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EFFECT OF DIFFERENT ORGANIC MANURES AND MEDICINAL PLANTS IN THE BIOLOGICAL CONTROL OF NEMATODES INFECTING TOMATO PLANTS

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ABSTRACT

This experiment was conducted under green house conditions to evaluate the effect of cattle manure, poultry manure, neem leaf powder, White Wormwood leaf powder, Palestinian Arum leaf powder, singly and in combination, on the control of plant parasitic nematodes infecting tomato plants. Results indicated that, one month after applications, the highest decrease in the average numbers of plant parasitic nematodes was recorded with the treatments of Palestinian arum + Poultry manure (185.3 nematodes) and Neem + Poultry manure (200.3 nematodes), in comparison with the control treatment (390.7 nematode). After two months of applications, the highest decrease in the average numbers of nematodes was recorded with Neem + Poultry manure (90.3 nematodes) and Palestinian arum + farmyard manure (96.3 nematodes), in comparison with the control treatment (469.7 nematodes). Three months after applications, the highest decrease in nematodes was recorded with Palestinian arum + Poultry manure (68.3 nematodes) and Neem + Poultry manure (56.3 nematodes), in comparison with the control treatment (567.3 nematodes).The highest increase of tomato fruit yields was recorded with the nematicide Carbufuran , Neem + Poultry manure, and Neem + farmyard manure (50.68, 46.96, 45.36 %) . Finally, it could be concluded that the application of Neem plus Poultry manure to tomato seedlings gave very good results in the control of plant parasitic nematodes, as well as, it increased the tomato yield of fruits.

Key words: Nematodes, Tomato, Biological control, Medicinal plants.

INTRODUCTION

Nematode control is essentially prevention, because once a plant is parasitized it is impossible to kill the nematode without destroying the host. The most sustainable approach to nematode control will integrate several tools and strategies, including cover crops, crop rotation, soil solarization, least-toxic pesticides, and plant varieties resistant to nematode damage. These methods work best in the context of a healthy soil environment with sufficient organic matter to support diverse populations of microorganisms. A balanced soil ecosystem will support a wide variety of biological control organisms that will help keep nematode pest populations in check. Some plants produce allelochemicals that function as nematode-antagonistic compounds, such as polythienyls, glucosinolates, cyanogenic glycosides, alkaloids, lipids, terpenoids, steroids, triterpenoids, and phenolics, among compounds from these plants e.g., castor bean, chrysanthemum, partridge pea, velvetbean, sesame, jack bean, crotalaria, sorghum-sudan, indigo, tephrosia are exuded during the growing season or released during green manure decomposition. Sunn hemp, a tropical legume, and sorghum-sudan, a prolific grass plant grown for its biomass, are popular nematode-suppressive cover crops that produce the allelochemicals known as monocrotaline and dhurrin, respectively. (Chitwood, 2002; Grossman, 1988; Hackney and

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Dickerson, 1975; Quarles, 1993; Wang et al., 2002; Williams and Williams, 1990a, 1990b, 1993)

Therefore, this trail was conducted to use some materials as biological pesticides to control nematodes which also will decrease the population of other pathogenic microorganisms which participate with nematodes to cause complex diseases to vegetable crops in plastic houses.

MATERIALS AND METHODS

1- Agents and treatments:

Agents and treatments as well as the structure and rate of application was as follow in Table 1:

Table (1). Agents, structures and rate of applications.

Substances	Structure and rate of application
Farmyard manure	Mixture of cattle, sheep, goat dung, soil, nutrition substances, applied at the rate of 20 m3/feddan. (500 cm3 / seedling)
Poultry manure	Mixture of chicken refuse, soil, nutrition substances, applied at the rate of 5 m3/feddan. (125 cm3 / seedling)
Neem leaf powder	Neem Azadirachta indica is a medicinal plant contained sesquiterpene lactones. Used as dry powder of leaves and stems at the rate of 3 g/plant (100kg/feddan) (35 g / seedling)
White Wormwood leaf powder	Artemisia herba alba a herbal plant have strong aromas and bitter tastes from terpenoids and sesquiterpene lactones, which exists as an adaptation to discourage herbivory. Used as dry powder of leaves and stems at the rate of 35 g/plant (100 kg/fed).
Palestinian Arum leaf powder	Arum palestinian a repent plant contains Calcium oxalate and some minerals and vitamins. Used as dry powder of leaves and stems at the rate of 35 g/plant (100 kg/feddan).
Carbofuran	Trade Name: Carboran 10% G Common Name: Carbufuran 10% G Mole Formula: C12H15NO3 Chemical Name: 2, 3-di hydro-2, 2-dimethyl-7-benzofuranyl methyl carbamate. Applied as soil treatment at the rate of 6 kg / feddan. (2 g / seedling).

