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Efficiency of some Bio and organic agents to control root knot nematode *Meloidogyne spp* on Cucumber plants *Cucumis Sativus*

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Key words:
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ABSTRACT

This study was conducted to evaluate the efficiency treatments namely the pesticide Tervigo 20SC and some bio control fungi *Trichoderma harazianum* , *Paecililomycis lilacinus* and Nematron formulation and pomegranate peel powder compared with nematicide Vydate10/L against root-knot nematode *Meloidogyne spp* under greenhouse conditions in September 2016 in Kirkuk governorate. The results showed efficiency of all treatments in reducing the symptoms of the root-knot nematode and improve the growth characteristics of cucumber, Tervigo was the superior in reducing root nodes and nematode population 61.37% and 80.48% compared with control treatment, while *T. harazianum* was the least 43.19% and 52.58% . The effect of bio control fungi and plant organic formulation were similar effective. All treatments positively contributed in improvement of shoot system for infected and non-infected plants, Nematron , pomegranate peel powder and Tervigo were achieved highest increase in plant length, Tervigo and Nematron were the superior in increase rate of fresh and dry shoot weight and weight of fruits resulting in 54.24 and 33.11% for non-infected plants and 345.45 and 311.91% respectively, for infected plants compared with control treatment. All treatments had a positive effect in increase root system length except, Vydate which had a negative effect by 0.46% , Which led to reduced fresh and dry root weight for infected plants, except Nematron, which increased the rate of fresh and dry root weight compared with control treatment .

فعالية بعض العوامل الحيوية والعضوية في مكافحة نيماتودا تعقد الجذور *Meloidogyne spp* على نباتات الخيار *Cucumis Sativus*

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الخلاصة

اجريت هذه الدراسة لتقييم كفاءة المبيد Tervigo 20sc والمقاومين الحيويين *Trichoderma harazianum* ، *Paecililomycis lilacinus* ومستحضر Nematron النباتي ومسحوق قشور الرمان ، بالمقارنة مع المبيد Vydate السائل 10% في مقاومة نيماتودا تعقد الجذور على الخيار تحت ظروف البيت البلاستيكي خلال شهر ايلول 2016 في محافظة كركوك . أظهرت النتائج كفاءة جميع المعاملات في خفض أعراض الإصابة بنيماتودا تعقد الجذور وتحسين صفات النمو لنبات الخيار ، فقد تفوقت معاملة Tervigo على باقي المعاملات في خفض دليل العقد والكثافة العددية للنيماتودا في التربة بنسبة 61.37% و80.48% عن معاملة المقارنة، بينما سجلت معاملة *T.harazianu* اقل نسبة خفض بلغت 43.19% و52.58% ، وكان تأثير الفطريات الإحيائية والمواد العضوية النباتية متقاربا وفعالا بدون فروق معنوية بينها ، ومن جانب آخر أسهمت جميع المعاملات بشكل ايجابي في تحسين صفات المجموع الخضري للنباتات فقد سجلت

الكلمات المفتاحية:
العوامل الحيوية، العضوية، نيماتودا تعقد الجذور، نباتات الخيار.

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معاملات Nematron ومسحوق قشور الرمان وTervigo أعلى زيادة في طول النباتات ، وتفوق مبيد Tervigo والمستحضر Nematron في معدل زيادة الوزن الطري والجاف للمجموع الخضري وسجلت زيادة في حاصل الثمار بمعدل 54.24 ،33.11% (للنباتات السليمة) و 345.45 ، 311.91% (للنباتات المصابة) عن معاملة المقارنة ، كما أظهرت الفطريات الإحيائية كفاءة جيدة في تحسين صفات النمو وحاصل الثمار . وفي ما يخص صفات المجموع الجذري فكان لجميع المعاملات تأثيرا ايجابيا في زيادة طول المجموع الجذري للنباتات المصابة والسليمة قياسا بمعاملة المقارنة عدا المبيد Vydate الذي أثر سلبيا بمقدار 0.46% للنباتات السليمة ، وأدت جميع المعاملات الى خفض الوزن الطري والوزن الجاف للمجموع الجذري من خلال خفض أعداد العقد الجذرية عدا مستحضر Nematron الذي زاد من معدل الوزن الطري والجاف للمجموع الجذري للنباتات السليمة والمصابة قياسا بمعاملة المقارنة.

