ECOLOGY AND CONTROL OF ROOT-KNOT NEMATODES ON POTATO, 1981 *

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Root-knot nematodes are serious pests affecting potato production in Washington. The northern root-knot nematode (Meloidogyne hapla) has long been considered an important pathogen on potato. In 1978 a new root-knot species, the Columbia root-knot nematode (M. chitwoodi) was found attacking potatoes near Quincy, Wa. This nematode has been present in the Pacific Northwest for some time but was not recognized as a new species. Surveys show that M. chitwoodi is widespread in the Pacific Northwest. Ecological and control studies show that M. chitwoodi is more important on potatoes than M. hapla.

In 1980 and 1981, threshold studies were conducted to determine the effect of initial preplant populations of M. chitwoodi and M. hapla on Russet Burbank tuber infection. Test consisted of 70 microplots (32 in. diam. x 12 in. high fiber glass cylinders) with 4 inoculum levels (1, 10, 100, and 250 eggs per 250 cc (1/2 pint) soil) of each species. Results indicate that a threshold level for M. hapla may occur but not for M. chitwoodi. Initial M. hapla populations of 100 or less yielded tubers averaging less than 6 nematodes per tuber. Tubers having 6 or more nematodes were graded as culls. However, before control decisions based on preplant nematode populations can be made, nematode sampling and extraction procedures must be standardized.

For the past 3 years, field studies have been conducted to determine when during the growing season M. chitwoodi and M. hapla can be detected in potato tubers. Results have shown that tubers are infected earlier and more severely by M. chitwoodi than M. hapla. In our plots most of the tuber damage caused by M. hapla could have been avoided by harvesting tubers in early September. In 1981, 12% of the tubers growing in M. hapla infested soil were graded as culls on September 22 compared to 54% on October 27. Our results show that to avoid damage by M. chitwoodi tubers would have to be harvested by August 1.

Nematicide trials were conducted to evaluate soil fumigants and nonfumigants for the control of M. chitwoodi and M. hapla in fields of sandy loam soil at the Washington State University Irrigated Agriculture Research and Extension Center, Prosser, Wa. Plots were three rows, 35 ft. long, spaced 34 inches apart, and arranged in a randomized complete block design with five replications. Nematicides evaluated for control of M. hapla included DD, Telone II, Mocap 6 EC and Temik 15 G. DD and Telone II were injected with chisels 10 inches deep, spaced 9 inches apart (March 27); Mocap was sprayed on the surface and rototilled 4-6 inches deep (April 23); and Temik was sidedressed next to the seed-piece at planting (April 30) and 6 inches from the plant on both sides of the row 6 weeks after planting (June 18). In the M. chitwoodi plots, DD, Telone II, Telone C-17, Vapam, Mocap 6 EC, combination of Mocap plus Temik 15 G, and the combination of Telone II with Mocap, Temik, and Vydate L. were evaluated. DD, Telone II (March 26), Telone C-17 (March 30), Mocap (April 23), and Temik (June 18) were applied the same as the M. hapla plots. Vydate was sprayed on the seed-piece at planting (May 4). Vapam was sprayed on the surface and followed immediately with 1-acre-inch of water (March 28). Note that the method used to apply Vapam was contrary to the recommended sprinkler applied method. In another test adjacent to the M. chitwoodi plots, deep

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placement (20 inches) of Telone II was evaluated for control of M. chitwoodi. Soil temperatures during preplant applications ranged from 50-60°F at 6 and 10 inches deep. Plots were irrigated with sprinklers and maintained with standard cultural practices. Nematode soil samples were taken before (March 25), after treatment (July 23), and after harvest (October 27). Nematode counts, yield and tuber infection data were obtained from the middle row of each plot. Twenty tubers from each plot were peeled by hand and examined for nematode infection. Plots were harvested on October 27.

Results are summarized in Tables 1, 2, 3, and 4. No differences in yields were observed in any of the treatments. This was contrary to results obtained in 1979 and 1980 where the soil fumigants increased yields in plots infested with M. chitwoodi. Nematode soil population counts in the M. chitwoodi plots were quite variable. Only DD, 25 gal significantly ($P = 0.05$) reduced root-knot population at harvest compared to the nontreated plots. Most of the M. hapla plots that received nematicide treatment had lower nematode counts at harvest than the nontreated plots.

Results of the tuber infection data showed that most of the nematicide treatments effectively controlled M. hapla (Table 1). Only Temik 15 G applied at planting did not. However, Temik applied 6 weeks after planting gave excellent control. In the M. chitwoodi plots most of the treatments significantly reduced tuber infection compared to the nontreated plots (Table 2). Especially encouraging were the combination treatments of Mocap plus Temik and Telone II plus Mocap and Temik. However, the percentage of culls in the soil fumigant treatments were high compared to results obtained in 1979 and 1980 (Table 3). In 1979 and 1980, Telone II, 15 gal and Vapam, 50 gal effectively controlled M. chitwoodi. The results of the deep placement plot shows that the depth of fumigant placement may be an important factor in controlling M. chitwoodi in the spring (Table 4). Telone II applied 20 inches deep was more effective in controlling M. chitwoodi than at 10 inches. The general failure of the soil fumigants was probably due to the mild winter of 1980-81 which allowed tubers heavily infected with M. chitwoodi to survive the winter. This allowed for an abnormally high carryover of root-knot nematode inoculum for the 1981 potato crop. Most of the treatments probably would have given better control under less adverse conditions.

