J. Agric. Sci. Mansoura Univ., 30 (6): 3449 - 3457, 2005

CONTROL OF THE ROOT-KNOT NEMATODE WITH SOME MEDICAL PLANTS AS A SAFETY ENVIROMENTAL METHOD

Abd El-Bary, Nagwa A.*; Azza H. Ashoub**; M.Y. Yassin* and Ghena M. Abd El-Razek**

* Department of Zoology and Nematology, Faculty of Agriculture, Cairo University, Giza, Egypt.

** Department of Plant Protection, Nematology Unit, Desert Research Center, Cairo, Mataria, Egypt.

ABSTRACT

According to the nematicidal potential effect of medical plants, they are considered as potential safe tool in the biocontrol of phytonematodes. This method of nematode management fits well into agricultural practices and integrated pest control programs. The aim of this present study is to investigate the effect of six medical plants; (*Pelargonium gravealens*, *Datura metel, Simmondisa chinensis, Cymbopogon citratus, Thymus vulgaris* and *Artemisia herba-alba*) for suppressing root-knot nematode development under greenhouse conditions. The results reported that *Meloidogyne incognita* was greatly affected by the previous medical plants and also with there level of intercropping, where they had a pronounced effect on nematode reproduction. The *Pelargonium gravealens* appears the greatest effect out of the six medical plants used at the level of four plants per pot. Whereas the lowest number of egg-masses and larvae were obtained at the level of intercropping 4 plants per pot.

Keywords: Root–knot nematode, *Meloidogyne incognita*, medical plants, intercropping levels.

INTRODUCTION

Several studies were done to define the effectiveness of the intercropping systems as an easy natural non-expensive method to manage root-knot nematode. Tiyagi *et al.* (1986) showed that, growing seedling of *Zinia elegans* in the same pots with tomato seedling reduced final population of both *Meloidogyne incognita* and *Rotylenchulus reniformis* to below the initial levels. The same effect was obtained by Sidiqui and Alam (1987), whereas using marigold *Tagetes minuta* as intercropped plant, inhibited the multiplication of *M. incognita*, *R. reniformis*, and *Tylenchorhynchus brassicae* on tomato and aubergine roots. Also, Sidiqui and Saxena (1987) reported that *Azadirachta indica* and *Melia azedorach* reduced the root galling of *M. incognita* on tomato and aubergine. Salem and Osman (1988) demonstrated that the intercropping is more effect than the using of *Tagetes spp* root extract on tomato in reducing root-knot, *M. javanica* population in soil. The same results were confirmed by Marwoto and Rohama (1988), Abid and Maqbool (1990) about *Tagetes patula* and *T. erecta* intercropped with capsicum and tomato plants. In 1991, Aktar and Alam showed the role of mustard *Brassica juncea* in arresting *M. incognita* associated with potato roots.

Ameen and Hasabo (1995) detected that the intercropping of *Asparagus scandens* with sour orange seedlings *Citrus aurantium* gave a significant reduction on *Tylenchulus semipenetrans* larvae in the soil. In 1995, Ali *et al.* noted that using *Tagetes erecta* as intercropped plant with infected tomatoes by *M. incognita* lead to decrement the galls formation and eggs/plant and J_2 in soil than the use of garlic. Also, Dhangar *et al.* (1995) noticed that, *Tagetes erecta* intercultured with aubergine was significantly superior over the carbofuran treatment. Moreover, Zavaleta and Gomez (1995) added that the date and plant spacing of *Tagetes erecta* had an effect on the ability of it in reducing the infection of tomato roots by *Nacobbus aberraus*. They concluded that by manipulation the *Tagetes* planting date and the spacing between plants, we can possible to achieve some phytosanitary protection on tomato with significant increase in fruit production.

Ibrahim *et al.* (1998) found that using sesame as intercropping plant with aubergine was more effect than asparagus, whereas it decreased number of galls by 66 % and egg-masses by 77%. Shalaby, (1999) detected that the intercropping of *Allium sativum*, *Lupinus termis*, *Ruta graveolens* and *Nigella sativa* were found to be suppressive to *M. javanica* infected tomato roots.

