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IMPACT OF CERTAIN PLANT OILS ON *Meloidogyne incognita* INFECTING OKRA PLANT

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ABSTRACT

Eight essential oils i.e. almond, carnation, castor, chamomile, eucalyptus, garlic, lupine and sesame in comparison with oxamyl were used in controlling the root-knot nematode, *Meloidogyne incognita* infecting okra. The trial was carried out in plastic pots under greenhouse conditions. Results illustrated that the tested plants oils remarkabley reduced root galling and eggmasses of *M. incognita* on okra as well as improved plant growth parameters to various degrees. Among plant oils tested, garlic treatment accomplished the highest values in improving plant growth parameters which averaged 47.8, 71.7 and 105.5% for plant length, total plant fresh weight and shoot dry weight, followed by sesame application with values of 39.7, 52.1 and 61.1% and then castor treatment with values of 39.7, 50.0 and 61.1% for the same plant criteria, whereas, the least values was recorded by chamomile oil that averaged 3.1, 16.3 and 5.5%, respectively, as compared to nematode alone. Moreover, sesame oil surpassed over tested plant oils in eliminating root galls (70.5%) and eggmasses (84.0%) of *M. incognita* on okra roots, followed by garlic oil (69.2 & 84.0%), lupine oil (68.8 & 84.0%) and then castor oil (50.9 & 84.0%), whereas, eucalyptus oil gave the least values for these two nematode criteria (12.5 & 43.0%), respectively. Oxamyl also improved plant growth parameters and gave 100.0% reduction in nematode criteria.
Keywords: Essential plant oils, *Meloidogyne incognita* , okra, oxamyl.

INTRODUCTION

Okra, *Abelmoschus esculentus* L. is considered to be one of the most important commercial vegetable crops in most countries including Egypt. The root-knot nematodes, *Meloidogyne* spp. are considered to be one of the most important major nematode pests all over the world. They are widely distributed in the cultivated areas of Egypt causing appreciable crop losses including okra plantations. The wide host range of such nematodes and the favorable environmental conditions provoked suitable control measures to achieve satisfactory results. The nematicidal activity of certain plant products i.e. plant oils when applied to soil against plant parasitic nematodes have been studied as soil organic amendments by many scientists (Mostafa and El-Batran, 1998; Oka *et al.*, 2000, El-Sherif *et al.*, 2004 and Nour- El-Deen, 2008). Plant oils especially the essential ones are known to have antimicrobial and insecticidal activities (Thabet, 1999). Moreover, during the last decade, great efforts have been focused on the nematicidal properties of plant oils and their components (Pandey *et al.*, 2000 ; Lee et al., 2002; Perez *et al.*, 2003 Neves *et al.*, 2005 ; Radwan *et al.*, 2007 ; and Jabar & Al-Mossawi, 2007). In Egypt, Ali and Al-Shalaby (2004) reported that essential oils of some umbelliferous plants seeds i.e. anise, caraway, celery, coriander, dill and fennel evaluated against *M. javanica* infecting okra at 0.50, 0.75 and 1.0 µl/ml, showed highly nematicidal activity at all concentrations, resulted in improving growth of okra plants and reducing

number of galls, counts of egg-laying females, number of egg / eggmass, juveniles in soil, the nematode final population and its rate of reproduction.

The present investigation was carried out to study the influence of certain plant oils i.e. almond, carnation, castor, chamomile, eucalyptus, garlic, lupine and sesame in comparison with oxamyl against, *M. incognita* infecting okra plant under greenhouse conditions.

MATERIALS AND METHODS

- **Nematode inoculm:**

Fresh hatching second-stage juveniles of the root-knot nematode *M. incognita* were obtained from a pure culture established from a single eggmass of *M. incognita* that previously identified according to the characteristics of its perineal pattern (Taylor and Sasser, 1978), and reared on coleus plants, *Coleus blumei* in the greenhouse of Nematology Research Unit, Faculty of Agriculture, Mansoura University, Egypt, where this work was done. Sufficient inoculum of *M. incognita* (J_2) from soil was extracted by sieving and modified Baermann- technique (Goodey, 1957).

- **Essential oils:**

The following eight essential oils, almond, carnation, castor, chamomile, eucalyptus, garlic, lupine and sesame used in this study were obtained as pure oils from Al-Nekeety company, Mansoura city, Egypt. Each of the tested oils was used at the concentration of 4000 ppm per pot around seedling.

- **Nematicide:**

Oxamyl (Vydate 24% L), Methyl – N'N'- dimethyl-N {(methyl) carbamyloxy}-1-thioxmidate) was used at the recommended dose of 0.3ml/pot.