Introduction:

Vegetable crops including option exposed to large losses due to root-knot nematodes (Abu-garbia ,2010). Where a reduction in the quantity and quality of production and affect the marketing of these crops significantly (Gharabadiyan *et al*، 2013).In Iraq , 120 botanically breadwinner can infect by this disease which made them take first place among a group of nematodes that cause plant diseases(Antwan , 2014). Nematodes disease management mechanisms still depend largely on the use of pesticides contain to reduce the harmful effects on vegetable crops (Koenning *et al*، 2004).The more effective pesticide oxamyl and Alidicarb where they have demonstrated high efficiency in controlling nematodes, but acute and chronic toxicity contributed to serious pollution of the ecosystem, threatening human health and safety as well as the long term survival and toxicity to non-target organisms (Ghini and Kimati ،2000) . Given these serious effects in the environment had become improperly use pesticides gradually roll back and replaced with integrated pest management (Agrios , 2005) Research is directed to adopt alternative and effective methods such as the use of biological control agents or induction of systemic resistance in plants (Sikora, 2005). In recent years, researchers have focused on the use of natural materials while avoiding excessive use of chemical pesticides, and focused their efforts on finding organisms from the environment works to curb the pests and reduce the damage (Hubbard *et al*, 2013) . Fungi and bacteria were the most important means of using biological control, and resorting to chemical pesticides if other methods could not achieve convincing control of intractable lesions ، Recent studies have focused on these methods to combat nematodes that infect crops such as the use of antifungal fungi (*Paecilomyces spp, Trichoderma spp,Verticillium spp , Fusarium spp*) (khan *et al*,2002 ; Meyer *et al*,2000), Biological products based on microorganisms are candidates for IPM programs, As they are useful for plant hostes and environmentally friendly (Rehman *et al*, 2009). The basis of the work of these microorganisms is to reduce the amount of primary and pathogens inoculum preventing it from penetrating the host tissue and thereby increase plant resistance to disease (Fokkema , 1995) Abamectin is one of the bio nematicides produced by *Streptomyces avermitilis* that live in soil (Bessi *et al*, 2010) Which assessed to control nematodes of several crops including cotton and tomato by treating the seeds and showed high efficiency in nematode control (Debeer , 2010) .

The successful use of these agents in the control of serpentine worms depends on the choice of the correct strategy and the method of adding these factors to the plants for the purpose of controlling or preventing plants from infection (Molinari and Baser, 2010) . Therefore, the objective of the research is to determine the efficient of pesticides (Tervigo 20SC , Vydate10/L) and biological factors (*Trichoderma harazianum* and *Paecililomycis lilacinus*) and organic matters (Nematron formulation

and pomegranate peel powder) to manage this disease by evaluating their performance and comparison among them to show their efficiency in influencing the disease and its susceptibility to improve the growth characteristics of the plant and reduce the economic losses caused by under greenhouse conditions .

Materials and methods:

This experiment was carried out at the greenhouse in the directorate of Agriculture of Kirkuk during the season 2016-2017. soil texture of greenhouse consists of (clay 2% , silt 32% , sand 66%) , The soil was sterilized by solar sterilization method in July and August for 8 weeks as follows : Soil was plowed and softened and then irrigated heavily , Drip lines were extended over the soil and covered with a transparent plastic cover thickness of 80 microns and 40 x 10 meters in size , The soil was irrigated once a week to maintain soil moisture during the solar sterilization period under the plastic cover (Abu-Gharbieh, 2000) .

Cucumber seeds (Karol) were planted on December/2016 in plastic trays and then transferred to the greenhouse at the age of 4-5 leaves and planted after the end of solar sterilization process of soil by 6 lines and 40 cm between the plant and irrigated by drip irrigation system . Cucumber plants were treated with nematode eggs three days after planting extracted from the roots infected with root-knot disease according to (Javed *at al* ,2007). Nematode species were identified by morphological characteristics and internal structures that distinguish nematodes from each other according to (Coyne *at al* ,2007) By experts specializing in the nematology in the Ministry of Agriculture . Two levels of egg inoculation were used (0 , 2000) eggs . The eggs were extracted by a sieve of 200 mesh and 500 mesh then collected in Baker and counted under dissection stereo- microscope by placing 1 mL of egg extract and counting the eggs and then estimated the total number of eggs . 2 mL of egg extract were added to the soil by pipette at a depth of 2 cm by making three pits with equal distances 3 cm around the plant .