Haider *et al.* (2001) studied the effect of the intercropping system on root-knot larvae and found that the using of *Zea mays* with sugar cane minimized root-knot nematode multiplication. While, the use of *Nigella sativa* resulted in the maximum reduction in the nematode population of *Tylenchorhynchus*, *Hemicriconemoides* and *Pratylenchus*. In 2002, Dhangar *et al.* studied some intercropping systems of *Tagetes erecta* with aubergine on *Meloidogyne javanica*. They found that, all intercropping systems registered lower root-knot index than the control.

MATERIALS AND METHODS

A greenhouse experiments were conducted to determine the efficacy of medical plants for protecting economic crops from phytonematode attack when they are use as intercropped plants. First step in this study was a screening experiment to choose the most resistant plants to infection by evaluating their resistance (visual) against *Meloidogyne incognita* (Kofoid & White) Chitwood according to Shahina and Maqbool, 1990 at inoculum levels; 2000, 4000 and 8000 infective second stage juvenile (I J2). At the end of this step the chosen plants were; *Pelargonium gravealens*, *Datura metel*, *Simmondisa chinensis*, *Cymbopogon citratus*, *Thymus vulgaris* and *Artemisia herba-alba*.

Second step was to determine the role of intercropped medical plants and their levels in suppressing *Meloidogyne incognita* multiplication on egg-plant roots and their effect on plant growth. For this purpose pots were filled with 1 kg sterilized mixed soil(2sand : 1 clay v/v) Egg-plant seedlings 45 days old were transplanted into these pots. Then after 15 days of transmission each seedling were inoculated by 3000 freshly (I J2) *M. incognita*. These juveniles were obtained from pure culture that was reared

on egg-plant roots in greenhouse from one egg-mass which was defined according to perennial pattern, Taylor and Sasser, 1978.

After 10 days inoculated plants were transplanted with its own soil into the center of the pot which previously filled with 25 Kg sterilized mixed soil(2 sand : 1 clay v/v). These pots containing seedlings of medical plants (6 months old) as follows: first treatment was 2 plants one on each opposite side of the pot, second treatment was 4 plants at the four corners of the pot. The two treatments were repeated with each kind of the medical plants. In addition to the previous treatments a control treatment (infected egg-plant without medical plants) was done. The pots were arranged in a complete randomized design. The pots were watered and fertilized with the same manner during the experimental period. Each treatment was replicated three times. Sixty days after inoculation egg-plants were removed. Infected roots were washed, galls and egg-masses were counted and their indices were rated (Sharma, *et al.* 1994). Soil nematodes were extracted and counted according to Goody, 1963. The reduction percentage of larvae, also egg-masses and galls formation reduction were calculated according to the following formula:

Control – Infected / Control*100.

Plant growth response base on number of leaves, shoot length, fresh and dry shoot weight, also root fresh weight, were determined. Data was statistically analyzed by using the Fisher's Least Significant Differences (L.S.D) according to Gomez and Gomez, 1984.

RESULTS AND DISCUSSION

Data illustrated in Table 1, showed the resistance results of the tested medical plants to *Meloidogyne incognita* infection. The nematode failed to penetrate and reproduce on the seven plants under the different inoculum levels with one exception that in the case of using *Datura metel* at 8000 inoculum level there was no response except by very small root galls (none egg-masses were appeared). The other plants appeared to be attacked by *M. incognita* in variable degrees and their resistance diminished gradually with the increment of the initial inoculum level.

Results presented in Table 2 and illustrated in Fig. 1 (A&B) and Fig. 2 demonstrated the effect of intercropping levels of the resistant medical plants as chosen out of the screening experiment. As it is clear that all the intercropped medical plants affected M. *incognita* development at both intercropping levels. Generally, the two levels of intercropping minimized number of larvae, galls and egg-masses than the control. The most effective plant was *Pelargonium gravealens* which caused the greatest reduction in gall number and egg-masses formed which were counted 92% and 93% respectively. On the other hand, the minimum reduction in galls number was 58.98% related to Artemisia *herba-alba* at level of 2 plants intercropped, while the minimum egg-masses production was recorded 71.73% by *Datura metel* at the second level of intercopping. The highest number of larvae was associated with *Artemisia herba-alba* (3333 larvae) at the level of two

intercropped plants that subsequent to the control which recorded 10667 larvae. While *Cymbopogon citratus* recorded the lowest number of larvae (1500) at four intercropped plants level. Moreover, all treatments at level of intercropped 4 plants decreased the number of larvae to 1000 larvae except with *Thymus vulgaris* and *Artemisia herba-alba* which resulted in 1667 larvae.

