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Nematicidal Activities of Certain Animal Manures and Biopesticides against *Meloidogyne incognita* Infecting Cucurbit Plants under Greenhouse Conditions

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ABSTRACT

A greenhouse experiment was carried out to evaluate the nematicidal activity of animal manures viz. chicken and goat manures, biopesticides viz. bio-zeid and nemex against *Meloidogyne incognita* infecting three cucurbits compared with oxamyl. Cucurbit plants namely cucumber (*Cucumis sativus* L.) cv. Biet Alpha, squash (*Cucurbita pepo* L.) cv. Escandrany and watermelon (*Citrullus lanatus*) cvs. Master and. Mloky were chosen for this study. Results indicated that of five tested materials, oxamyl, chicken and goat manures were the most effective in suppressing root galling and number of egg masses of *M.incognita* infecting cucurbit plants. Oxamyl (69.22%), chicken (60.98%) and goat (56.60 %) manures showed better performance in reducing root galling on cucumber than did on squash. Among the two cultivars of watermelon, the effectiveness of oxamyl (70.75), chicken (52.29) and goat (49.22%) manures were more pronounced on Master than on Mloky cultivar with root galling reached 50.74, 28.36 and 23.88% respectively. On the other hand, all treatments showed significant ($P \leq 0.05$) improvement in cucurbits to certain extent. The maximum percentage of increase in shoot fresh weight was recorded on cucumber (93.30; 74.76%) and watermelon cv. Mloky (92.74; 76.81%) in pots receiving oxamyl and chicken manure, respectively. In general, number of galls showing fewer and smaller gall diameter (< 2 mm) was significantly decreased by oxamyl, chicken and goat manures in the three plant species. Our results showed that chicken and goat manures could be used to increase crop yield of cucurbit plants and for controlling root-knot nematode, *M.incognita* .

Keywords: Control, *Meloidogyne incognita*, oxamyl, manures, biopesticides.

INTRODUCTION

Vegetables are one of the highest valuable groups of crops for small and large growers and one of the most important components of the human diet, especially concerning fresh consumption (Sikora and Fernández, 2005). Vegetables cover a 1.1 % of the whole agricultural surface of the world and China being the largest producer. Vegetable production in developing countries has increased by 60 % over the last two decades (Anonymous, 2013). In Egypt, cucumber production reached to 519.858 tonnes /ha and water melon 1.680994/ ha (Anonymous, 2016).

Cultivation of the vegetable as a food source began nearly 3000 years ago and India and other parts of Western Asia are the habitat of cucurbit plants. Also the cucumbers can be existed in other countries like China and Middle East, however cucurbits were most likely domesticated in Asia. Throughout the world, production of vegetables under protected cultivation has increased significantly and the Mediterranean basin being the largest production area.

Most cultivated plant species are susceptible to nematodes, especially root-knot nematodes (RKN) (*Meloidogyne* spp.) which attack and cause remarkable damage to vegetables, with certain predilection for melon and cucumber (Bertrand, 2001). In tropical countries, these vegetables are usually susceptible to nematode and their production depends on the correct management of these pathogens (Sikora & Fernandez, 2005). RKN have a high reproduction rate, which results in the accumulation of large quantities of eggs in the soil (Campos *et al*., 2001) and are a major constraint to successful vegetable production all over the world, causing severe damage that leads to 10% of loss in yield (Sasser and Carter, 1985; Amin, 1993; 1994; Sikora and Fernandez, 2005; Karssen and Moens, 2006. In Egypt, root-knot nematodes, *Meloidogyne* spp., are becoming real threats to almost all vegetable crops and are considered as limiting factors in crop production, particularly with cucurbit yields (Ibrahim, 2011).

Chemical nematicides control has disadvantages like high expensive and hazard to human health and the environment. Thus, there is urgently needed to replace chemical control. Now, several alternative techniques are available, including biocontrol agents and soil amendments. Therefore, the aim of present study was to determine the effect of two animal manures, and two biopesticides on *M. incognita* infecting certain cucurbit plants under greenhouse conditions.