The treatments used in the experiment were used as follows :

1 – control treatment , Plants were polluted by two levels (0 , 2000) egg .

2 - Tervigo 20 SC (Abametin + FE- chlate) Producing by (Syngenta / Spain) added at 2 ml/l concentration by 250 ml/l solution per plant after 7 days of inoculation with nematodes .

3 - Vydate 10 L (Oxamyl) Added at 3.6 ml/l concentration by 250 ml/l solution per plant after 7 days of inoculation with nematodes .

4 - *Trichoderma harazianum* , pure culture was obtained from the isolate bank in Baghdad .

5 - *Paecililomycis lilacinus* , pure culture was obtained from the isolate bank in Baghdad .

pure culture of bio fungi was used after its development in petri dish 9 cm on a PDA medium and then they were loaded onto millet medium as follows : 250 g of millet was placed in 500 ml/l flasks with 100 ml distilled water. The grains were sterilized in the autoclave for 20 minutes at 1.5 kg / cm^2 pressure and 121 ° C and then left the flasks at room temperature until their temperature dropped, then the millet grains were inoculated by 5 tablets of a fungus culture growing on the PDA medium at 7 days old. The flasks were placed in the incubator under a temperature of 26 ± 1 ° C and left for 14 days with shaking continuously between periods to ensure the homogeneous diffusion of the fungal mycelium on the millet medium (yas , 2015) . The fungus that carrying on the millet medium was added to the soil at a rate of 1 g of millet per plant by making a longitudinal incision around the plant and at a depth of 5-7 cm before pollution with nematodes .

6 - Nematron (Liquid formulation) It is a new plant formula produced by (Cosmocell) , It is used as an organic fertilizer and anti-nematode contains natural oils like garlic and vegetal extracts and some nutrients such as phosphorus and potassium , added at 2 ml/l concentration by 200 ml/l solution per plant after 3 days of inoculation with nematodes by watering .

7 - Pomegranate peel powder contains , Tannic, Pelletierine , Galutannic , Punicin , It was added at a rate of 2 g per plant by mixing it with soil and before treated with nematodes .

Results were taken after 60 days of pollution with nematodes, after plants extraction and the following traits were measured:

1 - Calculation of nodes index: The degree of root injury was calculated by root nodules based on the contract manual which was developed by Bridge and Page (1980) . as follows :

0 = No nodes, 1 = nodes spread over 10 % of the root , 2 = nodes spread over 20 % of the root , 3 = nodes spread over 30 % of the root ,4 = nodes spread over 40 % of the root,5 = nodes spread over 50 % of the root , 6 = nodes spread over 60 % of the root , 7 = nodes spread over 70 % of the root , 8 = nodes spread over 80 % of the root , 9 = nodes spread over 91 % of the root , 10 = nodes spread over 100 % of the root .

2 – Calculation the nematode population per 100 g of soil was calculated as follows :

Tissue paper was placed in the plastic sieve/basket placed on a plastic plate after that the soil placed on the tissue in the sieve and water was added to the extraction plates to fresh the soil and left for 48 hours after the extraction period the sieve and disposed soil were removed ,The water was taken and examined under a stereoscope to calculate the nematode numbers under dissection microscope(Coyne *at al* ,2007) .

3 – Shoot and root system growth : The length of plants is measured by the measuring tape , and the fresh weight was measured by the sensitive balance , To calculate the dry weight the samples were placed in dry paper bags and placed in an oven under 70 ° C for 48 hours. The dry weight was calculated using the sensitive balance .

4 - Calculate the value of reduction : The changes in the values of the studied characteristics were estimated as a percentage in the following formula

$$\% \text{ of reduction} = \frac{\text{Average of treatment} - \text{Average of control treatment}}{\text{Average of control treatment}} \times 100$$

Statistical analysis:

Data of the present study were subjected to the analysis of variance test (ANOVA) as (RCBD)
The averages of studied traits were tested according to the Duncan multiple test.