- **Impact of certain essential oils on okra seedlings growth and nematode infection:**

In order to study the impact of eight plant oils i.e. almond, carnation, castor, chamomile, eucalyptus, garlic, lupine and sesame in comparison with oxamyl against, *M. incognita* infecting okra plant, a pot experiment was carried out under greenhouse conditions at 19±5°C. In this experiment, thirty three plastic pots 10 cm.diam. filled with steam sterilized sandy loam soil (1:1)(v:v) were planted with three seeds of okra cv. Hybrid Dokki-2 per pot, irrigated with water as needed and then thinned at one seedling per pot after three weeks. Thirty seedlings were then separately inoculated with 1000 second-stage juveniles (J_2) of *M. incognita* and the eight plant oils under study were only added to twenty four pots at the rate of 4000 ppm / pot around seedling immediately after the nematode inoculation. Whereas oxamyl at the recommended dose (0.3 ml / pot) was separately added to three pots. Three seedlings were left free of nematode (N) and untreated that served as healthy plants (Check).

Treatments were as follows:

1. Almond oil ,
2. Carnation oil ,
3. Castor oil ,
4. Chamomile oil,
5. Eucalyptus oil ,
6. Garlic oil ,

7. Lupine oil , 8. Sesame oil ,
9. Oxamyl , 10. N alone and
11. Plant free of N and untreated.

Each treatment was replicated three times. Pots were arranged in a randomized complete block design in a greenhouse bench maintained at 19±5°C. Plants received water and were protected by conventional pesticides against mites and insects as needed. Forty five days after nematode inoculation, plants were harvested and root of each pot were gently rinsed with tap water to remove adhering soil particles. Lengths as well as fresh weight of shoot and root systems, and shoot dry weights were determined and recorded. Number of galls and eggmasses of *M. incognita* per each root system of okra was also counted and recorded.

Statistically, the obtained 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

The influence of certain plant oils i.e. almond, carnation, castor, chamomile, eucalyptus, garlic, lupine and sesame in comparison with oxamyl at the recommended dose on controlling, *M. incognita* infected okra plant is presented in tables (1 &2). It was evident that all treatments improved okra growth exceeded that of nematode alone. Among the tested plant oils, garlic treatment achieved the highest values of increase percentage for plant length, total fresh weight and shoot dry weight which were amounted to 47.8, 71.7 and 105.5%, respectively, surpassed oxamyl application for value of the second plant growth parameters (59.6%) and on par with third one (105.5%), followed by those of sesame oil (39.7, 52.1 and 61.1%), castor oil (39.7, 50.0 and 61.1%), and eucalyptus oil (37.2, 45.4, and 55.5%), respectively, compared to nematode alone.. Meanwhile, considerable results were recorded by almond and carnation oils treatments since their percentage of increase were averaged 22.4% each for plant length, 42.5 & 35.0% ; and 50.0 & 44.4% for total plant fresh weight and shoot dry weight, respectively, comparing to nematode alone. However, the least values of increase percentage was recorded by chamomile oil which were amounted to 3.1, 16.3 and 5.5% for the same plant growth parameters, whereas, lupine oil gave the modest values of 38.1, 19.6 and 38.8% for the same previous plant growth criteria. Obviously, treatment of plant free of nematode and untreated with any plant oil gave better performance in improving plant growth than some of tested components (Table 1), with values of 14.3, 53.3, and 66.6% for plant length, total plant fresh weight as well as shoot dry weight, respectively, comparing to nematode alone.Moreover, significant reduction in number of nematode galls and eggmasses of *M. incognita* per root system was achieved with most treatments in the case of root galling while this occurred completely in the case of eggmasses. (Table 2). Among plant oils treatments tested, sesame oil surpassed all other plant oils in reduction percentage of gall and eggmasses numbers with values of 70.5 and 84.0%, respectively, followed by garlic oil (69.2 and 84.0%), lupine oil (68.8 and 84.0%) and then castor oil (50.9 and 84.0%) comparing to nematode alone (Table 2).

Table 1: Okra growth as influenced by certain plant oils in comparison with oxamyl in controlling *Meloidogyne incognita* under greenhouse conditions.