MATERIALS AND METHODS

Source of root – knot nematode:

Second stage juveniles (J2) were collected from an identified pure culture of *M. incognita* that was maintained in the greenhouse on eggplant seedling *Solanum melongena* cv. Beauty planted in the greenhouse of Faculty of Agriculture, Zagazig University, Egypt where this work was conducted.

Plants culture:

Three cucurbit plants were chosen in the present study because of severely attacked by *M.incognita* besides regional economic importance. Seeds of cucumber (*Cucumis sativus* L.) cv. Biet Alpha, summer squash (*Cucurbita pepo* L.) cv. Escandrany, watermelon (*Citrullus lanatus*) cvs. Master (France) and Mloky (India) were soaked in sterile distilled water in Petri dishes and kept in an incubator at 26±1°C.

Experimental design:

After germination, cucurbit plants were planted in sandy plastic pots of 20-cm diameter containing steam sterilized sandy soil (95.7% sand; 1.2% silt and 3.1% clay) and two weeks later, plants were thinned to one per pot. When seedlings were approximately 10 cm in height (time of inoculation), they were inoculated with 1000 newly hatched infective juveniles (IJs) of *M.incognita* per plant. Inocula were obtained from available pure culture formerly prepared and propagated in the greenhouse. IJs were added by pipetting 2 ml of the inoculum suspension into four holes around the root system. Immediately, after inoculation the holes were covered with moist soil. The treatments were done according to the following scheme:

1- Bionematicides (Bio-zeid and Nemex), bio-zeid ($1x10^{10}$ vital spores per gram product of fungus, *Trichoderma album*) was applied at the rate of 0.2 g/plant whereas, nemex (*Serratia marcescens*) was introduced to soil at the rate of 0.4 ml /plant

2- Chicken and goat manures, were applied simultaneously to cucumber seedlings at the rate of 3 g/plant.

3-Chemical pesticide (oxamyl) was applied together to cucurbit seedlings at the rate of 0.3 mL/plant.

4-Control treatments included inoculation of *M. incognita* IJs alone as well as healthy plants without nematode inocula. Each treatment was replicated three times.

All treatments were arranged in a randomized complete block design in the greenhouse at 26 ± 4°C., and all received similar horticultural treatments. Two months after inoculation, plants were removed carefully from pots and data on plant growth (fresh weight of shoots and roots) were recorded. Roots and surrounding soil in the pots were soaked in clean water for 2 hours to facilitate removing adhering soil and keep egg masses on root surface.

Roots were wrapped in tissue paper to prevent drying out during the steps of evaluation. Moreover, Root weight, shoot weight, numbers of galls and egg masses were counted per root system under a stereomicroscope. Root-knot index was assessed using Taylor and Sasser (1978) scale of 0 = No galling; 1 = 1-2 galls; 2 = 3 - 10 galls; 3 = 11 - 30 galls; 4 = 31-100 galls and 5 = more than 100 galls. Gall diameter was also measured at its greatest diameter. Means were compared by Duncan's multiple range test at P<0.05 level (Duncan, =1955).

RESULTS AND DISCUSSION

Data in Table (1) show the effect of two biopesticides (bio-zeid and nemex) and two of animal manures (chicken and goat manures) compared to oxamyl on root- knot nematode, *M. incognita* infecting cucumber (*C. sativus* L. cv. Biet Alpha) plants after two months of application. The obtained results revealed that all treatments significantly (P ≤0.05) reduced the galls numbers as compared to check treatment. Pots treated with oxamyl overwhelmed those treated with animal manures or biopesticides in minimizing numbers of root-galls. Since maximum percentages of reduction were recorded when plants treated with oxamyl (69.22%) followed by chicken (60.98%) and goat manure (56.60%). It was evident that, oxamyl application suppressed root galls with insignificantly variations with chicken and goat manures. On the other hand, high significantly differences were detected between animal manures (chicken and goat manures) treatments compared with bio-zeid and nemex. However, the minimum percentage reduction was obtained in case of pots treated with nemex (44.50%) followed by bio-zeid (46.71%). Gall ratings were lower for chemical pesticide treatment as compared with animal manures and biopesticides with root galling 2.3, 2.6 and 3.0 in case of oxamyl, chicken manure and goat manure, respectively.

