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ROLE OF SOIL TYPE, PH AND TEMPERATURE ON THE EFFICACY OF NEMATICIDES FENAMIPHOS AND OXAMYL AGAINST *Meloidgyne javanica*

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ABSTRACT

Under laboratory conditions, *M. javanica* in calcareous sandy loam soil was more sensitive to both fenamiphos and oxamyl. While it on clay loam soil was more tolerant to both nematicides. At LC_{50} level, the nematodes in calcareous sandy loam soil were the most sensitive to fenamiphos (LC_{50} : 0.72 ppm) followed by those in sandy soil (LC_{50}: 3.81 ppm) and then nematodes of loamy soil (LC_{50}: 5.03). The most tolerant nematodes were those in clay loamy soil (LC_{50} : 6.83). The same trend was found with oxamyl. The LC_{50} was arranged as follows : calcareous sandy loam, sandy, loamy and clay loamy soil 5.14, 9.27, 11.88 and 16.40 ppm respectively. Fenamiphos was more effective in the acidic media, specially in pH 5 while oxamyl was more effective in alkaline direction specially in pH 9. Under the temperature degrees of 30, 25, 20, 15 and 10 ^{0}C the LC_{50} of fenamiphos were 0.4, 0.8, 1.5, 4.7 and 4.8 ppm respectively. The same trend was found by oxamyl which gave the follows LC_{50} under the above mentioned degrees, 2.0, 2.7, 9.8, 20.8 and 27.9 ppm respectively. Generally fenamiphos was more effective than oxamyl.

INTRODUCTION

The effect of soil type as a limiting factor for the efficacy of nematicides has been studied and reported by many workers. Fenamiphos was recorded to be not active enough in reducing numbers of nematode egg masses and delaying egg deposition of *M. javanica* in clay and loamy soils as recorded by Farahat and Osman (1990).

Barker and Weeks (1991) and Gourd *et al.* (1993) studied the effect of soil types on the efficacy of aldicarb and fenamiphos. They reported that aldicarb was more effective than fenamiphos achieving it best effect in reducing number of egg masses of *M. incognita* in clay and loamy soils. The same result was reported by Zawam (1994) who found that fenamiphos and oxamyl showed lower activity against *M. javanica* collected from heavy soil.

The efficacy of nematicides were found to be affected by soil pH. Miller (1976), Babatola, (1981), and Schmitt, (1989) reported that soil pH played an important role on efficacy of fenamiphos. Babatola, (1981) found significant differences among the sensitivity of three species of Hirschmanniella after 10 weeks exposure to pH ranging between 3.0 – 9.0. *Kimpinski* and Willis, (1981)) mentioned that the optimum soil pH for movement of *Pratylenchus. penetrans* was 6.0 whereas P. crenatus moved equally well over the range of pH 5.0 – 7.0. Schmitt (1989) found that most

nematicides increased yield of soybean at pH 6.0, whereas fenamiphos also increased yield only at pH 5.5. Also, temperature plays an important role on the efficacy of nematicides. Miller and Rich (1974) found that fenamiphos was the most effective nematicides in temperatures ranging between 10 ^{0}C to 30 ^{0}C, followed by oxamyl which was effective only after 14 days at higher temperatures. This work was designed to evaluate two nematicides under stress of environmental coonditions.

MATERIALS AND METHODS

Tested nematicides:

1 – Fenamiphos (Nemacure 10 % G and 40 % EC): Ethyl-3- methyl-4-(methylthio)-phenyl-(1-methyl-ethyl phosphoramidate.

2 – Oxamyl (Vydate 24 % I): NN.dimethyl- methyl carbamoyloximino-(methylthio) acetamidate.**αα**

A – Soil type :

Soil samples of naturally infested tomatoes with the root–knot nematode, *M. javanica* were collected from Gezerat – El – Dahab, Western farm of Faculty of Agric., Cairo Univ., Giza governorate, West Nubaria and south Tahrer., Menofia governorate. Its represent different soil types. Nematodes were identified, propagated and used in inoculating tomato variety Ace 55 grown in 15 cm. Clay pots .

