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CONTROLLING *Meloidogyne incognita* ON TOMATO PLANT USING CERTAIN ORGANIC AMENDERS AND OXAMYL.

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ABSTRACT

Greenhouse experiment on the impact of certain organic amenders i.e. shrimp shell and castor dried leave powders applied singly or in combination with oxamyl (at half of recommended dose) in comparison with oxamyl on the infection of *Meloidogyne incognita* to tomato plant cv. strain- B3 revealed that all treatments tested obviously improved plant growth criteria and significantly suppressed nematode population in roots, number of galls and eggmasses. Moreover, the application of shrimp shell powder to tomato plant infected with *M. incognita* showed the greatest performance of plant growth parameters when oxamyl was added at the half recommended dose, following with plant receiving castor powder with the same dose of oxamyl over single application tested with values of 50.85% and 44.02% for plant fresh weight; and 137.3% and 85.1% for shoot dry weight, respectively as compared to nematode alone. The concomitant treatments using shrimp shell or castor powders plus oxamyl showed better reduction in nematode population densities, number of galls and eggmasses than single application except in the case of eggmasses with castor + oxamyl treatment (63.9%) in relation to oxamyl (65.2%), respectively, as compared to nematode alone.

Keywords: Integrated control, *Meloidogyne incognita*, organic amenders (castor, shrimp shell), and tomato plant.

INTRODUCTION

Meloidogyne spp. are considered to be one of the most important nematode pests of plant in many soil types all over the world. They are widely distributed in the cultivated areas of Egypt, causing remarkable crop losses especially with tomato yield. Their wide host range and favourable environmental conditions provoked suitable control measure to achieve reasonable results. An effective integrated pest management program is quite suitable for these plant parasitic nematodes.

The improvement in plant growth and yield criteria after the addition of organic matter due to the disinfection of such plants with nematodes and/or to the nutritive value of any animal manure and plant dry leaves which served as fertilizers were recorded by many workers (Siddiqui and Alam, 1988; Akher and Alam, 1989; Almihanna *et al.*, 1999; Frahat *et al.*, 1999 and El-Sherif *et* al., 2001, 2003 & 2004).

Moreover it is well known that organic matter reduces nematode population in two different ways, directly by possessing nematocidal properties during its degradation (Sitaramaiah and Singh, 1978); or indirectly by enhancing the development of nematode natural enemies (Errico and Maio, 1980).

The present investigation was carried out to evaluate the role of shrimp shell as well as castor dry leaves as soil amender powders and oxamyl as nematicide on development and root galling of *Meloidogyne incognita* infecting tomato plant with reference to plant growth criteria under greenhouse conditions.

MATERIALS AND METHODS

Twenty one plastic pots 10-cm diam. were potted with 850 g/pot of steam-sterilized clay loam soil (3:1) (V:V), tomato, *Lycopersicon esculentum* Mill cv. Strain-B3 seeds were germinated in vermiculate, transplanted when 15 days old at the rate of one seedling/pot.

The organic matter of either plant or animal origin used in the present study were shrimp shell after cooking and castor leaves. Both materials were separately sun-dried and powdered before adding. The nematicide, oxamyl (Vydate G10%) (Methyl N-N2 dimethyl-N- (methyl) carbamyl) oxy -1-thioxamidate) was used at the recommended dose (0.3 g/pot) as a check. After two days from transplanting seedlings, tested amendments at the rate of 2 g/pot were incorporated into twelve pot soils around the seedlings, (6 pots for each amender). Pots were then watered to keep soil moist and left for 7 days to facilitate these materials decomposition. Then eighteen seedlings were infected with 1000 j2 of *M. incognita* each which was previously obtained by sieving and baermann method (Goodey, 1957) from the pure culture of *M. incognita* propagated on coleus plants under the greenhouse conditions of Nematology research Unit, Agricultural Zoology Department, Faculty of Agriculture, Mansoura University where this work was conducted. Two days later, the nematicide was separately added at the recommended dose and in combination with each soil amender at the half dose each. Treatments were as follows:

1- N + Shrimp shell powder (2.0 g/pot),
2- N + Shrimp shell powder (1.0 g + 0.15 g oxamyl/pot),
3- N + Castor powder (2.0 g/pot),
4- N + Castor powder (1.0 + 0.15 g oxamyl/pot),
5- N + Oxamyl at the recommended dose (3.0 g/pot).
6- N + alone, and
7- Plant free of N and untreated.

Each treatment was replicated three times and all pots were randomly arranged on a greenhouse bench at 30 $\pm$ 5°C. Plants were watered and regularly receiving conventional pesticides to control mites and insects as needed. Five weeks from nematode inoculation, the plants were harvested. Data dealing with length of shoot and root, fresh weight of shoot and root as well as shoot dry weight was measured and recorded. Infected roots of each plant were washed with tap water, fixed in 4% formalin for 24 hr and then stained in 0.01 acetic acid-fuchsin method (Byrd *et al.*, 1983); and then examined for recording number of developmental stages, females, galls and eggmasses. Data were subjected to analysis of variance (ANOVA) (Gomez and Gomez, 1984) followed by Duncan's multiple range test to compare means (Duncan, 1955).