Results and discussion:

1 -The effect of nematicides , biological agents and plant organic matter on galls and nematode population of cucumber infected with *Meloidogyne spp* .

Data in table 1 indicated that Tervigo was the most effective treatment which recorded 61.37% reduction followed by Vydate and *P. lilacinus* , Pomegranate peel powder giving 52.28, 50.01 and 50.01% reduction respectively. While, the least effective treatment was *T. harazianum* that gave 43.19% galls reduction per plant root.

Data represented in table 1 showed the influence of the evaluated treatments on root-knot nematode population densities which considered an important indicator to the efficacy of the used compounds which recorded reduction ranged from (52.58 and 80.48%). The collection data in table (1) showed that the evaluated treatments suppressed the nematode population densities Tervigo was the superior treatment that reduced nematode juveniles numbers in the soil giving 80.48 % followed by Vydate, *P. lilacinus* and pomegranate peel powder which recorded 62.17, 56.69 and 56.36% reduction, respectively. while, Nematron and *T. harazianum* recorded 56.06 and 52.58% reduction, respectively .

The present results are in agreement with study reported by Becker *et al*. (2006) who found that use of Abamectin in treatment of cucumber seeds reduced the penetration rate of the roots by the juveniles(J2) of the *M. incogenita* nematode. Kalil *et al*. (2012) found that abamectin , Oxamyl , *P. lilacinus* were effective in reducing the number of root nodes and *M. incogenita* population on tomato and they were superior to other treatments . The effect of Tervigo treatment is attributed to Abamectin which have a killer effect for nematodes which is a biocides that contains *Streptomyces avermitilis* and used in biological control because of its high ability to produce some compounds (Extracelluler protease) that affect pathogens, including growth regulators (IAA) and Siderofores compounds and production of vitamin B group in addition to the production of hydrolytic enzymes and chitinase, which has the ability to analyze the walls of pathogens without affecting the walls of plant cells and help to increase the growth of plant and crop(Gonzalez-lopez , 1986). Faske and Sttar (2007) , Abdu-El fattah (2016) said that Abamectin has a nematicides effect against root-knot nematode .

Table 1. The effect of nematicides and biological agents and plant organic matter on galls and nematode population of cucumber infected with *Meloidogyne spp.*

treatments	nodes index/ Plant	reduction (%)	Nematode population (100 g soil)	reduction (%)
Tervigo 20sc	1.89 c	− 61.37	200.89 d	−80.48
Vydate 10 L	2.33 c b	−52.28	389.33 c	−62.17
Trichoderma harazianum	2.78 b	−43.19	488.00 b	−52.58
Paecilomyces lilacinus	2.44 c b	− 50.01	445.67 b	−56.69
Nematron	2.56 c b	− 47.74	452.22 b	−56.06
Pomegranate peel powder	2.44 c b	−50.01	449.11 b	−56.36
Control	4.89 a		1029.11 a	

Each value represents an average of three values. * The averages that share the same letter are not significantly different at the probability level of 0.05 . (-) The impairment than control treatment

The effect of Vydate is due to its ability to affect the nervous system of nematodes by inhibiting the enzyme Acetylcholine esterase, which leads to the accumulation of acetylcholine in the membranes beyond the zone of engagement causing permanent stimulation of the nerve and thus paralyzed movement and weaken the ability ,that in agreement with (Amy and Aahmed , 2010) , (EL-gboory , 2003) studies . Khan et al. (2002), Sukumer et al. (2005) indicated that the effect of fungus *T. harazianum , P. lilacinus* on the nematode juveniles is due to the release of a group of antibiotics such as Penicillin, Giotoxin, Viridin and Hadeciden, which inhibits the movement of the larvae and becomes unable to penetrate the roots and the formation the nodes on roots. Hannawy et al. (2014) Found the use of these bio control fungi reduced the rate of root nodes effectively on the tomatoes and had a synergistic effect with solar sterilization. The results are in agreement with similar studies on the role of plant organic matter in reducing nematode population and reducing their root nodes. The effect of these substances may be due to their containment of some toxic chemicals of nematodes and may vary in their effect depending on the quantity, quality and toxicity of the toxic compounds they contain. and also effect on host physiology to become more resistant to nematodes within its roots (Hussain and Masood ،1975). Amy (1993) found the extracts of plants, including pomegranate peel, have a significant effect on the ratio of hatching nematodes eggs , as well as the deadly effect of the juveniles

