EFFECT OF SOIL TYPES AND COMBINATION OF CERTAIN BIO-AGENT COMPOUNDS ON THEIR EFFECTIVENESS AGAINST THE ROOT- KNOT NEMATODES, *Meloidogyne incognita*

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ABSTRACT

The effect of soil types on the effectiveness of the tested bio-agent compounds against *M. incognita*, treatment with Bio-Nema resulted in the highest efficiency in sandy soil. Treatment with Sincocin sighted the lowest efficiency in sandy soil and clay soil. The results for effect of the combination between the tested bio-agent compounds itself on their effectiveness against *M. incognita* illustrated that, treatments with Nematoxin + cadusafos and Nembecidin + cadusafos due the highest effect against *M. incognita*. Treatments with Sincocin + Bio-Nematon; Sincocin + Bio-Nema resulted the lowest effect, respectively. The combination between cadusafos and the other bio-agent compounds decrease the effectiveness of cadusafos against nematode reproduction.

Keywords: Bio-agent compounds, nematicides, soil types, effectiveness and the plant parasitic nematodes.

1. INTRODUCTION

The plant parasitic nematodes cause great economic losses to agricultural crops worldwide (**Sasser, 1979**) and are considered an economically important group of soil borne pathogens. Root-knot nematodes are serious pathogen of most crops causing quality defects that result in reduced crop value or crop rejection particularly in the warm climate. Root-knot nematodes cause annual losses of about USD $100 billion worldwide **(Brand *et al*., 2010).**Certain safe procedures for nematode control have been developed based on bio-control agents and organic amendments, control plant parasitic nematode by reducing egg production of root – knot nematode which infects roots of several hosts. Research on the possible mechanisms involved in biological control by bio-agents has led to several alternative explanations for successful bio control. Based on this background, greenhouse experiments aimed at substituting nematicides in controlling root-knot disease of okra plants induced by *Meloidogyne* spp. using of commercial antagonists and plant extract. The present work was carried out to evaluate five bio agent compounds namely, Bio--Nema, Bio-Nematon, Sincocin, Nematoxin and Nembecidin to testify their efficacy , as well as the in impact either alone or in mixture of them in comparison with cadusafos (10% G) on *Meloidogyne incognita* infecting okra plants under greenhouse conditions to avoid the hazards of chemicals. Accordingly, the present study aims to investigate the effect of soil type on the efficiency of some bio-agent compounds and effect of interaction between some bio-agent compounds or with the nematicide, cadusafos for controlling the root-knot nematodes, *Meloidogyne incognita* under greenhouse conditions.

2. MATERIALS AND METHODS

2. 1. Root-knot nematode culture:

Culture of *Meloidogyne incognita* (Kofoid & White) was maintained on eggplant plants (Solanum melongena cv. Black Beauty) growing in 20 cm diameter clay pots filled with steam sterilized soil comprised of 1 clay: 2 sand (v /v) . Infected plants were placed in a greenhouse at 25 ± 5 °C and watered regularly. Two months later, infected roots were cut down into pieces and used as sources of inoculation for other healthy eggplant seedlings. By repeating this procedure, enough quantities of *M. incognita* inocula were obtained for other experiments. Mature egg- masses obtained from the source cultures were put in sterilized water in **Petri** dishes for hatching of second stage juveniles (J2s). The emerged J2s were collected and refrigerated at 60C for the experimental use.

2.2. Bio-agent compounds and the nematicide used:

Five tested bio-agent compounds which not registed in Egypt as nematicides and the nematicide, cadusafos were illustrated in Table (1).

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Table (1): The tested bio- agent compounds and the nematicide, cadusafos

Commercial name	Essential components / Concentration	The rate of application
Bio-Nema	*lBacillus penetrans* (32x10^3 spores /g) Liquid	10 L / feddan
Bio-Nematon	*Paecilomyces Lilacinus* (1x10^9 CFU's/ml) – Liquid	2 L / feddan
Nematoxin	Plant extracts 25% - Liquid	1.5 L / feddan
Nembecidin.	Azadirachtin 0.03 % – EC.	1 L / feddan
Sincocin	Plant extracts of Rhizopgora mangle , Rhus aromatic (sumac), Quercus falcate ,Opunita lindheimeria (Prickly Peasrcactus)and (Magngrove) – Liquid.	0.4 L / feddan
Rugby (Common name: cadusafos)	S, S-di-sec-butyl O-ethyl phosphorodithioate (10 %) - Granules.	20kg / feddan

Table (2):Interaction between the tested compounds.

compounds	A	B	C	D	E
A	-	-	-	-	-
B	A+B	-	-	-	-
C	A+C	B+C	-	-	-
D	A+D	B+D	C+D	-	-
E	A +E	B+E	C+E	D+E	-
F	A +F	B+F	C+F	D+F	E+F

2.3. ffect of soil types on the effectiveness of the bio-agent compounds against *M. incognita*.

