Effects of Oxamyl on the Reproduction of Meloidogyne hapla and Heterodera schachtii

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Veech (7) reported that diflubenzuron had ovicidal activity against *Meloidogyne incognita* and suggested that this activity could be important in developing new control strategies. Radewald et al. (5) and Birchfield (1) respectively provided preliminary evidence that oxamyl suppresses reproduction of *M. incognita* and *Rotylenchulus reniformis*.

This study was conducted to determine the effects of oxamyl on the reproduction of *Meloidogyne hapla* Chitwood 1949, and *Heterodera schachtii* Schmidt 1871, and to determine the impact of time of application on the control of *M. hapla* and *H. schachtii*.

Three-week-old lettuce (*Lactuca sativa* L. cv 'Ithaca') seedlings in 10-cm-diam pots of autoclaved organic soil (Carlisle muck) were inoculated with 6,800 *M. hapla* eggs. Similarly, 5-week-old table beet (*Beta vulgaris* L. cv 'Ruby Queen') seedlings in 10-cm-diam pots of autoclaved sandy loam soil were inoculated with 6,000 *H. schachtii* larvae. Beginning at the time of inoculation or 1 week after inoculation, the lettuce and beet seedlings each received two foliar applications of oxamyl (methyl *N,N*-dimethyl-N[(methylcarbamoyl)oxy]-1-thiooxamimidate) at 2-week intervals at a rate of 4.8 g a.i./liter. During application of oxamyl the pots were placed on their sides and the surface covered with aluminum foil to prevent contamination of the soil. The seedlings were sprayed to run-off, left in the horizontal position until the foliage had dried, and then placed in controlled-environment chambers at 25 C with a 14-h photoperiod (26,900 lx).

Lettuce plants were harvested six weeks after inoculation and the root-gall index was determined on a rating system of 0 = no galling; 1 = 1–10%; 2 = 11–25%; 3 = 26–50%; 4 = 51–75%; and 5 = 76–100% of the roots galled. The reproduction of *M. hapla* was determined by counting the eggs/g of roots (6). The beets were also harvested 6 weeks after inoculation, and the white females on the outside of the soil-root ball were counted. The soil and beet roots were then incubated for 3 weeks at 10 C to allow the cysts to mature and the roots to decay. Mature cysts were then extracted from the soil (2) and the numbers of eggs and larvae per cyst determined.

Additionally, foliar applications of oxamyl were evaluated for control of *H. schachtii* on beets in a heavily infested commercial field. The beets received two applications of oxamyl (4.8 g a.i./liter) at 2-week intervals. The first application was applied 25 days after planting. At weekly intervals after treatment, root samples were randomly collected and examined for development of *H. schachtii*.

Lettuce roots inoculated with *M. hapla* were heavily galled in the absence of any oxamyl treatment (Table 1). Plants treated with oxamyl at inoculation and 1 week after inoculation had root-gall indices respectively 43% and 27% less than those of untreated plants. The number of *M. hapla* eggs/g of roots for plants treated with oxamyl at inoculation and 1 week after inoculation were respectively 86% and 48% less than the number of eggs/g of roots from untreated plants.

Oxamyl applied at the time of inoculation effectively suppressed the development of white *H. schachtii* females on table beet roots (Table 1). The number of eggs and larvae/cyst from plants treated with oxamyl at inoculation was 94% less than for cysts from untreated plants. Plants treated with oxamyl 1 week after inoculation had as many white females per gram of roots as the untreated controls. However, the resulting cysts contained 78% fewer eggs and larvae than did cysts from untreated plants. Under field conditions oxamyl did not suppress the development of *H. schachtii* on table beet roots during the first generation. There were 64 females/g of roots on untreated plants and 72 females/g roots on treated plants. In the second generation,

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TABLE 1. Effect of foliar applications of oxamyl on the development and reproduction of *Meloidogyne hapla* on lettuce and *Heterodera schachtii* on beets.

Initial application of oxamyl[a]	*M. hapla*[b]		*H. schachtii*[c]	
	Root-gall index	Eggs/g roots	White females on soil-root ball	Eggs and larvae/cyst
None	4.4 x	26,297 x	36.6 x	245 x
At inoculation	2.5 y	3,790 z	0.5 y	14 z
One week after inoculation	3.2 xy	13,698 y	41.2 x	53 y

[a]Oxamyl applied at 4.8 g a.i./liter.
[b]Values are means of 10 replicates. Column means followed by common letters are not different according to Duncan's multiple-range test (P = 0.05).
[c]Values are means of 10 replicates. Column means followed by common letters are not different according to Duncan's multiple-range test (P = 0.01).

however, the mean numbers of white females/g of roots of untreated and treated plants were respectively 38 and 5.

The data presented agree with a growing number of reports that foliar applications of oxamyl for control of *Meloidogyne* spp. and *Heterodera* spp. are most effective when applied to the host prior to infection (1, 3, 4, 5). With increasing time after infection, the inhibitory effect of oxamyl on nematode development apparently decreases. These data also suggest that oxamyl applied after inoculation of the host has a significant effect on the reproduction of *M. hapla* and *H. Schachtii* as respectively measured by eggs/g of roots, and eggs and larvae/cyst.

It may be possible to develop new control tactics on the basis of the effects of oxamyl on the reproduction of *Meloidogyne* spp. and *Heterodera* spp., and of chemicals with ovicidal properties such as diflubenzuron (7). The aim would be to inhibit nematode reproduction rather than host infection.

LITERATURE CITED

1. BIRCHFIELD, W. 1971. Systemic nematicides control Rotylenchulus reniformis of cotton. Plant Dis. Reptr. 55:362-365.
2. DUNN, R. A. 1969. Extraction of cysts of Heterodera species from soils by centrifugation in high density solutions. J. Nematol. 1:7 (Abstr.).
3. GRIFFIN, G. D. 1975. Control of Heterodera schachtii with foliar applications of nematicides. J. Nematol. 7:347-351.
4. POTTER, J. W., and C. F. MARKS. 1976. Efficacy of oxamyl against Heterodera schachtii on cabbage. J. Nematol. 8:38-42.
5. RADEWALD, J. W., F. SHIBUYA, J. NELSON, and J. BIVINS. 1970. Nematode control with 1410, an experimental nematicide-insecticide. Plant Dis. Reptr. 54:187-190.
6. STARR, J. L., and W. F. MAI. 1976. Predicting on-set of egg production by Meloidogyne hapla on lettuce from field soil temperatures. J. Nematol. 8:87-88.
7. VEECH, J. A. 1977. A possible new approach to the chemical control of nematodes. J. Nematol. 9:184-185.