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Influence of Four Chemical Nematicides on *Meloidogyne incognita* Infecting Squash Plants under Greenhouse Conditions

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ABSTRACT

Greenhouse trial was conducted to assess the impact of three chemical nematicides i.e. Furdan, Gupter and Mocap in contrast with the oxamyl on vegetation of squash cv. Elxandrany under the stress of *M. incognita* contamination at the greenhouse situation (25± 3˚C). The obtained data indicated that all tested nematicides enhanced squash plant growth with various degrees. Mocap surpassed extra chemicals in the increment percentage increase values of plant length (83.65%), quantity of flowers and leaves (85.39& 56.54%) sum plant fresh weight (35.2%) and shoot arid weight (87.1%), and surpassed other chemicals in surpassing final nematode population (96.0%), number of galls and eggmasses (99.2 & 99.9%), followed by Gupter with values of 95.1, 98.6 and 99.1% for the similar nematode criteria, comparing to nematode only, in that order. Furdan exhibited the slighter values in this respect. The rate of nematode reproduction factor (RF) of *M. incognita* on squash were negatively affected by the tested nematicides and ranged between 0.077 for Furdan and 0.12 for oxamyl vs 1.97 for nematode single-handedly, respectively. The root galls and eggmasses indices of furdan and Gupter were on parity (3&3 and 1&1), respectively vs. 5&5 for nematode alone. Oxamyl as the typical nematicide gave indices of galls and eggmasses values of 2&2 vs 5&5 for nematode alone, respectively.

Keywords: *Cucurbitaceae* , control, *Meloidogyne incognita*, Furdan, Gupter , Mocap , oxamyl.

INTRODUCTION

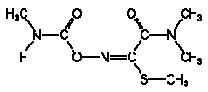
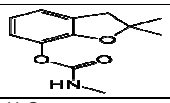
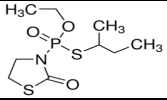
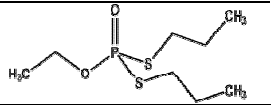
Cucurbitaceous crops are known for their fruit, consumed raw or cooked, and used for human or animal nourishment. *Cucurbitaceae* plants had no resistance to *Meloidogyne* spp (Thomanson and McKiney, 1959). The root-knot nematode, *Meloidogyne incognita* (Kofoid &White) Chitwood, is one of the mainly injurious root-knot nematode species, in the last two decades, and one of the most tricky plant diseases to manage. Pytonematodes are at their most weak during their active stage when searching for host plants, and when penetrated a plant roots, control with chemicals is not easy as nematicidal have to be non-phytotoxic and rather systemic. A nematicide that can be securely practical to infected plants and is moved through the roots in sufficiently great amounts to control parasitic nematodes has not been discovered. Oxamyl, is the single marketable product that is used as a foliar treatment, and limited in numerous countries for toxicological effects. There are some nematicides that can be used successfully for phytonematode infecting annual crops (Van Berkum and Hoestra, 1979), but there appears to be slight vision for management of nematodes in several susceptible crops without repeat application of nematicides. The current research was carried-out to determine the activity of three chemical nematicides i.e. Furdan, Gupter and Mocap comparing to oxamyl on *M. incognita* infecting squash plant in the greenhouse conditions (25± 3˚C),

MATERIALS AND METHODS

Nematode inoculums:

The root-knot nematode, *M. incognita* culture was initiated via only eggmass of earlier recognized females (Talyor *et al.,* 1955) and secluded from galled roots of extremely infected tomatoes collected from coleus plants, *Coleus blumei* in the greenhouse of Nematology Research Unit, Agricultural Zoology Department, Faculty of Agriculture , Mansoura University , where this trial was ended. Nematode inoculum of *M. incognita* was then prepared according to the technique recorded by Hussey and Barker, (1973).