Two types of autoclaved soil, i.e., clay and sandy soil were used in this experiment (1kg soil/pot).The tested compounds were used at recommended rates. One seedling of okra plants (Hibiscus esculentus, cv. Balady) was planted in each pot. Four replicates were used for each treatment. Each pot was inoculated with about 2000 newly hatched second stage juveniles (J2s) of *M. incognita*. Nematode inoculation was added one week after application of the tested compound. The plants were plucked after 45 days from inoculation. Nematode extraction was conducted according to **(Goody, 1963)** and **(Goodey, 1957).** Numbers of galls, egg masses per root system and number of second stage larvae in the soils were counted according to **(Goodey, 1957).** Eggs per an egg mass were collected according to **(Hussey and Barker, 1973).** Average number of eggs per an egg mass was calculated. Also the plant growth parameters were determined; shoot & root length (cm), shoot & root fresh weights (gm.) and the number of leaves /plant were counted.

2.4. Effect of combination between the bio-agent compounds and/or cadusafos on their effectiveness against *M. incognita*.

Five bio- agent compounds, namely; Sincocin (A), Nematoxin (B), Bio-Nematon (C), Nembecidin (D) and Bio-Nema(E) and the traditional nematicide, cadusafos (F) were tested against root-knot nematode, *M. incognita*. The rate of each compound was applied. The above tested compounds were mixed as shown in table (2).

In addition to A, B and D compounds were mixed together, also the all above six compounds were mixed and tested. Other procedures were conducted as mentioned previously.

2.5. Statistical Analysis:-

Obtained results were analyzed using proc. ANOVA in SAS Mean Separation were conducted using Duncan's multiple range tests in the same program.

3. RESULTS AND DISCUSSION

3.1. Effect of soil types on the effectiveness of the tested bio-agent compounds against *M. incognita*.

Data given in Tables (3& 4) indicated that, in clay soil, Nembecidin resulted in the highest decrease percentage of numbers of galls (64.77%), J2s in soil (62.71%) and total number of eggs (85.71%). While in the sandy soil the bio-agent compounds Bio-Nema showed the highest decrease percentage where the values were 36.34, 39.62 and 56.62% for the same parameters, respectively comparing with the control. By the contrast, treatments with Sincocin resulted the lowest decrease percentages of the same parameters in clay soil (38.30, 47.71 and 69.86%) and in sandy soil (19.95, 16.34 and 28.86%), respectively. Treatment with cadusafos gave superior effect on the nematode. Data indicated that in clay soil, cadusafos decreased the number of galls (90.6%), J2s in soil (95.91%) and total number of eggs (96.30%). Whereas in sandy soil, decreased the same parameters to 87.66, 88.12 and 97.55%, respectively. However, the present results obviously indicated that treatment with bio-agent compounds significantly suppressed the nematode reproduction in clay soil more than in sandy soil. Data given in Tables (5 and 6) revealed that treatment with Nembecidin and Sincocin in clay soil increased the length of shoot with a percentage of 10.05 and 3.50%, respectively comparing with the control. While in sandy soil, treatment with Bio-Nema and Sincocin increased the same parameters with a percentage of 15.68 and 2.16%, respectively. Treatment with cadusafos resulted the highly increase percentages of all plant growth parameters in both type of soils. Similar observation was recorded by the fowling authors, **Ahmed *et al*., (1991)** who said that, the lowest populations occurred in clay loam soil. The increase in clay content of soil decreased the ability of larvae to move freely and penetrate cowpea roots. Also, **Akhtar *et al*., (1998)** determined the effect of autoclaved loamy sand, sandy loam, sandy clay loam or silt loam soils in the presence and absence of *M. incognita*. They observed the highest growth of plants in absence of nematode in sandy loam followed by sandy clay loam, loamy sand and silt loam, respectively. Final nematode

Table (3): Effect of the tested bio- agent compounds and the nematicide, cadusafos on *M. incognita* activity infecting okra plants grown in clay soil.

