Efficacy of some Bioagents and Plant Extracts in Controlling *TylenchulusSemipenetrans*on Citrus in Egypt

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Abstract

This study was conducted to determine the susceptibility of four citrus rootstock; Sour orange (SO), Volkameriana (VOL), Cleopatra mandarin (CM) and Troyer citrange (TC) to citrus nematode; *Tylenchulussemipenetrans* and control citrus nematodes by using bioagents and plant extracts under both greenhouse and fieldconditions. In addition to determine the citrus yield (cv. Volkameriana) in Egypt.

Data showed that Volkameriana is the most susceptible rootstock; whereas Troyer citrange is the least susceptible rootstock to the citrus nematodes under greenhouse conditions.

Seven treatments (*Psudomonasfluorescens*, *Arthrobotrysoligospora, Trichodermaharzianum*, *Origanummajorana*,*Tageteserecta*, *Eucalyptus globules*, at different concentrations, and oxamyl (24%)) were used to control *T. semipenetrans* under both greenhouse and fieldconditions on citrus.

The most effective treatment in controlling citrus nematodes; *T. semipenetrans* was *Psudomonasfluorescens* whereas the least effective was suspension of *Eucalyptus globules* under both greenhouse and field conditions. *Psudomonasfluorescens* was more effective in reducing numbers of egg laying females, number of eggs/ egg-mass and number of second stage larvaein the soil, whereas the suspension of *Eucalyptus globules* was the least effective under both greenhouse and field conditions.

Under greenhouse conditions all treatments led to increase the total fresh weight of shoots and roots of citrus seedlings especially at the highest concentration. The application of treatments achieved high decrease in nematodes population in both roots and soil under both greenhouse and field conditions also, increased the yield of citrus under field conditions.

Key words:efficacy, rootstock, citrus nematodes, *T. semipenetrans*, *Psudomonasfluorescens*, *Arthrobotrysoligospora,Trichodermaharzianum*, *Origanummajorana*,*Tageteserecta, Eucalyptus globules,*oxamyl andcitrus.

Introduction

Citrus (Citrus spp.) are considered of the most important horticultural crops in Egypt, due to their economic export value and their local consumption and industries. Also, it is one of the major fruit crops of global importance and cultivated in more than 125 countries. Approximately 68% of the world's citrus production is consumed as fresh fruits, and about 11% of total production is used in international trade **(Anonymous, 2002)**. Numerous nematode species are associated with the citrus rhizosphere such as: the citrus nematode,*Tylenchulussemipenetrans***(Duncan, 1999)**. In the recent years, the awareness of the nematicides hazards to human and environment has directed the attention towards soil-borne antagonists and the natural plant extracts as an alternative method to chemical control. Biological control and natural plant extracts are gaining an increasing role throughout the world for decreasing nematode population.

*Psudomonasfluorescens*has been reported as a biocontrol agent against nematodes **(Devi and Upma, 2002; Hamid *et al*., 2003; Mahapatra and Mohanty, 2003; Rao*et al*., 2004; Siddiqui&Shaukat, 2005 and Shawky, *et al*., 2010)** as well as*Arthrobotrysoligospora*has been mentioned by **(Bandyopadhyay*et al*., 2001; Duponnois*et al*., 2001; Singh *et al*., 2001**; **Khan *et al*., 2002;El Gendy&Shawky; 2006**and **Ali*et al*., 2012).** *Trichodermharzianum* act through different mechanisms including mycoparasitism, also through production of antibiotic substances (**Sharon *et al*., 2001; Faruk *et al*., 2002; Shawky and Abd El- Moneim, 2005; Sahebani &Hadavi, 2008 and Shawky, *et al*., 2010).**

The impact of aqueous plant extracts on plant parasitic nematodes has been reported by several authors. Plant extracts of *Tageteserecta* has nematicidal effect on root-knot nematode **(Kimpinski*et al.,* 2000; El-Hamawi*et al.,* 2004; Verma, 2006; Khalil &Shawky, 2008** and **Ali *etal*., 2012).** Also, plant extracts of *Origanummajarana*containing some substances reduce the nematode populations **(Saravanapriya*et al* 2004; Shawky*et al*., 2010** and **Ali *et al*., 2012).**Eucalyptus*; Eucalyptus globules*has nematicidal effect on nematode population according to **(Sabira*et al*., 2000**;**Shaukat*et al*., 2003** and **2006 Ali *et al*., 2012)**.