Mechanical analyses of the collected soil samples proved the presence of four soil types, i.e. loamy, calcareous sandy loam soil, clay loamy and sandy textures, which were used in this experiment. The recommended dose rate of fenamiphos and oxamyl was 20 kg per feddan (10% G) and 3 liter / 600 liter water (24 % L) spraying liquid, respectively. When these doses were recalculated to match the experiment, these rates per pot were 8.42 mg and 1.26 ml of fenamiphos and oxamyl, respectively. Nematicidal concentrations used in these experiment were 1/2, 1 and 3/2 of the recommended dose. Inoculation level of M. javanica was 3000 newly hatched juveniles\ pot for each treatment. Each soil type was replicated three times. All pots were arranged in greenhouse at 25 $\pm$ 5 ^{0}C.

B – pH degree :

Acetic acid anhydride and sodium hydroxide were used in preparing buffer solutions of pH 5, 6, 7, 8 and 9 in which the survival of the root – knot nematode juveniles was studied. The second – stage juveniles were suspended in 2.5 ml from of each buffer and placed directly in glass vials.

To study the effect of both nematicides under each pH degree, nematicidal concentrations were prepared, and added to the buffer solutions Approximately 3000 second stage juveniles were incubated for 7 days in each solution. Each concentration was replicated three times. Control treatment of each pH degree was done without adding nematicides and each was replicated three times. This experiment was repeated five times. Mortality were recorded after 7 days posttreatment and corrected by Abbott's formula (1925). The concentration mortality lines for the tested nematicides

were calculated according to the method of Finny (1952). The values of LC_{50} and LC_{90} of fenamiphos and oxamyl were calculated and tabulated under each pH degree.

C – Temperature:

Response of the second stage juveniles of *M. javanica* to fenamiphos and oxamyl was evaluated under five degrees of temperatures (10, 15,20 and 30 ^{0}C). Approximately 3000 second stage juveniles for each replicate were suspended in 2.5 ml water and placed directly in glass. Five concentrations of each nematicide were prepared which added individually to the vials of the nematodes. All vials were kept in incubators at the tested temperatures for 7 days. Each concentration was replicated three times. Control treatment of each temperature degree was done by adding 2.5 ml distilled water to 2.5 ml suspension of nematodes without adding nematicides and was replicated three times. This experiment repeated five times. Mortality were recorded and corrected by Abbott's formula (1925). The concentration mortality lines for the tested nematicides were calculated according to the method of Finny (1952). The values of LC_{50} and LC_{90} of fenamiphos and oxamyl under each temperature degree were calculated and tabulated

RESULTS AND DISCUSSION

A - Soil type:

Data illustrated in table (1) revealed that sensitivity of *M. javanica* to the tested nematicides differed according to soil type. At LC_{50} level, the nematodes in calcareous sandy loam soil were the most sensitive to fenamiphos (LC_{50} 0.72 ppm) followed by that in sandy soil (LC_{50} 3.81 ppm) and then nematodes in loamy soil (LC_{50} 5.03). The most tolerant nematodes, were those in clay loamy soil (LC_{50} 6.83). The same trend was found with oxamyl. The LC_{50} for oxamyl in calcareous sandy loam, sandy, loamy and clay loam soil were 5.14 , 9.27 , 11.88 and 16.40 ppm, respectively. Thus, the variation in efficacy may due to the soil structure and contents of organic matters.

