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Biological Control of Root-Knot Nematode, *Meloidogyne Incognita* on Cucumber

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ABSTRACT

The current study supported the possibility of nematode control by using some of non-chemical control which gave a very promising results especially when compared with the chemical compounds. Soil amendments with an additive plant materials considered strategy for improving the properties of the soil were used as dried leaves from resistant plants; *Eucalyptus globules*, *Tagetes erecta*, and *Allium sativum* which were found reduced significantly the nematode population of *Meloidogyne incognita* on cucumber plants by (86.3, 85.0, 84.6%) . Results showed also that all bio-agents treatments of fungi *Artrobotrys oligospora* , *Paecilomyces lilacinus, Glomus faciculatum* and antagonistic plants were significantly reduced *M. incognita* in soil and on cucumber roots. The highest effect on *M. incognita* in soil and on cucumber plants with the tested fungi ,*G.faciculatum* ,*A.oligospora* and *P.lilacinus* reached to (87.7, 85.4 and 84.5%) respectively using the highest concentrations. *Eucalyptus globules* and *Allium sativum* were most effective in reduction the nematodes population of *M. incognita* in soil and on cucumber roots by (86.3, 85.1%). Several antagonistic fungi are known to destroy the eggs of *M.incognita* such *P.lilacinus, A.oligospora* ,and *G. faciculatum* when added to the plants together were more effective against nematodes population than each treatment separately. All the treatments were induced remarkable improvement in plants growth parameters of cucumber. The highest length of shoot and increase in fresh weight of whole cucumber plants by (75.9,73.8%) . was associated with the two combinations of *G.faciculatium* plus *E.globules* and *A.oligospora* plus *A.sativum*

Keywords: Root-knot nematode, *Meloidogyne incognita, Paecilomyces lilacinus, Arthrobotrys oligospora, Glomus faciculatum, Eucalyptus globules*, and Fenamiphos (10%G.)

INTRODUCTION

Cucumber "*Cucumis sativus L"* is the most important tropical vegetable crop widely used throughout the world. In recent years, root-knot nematodes,*Meloidogyne* spp. have become specific for cucumber cultivation. The previous survey study revealed that root-knot nematode *Meloidogyne* spp, was the common nematode infection on cucumber in Egypt. This problem is one of the most determined factors of productivity of cucumber. The present study supported the possibility of nematode control by using some of non-chemical which gave a very promising results in this concern, especially when compared with the other chemical compounds. Use of antagonistic plants and biological control as an additive material to the soil .All microorganisms may be having on adversely affect against the parasitic nematode. However, the indiscriminate use of chemical pesticides causes great harm to human, animals, vegetation and to the environment. Plant parasitic nematodes and soil-borne pathogens also attack a wide range of vegetables, and reducing cucumber yield quality and quantity. The root–knot nematodes , *Meloidogyne* spp. is one of the most important pests. Cucumber was

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subjected to the infection with root–knot nematode which decrease yield by 40% or more under Egyptian conditions. **Ali *et al.*, (2012**) showed that maximum reduction of root-knot nematode on chickpea and cucumber which were recorded with *P. lilacinus ,A.oligospora* comparing with control. Also they found that the best crop growth was found with *P.lilacinus ,A.oligospora* **Sharma *et al*., (2009)** they tested the efficacy of fungi *P. lilacinus* flavor on the biological control of *M. incognita* on okra. They revealed that application of biological control enhanced plant growth characteristics. Also, they noticed that garlic was more toxic to nematodes on tomato and cucumber. **khalil and Shawky (2008)** research revealed that the nematicidal compound (alpha-tertheinyl) is only released by active, living marigold roots. Also they recorded the highest nemaicidal activity of *T. erecta*. The aim of the present study is the control of *M. incognita* infecting cucumber and increase the yields.

MATERIALS AND METHODS

1- Efficacy of some bio-agents and antagonistic plants on the nematodes population of *M. incognita* infecting cucumber roots.