The aim of this work determine the suitability of four citrus rootstocks to citrus nematode and evaluation of different bioagents and plant extracts treatments to control citrus nematodes; *Tylenchulussemipenetrans* on citrus under both greenhouse and fieldconditions in Egypt.

Material and Methods

The experiments were conducted under greenhouse and field conditions. The field experiment was conducted in a naturally infested field with

Tylenchulussemipenetrans on citrus trees in a private vineyard situated at Cairo-Alexandria desert road (78th kilometer).

I. Greenhouse experiments

1. Host susceptibility of some citrus rootstocks to the citrus nematode; *T. semipenetrans*

Two year's old healthy seedlings belonging to the most widespread commercial rootstocks in Egypt were obtained from Citrus Research Dept., ARC, Giza. Rootstocks used were: Sour orange (*Citrus aurantum* L.), Volkameriana (*C. volkameriana* Ten et Pas), Cleopatra mandarin (*C. reshni*L.) and Troyer citrange (*C. sinensis x P. trifoliate* L.).These rootstocks were examined for their relative susceptibility to the infection of citrus nematode; *T. semipenetrans*. Five seedlings of each rootstock were put in clay pots each pot (one seedling/pot) filled with sandy loamy soil (18% clay, 10% silt and 72% sand) steam sterilized soil.

Each pot was inoculated with 3000 newly hatched larvae of *T. semipenetrans* around the roots one week after planting. All rootstocks received the same agricultural treatments. Each rootstock replicated five times as well as five seedlings for each rootstock was kept without inoculation to serve as a check. All pots were arranged in completely randomized design, and kept under greenhouse conditions at about 25-28°C.

After 120 days, all plants were carefully uprooted and fresh root and shoot systems were weighted. Nematode populations in soil (number of juveniles/ 250g. soil) were determined according to **(Franklin &Goodey, 1957)** Roots were stained by acid fuchsin in acetic acid according to (**Byrd *et al*.1983),** and examined for egg laying females/1g.root. Eggs /egg-mass of *T. semipenetrans* were extracted by using sodium hypochoride (NaOCl) method as described by **(Husssey and Baker, 1973).**

2. Efficacy of some concentration of some bioagents and plant extracts in controlling citrus nematode; *T. semipenetrans*

In this study seven different treatments were used**:**

Bioagents micro-organisms

1. Psudomonasfluorescens. 2. *Trichodermaharzianum.*

3.*Arbascularmycorrhizae*.

Plant aqueous extracts

4. Marjoram; *Origanummajorana***.** *5.* Marigold;*Tageteserecta***.**

6. Eucalyptus, Eucalyptus globules.

Nematicide

7. Oxamyl (24% EC).

The concentrations of *Psudomonasfluorescens*(1×10^5,1×10^8,5×10^8 cells)/ pot, *Arthrobotrysoligospora* and *Trichodermaharzianum* were (1×10^5,1×10^8,5×10^8cfu)/ pot. While,fresh leaves of three plants were marjoram; *Origanummajorana*, marigold;*Tageteserecta*and Eucalyptus, *Eucalyptus globules*. The plants were prepared by using three concentrations; (C1)10g./100ml. sterilized distilled water, (C2)15g./100ml. sterilized distilled water and (C3)20g./100 ml. sterilized distilled water/ pot against *T. semipenetrans.*

The *Psudomonasfluorescens*was taken from Microbiology Department, Soils, Water and Environment Research Institute, Agriculture Research Center. *Arthrobotrysoligospora* and *Trichodermaharzianum* were taken from Plant Pathology Department, Faculty of Agriculture, Cairo University and oxamyl was used in the recommended concentration (5L/feddan).

The rate of application for each plant aqueous extracts was (100 ml./ seedling). Also, oxamyl (vydat; 24% EC) asnematicide at the recommended concentration (24% EC) at the rate of application (5L / 600 L water /fed).