Table (1): Response of some medical plants (M.P.) against different inoculum levels of ***Meloidogyne incognita***.

Medical Plant		M.P. response at different inoculum levels					
English name	Scientific name	2000		4000		8000	
		Inf. R	G.S	Inf. R	G.S	Inf. R	G.S
Common thyme	*Thymus vulgaris*	-		-		-	
Geranuim	*Pelargonium gravealens*	-		-		-	
Hen-bane	*Hysocyamum muticus*	+	S	++	S	+ + +	S
Henna	*Lawsonia inermis*	+ + +	L	+ + + +	L	+ + + + +	L
JoJoba	*Simmondisa chinensis*	-		-		-	
Lemon-grass	*Cymbopogon citratus*	-		-		-	
Rosemary	*Rosmarinus officinalis*	+ +	M	+ + +	M	+ + + +	M
Roseu	*Hibiscus sabdariffa linne*	+	S	+ +	S	+ + +	S
Sawsan (local)	*Pancratium maritimum*	-		-		-	
Sweet basil	*Ocimum basilicum*	+ + +	S	+ + + +	S	+ + + + +	S
Thron apple	*Datura metel*	-		-		+	S
Wormwood	*Artemisia herba-alba*	-		-		-	

Inf. R. = Infection Rate
- = non – infection.
+ = low infection.
+ + = Moderate infection.
+++ = High infection.
> ++++ = Severe infection.

G.S = Gall Size
S = Small
M = Medium
L = Large

Table (2): Effect of intercropping levels of some medical plants on *Meloidogyne incognita* development associated with egg-plant roots.

Medical plant	Inter-crop levels	Nematodes / plant						
		Larvae	R. %	Gall No.	R. %	Egg-mass No.	R. %	G/E I.
Pelargonium gravealens	2 plants	2000	81.25	131	75.46	112	70.13	9/9
	4 plants	1000	90.62	41	92.32	26	93.06	6/5
Datura metel	2 plants	1667	84.37	178	66.66	106	71.73	9/9
	4 plants	1000	90.62	90	83.14	69	81.6	8/7
Simmondisa chinensis	2 plants	1667	84.37	182	65.91	106	71.73	9/9
	4 plants	1000	90.62	65	87.82	40	89.33	7/6
Cymbopogon citratus	2 plants	1500	85.93	83	84.45	50	86.66	8/6
	4 plants	1000	90.62	53	90.07	38	89.86	7/6
Thymus vulgaris	2 plants	2000	81.25	154	71.16	75	80.00	9/8
	4 plants	1667	84.37	103	80.71	62	83.46	9/7
Artemisia herba-alba	2 plants	3333	68.75	219	58.98	81	78.40	9/8
	4 plants	1667	84.37	106	80.14	64	82.39	9/7
Control	-	10667	0	534	0	375	0	9/9
LSD 0.05 *		526.47		10.11		11.413		
LSD 0.05 **		744.54		14.298		16.141		

* = LSD 0.05 value for intercropping levels. ** = LSD 0.05 value for medical plants.
G/E I = Gall index / Egg-mass index, where 1 = no galls or egg-masses, 2 = 1-5 galls or egg-masses, 3 = 6-10 galls or egg-masses, 4 = 11-20 galls or egg-masses, 5 = 21-30 galls or egg-masses, 6 = 31-50 galls or egg-masses, 7 = 51-70 galls or egg-masses, 8 = 71-100 galls or egg-masses and 9 = > 100 galls or egg-masses per plant.

