

Control of *Meloidogyne* spp. on Russet Burbank Potato by Applying Metham Sodium through Center Pivot Irrigation Systems¹

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Abstract: Metham sodium applied in October through center pivot irrigation systems was evaluated for control of *Meloidogyne hapla* at 374, 468, and 701 liters/ha and for control of *M. chitwoodi* at 468 liters/ha on potato. Metham sodium at the high rates effectively controlled *M. hapla*. No females were detected in the tubers at the high rates of nematicide application, whereas a mean of 19 and 69% of the tubers were infected at the low rate and in the nontreated controls, respectively. In the *M. chitwoodi* trial only 1.5% of the tubers in the treated plots were infected compared with 82% in the nontreated plots. Metham sodium effectively controlled *M. chitwoodi* to soil depths of 30, 61, and 91 cm.

Key words: root-knot nematodes, *Meloidogyne chitwoodi*, *Meloidogyne hapla*, chemical control, *Solanum tuberosum*.

The Columbia (*Meloidogyne chitwoodi* Golden et al.) and northern (*M. hapla* Chitwood) root-knot nematodes cause severe problems in potato (*Solanum tuberosum* L.) production in the Pacific Northwest because they lower tuber quality (2). In Washington there are about 49,470 ha of potatoes of which 60-70% receive annual nematicide treatments to control root-knot nematodes. The nematicides most commonly used are the soil-injected 1,3-dichloropropene fumigants. Metham sodium use (sodium N-methyl-dithiocarbamate) has increased in recent years for controlling nematodes and other pests and soilborne pathogens on potato, since Gerstl et al. demonstrated (1) that it effectively controlled *Verticillium dahliae* on potato when applied in irrigation water to infested soil. Approximately 90% of the potatoes in the Pacific Northwest are irrigated by overhead sprinkler systems; therefore it seemed appropriate to evaluate the application of metham sodium through these systems for control of root-knot nematode. Thus, two field trials applying metham sodium through center pivot irrigation systems were conducted to determine its efficacy in controlling *M. chitwoodi* and *M.*

hapla on Russet Burbank potato. A portion of this work has been published (4).

MATERIALS AND METHODS

The first trial was established near Pasco, Washington, in a loamy sand (88% sand, 9% silt, 3% clay, 0.5% organic matter, 7.1 pH). Metham sodium was applied by injection into the mainline of a center pivot irrigation system on 24 October 1978 directly on a 3-year-old alfalfa (*Medicago sativa* L.) field uniformly infested with *M. hapla*. The chemical was applied in 2.5 cm (one-acre-inch) of water at 374, 468, and 701 liters/ha (40, 50, and 75 gal/A). During application soil temperature at 15 cm deep was 14.5 C, water temperature was 12.8 C, and soil moisture was about 50% of field capacity. Each chemical treatment consisted of a single 1.7-ha wedge. Within each treated plot an area 6.1 × 30.5 m was covered with a plastic tarp during chemical application to serve as a nontreated control. Five paired plots were located in the nontreated and adjacent treated areas. Soil and/or alfalfa root samples for nematode analysis were taken on 23 October 1978 (pretreatment) and 3 March and 10 April 1979. Soil samples were taken to 46 cm deep. Nematodes were extracted from soil and roots by centrifugal flotation and root incubation, respectively. Russet Burbank potatoes were planted on 15 April 1979. Tubers were harvested 24 October and 15 November 1979. Tuber samples were obtained from 3 m of row in each plot, lye peeled, and examined for nematode infection.

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TABLE 1. Control of *Meloidogyne hapla* with metham sodium applied through a center pivot irrigation system, 1978-79.

Metham sodium (liters/ha)	Number of <i>M. hapla</i> juveniles*					
	Per 250 cm ² soil			Per gram alfalfa roots*	Tubers infected*	
	Pretreatment	Posttreatment			(%)	
	Oct. '78	Mar. '79	Apr. '79	Apr. '79	Oct. '79	Nov. '79
0	405 a	42 a	58 a	220 a	87 a	†
374	390 a	0 b	0 b	0 b	19 b	17
0	450 a	51 a	605 a	56 a	60 a	†
468	410 a	0 b	0 b	0 b	0 b	7
0	465 a	32 a	180 a	7 a	60 a	†
701	420 a	0 b	0 b	0 b	0 b	0

* Values are means of five replicates. Values followed by the same letter are not significantly different ($P = 0.05$) according to Duncan's multiple-range test.

† No tuber samples were taken from nontreated plots.