Pure culture of the three microorganisms *Glomus faciculatum, Arthrobotys oligospora* and *Paecilomyces lilacinus* were obtained from the water and Environment Res. Inst., Agricultural Research center Giza, Egypt., Fungi of *G. faciculatum* was added as rate 5,10,15 spores /plant, *A.oligospora* and *P.lilacinus* were added by three concentrations at rates ($1x10^6$,$1x10^8$,$5x10^8$spores/ ml sterilized water) to each pot. Each pot filled with steam sterilized sandy loam soil. Cucumber seedlings two weeks aged were transplanted individually in 25cm. diameter clay pots. After two weeks of cultivation each pot was inoculated with 3000 newly hatched larvae of *M. incognita* around the cucumber roots. The plants *Tagetes erecta, Eucalypyus globules* and *Allium sativum*. were powdered and added with the rate of (20 g. /plant). Each treatment replicated four times and four pots were infected with *M. incognita* (check) and other four pots were left as cucumber plants alone (control). Other four pots were treated with nematicide Fenamiphos (10%G) at rate 0.4g./pot. All pots were arranged in complete and randomize design and kept under greenhouse conditions at about 25-28C$^{\circ}$. After 60 days from inoculation the experiment ended. All plants were carefully uprooted , fresh root and shoot systems were weighted. Roots were stained by acid fuchsine in acetic acid according to **Byrd *et al.*, (1983)** On the other hand, number of second stage juveniles in soil per pot were extracted by sieving modified Baerman technique **(Goodey,1957)**, number of developmental stages, number of females/root, number of galls and number of egg-masses/roots of cucumber were counted by using sodium hypochlorite (NaOCl) Root gall index (RGI) was rated on a scale of 0-5 where: 0= no galls or egg masses, 1= 1-2, 2= 3-10, 3= 11- 30, 4= 31-100 and 5= more than 100 galls or egg masses.

Taylor and sasser (1978).

Final nematodes population (Pf) = (No. of egg-masses x no. of eggs/egg-mass) +No. of females +No. of developmental stages + No. of juveniles/250gr.soil

The treatments were as follows**:-**

1- *P. lilacinus*+ nematodes
2 – *A. oligospora* +nematodes
3- *G. faciculatum* +nematodes
-
5–*T.erecta*+nematodes .

6- *E.globules* +nematodes

7-Fenamiphos+nematodes .

8- Check (nematodes alone) .

.

9- Cucumber plant alone (control).

2- Effect some combinations of bio-agents and antagonistic plants for controlling *M . incognita* infecting cucumber roots.

Three bio-agents are *Paecilomyces lilacinus*, *Arthrobotrys oligospora,* at concentration ($5x10^8$ spores/ml water/plant) and *Glomus faciculatum* at rate (15g. spores/plant) mixed with dried leaves powder of the three plants, Camphor (*E. globules*) and Marigold (*T.erecta*) and dried cloves of garlic (*A. sativum*) at rate (20g./plant)and nematicide Fenamiphos (10%G) was used at rate (0.4g. /pot). Each pot filled with steam sterilized sandy loam soil and cucumber seedlings *cv. Celebrity* two weeks aged were transplanted individually in 25cm. diameter clay pots. After Two weeks of cultivation each pot was inoculated with 3000 newly hatched larvae of *M. incognita* in three holesaround the cucumber roots. Each treatment replicated four times and four pots were infected by *M. incognita* (check) and other four pots were left as cucumber plants alone (control). All pots were arranged and kept under greenhouse conditions 25-28°C. Sixty days after inoculation, all plants were carefully uprooted and fresh root and shoot systems were weighted as mention before. This work was undertaken in the greenhouse of Nematology Research Department, Plant Pathology Research Institute, Agricultural Research Center, Giza Egypt.

The treatments were as follows**:** -

1- T.erecta +A.oligospora

2 - *T. e rc eta + G. faciculatum*

3- *T. erecta + P. lilacinus*

4 - *A .sativum+ A.oligospora*

5- *A. sativum + G. faciculatum*

6- *A.sativum + P. lilacinus*

7- *E. globules+P.lilacinus*

8- *E .globules+ A.oligospora*

9 - *E. globules + G. faciculatum*

10- Fenamiphos

11– Check (nematode alone) .

