ROOT-KNOT NEMATODE INVESTIGATIONS ON POTATOES, 1978

by
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Root-knot nematodes (Meloidogyne spp.) are serious pests affecting potato production in irrigated central Washington. The economic threshold levels for the root-knot nematode are not known and studies of this nature to determine the economical feasibility of nematicide treatments are needed. Fields known to be infested are usually treated. If not, the farmer faces the possibility of losing his entire crop. Preliminary results obtained in 1977 indicate that at low root-knot nematode population levels control measures may not be necessary to produce high quality potatoes. Information is also lacking as to the feasibility of treating high nematode populations.

Soil fumigants are the most commonly used nematicides to control nematodes on potatoes. Recently, the introduction of non-fumigant or systemic nematicides have shown promise. Non-fumigant nematicides have several important advantages: at the recommended rates cost may be $30-70 per acre less than the standard fumigant s. Additional savings are derived from the elimination of an extra operation by applying materials at the time of planting. Soil temperature, soil moisture and field preparations are not as critical. Systemic materials are effective against both nematodes and insects.

Recently, an important new area of research has developed in controlled-release pesticides. Nematicides may be chemically attached to a biodegradable substance and as this substance degrades the nematicide is released at a controlled rate. This continued but controlled rate of release may control nematodes as well or better and for a longer perior than nematicides applied in the original form.

Economic threshold and chemical control studies proposed on potatoes may greatly reduce production cost and thereby increase the profits of the potato producer.

Economic Threshold Studies

Threshold studies to determine the effect of initial population levels of Meloidogyne hapla on yield and tuber infection of potatoes were conducted in a field of sandy loam soil at the Irrigated Agriculture Research and Extension Center, Prosser, Wa. Tests consisted of 93 plots. Plots were single rows 25 ft long. Adjacent rows served as borders between plots. Nematode soil samples were taken with a 1-in. diameter soil probe, 12 in. deep prior to planting (May 3). Fifteen subsamples were taken and composited from each plot. Samples were mixed thoroughly; processed using the centrifugal-flotation technique; and nematode counts determined per 250 cc soil. Nematode soil populations ranged from a low of 18 to a high of 595 per 250 cc soil. Plots were planted on May 15 and harvested Nov. 1 and 2. Yield data were obtained from each plot and 15 tubers were graded for nematode infection by USDA inspectors. Yield and nematode infection data were then compared to the initial root-knot population levels to determine the relationship between initial nematode population levels and yield and nematode tuber infection.

Analysis of the results showed that there was no correlation between initial nematode population and yield (R=0.1954) or nematode tuber infection (R=0.0560) (an R value of 0.700 or more would be considered a close correlation.) In other words, the plots with the higher initial root-knot counts did not necessarily yield less or have a higher incidence of nematode infected tubers than the plots with lower nematode numbers or vice versa.

Although yields of potato may not be affected by M. hapla the failure to correlate initial nematode soil population levels and tuber infection was not expected. A possible reason may have been that in fall 1977 root-knot infected potato tubers were added to the field by rototilling. Some pieces of infected tubers may not have had sufficient time to break down. Thus, the nematode populations determined by soil counts may have been inaccurate.

Controlled-Release Nematicide Trials

A greenhouse pot experiment was set up to compare the residual activity of Temik and controlled-release Temik in controlling the root-knot nematode on potatoes. Potato seed-pieces were planted in MBr fumigated sandy loam soil in 2-gallon plastic pots. The nematicides were added at rates of 0, 1 and 3 lb AI/A with the seed-piece at the time of planting. M. hapla 2nd stage larvae (1,000/pot) inoculations were made every 2 weeks for 16 weeks. Each treatment was replicated five times. Experiment was harvested after 5 months. Results showed that fewer nematodes were found infecting tubers treated with controlled-release Temik as compared to Temik treatments for at least 8 weeks (inoculation treatments made after 8 weeks did not allow enough time for nematode development). Differences, however, were not statistically significant.

Controlled-release Temik was compared in the field of Temik, Telone II, and D-D. Controlled-release Temik did not differ from Temik or the non-treated plots in terms of nematode counts, yield, or nematode infected tubers (Table 1).

Table 1. Control of Meloidogyne hapla with Telone II, D-D, Temik and controlled-release Temik[1/]

Treatment (rate AI/A)[2/]	Nematode counts/250 cc soil: Post-treatment[3/]	Nematode counts/250 cc soil: Harvest[3/]	Yield (cwt/A)[3/]	% No. 2's & culls[3,4/]
Non-treated	21a	58a	486a	11.1a
Telone II 15 gal	13a	24 b	526a	4.6 b
D-D 20 gal	19a	34 b	468a	2.2 b
Temik 15G 3 lb	12a	44ab	482a	14.7a
Temik 15G Control-Release 3 lb	20a	90a	491a	12.6a

1/ Results taken from Table 2.