Treatment	Nematode parameters				
	No. of galls	No. of J2 In soil	No. of eggmasses	average eggs /an eggmass	Total No. of eggs
Bio-Nema	35.0cd	1155.0bcd	9.0b	203.3cd	1829.7
Bio-Nematon	46.3bc	1247.5bc	10.5b	216.5bc	2273.3
Sincocin	54.3b	1343.3b	12.8b	236.3b	3024.6
Nematoxin	38.3cd	1120.8cd	10.3b	209.5c	2157.9
Nembecidin	31.0d	958.0d	8.0b	179.3d	1434.4
cadusafos	8.3e	105.0e	3.5b	106.0e	371.0
Control inoculated untreated	88.0a	2568.8a	38.3a	262.0a	10034.6

In Each column means not followed by the same letter differ significantly from one another at the 0.05 level.

Table (4): Effect of the tested bio- agent compounds and the nematicide, cadusafos on *M. incognita* activity infesting okra plants grown in sandy soil.

Treatment	Nematode parameters				
	No. of Galls	No. of J2 In soil	No. of eggmasses	Average No. of eggs/an eggmas	Total No. of eggs
Bio-Nema	188.3d	6165.8c	143.8d	418.0c	60108.4
Bio-Nematon	211.5c	7143.5c	171.0c	454.3bc	77685.3
Sincocin	236.8 b	8542.8b	196.8b	501.0ab	98596.8
Nematoxin	198.3cd	6560.3c	160.8cd	389.5c	62631.6
Nembecidin	200.3cd	6828.8c	158.5cd	446.5bc	70770.25
cadusafos	36.5e	1213.0d	18.3e	185.8d	3400.14
Control inoculated untreated	295.8a	10211.0a	255.0a	543.5a	138592.5

In Each column means not followed by the same letter differ significantly from one another at the 0.05 level.

population (Pf) was highest in silt loam followed by sandy clay loam, loamy sand and silt loam, respectively. The edaphic factors of soil such as soil texture play a vital role in determining the severity of diseases caused by phytoparasitic nematodes, **Verma and Jain (1998)** mentioned that, reproduction factor of *M. incognita* was the highest in sandy soil followed by loamy soil and it was minimum in clay soil, making it least favorable for the nematode and the significantly highest shoot length, fresh and dry root and shoot weight and number of leaves were obtained in sandy loam soil while these growth parameters were the minimum and significantly lower in clay loam soil. As the same, **Deabes (2005)** reported that, the values of rate of nematode reproduction of *M. incognita* infecting okra plants were higher in sandy loam soil than loamy soil. **Prot** and **Van Gundy (1981)** and **Korra *et al*. (2009)**

noted that, the soil texture effects on the efficacy of some biological compounds on controlling the root- knot nematode, *Meloidogyne* spp.

Table (5): Effect of the tested bio- agent compounds and the nematicide, cadusafos on the growth of okra plants infected with *M. incognita* grown in clay soil.

Treatments	Length (cm)		Fresh weight (gm.)		No. of
	Shoot	Root	Shoot	Root	leaves
Bio-Nema	47.1ab	29.1ab	10.2ab	4.1b	16a
Bio-Nematon	45.4bc	26cd	9.4bc	3.7bc	16a
Sincocin	44.3cd	25.5cd	8.4cd	3.7b	13.8b
Nematoxin	46.4b	27.4bc	10.2ab	3.9b	15.8a
Nembecidin	47.1ab	29.4ab	10.6ab	4. 3ab	15.8a
cadusafos	48.9a	30.5a	11.2a	4. 9 a	16.8a
Control inoculated untreated	42.8d	23.9d	7.5d	3c	13.8b

In Each column means not followed by the same letter differ significantly from one another at the 0.05 level.

Table (6): Effect of the tested bio- agent compounds and the nematicide, cadusafos on the growth of okra plants infected with *M. incognita* grown in sandy soil.

