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BIOLOGICAL CONTROL OF PLANT PARASITIC NEMATODES INFECTED CUCUMBER PLANTS UNDER SHIELD PLANTATION CONDITIONS

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ABSTRACT: *The main purpose of the experiments was to study the abundance of nematode genera in the soil of the commercial plastic houses cultivated with cucumber crop, under controlled conditions and to study the effect of 17 bioagents in the control of plant parasitic nematodes infecting cucumber plants variety (Medina) under plastic house conditions. Results indicated that the highest grand mean reduction percentages of nematodes were recorded with the treatments of Carbufuran (93.3 %); followed by powder of fish bones (92.1 %); and Poultry manure (91.0 %) without significant differences, while the treatments of Compost, 1part farmyard manure + 2 part poultry manure; Potassium; Saccharomyces; and Streptomyces gave moderate reduction percentages without significant differences, as (85.4 %), (82.5 %), (80.3 %), (80.3 %), (80.1 %), respectively. The lowest grand mean reduction percentages of nematodes were recorded with the treatments of Sulfur, Bacillus thuringiensis , (Zn, Mn, Fe) , Demssisa, Neem, resulting (44.6 %), (51.4 %), (51.4 %), (54.4 %), (54.5%), respectively. The highest weights in the cucumber fruit crops were recorded with the treatments of Farmyard manure (130.7 %) (17.3 kg) , followed by the treatment of Poultry manure giving (113.3 %) (16.0 kg), Compost (105.3 %) (15.4 kg), powder of fish bones (100.0 %) (15.0 kg), while the least weights in the cucumber fruit crops were recorded with the treatments of Saccharomyces (32.5 %) (9.9 kg) , followed by the treatment of Zn, Fe, Mn giving (58.7 %) (11.9 kg), Potassium, (69.3 %) (12.7 kg), Sulfur (70.7 %) (12.8 kg), Streptomyces (72.0 %), (12.9 kg), and finally Beauveria bassiana (78.7 %), (13.4 kg / 10 plants), in comparison with the control which harvested only (7.5 kg).*

Key words: *Biological control, bioagents , cucumber, organic manures, parasitic nematodes, solarization.*

INTRODUCTION

Plant-parasitic nematodes comprised about 40% of the nematode community following a short fallow, and multiplied to about 67%, of the population within 11–16 months of planting different crops (Stirling *et al*., 2001, 2003). The most widely distributed nematode species in vegetable crop fields are lesion nematode (*Pratylenchus* spp.), root-knot nematode (*Meloidogyne* spp.) stunt nematode (*Tylenchorhynchus* spp.), stubby root nematode (*Paratrichodorus* spp.), reniform nematode (*Rotylenchulus* spp.), spiral nematode (*Helicotylenchus* spp.), ring nematode (*Criconemella* spp.), and dagger nematode (*Xiphinema* spp.). In the past 20 years three developments have occurred which have had significant effects on the prospects and opportunities for the biological control of plant-parasitic nematodes. First, several nematicides have been withdrawn from the market because of health and environmental problems associated with their production and use (Thomason, 1987). As a result of this, and increasing public concern over the use of pesticides in food production, there has been increased interest in the development of alternative methods of control, including the use of biological agents. Second, it has been demonstrated in several soils that nematophagous fungi and bacteria increase under some perennial crops, and under those grown in monocultures, and so may control some nematode pests, including cyst and root-knot nematodes (Stirling, 1991). Finally, a number of commercial products based on nematophagous fungi and bacteria have been developed, but all so far have had only limited success. Their use has been based on empirical research, and it is instructive to consider what might be the key factors for a successful biological control agent for nematodes in order to identify the reasons for the general failure of the products that have been developed.