RESULTS AND DISCUSSION

Data in Tables (1& 2) represented the effect of powders of either shrimp shell or castor or oxamyl singly or in combination at half dose each on plant growth response of tomato cv. Strain – B3 infected with *M. incognita* as well as nematode development and root galling under greenhouse condition at 30 ± 5°C. It was evident that all treatments tested remarkably proved to be more effective in improving tomato plant growth exceeded that of nematode alone with significant increment in shoot length and root fresh weight in this respect (Table 1).

Table (1): Plant growth response of tomato plant infected with *M. incognita* as influenced by shrimp shell or castor powders separately or mixed with oxamyl under greenhouse conditions.

Treatments	*Plant growth response							
	Length (cm)		Fresh wt. (g)		F. wt. of whole plant (g)	% of increase	Shoot dry wt. (g)	% of increase
	Shoot	Root	Shoot	Root				
Shrimp shell	12.73^{a}	17.20^{a}	2.94^{a}	1.24^{de}	4.18^{b}	42.66	1.13^{d}	68.7
Castor	11.30^{a}	9.86^{bc}	2.88^{a}	1.25^{d}	4.13^{b}	40.95	1.11^{d}	65.7
Oxamyl	9.26^{b}	8.50^{bc}	2.84^{a}	1.28^{cd}	4.12^{b}	40.60	1.08^{d}	61.2
Shrimp shell + oxamyl	12.90^{a}	17.66^{a}	2.84^{a}	1.62^{a}	4.42^{a}	50.85	1.59^{b}	137.2
Castor + Oxamyl	11.50^{a}	11.06^{b}	2.85^{a}	1.37^{b}	4.22^{b}	44.02	1.24^{c}	85.1
N. alone	6.90^{c}	6.70^{c}	1.77^{b}	1.16^{e}	2.93^{c}	-	0.67^{e}	-
Plant free of N and untreated	11.73^{a}	10.33^{b}	2.90^{a}	1.35^{bc}	4.25^{b}	45.05	1.90^{a}	183.6
LSD	1.85	3.46	0.13	0.08	0.16	-	0.07	-

N = M. incognita at 1000 second stage Juvineles (j2).
* Each figure represents the average of three replicates. Means with the same letter are not significantly different.

With regard to fresh weight of the whole tomato plant and shoot dry weight as affected by *M. incognita* infection, a high percentage of increase was recorded with concomitant treatments tested as compared to nematode alone with values of 50.85% and 137.2% for shrimp shell powder plus oxamyl and 44.02% and 85.10% for castor powder plus oxamyl respectively, over single application tested (Table 1) with values of 42.66%, 40.95% and 40.60% for whole plant fresh weight as well as 68.7; 65.7% and 61.2% for shoot dry weight with shrimp shell powder, castor powder and oxamyl, respectively.

Concerning Table (2), it was evident that nematode population density, number of galls and eggmasses within tomato roots infected with *M. incognita* were significantly suppressed in all treatment when compared to nematode alone. Among single application, it can be noticed that moderate suppression in nematode population in roots was achieved by pots receiving oxamyl or shrimp shell powder with percentage reduction 50.54 or 37.02%, followed by castor powder (24.32%) respectively. The application of any powder tested mixed with oxamyl significantly gave the highest percentage of

nematode reduction of developmental stages plus females of *M. incognita* within tomato roots over other treatments, whereas, oxamyl alone ranked second to such concomitant treatments when compared to nematode alone. These values were 75.67, 62.16% and 50.54% for shrimp shell powder + oxamyl, castor powder plus oxamyl and oxamyl alone, respectively.

However, non-significant difference was noticed between the application of any powder and/or mixing with oxamyl with respect to number of galls when compared to nematode alone. On the other hand, an obvious significant difference between all treatments tested and nematode alone was recorded for nematode population density in roots as well as number of galls and eggmasses per root system of infected tomato plant (Table 2). With regard to the eggmasses number of *M. incognita* on tomato roots, a significant suppression in all treatments in relation to plants inoculated with nematode alone was recorded (Table 2). Moreover, the integration of shrimp shell powder with oxamyl showed greater suppression in total nematode population in roots, numbers of galls and eggmasses with percentage of reduction 75.67, 63.6% and 76.4%, respectively, followed by castor powder + oxamyl with values of 62.16, 60.1% and 63.9%, respectively, in relation to the application of single treatment, except that value of eggmasses recorded by castor + oxamyl application (63.9%) as compared to oxamyl alone (65.2%), respectively.

Table (2): Number of developmental stages, females eggmasses and galls on roots of tomato plant infected with *M. incognita* as affected by the application of shrimp shell or castor as powders singly or in combination with oxamyl under greenhouse conditions.

