VERTICAL DISTRIBUTION & CONTROL OF ROOT-KNOT NEMATODES

L. R. Faulkner and W. J. Bolander

Chemical control experiments were conducted at 2 locations near Prosser and Quincy, Washington, where infestations of Meloidogyne hapla Chitwood (Prosser) and Meloidogyne incognita Chitwood (Quincy) are known to occur. These nematodes differ in their respective host ranges. M. hapla, the northern root-knot nematode, affects a wide variety of crop plants excepting cereals. M. incognita, the southern root-knot nematode, differs in that it may also affect cereals. Control procedures differ for these nematodes primarily with respect to cropping sequence.

In the plots at Prosser 5 soil fumigants and 5 granular nematicides were tested. Each material was applied at 3 rates in 5 replications. The fumigants were injected to a depth of 8-10" at 9" spacing as broadcast treatments. Granular materials, also broadcast, were incorporated to a depth of 6-8". Soil temperatures at an 8" depth ranged from 44° to 52° F. during the application period (March 18, 1969 to March 24, 1969). Soil moisture was approximately 13.8% by weight, approximately 65% available moisture. The field, planted to peas the previous summer, was free from excessive undecomposed organic matter. Netted Gems were planted April 9 and 10, 1969 at 1600 lbs per acre.

A comparison of the chemical treatments, as affecting root-knot nematodes and potato yields, is given in Table 1. All treatments, excepting Lanate at 4 and 8 lbs active per acre, gave significant control or northern root-knot nematode. Potato yields were increased significantly by most materials at one or another of the rates applied. Yields generally increased with application rate when fumigants were used. However, the granular materials tended to retard yields at the highest rates applied.

The yield data relate to yields of No. 1's and No. 2's only. Total yields were not measured. No significant differences, based on the per cent No. 1's, were observed among the treatments.

The yield differences shown cannot be attributed to the control of root-knot nematodes in these studies. However, in a separate experiment (Prosser) we fumigated with Methyl Bromide, under a 4 ml polyethylene tarp, at 2 lbs per 100 sq. ft. Part of the plots received heavy doses of nematode inoculum, whereas the remaining portion did not. An untreated-uninoculated area was used as a control. Yields and root-knot indices were as follows:

Treatment	Yield (tons/A)	Root-knot symptoms
A. Methyl Bromide	32.5	Trace
B. Methyl Bromide + nematode inoculum	23.6	Very severe
C. Control	13.7	Moderate

In this experiment root-knot nematode affected potato yield but only at an extremely high inoculum potential. Even then it did not have as great an effect as other causes (probably Verticillium) as shown by the non-treated control.

A preliminary study, testing application methods (broadcast vs. band treatments) on nematode control by fumigants, fumigant combinations, and fumigants + granular nematicides, was conducted near Quincy, Washington. Broadcast treatments (March 28, 1969) consisted of injection of fumigants to 8-10" depth with or without incorporation of granular nematicides to a 3" depth. Band treatments (March 31, 1969) varied in that the various fumigants were injected at 2 points 4.5" from the row centers. Hills were formed over the row centers following treatment. Soil temperatures ranged from 42^{o}-48^{o}F. The plots were planted to Norgolds on April 12, 1969.

The effects of these treatments on nematode control and potato yield are shown in Table 2. Band treatments usually resulted in slightly increased nematode control, although not significantly so. Here the banded materials were applied at 2/3 the broadcast rate, but concentrations within the treated bands were 1 1/2 times as great. It was also noted that where plots were fumigated, followed by immediate incorporation of a granular nematicide in the surface layer, the greatest yields were encountered.

These observations suggest possibilities for further testing.

The vertical distribution of root-knot nematode was followed throughout a one-year period (Table 3). Although these data might indicate larval movement relative to changes in soil temperature, they could also indicate the effects of temperature on hatching. Nonetheless, detailed experiments on vertical distribution could serve as guidelines for control procedures.