Regarding the efficiency of the treated materials on egg masses, results clearly showed that oxamyl, animal manures and biopesticides significantly minified numbers of egg masses as compared to control treatment. Bio-zeid achieved the lowest insignificantly effect compared to untreated plants. Percentages of reduction in egg-masses for treated materials were 40.73, 28.88, 25.17, 24.44 and 15.55% with oxamyl, chicken manure, nemex, goat manure and bio-zeid, respectively.

Table 1. Effect of two biopesticides and two animal manures on root-knot nematode, *M. incognita* infecting cucumber (*Cucumis sativus* L. cv. Biet Alpha) and the resulting effect on plant growth.

Treatments	Fresh root weight (g) (Increase %)	Fresh shoot weight (g) (Increase %)	Root galls/Root (Reduction %)	Egg masses /Root (Reduction %)	Number of galls Gall diameter ≥ 4 mm			Root Gall - Index
					≥ 4 mm	< 4-2 mm	< 2 mm	
Healthy plants (Control)	12.71 a	17.58 a	0.00 e	0.00 d	0.00	0.00	0.00	0.0
M.incognita alone	4.53 e	8.36 f	60.67 a	45.00 a	3.00 a	25.00 a	37.00 a	4.0
M.incognita + Bio-zeid	6.51 d (43.70)	9.50 e (13.36)	32.33 b (46.71)	38.00 ab (15.55)	2.00 ab	12.67 c	17.67 b	3.6
M.incognita + Nemex	7.26 d (60.26)	11.64 c (39.32)	33.67 bc (44.50)	33.67 bc (25.17)	2.33 a	12.67 c	15.00 b	3.0
M.incognita + Chicken manure	8.95 c (97.57)	14.61 bc (74.76)	23.67 cd (60.98)	32.00 bc (28.88)	1.67 ab	17.33bc	4.67 c	2.6
M.incognita + Goat manure	8.80 c (94.26)	13.11 cd (56.81)	26.33 cd (56.60)	34.00 bc (24.44)	2.00ab	18.67 b	5.67 c	3.0
M.incognita + Oxamyl	9.05 b (99.77.)	16.16 ab (93.30)	18.67 d (69.22)	26.67c (40.73)	0.00 b	11.67 c	7.00 c	2.3

Same letter (s) in each column indicate no significant difference (P ≤ 0.05) between treatments according to Duncan's multiple range test.

$$\text{Increase } (\%) = \frac{\text{Treated - Control}}{\text{Control}} \times 100 \qquad \text{Reduction } (\%) = \frac{\text{Control - Treated}}{\text{Control}} \times 100$$

Root-knot index (RGI) or eggmasses index (EI) : 0 = No galling r; 1 = 1-2 galls; 2 = 3 - 10 galls; 3 = 11 - 30 galls; 4 = 31-100 galls and 5 = more than 100 galls (Taylor and Sasser, 1978).

In general, it could be concluded that curative application of oxamyl and animal manures significantly reduced gall formation and egg mass production of M. incognita in cucumber plants. Moreover, oxamyl of all tested treatments gave good results as compared to animal manures and biopesticides treatments. On the other hand, pots receiving oxamyl, chicken and goat manures showed significantly ($P \leq 0.05$) fewer and smaller galls (<2 mm) compared to control. Also, number of galls showing <4-2 mm diameter were significantly decreased with all treatments .

