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Effect of Chemical Nematicides, Chicken Manure and Biocontrol Agents as a Control Method for Certain Plant Parasitic Nematodes Infecting Orchards under Field Conditions in Sharkia Governorate, Egypt

Abd El-Aal, E. M. and R. M. El-Ashry
Department of Plant Protection, Faculty of Agriculture, Zagazig University, Egypt.
*** Corresponding author: Tel. : +201097045440 ,+ 201018434289**
E-mail address: mrmaa2010@ yahoo.com , dr.agric2013@ yahoo.com

ABSTRACT

A field treatment was conducted to evaluate the nematicidal activity of chicken manure and biopesticides (bio- arc , bio-zeid and nemex) viz. chemical nematicides (fydal 24 % SL , tervigo (2% SC), laguna (40% EC) and nemathorin (10% G) against plant –parasitic nematodes infecting fruit orchard located in Sharkia Governorate during 2018. Treatments of chicken manure was at the rate of 30 Kg/ tree , while that of biopesticides were applied at rate of 160 g/tree with bio-arc and bio-zeid , whereas nemex was applied at rate of 24 mL/ tree. Chemical nematicides were applied at rates of 15 mL//tree , 50 g/ tree , 24 mL/tree and 12 mL with fydal 24 % SL, tervigo , laguna and nemathorin , respectively. Samples were taken monthly during three months after application. Results indicated that of the eight tested materials, fydal was the most effective in suppressing umbers of phytonematodes followed by chicken manure while among biopesticides , bio- arc was the least effective one. After one month of application, remarkable decreased in numbers of plant-parasitic nematodes was detected. For instance, in fydal and chicken manure treatments, percentages of reduction in numbers of *Tylenchulus semipenetrans*, *Pratylenchus* spp., *Tylenchorhynchus* spp., *Hoplolaimus* spp. and *Helicotylenchus* spp. were diminished by 49.75 %(40.92 %) ,56.97% (53.54%), 55.47% (55.83%), 50.53% (50.53%) and 52.52 % (50.42%), respectively. After two months of application, percentage of reduction was increased to reach 69.25 %(68.53%) ,81.26% (71.37%), 83.18% (80.08%), 86.92% (83.00%) and 81.77 % (61.93%), respectively for mentioned nematodes. On the other hand, after three months of application, no significant differences ($P \leq 0.05$) was noticed between fydal and chicken manure whereas, the biopesticides were the least effectiveness against plant –parasitic nematodes. Generally, results emphasized that chicken and biopesticides could be used to minimize the population density of plant- parasitic nematodes in citrus orchards.

Keywords: Control, chicken manure , biopesticides, phytonematodes , citrus .

INTRODUCTION

Cultivation of fruits as a food source began nearly 2000 years ago in many parts of the world. In developed Middle East countries, protected cultivation has increased significantly and still based on chemical pesticides in controlling plant – parasitic nematodes especially in intensive crop-production system.

Most cultivated plant species are susceptible to nematodes, and their production depends on the correct management of these pathogens (Sikora & Fernandez, 2005). In Egypt, previous nematological surveys carried out in mandarin orchards have shown the occurrence of many phytoparasitic nematodes, i.e. *Tylenchulus semipenetrans, Pratylenchus* spp., *Helicotylenchus* spp., *Tylenchorhynchus* spp., *Meloidogyne* spp., *Xiphinema* spp. and *Trichodorus* spp. (Mahrous *et al.,* 1985; and Ibrahim *et al*., 2016).

Among which, *T. semipenetrans* was reported to cause remarkable damage to citrus trees (Abou-El-Naga *et al*., 1984; Bakr *et al.*, 2011 and Montasser *et al.*, 2012). The annual economic losses in crop yield due to infestation with citrus nematode were ranged from 8.7 to 12.2%, according to Cohn (1972) and 14% according to Sasser (1989).