•Nematicide :

Common name	Formulation	Chemical name	Molecular formula	Chemical Structure
Oxamyl (Vaydate)	10% Granules	:(EZ)-N,N-dimethyl-2-methylcarbamoyloxyimino-2-(methylthio)acetamide	$C_7H_{13}N_3O_3S$	
Carbofuran (Furadan)	10% Granules	(RS)-S-sec-butyl-O-ethyl-2-oxo-1,3-thiazolidin-3-ylphosphonothioate	$C_9H_{18}NO_3PS_2$	
Gupter (Fothiazate)	10% Granules	2,2-Dimethyl-2,3-dihydro-1-benzofuran-7-yl methylcarbamate	$C_{12}H_{15}NO_3$	
Mocap (Ethoprophos)	150 GR	O-ethyl S, S-dipropyl phosphorodithioate (IUPAC)	$C_8H_{19}O_2PS_2$	

Greenhouse experiment:-

Thirty four plastic pots (10 cm-diam.) containing one kg of steam clean clay loamy soil (1:1, v:v) were growing with three squash cv. Eskandrany and irrigated. One week after, the germinated squash plantlet were thinned to one plant per pot and inoculated with 1000 *M. incognita* juveniles to twenty seedlings each and left four seedlings (pots) with no nematode (check). One week later

from nematode inoculation, four chemical nematicides i.e. Furdan, Gupter , Mocap and Oxamyl were individually additional to four seedlings each and mixed with soil. Each treatment was replicated four times. Treatments were as follows:

1- N+ Furdan (5 g / pot), 2- N+ Gupter (3 g/ pot),
3- N + Mocap (3 g/ pot), 4- Oxamyl (ox), (0.3 g/ pot)
5- N alone, and 6- Check.

Treatments were then set in a randomized absolute block design on at the greenhouse at 25±3 °C and irrigated with water as required. The experiment were harvested 45 days after nematode inoculation, vegetation criteria such as plant lengths and weights, as well as shoot dry weight were determined. *M. incognita* in 250 g. juveniles were extracted by sieving and modified Baermann- method (Goodey, 1957), counted by Hawksely counting slide under 10x magnification and considered for every pot. Roots of each plant were washed with tap water, fixed and stained according to Byrd *et al*., 1983. The infected roots examined under a stereomicroscope for developmental stages, females and egg-masses. Data were subjected to analysis of variance (ANOVA) (Gomez and Gomez, 1984) then by Duncan's multiple range tests to compare means (Duncan, 1955).

RESULTS AND DISCUSSION

Data in Table (1) illustrated the influence of three synthetic nematicides namely Furdan, Gupter and Mocap in comparison with the standard oxamyl at the optional dose on plant growth response of squash plant cv. Elxandrany beneath the stress of *M. incognita* infection at the greenhouse conditions (25± 3°C). Data indicated that all tested nematicides enhanced plant growth of squash with different degrees. Mocap surpassed other nematicides in the increment percentage values of plant length (83.65%), flowers and leaves numbers (85.39& 56.54%) whole plant fresh weight (35.2%) and shoot dry weight (87.1%), followed by that of Gupter nematicide with values that were amounted to 65.42, 66.67, 44.86, 11.12 and 49.1%, for the similar plant growth characters comparing the check, correspondingly (Table 1). In the meantime, Furdan exhibited the less significant values of plant length (57.58%), flowers and leaves numbers (38.89& 35.51%) total plant fresh weight (9.56%) and shoot dry weight (37.4%). It is attractive to note that oxamyl as the typical nematicide significantly showed that percentage increase values of plant length (117.69%), flowers and leaves numbers (96.3& 49.53%) totality plant fresh weight (89.5%) and shoot dry weight (160.8%) compared to other nematicides as well as nematode alone. Nevertheless, plants free of the nematicides nematode infection recorded extensive percentage increase values of plant length (7.32%), number of flowers and leaves (29.63& 26.17%) whole plant fresh weight (4.78%) and shoot dry weight (28.6%) when compared to nematode alone (Table 1).

Table 1. Plant growth response of squash plant cv. ELxandrany infected with *Meloidogyne incognita* as affected by three chemical nematicides in contrast with oxamyl under greenhouse conditions (25± 3°C).

