).

Half of the plants were destroyed immediately after treatment for assay of live *M. incognita* populations. Root sections containing 15 egg masses of *M. incognita* were removed from each plant and incubated in aerated water. After 6 days, the live *M. incognita* larvae that had hatched or emerged from the roots were counted. Rhizomes were trimmed of all roots and incubated separately.

The remaining treated plants were planted in a sterile mix (one part sand: one part peat moss, v/v) in 946-cm^3 plastic pots and placed in a shadehouse exposed to natural rainfall. Plants were harvested and washed on 5 April 1983. The number of shoots per plant and fresh weights of the tops, roots, and the entire plant were determined. A 5-g sample of fresh roots was removed from each of the plants and incubated in aerated water for 6 days for recovery of nematodes. In the case of a few plants that had fewer than 5 g of roots, lesser amounts were incubated.

RESULTS AND DISCUSSION

Larvae of *M. incognita* were readily recovered from egg masses 6 days after treatment, with an average of 182 larvae per 15 egg masses over all of the 25 C control treatments. At 47.5 C, however, 56 larvae were recovered after a 2.5-min exposure and only 12 larvae after a 10-min exposure. No larvae were recovered after exposure times of 5, 7.5, or 15 min at that temperature, and no root-knot nematodes were recovered at temperatures of 50 C or higher, regardless of exposure time.

At the 76-day sampling, five *M. incognita* larvae per 5 g of root were recovered from the 47.5 C/2.5-min combination, although no nematodes were recovered from the root systems of plants exposed at any other temperature/time combination involving a temperature

Table 1. Fresh top weight of society garlic plants 76 days after immersion in water at selected temperatures for various times of exposure

Treatment temperature (C)	Fresh top weight (g) at exposure time[a]				
	2.5 Min	5 Min	7.5 Min	10 Min	15 Min
25.0	11.3 ± 3.48	16.7 ± 1.86	14.7 ± 1.77	22.0 ± 4.94	16.7 ± 2.67
47.5	14.7 ± 1.20	15.0 ± 0.58	14.7 ± 0.67	17.7 ± 2.34	15.0 ± 0.58
50.5	14.3 ± 2.19	11.0 ± 0.58	10.7 ± 0.33	12.3 ± 3.18	8.7 ± 1.45
52.5	10.7 ± 1.20	7.7 ± 0.88	7.3 ± 4.34	7.0 ± 5.14	1.0 ± 0.58
55.0	12.7 ± 1.20	2.0 ± 1.53	0	0	0
57.5	0.7 ± 0.67	0	0	0	0

[a] Means of three replicates ± standard errors for nonzero means.

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of 47.5 C or higher. The number of larvae recovered averaged 22 per 5 g of root over all of the 25 C control treatments on this sampling date.

No *M. incognita* emerged from rhizomes after 5 days, regardless of treatment. This is not unusual because egg masses were never observed on the rhizomes.

Damage to plants from heat treatment was evident within several days, and most plants exposed to the highest temperatures (55 C, 57.5 C) died after a few weeks. In early February, plant damage at the highest two temperatures occurred after a 2.5-min exposure, but those treated at 52.5 C for 7.5 min also showed damage and those treated at 50 C showed some thinning of the foliage after a 15-min exposure. At the conclusion of the experiment, the fresh top weight per plant over all exposure times at 47.5 C averaged 15.4 g, which was similar to the average weight per plant of 16.3 g obtained over the exposures at 25 C (Table 1). Top weight declined after exposure intervals of 5 min or greater at 50 C or any exposure intervals at higher temperatures. Effects of heat treatment on number of stems per plant, fresh root weight, and total plant weight closely paralleled the results obtained with top weight and are not shown.

These experiments indicate effective control can be achieved without undue plant damage at 50 C for 2.5 min or at 47.5 C for 15 min.

Because plant-parasitic nematodes are relatively easily killed by heat, hot water treatment for nematode control could be considered for many species of ornamental plants. Provided that the temperature tolerance of the plant species is known, this old control method can be an effective, economical, and safe alternative to chemical control, especially because repeated chemical treatments may often be necessary to maintain the nematodes at a low level to produce a high-quality, salable plant.

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