Many problems initiated from using nematicides for their highly toxicity to animals and humans, contamination of soil and groundwater applied and some of them are absorbed by plants. On the other hand, Egyptian citrus exports are facing severe competition with Mediterranean countries. The main problem in this respect is the extensive use of chemical fertilizers and pesticides that are not accepted by the European markets (Bazargan, 2017).

Nowadays, many alternative methods used to prevent or decrease hazards resulting from overdose usage of chemical pesticides to manage plant-parasitic nematodes in citrus orchards.

Traditional cultural practice, such as addition of animal manures as soil amendments which use as organic or sustainable farming systems , is a curative method for plant-parasitic nematodes and to improve soil fertility and structure; also known as a control method for soilborne diseases.

The organic manures were shown to be rich in nitrogen and phenolic compounds (Renco &Kovácik 2012). In addition, in decomposition process of these materials, nitrogen converted to ammonia (Oka, 2010 and Thoden *et al.,* 2011). Therefore, many authors suggested using animal manures, i.e., poultry, pigeon, horse, sheep and duck dung in the programs of controlling phytonematodes (Kimenju *et al*., 2004). Biopesticides, like bacteria or fungus enable conventional farmers to reduce their use of nematicides (Rodrı´guez-Ka´bana, I986).

Therefore, the aim of present study was to determine the effect of three biopesticides and chicken manure in comparison with four nematicides in controlling phytonematodes infesting fruit orchards in Wadi elmoulak district, Sharkia Governorate, Egypt under field conditions.

MATERIALS AND METHODS

1. Site of experiments:

This experiment was carried out in a Balady citrus orchard, cultivated with 20-years old trees grafted on sour orange rootstock (*Citrus aurantium*), spaced at 4m apart and located in Basateen El- Basha, Wadi elmoulak district, Sharkia Governorate. The experimental area was characterized by sandy soil (70.45% sand, 17.72% clay and 11.83% silt), with surface irrigation system.

The treatments were done as following scheme:

1-Bionematicides (Bio- arc , Bio-zeid and Nemex), bio-zeid ($1x10^{10}$ vital spores per gram product of fungus, *Trichoderma album*) was applied at the rate of 160 g/tree (40 kg /feddan) , bio-arc (*Bacillus megaterium*) was applied at rate of160 g/tree (40 kg /feddan) whereas,

nemex (*Serratia marcescens*) was introduced to soil at the rate of 24 mL /tree (6 L/feddan).

2- Chicken manure were applied at 30 kg/ tree (4.98 tons/ feddan).

3-Chemical nematicides (fydal 24% L) was applied at the rate of 15 mL//tree (3L/feddan) , Nemathorin (Fosthiazate) 50 g/tree (12.5 kg/feddan) , Laguna 24 ml/tree (6 L/feddan) and tervigo 12 mL/tree (3 L/feddan) .

4-Trees of the control treatment were left without any amendment or chemical/ biopesticides.

2. Effect of the certain chemical, biopesticides and chicken manure on population density of nematode species in the soil:

During the growing season of a given crop, chicken manure was regularly applied to the soil during the growing season of a given crop. Treatments were conducted to compare between the effect of biopesticides and chicken manure with chemical nematicides in suppressing populations of plant parasitic nematodes in the selected citrus orchard. Chemical pesticides were obtained from Plant Protection Research Institute, Dokki, Giza. A complete randomized block design with three replicates was followed.