12- Control (cucumber plant alone)

Statistical analysis procedure:

All obtained data were subjected to statistical analysis according to the procedures (ANOVA) and regression coefficient analyses were performed by WASP-web Agri. Stat. Package statistical analysis software. Treatment means were separated using Duncan's multiple range test (Duncan,1955). All analyses were conducted at the Significance value of $P<0.05$.

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RESULTS

1- Efficacy of some bio-agents and antagonistic plants on the nematodes population of *M. incognita* infecting cucumber roots.

Data in Table (1) revealed that all tested treatments of bio-agents fungi ,*Paecilomyces lilacinus, Arthrobotrys oligospora*,and dried powdered leaves of antagonistic plants*;Tagetes erecta, Eucalyptus globules* and dried garlic cloves of *Allium sativum* were effective to control of root-knot nematodes,*M. incognita* on cucumber plants variety *Celebrity*. Results showed all bio-agents of fungi and antagonistic plants were significantly reduced the total nematodes population of *M.incognita* in soil and on cucumber roots when compared with check. All treatments reduced total population of *M. incognita* in soil and on cucumber roots ranged from (987 to 632 /250g.soil) reduced by (80.2 to 87.7%) when comparing with check. The treatments of *A. oligospora* (5x10^8 spores /ml) and *A.sativum (*20g./plant) were reduced the population of *M. incognita* reached to (86.3 ,87.7 %) and the least in total number of nematode by (683 ,632/ 250g.soil) respectively compared with other treatments and check.The highest concentration of the mixed fungi reduced the population of *M.incognita* in soil and on the cucumber roots comping with check treatment .Also,treatment with Fenamiphos reduced the population in soil to 243/250g.soil compring with check .The treatments of *A.oligospora* by (5x10^8 spores/ml) and *A.sativum* were the highest effective in reducing number of galls by (67.0 , 64.9 %) .Also the treatments of anagonsitic plants and fungi were caused significant reduction in number of egg-masses per cucumber roots between (54.4 to 75.2 %) . Then *T.erecta* and *A.oligospora* (5x10^8 spores/ml) were the highest effective in reducing number of egg-masses per cucumber roots by(64.7 and 75.2 %) respectively when compared with other treatments .While the nematicide Fenamiphos caused the highest reduction in number of galls per cucumber roots reached to 90.0% and egg-masses /cucumber root 87.8% when compared with check. The fungi treatments effective in reduction nematodes of *M.incognita* in soil and on cucumber plants with highest the concentration Data in Table (2) showed that all the treatments of the tested bio-gents and anagonsitic plants were caused significant increase in growth parameter of the cucumber plants when compared with check. All the treatments were induced remarkable improvement in plants growth parameters of cucumber.Also all the treatments were caused an increase in cucumber shoot length from (74.2 to 80.5%). The tested treatments of *G.faciculatum* (15g.spores/plant) ,*T.erecta* and *A.sativum* achieved the highest increase in shoot length by (128, 126 and 123cm.) and increase by (80.5, 80.2,79.6%) respectively when compared with check.While the nematicide of Fenamiphos had increased in shoot length (106cm.) and increase by 74.4%when compared with check. Data revealed that all treatments were significantly an increased the total fresh weight of the whole cucumber plants. The treatments of *G.faciculatum* (15g.spores/plant) and *T.erecta* had the highest increase in total fresh weight of the whole cucumber plants (26.9 and27.5g.) and increase by (79.5 and 80.0 %) respectively when compared with check. While other treatments had increase in fresh weight of the whole cucumber plants from (26.0 to19.5g.) and increased by (71.8 to79.1%) . While the treatment of Fenamiphos had increased the fresh weight of the whole cucumber plants to (19.4g).Shown Table (1&2) and Figure (1). .

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Table 1 .Influence of some bio-agents and antagonistic plants on nematodes population of *M. incognita* infecting on cucumber plants under greenhouses conditions.