Two year's old healthy citrus seedlings*,*Volkameriana rootstock were transplanted individually in clay pots each pot containing sandy loamy soil (18% clay, 10% silt and 72% sand) steam sterilized soil. Each pot was inoculated with 3000 newly hatched larvae of *T. semipenetrans* around the roots. All treatments received the same agricultural treatment. Each treatment replicated five times. All pots were arranged in completely randomized design, and kept under greenhouse conditions at about 25-28°C. The citrus seedlings were treated with each mentioned concentration/ pot of the treatments suspension of (*Psudomonasfluorescens*, *Arthrobotrysoligospora*and*Trichodermaharzianum*), (*Origanummajorana*,*Tageteserecta*and *Eucalyptus globules*) and oxamyl (24% EC). Also, five citrus seedlings were treated with newly hatched larvae of *T. semipenetrans* alone as check.

After 120 days, all plants were carefully uprooted and fresh root and shoot systems were weighted. Nematode populations in soil (number of juveniles/250g. soil) were determined according to **(Franklin &Goodey, 1957).** Roots were stained by acid fuchsin in acetic acid according to **(Byrd *et al.*,1983)** and examined for number of egg laying females/1g.root. Eggs/egg-mass of *T. semipenetrans* were extracted by using sodium hypochoride (NaOCl) method as described by**Husssey and Baker (1973).**

3. Efficacy of number of application of some bioagents and plant extracts in controlling *T. semipenetrans* on citrus cv. Volkameriana

Citrus seedlings (Volkameriana rootstock), Two year's old healthy seedlings

were planted in clay pots each containing steam sterilized sandy loamy soil (18% clay, 10% silt and 72% sand) soil. The treatments were designed in five replicates (one seedling for each pot).

This experiment was conducted to determine the effect of some bioagents and plants extracts in controlling *T. semipenetrans* by using the highest concentration of the suspension of bioagents at concentration (5×10^8cfu& 5×10^8 cells) and the plant extracts at concentration (20g./100 ml. sterilized distilled water) under greenhouse conditions at about (25 - 28^{o}C). Each pot was inoculated with 3000 newly hatched larvae of *T. semipenetrans* around the roots. All treatments received the same agricultural treatment. Each treatment replicated five times.

After 120 days, all plants were carefully uprooted and fresh root and shoot systems were weighted. Nematode populations in soil (number of juveniles/ 250g. soil) were determined according to **(Franklin &Goodey, 1957)** Roots were stained by acid fuchsin in acetic acid according to **(Byrd *et al*., 1983),** and examined for egg laying females/1g root. Eggs /egg-mass of *T. semipenetrans* were extracted by using sodium hypochoride (NaOCl) method as described by**Husssey and Baker (1973).**

II. Field experiments

Efficacy of some bioagents and plants extracts in controlling citrus nematode; *T. semipenetrans*on citrus

This experiment was conducted in naturally infested sandy soil to determine the efficacy of some bioagents and plant extracts treatments to control *T. semipenetrans* under field conditions at the high concentration (20g./100 ml) for plant extracts and at the high concentration (5×10^8cfu& 5×10^8 cells) for the bioagents. Oxamyl at the rate of 5L/Feddan was used as recommended concentration. All treatments were replicated three times (every replicate was ten trees of citrus).

Every month, nematode populations in both soil and root including number of second stage juveniles /250g. and egg laying females and eggs/egg-mass/gm. root were determined after treatments to the harvesting time during the growing season according to (**Franklin &Goodey, 1957).** Roots were stained by acid fuchsin in acetic acid according to (**Byrd *et al*., 1983**) and examined for number of egg laying females/1g. Eggs /egg-mass of *T. semipenetrans* were extracted by using sodium hypochoride (NaOCl) method as described by **(Husssey and Baker, 1973).** At the end of the experiment the fruit yield of citrus were determined.

Statistical analysis procedure

All obtained data were subjected to analysis of variance (ANOVA) **Gomez and Gomez (1984)** and means were compared by using L.S.D. at 5% level of significance.

Results and Discussion

I. Greenhouse experiments

1. Host susceptibility of some citrus rootstocks to the citrus nematode; *T. semipenetrans*

Data in table (1) indicate that citrus is a good host for the citrus nematode, *T.semipenetrans*in all rootstocks.Volkameriana rootstock was the most susceptible rootstock to the citrus nematode in comparing to other tested rootstocks, while Troyer citrange rootstock exhibited some resistance to the citrus nematode. The nematode population in 250g soil and in root (egg laying females and number of eggs/ egg mass) were significantly higher on Volkameriana rootstock than those on the other tested rootstocks (P<0.05). Cleopatra-mandarin and Sour-orangeranked statistically in the intermediate category in nematode population in both soil and roots.