The experimental site was divided into five plots (rows), each plot contains 10 trees. The selected rows were separated from each other by one parallel row. Three trees in each row were chosen randomly, labelled and served as replicates for the treatments. Animal manure was air dried for three weeks before use. Chicken, biopesticides and nematicides were separately incorporated in the top 10-20 cm of the soil layer in the canopy of the treated trees. Three subsamples were taken at 20-25cm depth, under tree canopy with a hand trowel after one, two and three months of application during the period from January to April 2018. The three subsamples were mixed to form a composite sample of about 1 kg, kept in polyethylene bags and sent directly to the laboratory. An aliquot sample of 250 g soil was processed for nematode extraction. Nematodes were extracted using a combination of serving and Baermann trays technique (Hopper *et al*., 2005). For nematode identification, 1 ml of nematode suspension was pipetted into Hawksely counting slide and nematodes were examined by the aid of the of research microscope under 100X magnification. Based on morphology of adult and juvenile forms nematodes were identified according to Mai and Lyon (1975) and Siddiqi (1986). The nematode reduction (%) was calculated according to the following equation:

$$\text{Nematode reduction } (\%) = \frac{\text{Control - Treated}}{\text{Control}} \times 100$$

RESULTS AND DISCUSSION

1. Effect of chemical pesticides, chicken manure and biocontrol agents on nematodes infesting citrus orchard .

The effect on phytonematodes after one month:

Preliminary samples were collected from a chosen citrus orchard before experimentation to morphological identification of adult and juvenile forms of occurrence phytonematodes.

Data revealed the occurrence of the citrus nematodes, *Tylenchulus semipenetrans* Cobb; the lesion nematodes, *Pratylenchus* spp. Flipjev; the stunt nematodes, *Tylenchorhynchus* spp. Cobb and the spiral nematodes, *Helicotylenchus* spp. Steiner and *Hoplolaimus* spp. Daday.

Data in Table (1) showed the effect of biopesticides (bio-arc , bio-zeid and nemex) and chicken manure compared to chemical nematicides (fydal, tervigo , laguna and nemathorin) on plant-parasitic nematodes after one month of application. It was found that, all treatments significantly ($P \leq 0.05$) reduced numbers of *T. semipenetrans* compared to control treatment.

Table 1. Effect of chemical pesticides, chicken manure and biocontrol agents on nematodes infesting citrus orchard, one month after application.

Pesticide (Active ingredient)	Trade name/ Formulation	Concentration	Nematode populations per 250 g soil				
			T. semipenetrans	*Pratylenchus* spp.	*Tylenchorhynchus* spp.	*Hoplolaimus* spp.	*Helicotylenchus* spp.
Control			2860 a (0)	96.0 a (0)	112.3 a (0)	9.3 a (0)	47.6 a (0)
Abamectin	Tervigo (2% SC)	Recommended	1554.0 de (45.66)	61.3 bc (36.14)	56.6 bc (49.59)	5.0 b (46.23)	24.6 b (48.31)
Fenamiphos	Laguna (40% EC)	Recommended	1610.3 cde (43.69)	53.3 bc (44.47)	50.3 c (55.20)	5.6 b (39.78)	25.0 b (47.48)
Fosthiazate	Nemathorin (10% G)	Recommended	1795.0 bc (37.23)	62.0 bc (35.41)	57.3 bc (48.97)	5.3 b (43.01)	27.3 b (42.64)
Oxamyl	Fydal (24 % SL)	Recommended	1437.0 e (49.75)	41.3 c (56.97)	50.0 c (55.47)	4.6 b (50.53)	22.6 b (52.52)
Bacillus megaterium	Bio-arc (6 % WP)	Recommended	1892.3 b (33.38)	69.3 b (27.81)	65.3 b (41.85)	6.3 b (32.25)	30.0 b (36.97)
Trichoderma album	Bio-zeid (2.5 % WP)	Recommended	1798.6 bc (37.11)	59.0 bc (38.54)	60.3 bc (46.30)	6.0 b (35.48)	30.3 b (36.34)
Serratia marcescens	Nemex (2 % SL)	Recommended	1669.6 cd (41.62)	57.3 bc (40.31)	57.6 bc (48.70)	6.0 b (35.48)	28.0 b (41.17)
Chicken manure		Recommended	1689.6 cd (40.92)	44.6 c (53.54)	49.6 c (55.83)	4.6 b (50.53)	23.6 b (50.42)