Treatments	Concentration	Nematode population				**No. galls/ roots**	**Reduction %**	**RGL**	**No.eeg-masses/ root**	**Reduction%**
		No.nemato de in250g. soil/pot	**No. females +Deveplm antal stage**	**Total**	**Reduction %**					
P.lilacinus	$1x10^6$spores/ml	440b	547^b	987^b	80.2	367^b	52.7	5	378^c	55.2
	$1x10^8$ spores/ml	415^c	530^c	945^c	81.1	356^c	54.1	5	364^d	56.9
	$5x10^8$ spores/ml	349^f	423^h	772^g	84.5	342^d	55.9	5	354^e	58.1
A.oligospora	$1x10^6$ spores /ml	360^e	481^d	861^d	82.8	282^h	63.6	5	385^b	54.4
	$1x10^8$ spores/ml	315^i	417^h	732^h	83.9	264^i	65.9	5	368^d	56.4
	$5x10^8$spores/ml	226^i	406i	632^j	87.7	256^j	67.0	5	209^j	75.2
G. faciculatum	5g . spores	357^e	464^e	821^e	83.6	322^e	58.5	5	343^f	59.2
	10 g. spores	352^e	456^f	808^f	84.6	313^f	59.6	5	324^g	61.6
	15g. spores	323^h	447^g	770^g	85.4	275^k	63.5	5	318^h	62.3
A. sativum	20g./plant	308^h	375^j	683^i	86.3	280^k	64.9	5	313^h	63.9
T. erecta	20g./plant	336^g	397i	733^h	84.6	294^g	62.1	5	298^i	64.7
E. globules	20g./plant	384^d	380j	864^d	85.1	328^e	57.7	5	341^f	60.0
Fenamiphos	0.4g./pot	122^j	121^k	243^k	95.1	71^l	90.0	4	103^k	87.8
Check	--------	2843^a	2164^a	5007^a	----	776^a	-----		845^a	-----

Each value presented the mean of four replicates . .
Mean in each column followed by the same letters did not differ at (P< 0.50) according to Duncan's multiple range test

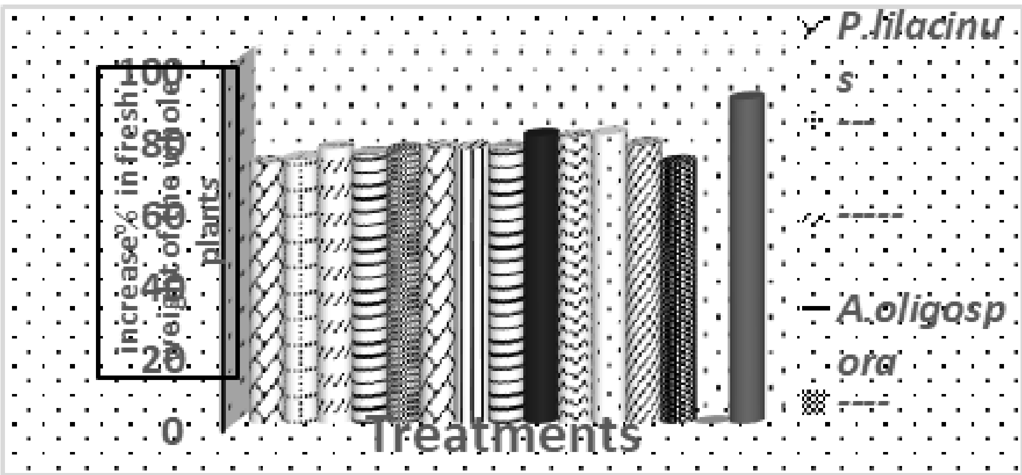

Figure (1). Effect some bio- gents and antagonistic plants on growth parameter of cucumber plants infected by *M. incognita* .

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2- Combination efficiency of bio-agents and antagonistic plants on nematodes of *M .incognita* infecting cucumber under greenhouse conditions.