Table (1): Reproduction of citrus nematode, *T. semipenetrans* on some citrus rootstocks.

Rootstocks	Nematode population		
	No. of nematodes in soil/250 g.	In 1 g. root	
		No. of egg laying females	No. of eggs /egg-mass
Cleopatramandarin	4280 B	51 B	315 B
Sourorange	1180 C	29 C	219 C
Troyer citrange	580 D	18 D	169 D
Volkameriana	5600 A	72 A	354 A
L. S. D. at 0.05%	87.9	16.4	55.8

Numbers followed by the same letter (s) within a column are not significantly different (P= 0.05) according to Duncan's new multiple- range test.

Fig. (1) showed the reduction of total fresh weights (shoot and root) of the tested infected cultivars with *T. semipenetrans* compared with non-infected cultivar plants. Volkameriana rootstock showed the highest reduction in total fresh weights (shoot and root), while Troyer citrangerootstock showed the lowest reduction in total fresh weights (shoot and root).

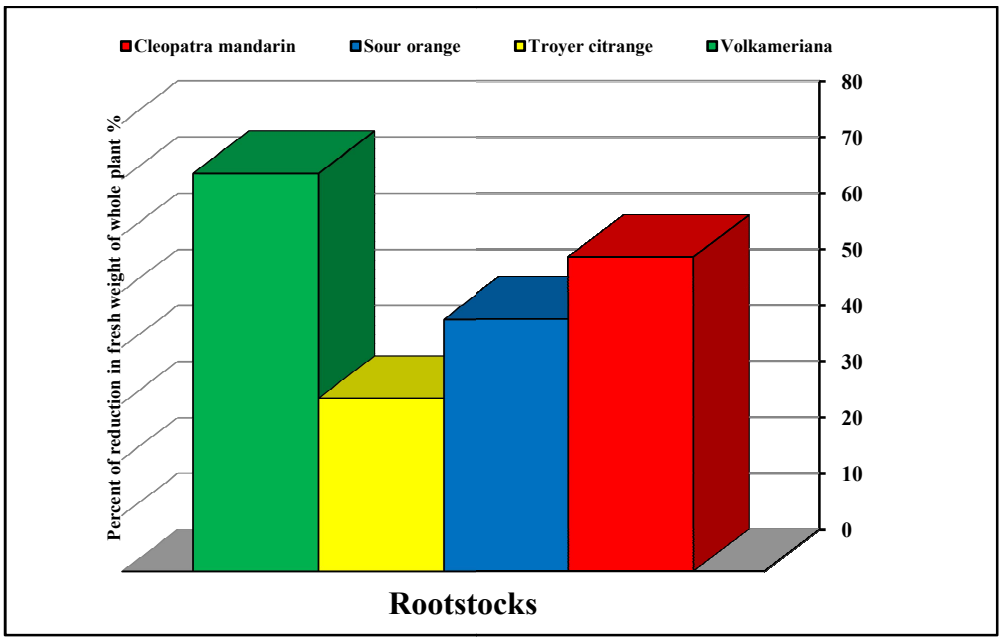

Fig. (1): Reduction% of total fresh weights of some citrus rootstocks infected with *T. semipenetrans* compared with healthy rootstocks.

2. Efficacy of some concentration of some bioagents and plant extracts in controlling *T. semipenetrans*on citrus

A. The effect on nematode population of citrus nematode; *T. semipenetrans*

Data in table (2) showed that all tested bioagents and plant extracts treatments were effective in controlling citrus nematode; *T. semipenetrans* under greenhouse conditions.*Psudomonasfluorescens* treatments were the most effective treatment than the other treatments whereas the least effective treatment was the *Eucalyptus globules.* Also, data showed that positive correlation between efficacy of the treatments and concentrations.