Biological control is more inconsistent, less effective and slower acting than control normally achieved with chemicals. Although improvements in performance might be expected from more research on individual agents, it seems likely that these limitations are inherent in most biological control agents and that their successful application will depend on integration with other control measures. Akhtar (1999 & 2000) investigate in field plot experiments the influence of soil applications of neem-based and crop fertilizer (urea and cattle manure) treatments, separately and in combination on plant-pathogenic nematode populations and crop productivity, and found that all the treatments significantly decreased the number of plant-parasitic nematodes with increasing doses. In addition, Akhtar and Abdul Malik (2000) reported that organic soil amendments stimulate the activities of microorganisms that are antagonistic to plant-parasitic nematodes. The decomposition of organic matter results in accumulation in the soils of specific compounds that may be nematicidal. Control of plant-parasitic nematodes can be by improvements of soil structure and fertility, alteration of the level of plant-resistance, release of nemato-toxic compounds), parasites (fungi and bacteria) and other nematode antagonistic (biological control agents).

However, if agents are only effective against specific nematode pests, and their efficacy is dependent on pest densities, then their effective use will require expert advice that may not be available in many developing countries. Sikora (1992) reviewed a range of control measures, including crop rotation, partial soil sterilization, soil amendments and nematicides, that could be combined to increase the activity of naturally occurring biological control agents. Such measures could also be used to improve the performance of agents added to soil. Partial soil sterilization by methods such as solarization reduces nematode infestations and also reduces the competition from the residual soil microflora, enabling the biological control agent to establish more readily. Soil amendments may also reduce nematode infestations and, by providing an energy source, help to increase numbers of facultative parasites; pre-colonized substrates are most effective in establishing nematophagous fungi in soil.

From these points of view this research was conducted to determine the efficacy of different bio agents i. e. farm yard manure, poultry manure, neem , compost, some bacterial and fungal compounds, some plant and animal wastes, in comparison with a nematicide , in the control of plant parasitic nematodes infecting cucumber plants grown under shield plantations conditions, in addition to study the effect of these agents on the non parasitic nematode populations.

MATERIALS AND METHODS

The present studies were carried out at the experimental station of the Faculty of Agriculture , Menoufia University, Shebin El-Kom and the laboratory of Economic Entomology and Agricultural Zoology Department of Faculty of Agriculture, Menoufia University.

The main purpose of the experiments was to study the abundance of nematode genera in the soil of the commercial plastic houses cultivated with cucumber crop, under controlled conditions and to study the control of plant parasitic nematodes using some new approaches and bio-agents.

1-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, enumeration and identification.

2- Nematode Extraction and Numeration:

Each soil sample was carefully mixed, and an aliquot of 250 cm3 was processed for nematode extraction according to methods described by Christie and Perry (1951) and Southey (1970). 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 and identification to generic level were based on morphology of the adult and larval forms, according to the description of Goodey (1963) and Mai and Lyon (1975).

3- Used materials:

Used materials were added before cultivation and implemented as shown in (Table 1).

4- Effect of single application of some materials on the control of plant parasitic nematodes:

To study the effect of 17 materials in the control of plant parasitic nematodes infecting cucumber plants variety (Medina) under plastic house conditions, 55 plots each 3 m^2 were planted with cucumber seedlings at 30cm long and 90 cm width. Each spot were planted with 2 seedlings. Each treatment were replicated 3 times. Treatments were arranged as a randomized complete block design.

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 C°. and the relative humidity was ranged between 60-70% .Seedlings were planted at the first of February 2008 and continued to the end of June 2008. Composite soil samples each about 1 kg were collected from treatments before planting and every one month to the end of the experiment . Accumulative crop of cucumber fruits was recorded from each treatment as kg / plant.

Table 1 : Structure and rate of application of different used substances.