For plant growth, effect of curative treatments by abovementioned materials on growth of cucumber plants was indicated by fresh root weight and shoot fresh weight (Table 1). It is clear that, M. incognita caused remarkable reduction in cucumber growth response in terms of root fresh weight (64.36%) and fresh shoot weight (52.45%) as compared to healthy plants. On the other hand, all tested treatments ameliorated shoot fresh weight of cucumber plants to a certain extent. Oxamyl and animal manures significantly improved shoot fresh weight of cucumber plants. Generally, application of oxamyl overwhelmed biopesticides and animal manures in improving plant growth of cucumber plants. For instance, percentage increase in root and shoot fresh weight of in treatment of oxamyl, chicken, goat manure, nemex and bio-zeid were 99.77 , 93.30; 97.57 ,74.76; 94.26 , 56.81; 60.26,39.32 and 43.70 ,13.36% , respectively.

As expected, data in Table (2) clearly showed that oxamyl proved to be the most suppressive effect on root knot nematode nematode, *M. incognita* squash infecting which recorded 45.34 % reduction in root galling followed by chicken (37.11%) then goat (34.02%) manures. However, oxamyl and chicken manure achieved the highest insignificantly effect with percentage of reduction in egg-masses 44.88, 38.57 and 34.63 for oxamyl , chicken and goat manures, respectively. However, bio-zeid achieved the lowest insignificantly effect with percentages of reduction 15.73% in egg masses. Gall ratings were lower for chemical pesticide (oxamyl), animal manures and biopesticides with root galling 2.0, 2.6 and 2.6, respectively (Table 2).

On the other hand, statistical analysis showed that oxamyl ranked the first in decreasing gall diameter followed by chicken manure. Since number of galls (< 2 mm) decreased to reach 5.00 and 4.00 with oxamyl and chicken manure, respectively. Whereas, bio-zeid and nemex had the lowest effect in diminishing number of galls (≥ 4 mm).

For plant growth, inoculated plants with root knot nematode alone (untreated), *M. incognita* caused remarkable reduction in squash growth response in terms of root fresh weight (44.25%) and fresh shoot weight (46.76 %) as compared to healthy plants. On the other hand, all tested treatments enhanced shoot fresh weight of squash plants to a certain extent. Generally, application of oxamyl and animal manures significantly improved shoot fresh weight of squash plants compared to check treatment. However, insignificant variations in shoot fresh weight were detected between oxamyl (65.84%) and chicken manure (59.23%). Application with oxamyl, goat, chicken manure, nemex and bio-zeid improved root condition and significantly promoted the growth of plants compared with the control.

Table 2. Effect of two biopesticides and two animal manures compared to oxamyl on root-knot nematode, *M. incognita* infecting summer squash (*Cucurbita pepo* L. cv. Escandrany) plants.

Treatments	Fresh root weight (g) (Increase %)	Fresh shoot weight (g) (Increase %)	Root galls (Reduction %)	Egg masses /Root (Reduction %)	Number of galls – Gall diameter ≥ 4 mm	< 4-2 mm	< 2 mm	Root Gall - Index
Healthy plants (Control)	8.18 a	12.21 a	0.00 e	0.00 e	0.00	0.00	0.00	0.0
M.incognita alone	4.56 f	6.50 f	32.33 a	42.33 a	2.67 a	17.00 a	12.67 a	3.6
M.incognita + Bio-zeid	5.48 e (20.17)	7.86 e (20.92)	23.67 b (26.78)	35.67 ab (15.73)	1.33 bc	15.67 a	6.67bc	2.6
M.incognita + Nemex	5.84 de (28.07)	8.72 d (34.15)	22.00 bc (31.95)	32.33 bc (23.62)	1.67 b	15.67 a	4.67 c	2.6
M.incognita + Chicken manure	7.29 bc (59.86)	10.35 bc (59.23)	20.33 cd (37.11)	26.00 cd (38.57)	0.67cd	15.67 a	4.00 c	2.6
M.incognita + Goat manure	6.74 cd (47.80)	9.77 c (50.30)	21.33 bc (34.02)	27.67 cd (34.63)	0.67 cd	16.33 a	9.33 b	2.6
M.incognita + Oxamyl	7.99 b (75.12)	10.78 b (65.84)	17.67 d (45.34)	23.33 d (44.88)	0.00 d	12.67 b	5.00 c	2.0

Same letter (s) in each column indicate no significant difference ($P \leq 0.05$) between treatments according to Duncan's multiple range test.

$$\text{Increase } (\%) = \frac{\text{Treated - Control}}{\text{Control}} \times 100 \qquad \text{Reduction } (\%) = \frac{\text{Control - Treated}}{\text{Control}} \times 100$$

Root-knot index (RGI) or eggmasses index (EI) : 0 = No galling r; 1 = 1-2 galls; 2 = 3 - 10 galls; 3 = 11 - 30 galls; 4 = 31-100 galls and 5 = more than 100 galls (Taylor and Sasser, 1978).