Treatments	Length (cm)		Fresh weight (gm.)		No. of
	Shoot	Root	Shoot	Root	leaves
Bio-Nema	42.8ab	23.8b	8.6ab	2.9b	13.5ab
Bio-Nematon	40.5b	22.8bc	7.8b	2.5bc	11.8c
Sincocin	37.8c	20.8cd	6.3c	2cd	9.5d
Nematoxin	42ab	22.8bc	8.6ab	2.8b	12.5bc
Nembecidin	41.3b	22.8bc	8.1ab	2.6bc	11.8c
cadusafos	44.5a	27a	9.2a	3.9a	14.5a
Control inoculated untreated	37c	20.3d	5.8c	1.8d	8.8d

In Each column means not followed by the same letter differ significantly from one another at the 0.05 level.

3.2. Effect of the combination between the tested compounds on their effectiveness against *M. incognita*.

Data presented in **Table (7)** indicated that, treatments with (Sincocin + Bio-Nematon, Sincocin + Bio-Nema or Sincocin + Nematoxin + Bio-Nematon + Nembecidin + Bio-Nema + cadusafos) gave the lowest percentages of numbers of galls, J2s in soil and total number of eggs with a decrease percentage of (14.82, 30.40 & 26.68, 16.39, 32.04 &22.98, 29.83, 12.88 and 36.71%), respectively comparing with the control. While, the treatments (Nematoxin + Rugby or Nembecidin + cadusafos) gave the highest decrease in the same parameters with a decrease percentage of (51.11, 56.27 & 59.96 and 50.28, 54.62 70.87%), respectively, comparing with the control only inoculated plants. Also, it was observed that, the combination included cadusafos and the other bio- agent compounds decreased the effectiveness of cadusafos against nematode reproduction. For example, the combination included Nematoxin and cadusafos decreased the effectiveness of cadusafos when used alone (Table 7).

Table (7): Effect of the interaction between the tested compounds on *M. incognita* infecting okra plants.

Treatment	Nematode parameters (number/plant/pot)				
	No. of galls	No. of J2 In soil	No. of eggmasses	average eggs /an eggmas	Total No. of eggs
Sincocin + Nematoxin	198.3bcd	5483.5def	123.5bcd	389.8de	49446.3
Sincocin + Bio-Nematon	227.0ab	6311.0cd	142.3b	509.0a	72716.0
Sincocin + Nembecidin	184.3b-f	5215.3de	86.8e	287.0f	26477.3
Sincocin + Bio-Nema	222.8abc	6162.5cd	152.3b	501.5a	76388.5
Sincocin + cadusafos	147.3efg	4267.3efg	77.3e	368.0de	29303.5
Nematoxin + Bio-Nematon	177.0ef	5190.0dg	109.0cde	420.8bcd	46386.5
Nematoxin + Nembecidin	184.3	4951.8d-g	106.8cde	370.0de	40615.5
Nematoxin + Bio-Nema	202.8bcd	5684.0de	152.3b	502.3a	76596.3
Nematoxin + cadusafos	130.3gh	3965.0gh	106.8cde	366.8de	39710.0
Bio-Nematon + Nembecidin	179.8cde	5701.3de	129.8bc	462.3abc	61325.0
Bio-Nematon + Bio-Nema	149.5efg	4067.0fgh	108.5cde	488.3a	52558.5
Bio-Nematon + cadusafos	165.8d-g	5725.5de	93.0de	391.0de	36618.0
Nembecidin + Bio-Nema	206.8bcd	6070.8cd	139.8bc	473.0ab	66688.3
Nembecidin + cadusafos	132.5fgh	4115.0fgh	81.5e	349.8e	28887.5
Bio-Nema + cadusafos	182.8b-e	4847.0d-g	77.5e	405.8cde	31721.0
Sincocin + Nematoxin + Nembecidin	208.8bcd	7274.8bc	145.3b	502.8a	73115.0
Sincocin + Nematoxin + Bio-Nematon + Nembecidin + Bio-Nema + cadusafos	187.0b-e	7900.0ab	129.8bc	483.3a	62769.3
cadusafos	97.8h	2701.5h	30.0f	203.3g	6183.5
Control inoculated untreated	266.5a	9067.8a	189.8a	520.3a	99174.8

In Each column means not followed by the same letter differ significantly from one another at the 0.05 level.