Substances	Structure and rate of application
Farmyard manure	Mixture of cattle, sheep, goat dung ,soil, nutrition substances, applied at the rate 20 m^3/feddan.
Poultry manure	Mixture of chicken refuse, soil , nutrition substances, applied at the rate of 5 m^3/feddan.
Compost	(100 kg farm yard manure + 40 kg fragments rice + 265 cm3 effective micro-organisms (EM1) + 265 cm3 Molasses + 26 liters of water). Applied at the rate of 10 m3 / feddan to the soil
Dimseisa	Dimseisa *Ambrosia maritime* is a medicinal plant contained ses quiterpene lactones which consisted of demssin and ambrosine was used as dry powder of leaves and stems at the rate of 3 g/plant (100kg/fed).
Neem	Neem *Azadirachta indica* is a medicinal plant contained ses quiterpene lactones. Used as dry powder of leaves and stems at the rate of 3 g/plant (100kg/fed).
Sulphur	Used as a pure element at the rate of 100 kg / feddan.
Potassium	Potassium fertilizer was used as potassium sulfate 33% at the rate of 100 or 200 kg per feddan as a side treatment.
Chelated micro-elements	Commercial chelated compound (14%) Zn, Mn, Fe , used at the rate of 250 g / 200 liters of water.
Biosect	Biosect is a liquid Bio-product contains Egyptian fungus race of *Beauvaria bassiana* used as liquid solution at the rate of (150cm/fed) spraying on the plants and soil.
Protecto	A natural biocide extracted from the bacterium, *Bacillus thuringiensis* . Formulation of WP 32000 I.U/mg. Introduced by K.Z Egypt, applied at the rate of 250 g / feddan.
Vapcomic	Common Name: Abamictin 1.8 % E.C A biochemical pesticide from plant origin as thread bacterium, applied as soil treatment at the rate of 0.25 g / seedling.
Yeast	Yeast an commercial product of the *Saccharomyces* (baker's yeast) , used as spot treatment at the rate of 25 g per seedling.
Trichoderma	*Trichoderma harzianum* is a fungus that is used as a fungicide, applied as soil treatment at the rate of 0.35 g / seedling.
Powder of fish bones	A dry powder of the bones and spines of the Egyptian Bolti fish, *Tilapia nilotica* , applied as soil treatment at the rate of 20 g / seedling.
Powder of cabbage leaves	A dry powder of the outer leaves of the cabbage plants , *Brassica oleracea* Linne., applied as soil treatment at the rate of 30 g / seedling
Carbufuran	Trade Name: Carburan 10% G. Applied as soil treatment at the rate of 6 kg / feddan.
Solarization	Clear plastic 2 mm thickness covered all area except the stems .

5- Statistical analysis:

All obtained data were analyzed by one way analysis of variance (ANOVA) and the means were separated using Duncan's multiple range test and the LSD 5% (least significant difference) according to the computer program , CoStat, Software, (Norman and Streiner, 1994) .

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

RESULTS AND DISCUSSION

The identification of plant parasitic nematode genera in both shield plantation and open fields revealed the presence of the following genera : *Pratylenchus, Helichtylenchus, Meloidogyne, Partylenchus* , *Tylenchorhynchus, Xiphinema, Longidorus,* and *Trichodorus*, while the identification of non parasitic nematodes in both shield plantation and open fields revealed the presence of the following genera: *Mononchus, Rhabditis, Dorylaimus, Aphelenchus* , and *Tylenchus.*

Data presented in Table (2) indicated the average numbers of plant parasitic nematodes per 100 g soil 30, 60, 90 days after the application of some biological control agents and also pretreatment averages , under shield plantation conditions , in comparison with the organocarbamate nematicide, Carbufuran.

Statistical analysis of the data (Table 2) indicated that there were significant differences, in the average numbers of plant parasitic nematodes ,90 days after planting, between Check treatment and all other treatments at all examined samples (30, 60, 90 days after treatment applications) . The least grand mean numbers of nematodes , were recorded with the treatment of powder of fish bones (7.1 nematodes/100 g soil) , followed by Carbufuran (8.8 nematodes/100 g soil), Poultry manure (9.3 nematodes/100 g soil), and Biosect (9.7 nematodes/100 g soil) without significant differences among them (LSD 5% = 2.7) , while Check treatment registered (120.9 nematodes/100 g soil).