2- Effect of single and mixed applications of some materials on the control of plant parasitic nematodes:

To study the effect of 12 materials in the control of plant parasitic nematodes infecting tomato plants variety (Pritchard) under plastic house conditions (25 ± 5 ºC & 70 ± 5 % relative humidity). Thirty-nine plots each 3 m2 were planted with tomato seedlings (4 weeks old) at 30cm long and 90 cm width. Each spot was planted with 2 seedlings. Each treatment was replicated 3 times. Treatments were arranged as a randomized complete block design.

Materials were applied at the time of planting as follows:

1- Farmyard manure

2- Poultry manure

3- Neem

4- White wormwood

5- Palestinian arum

6- Neem + Farmyard manure

7-White wormwood+ Farmyard manure

8-Palestinian arum + Farmyard manure

9- Neem + Poultry manure

10- White wormwood + Poultry manure

11- Palestinian arum + Poultry manure

12- Carbofuran

13- Control

All agricultural practices were done as usual except application of any chemicals and pesticides. Check treatment was left without any applications. Drop irrigation was established in the plastic houses, the mean average of air temperature was ranged from 22-26 ºC. and the relative humidity was ranged between 60-70%. Seedlings were planted at the first of February 2018 and continued to the end of June, 2018, while irrigation was established under plastic houses, the mean average of air temperature was ranged from 19-23 ºC. Seedlings were planted at the same time of irrigation in the plastic houses. Composite soil samples each about 1 kg were collected from treatments before planting and monthly to the end of the experiment. Crop of tomato fruits was recorded from each treatment as kg / plant. At the end of the experiment, fresh weights of plants were calculated.

3-Sampling Procedures:

Soil samples were collected from plastic houses, using a hand trowel where while the dried surfaces of soil was removed and samples were taken from the wetted rhizosphere region of the soil and transferred to the laboratory to extract nematodes and determine the population of each genus and to identify nematode genera especially plant parasitic ones.

Soil samples of about 1 kg were collected from the rhizosphere of growing plants by digging the soil to a depth of 15-20 cm. From each sampling site a number of subsamples were collected and thoroughly mixed to form a composite sample, representing the whole treatment.

The collected samples were kept in polyethylene bags and sent to the laboratory for nematode extraction, numeration and identification.

4-Nematode Extraction and Numeration:

Each composite soil sample was carefully mixed, and an aliquot of 100 cm3 was processed for nematode extraction according to methods described by Southey (1970), each treatment was replicated three times. About 300-400 ml of water were added to the soil in a glass beaker (1000 ml) and the mixture was agitated by fingers, after few seconds the suspension was poured onto a 60 mesh-sieve and passing suspension was collected in another clean glass beaker. Materials caught on the 60 mesh-sieve were discarded, while the collected suspension was then poured onto a 200 mesh-sieve. Materials remain on the sieve were thoroughly washed by a gentle streamed of water into a 200 ml beaker. The resulting suspension containing nematodes was then transferred to a Modified

Baermann pan fitted with soft tissue paper for the separation of active nematodes from debris and fine soil particles. After 72 hrs, nematode water suspension was collected and concentrated to 20 ml in a vial by using a 350 mesh-sieve. An aliquant of 1 ml each of nematode suspensions were pipetted off, placed in a Hawksley counting slide and examined using a stereomicroscope.

Nematode counts were made 1,2, and 3 months of application, and the identification to generic level were based on morphology of the adult and larval forms, according to the description of Mai and Lyon (1975).