*** Each value is a mean of 3 replicates. * Values in brackets indicate % reduction = Control- Treatment x 100 / Control**

*** Means in each column followed by the same letter(s) are not significantly different at P ≤ 0.05 according to Duncan's multiple range test.**

Trees treated with faydal surpassed all applications with significant variations with chicken manure and biopesticides. On the other hand, slightly insignificant differences were detected between the four nematicides under investigation treatments when they were compared with each other. However, plots treated with faydal overwhelmed those amended with chicken manure or biopeticides in decreasing numbers of phytonematodes. On the other hand, high significantly differences were detected between chemical nematicide treatments and biopesticides treatments.

Percentages reduction in descending order for chemical nematicides were 49.75, 45.66, 43.69 and 37.23 with fydal, tervigo , laguna and nemathorin, 40.92 with chicken manure and 41.62,37.11 and 33.38% with biopesticides (nemex, bio-zeid and bio-arc),consecutively.

Regarding the efficiency of the treated materials on other phytonematodes, results in Table (1) clearly showed that nematicides, chicken manure and biopesticides significantly (P≤0.05) minified numbers of *Pratylenchus* spp., *Tylenchorhynchus* spp. ,*Helicotylenchus* spp. and *Hoplolaimus* spp. compared to control treatment. However, bio-arc achieved the lowest insignificantly effect. Ranges of percentages reduction in populations of *Pratylenchus* spp., *Tylenchorhynchus* spp., *Hoploaimus* spp. and *Helicotylenchus* spp. for tested materials were 27.81 to 56.97%, 41.85 to 55.47 % , 32.25 to 50.53 % and 36.34 to 52.52 %, respectively.

The effect on phytonematodes after two and three months of treatment:

As expected, data in Table 2 and 3 clearly illustrated that increase in percent reduction in population densities of phytonematodes in due to the application of the tested materials compared to the untreated control. Fydal caused remarkable reduction in population density of phytonematode , *T. semipenetrans* after two months of application which recorded 69.25 % next by tervigo (68.43 %) , laguna (62.78%) and Nemathorin (62.44%) . whereas with soil amendment and biopesticides were 68.53 , 62.64 , 62.36 and 53.42 % , respectively with chicken manure , nemex , bio-zeid and bio-arc.

Also, after two months of application, fydal achieved 81.26, 81.18, 86.92 and 81.77 % reduction in numbers of *Pratylenchus* spp., *Tylenchorhynchus* spp., *Hoplolaimus* spp. and *Helicotylenchus* spp.. While after three months of application, these values were reached to 88.74 , 85.12, 90.75 and 89.60 % respectively. On the other hand, it worth mentioning that chicken manure (68.53 & 79.29 %) sustained the best results in prohibiting numbers of *T. semipenetrans* with no significant difference with oxamyl (69.25 & 78.64 %) treatment after two and three months . Regarding effects of biopesticides on the genera, *Pratylenchus* spp., *Tylenchorhynchus* spp., *Hoplolaimus* spp. and *Helicotylenchus* spp. it was clear that all the tested biopesticides, bio- arc, bio-zeid and nemex showed moderately effect on reducing population density of phytonematodes after 2 and 3 months of application. In all cases lower decrease in numbers of these genera was noticed as the time elapsed from second to third month after application.

For instances, in nemex treatment numbers of *Pratylenchus* spp., *Tylenchorhynchus* spp., *Hoplolaimus* spp. and *Helicotylenchus* spp., after 2 and 3 months of application were 38.3 (30.6), 31.0 (31.1) and 3.3 (5.3) and 28.0 (26.3) individuals per 250 g soil, respectively. Likewise, the respective values in bio-zeid treatment were 41.3 (35.6), 42.6 (41.6), 4.3 (4.6) and 30.3 (27.6) individuals per 250 g soil. While, with bio- arc the respective values were 48.6(30.6) , 43.6 (43.6) , 4.0 (4.3) and 30.0 (28.0).