Data revealed that, of the five tested materials oxamyl, chicken and goat manures were the most effective, whereas bio-zeid and nemex showed moderately effect on reducing root galling and number of egg masses of *M. incognita* (Table 3). Root galling and egg masses were evaluated on the basis of percentage reduction to the control.

Oxamyl significantly had high effect which recorded 70.75 % reduction in root galling followed by chicken manure (52.29 %) then goat manure (49.22%), nemex (37.68%) and bio-zeid (12.30%). Data in Table (3) illustrated that bio-zeid (3.46 %) achieved the lowest insignificantly effect on number of egg masses. While the percentage of reduction in egg masses for oxamyl, chicken and goat manure were 33.61, 30.17 and 20.68%, consequently. The highest level of galling which indicated root damage was recorded in inoculated-untreated plants (3.6). The least galling was recorded for oxamyl treated watermelon plants (2.0) which were significantly lower than those of animal manures (poultry and goat manure) treated plants (2.6 for each). However, all treated plants with either animal manures or oxamyl significantly reduced galling when compared with inoculated-untreated watermelon plants. In watermelon cv. Master, there were no remarkable differences between oxamyl and chicken manure treatments in egg masses reduction but significantly exceed those in the control. On the other hand, pots receiving oxamyl, chicken and goat manures showed significantly ($P \leq 0.05$) fewer and smaller galls(< 2 mm) compared to bio-zeid and nemex. Also, number of galls showing < 4-2 mm diameter were significantly decreased to 10.33 and 14.33 with oxamyl and goat manure, respectively.However, no galls (< 4-2 mm) were recorded with oxamyl and goat manure.

For plant growth response, application with oxamyl, animal manures and biopesticides improved root condition and significantly promoted the growth of plants compared with the control. Inoculated (untreated) plants with root knot nematode, *M. incognita* caused remarkable reduction in watermelon growth response in terms of root fresh weight (57.10 %) and fresh shoot weight (47.52 %) as compared to healthy plants. Oxamyl has insignificant variations in root fresh weight with chicken and goat manures. Whereas, there were significant variations in shoot weight between oxamyl and other treatments.

Table 3. Effect of two biopesticides and two animal manures compared to oxamyl on root-knot nematode on root-knot nematode , *M. incognita* infecting watermelon (*Citrullus lanatus*) cv. Master) plants .

Treatments	Fresh root weight (g) (Increase %)	Fresh shoot weight (g) (Increase %)	Root galls (Reduction %)	Egg masses /Root (Reduction %)	Number of galls Gall diameter ≥ 4 mm	< 4-2 mm	< 2 mm	Root Gall - Index
Healthy plants (Control)	8.09 a	7.87 a	0.00 d	0.00 c	0.00	0.00	0.00	0.0
M.incognita alone	3.47 e	4.13 d	43.33 a	38.67 a	2.33 a	24.00 a	17.00a	3.6
M.incognita + Bio-zeid	4.25 d (22.47)	4.51 cd (9.20)	38.00 a (12.30)	37.33 ab (3.46)	1.67 ab	13.00d	9.00 b	2.6
M.incognita + Nemex	5.21 c (50.14)	4.55 cd (10.16)	27.00 b (37.68)	31.67 ab (18.10)	1.33 b	19.33b	8.00 b	3.0
M.incognita + Chicken manure	6.13 b (76.65)	6.19 b (49.87)	20.67 bc (52.29)	27.00 ab (30.17)	1.67 ab	17.33 c	4.67 c	2.6
M.incognita + Goat manure	6.22 b (79.25)	5.43 bc (31.47)	22.00 b (49.22)	30.67 ab (20.68)	0.00 c	14.33 d	7.67 b	2.6
M.incognita + Oxamyl	6.84 b (97.11)	7.27 a (76.02)	12.67 c (70.75)	25.67 b (33.61)	0.00 c	10.33 e	2.33 c	2 .0