Data in Table (3) showed the effect of different combination as fungi *A. oligospora* , *P. lilacinus* (5x10^8 spores /ml) ,*G. faciculatum* (15g.spores/plant) and powdered leaves of *T. erecta*, *E. globules* and *A. sativum* (20 g./plant) were tested against the root-knot nematodes , *M. incognita* on cucumber roots. Data revealed that all treatments were significantly reduced the total nematodes population of *M. incognita* in soil, number of galls and number of egg-masse on cucumber roots when comparing with check. All treatments reduced the total nematodes population of *M. incognita* in soil and on roots of cucumber ranged from (224 to156 /250g.soil) and reduce by (95.7 to 97.0%). Also number of galls was reduced from (73to 52 galls/cucumber roots) and reduce by (93.2 to 90.4 %) and number of egg-masses /root system from (80 to 46) and reduce by (94.7 to90.8%). Datarevealed that the highest reduced in nematodes population of *M. incognita* in soil and on roots of cucumber with the combination of *T. erecta* plus *A. oligospora* were reduce by 97.0%. The number of galls were (52galls /roots system) reduced by 93.2. % while with combination of *E. globules* plus *G.faciculatum* were the lest reduced in nematodes population by 95.7% , the number of galls were (57galls /roots system) reduced by 92.5. when compared with check. While the highest reduced in number of egg-masses with the combination of. *sativum* and *A. oligospora* were (46 egg-masses / cucumber roots) and reduced 94.7%. while the combination *E. globules* plus *A. oligospora* were (80 egg-masses / cucumber root) and reduced by 90.8% when compared with check. The nematicide Fenamiphos (10%G) recorded the highest of reduction in nematodes population of *M. incognita* in soil and on cucumber roots were recorded (30/250g.) and percent reduced by 98.4 %. While number of galls /cucumber root were (13 galls /cucumber root) reduce by 98.3% and (10 egg-masses / cucumber root) reduced by 98.8 % when compared with other treatments and check. Data in Table (4) showed that the combination of antagonistic plants and bio–agents were caused significant increase in growth parameters of cucumber when compared with check. The increase in length of cucumber shoot was associated with the treatments combinations from (120 to 137 cm.) and increase by (72.3 to76.6%) .The highest increase in fresh weight of the whole cucumber plants with the treatments *G. faciculatium* plus *E. globules* and *A. oligospora* plus *E.globules* were (51.3, 54.0g) and increase by (75.9 and74.6 %) respectively when compared with other treatment and check .While other treatments of combinations caused increase in fresh weight of the whole cucumberplants ranged from (38.0 to 49.7g.) and increase (73.8 to 65.7%).The treatment of nematicide Fenamiphos had increase in shoot length of cucumber plants reached to (113cm.) and increase by 71.7 while increase in the fresh weight of the whole cucumber plants reached to (37.0g.) and increase by 64.8 %when compared with other treatment and check. Shown Table (3&4) and Figure (2).

Table 2. Effect some bio -gents and antagonistic plants on growth parameter of cucumber plants infected by *M. incognita* under greenhouse conditions.

Treatments	Concentration	Plant growth response					Fresh weight of the whole plant	Increase %
		Length(cm.)			Weight (g.)			
		Shoot	Increase %	Root	Shoot	Root		
P.lilacinus	$1x10^{6}$ spores/ml	98^{f}	74.5	6.4^{e}	16.5^{e}	3.0^{f}	19.5^{d}	71.8
	$1x10^{8}$ spores/ ml	103^{e}	75.7	6.8^{e}	17.0^{d}	3.5^{f}	20.5^{d}	73.1
	$5x10^{8}$ spores/ml	108^{d}	76.8	7.9^{c}	18.5^{c}	4.5^{e}	23.0^{c}	76.0
A. oligospora	$1x10^{6}$ spores/ml	105^{e}	76.1	7.0	17.5^{d}	4.0^{e}	21.5^{c}	74.4
	$1x10^{8}$spores/ml	110^{d}	77.2	7.6	18.0^{c}	4.5^{e}	22.5^{c}	75.5
	$5x10^{8}$spores//ml	114^{d}	78.1	8.[illegible]	19.7^{b}	5.6^{d}	25.3^{c}	76.3
G. faciculatum	5 gr. spores	97^{e}	74.2	8.1	18.4^{c}	5.8^{d}	23.2^{e}	75.9
	10 gr. spores	124^{b}	79.8	8.7^{c}	18.7^{b}	6.5^{d}	25.2^{c}	76.2
	15gr. spores	128^{b}	80.5	9.5^{b}	19.5^{b}	7.4^{c}	26.9^{b}	79.5
A.sativum	20gr.//plant	123^{b}	79.6	9.4^{b}	18.6^{c}	7.8^{bc}	26.4^{b}	79.1
T.erecta	20gr./plant	126^{b}	80.2	9.7^{b}	19.0^{b}	8.5^{b}	27.5^{b}	80.0
E.globules	20gr./plant	120^{c}	79.2	7.4^{c}	17.6^{d}	6.6^{d}	24.2^{c}	77.3
Fenamiphos	0.4gr./pot	106^{e}	74.4	5.7^{e}	14.5^{f}	4.9^{e}	19.4^{d}	71.6
Check		25^{g}	----	3.1^{f}	4.5^{g}	2.0^{g}	5.5^{e}	----
Control		137^{a}	81.7	11.7^{a}	44.0^{a}	9.0^{a}	53.0^{a}	84.8