Generally, it could be concluded that, chicken manure was the best treatment after the nematicides in suppressing numbers of phytonematodes infesting citrus trees, and biopesticides were the least effective one in this respect.

Table 2. Effect of chemical pesticides, chicken manure and biocontrol agents on nematodes infesting citrus orchard, two month after application.

Pesticide (Active ingredient)	Trade name/ Formulation	Concentration	Nematode populations per 250 g soil				
			T. semipenetrans	*Pratylenchus* spp.	*Tylenchorhynchus* spp.	*Hoplolaimus* spp.	*Helicotylenchus* spp.
Control			3210 a (0)	115.3 a (0)	138.6 a (0)	15.3 a (0)	62.0 a (0)
Abamectin	Tervigo (2% SC)	Recommended	1013.3 d (68.43)	31.6 e (72.59)	29.6 de (78.64)	3.3 b (78.43)	16.3 d (73.70)
Fenamiphos	Laguna (40% EC)	Recommended	1194.6 c (62.78)	39.3 cd (65.91)	35.3 cd (74.53)	2.0 b (86.92)	18.3 d (70.48)
Fosthiazate	Nemathorin (10% G)	Recommended	1205.6 c (62.44)	40.0 cd (65.30)	31.3 de (77.41)	2.6 b (83.00)	18.3 d (70.48)
Oxamyl	Fydal (24 % SL)	Recommended	987.0 d (69.25)	21.6 f (81.26)	23.3 e (83.18)	2.0 b (86.92)	11.3 e (81.77)
Bacillus megaterium	Bio-arc (6 % WP)	Recommended	1495.0 b (53.42)	48.6 b (57.84)	43.6 b (68.54)	4.0 b (73.85)	30.0 b (51.61)
Trichoderma album	Bio-zeid (2.5 % WP)	Recommended	1208.0 c (62.36)	41.3 bc (64.18)	42.6 bc (69.26)	4.3 b (71.89)	30.3 b (51.12)
Serratia marcescens	Nemex (2 % SL)	Recommended	1199.0 c (62.64)	38.3 cde (66.78)	31.0 de (77.63)	3.3 b (78.43)	28.0 b (54.83)
Chicken manure		Recommended	1010.3 d (68.53)	33.0 de (71.37)	27.6 de (80.08)	2.6 b (83.00)	23.6 c (61.93)

*** Each value is a mean of 3 replicates.** *** Values in brackets indicate % reduction = $\frac{\text{Control- Treatment}}{\text{Control}} \times 100$**

*** Means in each column followed by the same letter(s) are not significantly different at P ≤ 0.05 according to Duncan's multiple range test.**

Table 3. Effect of chemical pesticides, chicken manure and biocontrol agents on nematodes infesting citrus orchard, three month after application.

Pesticide (Active ingredient)	Trade name/ Formulation	Concentration	Nematode populations per 250 g soil				
			T. semipenetrans	*Pratylenchus* spp.	*Tylenchorhynchus* spp.	*Hoplolaimus* spp.	*Helicotylenchus* spp.
Control			3328 ab (0)	127.0 a (0)	156.6 a (0)	17.3 a (0)	86.6 a (0)
Abamectin	Tervigo (2% SC)	Recommended	962.3 bc (71.08)	31.6 cd (75.11)	30.0 bc (80.84)	2.6 c (84.97)	14.0 c (83.83)
Fenamiphos	Laguna (40% EC)	Recommended	976.3 bc (70.66)	26.0 d (79.52)	29.6 bc (81.09)	3.6 (79.19)	12.6 cd (85.45)
Fosthiazate	Nemathorin (10% G)	Recommended	989.6 bc (70.26)	35.3 bc (72.20)	31.3 bc (80.01)	2.6 c (84.97)	14.6 c (83.14)
Oxamyl	Fydal (24 % SL)	Recommended	710.6 c (78.64)	14.3 e (88.74)	23.3 c (85.12)	1.6 c (90.75)	9.0 e (89.60)
Bacillus megaterium	Bio-arc (6 % WP)	Recommended	1138.3 abc (65.79)	39.6 bc (68.81)	43.6 b (72.15)	4.3 bc (75.14)	28.0 b (67.66)
Trichoderma album	Bio-zeid (2.5 % WP)	Recommended	1108.3 abc (66.69)	35.6 b (71.96)	41.6 b (73.43)	4.6 bc (73.41)	27.0 b (68.82)
Serratia marcescens	Nemex (2 % SL)	Recommended	1001.0 a (69.62)	30.6 cd (75.90)	31.1 bc (80.20)	5.3 b (69.36)	26.3 b (69.63)
Chicken manure		Recommended	852.3 c (74.39)	26.3 d (79.29)	27.6 bc (82.37)	2.3 bc (86.70)	10.0 de (88.45)