Data presented in Table (3) show the reduction percentages of plant parasitic nematodes, infesting cucumber plants after30, 60, 90 days of planting, as influenced by different biocontrol agents in comparison with the organocarbamate nematicide, Carbufuran. Results indicated that the highest grand mean reduction percentages of nematodes were recorded with the treatments of Carbufuran (93.3 %), followed by powder of fish bones (92.1%), and Poultry manure (91.0 %), without significant differences, while the treatments of Compost, 1part farmyard manure + 2 part poultry manure, Potassium, *Saccharomyces*, and *Streptomyces* gave moderate reduction percentages, without significant differences, as (85.4 %), (82.5 %), (80.3 %), (80.3 %), (80.1 %), respectively . The lowest grand mean reduction percentages of nematodes were recorded with the treatments of Sulfur, *Bacillus thuringiensis* , (Zn, Mn, Fe) , Demssisa, Neem, resulting (44.6 %), (51.4 %), (51.4 %), (54.4 %), (54.5 %), respectively .

Table 2 : Effect of different treatments on the population density of plant parasitic nematodes infected cucumber plants under shield plantation conditions .

Treatments	Aver. no. of plant parasitic nematodes / 100g soil				
	Pre-treatment	Days post-treatments			
		30 Days	60 Days	90 Days	Mean
Farmyard manure	98.0 c	40.0 g	31.4 d	11.3 d	27.6 e
Poultry manure	86.6 e	18.0 k	7.9 j	2.0 h	9.3 i
1F : 2P	68.9 g	29.5 i	8.1 j	5.3 fg	14.3 h
Compost	109.2 b	50.7 e	3.6 k	2.0 h	18.8 g
Demssisa	45.8 j	38.1 g	22.2 f	18.0 c	26.1 e
Neem	85.2 e	66.7 c	47.4 b	29.5 b	47.9 b
Sulphur	45.8 j	32.7 h	34.2 c	30.0 b	32.3 d
Zn, Fe, Mn	60.0 h	53.3 d	33.8 c	21.0 c	36.0 c
Potassium	61.3 h	24.2 j	13.7 g	7.0 ef	15.0 h
(Biosect) *Beauveria bassiana*	40.0 k	11.9 m	10.8 hi	6.3 ef	9.7 i
(Protecto) *Bacillus thuringiensis*	42.2 k	30.5 i	28.0 e	19.0 c	25.8 e
(Vapcomic) *Streptomyces* spp	55.6 i	19.0 k	13.3 g	9.1 de	13.8 h
Saccharomyces	60.0 h	24.4 j	11.7 gh	7.0 ef	14.4 h
Trichoderma	84.4 e	43.3 f	13.3 g	11.0 d	22.5 f
Powder fish bones	77.8 f	10.0 m	8.3 j	3.0 gh	7.1 i
Powder cabbage leaves	101.0 c	71.2 b	32.2 cd	11.2 d	38.2 c
Carbufuran	116.6 a	14.5 l	9.0 ij	3.0 gh	8.8 i
Check	93.3 d	107.3 a	115.0 a	140.5 a	120.9 a

Means in each column followed by the same letter (s) are not significantly by ($P \leq 0.05$) accorlingly to Duncan's multiple range test.

Table 3 : Reduction percentage of nematodes infected cucumber plants as affected by different treatments under shield plantation conditions .

Treatments	Reduction percentage %			
	30 Days	60 Days	90 Days	Grand mean
Farmyard manure	64.3	74.1	92.1	76.8
Poultry manure	81.7	92.7	98.7	91.0
1F : 2P	62.6	90.3	94.7	82.5
Compost	60.0	97.6	98.7	85.4
Demssisa	27.8	61.1	74.3	54.4
Neem	32.1	54.6	76.9	54.5
Sulfur	38.2	39.3	56.4	44.6
Zn, Fe, Mn	22.6	54.6	76.9	51.4
Potassium	66.1	82.2	92.7	80.3
(Biosect) *Beauveria bassiana*	70.3	78.1	89.4	79.3
(Protecto) *Bacillus thuringiensis*	37.4	46.5	70.3	51.4
(Vapcomic) *Streptomyces spp*	70.4	80.6	89.4	80.1
Saccharomyces	64.3	84.6	92.1	80.3
Trichoderma	55.6	87.0	91.4	78.0
Powder of fish bones	88.7	90.3	97.4	92.1
Powder of cabbage leaves	39.1	74.1	92.7	68.6
Carbufuran	89.6	93.5	98.0	93.7