Data in table (2) revealed that by using*Psudomonasfluorescens*at *(*5×10^8 cells*)* achieved the highest decrease in both soil/ 250g and root (egg laying females, number of eggs/ egg-mass) comparing with the other treatments. *Trichodermaharzianum*, *Arthrobotrysoligospora, Origanummajorana* and*Tageteserecta*occupied the second rank in reducing the nematode populations, whereas, *Eucalyptus globules* at the rate of 10g. /100 ml. resulted in the lowest number of nematode population in both soil and roots.

Table (2): Effect of concentration of some bioagents and plant extracts on nematode population of *T. semipenetrans* on citrus (Volkameriana rootstock).

Treatments	Concentration / pot	Nematode population		
		No. of nematodes in soil/250 g.	On 1 g. root	
			No. of egg laying females	No. of eggs /egg-mass
Psudomonasfluorescens	1×10^5 cells	530	35	157
	1×10^8 cells	330	28	145
	5×10^8 cells	260	23	131
Arthrobotrysoligospora	1×10^5cfu	720	39	185
	1×10^8cfu	680	33	178
	5×10^8cfu	520	29	169
Trichodermaharzianum	1×10^5cfu	590	37	162
	1×10^8cfu	490	31	155
	5×10^8cfu	410	25	142
Eucalyptus globules	10 g./100 ml. water	1940	47	231
	15 g. /100 ml. water	1820	71	225
	20 g. /100 ml. water	1680	62	219
Origanummajorana	10 g./100 ml. water	840	48	225
	15 g. /100 ml. water	760	41	201
	20 g. /100 ml. water	680	36	188
Tageteserecta	10 g. /100 ml. water	1120	52	224
	15 g. /100 ml. water	980	54	219
	20 g. /100 ml. water	740	43	205
Oxamyl (24% EC)		180	11	109
Check control (nematodes only)		5160	89	356
L. S. D. at 0.05%		36.9	2.1	9.3

Numbers followed by the same letter (s) within a column are not significantly different (P= 0.05) according to Duncan's new multiple- range test.

B. The effect on total fresh weights (shoot and root)

All the treatments provoked the total fresh weight of treated seedlings compared with the infected seedlings with;*T. semipenetrans*. The results in fig. (2) revealed different response in total fresh weight of shoots and roots by using different concentrations. Themaximum increasing % at the highest concentrations (5×10^8cfu in the bioagents and 20g. /100 ml. water of the plant extracts. Also,

Psudomonasfluorescens increased the total fresh weight with (83.3%) while; *Eucalyptus globules* increased the total fresh weight with (32.6%). *Arthrobotrysoligospora, Trichodermaharzianum*, *Origanummajorana* and*Tageteserecta* ranked in the intermediate position.

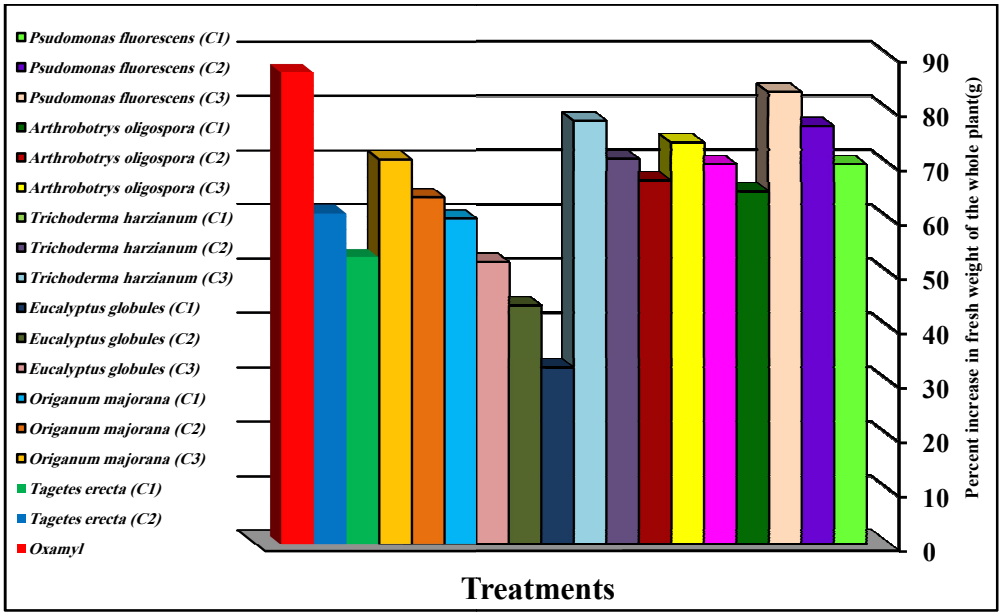

Fig. (2): Efficacy of some bioagents and plant extracts at different concentrations on increasing % of total fresh weights of citrus seedlings infected with *T. semipenetrans*.

