Efficacy of Certain Systemic Nematicides for the Control of Root-Knot Nematodes Under Glasshouse Conditions *

KHALIFA H. DABAJ AND M. WAJID KHAN[1]

ABSTRACT

The systemic nematicides Oxamyl-G (Vydate G), Oxamyl-L (Vydate L), Aldicarb (Temik), Fenamiphos (Nemacur), and Fensulfothion (Terracur) were tested at different dosages for the control of *Meloidogyne javanica* on tomato under glasshouse conditions. All nematicides except Vydate L, when applied at the time of inoculation, were effective in inhibiting the development of galls and eggmasses at all the dosages used. Nemacur was found to be the most effective since it completely inhibited development of galls and eggmasses. Oxamyl-G, Fensulfothion and Aldicarb were equally effective. However, at lower dosage rates there was little formation of galls and eggmasses. Oxamyl-L which was applied as foliar spray was not effective in controlling the disease. These nematicides, when applied two weeks following inoculation with the nematodes, were not effective.

INTRODUCTION

Systemic nematicides offer new hope for the control of root-knot namatodes. They have been successfully applied in controlling these nematodes on certain crops. Abdel-Rahman and Eissa (1) observed that Aldicarb granules prevented the invasion of roots by second stage larvae. Raj and Nirula (6) observed significant low nematode population and root-infection by the use of certain systemic nematicides. Sivakumar *et al.* (7) obtained commercially acceptable control of root-knot nematodes on tomato by granular formulation of Aldicarb (Temik), Fensulfothion or Carbofuran. Considerable increase in the yield of tomato was obtained when Aldicarb, Ethprop and Oxamyl were applied in a field infested with the root-knot (5), Khan (4) observed reduction in galling and increase in plant growth of tomato by application of Vydate at low dosage under glasshouse conditions. Alam *et al.* (2) reported complete control of root-knot nematode on tomato by sprays of Vydate following the root-dip treatment. Soil sprays or fòliar sprays alone were not effective.

In a survey, *Meloidogyne javanica* was found to be widely occurring species in the

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[1] *Department of Plant Protection, Faculty of Agriculture, University of Al-Fateh, Tripoli, S.P.L.A.J.*

Western region of the Libyan Jamahiriya (3). An attempt was made to test the efficacy of certain systemic nematicides available in the country.

MATERIALS AND METHODS

The efficacy of the systemic nematicides Oxamyl-G (Vydate G), Oxamyl-L (Vydate L), Aldicarb (Temik), Fenamiphos (Nemacur), and Fensulfothion (Terracur) was tested against *M. javanica*, the most common root-knot species found in the western region. Maramande, a highly susceptible cultivar of tomato was selected as the test plant. Four different dosages were used as follows: 5 Kg, 10 Kg, 15 Kg and 20 Kg (ai/ha). In two separate experiments, the efficacy of nematicides was tested; in the first application was made at the time of inoculation and in the second, two weeks after inoculation.

In the first experiment, four weeks-old single tomato seedlings were transplanted in 12 cm plastic pots containing sterilized sandy loam soil. After 3 days of transplanting, different dosages of the nematicides, except Oxamyl-L, were applied to the soil. There were three replicates for each dosage. Oxamyl-L was applied as foliar treatment. Each pot was inoculated with 10,000 eggs of *M. javanica* maintained on tomato as pure culture. Two sets of controls were used. In the first set, neither nematicides nor nematode eggs were added to the pots. In the second set, the plants were inoculated with 10,000 eggs of *M. javanica* and no nematicides were added.

In the second experiment, which was similarly designed, the nematicides were applied two weeks after inoculation.

All the pots after inoculation and treatments were kept on greenhouse benches in a split plot design. Plants were regularly watered. After 50 days of transplanting, plants were harvested. Root and shoot lengths of plants from all the treatments were measured. Fresh weight of roots and shoots was also determined. Root-knot and eggmass indices of the inoculated plants were determined according to the following scale: $\underline{0}=0$, $\underline{1}=1-2$, $\underline{2}=3-10$, $\underline{3}=11-30$, $\underline{4}=31-100$ and $\underline{5}=$ greater than 100 galls or eggmasses per root system (8). Data from root and shoot lengths and fresh weights of roots and shoots were statistically analysed.

RESULTS AND DISCUSSION

Results obtained showed that all nematicides except Oxamyl-L (Vydate-L) when applied just before the inoculation were effective in inhibiting gall development and reproduction of root-knot nematode (*M. javanica*) on tomato (Table 1). Fifty days after the inoculation, plants inoculated with the nematodes only exhibited well developed galls on the roots and the eggmasses were apparent. Root-knot and eggmass indices were rated as high i.e. 5 in all the replicates.

Among all the nematicides applied, Fenamiphos (Nemacur) appeared to be the most effective since it inhibited the infection at all rates of applications. Oxamyl-G and Fensulfothion completely prevented infection at 10, 15 and 20 Kg (ai/ha). However, slight infection developed at application rate of 5 Kg (ai/ha). Upon application of Aldicarb, infection was found at rates 5 and 10 Kg (ai/ha) and root-knot index was 2 and 1 respectively. The eggmass index was 1 at 5 Kg (ai/ha), even though galls were present. At other rates of application, no galls or eggmasses were observed. Oxamyl-L which was applied as foliar spray failed to prevent infection at any rate of application used (Table 1).