3- Effect of the applications of bioagents on the accumulative cucumber fruit crops grown under shield plantation conditions :

Data presented in Table (4) show the effect of the applications of different bioagents on the accumulative cucumber fruit crops grown under shield plantation conditions. Results on the total weight of cucumber fruit crops (Table 4) indicated that the applications of the all bioagents gave positive increases in the weights of cucumber fruits which ranged between 9.9 kg /10 plants to 17.3 kg / 10 plants representing 32.5 % to 130.7 %, in comparison with the control which harvested only (7.5 kg / 10 plants). The highest weights in the cucumber fruit crops were recorded with the treatments of Farmyard manure (130.7 %) (17.3 kg) , followed by the treatment of Poultry manure giving (113.3 %) (16.0 kg), Compost (105.3 %) (15.4 kg / 10 plants), powder of fish bones (100.0 %) (15.0 kg / 10 plants), while the least weights in the cucumber fruit crops were recorded with the treatments of *Saccharomyces* (32.5 %) (9.9 kg) , followed by the treatment of Zn, Fe, Mn giving (58.7 %) (11.9 kg), Potassium, (69.3 %) (12.7 kg / 10 plants), Sulfur (70.7 %) (12.8 kg / 10 plants), *Streptomyces* (72.0 %), (12.9 kg / 10 plants), and finally *Beauveria bassiana* (78.7 %), (13.4 kg / 10 plants), in comparison with the Check treatment which harvested only (7.5 kg / 10 plants).

Table 4 : Effect of biocontrol agents,applied against nematodes infecting cucumber plants on yield under shield plantation conditions.

Treatments	Fresh fruit yield (kg/10plants)						
	1st	2nd	3rd	4th	5th	Total	% increase
Farmyard manure	4.3	2.8	4.7	2.5	3.0	17.3	130.7
Poultry manure	2.5	2.9	3.1	3.8	.07	16.0	113.3
1F : 2P	2.5	3.1	2.9	2.5	3.0	14.0	86.7
Compost	2.8	3.0	3.4	3.8	2.4	15.4	105.3
Demssisa	3.0	3.8	2.7	1.8	2.3	13.6	81.3
Neem	2.3	4.3	2.6	1.5	1.9	12.6	68.0
Sulfur	2.8	3.4	2.9	1.9	1.8	12.8	70.7
Zn, Fe, Mn	2.8	3.5	2.3	2.5	0.8	11.9	58.7
Potassium	3.0	4.0	2.8	2.4	0.5	12.7	69.3
(Biosect) *Beauveria bassiana*	2.8	3.7	1.7	3.0	2.2	13.4	78.7
(Protecto) *Bacillus thuringiensis*	3.5	3.7	2.6	3.0	2.1	14.9	98.7
(Vapcomic) *Streptomyces* spp	2.4	3.8	2.2	2.5	2.0	12.9	72.0
Saccharomyces	2.3	2.8	2.2	1.4	1.2	9.9	32.5
Trichoderma	2.6	4.0	2.9	3.3	2.0	14.8	97.3
Powder fish bones	3.7	3.4	2.9	3.2	1.8	15.0	100.0
Powder cabbage leaves	4.0	3.1	2.8	3.0	2.0	14.9	98.7
Carbufuran	2.9	4.7	2.0	3.6	1.3	14.5	93.3
Check	2.8	1.8	1.5	1.1	0.3	7.5	-

These 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. Ashraf and Khan (2008) evaluated fruit wastes of different crops and the fungal biocontrol agent *Paecilomyces lilacinus* for the management of reniform nematode, *Rotylenchulus reniformis* infecting chickpea under glasshouse conditions. Khan, *et al.*, (2008) examined the effect of single and repeated applications of organic amendments, including castor, mustard and neem oil-cakes and poultry manure, on *Meloidogyne incognita* populations associated with the rhizosphere of date-palm. Wani, (2008) studied the efficacy of soil amendment with dry crop residues on *Meloidogyne incognita* root-knot nematode and plant growth of okra and lentil. Akhtar and Siddiqui (2009) studied the effects of *Pseudomonas putida*, *Pseudomonas alcaligenes* and a *Pseudomonas* isolate (Ps28) on the hatching and penetration of *Meloidogyne incognita* in chickpea .