The combination included Sincocin and cadusafos increased the length of shoot and tested number of leaves with a percentage of 35.8 and 18.52% while the combination between Bio-Nema and cadusafos increased the same parameters with a percentage of 22.54 and 3.57% respectively, comparing with the control only inoculated plants (Table 8). In comparison with the data given in Tables (5 & 6)), it could be observed that, the combination between the tested bio- agent compounds mostly gave a positive effect on suppressing nematode reproduction and increasing plant growth parameters. The obtained results confirmed by the several authors; **Mousa (1994)** reported that, the reduction in number of galls, nematode population and mature females was higher when the soil was inoculated with the fungus of *P. lilacinus* and Sincocin compared to nematode alone**. Ehteshamul-Haque *et al* (1996)** reported that, the combined use of *P. lilacinus* and neem cake controlled *M. javanica* infesting okra plants. **Sadat *et al*. (2007)** mentioned that, Nembecidin, Poultry refuse and combination of Rugby 10 G, Furadan 5G with Poultry refuse reduced root- knot nematodes population, gall index and improved plant growth of banana. Application of *P. lilacinus* and *Bacillus firmus*, singly or together in pot experiments, provided effective control of second-stage juveniles, eggs or egg masses of root-knot nematodes. The use of oxamyl, which was applied two weeks before and during transplanting, gave results similar to the commercial product containing *P. lilacinus* (**Anastasiadis *et al.*, 2008). Mahendra *et al*. (2009)** found non significant increase in growth characters and reduction in nematode population in the treatments receiving1 g of *P. lilacinus* and these nematode populations were recorded in the treatments where *P. lilacinus* increased further with the increase in *P. lilacinus*

Table (8): Effect of the interaction between the tested compounds on the growth of okra plants infected with *M. incognita*.

Treatment	Plant parameters/ pot				
	Length (cm)		Fresh weight (gm)		No. of
	Shoot	Root	Shoot	Root	leaves
Sincocin + Nematoxin	62.8ab	34.0ab	17.3b-f	9.1ab	15.0ab
Sincocin + Bio-Nematon	54.0ab	35.5ab	11.2ef	7.1b	14.0abc
Sincocin + Nembecidin	62.3ab	37.0a	22.9abc	10.2ab	14.8abc
Sincocin + Bio-Nema	61.8ab	31.8ab	9.3f	6.2b	13.5bc
Sincocin + cadusafos	66.3a	32.3ab	25.3a	8.0ab	16.0a
Nematoxin + Bio-Nematon	54.5ab	34.8ab	11.3def	19.8ab	14.3abc
Nematoxin + Nembecidin	51.8ab	35.0ab	12.0def	11.5ab	12.5c
Nematoxin + Bio-Nema	57.8ab	32.5ab	11.5def	5.3b	13.5bc
Nematoxin + cadusafos	59.8ab	30.3ab	18.3a-e	11.1ab	14.0abc
Bio-Nematon + Nembecidin	52.3ab	33.8ab	11.3def	7.0b	13.5bc
Bio-Nematon + Bio-Nema	61.3ab	33.8ab	15.3c-f	9.4ab	13.8abc
Bio-Nematon + cadusafos	62.3ab	34.0ab	13.5def	8.4ab	15.0ab
Nembecidin + Bio-Nema	57.5ab	33.3ab	14.5def	7.7b	14.8abc
Nembecidin + cadusafos	63.5	34.5ab	19.5a-d	16.0ab	15.8ab
Bio-Nema + cadusafos	56.0ab	33.8ab	13.8def	8.0ab	15.8ab
Sincocin + Nematoxin + Nembecidin	51.5ab	35.3ab	12.7def	7.6b	15.0ab
Sincocin + Nematoxin +Bio-Nematon + Nembecidin + Bio-Nema + cadusafos	58.3ab	33.5ab	13.8def	7.9ab	15.8ab
cadusafos	60.5ab	34.3ab	17.1b-f	9.3ab	15.8ab
Control inoculated untreated	48.8b	29.3b	10.8ef	5.8b	13.5bc
Control un-inoculated untreated	62.3ab	33.8ab	23.7ab	11.1ab	16.0a

In Each column means not followed by the same letter differ significantly from one another at the 0.05 level.