Table (1) : Effects of soil type on the efficacy of fenamiphos and oxamyl on *Meloidogyne javanica* under laboratory conditions

Soil Type	Nematicides							
	Fenamiphos				Oxamyl			
	LC_{50}	LC_{90}	Slope	$\frac{LC_{90}}{LC_{50}}$	LC_{50}	LC_{90}	Slope	$\frac{LC_{90}}{LC_{50}}$
Loamy	5.03	41.35	1.40	8.22	11.88	41.99	2.53	3.45
Calcareous Sandy Loam	0.72	69.12	0.64	96.00	5.14	18.34	2.31	3.56
Clay Loamy	6.83	40.90	1.64	5.98	16.4	70.66	2.01	4.30
Sandy	3.81	49.13	1.15	12.89	9.27	46.19	1.83	4.98

The presence of organic matters in soil structure affected directly or indirectly on nematicidal efficacy. The efficacy of both nematicides was however rather poor in the clay loam and loamy soils as compared to that of the other soil types. Loamy and clay loamy soils are usually rich with different kinds of microorganisms which may play an important role in nematicidal detoxification processes causing lower nematicidal activity (higher LC_{50} levels). In contrast, both nematicides were more effective in calcareous sandy loam and sandy soil. The low contents of organic matters in such soils lead to reduce detoxification microorganisms. Therefor, low or no degradation of nematicidal chemical structure could be occurred. Moreover, efficacy of both nematicides in calcareous sandy loam soil may also be due to the presence of $CaCO_3$ which is unsuitable for nematode survival. Thus the presence of $CaCO_3$ may play a synergistic effect with both nematicides. These results are in agreement with those reported by (El – Eraki 1976).

B– pH degree :

Sensitivity of *M. javanica* to fenamiphos or oxamyl under five pH degrees (5 –9) was greatly differed. Data in table (2) show that the LC_{50} of fenamiphos in the acidic media was lower than in the alkaline one. This may be due to the effect of alkaline media on the ester bond of phosphorus compounds. The degradation of fenamiphos increased by the increase of pH degree and therefore, the toxicity of the compound decreased. The LC_{50} increased about two times by the increase of pH from 5 to 9 which means that the alkaline media had a negative effect on this nematicide.

Table (2) : Effects PH on the efficacy of fenamiphos and oxamyl on *Meloidogyne javanica* under laboratory conditions

pH Degree	Nematicides							
	Fenamiphos				Oxamyl			
	LC_{50}	LC_{90}	Slope	$\frac{LC_{90}}{LC_{50}}$	LC_{50}	LC_{90}	Slope	$\frac{LC_{90}}{LC_{50}}$
pH 5	0.97	8.29	1.33	8.54	4.51	32.57	1.49	7.22
pH 6	1.55	8.79	1.70	5.67	3.93	19.82	7.82	5.04
pH 7	2.06	15.93	1.44	7.73	3.53	15.90	1.95	4.50
pH 8	2.18	20.37	1.32	9.34	3.18	15.71	1.84	4.94
PH 9	3.02	27.84	1.32	9.21	3.07	21.07	1.53	6.86

On the other hand, alkaline media gave the opposite effect on oxamyl. The LC_{50} and LC_{90} increased 1.5 times by the decrease of pH values from 9 down to 5. For instance, values of LC_{50} of fenamiphos increased by increasing the pH degrees from 5 up to 9 giving more toxicity in the acidic media; while oxamyl was more toxic in alkaline direction specially in pH 9. Thus. it could be concluded that fenamiphos can be applied in acidic or neutral soils while oxamyl can be used in alkaline soil.

These results are confirm the findings of Schmitt (1989) who found that all nematicides increased yield of soybean at pH 6, whereas fenamiphos only increased yield at pH 5.5. Similar results are obtained by Miller (1976) who found that all populations of *P. penetrans* were killed by three

concentrations of oxamyl at pH 7.5. Fenamiphos was also equally effective at all concentrations.

C – Temperature:

It is interested to notice that both nematicides showed a positive correlation with temperature producing a gradual increasing effect with the increase of temperature. Fenamiphos under different temperature degrees of 30, 25, 20, 15 and 10 ^{0}C gave the following LC_{50} values ; 0.4 , 0.8 , 1.5 , 4.7 and 4.8 ppm, respectively. The same trend was found for oxamyl which gave the following LC_{50} values 2.0, 2.7, 9.8, 20.8 and 27.9 ppm, respectively.