Metasebia, *et al.*, (2009) studied the efficacy of a formulation of *Bacillus firmus* on root-knot nematode *Meloidogyne incognita* infestation and the growth of tomato plants in the greenhouse and nursery.

Finally it could be concluded that the application of cattle and poultry manures as well as compost , in addition to the potassium sulphate fertilizer, at the time of cultivation of different vegetable seedlings at shield plantation houses will significantly decreased nematode population and increase fruit yields , and at the same time will protect our environment form chemical pollution.

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المكافحة البيولوجية للنيماتودا المتطفلة التي تصيب نباتات الخيار تحت ظروف الزراعات المحمية

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تناولت الدراسة حصر للنيماتودا المتطفلة على نباتات الخيار المنزرعة تحت ظروف الزراعات المحمية بالمحطة البحثية الخاصة بكلية الزراعة جامعة المنوفية وكذلك مكافحة النيماتودا بواسطة استخدام بعض المواد البيولوجية وذلك بتطبيقها عند زراعة شتلات الخيار صنف مدينة . أظهرت النتائج وجود اجناس نيماتودا تعقد الجذور والتقرح والتقزم والحلزونية. سجل مبيد الـ Carbufuranأعلى نسبة موت في النيماتودا المتطفلة على الخيار وصلت إلى (٩٣.٣%) ويلية مسحوق عظام السمك بنسبة (٩٢.١%) ثم سماد الدواجن (٩١.٠%) بدون فروق معنوية. أما المعاملات الـ Compost, 1part farmyard manure + 2 part poultry manure, Potassium, *Saccharomyces*, and *Streptomyces* فقد اعطوا معدلات نسب موت (٨٥.٤%) & (٨٢.٥%) & (٨٠.٣%) & (٨٠.٣%) & (٨٠.١%) على التوالي بدون فروق معنوية. وأقل نسب الموت فقد سببتها المعاملات Sulfur, *Bacillus thuringiensis* , (Zn, Mn, Fe) , Demssisa, Neem. بمعدل (٤٤.٦%) & (٥١.٤%) & (٥١.٤%) & (٥٤.٤%) & (٥٤.٥%) على التوالي. أعلى المعاملات التي سجلت نسبة زيادة في وزن ثمار الخيار كانت السماد البلدي (١٣٠.٧%) ١٧.٣كجم/١٠نباتات يليها سماد الدواجن (١١٣.٣%) ١٦.٠كجم/١٠نباتات ثم الـ Compost (١٠٥.٣%) ١٥.٤كجم/١٠نباتات وأخيراً مسحوق عظام السمك (١٠٠.٠%) ١٥.٠كجم/١٠نباتات. وسجلت أقل الأوزان في ثمار الخيار على معاملة الـ *Saccharomyces* (٣٢.٥%) ٩.٩كجم/١٠نباتات ويليها الـ Zn, Fe, Mn (٥٨.٧%) ١١.٩كجم/١٠نباتات ثم الـ Potassium (٦٩.٣%) ١٢.٧كجم/١٠نباتات ثم يليها الـ Sulfur (٧٠.٧%) ١٢.٨كجم/١٠نباتات والـ *Streptomyces* (٧٢.٠%) ١٢.٩كجم/١٠نباتات وأخيراً الـ *Beauveria bassiana* (٧٨.٧%) ١٣.٤ كجم/١٠نباتات وذلك مقارنة بالكنترول ٧.٥ كجم/١٠ نباتا.