Life cycle studies indicate that 3 generations of root-knot nematodes may be produced each year in the field under Washington conditions (preliminary results). During 1969 peak populations of larvae occurred in mid-April, late-July and early-September. It was the second generation larvae that first entered potato tubers and ingress appeared to be through lenticels.

Table 1. Comparison of chemical treatments and rates on potato yields (tons/acre) and nematode control (root-knot indices).

		Low		Med.		High	
Fumigant	GPA	Yield	RK* Index	Yield	RK* Index	Yield	RK* Index
Telone	14, 21, 28	19.91	0.12	19.53	1.42	20.98	0.06
DD	16, 24, 32	18.26	0.12	19.72	0.02	20.91	0.01
Telone C	-, 18, 24	--	--	21.29	0.01	21.10	0.38
Vorlex	6, 9, 12	19.68	0.01	20.56	0.33	21.48	0.01
Terr-O-Cide 15	8, 12, 16	20.48	0.10	20.94	0.01	21.22	0.01
Granular	**lb act/A**						
68138	4, 6, 10	18.71	0.27	22.14	0.21	18.79	0.08
Dasonit	6, 9, 15	16.33	1.96	17.75	1.52	18.33	0.71
Temik	3, 6, 9	20.56	0.86	20.94	0.88	19.22	0.13
Lanate	4, 8, 12	20.33	4.73	16.02	22.01	20.83	0.12
Mocap	2, 4, 6	17.06	0.23	20.87	1.05	18.56	0.02
Controls		17.10	4.69	18.90	17.65	18.76	10.16
		Tilled		Shanked		NT	

$$\text{* Root-knot index} = \frac{\text{No. spots x No. tubers spotted}}{\text{No. tubers in sample}}$$

____ Significant at 5% level (LSD = 1.55 tons and 5.76 root-knot index)

Table 2. Comparison of treatment methods, broadcast vs. band.

	BROADCAST			BAND		
Material	Rate	Yield	RK* Index	Rate	Yield	RK* Index
Telone	21 gpa	11.49	0.79	14 gpa	13.45	0.13
Telone C	24 gpa	12.21	0.18	16 gpa	14.00	0.03
Vorlex	12 gpa	14.34	2.65	8 gpa	13.65	0.88
Telone + Temik	14 gpa + 3 lb	16.00	1.98	9.6 gpa + 3 lb	14.99	0.02
Telone + Dasanit	14 gpa + 3 lb	14.66	2.41	9.6 gpa + 3 lb	12.83	0.10
Control		11.58	340.89			

* Root-knot index = $\frac{\text{No. spots x No. tubers spotted}}{\text{No. tubers in sample}}$

______ Significant at 5% level (LSD = 2.20 tons and 71.45 root-knot index)

Table 3. Seasonal distribution of larvae.

Month	Temp. at 6" depth	Relative concentration, inches below surface 0-6"	7-12"	13-18"	19-24"	25-30"	31-36"
Jan.	33	o	oo	IIIII	IIIIII	IIII	ooo *
Feb.	34	o	oo	IIII	IIIIII	IIIII	ooo
March	45	o	ooo	IIII	IIIIII	IIIII	oo
April	58	oo	IIII	IIIII	IIIIII	ooo	o
May	62	ooo	IIIII	IIIIII	IIII	oo	o
June	72	o	IIII	IIIIII	IIIII	ooo	oo
July	69	IIIII	IIIIII	ooo	IIII	oo	o
Aug.	69	IIIII	IIIIII	IIII	ooo	o	oo
Sept.	66	IIIII	IIIIII	IIII	ooo	oo	o
Oct.	58	o	IIIII	IIIIII	IIII	oo	ooo
Nov.	47	o	oo	ooo	IIII	IIIIII	IIIII
Dec.	40	o	oo	IIII	ooo	IIIIII	IIIII

* Proportional distribution (o = lowest concentration of larvae to
IIIIII = highest concentration of larvae.)