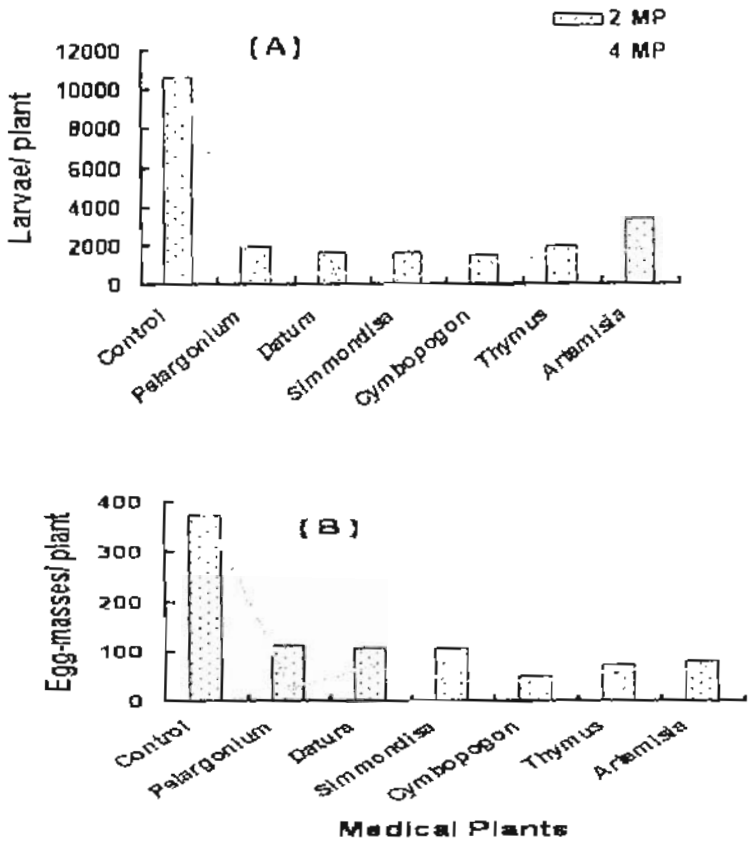

Fig. (1). Effect of intercopping levels of some medical plants (MP) on *Meloidogyne incoginta* development associated with egg plant roots.

The indices of galls and egg-masses ranged between 6 -9 and 5 -9, respectively. The most effective plant was *Pelargonium* which decreased G/E index to 6/5, Table (2).

The obvious results can be explained according to root-knot resistance types, which were reported by Fassuliotis, (1979). He indicated that there are two types of resistance. The first is the preinfection resistance which operates before the nematode penetrates the surface of the roots and may be attributed mainly to the toxic nature of this root exudates. Moreover, it is evident that there are several plants which suppress the population of plant parasitic nematodes by releasing nematotoxins into the soil, Siddiqui and Alam1987. The second is the postinfectional resistance which is manifested after the nematode penetrates the plant tissues. This vision is agreement with ours in table 1, in which indicated that the chosen plants have these both types of resistance.

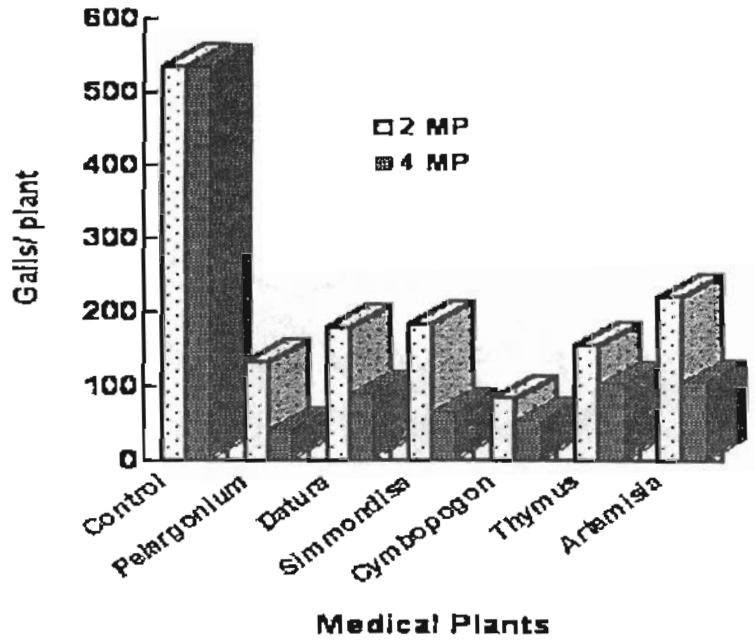

Fig. (2). Effect of intercropping levels of some medical plants (MP) on galls number of *Meloidogyne incognita* associated with egg plant roots.