Treatments	* Plant growth response									
	Plant leng. (cm)		Total Length (cm)	Inc. %	Fresh wt.(g.)		Total F.wt (g.)	Inc. %	Shoot D. Wt. (g.)	Inc. %
	Shoot	Root			Shoot	Root				
Almond oil	28.0 bcd	26.6 cd	54.6	22.4	2.35 bcd	1.07 cde	3.42	42.5	0.27 ab	50.0
Carnation oil	27.3 bcde	27.3 cd	54.6	22.4	2.42 bc	0.82 ef	3.24	35.0	0.26 ab	44.4
Castor oil	25.6 cde	36.7 ab	62.3	39.7	2.43 bc	1.17 bc	3.60	50.0	0.29 ab	61.1
Chamomile oil	24.6 ef	21.4 e	46.0	3.1	1.80 def	0.99 de	2.79	16.3	0.19 b	5.5
Eucalyptus oil	28.6 abc	32.6 bc	61.2	37.2	2.17 bcd	1.32 ab	3.49	45.4	0.28 ab	55.5
Garlic oil	30.3 ab	35.6 ab	65.9	47.8	2.77 b	1.35 a	4.12	71.7	0.37 a	105.5
Lupine oil	30.3 ab	31.3 bcd	61.6	38.1	1.72 ef	1.15 bc	2.87	19.6	0.25 ab	38.8
Sesame oil	31.3 a	31.0 bcd	62.3	39.7	2.29 bcd	1.36 a	3.65	52.1	0.29 ab	61.1
Oxamyl	29.3 ab	40.0 a	69.3	55.3	2.84 a	0.99 de	3.83	59.6	0.37 a	105.5
N alone	21.6 f	23.0 de	44.6	---	1.67 f	0.73 f	2.40	---	0.18 b	---
Plant free of N and untreated	25.0 de	26.0 cd	51.0	14.3	2.70 b	0.98 de	3.68	53.3	0.30 ab	66.6

N= 1000 J2 of *M. incognita*

*Each figure represented the mean of three replicates.

Means in each column followed by the same letter(s) did not significantly differ at (P<.05) according to Duncan's multiple range test.

Table 2: Number of root galling and eggmasses as affected by adding certain plant oils in comparison with oxamyl in controlling *Meloidogyne incognita* infecting okra plant under greenhouse conditions.

Treatments	* Nematode parameters			
	No. of Root galls	Reduction. %	No. of eggmasses	Reduction. %
Almond oil	34.3 ab	15.7	3.3 c	67.0
Carnation oil	26.7 cd	34.4	2.0 cd	80.0
Castor oil	20.0 d	50.9	1.6 d	84.0
Chamomile oil	21.0 d	48.4	3.3 c	67.0
Eucalyptus oil	35.6 ab	12.5	5.7 b	43.0
Garlic oil	12.5 e	69.2	1.6 d	84.0
Lupine oil	12.7 e	68.8	1.6 d	84.0
Sesame oil	12.0 e	70.5	1.6 d	84.0
Oxamyl	0.0 f	100.0	0.0 e	100.0
N alone	40.7 a	----	10.0 a	----

N= 1000 J2 of *M. incognita*

*Each figure represented the mean of three replicates.

Means in each column followed by the same letter(s) did not significantly differ at (P < 0.05) according to Duncan's multiple range test .

Meanwhile, treatments of plant oils of either chamomile or almond gave a considerable equal value of reduction percentage of eggmases that was amounted to 67.0% each. However, the least value was recorded by eucalyptus and almond treatments on galls number with values of 12.5 and 15.7%, respectively. It is worth to note that eucalyptus treatment gave a reseanable reduction percentage of eggmasses number with values of 43.0% comparing to nematode alone. Likewise, similar results was also obtained by carnation treatment for the nematode parameters i.e. root galls and eggmasses with values of 34.4 and 80.0%, respectively, comparing to nematode alone. Great suppression in number of nematode galls as well as eggmasses on root system of okra plant was recorded by oxamyl treatment with values of 100.0% each, which was ranked first followed by sesame oil in this respect(70.5 and 84.0%), respectively, comparing to nematode alone. (Table 2).

Apparently, results of the present work indicate clearly that all tested plant oils were variable in improving plant growth parameters but with distinguished performances in reducing root galling and eggmasses number. It was obvious that reduction percentage in gall formation and eggmasses number of *M. incognita* on okra roots were related to the type of the plant oils. For instance, sesame oil represents the best in reducing number of galls value (70.5%), followed by garlic oil (69.2%), lupine oil (68.8%) and then castor oil (50.9%) whereas, they were on par value (84.0%) for eggmasses number. These findings are in accordance with the work reported by Zahir (2004) in respect to sesame, garlic, lupine and castor oils. Moreover, these results also supported the findings of Rodriguez-Kabana (2000) in respect to garlic oil. On the other hand, oils of garlic overwhelmed all treatments in increasing percentages of plant growth parameters, especially total plant fresh weight (71.7%) followed by sesame (52.1%), then castor (50.0%), and eucalyptus (45.4%), respectively.