Each value presented the mean of four replicates . . Mean in each column followed by the same letters did not differ at (P< 0.50) according to Duncan' multiple range test.

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Table3. combination efficiency of bio-agents and antagonistic plants on nematodes population , *M. incognita* infecting on cucumber plants under greenhouse conductions.

Each value presented the mean of four replicates.   .

Treatments	Nematode population			**Red% of final nematode population**	**No. galls/root**	**RGl**	**Reduction %**	**No.Egg masses/ roots**	**Reduction%**
	No.of nematode in250g. soil	**No . of females+ developmental stage eve/root**	**Final nematode population (Pf)**						
T. erecta + P. lilacinus	87^{e}	82^{d}	169^{fg}	96.7	73^{b}	4	90.4	70^{c}	91.9
T. erecta + A. oligospora	77^{f}	79^{e}	156^{g}	97.0	52de	4	93.2	49^{g}	94.4
T. erecta + G. faciculatum	90de	83^{d}	173^{f}	96.7	67^{b}	4	91.2	63^{d}	92.7
A .Sativum + P.lilacinus	95^{d}	85^{d}	180^{e}	96.5	69^{b}	4	91.0	67^{cd}	92.3
A. Sativum+ A.oligospora	85^{e}	75^{e}	160^{g}	96.9	53^{d}	4	93.0	46^{g}	94.7
A. Sativum + G. faciculatum	110^{c}	95^{c}	205^{d}	96.1	57^{d}	4	92.0	51^{f}	94.1
E.globules + P. lilacinus	114^{b}	100^{c}	214^{c}	95.9	63^{c}	4	91.5	58^{e}	93.3
E. globules + A. oligospora	93^{d}	96^{c}	189^{d}	96.4	65^{c}	4	92.0	80^{b}	90.8
E .globules+ G . faciculatum	117^{b}	107^{b}	224^{b}	95.7	57^{d}	4	92.5	53^{f}	93.9
Fenamiphos	13^{g}	17^{f}	30^{h}	98.4	13^{e}	2	98.3	10^{h}	98.8
Check	3150^{a}	2127^{a}	5277^{a}	-----	768^{a}	5	-----	870^{a}	----

Mean in each column followed by the same letters did not differ at (P< 0.50) according to Duncan' multiple range test.