5- Tomato fruit crops:

The total accumulative fruit crops were calculated to the end of the experiments.

6- Statistical analysis:

All obtained data were subjected to ANOVA test using a computer program (CoStat 6.400, 2008) to determine Duncan's multiple range test and the LSD 5% (least significant difference). In addition, Abbott's formula (1925) was used to determine the increase percentages of vegetative characters.

Reduction percentages were counted according to the formula of Henderson and Tilton (1955):

$$\text{Reduction \%} = \left[1 - \left(\frac{\text{Treatment after}}{\text{Treatment before}} \times \frac{\text{Control before}}{\text{Control after}}\right)\right] \times 100$$

RESULTS AND DISCUSSION

The identification of plant parasitic nematode genera in the experimental area revealed the presence of the following genera: *Pratylenchus, Helicotylenchus, Tylenchorhynchus, Meloidogyne*, *Pratylenchus, Xiphinema, Longidorus*, and *Trichodorus*.

Data presented in Table (2) show the average numbers of plant parasitic nematodes infected the rhizosphere soil of tomato plants cultivated under greenhouse conditions (25 ± 5 ºC & 70 ± 5 % relative humidity) as affected by the application of leaf powders of medicinal plants singly or in combinations, in addition to the reduction percentages of nematodes.

Statistical analysis of data in Table (2) cleared that there were significant differences, in the average numbers of plant parasitic nematodes infected the rhizosphere soil of tomato plants, between control treatment and all other treatments, one, two, and three months after applications.

One month after applications, the highest decrease in the average numbers of plant parasitic nematodes infected the rhizosphere soil of tomato plants was recorded with the treatments of Palestinian Arum + Poultry manure (185.3 nematode individual / 100 cm3 soil) and Neem + Poultry manure (200.3 nematode individual / 100 cm3 soil), in comparison with the control treatment (390.7 nematode individual / 100 cm3 soil).

Two months after applications, the highest decrease in the average numbers of plant parasitic nematodes infected the rhizosphere soil of tomato plants was recorded with the treatments of Worm wood + Poultry manure (110.3 nematode individual / 100 cm3 soil) and Poultry manure (112.3 nematode individual / 100 cm3 soil), in comparison with the control treatment (469.7 nematode individual / 100 cm3 soil).

Three months after applications, the highest decrease in the average numbers of plant parasitic nematodes

infected the rhizosphere soil of tomato plants was recorded with the treatments of Palestinian arum + Poultry manure (68.3 nematode individual / 100 cm3 soil) and Poultry manure (75.7 nematode individual / 100 cm3 soil), in comparison with the control treatment (567.3 nematode individual / 100 cm3 soil).

Data presented in Table (3) clear the effect of the application of different materials on the fruit yields of tomato plants as a result of the control of plant parasitic nematodes.

Statistical analysis of data in Table (3) cleared that there were significant differences, in the average weights of fruit yields of tomato plants, between control treatment and all other treatments.

The highest numbers in the average weights of fruit yields of tomato plants was recorded with the treatments of the nematicide.

Table (2): Average numbers of plant parasitic nematodes infecting tomato plants, 1,2, and 3 months after applications of different materials, under green house conditions

Treatments	Average numbers of nematodes per 100 g soil				Reduction percentages
	Pre treatment	One month after application	Two month after application	Three month after application	
Farmyard manure	395.3 a	360.3 b	210.0 d	115.7 d	82.15
Poultry manure	380.3 b	320.0 c	112.3 g	75.7 g	87.86
Neem	378.7 b	251.3 b	265.0 b	180.7 b	70.90
Worm wood	295.0 f	260.0 d	230.0 c	180.0 b	62.79
Palestinian arum	350.7 c	223.0 e	125.3 f	112.3 d	80.47
Neem + Farmyard manure	326.7 e	320.0 c	200.0 d	96.3 e	81.99
Worm wood + Farmyard manure	349.3 c	241.3 d	183.3 e	126.7 c	77.88
Palestinian arum + Farmyard manure	289.3 f	200.3 fg	96.3 hi	85.0 f	82.08
Neem + Poultry manure	321.7 e	210.0 ef	90.3 i	56.3 h	89.33
Worm wood + Poultry manure	365.0 b	210.3 ef	110.3 g	87.7 f	85.35
Palestinian arum + Poultry manure	333.3 de	185.3 g	125.3 f	68.3 g	87.50
Carbufuran	370.0 b	210.0 ef	103.3 gh	25.0 i	95.88
Control	346.0 cd	390.7 a	469.7 a	567.3 a	-
LSD 5 %	14.5	16.3	10.3	8.1	-

Means in each column followed by the same letter (s) are not significantly different at 5% level.