It is worthy to note that the tested essential oils i.e. almond, carnation, castor, chamomile, eucalyptus, garlic, lupine and sesame showed the highest nematicidal properties against the target nematode, *M. incognita* infecting okra. Literature revealed that the nematicidial activity of such essential oils could be attributed to the richness of essential fatty acids, oleic acid, linoleic acid, palmitic acid, oleanolic acid, saponin, sinapic acid, angelic acid, resin, tiglic acid, athesterol and bezaldehyde (Simon *et al.,* 1984; Balch, 2000; and Wikipedia, 2007). The mode of action of fixed or essential oils against nematode is not clear. In insects several essential oils inhibit acetyl cholinesterase activity (Ryan and Byrne, 1988). Essential oils may disrupt the cell membrane of the nematode and change its permeability (Oka *et al.*, 2000). Since essential oils have been recorded to have fungicidal, antibacterial and nematicidal activities, soil treatment with the botanical pesticide oil could serve as a soil disinfectant. From the previous results, it can be concluded that all tested plant oils have the potential for use in root-knot nematode control. However, further investigations are needed to evaluate economic aspects and nematicidal activity under field conditions with other nematode species and such types of oils.

REFERENCES

Ali, Hanna, F.M. and Mona E. M. Al-Shalaby (2004). Evaluation of essential oils of some umbelliferous plants as natural nematicides against *Meloidogne javanica*. Annals of Agric. Sci. Moshtohor, 42(1) : 321-333.

Balch, P. A. (2000). Prescription of Nutritional Healing, 3rd ed. New York: Avery.p.97.

Duncan, D.B. (1955). Multiple range and multiple,F-test. Biometrics,11: 1-42.

El-Sherif, A.G.; Fatma A. Mostafa and A.M. Zahir (2004). Impact of certain plant oil products and oxamyl on *Meloidogyne incognita* infecting sunflower plant. J. Agric. Sci. Mansoura Univ., 29(2): 935 – 942.

Gomez, K. A. and A.A. Gomez (1984). Statistical procedures for Agricultural Research. 2nd Ed., John Wiley &Sons: Inc., New York.

Goodey, J.B. (1957). Laboratory methods for work with plant and soil nematodes. Tech. Bull. No. 2. Min. Agric. Fish Ed. London, pp 47.

Jabar, M. A. and A. Al-Mossawi (2007). Susceptibility of some multiple resistant bacteria to garlic extract. African J. of Biotechnology, 6(6): 771-776.

Lee, S. Y.; S. D. Iksan; K. C. Shim ; S. D. Kongju; J. H. Kil and K. D. Seo-gu (2002). Phytotoxic effect of aqueous extracts and essential oils from southern marigold (*Tagetes minuta*). New Zealand Journal of Crop and Horticultural Science, Vol. 30 : 161-169.

Mostafa, Fatma A. M. and L. A. El-Batran (1998). Effectiveness of the essential oils of certain ornamental plants on the root-knot nematode, *Meloidogyne javanica* and the Florida red scale insects *Chrysomphalus aondum* L. infesting *Ficus retusa*. E. Biol.C.8(2):85-88.

Neves, W. S. ; L. G. Freitas ; R. D. Giaretta ; C. F. S. Fabryi ; M. M. Coutinho ; O. Dhingra ; S. Ferraz and A. J. Demuner (2005). Activities of garlic, mustard and chili pepper extracts on *Meloidogyne javanica* egg hach. Nematologia Brasileira, 29 (2):273-278.

Nour El- Deen, A. H. H. (2008). Potential use of tissue culture technology in controlling plant parasitic nematodes. Ph. D. Thesis, Fac. Agric . Mansoura Univ., Egypt. 152 pp.

Oka, Y. ; S. Necar, ; E. Putievesky, ; V. Ravid, ; Z. Yaniv, and Y. Spiegel (2000). Nematicidal activity of essential oils and their components against the root-knot nematode. Phytopathol. 90(7):710-715.

Pandey, R.; A. Kalra; S. Tandon; N. Mehrotra; H. N. Singh and S. Kumar (2000). Essential oils as potent source of nematicidial compounds. J. Phytopathol., 148: 501-502.