Table 1. Effect of different dosages of different nematicides on the development of galls and eggmasses of *M. javanica* on tomato.

	Root-knot index				Eggmass index			
	Dosages (kg ai/ha)				Dosages (kg ai/ha)			
Treatment	5	10	15	20	5	10	15	20
	Application at the time of inoculation							
Control	0*	0	0	0	0	0	0	0
Nematode alone	5	5	5	5	5	5	5	5
Oxamyl-L (Vydate L)	5	5	5	5	5	5	5	5
Oxamyl-G (Vydate G)	1	0	0	0	1	0	0	0
Aldicarb (Temik)	2	1	0	0	1	0	0	0
Fenamiphos (Nemacur)	0	0	0	0	0	0	0	0
Fensulphothion (Terracur)	1	0	0	0	1	0	0	0
	Application two weeks after inoculation							
Control	0*	0	0	0	0	0	0	0
Nematode alone	5	5	5	5	5	5	5	5
Oxamyl-L (Vydate L)	5	5	5	5	5	5	4	4
Oxamyl-G (Vydate G)	5	5	5	5	5	5	5	5
Aldicarb (Temik)	5	5	4	4	5	4	4	4
Fenamiphos (Nemacur)	4	4	4	4	5	5	4	4
Fensulphothion (Terracur)	5	4	4	4	5	4	4	4

* Values represent average of 3 replicates.

Although the nematicides were effective in suppressing the development of galls and eggmasses, the differences in growth performance of plants at this age were not significant among most of the treatments (Table 2).

When the nematicides were applied two weeks after inoculation, none of the dosages effectively suppressed the development of galls and eggmass formation. There was, however, marginal effect when higher rates of Fensulfothion, Fenamiphos and Aldicarb were applied. Similarly Oxamyl-G was not effective whereas Oxamyl-L suppressed

Table 2. Effect of different nematicides on the development of galls, eggmasses and growth of tomato plants inoculated with *M. javanica* at the time of application.

Treatment	Root length *(cm)	Root weight *(gm)	Shoot length *(cm)	Shoot weight *(gm)	Root-knot index	Eggmass index
Fenamiphos (Nemacur)	14.5 a**	0.8 ab**	25.3 ab**	2.9 a**	0	0
Aldicarb (Temik)	11.6 ab	0.5 bc	27.1 a	3.3 a	0.75	0.75
Fensulphothion (Terracur)	11.8 ab	0.5 c	25.5 ab	3.5 a	0.25	0.25
Control	13.5 ab	0.8 abc	24.7 abc	3.3 a	0	0
Nematode alone	12.2 ab	1.1 ab	22.3 c	3.0 a	5	5
Oxamyl-L (Vydate L)	10.6 bc	0.6 bc	23.7 bc	3.2 a	5	5
Oxamyl-G (Vydate G)	9.8 c	0.4 c	24.3 bc	2.6 a	0.25	0.25

* Values are an average of three replicates of 4 doses (5, 10, 15, and 200 kg ai/ha).

** Treatments followed by the same letter(s) are not significantly different from each other within each column (P = 5%) according to Duncan's Multiple Range Test.

Table 3. Effect of different nematicides on the development of galls, eggmasses and growth of tomato plants inoculated with *M. javanica* 2 week before nematicide application.

Treatment	Root length *(cm)	Root weight *(gm)	Shoot length *(cm)	Shoot weight *(gm)	Root-knot index	Egmass index
Control	53.4 a**	1.3 c	53.5 a	9.6 a	0	0
Nematode alone	33.9 b	2.9 ab	30.8 c	7.6 ab	5	5
Oxamyl-L (Vydate L)	12.8 c	2.9 a	43.2 ab	9.4 a	4.75	4.5
Oxamyl-G (Vydate G)	13.8 c	1.5 c	27.3 c	6.0 b	4.75	4.5
Aldicarb (Temik)	13.9 c	2.1 bc	38.1 bc	5.7 b	4.5	4.25
Fenamiphos (Nemacur)	14.0 c	1.4 c	37.6 bc	8.2 ab	4.5	4.25
Fensulphothion (Terracur)	15.5 c	1.3 c	35.8 bc	6.3 b	4.5	3.75

*Values are an average of three replicates of 4 doses (5, 10, 15, and 20 kg ai/ha).

**Treatments followed by the same letter(s) are not significant from each other within each column (P = 5%) according to Duncan's Multiple Range Test.

eggmass formation at 15 and 20 Kg (ai/ha) but had no effect on the development of galls (Table 1).