Carbofuran, Neem + Poultry manure, and Neem + farmyard manure 51.3, 47.7 46.3 kg / 10 plants, respectively, in comparison with the control treatment (25.3 kg / 10 plants).

The highest increase percentages of fruit yields of tomato plants was

recorded with the treatments of the nematicide Carbofuran, Neem + Poultry manure, and Neem + Farmyard manure 50.68, 46.96, 45.36 %, respectively, in comparison with the control treatment.

Table (3): Average weights of tomato fruit yields as affected by the application of different materials, under green house conditions.

Treatments	Application rates	Average weights of tomato fruits per 10 plants	Increase percentages of tomato fruits %
Farmyard manure	(500 cm^3 /seedling)	39.7 ef	36.27
Poultry manure	(125 cm^3 / seedling)	43.7 cd	42.11
Neem	(35 g / seedling)	33.7 hi	24.93
White Wormwood	(35 g / seedling)	30.3 i	16.50
Palestinian Arum	(35 g / seedling)	35.0 gh	27.71
Neem + Farmyard manure	(35 g / seedling) + (500 cm^3 / seedling)	46.3 bc	45.36
White Wormwood + Farmyard manure	(35 g / seedling) + (500 cm^3 / seedling)	37.0 fg	31.62
Palestinian Arum + Farmyard manure	(35 g / seedling) + (500 cm^3 / seedling)	43.0 cd	41.16
Neem + Poultry manure	(35 g / seedling) + (125 cm^3 / seedling)	47.7 b	46.96
White Wormwood + Poultry manure	(35 g / seedling) + (125 cm^3 / seedling)	43.7 cd	42.11
Palestinian Arum + Poultry manure	(35 g / seedling) + (125 cm^3 / seedling)	42.3 de	40.19
Carbofuran	(2 g / seedling)	51.3 a	50.68
Control	-	25.3 j	-
LSD 5 %		3.2	

Means in each column followed by the same letter (s) are not significantly different at 5% level.

Finally, it could be concluded that the application of Neem plus Poultry manure to tomato seedlings gave very good results in the control of plant parasitic nematodes, as well as, it increased the tomato yield of fruits.

The obtained results are in harmony with the experiments conducted by El-Rab (2000) who controlled *Meloidogyne incognita* using Damsis plants dry matter (*Ambrosia martimala* L.) as natural material on cucumber in Egypt. Ibrahim and Ibrahim (2000) evaluated marine algae in the control of *Meloidogyne incognita* on common bean. Bari, *et al*. (2004) who used organic soil amendments to control root-knot nematode of Brinjal. Jung, and Han (2004) studied the biological control of the northern root-knot nematode, *Meloidogyne hapla* using cultural method and biological agents, i.e. *Bacillus thuringiensis* (Bt), *Paecilomyces lilacinus* and plant extract (Huhjuni), in the fields of *Codonopsis lanceolata*. El-Gindi *et al*. (2005) evaluated the efficacy of the aqueous extracts of cabbage, *dill, fennel*, *Sesbania aculeata*, Washingtonia filifera, *Pimpinella anisum* and *Thymus vulgaris* in controlling the root-knot nematode, *M. incognita*. El-Nagdi (2006) studied the

management of the root-knot nematode, *Meloidogyne incognita* infecting cowpea as influenced by intercropping with sea ambrosia, jojoba and marigold as antagonistic plants. Radwan *et al*. (2007) compared the nematicidal potentials of dried leaves of five plant species against *Meloidogyne incognita* infecting tomato. Recently, Sweelam *et al*., 2019 successively controlled citrus nematode using three bioagents under field conditions.

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