2/ Telone II and D-D applied before planting--injected 10 in. deep, 9 in. apart; Temik applied sidedress at planting.

3/ Values are mean of 6 replicates. Values in each column not followed by the same letter differ significantly (P=0.05).

4/ Tubers were graded by USDA inspectors for nematode infection.

Nematicide Trials

Twenty-four nematicide treatments were evaluated for control of Meloidogyne hapla in a field of sandy loam soil at the Irrigated Agriculture Research and Extension Center, Prosser, Wa. The original population of M. hapla present in the field was increased by rototilling potato tubers heavily infected with the root-knot nematode. Plots were 85 ft wide (three 34-in. rows/plot) and 35 ft. long. Treatments were replicated 6 times and arranged in a randomized block design. Pretreatment (March 7) nematode soil samples showed that the plots were infested with an average of 11 second-stage larvae/250 cc soil. The low nematode soil counts obtained were due to the fact that the majority of the nematode population were present in tubers (used for inoculum) that had not sufficiently decomposed. Telone II and D-D were applied on March 28; Terr-o-cide 5445 and Bunema March 29; Agramine 25 gal March 30; at-plant treatments April 27-29; and post-plant treatments June 16. Soil temperatures at 6 and 10 inches deep during application were 60 and 56° F for Telone II and D-D; 61 and 57° F for Terr-o-cide 5445 and Bunema; 60 and 56° F for Agramine 25 gal; 61 and 58° F for at-plant treatments; and 64 and 63° F for the post-plant sidedress treatments. Potato seed-pieces were planted April 27-29. Plots were irrigated with sprinklers and standard cultural practices were used in maintaining the plots. Nematode post-treatment samples were taken on June 12 and at harvest (October 25). Yield data were obtained from the middle row of each plot. Twenty tubers were brine peeled and examined for nematode infection and graded by USDA inspectors. The plots were harvested on October 23-24. Results are summarized in Table 2.

Observations made June 2 showed that plants treated with Agramine 10 gal were stunted. On September 21 the plots were rated for vine vigor. The vines in the plots treated with D-D, Bunema, and Telone II were significantly greener than the untreated plots. None of the nematicide treatments yielded significantly more than the plots that received 300 lbs/A nitrogen only. No differences were observed in terms of yields of grade 1 and grade 2 potatoes among the treatments. No differences in nematode counts were found among the treatments in the post-treatment (June 12) soil samples. However, the soil samples taken immediately after harvest (October 25) showed the plots treated with Telone II and D-D had fewer M. hapla second-stage larvae than the untreated plots. Results of the USDA tuber inspection showed that only the D-D and Telone II treatments had less than 5% of the tubers graded as No. 2's and culls for nematode infection; the Terr-o-cide 5445 6.5 gals/A treatment was next best with 7.5%; all of the other treatments had more than 10%.

In a separate test adjacent to the above plots, Furadan and Temik were evaluated. Size, design and care of the plots were the same as the first test. Pretreatment (May 15) nematode soil samples showed that the plots were infested with an average of 14 second-stage larvae/250 cc soil. All treatments were applied at planting on May 16. Soil temperatures at 6 and 10 inches deep during application were 55° F. Nematode post-treatment samples were taken June 28 and at harvest (October 25). Yield data were obtained from the middle row of each plot. Twenty tubers were brine peeled and examined for nematode infection and graded by USDA inspectors. The plots were harvested on October 25.

No differences in yield or nematode counts were found among the treatments. Furadan 10G sidedressed next to the seed-piece had fewer percent of the tubers graded as number 2's and culls (Table 3.)

Population Dynamics Studies

A field study was conducted to determine the time during the growing season tubers become infected with the root-knot nematode. Soil, root and tuber samples were taken weekly throughout the growing season. Tubers were planted on May 15. Root-knot females were first observed within tubers August 1 (Fig. 1). However, higher incidence of nematodes were found to occur in early September. It would be ideal if a mid-season chemical application could protect the tubers from nematode infection. Studies to determine the effect of planting dates (early, normal, late) on nematode tuber infection will also be conducted.

Table 2. Control of Meloidogyne hapla on Russet Burbank potatoes.