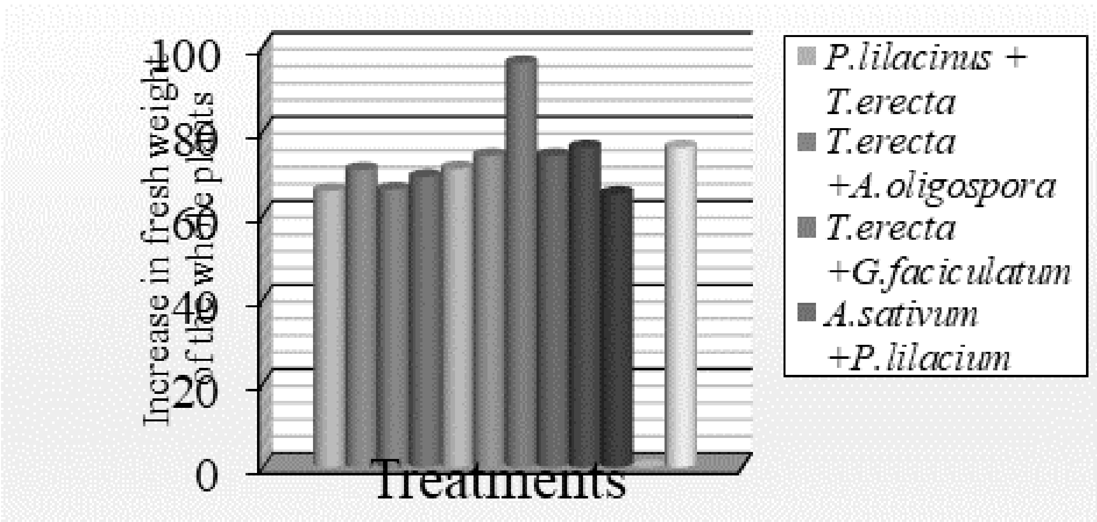

Fig. (2). combination efficiency of bio-agents and antagonistic plants on growth parameters of cucumber infected with *M. incognita* .

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Table 4. combination efficiency of bio-agents and antagonistic plants on growth parameters of cucumber infected with *M. incognita* under greenhouse conductions .

Mean in each column followed by the same letters did not differ at (P< 0.50) according to Duncan's multiple rang test.

Treatments	The plant growth response						**Increase %**
	Length(cm.)			Weight (g.)		Fresh weight of the whole plant	
	Shoot	Increase %	Root	Shoot	Root		
T. erecta + P. lilacinus	130^{b}	75.3	10.0^{b}	30.0^{d}	8.0^{b}	38.0^{d}	65.7
T. erecta +A .oligospora	137^{a}	76.6	9.1^{c}	35.0^{c}	8.5b	44.5^{bc}	70.7
T. erecta + G. faciculatum	124^{b}	74.2	11.2^{a}	32.0^{b}	6.7^{d}	38.7^{c}	66.4
A. sativum + P. lilacinus	120^{c}	72.3	10.5^{b}	35.0^{b}	7.7^{b}	42.7^{b}	69.5
A.sativum + A oligospora	125^{b}	74.4	9.0^{c}	41.0^{a}	8.7^{ab}	49.7^{ab}	73.8
A. sativum +G. faciculatum	135^{a}	76.3	10.0^{b}	37.0^{b}	8.0^{b}	45.0^{b}	71.1
E . globules + P. lilacinus	127^{b}	74.8	9.4^{c}	30.0^{c}	9.0^{a}	39.0^{c}	66.6
E. globules +A. oligospora	133^{a}	75.9	10.0^{b}	42.0^{a}	9.3^{a}	51.3^{a}	74.6
E. globules + G. fasciculate	137^{a}	76.6	11.0^{a}	45.0^{a}	9.4^{a}	54.0^{a}	75.9
Fenamiphos	113^{d}	71.7	8.0^{d}	31.0^{bc}	6.0^{d}	37.0^{c}	64.8
Check	32^{e}	-----	4.0^{e}	11.0^{d}	2.0^{e}	13.0^{d}	------
Control	138^{a}	76.8	11.7^{a}	46.0^{a}	9.0^{a}	55.0^{a}	76.3

DISCUSION

Root- knot nematodes, *M. incognita* has become a determinant of cucumber production throughout of the world wide (Sikora and Fenandez,2005) causing damage of about hundred billion dollars all over the world (Oka *et.al* ,2000). The successive management are those of the low cost and efficient in controlling plant parasitic nematodes but programs require the provision of many information such as nematodes population, resistant cultivars and environmental factors.

1-The tested treatments of *E. globules* and *A.sativum* were most effective in reduction the nematodes population of *M. incognita* in soil and on cucumber roots El Gendy and Showky (2006) showed that *Allium sativum* leaf extract has been successfully used to control *M. incognita* at high concentrations in laboratory conditions. Garlic has indirect effects on nematode populations because it disrupts their mobility and reproduction, Garlic *(A.sativum)* contain (Allyl sulfide, Methyl disulfide, Propyl sulphide and Allicin.) Marigolds and Garlic oil are two known sources of biological control. Also showed the effectiveness from the plant species *Eucalyptus* spp. significantly reduced nematode multiplication and gall formation on tomato roots. *Eucalyptus* leaves contain volatile oil contain (Pinene, Phellendrene, Terpincol Citronella, Piperitone, Astringents and bitter princills) showed that *Eucalyptus* spp. were highly toxicity against the juveniles (J_2) of *Meloidogyne* spp.. The treatments of fungi *A.oligospora* and *P.lilacinus* and