II. Field experiments

Efficacy of some bioagents and plant extracts in controlling *T. semipenetrans*

A. The effect on nematode population; *T. semipenetrans*

This trial was carried out under field conditions on citrus trees in a private vineyard situated at Cairo- Alexandria desert road (78th kilometer). The trial was conducted in sandy soil area whereas the nematode infestation is somewhat homogenized on Volkameriana trees. Thenematode population were counted throughout the experimental period and documented in table (3). Total nematode population in both soil and root samples revealed the suppressive effect of all materials on the nematode counts. In general, the nematode counts decreased gradually in both soil and root of the treated trees.

Results showed an increase in the efficacy percentages of the treatments and caused a decrease in total nematode population ranging between (36-61%) after one month. Then, remarkable suppression in nematode counts obtained after two months or more expect after the fourth month the total nematode population in

both soil and root samples increased. At the end of experiment all the treatments gave satisfactory reduction in the nematode counts.

Table (3): Efficacy of some bioagents and plant extracts on nematode population of *T. semipenetrans* on citrus (cv. Volkameriana) under field conditions.

	Treatments	Conc./ tree	Initial	After one month		After two months		After three months		After four months	
			Total population in soil and roots *	Total population in soil and roots*	Efficacy	Total population in soil and roots*	Efficacy	Total population in soil and roots*	Efficacy	Total population in soil and roots*	Efficacy
Bioagents	*Psudomonas fluorescens*	5×10^{8} cells	2620	1290	(58)	1220	(69)	980	(77)	1190	(73)
	Arthrobotrys oligaspora	5×10^{8} cfu	2540	1450	(52)	1320	(65)	1160	(72)	1290	(70)
	Trichoderma harzianum	5×10^{8} cfu	2580	1360	(55)	1290	(66)	1060	(75)	1340	(72)
Plants	*Eucalyptus globules*	20 g. /100 ml. water	2630	1990	(36)	1740	(55)	1540	(64)	1700	(62)
	Origanum majorana	20 g. /100 ml. water	2640	1700	(45)	1480	(62)	1270	(70)	1440	(68)
	Tagetes erecta	20 g. /100 ml. water	2560	1820	(40)	1570	(58)	1380	(67)	1520	(65)
Oxamyl (24% EC)			2600	1200	(61)	1100	(71)	890	(79)	1060	(76)
Check (nematodes only)			2880	3380	-	4200	-	4580	-	4840	-
L. S. D. at 0.05%			23.9	46.7		55.1		77.5		57.1	

* 250 g. soil + 1 g. roots

Percentage of nematode reduction from soil {% efficacy according to Handerson & Tilton formula, (Anonymous, 1981)}

$$\text{Efficacy} = 1 - \left(\frac{\text{Total nematode population of treated trees after application}}{\text{Total nematode population of treated trees before application}} \times \frac{\text{Total nematode population of check trees before application}}{\text{Total nematode population of check trees after application}} \right) \times 100$$

Data in table (3) reveled that by using *Psudomonasfluorescens* the highest decrease in the total number of nematodes in both soil and root samples was achieved in comparing with the other treatments. *Arthrobotrysoligospora*,*Trichodermaharzianum* and *origanummajorana* and*Tageteserecta* occupied an intermediate position in reducing the number of total of nematodes while *Eucalyptus globules* showed the lowest efficacy in reducing total number of nematodes in both soil and root samples.

B.The effect on yield fruit weights

Data in fig. (3) illustrated the effect of different bioagents and plant extracts on fruit weights of citrus after treatments under field conditions. All the treatments showed remarkable increasing % in fruit weights. The treatment *Psudomonasfluorescens*had the highest effect in the increasing of fruit weights (54.1%). While, the treatment *Eucalyptus globules* had the lowest effect in the increasing of fruit weights (22.2%).