Perez, M. P. : J. A. Navas-Cortes: M. J. pascual-Villalobos and P. Castillo (2003). Nematicidial activity of essential oils and organic amendments from Asteraceae against root-knot nematodes. Plant Pathology, 52 : 395-410.

Radwan, M. A. ; E. K. El-Maadawy ; S. I. Kassem and M. M. Abu-Elamayem (2007). Oil cakes soil amendments effects on root-knot nematode *Meloidogyne incognita* infecting tomato. Archives of Phytopayhology and Plant Protection 22 March.

Rodriguez-Kabana, R. (2000). Comparative study on the nematicidal activities of garlic and mustard oils. Annual International Research Conference on methyl bromide alternative and emissions reductions. Auburn Univ.

Ryan, M. F. and O. Byrne, (1988). Plant-insect co evaluation and inhibition of acetyl cholinesterase . J. Chem. Ecol. 14: 1965-1975 .

Simon, J. E. ; A. F. Chadwick, and L.E. Craker (1984).Herbs: An Indexed Bibliography. 1971-1980. The scientific literature on selected herbs, and aromatic and medicinal plants of the temperature zone. Archon books, 770 pp., Hamden, CT.

Taylor, A. L. and J.N. Sasser (1978). Biology, indentification and control of root-knot nematodes (*Meloidogyne* species).Coop. Publ, Dept. Plant Pathol., North Carolina State Univ., and U.S.Agency Int. Dev., Raleigh, NC., 111pp.

Thabet, A. A. (1999) Evaluation of some vegetable oils against laboratory and field strains of stored grain insects. J. Pest and Environ. Sci. 7(3) : 69-76.

Wikipedia, the free encyclopedia (2007). Cited from: http://en.wikipedia.org/wiki/castoroil.

Zahir, Gehan, A. M. (2004). Controlling root-knot nematodes by certain plant extracts. M. Sc. Thesis, Agric. Zool. Dept., Fac. Agric., Mansoura Univ. 99pp.

تاثير بعض الزيوت النباتية علي نيماتودا "ميليدوجين انكوجنيتا" والتي تصيب نباتات البامية.

عبد الفتاح رجب رفاعي

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تم اختبار ثمانية زيوت نباتية اساسية وهي زيت اللوز والقرنفل والبابونج والخروع والترمس والكافور والثوم والسمسم مع مقارنتها بمبيد الاوكساميل ضد نيماتودا تعقد الجذور "ميليدوجين انكوجنيتا" والتي تصيب البامية (صنف هجين دقي –٢) وتم اجراء التجربة في اصص بلاستيكية تحت ظروف الصوبة عند درجة حرارة ١٩±٥°م . واسفرت النتائج علي ان الزيوت المختبرة قد خفضت بشكل كبير العقد النيماتودية وكتل بيض النيماتودا علي جذور نباتات البامية وفي نفس الوقت حسنت من نمو النباتات بنسب مختلفة. ومن بين الزيوت المختبرة حقق زيت الثوم اعلي القيم في تحسين نمو النبات حيث احدث زيادة في طول النبات والوزن الكلي الرطب وكذلك الوزن الجاف للمجموع الخضري بقيم قدرها ٤٧,٨ و ٧١,٧ و ١٠٥,٥% علي الترتيب , واتبعة زيت السمسم بنسب ٣٩,٧ و ٥٢,١ و ٦١,١% ثم جاء بعد ذلك زيت الخروع بنسب ٣٩,٧و ٥٠,٠ و ٦١,١% لنفس المقاييس النباتية السابقة . في حين اعطي زيت البابونج اقل المعدلات والتي كانت ٣,١ و ١٦,٣ و ٥,٥% علي التوالي وذلك عند مقارنة هذة المعاملات بالمعاملة المصابة بالنيماتودا فقط. بالاضافة الي ذلك تفوق زيت السمسم علي كل الزيوت الاخري في خفض العقد النيماتودية بنسبة ٧٠,٥% وكتل بيض النيماتودا بنسبة ٨٤,٠% علي جذور البامية واتبعة زيت الثوم بنسب ٦٩,٢% و ٨٤,٠% ثم زيت الترمس (٦٨,٨% و ٨٤,٠%) ثم زيت الخروع (٥٠,٩% و ٨٤,٠%) في حين اعطي زيت الكافور اقل القيم في خفض هذة المقاييس بنسب (١٢,٥% و ٤٣%) فقط. واوضحت النتائج ايضا ان مبيد الاوكساميل ساعد في تحسين نمو النباتات وفي الوقت ذاتة اعطي نسبة خفض بلغت ١٠٠% للعقد النيماتودية وكتل بيض النيماتودا.