BIOLOGY AND CONTROL OF ROOT-KNOT NEMATODES ON POTATO, 1986

by
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Washington State annually grows about 110,000 acres of potatoes. Approximately 40 percent of this acreage is infested with the Columbia (Meloidogyne chitwoodi) and/or Northern (M. hapla) root-knot nematodes. Both species are severe problems in potato production because they reduce the quality of the potato tuber. M. chitwoodi is more important on potatoes than M. hapla, causing more severe damage to tubers and is more difficult to control.

A two-year study followed M. chitwoodi population dynamics on potato in microplots and a commercial field. Soil population density of second stage juveniles peaked in mid-fall, declined through the winter, and was lowest in early July. Eggs produced on roots by the first generation hatched in mid-July at 1000-1100 degree days (DD) base 5C after planting. The second and third generations were completed in 1600-1700 DD and by harvest in early October, respectively. These studies show that the best time to take post-treatment soil samples and/or to monitor nematode populations in a potato field would be in May or beginning in August. Nematode soil populations are lowest in June and July when most of the nematodes are developing within the roots. These studies also show that M. chitwoodi juveniles do not attack tubers until about mid-July following egg hatch. Thus, studies are in progress to determine the feasibility of controlling M. chitwoodi by protecting tubers with chemical treatments prior to nematode invasion.

The most common method used to control root-knot nematodes on potatoes is by soil fumigation with Telone II or the metham sodium products (Metam, Nemasol, Soil Prep or Vapam). Approximately 70-80% of the potato acreage is fumigated at an estimated annual cost of $20 million. The estimated loss without fumigation would be $40 million. Thus, we cannot afford to lose the use of these fumigants. In 1986, a number of potato crops were damaged by M. chitwoodi even after treatment with metham sodium.

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One of the reasons for an increase in nematode problems was probably due to the unusually warm spring that occurred in 1986, which promoted nematode development and reproduction. However, no fields were reported damaged by Telone II. Several questions were raised: 1) Is M. chitwoodi becoming resistant to metham sodium? 2) Are soil microorganisms degrading metham sodium, thus reducing its effectiveness against M. chitwoodi? or 3) Are edaphic factors, such as soil moisture and soil type affecting the performance of metham sodium? In an effort to answer the first two questions, soil was obtained from a field in the Quincy area that had received metham sodium but failed to provide adequate control of M. chitwoodi. A greenhouse pot test was conducted to compare Vapam to Telone II and Mocap for control of M. chitwoodi. The results showed that at the commercial rates, all three chemicals were able to eliminate the nematodes under these pot conditions. Thus, these results indicate that the answer to the first two questions would be no. It appears that edaphic factors affecting the movement of metham sodium in the soil are probably contributing significantly to the poor performance of this chemical. Studies are underway to determine the effect of soil type, soil moisture and soil temperature on the movement of metham sodium in the soil and its relationship to M. chitwoodi control.

Several nonfumigant insecticide-nematicide treatments have shown promise in controlling M. chitwoodi the past 2 years in our field trials. The experimental compound Apache (FMC Corporation) has performed better than Mocap and was comparable to Telone II in 1986 (Table 1). Also, the combination of Mocap applied prior to planting and Nemacur (not registered for use on potatoes) applied post-plant prior to tuber penetration has performed well (Table 1). Post-plant treatments of nonfumigants applied through sprinkler systems have also shown promise for control of M. chitwoodi. These treatments will be retested in 1987.

Crop rotation can be an effective means to suppress nematode populations. However, the rotational crop must not be a suitable host and the field must be kept free of weeds that may serve as host for the nematodes. The difficulty with M. chitwoodi and M. hapla is that they have a very wide host range. The principle difference between these species is that many of the graminae are hosts for M. chitwoodi but are not hosts for M. hapla. Thus, the cereals would be excellent crops to rotate with potato to suppress M. hapla populations. Alfalfa, on the other hand, is a good host for M. hapla but has a mixed reaction to M. chitwoodi race 1 and 2. Race 1 (non-alfalfa race) reproduces poorly or not at all on alfalfa and race 2 (alfalfa race) reproduces well. Thus, alfalfa would be a good rotational crop for race 1 but not race 2. Presently, no good rotational crop is available to suppress M. chitwoodi race 2 populations. In 1986, 54 alfalfa cultivars were tested for host suitability to M. chitwoodi race 2. Of these, only one cultivar (W12R2W1) exhibited a high degree of resistance to race 2. Studies, however, need to be conducted under field conditions to confirm resistance to M. chitwoodi race 1 and 2, and M. hapla before this cultivar can be registered for commercial release.

Host suitability of M. chitwoodi race 1 and 2, and M. hapla were also conducted on five carrot cultivars; A-Plus, Chancellor, Chantenay Red Cored, Orlando Gold and Six Pack. All were suitable hosts for M. chitwoodi race 1 and M. hapla, but only Orlando Gold supported populations of race 2. Thus, carrots may be a good rotational crop to suppress M. chitwoodi race 2 populations.

Table 1. Control of Meloidogyne chitwoodi on Russet Burbank potato, IAREC, Prosser, 1986[1].

Treatment (rate AI/A)[2]	% culls[3]	Infection index[4]
Nontreated	100 a	6.0 a
Telone II 20 gal (S, BP)	46 cd	2.3 c
Mocap 6EC 6 lb (BP)	88 b	4.7 ab
Mocap 6EC 9 lb (BP)	92 ab	4.6 c
Apache 6 lb (BP)	62 c	3.2 c
Apache 9 lb (BP)	17 d	1.0 c
Apache 12 lb (BP)	24 d	1.3 c
Nemacur 3 6 lb (PP)	92 ab	4.6 b
Mocap 6EC 6 lb (BP) + Nemacur 3 6 lb (PP)	33 d	1.6 c

[1]Values are means of five replicates. Values in each column not followed by the same letter differ significantly at P=0.05 (DMRT).

[2]S = Spring application; BP = Before planting; PP = Post-plant (June 25).

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