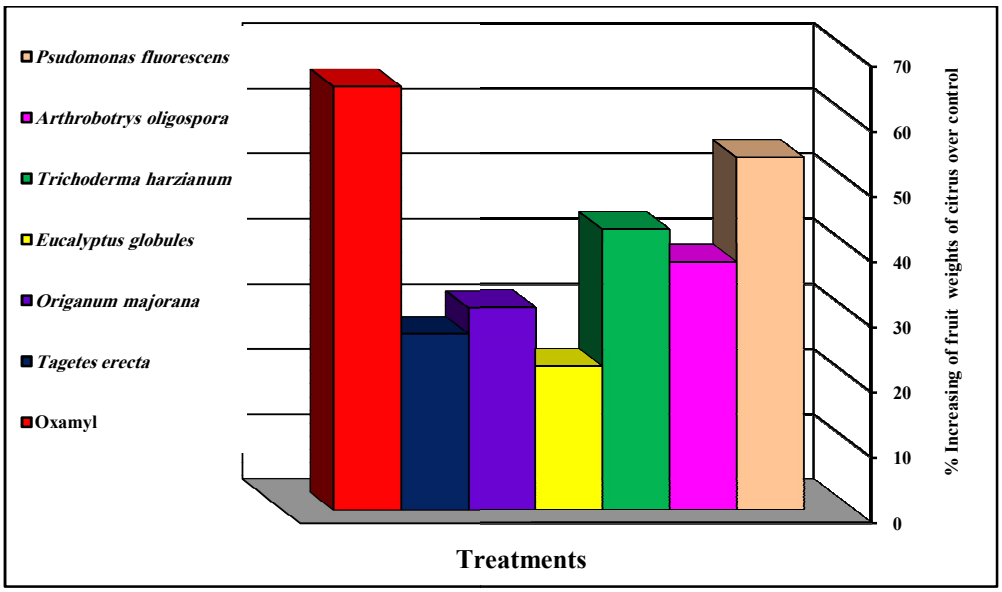

Fig. (3): Efficacy of some bioagents and plant extracts on increasing % of fruit weights of citrus trees infected with *T. semipenetrans* under field conditions.

These results may due to that *Psudomonasfluorescens*,*Arthrobotrysoligospora*and *Trichodermaharzianum* has produce various toxin metabolites and different enzymes that improve photolytic activity of the antagonist and control of nematodes (**Duponnois*et al.*, 2001; Singh *et al.*, 2001; Devi and Upma, 2002; Khan *et al.*, 2002; Hamid *et al.*, 2003; Mahapatra and Mohanty, 2003; Rao*et al.*, 2004; Siddiqui&Shaukat, 2005; El Gendy&Shawky, 2006; Shawky*et al.*, 2010**and **Ali*et al.*, 2012).

*Psudomonasfluorescens*has been reported as a biocontrol agent against nematodes **(Upma, 2002; Hamid *et al*., 2003; Mahapatra and Mohanty, 2003; Rao*etal*., 2004; Siddiqui&Shaukat, 2005** and **Shawky*et al*., 2010)** as well as*Arthrobotrysoligospora*has been mentioned by **(Bandyopadhyay*et al*., 2001; Duponnois*et al*., 2001; Singh *et al*., 2001**; **Khan *et al*., 2002; El Gendy&Shawky, 2006**and **Ali *et al*., 2012).** *T. harzianum* acts against nematode through different mechanisms including mycoparasitism**,** also through production of antibiotic substances **(Banhamoud& Chet 1993)**. *Trichodermaharzianum* acts through production of destructive enzymes i.e., chitenase**(Bolar *et al*., 2000).** *Trichoderma* spp. can produce various toxin metabolites and different enzymes that improve photolytic activity of the antagonist against nematodes. **(Sharon *et al*., 2001;Faruk *et al*., 2002;Siddiqui and Shawkat, 2004;ShawkyandAbd El- Moneim, 2005;Sahebani andHadavi, 2008** and**Abd El- Moneim*et al.,*2010).**