Treatment, rate/A (active) and time of application[1/]	Method of Application[2/]	Nematode counts/250 cc soil: Post-treatment[3/]	Nematode counts/250 cc soil: Harvest[3/]	Vine vigor[3/]	Yield (cwt/A)[3/]	% No. 2's and culls[3,5/]
Non-treated[7/]	--	21a[4/]	58abcdef[4/]	2.1 bcd[6/]	486abc	11.1 bcd[4/]
Non-treated (200 lb N)	--	24a	104abcde	1.7 d	450 cd	23.8ab
Telone II 15 gal (BP)	A	13a	24 g	3.3a	527ab	4.6 ef
DD 20 gal (BP)	A	19a	34 g	3.5a	468abcd	2.2 f
Terr-o-cide 5445 5 gal (BP)	A	17a	43 efg	2.3abcd	459 cd	14.6abcd
Terr-o-cide 5445 6.5 gal (BP)	A	16a	48 defg	2.8abcd	477abcd	7.5 de
Bunema 30 gal (BP)	A	22a	160ab	3.5a	491abc	20.4abc
Telone II 6 gal (BP)+Temik 15G 3 lb (AP)	A,B	9a	32 fg	3.1abc	468abcd	10.4 bcd
Agramine 25 gal (BP)	A	23a	84 bcdefg	1.9 cd	414 d	38.8a
Agramine 25 gal (200 lb N)(BP)	A	23a	69abcdef	2.3abcd	500abc	20.3abc
Agramine 5 gal (AP)	C	20a	188ab	2.5abcd	454 cd	21.7ab
Agramine 5 gal (200 lb N)(AP)	C	23a	95abcd	2.0 bcd	445 cd	18.3abcd
Agramine 10 gal (AP)	C	17a	94abcd	3.2ab	477abcd	17.9abcd
Agramine 5 gal (AP)+Temik 15G 3 lb (AP)	C,B	22a	78abcde	2.9abc	464 bcd	11.3abcd
Temik 15G Control Release (Corn Cob) 3 lb (AP)	B	20a	90abcde	3.2ab	491abc	12.6 bcd
Temik 15G 2 lb (AP)	B	21a	62abcdef	3.0abc	468abcd	15.4abcd
Temik 15G 3 lb (AP)	B	12a	44 cdefg	3.1abc	482abcd	14.7abcd
Temik 15G 6 lb (AP)	B	24a	70abcdef	2.4abcd	491abc	12.1 bcd
Temik 15G 3 lb (AP)+3 lb (PP)	B,D	24a	86abcd	3.1abc	477abcd	13.3 bcd
Dacamox 10G 2 lb (AP)	B	22a	86abcd	2.4abcd	532a	11.4 bcd
Dacamox 10G 3 lb (AP)	B	28a	112abcd	3.1abc	491abc	24.2ab
Dasanit 15G 2 lb (AP)	B	18a	134abc	2.4abcd	500abc	18.3abcd
Dasanit 15G 3 lb (AP)	B	23a	88abcde	2.9abc	473abcd	19.2 abcd
Nemacur 15G 3 lb (AP)	B	17a	147a	2.5abcd	491abc	11.2 cde
Nemacur 15G 3 lb (PP)	D	22a	96abcd	2.6abcd	445 cd	15.1 bcd
Nemacur 15G 1.5 lb (AP)+1.5 lb (PP)	B,D	17a	76abcdef	2.5abcd	432 cd	16.2abcd

1/ BP=Before Planting; AP=At Planting; PP=Post Plant

2/ A=injected 10 inches deep, 9 inches apart; B=sidedressed next to seed-piece; C=sprayed on seed-piece at planting; D=applied by hand 6 inches from the plant and 6 inches deep on both sides of the row.

3/ Values are means of six replicates. Values in each column not followed by the same letter differ significantly (P=0.05), according to Duncan's Multiple Range Test.

4/ Statistical analysis was done after transforming data to Log (X+1)

5/ Tubers were graded by USDA inspectors for nematode infection as follows: #1=3 nematodes or less; #2=4-5 nematodes; and culls=6+ nematodes/tuber.

6/ Vine vigor rating: 0=dead vines; 1=less than 25% green vines; 2=25% green; 3=50% green; 4=75% green' 5=100% green.

7/ Except where noted, all plots received 300 lbs of nitrogen (N).

Table 3. Control of Meloidogyne hapla on potatoes with Furadan and Temik.