*** Each value is a mean of 3 replicates.** *** Values in brackets indicate % reduction = $\frac{\text{Control- Treatment}}{\text{Control}} \times 100$**

*** Means in each column followed by the same letter(s) are not significantly different at P ≤ 0.05 according to Duncan's multiple range test.**

Plant – parasitic nematodes are particularly difficult pathogen to manage, especially under field conditions because the optimum or protected cultivation conditions in citrus orchards (temperatures, soil moisture) throughout most of the year (Díez and Dusenbery,1989). Beside suitable host plants with long crop cycles are suitable for phytonematodes to thrive and increase population densities within host plants (Roberts *et al.,* 1981).

Pollution to soil, air and environment results from the traditional methods used to protect crops from plant-parasitic nematodes (Naseby *et al*., 2000), biopesticides and animal manures have been used as alternatives materials in controlling nematodes.

Goswami and Mittal, 2004) showed that bacteria and fungi were used as biological agents to protect field crops, whereas, Mascarin *et al*., 2012 concluded that the fungus *T. harzianum* is a good material in IPM program.

Results of current study showed major advanced in the control of phytonematodes with all the tested materials and significantly minified their populations. In all treatments, fydal proved to be the most suppressive one in all tested chemical nematicides and followed by chicken manure. Whereas, among bipesticides, nemex was the best treatment followed by bio-zeid while the bio-arc was the least effective one. After one month of application, all treatments showed significant reduction ($P \leq 0.05$) in numbers of plant parasitic nematodes and as the time elapsed from second and third months.

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) . El-Deeb *et al.,* 2018 revealed that insignificant variations were detected between oxamyl and manures when chicken and goat manures were used to control *M. incognita* under greenhouse conditions. Also many authors who tested organic manures against *T semipenetrans* (Badra *et al.*, 1979 and Montasser *et al.,* 2012), *Pratylenchus* (Yang *et al.*,2016) and *Helicotylenchus*, *Tylenchorhynchus* (Rodriguez- Kabana, 1986).

On the other hand, treatments of manures were increased numbers of *P. penetrans* in potato soil as results of increase in soil moisture and better development of potato roots which provided more recourses for nematode populations (Kimpinski *et al.*, 2003). Moreover, McSorley & Gallaher (1996) found that yard-waste compost did not affect *Pratylenchus* spp. Whitehead (1998) showed that even when organic amendments appear to have negative effect on plant parasitic nematodes, the large amount needed for effective control make their use feasible only in small areas.

Lazarovits *et al*., 2001 and Lopez-Pérez *et al*., 2005 thought that mode of action of chicken manure is to be based on the release of toxic levels of ammonium and stimulation of antagonistic organisms.

In conclusion, chicken and biopesticides could be used to minimize the population density of plant- parasitic nematodes. However, further studies are needed under greenhouse and field conditions to improve methods of use biocontrol agents and animal manure for obtaining maximum control efficacy.

