

NEMATODE BIOLOGY AND SOIL FUMIGATION

by

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The northern root-knot (Meloidogyne hapla) and the Columbia root-knot (M. chitwoodi) nematodes are important pests on potato in the Pacific Northwest (1). Studies conducted at Prosser show that M. chitwoodi damages potato tubers more severely and is more difficult to control than M. hapla (2). External symptoms produced by both species on Russet Burbank potato tubers are distinct. M. chitwoodi produces distinct bumps or lumps on the surface of the tubers, whereas M. hapla produces more of a general type of swelling. It is sometimes difficult to differentiate between a tuber infected with M. hapla and a healthy tuber by external symptoms alone. However, internal symptoms produced by both species are similar. Both species produces typical brown spots within the tissue.

The root-knot nematodes, similar to other nematodes, have six stages in their life cycle, consisting of four molts. The first stage juvenile (larva) develops within the egg and molts to the second stage. The second stage juvenile then hatches from the egg and is free in the soil or plant tissue. This is called the infective stage, because it is the only stage of the root-knot nematode that can infect roots. The second stage juveniles enter the roots and begin feeding. The plant in response to the nematode's feeding produces enlarged plant cells (giant cells), which provides nutrients for the nematode. The nematodes begin to enlarge and the second stage molts to the third stage, the third molts to the fourth and the fourth molts to the adult stage. The root-knot nematode female is unique among nematodes, in that, it is swollen at maturity. The male, like most other nematodes is vermiform (worm like) as an adult. The mature female lays eggs in a gelatinous matrix and may lay as many as 500-1,000 eggs per female. The second stage juveniles hatching from these eggs may then infect roots and/or tubers.

There are several factors that affect root-knot nematode soil populations. One of the most important factors is soil temperature. M. chitwoodi reproduces best at 20-25 C and M. hapla at 25-30 C. The length of the life cycle is also affected. Controlled temperature studies shows that both species at 24 C is able to complete their life cycle in 21 days. As the soil temperature was lowered it took both species longer to complete their life cycle, especially M. hapla at 7 C. At 30 C it took M. chitwoodi 35 days to complete its life cycle, whereas it took M. hapla only 21 days. The environmental conditions present in the Pacific Northwest tends to favor M. chitwoodi rather than M. hapla. Another factor influencing nematode populations is soil type. Root-knot nematodes are most important in the coarse textured compared to the fine textured soils. Crops used in rotation with potato, such as alfalfa, wheat and corn have a definite influence on nematode populations. Wheat and corn are good hosts for M. chitwoodi but are not hosts for M. hapla. Alfalfa is a good host for M. hapla but in most cases a none to poor host for M. chitwoodi. However, recently populations of M. chitwoodi have been discovered that are capable of reproducing on alfalfa.

The most common means to control root-knot nematodes on potato is with the soil fumigants 1,3-D (Telone II) and metham sodium (Nemasol, Soil Prep, Vapam). These fumigants are effective when applied properly and under the proper conditions. Majority of the fumigation failures have been attributed to improper application methods and/or applications under poor fumigation conditions (i. e. cold and wet).

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Results of nematicide trials in 1983 showed that Telone II at 20 gals/A gave excellent control of M. chitwoodi on potato in a field not continuously cropped to potatoes (Table 3). In a field continuously cropped to potatoes for 5 years Telone II and DD did not give adequate control (Table 1). However, when combined with a preplant treatment of Mocap (ethoprop) control was outstanding (Table 2). Mocap was comparable to Telone II in the trial not continuously cropped to potatoes (Table 3). Furdan (carbofuran) when applied in-furrow with the seed-piece and combined with Telone II gave added nematode control, whereas Temik (aldicarb) applied as a postplant sidedress treatment did not (Table 2). However, in a separate trial conducted by Steve Holland of U & I, Inc., at K2H in Pasco, Temik applied alone as a postplant surface incorporated treatment gave excellent control. Thus, the method used to apply these chemicals may be a critical factor in controlling M. chitwoodi on potatoes. Comparison of fall (November) vs spring (March) fumigation for control of M. chitwoodi showed that spring fumigation was better (Table 1). This was attributed to better conditions in the spring at the time of fumigation in terms of higher soil temperatures and lower soil moisture. Thus, if conditions are right for soil fumigation there should be no difference between fall or spring fumigation. However, fall conditions are generally better than spring when soil temperatures are usually warmer and soils drier.

REFERENCES

1. Nyczepir, A. P., J. H. O'Bannon, G. S. Santo, and A. M. Finley. 1982. Incidence and distinguishing characteristics of Meloidogyne chitwoodi and M. hapla in potato from the Northwestern United States. *J. Nematology* 14:347-353.
2. Santo, G. S., J. H. O'Bannon, and R. P. Ponti. 1983. Potato root-knot nematode situation. Proceedings, 22nd Ann. Washington State Potato Conference, pp. 49-50.

Table 1. Fall vs. spring soil fumigation for control of M. chitwoodi on potato in a field continuously cropped to potatoes for 5 years, 1982-83.

Treatment (rate gal/A) ^a	% Culls ^b
Nontreated	100
Telone II 20 (Fall)	70
Telone II 20 (Spring)	55
DD 34 (Fall)	62
DD 34 (Spring)	13

^a The fumigants were applied with chisels, 10 inches deep, spaced 9 inches apart.

^b Values are means of five replicates. Tubers with 6 or more nematodes/tuber were graded as culls.

Table 2. Soil fumigants in combination with non-fumigants for control of *M. chitwoodi* on potato in a field continuously cropped to potato for 5 years, 1982-83.

Treatment (rate AI/A) ^a	% Culls ^b
Nontreated	100
Telone II 20 gal	55
Telone II 20 gal + Mocap 6EC 6 lb	0
Telone II 20 gal + Temik 15G 3 lb	47
Telone II 20 gal + Furadan 10G 3 lb	18

^a Telone II was applied in the spring with chisels 10 inches deep, spaced 9 inches apart. Mocap was applied as a preplant broadcast spray and rototilled 4-6 inches deep. Temik was applied as a postplant sidedress 8 weeks after planting. Furadan was applied as an in-furrow treatment with the seed-piece.

^b Values are means of five replicates. Tubers with 6 or more nematodes/tuber were graded as culls.

Table 3. Control of *M. chitwoodi* on potato with Mocap in a field not continuously cropped to potatoes, 1983.

Treatment (rate AI/A) ^a	% Culls ^b
Nontreated	89
Telone II 20 gal	0
Mocap 6EC 9 lb	1
Mocap 6EC 6 lb + Mocap 10G 3 lb	0
Mocap 6EC 6 lb + Mocap 10G 6 lb	0

^a Telone II was applied in the spring with chisels 10 inches deep, spaced 9 inches apart. Mocap 6EC was applied as a preplant broadcast spray and rototilled 4-6 inches deep. Mocap 10G was applied in a 2-ft band directly on to the plants in the row 8 weeks after planting and followed immediately with 1-acre-inch of water.

^b Values are means of five replicates. Tubers with 6 or more nematodes/tuber were graded as culls.