The study on the effect of certain systemic nematicides on *M. javanica* on tomato, under glasshouse conditions, revealed that Fenamiphos, Fensulfothion, Oxamyl-G and Aldicarb effectively controlled the nematode when applied at the time of inoculation. All these were granular formulations and when applied to the soil were equally effective. However, slight infection was noticed at lower dosages of Fensulfothion, Aldicarb and Oxamyl-G. Fenamiphos completely eliminated the infection (Table 1). These results are in accordance with those obtained by different workers for the control of root-knot nematode on tomato (5, 6, 7, 9). Oxamyl-L applied as foliar spray was not effective in controlling root-knot nematode (Table 1). This supports the findings of Alam *et al.* (2) who reported that soil or foliar sprays were not effective to control *Meloidogyne* spp. However, they could control root-knot nematode on tomato by spray of Vydate following root dip.

The growth performance of plants due to application of these nematicides did not show any consistent trend. In most cases there was no significant improvement in the growth of the plants even 50 days after transplanting. The effect of nematicides on growth of tomato perhaps could have been apparent if the plants were grown to maturity. No phytotoxicity was noticed at all the rates of application used. Although post-planting treatments failed to prevent the disease, however, at higher dosages of some nematicides, there was a slight control (Table 3). Failure of nematicides in post-planting treatment might be attributed to the time lag between inoculation and treatment of nematicides. This might have allowed the eggs to hatch, penatrate the plants and got successfully established. Although nematicides applied are inherently systemic but certain ecological factors might have inactivated the active ingradients or inhibited the absorption of nematicides by plants enabling nematodes to form galls and produce eggmasses. Based on these findings, pre-plant treatment can be considered as a suitable and effective measure for control of root-knot nematodes on vegetables grown in greenhouses and plastic tunnels.

LITERATURE CITED

1. Abdul-Rahman, T. B. and M. F. M. Eissa. 1974. Some effects of Aldicarb on the life cycle and pathogenicity of *Meloidogyne incognita* in potato roots. Nematol. Medit. 3:173–175.
2. Alam, M. M., A. M. Khan and S. K. Saxena. 1975. Efficacy of 'Vydate' Oxamyl for the control of root-knot nematode, *Meloidogyne incognita* (Kofoid and White, 1919) Chitwood, 1949 attacking tomato. Botyu-Kagaku 40:159–161.
3. Dabaj, K. H. and M. W. Khan. 1981. Incidence of root-knot disease on tomato and potato and identity of the causal species in the western region of the Libyan Jamahiriya. Libyan J. Agr. 10:103–109.
4. Khan, M. W. 1981. Influence of Vydate and Benlate on root-knot and plant growth of tomato in greenhouse. Libyan J. Agr. 10:135–143.
5. McLeod, R. W. 1977. Control of root-knot in tomatoes Trials with granular nematicides. Agricultural Gazette of New South Wales. 88:38–41. (Helminthol. Abstr. B. 47:107, Abstr. No. 1091, 1978).
6. Raj, B. T. and K. K. Nirula. 1970. Soil treatments for the control of root-knot nematodes on potato (*Solanum tuberosum* L.) Indian J. Agric. Sci. 40:878–882.
7. Sivakumar, C. V., P. Rajgopalan and M. Meer Zainuddin. 1974. Control of tomato root-knot by spot application of granular systemic nematicides. South Indi. Hort. 22:5–7 (Helminthol. Abstr. B. 45:250, Abstr. No. 1211, 1976).
8. Taylor, A. L. and J. N. Sasser. 1978. Biology, identification and control of root-knot nematodes (*Meloidogyne* species). IMP Publication, NSCU; Raleigh, U.S.A.
9. Waldman, H. 1971. (A new method of controlling the root-knot nematode) Gesunde pflanzen. 23:227–228 (Helminthol. Abstr. B. 42:89, Abstr. No. 451, 1973).

إختبار فعالية بعض مبيدات النيماتودا الجهازية لمقاومة نيماتودا تعقد الجذور تحت البيوت الزجاجية

خليفـة حسين دعباج د . محمد واجد خان

المستخلـــص

لـقـد تم في هـذا الـبـحث إخـتـبار بعض مبيدات النيماتودا الجهازية وهي : (Temik, Vydate L, Vydate G, Terracur & Nemacur.) على أربع جرعات مختلفة ٥ ، ١٠ ، ١٥ ، ٢٠ كجم مادة فعالة للهكتار وذلك لمقاومة نيماتودا تعقد الجذور *Meloidogyne javanica* على الطماطم تحت البيوت الزجاجية .

وقد تبين من النتائج أن جميع هذه المبيدات عدا مبيد (*Vydate L*) فعالة جداً عند استعمالها أثناء العدوى وتمنع تكون العقد وأكياس البيض وخاصة مبيد (Nemacur) حيث كان فعالاً جداً عند كل الجرعات أما مبيدات (Vydate G, Terracur, Temik) فقد كانت فعالة عند الجرعات العالية ولكن عند الجرعات المنخفضة فإنها لم تمنع تكون العقد وأكياس البيض .

كما دلت النتائج أيضا أن جميع هذه المبيدات وعند كل الجرعات لم تمنع تكون العقد وأكياس البيض عند استعمالها بعد أسبوعين من العدوى .