Reference

Santo, G. S., J. H. O'Bannon, A. P. Nyczepir, and R. P. Ponti. 1981. Ecology and control of root-knot nematodes on potato. Proceedings of 20th Ann. Wash. Potato Conf., pp. 135-139.

Table 1. Nematode counts, potato yields, % culls and tuber infection index from Meloidogyne hapla plots, Pear Acres 1981. [1]

Treatment (rate AI/A)	Root-knot juveniles per 250 cc soil			Yield (T/A)	% Culls[2]	Infection index[3]
	Pre	Post	Harvest			
Nontreated	160	32	450	15.4	54	2.7
Telone II - 12 gal	84	23	84	20.3	0*	0.2*
DD - 20 gal	140	75	13	17.6	0*	0*
Temik 15 G - 3 lb	300	56	320	14.8	23	1.1*
Temik 15 G - 6 lb	190	140	270	20.1	34	1.6
Temik 15 G - 3 lb(PP)[4]	98	390	160	16.1	7*	0.3*
Temik 15 G - 6 lb(PP)	150	60	110	17.6	2*	0.2*
Mocap 6 EC - 4 lb	85	25	61	17.8	3*	0.2*
Mocap 6 EC - 6 lb	140	31	22	16.7	1*	0.1*
Mocap 6 EC - 9 lb	130	26	37	15.0	0*	0.02*

[1] Values are means of five replicates. * = differs from nontreated at P = 0.05, Duncan's multiple range test.

[2] Tubers with 6 or more nematodes/tuber were graded as culls.

[3] Infection index: 0 = no nematodes; 1 = 1-3; 2 = 4-5; 3 = 6-9; 4 = 10+; 5 = 50+; 6 = 100+ nematodes/tuber.

[4] PP = postplant application.

Table 2. Nematode counts, potato yield, % culls and tuber infection index from Meloidogyne chitwoodi plots, Pear Acres 1981. [1]

Treatment (rate AI/A)	Root-knot juveniles per 250 cc soil Pre	Post	Harvest	Yield (T/A)	% Culls[2]	Infection index[3]
Nontreated	25	48	185	18.9	100	5.8
Telone II - 15 gal	17	24	33	22.9	37*	1.8*
Telone II - 20 gal	93	23	32	23.7	15*	0.7*
DD - 25 gal	4	11	17*	23.0	5*	0.2*
DD - 34 gal	40	15	35	22.6	19*	1.0*
Telone C-17 - 6 gal	24	45	130	19.9	67	3.4
Telone C-17 - 9 gal	1	32	15	22.9	29*	1.5*
Vapam - 50 gal	37	0	170	21.3	77	4.0
Mocap 6 EC - 6 lb	19	6	90	21.2	46	2.6*
Mocap 6 EC - 9 lb	29	26	140	22.1	84	4.4
Mocap 6 EC - 12 lb	26	19	41	21.4	35*	2.0*
Mocap-6 lb + Temik-6 lb (PP)[4]	120	200	49	22.2	11*	0.6*
Telone II - 10 gal + Mocap - 6 lb	18	5	12	21.8	7*	0.2*
Telone II - 10 gal + Temik - 6 lb	33	21	22	20.1	2*	0.1*
Telone II - 10 gal + Vydate L - 2 lb	21	43	27	22.0	34	1.7*

[1] Values are means of five replicates. * = differs from nontreated at P = 0.05, Duncan's multiple range test.

[2,3] Percent culls and infection index determined same as Table 2.

[4] PP = postplant application.

Table 3. Control of Meloidogyne chitwoodi with soil fumigants 1979, 1980, and 1981.

Treatment (rate gal/A)	Percent Cull[1] 1979	1980	1981
Nontreated	53	100	100
Telone II - 12	14	23	--
Telone II - 15	1	6	37
Telone II - 20	--	--	15
DD - 20	11	32	--
DD - 25	--	--	5
DD - 34	--	--	19
Vapam - 50	9	10	77

[1]Values are means of five replicates.

Table 4. Nematode counts, potato yield, % culls, and tuber infection index from Meloidogyne chitwoodi deep placement plots, Pear Acres 1981. [1]

Treatment (rate gal/A)	Depth Application (inches)	Root-knot juveniles per 250 cc soil Pre	Post	Harvest	Yield (T/A)	% Cull[2]	Infection index[3]
Nontreated	--	21	20	460	19.2	84	4.2
Telone II - 12	10	17	4*	960	19.5	81	3.9
Telone II - 12	20	22	2*	80*	20.2	20*	1.0*
Telone II - 6	10 & 20	20	6	1,000	20.1	87	4.5

[1]Values are means of five replicates. * = differs from nontreated at P = 0.05, Duncan's multiple range test.

[2,3]Percent culls and infection index determined same as Table 2.