Treatments	*Plant growth response													
	Length (cm)		Total plant length (cm)	** Inc. %	No. of flowers	** Inc. %	No. of leaves	** Inc. %	Fresh weight(g)		Total plant F.Wt (g)	** Inc. %	Shoot dry weight (g)	** Inc. %
	Shoot	Root							shoot	root				
Furdan	31.72 b	11.92 b	43.65 bc	57.58	3.75 b	38.89	14.5 ab	35.51	9.58 c	1.10 bc	11.92 c	9.56	0.47 b	37.4
Gupter	31.02 b	14.8 b	45.82 bc	65.42	4.5 ab	66.67	15.5 ab	44.86	10.91 bc	1.18 bc	12.09 bc	11.12	0.51 b	49.1
Mocap	38.87 b	12.0 b	50.87 b	83.65	5 ab	85.19	16.7 ab	56.54	13.15 b	1.55 b	14.71 b	35.20	0.64 a	87.1
Oxamyl	39.2 b	21.1 a	60.3 a	117.69	5.3 abc	96.30	16.0 ab	49.53	18.9 a	1.5 b	20.4 a	87.50	0.89 b	161.8
*N alone	16.3 c	11.4 c	27.7 c	0.00	2.7 c	---	10.7 b	-----	10.0 c	1.0 b	10.88 b	-----	0.342 a	0.0
Plant Free	14.2	15.5 bc	29.7 c	7.22	3.5 abc	29.63	13.5 ab	26.17	9.5 c	1.9 b	11.4 b	4.78	0.44 b	28.6
L.S.D at 0.05 %	6.74	4.52	9.39	---	2.58	---	4.19	---	2.28	0.46	2.67	---	0.23	---

****N= 1000 *M. incognita* (J_2).**

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

Data in Table (2) documented the efficacy of four chemical nemticides, Furdan, Gupter, Mocap and oxamyl on development and reproduction of *M. incognita* infecting squash plant beneath greenhouse conditions (25± 3°C). All tested chemical nematicides significantly reduced the immature stages, nematode populations, galls and eggmasses number (Table 2). Mocap surpassed other tested chemicals in surpassing final nematode population (96.0%), number of galls and eggmasses/ root system (99.2 & 99.9%), then that of Gupter treatment with values of 95.1, 98.6 and 99.1% for the similar nematode criteria, respectively. Furthermore, Furdan ranked the third in diminishing the same nematode criteria values that amounted to 94.7, 98.5 and 99.0% as compared to nematode alone, in that order. Oxamyl was significantly adjusting the nematode parameters with slightly lower values than those of other nematicides since these values were amounted to 93.9, 95.8 and 96.2% for final nematode population, galls and eggmasses numbers. Moreover, rate of nematode reproduction factor (RF) of *M. incognita* on squash plant were harmfully affected by the tested chemical nematicides. Such rate of nematode reproduction was ranged beginning 0.077 for Furdan and 0.12 for oxamyl in opposition to 1.97 for nematode alone, respectively. It is valuable to note that Mocap represented the lowest values (0.077), whereas oxamyl showed the greatest value (0.12). Meanwhile, indices values of root galls and eggmasses for Furdan and Gupter were on parity (3&3 and 1&1), respectively vs. 5&5 for nematode only. In the meantime, oxamyl as the typical nematicide recorded indices of galls and eggmasses values of 2&2 vs 5&5 for nematode alone, respectively. (Table 2).

Certainly, the utilization of three chemical nematicides i.e. Furdan, Gupter and Mocap comparing to standard oxamyl on squash plant under the stress of *M. incognita* infection indicated that all tested nematicides improved plant growth of squash with different degrees. Mocap treatment surpassed other chemicals in the increment percentage increase values of plant growth parameters and suppressing other tested chemicals insurpassing nematode population followed by that of Gupter treatment. The current results were in agreement with those of Khalil (2013) who stated that oxamyl or fosthiazate recorded the maximum decrease of nematode population. The application of Furdan was the lowest effective treatment against the root-knot nematode population in this investigation. On the other hand, these results are supported by those of Saad *et al* (2017) who revealed that fenamiphos or oxamyl achieved the highest decrease values of galls and egg-masses. Avermactin has moderately reduction in gall formation and egg-masses. Meanwhile, cadusafos and oxamyl achieved the supreme decrease for eggs per egg-mass.

Table 2. Development and reproduction of *Meloidogyne incognita* infecting squash plant cv. ELxandrany as affected by three chemical nematicides comparing to typical oxamyl under greenhouse conditions (25± 3°C).