Same letter (s) in each column indicate no significant difference ($P \leq 0.05$) between treatments according to Duncan's multiple range test.

$$\text{Increase } (\%) = \frac{\text{Treated - Control}}{\text{Control}} \times 100 \qquad \text{Reduction } (\%) = \frac{\text{Control - Treated}}{\text{Control}} \times 100$$

Root-knot index (RGI) or eggmasses index (EI) : 0 = No galling r; 1 = 1-2 galls; 2 = 3 - 10 galls; 3 = 11 - 30 galls; 4 = 31-100 galls and 5 = more than 100 galls (Taylor and Sasser, 1978).

Results in Table (4) showed that oxamyl significantly had high effect which recorded 50.74 % reduction in root galling followed by chicken manure (28.36 %) and goat manure (23.88 %). The least percentage reduction of root galling was recorded with bio-zeid treated plants (13.43%). Percentages of reduction in egg-masses could be arranged in ascending order as follows: bio-zeid (10.06 %), nemex (14.77%), goat manure (16.79 %), chicken manure (27.52 %) and oxamyl (41.61 %). The curative application of oxamyl, chicken and goat manures significantly reduced gall formation and egg mass production of *M. incognita* in watermelon cv. Mloky with root galling 2.6, 3.6 and 4.0, respectively. Also, oxamyl have the highest effect to diminish root gall diameter followed by goat and chicken manures. Number of galls (diameter ≥ 4 mm) significantly decreased to reach 0.00, 0.33 and 1.00 with oxamyl, goat and chicken manures, respectively.

Regarding to plant growth, root knot nematode, *M. incognita* caused remarkable reduction in root fresh weight (52.73%) and fresh shoot weight (55.19%) of watermelon cv. Mloky as compared to healthy plants. However, application with oxamyl, animal manures and biopesticides improved root condition and significantly promoted the growth of plants compared with the control. Oxamyl recorded significant variations in root galling which indicated root damage and fresh shoot weight which indicated improvement in plants growth response as compared to biopesticides.

Table 4. Effect of two biopesticides and two animal manures compared to oxamyl on root-knot nematode , *M. incognita* infecting watermelon (*Citrullus lanatus*) cv. Mloky plants.

Treatments	Fresh root weight (g) (Increase %)	Fresh shoot weight (g) (Increase %)	Root galls (Reduction %)	Egg masses /Root (Reduction %)	Number of galls Gall diameter ≥ 4 mm	< 4-2 mm	< 2 mm	Root Gall - Index
Healthy plants	7.13 a	9.53 a	0.00 e	0.00 d	0.00	0.00	0.00	0.0
M.incognita alone	3.37 e	4.27 d	44.67 a	49.67 a	2.67 a	26.00a	21.00a	4.0
M.incognita +Bio-zeid	4.63 d	6.10 c	38.67 b	44.67 ab	1.333b	23.67 b	13.67 bc	4.0
	(37.38)	(43.55)	(13.43)	(10.06)				
M.incognita + Nemex	5.39 cd	6.69 c	34.67 bc	42.33 ab	1.67 b	21.33 c	11.00 c	4.0
	(59.94)	(56.67)	(22.38)	(14.77)				
M.incognita + Chicken manure	6.47 b	7.55 c	32.00 c	36.00 bc	1.00bc	25.00ab	6.00 d	3.6
	(91.98)	(76.81)	(28.36)	(27.52)				
M.incognita + Goat manure	5.84 c	6.80 c	34.00 bc	41.33 ab	0.33cd	16.67d	17.67ab	4.0
	(73.29)	(59.25)	(23.88)	(16.79)				
M.incognita + Oxamyl	6.59 ab	8.23 b	22.00 d	29.00 c	0.00d	15.67d	6.33 d	2.6
	(96.43)	(92.74)	(50.74)	(41.61)				