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G.faciculatum with the highest concentration were most effective in reducing the nematodes population and reproduction on cucumber roots the tested fungi produce mycotoxins therefor the treatments fungi affect the nematodes and their reproduction, but the effect varies according to the type and concentration of the treatment and the number of nematodes in the soil and on cucumber plants the tested fungi produce mycotoxins these result agreements with El-Hamawi *et al*.,(2004) and Amin *et al.*(2012).Lopez-Perez *et al*., (2016) *Tagetes* species which exude polythienyls have been proven to be nematicidal. *T. erecta* is capable of suppressing a wide range (up to 14genera) of nematode pests in the soil and development on the roots of plants. Also the data showed that the treatments of bio-gents and antagonistic plants were caused significant increase in growth parameter of cucumber plants were with highest the concentration. The dried leaves of *T.erecta,* ,*A.sativum* and *G. faciculatum* achieved the highest increase in shoot length and the total fresh weight of cucumber plants. These result agreement with Renco M.(2013).Application of *A.oligospora* as an environment eco-friendly bio-control agent against root-knot nematodes in crop production have the ability to produce antibiotics and phytoalexins. *Arthrobotrys* species are trapping fungi which immobilize nematode by using non-adhesive knobs and constricting rings. There are possibilities for biological control of nematodes by selecting effective strains of *mycorrhizal* fungi and root- nodule bacteria, globules The camphor contain of toxic compounds which produced during the decomposition of such materiales in the soil against plant parasitic nematodes **.** The effectiveness of garlic extract (*Allium* spp.) against a range of plant pathogenic organisms because Ally sulfide, Methyl disulfide, Propyl sulphide and Allicin. These results are agreement with Bekhiet *et al.*,(2004) , Baimey *et al*., (2015), Neher (2010)and El-Deriny (2016).

2- The tested treatments of combination antagonistic plants and bio–agents were significantly in reduced the nematodes population of *M. incognita* in soil and reduced number of galls and egg-masses on cucumber roots these result agreements with Khalil. and Samaa (2008**)** cited that the treatments of *Glomus fasciculatum* and *Tagetes* spp. reduced root galling of *M .incognita* on crops. All the treatments of combination antagonist plants and bio–agents were caused significant increase in growth parameters of cucumber plants. The use of these two treatments together appears to be more beneficial for plant growth than their use individually. The highest length of shoot and increase in fresh weight of the whole cucumber plants was associated with the two combinations of *G.faciculatium* plus *A.sativum* and the treatment of *E.globules* plus *G.faciculatium* . fungi generally reduce the severity of nematode diseases of various crops Kesba (2003) showed that *G.faciculatum* increase soil nutrient and water absorption, beside fixing atmospheric nitrogen Talavera *et al*., (2001) The effectiveness of *Allium* sp. extract against a range of plant pathogenic organisms due to existence of (Ally sulfide, Methyl disulfide, Propyl sulphide and Allicin) .The allelopathic compounds from *T. erecta* suppress more efficiently if planted close to a nematode infected plant or nematodes colonized plant host. Treatments of biological control is considered the most relevant and least damaging approach as it is ecofriendly, economically viable and offers a sustainable and cost-effective alternative to chemical nematicides. The long-term protection of plants against root-knot nematodes and do not contain antifungals will be more effectively when the bio-control agents applied combined with other management strategies . These results are agreement with Sharma and Trived (2011), Verma (2006),Ansari *et al*.,(2016), Farag, *et al*.,(2013) and Sikora and Fernandez (2005) .

Conclusion:

The present study revealed that biological control gave very promising results for this concern. All these treatments of bio-agents and resistant plants decrease the nematode population o *M. incognita* on cucumber and retained to their nematicidal effects. The possibility of using this trend for integrated control of nematode. The treatments of bio-agents and resistant plants amendments improved the plants growth parameters. These methods are low cost, easy to apply and also have the ability to improve soil texture and fertility. Used these plant compounds and bio-agents to achieve safe and effective methods to control the root-knot nematodes

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