Treatments	*Nematode population in Root					***Reproduction			RGI	No. of	Red	EI
	Soil	Roots		Final	Red %	Factor (RF)	No. of	Red		Egg masses	%	
	(J_2)	Females	D.S.	population			galls	%				
Furdan 10%	97.5 b	2.0 b	3.5 b	103.0 b	94.7	0.10	3.5 b	98.5	3	0.75 b	99.0	1
Gupter	86.25 b	3.25 b	6.25 b	95.75 b	95.1	0.095	3.25 b	98.6	3	1.5 b	99.1	1
Mocap	72.5 b	2.0 b	3.25 b	77.75 b	96.0	0.077	2.0 b	99.2	1	0.25 b	99.9	0
Oxamyl	100.5 b	9.25 cd	9.5 ef	119.25 c	93.9	0.12	10.0 cd	95.8	2	6.5 c	96.2	2
**N-alone	1363.2	278.5 a	324.5 a	1966.2 a	----	1.97	240.7 a	-----	5	172.7 a	----	5
LSD	46.08	3.51	3.75	42.61	-----	---	4.75	---	---	3.12	---	---

****N = 1000 *M. incognita* J_2 D.V.= Developmental stages.**

*** Each value is a mean of four replicates. Mean values in each column followed by the same letter(s) did not differ at P< 0.05 according to Duncan's multiple- range test. ***Root gall index (RGI) or eggmasses index (EI) : O = No galls or eggmasses, 1= 1-2 galls or eggmasses, 2= 3-10 galls or eggmasses , 3=11-30 galls or eggmasses , 4= 31-100 galls or eggmasses and 5 = More than 100 galls or eggmasses (Taylor and Sasser, 1978).**

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تأثير اربعة من المبيدات الكيماوية علي نيماتودا تعقد الجذور التي تصيب نبات الكوسة تحت ظروف الصوبة الزراعية

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وحدة بحوث النيماتولوجى قسم الحيوان الزراعى – كلية الزراعة –جامعة المنصورة.

تم دراسة تأثير ثلاثة مبيدات نيماتودية كيميائية وهم الفيردان , الجيوبتر والموكاب, علي نبات الكوسة الإسكندراني وإضافة تلك المبيدات منفردة بمعدلات ٥ جرام/نبات , ٣ جرام/نبات و ٣ جرام/نبات على التوالى مقارنة بمبيد الأوكساميل عند الجرعة الموصى بها (٠.٣ جرام / نبات),عند مستوي عدوي ١٠٠٠ بيضة / نبات من نيماتودا تعقد الجذور تحت ظروف الصوبة وبعد ٤٥ يوم من اضافة العدوي تم حصاد التجربة وكانت النتائج علي النحو التالي: جميع المعاملات للمبيدات النيماتودية المختبرة أدت إلي زيادة معنوية في نمو نبات الكوسة الإسكندراني مع خفض واضح في تعداد النيماتودا بدرجات متفاوتة.١- إحتل مبيد الموكاب المرتبه الاولي في القيم بنسبة زيادة في طول النبات (٨٣.٦٥%) , عدد الازهار والاوراق / نبات (٨٥.٣٩% و ٥٦.٥٤%) , المجموع الكلي للوزن الرطب للنبات (٣٥.٢%) والوزن الجاف (٨٧.١%) مع خفض المقاييس النيماتودية المختبرة بقيم (٩٦.٠، ٩٩.٩ ، ٩٩.٢%) لكلا من التعداد النهائي وعدد العقد النيماتودية وكتل البيض علي التوالي مقارنة بالنيماتودا فقط.٢- سجل مبيد الجيوبتر المرتبة الثانية في تحسن المقاييس النباتية المختبرة بقيم (٦٥.٤٢%) , (٦٦.٦٧%) , (٤٤.٨٦%) ,(١١.١٢%) و (٤٩.١%) لكلا من طول النبات , عدد الازهار ,عدد الاوراق/نبات ,المجموع الكلي للوزن الرطب والوزن الجاف للمجموع الخضري علي التوالي مقارنة بالنيماتودا وحدها ، في حين حقق مبيد الفيوردان المرتبة الأخيرة في طول النبات (٥٧.٥٨%) وعدد الازهار والاوراق / نبات (٣٨.٨٩% و ٣٥.٥١%) , المجموع الكلي للوزن الرطب (٩.٥٦%) والوزن الجاف (٣٧.٤ %).٣- أظهرت المعاملة بمبيد جيوبتر المركز الثاني بقيم (٩٨.٦%,١.٩٥% و ٩٩.١%) في خفض تعداد النيماتودا, عددالعقد النيماتودية وكتل البيض علي التوالي، وجاءت المعاملة بمبيد الفيوردان في المركز الأخير بقيم (٩٨.٥% , ٩٤.٧% و٩٩.٠%) لنفس المقاييس النيماتودية , مقارنة بالنيماتودا وحدها .علي التوالي.