Table (3) and Fig.(3) reveal that the effect of *M. incognita* on growth of egg-plant intercropped with some medical plants at two levels, (*Simmondisa chinensis*, *Cymbopogon citratus* and *Artemisia herba-alba*). As shown they increased the plant length up to 18.20, 20.17 and 22.39 cm at the level of 2 intercropped plants and 18.93, 25.10 and 20.13 cm at the level of 4 intercropped plants, respectively, while the control registered 17.80 cm. As a result it was clear that all medical plants improved the shoot dry weight than control, and this improvement varied among the different medical plants and within the two levels of the intercropping. This result was confirmed with Siddiqui and Saxena, 1987; Shalaby, 1994 and 1999. Also, the fresh weight of shoot was enhanced at all treatments except within *Pelargonium graveolens* and *Cymbopogon citratus* levels. On the contrary, the root fresh weight of the intercropped egg-plant was decreased than the control with one exception that *Simmondisa chinensis* which appears an increase in weight with the two intercropping levels that recorded approximately the number 12.47 g opposite to 11.43 g for the control.

Table (3): Effect of intercropping levels of some medical plants on egg- plant growth affected by *Meloidogyne incognita*

Medical plant	Inter-cropping levels	Growth Parameters				
		Shoot				Root
		Plant leaves No.	Length, cm	Fresh wt., g	Dry wt.,g	Fresh wt., g
Pelargonium gravealens	2 plants	17	17.00	26.27	5.43	10.67
	4 plants	16	17.13	29.83	6.07	11.37
Datura metel	2 plants	19	15.90	30.80	6.00	11.07
	4 plants	22	16.83	32.50	5.93	10.07
Simmondisa chinensis	2 plants	20	18.20	33.73	5.77	12.47
	4 plants	24	18.93	40.57	6.87	12.57
Cymbopogon citratus	2 plants	22	20.17	35.50	6.23	8.40
	4 plants	22	25.10	27.93	5.87	7.00
Thymus vulgaris	2 plants	28	18.67	31.17	5.80	9.27
	4 plants	23	17.93	36.50	6.73	7.80
Artemisia herba-alba	2 plants	23	22.39	42.53	6.83	10.97
	4 plants	21	20.13	38.93	5.97	9.50
Control	-	21	17.80	28.93	4.10	11.43
LSD 0.05 *		0.843	0.985	2.17	0.269	1.209
LSD 0.05 **		1.192	2.122	3.069	0.381	1.71

* = LSD 0.05 value for intercropping levels.
** = LSD 0.05 value for medical plants.