Plant aqueous extracts of *O. majarana*,*T. erecta* and *Eucalyptus globules* decreased the build up of nematodes **(El-Hamawi*et al*., 2004; Khalil &Shawky 2008Shawky*et al*., 2010**and **Ali *et al*., 2012).**The active ingredients of *O. majarana*containing active substances i.e. thimol, alcavacrol, alorzamanik acid. Also it contains pilot oil: major components, hydrates alsabinin, alcarvakrwol, inalol, flavonyat, alcaviien acid,alagoesarniek acid and triturbines**(Saravanapriya*et al.,* 2004).***T. erecta*** contains lemonene,linalool,tagetone,ocimene,d-phellaudrene,linalyl acetate,n-nonyl aldehyde,1,8-cineole **(Ploeg 1999)**. (**El-Hamawi*et al*., 2004 and Verma,2006**) cited that the nematicidal compound (alpha-tertheinyl) is only released by active, living marigold roots.Also, *Eucalyptus globules* leaves contain volatile oil contain: (cencol, pinene, phellendrene, terpincol citronellal, piperitone, astringents and bitter princills). These compounds have nematicidal effect on nematode population according to **(Sabira*et al*., 2000**;**Shaukate*tal*., 2003; Shawky, *et al*., 2010**and **Ali *et al*., 2012**). All these compounds exhibited substantial activity against species of pathogens such as: nematodes. Using the application of nematicides to control citrus nematode in citrus was reported by **(McKenry, 1994).**

Conclusion

From the foregoing results, it can be concluded that Volkameriana rootstock was the most susceptible cultivar; whereas Troyer citrange rootstock was the least susceptible cultivar to the citrus nematodes under greenhouse conditions. The most effective treatments in controlling *T. semipenetrans* were *P. fluorescens* (at 5×10^8) whereas the least effective was *Eucalyptus globules* under both greenhouse and field conditions. All the treatments improved fruit yield of citrus under field conditions.

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الملخص العربي

كفاءة بعض الكائنات الحية والمستخلصات النباتية في مكافحة نيماتوداتيلينكيولسسيميبنيترانس على الموالح في مصر

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أجريت هذه الدراسة لاختبار حساسيةأربعة أصول منالموالح(البرتقال الحامضي وفولكا مريانا وكليوباترا وترويرسترنج) للإصابةبنيماتودا الموالح (نيماتوداتيلينكيولسسيميبنيترانس)ومكافحتها تحت ظروف الصوبة والحقل. وكذلك تقدير محصول ثمار الموالح (أصل فولكاماريانا) بعد الحصاد في مصر. أظهرت النتائج أن(أصل فولكاماريانا)أكثرالأصناف حساسية للإصابةبنيماتودا الموالح (تيلينكيولسسيميبنيترانس) بينما كان (أصلترويرسترنج) أقلهم في الحساسية تحت ظروف الصوبة.

تم اختبار سبعة معاملات (بكتريا البسيدومونسفلوروسنس وفطر الأرثروبتريتسأوليجوسبوراوفطر التريكودرماهريزيانم والمستخلص المائي للبردقوش والمستخلص المائي للقطيفة والمستخلص المائي للكافور بتركيزات مختلفةبالإضافة لمبيد الأوكساميل (٢٤% سائل)لمكافحة نيماتودا الموالح (تيلينكيولسسيميبنيترانس) تحت ظروف كلا من الصوبة والحقل على الموالح.

كانت أكثرالمعاملات فعاليةفي مكافحةنيماتودا الموالح بكتريا البسيدومونسفلوروسنس بينما كانت المعاملة باستخدام المستخلص المائي للكافورأقلهم فعالية تحت ظروف كلاً من الصوبة والحقل. أظهر استخدام بكتريا البسيدومونسفلوروسنستأثيرًا فعالاًفي خفض أعدادالإناث وكتل البيض في الجذور وكذلك تعداد اليرقات من العمر الثانيفي التربة وأقلهم تأثيرًا كانت المعاملة باستخدام المستخلص المائي للكافور تحت ظروف كلاً من الصوبة والحقل.

أدى استخدام جميع المعاملات إلى زيادة في الوزن الخضري والجذري لشتلات الموالح خاصة في التركيزات العالية تحت ظروف الصوبة. أدى استخدام المعاملات إلى خفض أعداد النيماتودا في كلا من الجذور والتربة وكذلك زيادة وزن محصول الموالح (أصل فولكاماريانا) تحت ظروف الحقل.