Same letter (s) in each column indicate no significant difference ($P \leq 0.05$) between treatments according to Duncan's multiple range test.

$$\text{Increase } (\%) = \frac{\text{Treated - Control}}{\text{Control}} \times 100 \qquad \text{Reduction } (\%) = \frac{\text{Control - Treated}}{\text{Control}} \times 100$$

Root-knot index (RGI) or eggmasses index (EI) : 0 = No galling r; 1 = 1-2 galls; 2 = 3 - 10 galls; 3 = 11 - 30 galls; 4 = 31-100 galls and 5 = more than 100 galls (Taylor and Sasser, 1978).

DISCUSSION

The traditional methods used to protect cucurbit crops from plant–parasitic nematodes especially , (root knot nematode, M. incognita) , mostly, have been based on the use of chemicals pesticides which not economical in the long run, in addition to polluting the air, soil, and environment (Naseby *et al.*, 2000). Therefore, biopesticides and animal manures have been evaluated as alternative to the use chemical pesticides for their effectiveness in suppressing root knot nematode and environmental friendliness .

On the other hand, in tropical countries, these vegetables are usually susceptible to nematode attack and their production depends on the correct management of these pathogens (Sikora & Fernandez, 2005). So, Egyptian cucumber yields are facing great competition with Mediterranean basin being the largest production area since the root-knot nematodes, Meloidogyne spp., are becoming real threats to almost all vegetable crops (Ibrahim , 2011). In this aspect, the main objective of this paper was to compare the effect of chicken manure, goat manure and nemex and bio-zeid as bipesticide in comparison with oxamyl .

Different biological agents are used such as bacteria and fungi (Siddiqui *et al.*, 2000; Goswami and Mittal, 2004). Regarding to effect of biopesticides bio-zeid (Trichoderma album), all Trichoderma spp. have also been described as biocontrol agents against root knot nematode, Meloidogyne spp. and provided significant inhibition of nematode reproduction, suppression of root galling in tomato plants (Affokpon *et al.* ,2011). Mascarin *et al.*, 2012 concluded that the fungus T. harzianum did not increase the fresh and dry root weight of cucumber plants. However, it was a good material in IPM program to protected cultivation of cucumbers from root-knot nematode, M. incognita .

The present results are in agreement with those reported by many authors who tested biopesticides against Meloidogyne javanica in vitro and in vivo assays (Sharon *et al.*, 2001; Goswami and Mittal, 2004; Goswami *et al.*, 2006 ; Yankova *et al.*, 2014) .

Our results proved that, oxamyl was the best treatment followed by chicken manure and goat manure while the bio-zeid (T. album) was the least effective treatment. Oxamyl also has remarkable percentage reduction in root galls and egg masses of root knot nematode, M. incognita. For plant growth, root condition was improved with four types of treatments (bio-zeid, chicken manure, goat manure and oxamyl) compared to control. However, insignificant variations in shoot fresh weight were detected between oxamyl and manures when chicken and goat manures were used at rate 3g/plant and significantly ($P \leq 0.05$) reduced gall formation and egg mass production of M. incognita .

Many authors well documented the successful control by amending soil with chicken and goat manures against root-knot nematodes (Chindo and Khan, 1990; Kaplan and Noe, 1993; Riegel *et al.*, 1996; Akhtar, 1997; Oka *et al.*, 2000; D'Addabbo *et al.*, 2003; Lopez-Pérez *et al.*, 2005; Karmani *et al.*, 2011 and Tanimola & Akarekor, 2014). The mode of action of chicken manure is thought to be based on the release of toxic levels of ammonium, although alterations in soil structure, the stimulation of antagonistic organisms, and improved plant tolerance also may play a role (Lazarovits *et al.*, 2001 and Lopez-Pérez *et al.*, 2005).