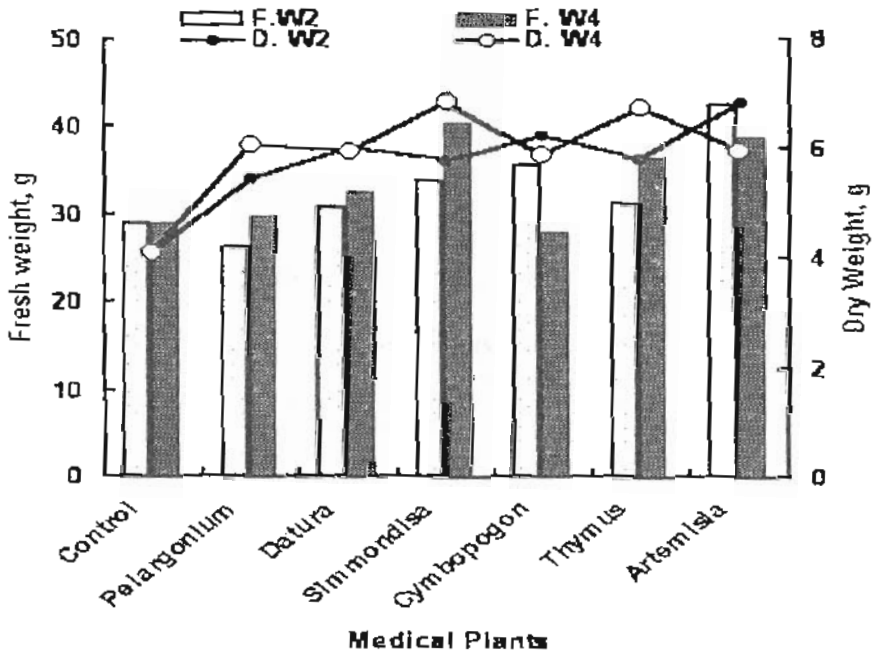

Fig. (3). Effect of intercropping levels of some medical plants on fresh and dry weight of egg- plant shoot affected by *Meloidogyne incognita*.

REFERENCES

Abid, M. and Maqbool, M. A. (1990). Effects of intercropping of *Tagetes erecta* on root-knot disease and growth of tomato. International Nematology, 7 (3): 41 - 42.

Akhtar, M. and Alam, M. M. (1991). Integrated control of plant parasitic nematodes on potato with organic amendments, nematicide and mixed cropping with mustard. Nematologia Mediterranea. 19 (2): 169 – 171.

Ali, E. M., El-Eraki, S., Anter, E. A. and El-Gindi, A. Y. (1995). Comparative effect of garlic and marigold on *Meloidogyne incognita* by intercropping or rotation with infected tomato. Egyptian Journal of Agricultural Research. 73 (4): 935 - 942.

Ameen, H. H, and Hasabo, S. A. (1995). Effect of intercropping *Asparagus scandens* with sour orange seedling in comparison with nematicidal and root exudates treatments on *Tylenchulus semipenetrans* larvae. Anzeiger fur Schadlingskunde, Pflanzenschutz, Umweltschutz. 68 (6): 129-130.

Dhangar, D. S., Gupta, D. C. and Jain, R. K. (1995). Effect of marigold (*Tagetes erecta*) intercropped with brinjal in different soil types on disease intensity of root-knot nematode *Meloidogyne javanica*. Indian Journal of Nematology. 25 (2): 181- 186.

Dhangar, D. S., Gupta, D. C. and Jain, R. K. (2002). Studies on intercropping of marigold (*Tagetes sp.*) with brinjal on plant growth and population of root-knot nematode (*Meloidogyne javanica*). Indian Journal of Nematology, 32 (2): 220 – 221.

El- Shalaby, M. (1994). Biological control of the root- knot nematode under laboratory and greenhouse conditions. M. Sc. Thesis, Cairo Univ., Fac. Agric., 94pp.

El- Shalaby, M. (1999). New trends in biological control against root- knot nematode by some plants and their natural products. Ph. D. Thesis, Cairo Univ., Fac. Agric., 94pp.

Fassuliotis, G. (1979). Plant breeding for root-knot nematode resistance. 425-453: In Root-knot nematode (*Meloidogyne* species). (Eds) F. Lamberti and C. E. Taylor, Academic press, London and New York.(C. F. Yassin, M. Y. and Ismail, A. E. (1993). Effect of *Zinnia elegans* as a mix-crop along with tomato against *Meloidogyne incognita* and *Rotylenchulus reniformis*. Pak.J. Nematology, 11 (1): 31-35).

Gomez, K. A. and Gomez, A. A. (1984). Statistical procedures for agricultural research. Willy-inter science, New-York 680 pp.

Goody, J. B. (1963). Laboratory methods for work with plant and soil nematodes. Bull. N0. 2, Min. Agric., Fishers and Food, London 47 pp.

Haider, M. G.,Sinha, U. P. and Nath, R. P. (2001). Effect of intercopping on the population of nematodes and sugarcane(*Saccharum officinarum*) yield. Indian Journal of Agricultural Sciences. 71 (1): 47-48.