The second trial was established near Pasco, Washington, in another loamy sand (86% sand, 10% silt, 4% clay, 0.5% organic matter, 6.9 pH) infested with *M. chitwoodi*. Metham sodium was applied on 8 October 1981 through a center pivot irrigation system directly onto wheat stubble at 468 liters/ha in 2.5 cm of water to 0.4 ha. Soil temperature during application was 10 C at 15 cm deep. Three replicates (6.1 × 30.5 m) were covered with plastic tarp during chemical application to serve as nontreated controls. Soil was sampled at two sites 12 m apart within each nontreated area and from adjacent treated areas. Samples were taken to 0-30, 31-61, and 62-91 cm monthly for 4 months after chemical application beginning on 20 November. Russet Burbank potatoes were planted on 24 February 1982. Tubers were harvested on 8 September 1982. Tuber samples were obtained from 3 m of row in each plot, lye peeled, and examined for nematode infection.

RESULTS

Metham sodium effectively controlled *M. hapla* in both soil and alfalfa roots in the first trial (Table 1). Nematodes were not found in treated plots. Tuber samples from the 468 and 701 liters/ha treatments examined on 24 October lacked *M. hapla* females, whereas an average of 19 and 69% of the tubers were infected from the 374 liters/ha and nontreated controls, respectively. On 15 November the tubers in the 701 liters/ha treatment were still free of

root-knot infection, but 7% of those in the 468 liters/ha were infected.

In the second trial, metham sodium at 468 liters/ha controlled *M. chitwoodi* at all depths sampled (Table 2). Live, but deformed root-knot nematode juveniles were obtained from samples taken on 17 December; however, a bioassay using tomato seedlings (*Lycopersicon esculentum* Mill. 'Columbian') showed no root infection. Only 1.5% of the tubers sampled on 8 September from treated plots were infected, compared to 82% infected in nontreated plots.

DISCUSSION

Fall application of metham sodium through the center pivot irrigation system is an effective method for control of *M. chitwoodi* and *M. hapla* on potatoes.

In both trials, posttreatment soil samples from the metham sodium-treated plots prior to planting contained no detectable infective juveniles. However, 1.5 to 19% of the tubers from the treated plots were infected. Tubers were harvested in the *M. hapla* plots on 24 October 1979, which is a late harvest. It is conceivable that if the tubers had been harvested in early September, none from the metham sodium treatments would have shown obvious root-knot nematode infection. Likewise, if the tubers in the *M. chitwoodi* plots had been harvested later than 8 September, they probably would have shown heavier infection. *M. chitwoodi* infects tubers earlier in the season and affects them more severely than does *M. hapla* (3). Most of the tuber damage

TABLE 2. Control of *Meloidogyne chitwoodi* with metham sodium applied through a center pivot irrigation system, 1981-82.

Metham sodium (liters/ha)	Sample depth (cm)	Number of <i>M. chitwoodi</i> juveniles/250 cm ³ soil*					Tubers infected* (%) Sept. '82
		Pretreatment	Posttreatment				
		Sept. '81	Nov. '81	Dec. '81	Jan. '82	Feb. '82	
0	30	151 ab	54 a	171 a	337 a	118 a	82 a
	61	124 bc	28 a	57 b	127 bc	11 b	
	91	2 d	2 b	2 c	26 b	4 bc	
468	30	264 a	0 b	2 c†	0 c	0 c	1.5
	61	28 bcd	0 b	0 c	0 c	0 c	
	91	14 cd	0 b	3 c†	0 c	0 c	

* Values are means of three replicates. Values followed by the same letter are not significantly different (P = 0.05) according to Duncan's multiple-range test.

† Nematodes were live but deformed. Bioassays on tomato for infective nematodes were negative.

caused by *M. hapla* may be avoided by harvesting in early September, but to avoid damage by *M. chitwoodi* tubers would have to be harvested before August. Thus, even with nematicide treatments, potatoes grown in soil infested with root-knot nematodes, especially *M. chitwoodi*, should be harvested as early as possible.

Application of metham sodium does not require soil tillage which is necessary for effective nematode control with soil-injected fumigants. Metham sodium can be applied directly in irrigation water onto growing alfalfa or onto wheat or corn stubble. This minimizes early spring wind erosion which can be a serious problem in the fine sandy soils of central Washington. In addition to controlling nematodes, metham sodium also effectively controls many weeds, soil insects, and phytopathogenic fungi including *Verticillium*, *Sclerotinia*,

Pythium, and *Phytophthora*. Approximately 12,140 ha of potatoes were treated with metham sodium in 1983 in Washington State.

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