Abdel-Dayem *et al.*, (2012) showed that the lowest root gall index of the nematode was achieved with chicken manure treatment and had a toxic effect on M. incognita by release the high amount of ammonium. The effectiveness of chicken manure depends on neutral pH, a high N content and a narrow C/N ratio (C/N=5.6). The nematicidal effect of organic manures on plant parasitic nematodes could be attributed to many factors. Among which direct affects of chemicals produces during manure decomposition such as ammonia, hydrogen sulphide , methan, fatty acids with low molecular weight like acetic , propionic , dimethlamine , trimethyamine and butric acids as well as phenols (Oka *et al* , 2000). Tanimola and Akarekor (2014) revealed that animal manures like poultry and goat manures have been successful tools for controlling root knot nematode, M. incognita and increase crop yield of cucumber plants therefore, may be used in place of oxamyl.

In conclusion, chicken and goat manures could be used to increase cucurbit yield and for controlling root knot nematode, M. incognita. However, further studies are needed under greenhouse and field conditions.

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تأثير استخدام بعض الأسمدة الحيوانية والمبيدات الحيوية كمبيدات نيماتودية في مكافحة نيماتودا *Meloidogyne incognita* التي تصيب نباتات العائلة القرعية تحت ظروف الصوبة

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أجريت تجربة تحت ظروف الصوبة لتقييم الأسمدة الحيوانية للدجاج والماعز, والمبيدات الحيوية مثل مبيد البيوزيد bio-zeid والنيمكس nemex كمبيدات نيماتودية ضد نيماتودا *Meloidogyne incognita* التي تصيب ثلاثة من النباتات القرعية مقارنة مع مبيد الأوكساميل oxamyl. نفذت التجربة على النباتات القرعية التالية الخيار (*Cucumis sativus* L.) صنف Biet والكوسة (قرع الكوسة) (*Cucurbita pepo* L.) صنف *Escandrany* وصنفين من البطيخ *Citrullus lanatus* هما Alpha و Master و Mloky . بصفة عامة ، أشارت النتائج أن من بين الخمسة مواد المختبرة ، كان الأوكساميل وسمادى الدجاج والماعز هم الأكثر فاعلية في خفض كل من العقد المتكونة على الجذر وعدد كتل البيض التي تكونها نيماتودا *M.incognita* على نباتات القرعيات المصابة. ولقد أظهر كل من الأوكساميل (69.22 %) ، سمادى الدجاج (60.98 %) والماعز (56.60 %) أفضل أداء في خفض العقد الجذرية المتكونة على نباتات الخيار عن تلك المتكونة على نباتات الكوسة. ومن بين صنفي البطيخ المختبرة ، كان الأوكساميل أعلى تأثيرا فى خفض العقد الجذرية بنسبة (70.75 %) يليه سماد الدجاج (52.29 %) ثم سماد الماعز (49.22 %) على الصنف Master عن نسب الخفض في العقد الجذرية المتكونة على الصنف Mloky والتي كانت 50.74 % ، 28.36 % و 23.88 % على التوالي. من ناحية أخرى، أعطت كل المعاملات تحسن معنوي ($P \le 0.05$) في نمو نباتات القرعيات. ووصلت أقصى نسبة مئوية للزيادة فى الوزن الطازج للمجموع الخضرى في نباتات الخيار (93.30; 74.76 %) ثم على نباتات البطيخ صنف Mloky (92.74 ; 76.81 %) في الأصص المعاملة بكل من الأوكساميل وسماد الدجاج على التوالي. وبصفة عامة، انخفض عدد العقد النيماتودية الأقل من 2 مم (< 2 mm) معنويا مع المعاملة بالأوكساميل وسماد الدجاج والماعز في الأنواع النباتية الثلاثة المختبرة. تظهر النتائج أن سمادى الدواجن والماعز يمكن استخدامهما لزيادة الناتج المحصولي لنباتات القرعيات ولمكافحة نيماتودا تعقد الجذور *M.incognita* .