Table (3) : Effects of temperature on the efficacy of fenamiphos and oxamyl on *Meloidogyne javanica* under laboratory conditions

Temp. Degree	Nematicides							
	Fenamiphos				Oxamyl			
	LC_{50}	LC_{90}	Slope	$\frac{LC_{90}}{LC_{50}}$	LC_{50}	LC_{90}	Slope	$\frac{LC_{90}}{LC_{50}}$
10 ^{0}C	4.8	101.4	0.97	21.12	27.9	279.2	1.65	10.00
15 ^{0}C	4.7	67.0	1.39	14.25	20.8	271.2	1.15	13.03
20 ^{0}C	1.5	39.2	0.78	26.13	9.80	166.8	0.88	17.02
25 ^{0}C	0.8	39.0	0.90	48.75	2.70	141.4	0.75	52.37
30 ^{0}C	0.4	32.1	0.68	80.25	2.00	84.90	0.79	42.45

These results indicate that the efficacy of both nematicides on *M. javanica* increased by increasing temperature. This may be due to the negative effect of high temperature on the detoxification enzymes of nematodes which help in degradation of nematicides preventing it to act with its complete chemical structure in sites of action of the nematode. These enzymes act with a complete activity in the optimum temperature. Moreover, temperature may activate oxidative enzymes of the organism which negatively act on the nervous system causing more nerve sensitivity and accumulation of acetyl choline. The inhibition of acetyl choline esterase (Achase) by the effect of organophosphorous nematicides prevent detoxification process, causing death of the organism.

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الـــدور الـــذي تلعبـــة كـــل مـــن نوعيـــة التربـــة و الحموضـــة و درجـــة الحـرارة علـى فعاليـة كـل مـن الأوكسـاميل و الفينـاميفوس كمبيـدات نيماتوديـة ضـد نيماتودا ألميلودوجينا جافانيكا.

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تحت الظروف المعملية فان العشيرة النيماتودية ميلودوجينا حافانيكا المأخوذة من التربة الكلسية كانت اكثر حساسية لمبيدي و الفينـاميفوس و الأوكساميل حيث وصلت ال ت ق ٥٠ الي 0.72 و ٥,١٤ جزء فى المليون على التوالي. وقد كانت العشيرة النيماتودية ميلودوجينا حافانيكا المأخوذة من التربة الطينية الطميية اكثر تحملا للمبيدين حيث وصلت ال ت ق ٥٠ الي ٦,٨٣ و ١٦,٤ جزء فى المليون على التوالي.و لقد كانت ال ت ق ٥٠ للعشيرة النيماتودية المأخوذة من التربة الرملية ٣,٨١ و ٩.٢٧ جزء فى المليون لكلا المبيدين على التوالي. وكانت ال ت ق للعشيرة النيماتودية المأخوذة من التربة الطميية ٥,٠٣ و ١١,٨٨ جزء فى المليون لكلا المبيدين على التوالي.

و لقد وجد أن درجة الحموضة تلعب دورا فى كفاءة المبيدين حيث وجد أن الفينـاميفوس اكثر تـأثيرا علىالنيماتودا عند درجة حموضة ٥ بينما كان الأوكساميل اكثر تأثيرا علىالنيماتودا فى الوسط القلوي أي عند درجة قلوية ٩

و لقد وجد أن درجة الحرارة تلعب دورا فى كفاءة المبيدين علىالنيماتودا حيث وجد أن الفينا ميفوس و الأوكساميل كانا اكثر تأثيرا علىالنيماتودا عند درجات الحرارة العالية مثل درجة حرارة ٣٠ درجة مؤوية بينما يقل التأثير عند درجات الحرارة الأقل.