(J2). The effect of pomegranate powder may be due to some active substances such as tannic acid that have a negative effect on cell walls of microorganisms by affecting the outer shell and increasing its hardness or increase its permeability to toxic substances and compounds (Voravuthikunchai et al,2006). A previous study also indicated that the treatment of watering the commercial product containing the garlic extracts of the tomato plants infected with root-knot nematode reduced the nodes of the roots because it contains some defensive enzymes (Abd-Elgawad et al,2009). Garlic extracts have an indirect effect on nematodes by inhibiting their feeding, movement and reproduction , As well as affect their reproductive capacity by prolonging their life cycle and reducing their reproductive efficiency or altering the sexual ratio to males only (Fadzirayi et al,2010 ; Gong et al,2013)

2 -The effect of nematicides and biological agents and plant organic matter in shoot system growth and weight yield for cucumber infected with *Meloidogyne spp* .

Data shown in table 2 , 3 revealed that all used treatments recorded an increase of shoot system length for infected and non-infected plants, Nematron shows the highest increase for infected plants evaluated by 74.64 % followed by Tervigo , pomegranate peel powder , *P. lilacinus* and *T. harazianum* with values of 71.98 , 51.69 , 46.14 and 41.06% increase respectively. While, Vydate was the least effective treatment which recorded 31.40% increase compared with control treatment .On the other hand Tervigo was the most effective treatment on the shoot fresh weight , dry weight and weight yield with values 254.85 ,202.53 and 345.45 % respectively. Whilst Vydate showed the least value of shoot weight (fresh ,dry) and weight yield increase with values 91.90 ,64.02 and133.78% increase respectively .

The positive effect of the treatments is due to the nature and content of these substances of active ingredient, Tervigo's effect is characterized by its content Fe-chelated as well as Abamectin , As iron is a basic element and helps in physiological processes such as photosynthesis, breathing, protein building, chlorophyll as well as cytokromates (Weidenhoeft , 2006).The use of micro-elements such as iron in chelated form will resistance to stabilization by the soil and become ready for absorption by the plant and leads to the absorption of other elements to balance the food and thus contribute to increase the shoot system growth for plants, this explains the superiority of this treatment more than others in increasing shoot system weight , it also increases the physiological processes, the number of green plastids, and the representation of nucleic acids this Leading to improved shoot system (El-Temimy and El-doory ,2012 ; Ana-flor *et al*,2010) . The effect of Abamectin is due to the presence of *Streptomyces avenmitilis*, which has a major role in influencing the pathogen through the secretion of many growth regulators and enzymes for the analysis of walls and cells of the nematodes as well as these microscopic organisms produce siderophores compounds which have an important role in increasing the readiness of the basic elements of the plant and thus increase its resistance and growth properties and yield weight (Silva *et al*,2008 ; Nageeb et al , 2007). The effect of bio-fungi may be due to their role in supplying plants with the important substances they need to increase their growth and weight, These results are in agreement with, Kalil *et al* (2012) who found that use both of Abamectin and *P. lilacinus* and oxamyl had a significant effect against *M. incognita* nematode and improved plant growth parameters and increased fresh and dry weight at high rates . As in agreement with El-Nagdi *et al* (2011) who indicated that *P. lilacinus* and *Trichorema album*, were controlled *M. incognita* nematode and *Fusarium solani* on the sugar beet plant compared with nematicides phenamivos and Kadiosavus and all treatments had increased in shoot and root system and the percentage of solids dissolved in sugar beet. Faraj and Alwan (2016) recommended the use of *T.harzianum* to increasing the productivity and growth of cucumber .