Ibrahim, I. K.A.,Shahda, W. T. and Dawood, O. L. (1998). Reaction of egg-plant and peper cultivars to *Meloidogyne arenaria* and its biological control on eegplant. Alexandria journal of Agricultural Research. 43 (3): 151-157.

Marwoto, B and Rohana,D. (1988).The effect of intercropping capsicums with some vegetable crops on capsicum yield and the incidence of *Meloidogyne sp*. Buleitin Penelitian hortikultura, 16 (1): 54-59.

Salem, F. M. and Osman, G. Y. (1988). Effectiveness of tagetes natural exudates on *Meloidogyne javanica* (Chitwood) nematode. Anzeiger fur Schadlingskunde, Pflanzenschutz, Umweltschutz. 61 (1): 17-19.

Shahina, F. and Maqbool, M. A. (1990). Distribution of corn cyst and cereal cyst nematodes. International Nematology Network Newsletter. 7 (3): 38 – 40.

Sharma, S. B., Mohiuddin, M., Jain, K. C. and Remanandan, P. (1994). Reaction of Pigeonpea cultivers and germplasm accessions to the root-knot nematode, Meloidogyne javanica. Journal of Nematology, 26 (4S): 644 – 652.

Sidiqui, M. A. and Alam, M. M. (1987). Control of phytonematodes by mix-culture of *Tagetes lucida*. Indian Journal of Plant Pathology. 5 (1): 73-78.

Sidiqui, M. A. and Saxena, S. K. (1987).Studies on control of the stunt nematode *Tylenchorhynchus brassicae* by interculture of margosa and *Bearsian lilac*. International Nematology Network Newsletter. 4 (4): 27-29.

Taylor, A. L. and Sasser, J. N. (1978). Biology, identification and control of root-knot nematodes (*Meloidogyne species*). Raleigh: North Carolina State University Graphics, 111 pp.

Tiyagi, S. A., Suhail Anver Mehar, Bano and Sidiqui, M. A. (1986). Feasibility of growing zinnia as a mix-crop along with tomato for control root-knot and reniform nematodes. International Nematology Network Newsletter. 3 (3): 6-7.

Zavaleta, Mejia-E and Gomez, R. O. (1995). Effect of *Tagetes erecta* L. in tomato (*Lycopersicon esculentum* Mill.) intercropping on some tomato pests. Fitopathologia. 30 (1): 35-46.

مكافحة نيماتودا تعقد الجذور باستخدام بعض النباتات الطبية كطريقة آمنة بيئيا

نجوى عبد الحميد عبد البارى*- عزة هاشم عشوب** - مصطفي يوسف ياسين* و غنا ممدوح عبد الرازق**

* قسم الحيوان و النيماتولوجيا الزراعية - كلية الزراعة - جامعة القاهرة – الجيزة

** قسم وقاية النبات – وحدة النيماتودا – مركز بحوث الصحراء – المطرية – القاهرة

أظهرت التجارب التي أجريت في البيت المحمي كفاءة جميع النباتات الطبية المستخدمة تحميلاً – العطر(*Pelargonium gravealens*)، الجوجوبا (*Simmondisa chinensis*)، الداتـــــــورة (*Datura metel*)، حشيشة الليمون (*Cymbopogon citratus*)، الزعتـــر (*Thymus vulgaris*)، والشيح (*Artemisia herba-alba*) في مكافحة نيماتودا تعقد الجذور وتخفيض أعداد العقد الجذرية وكتل البيض المتكونة بجذور نبات الباذنجان وذلك تحت مستويين مختلفين من التحميل هما ٢ نبات و ٤ نبات طبي. وقد أظهر مستوى التحميل الثاني تأثير أعلى من مستوى التحميل الأول في تثبيط نمـــو وتكـــاثر النيمـــاتودا مقارنة بمعاملة المقارنة (control). أعطى نبات العطر (*Pelargonium gravealens*) أعلي تأثير في خفض أعداد العقد الجذرية وكتل البيض واليرقات في التربة عند مستوى التحميل الثاني. وقد أدت جميع النباتات الطبية المستخدمة بصفة عامة إلى تحسين صفات نمو نبات الباذنجان.