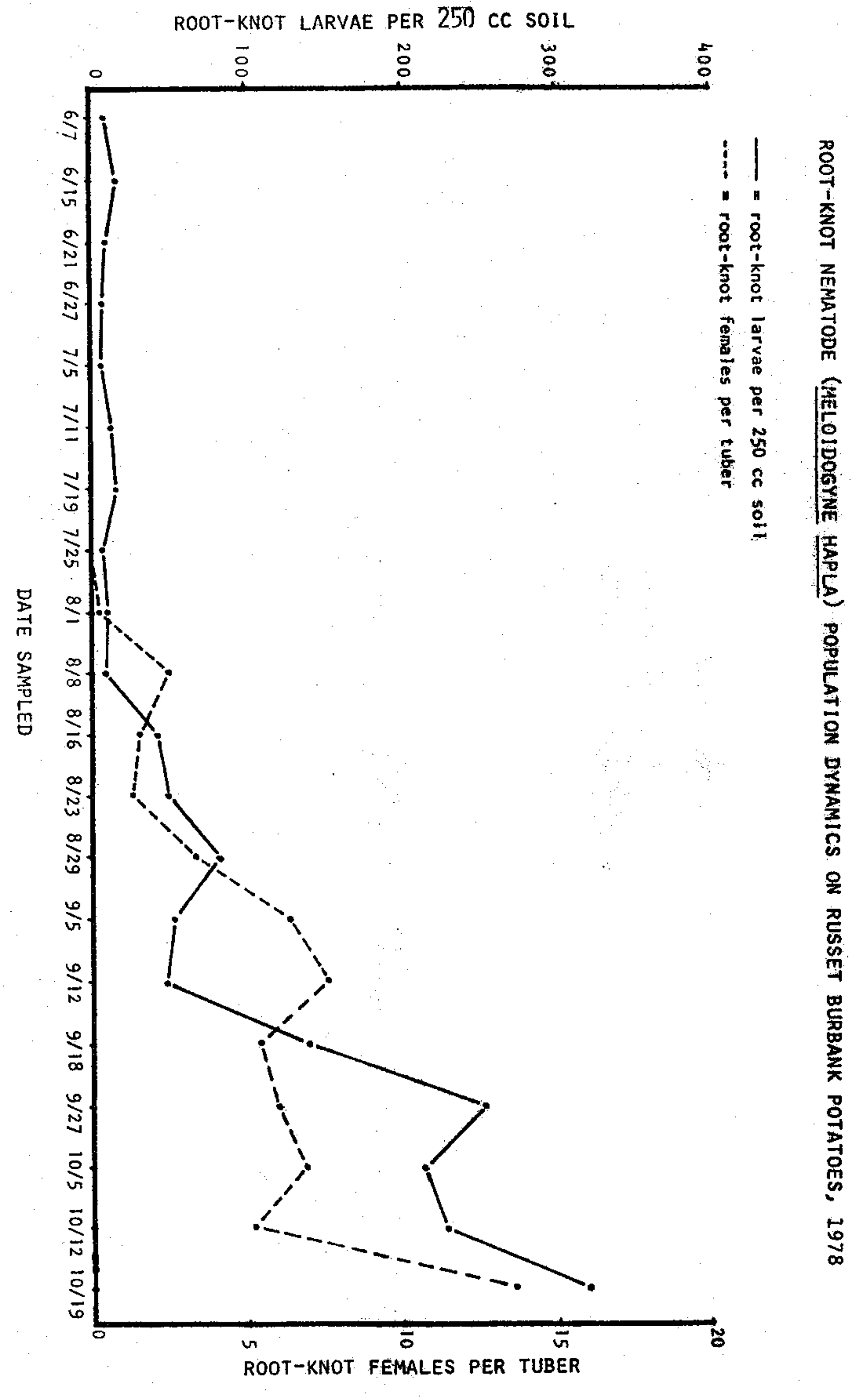
Treatment, lb/A (active) and method of application[1]	Nematode counts/250 cc soil Post-treatment[2]	Harvest[2]	Yield (cwt/A)[2]	% No. 2's & culls[2,3]
None treated	9a	18a	443a	10.0
Temik 15G 3 (SD)	16a	30a	405a	19.2
Furadan 10G 3 (IF)	10a	13a	409a	10.8
Furadan 10G 3 (SD)	7a	23a	457a	4.6

[1] Application done at planting time. SD-sidedress next to seed-piece; IF=in furrow with seed-piece.

[2] Values are mean of six replicates. Values in each column not followed by the same letter differ significantly (P=0.05).

[3] Tubers were graded by USDA inspectors for nematode infection as follows: #1=3 nematodes or less; #2=4-5 nematodes; and culls=6+ nematodes/tuber.

Figure 1.


ROOT-KNOT NEMATODE (MELOIDOGYNE HAPLA) POPULATION DYNAMICS ON RUSSET BURBANK POTATOES, 1978
—— = root-knot larvae per 250 cc soil
---- = root-knot females per tuber
ROOT-KNOT LARVAE PER 250 CC SOIL
0
100
200
300
400
6/7
6/15
6/21
6/27
7/5
7/11
7/19
7/25
8/1
8/8
8/16
8/23
8/29
9/5
9/12
9/18
9/27
10/5
10/12
10/19
DATE SAMPLED
0
5
10
15
20
ROOT-KNOT FEMALES PER TUBER