Table 2. The effect of evaluated treatments on shoot system growth qualities and weight yield for cucumber plants infected with *Meloidogyne spp*

treatments	inoculation level / egg	length (cm)	fresh weight (g)	dry weight (g)	Weight yield (g)
Tervigo 20sc	0	83.33 ba	101.22 a	15.07 a	1477.04 a
	2000	79.11 cb	98.70 ba	14.75 a	1355.00 ba
Vydate 10 L	0	75.22 dc	84.79 bac	11.25 bdc	973.90 ba
	2000	60.44 g	53.38 e	7.99 e	711.13 bc
Trichoderma harazianum	0	81.56 ba	88.95 bac	12.38 bac	965.60 ba
	2000	64.89 gf	62.01 ed	8.23 ed	848.70 bac
Paecilomyces lilacinus	0	83.22 ba	89.63 bac	12.43 bac	992.12 ba
	2000	67.22 ef	78.60 bdc	10.18 edc	866.54 bac
Nematron	0	87.00 a	93.48 bac	13.70 ba	1274.71 ba
	2000	80.33 bc	85.52 bac	11.99 bac	1252.99 ba
Pomegranate peel powder	0	84.11 ba	91.07 bac	12.96 bac	995.46 ba
	2000	69.78 def	79.12 bdc	10.68 bedc	898.23 bac
Control	0	71.33 de	71.80 edc	10.83 bedc	957.64 ba
	2000	46.00 h	27.82 f	4.88 f	304.19 c

Each value represents an average of three values *The averages that share the same letter are not significantly different at the probability level of 0.05

Table 3. Rates of increase on shoot system growth for non-infected and infected with *Meloidogyne spp*

treatments	inoculation level / egg	length Increase (%)	fresh weight Increase (%)	dry weight Increase (%)	Weight yield Increase (%)
Tervigo 20sc	0	16.82	40.98	39.09	54.24
	2000	71.98	254.85	202.53	345.45
Vydate 10 L	0	5.45	18.10	3.84	1.7 0
	2000	31.40	91.90	64.02	133.78
Trichoderma harazianum	0	14.33	23.89	14.30	0.83
	2000	41.06	122.92	68.69	179.00
Paecilomyces lilacinus	0	16.67	24.84	14.76	3.6 0
	2000	46.14	182.59	108.79	184.87
Nematron	0	21.96	30.21	26.42	33.11
	2000	74.64	207.45	145.77	311.91
Pomegranate peel powder	0	17.91	26.85	19.61	3.95
	2000	51.69	184.46	118.91	195.29
Control	0	-	-	-	-
	2000	-	-	-	-

On the other hand, the effect of Nematron and pomegranate peel powder is due to their content of some substances that stimulate growth in plants such as extracts of plants and garlic which contain some essential and important nutrients in vital activities such as sulfur, phosphorus and magnesium, these elements play an important role in building the chlorophyll molecule and thus increase the efficiency of photosynthesis process., and the amount of carbohydrate compounds, nitrogen ratio in the plant and increasing protein content (El-nieamy , 1999). They may also contain substances that have a toxic effect on nematodes, alert their natural enemies or change the level of plant resistance, as well as fertilize the soil and improve its composition, thus making plants more resistant to the effect of nematodes (Vawdrey and Stirling ,1997).These are in agreement with other studies that showed the treatment of soil with garlic extract is effective in increasing the activity of some proteins related to pathogenesis and some of the protective enzymes in the leaves of tomato against the *Meloidogyne spp* compared with untreated plans (Abd-Elgawad *et al*, 2009). Hussein and El-Rikabi (2006) found that the use of garlic extract on the cucumber plant gave a significant effect in increasing the shoot system growth . Morsy *et al*. (2009) tested the efficacy of garlic extract and onion extract to improve the shoot system characteristics of cucumber plant, giving good and significant results compared with control plants.

3 -The effect of nematicides and biological agents and plant organic matter on root system growth for cucumber infected with *Meloidogyne spp* .