Treatments	*Nematode population in roots			% Reduc.	No. of galls	% Reduc.	No. of egg-masse	% Reduc.
	Fem.	Deve-lop. Stages	Total					
Shrimp shell	13.0^{b}	10.3^{bc}	23.3	37.02	11.6^{b}	59.0	10.0^{b}	56.5
Castor	15.0^{ab}	13.0^{b}	28.0	24.32	12.3^{b}	56.5	11.0^{b}	52,2
Oxamyl	6.6^{c}	11.7^{bc}	18.3	50.54	11.3^{b}	60.1	8.0^{bc}	65.2
Shrimp shell + oxamyl	3.0^{c}	$6\ 0^{d}$	9.0	75.67	10.3^{b}	63.6	5.3^{c}	76.4
Castor + Oxamyl	5.0^{c}	9.0^{cd}	14.0	62.16	11.3^{b}	60.1	8.3^{bc}	63.9
N. alone	20.0^{a}	17.0^{a}	37.0	-	28.3^{a}	-	23.0^{a}	-

N = M. incognita at 1000 second stage Juvineles (j2).

*** Each figure represents the average of three replicates. Means with the same letter are not significantly different.**

Apparently, among the two tested organic amenders i.e. shrimp shell (chitin) and castor powders, shrimp shell powder (chitin) integrated with oxamyl performed the best in improving plant growth of tomato cv. Strain-B3 as well as suppressing nematode population in roots, numbers of galls and eggmasses, followed by castor + oxamyl application over single treatments tested. These results are in accordance with the work of Main *et al.* (1982) and Jaffee *et al.* (1994) who mentioned that the amendment alters the soil

environment so as to favor competing microbial populations, mycoflora capable of parasitizing nematode eggs of soil borne antagonists that destroy or weaken these plant parasites.

Obviously, results of the present investigation also agreed with the findings of El-Sherif *et al.* (2001 and 2004) who reported that the mixing of *Vinca rosea* with oxamyl showed better performance in sunflower growth infected with *Rotylenchulus reniformis* as compared to single application. In addition, application sesame as oil extract at 5% or oil cake alone or mixed with oxamyl caused significant and better increment in plant growth criteria of sunflower infected with *M. incognita* as well as great suppression in number of second stage juveniles/250 g soil and galls per root system.

Moreover, literature revealed that addition of chitin to soil results in increased numbers of chitinolytic actinomycetes, bacteria and fungi in soil (Mian *et al.* 1982; Godoy *et al.*, 1983 and Rodriguez-Kabana *et al.* 1983 & 1984). There are several species of fungi isolated from chitin treated soil that are capable of destroying *Meloidogyne* eggs and some of these species are well known pathogens of nematodes (Godoy *et al.*, 1983; Rodriguez – Kabana *et al.*, 1984 and Morgan – Jones and Rodriguez – Kabana, 1985). Therefore, the present study can interpret the superior effectiveness of shrimp shell powder (chitin) either singly or in combination with oxamyl over other treatments against such nematode to the activities of the stimulated chitinolytic microfloras in soil.

In conclusion, integrated control of *M. incognita* infecting tomato using shrimp shell powder (chitin) with minimizing of nematicide (oxamyl) proved to be better than single application.

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مكافحة نيماتودا "ميليدوجينى إنكوجنيتا" على الطماطم باستخدام بعض المواد العضوية والأوكساميل.

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تم دراسة تأثير بعض المواد العضوية مثل مسحوق قشور الجمبرى ومسحوق أوراق الخروع الجافة بمفردها أو مخلوطة مع مبيد الأوكساميل عند نصف الجرعة الموصى بها مقارنة بمبيد الأوكساميل لمكافحة نيماتودا "ميليدوجينى إنكوجنيتا" على نبات الطماطم صنف سلالة ب-٣ تحت ظروف الصوبة السلكية عند درجة حرارة ٣٠ ± ٥ درجة مئوية. حيث أظهرت النتائج أن كل المعاملات المختبرة أدت إلى تحسن ملحوظ فى صفات نمو النباتات المختبرة وخفضت بدرجة معنوية تعداد النيماتودا فى الجذر وكذلك أعداد العقد النيماتودية وكتل البيض. زيادة على ذلك فإن إضافة مسحوق قشور الجمبرى إلى نباتات الطماطم المصابة بنيماتودا تعقد الجذور "ميليدوجينى إنكوجنيتا" أعطى أحسن النتاج فى تحسن مقاييس النباتات عندما تم خلطها بمبيد الأوكساميل عند نصف الجرعة الموصى بها ويليه معاملة الخروع + المبيد مقارنة بالمعاملات الفردية بقيم ٨٥ر٥٠% و ٠٢ر٤٤% للوزن الرطب الكلى للنبات و ٣ر١٣٧% و ١ر٨٥% للوزن الجاف للمجموع الخضرى على التوالى عند المقارنة بمعاملة النيماتودا بمفردها.

إن المعاملات المخلوطة باستعمال مسحوق قشور الجمبرى أو أوراق الخروع مع مبيد الأوكساميل أوضحت أعلى نقص فى تعداد النيماتودا فى الجذر وأعداد العقد النيماتودية وكتل البيض من المعاملات الفردية ماعدا حالة كتل البيض فى معاملة الخروع + المبيد (٩ر٦٣%) وعلاقتها مع المبيد بمفرده ٢ر٦٥% عند المقارنة بالنيماتودا لوحدها على التوالى.