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تأثير بعض المبيدات النيماتودية وسماد الدجاج والأسمدة الحيوية كطريقة مكافحة لبعض أنواع النيماتودا التي تصيب الموالح تحت الظروف الحقلية بمحافظة الشرقية في مصر.

السيد محمد عبد العال و رمضان محمد العشري

قسم وقاية النبات ـ كلية الزراعة – جامعة الزقازيق

أجريت تجربة تحت ظروف الصوبة لتقييم سماد الدجاج , والمبيدات الحيوية مثل مبيد البيوأرك bio-arc البيوزيد bio-zeid والنيمكس nemex مقارنة مع المبيدات النيماتودية الكيماوية فايدال fydal ، تيرفيجو tervigo ، لاجونا laguna و نيماثورين nemathorin على النيماتودا المتطفلة على النبات التى تصيب بساتين الفاكهة فى محافظة الشرقية خلال عام ٢٠١٨ ، وكانت معاملات كل من سماد الدجاج بمعدل ٣٠ كيلو جرام / شجرة وكل من بيو أرك & بيوزيد بمعدل ١٦٠ جرام /شجرة ، بينما استخدم نيمكس بمعدل ٢٤ مل / شجرة بينما طبقت المبيدات النيماتودية بمعدل ١٥ مليلترِ / شجرة، ٥٠ جرام / شجرة، ٢٤ مليلتر / شجرة و١٢ مليلتر / شجرة مع كل من فايدال ، تيرفيجو ، لاجونا و نيماثورين على التوالي. أخذت العينات شهرياً ولمدة ثلاثة شهورِ بعد المعاملة. أشارت النتائج إلى أنه من بين المواد الثمانية المختبرة كان الفايدال هو الأكثر فاعلية فى خفض أعداد النيماتودا المتطفلة على النبات وكانت أفضل المعاملات (بعد المعاملة بالفايدال) هو سماد الدجاج بينما كان البيوأرك أقلهم تأثيرا. بعد شهر واحد من المعاملة لوحظ انخفاض ملحوظ في أعداد النيماتودا المتطفلة على النبات فعلى سبيل المثال في المعاملة بكل من الفايدال وسماد الدجاج كانت النسبة المئوية للانخفاض في أعداد كل من نيماتودا الموالح *Tylenchulus semipenetrans*، ونيماتودا التقرح .*Pratylenchus* spp ،ونيماتودا التقزم.*Tylenchorhynchus* spp ، والنيماتودا الرمحية .*Hoploaimus* spp والنيماتودا الحلزونية .*Helicotylenchus* spp ٤٩.٧٥ % (٤٠.٩٢ %)، ٥٦.٩٧ % (٥٣.٥٤ %)، ٥٥.٤٧ % (٥٥.٨٣ %)، ٥٠.٥٣ % (٥٠.٥٣ %) و٥٢.٥٢ % (٥٠.٤٢ %)، على التوالي . وبعد شهرينِ من المعاملة زادت النسبة المئوية للخفض لتصل إلى ٦٩.٢٥ % (٦٨.٥٣ %)، ٨١.٢٦ % (٧١.٣٧ %)، ٨٣.١٨ % (٨٠.٠٨ %)، ٨٦.٩٢ % (٨٣.٠٠ %) و٨١.٧٧ % (٦١.٩٣ %)، على التوالي مع أنواع النيماتودا سابقة الذكر. ومن ناحية أخرى، بعد مرور ثلاثة شهورِ من المعاملة، لا توجد إختلافات معنوية بين كل من فايدال وسماد الدجاج بينما كان المبيد الحيوي بيو أرك أقل المعاملات تأثير فى خفض أعداد النيماتودا المتطفلة على النبات . وعموماً ، وتؤكد هذه النتائج أن سماد الدجاج والأسمدة الحيوية يمكنهم خفض أعداد النيماتودا المتطفلة على النبات في بساتين الموالح.