Data represented in table 4 indicated that all used treatments recorded an increase of root system length for infected and non-infected plants , Except Vydate treatment which decreased the shoot length by(0.46%) for non-infected plants . It's obvious that there were no significant differences between treatments for non-infected plants , As for infected plants Nematron treatment recorded the highest increase of root length with value of 34.68% , While, Vydate was the least effective treatment which recorded 15.03% increase compared with control treatment . Also all used treatments recorded an increase of root weight and dry weight system for non-infected plants , Nematron, Pomegranate peel powder, Tervigo, and *P. lilacinus* were superior in root weight increase with values 17.35, 15.44, 15.06 and 15.01% respectively , and values 31.28, 18.70, 17.18 and 14.50% increase in dry weight . While, Vydate was the least effective recorded 11.69 and 9.16% respectively .In the case of infected plants, all used treatments contributed to the reduction of the fresh and dry root weight with no significant differences between treatments compared with control treatment , Except Nematron which recorded an increase in the fresh and dry root weight with values 6.28 and 9.27% . The effect of Nematron is due to the presence of nutrients such as phosphorus and potassium, which helped to increase the size of roots and the formation of many branches increased the weight of root system as well as the extract and oil of garlic, which contains (Allicin) and protein and vitamins such as niacin and thiamine and elements of metal and fat and enzymes (Morsy *et al*, 2009) . This is in agreement with(El-Nagdi and Youssef, 2013) . The causes of the increase in length and weight of the root system of non-infected plants are due to the role of treatments in enhancing the growth characteristics of the root system , As for the infected plants, the effect of nematode resulted in an increase in fresh and dry weight of the root system due to several reasons, including low root efficiency in the absorption of water and nutrients and deformity in the area of infection and the formation of giant cells in tissue (Amy, 1985). These results are consistent with previous studies that pointed the weight of the root becomes larger in case of injury due to the life mass of the root nodes caused by the nematode (Fortnum *et al*, 1995) The treatments have contributed to the reduction weight of the roots because of their ability to resist nematodes and reduce the number of nodes formed by nematode, The biological control that occurs in the root zone is caused by secretion iron carrier material (Siderophor) which are formed by some types of bacteria, which consists of Abamectin, the importance of these compounds in the denial of worms from the iron component, , so these organisms are important in providing the nutritious element(Rosenblueth and

Romero ,2006 ; Sessitsch *et al*, 2002).The effect of bio-agents were increased peroxidase and chitinase in root and leaf tissue, these enzymes produce melanin, which has an antimicrobial effect (Onaga and Tairal, 2008).This agree with Hinawi *et al*. (2014) who found similar results on the positive role of *T.harzianum, P. lilacinus* in improving the root system growth of the tomato plants in the pasteurized and unpasteurized soils with significant difference from the compared treatment .

Table 4. The effect of evaluated treatments on root system growth qualities for cucumber plants infected with *Meloidogyne spp*

treatments	Pollution level / egg	length [cm]	Increase [%]	fresh weight [g]	Increase [%]	dry weight [g]	Increase [%]
Tervigo 20sc	0	26.33 a	+8.72	2.35 bdc	+15.06	0.34 edc	+17.18
	2000	25.22 ba	+31.21	2.88 ba	−3.53	0.48 bac	−7.33
Vydate 10 L	0	24.11 bac	−0.46	2.28 dc	+11.69	0.32 ed	+9.16
	2000	22.11 c	+15.03	2.32 bdc	−22.46	0.32 ed	−37.07
Trichoderma harazianum	0	25.11 ba	+3.67	2.32 bdc	+13.76	0.31 ed	+8.02
	2000	22.78 c	+18.50	2.75 bac	−7.92	0.46 bdac	−10.78
Paecilomyces lilacinus	0	25.22 ba	+4.13	2.35 bdc	+15.01	0.33 edc	+14.50
	2000	22.44 c	+16.76	2.72 bac	−9.07	0.44 ebdac	−14.87
Nematron	0	26.00 ba	+7.34	2.40 bdc	+17.35	0.38 ebdc	+31.30
	2000	25.89 ba	+34.68	3.18 a	+6.28	0.56 a	+9.27
Pomegranate peel powder	0	26.00 ba	+7.34	2.36 bdc	+15.44	0.35 edc	+18.70
	2000	23.78 bc	+23.70	2.74 bac	−8.18	0.46 bdac	−11.42
Control	0	24.22 bac		2.04 d		0.29 e	
	2000	19.22 d		2.99 a		0.52 ba	

Each value represents an average of three values *The averages that share the same letter are not significantly different at the probability level of 0.05 . (-,+) The increase or impairment than control treatment according to Duncan multiple range test .

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