levels.Significant enhancement in all the plant growth parameters and reduction in was used in combination with carbofuran. **Sundraraju** and **Kiruthika (2009)** noted that, the effect of bio-control agent (Paecilomyces lilacinus) or neem cake against root-knot nematode, *M. incognita* by applying individually and in combinations was effective in increasing the plant growth with significant reduction in nematode populations. The combined application of *P. lilacinus* + neem cake resulted in maximum increase of plant growth and the lowest root gall index and nematode population from soils and roots. **Tanweer *et al*. (2009)** noted that, addition of *P. lilacinus* alone into the soil reduced nematode population and increased yield. Combinations of leaf powder of Cassia tora and Morus alba, (20 g each per kg soil) and *P. lilacinus* were most effective in controlling *M. incognita*. Finally, it could be concluded that, the results from this study indicated that using bio-agent compounds beside the chemical control in integrated pest management achieved a highly activity against root-knot nematode in addition gave increasing in plant growth. Also, the results imply that, it should focus on using biological agents as a safety method for human and environment to management the root-knot nematode in Egypt

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الملخص العربى

تأثير نوع التربة و خلط المركبات الحيوية على فاعليتها ضد نيماتودا تعقد الجذور(ميلودوجينى إنكوجنيتا)

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تم دراسة تأثير نوع التربة و كذلك خلط المركبات الحيوية مع بعضها البعض أومع مبيد الكادوسافوس على فاعليتها ضد نيماتودا تعقد الجذور ميلودوجينى إنكوجنيتا. و أوضحت النتائج ما يلى:

أولا: إختبار تأثير نوع التربة على فاعلية هذه المركبات ضد نيماتودا تعقد الجذور (ميلودوجينى إنكوجنيتا).

تم إختبار هذه المركبات بمعدل التطبيق المقترح به لكل مركب على نباتات باميا مصابة بنيماتودا تعقد الجذور تم زراعتها فى نوعين من التربة (طينية و رملية) وكانت النتائج كالآتى:

١- حقق مركب النيمبسيدين فى التربة الطينية أعلى نسبة خفض فى عدد العقد الجذرية والطور اليرقى الثانى والعدد الكلى للبيض حيث كانت (٧٧,٦٤% و ٧١,٦٢ % و ٧١,٨٥ %) على التوالى بينما فى التربة الرملية حقق مركب البيونيما أعلى نسبة خفض فى عدد العقد الجذرية والطور اليرقى الثانى والعدد الكلى للبيض حيث كانت (٣٦,٣٤ % و ٣٩,٦٢% و ٥٦,٦٢ %) على التوالى.

٢- عند إستخدام مركب السينكوسين فى التربة الطينية أو الرملية أعطى أقل نسبة خفض فى نفس القياسات السابقة حيث كانت فى التربة الطينية (٣٨,٣ % و ٤٧,٧١ % و ٦٩,٨٦ %) بينما فى الرملية كانت (١٩,٩٥% و ١٦,٣٤% و ٦٢٨,٨ %) على التوالى.

أعطى المبيد النيماتودى (الكادوسافوس) أعلى نسبة خفض على الإطلاق فى القياسات السابقة عند إستخدامه فى التربة الطينية حيث كانت ٩٠,٦ % للعقد الجذرية ، ٩٥,٩١ % للطور اليرقى الثانى و ٩٦,٣ % للعدد الكلى للبيض. بينما فى التربة الرملية كانت (٣٨,٦٦% و ٨٨,١٢% و ٩٧,٥٥ %) على التوالى.

ثانيا: إختبار تأثير خلط المركبات الحيوية مع بعضها البعض أومع مبيد الكادوسافوس على فاعليتها ضد نيماتودا تعقد الجذور (ميلودوجينى إنكوجنيتا).

١- عند خلط مركبى السينكوسين و البيونيماتون ، مركبى السينكوسين و البيونيما أو خلط جميع المركبات مع بعضها أعطت أقل نسبة خفض فى عدد العقد الجذرية ، الطور اليرقى الثانى والعدد الكلى للبيض حيث كانت (١٤,٨٢% و ٣٠,٤٠ % و ٢٦,٦٨ % و ٢٩,٨٣ % و ١٢,٨٨% و ٣٦,٧١ %) على التوالى بينما أعطت معاملة خلط مركب النيماتوكسين مع الكادوسافوس ومركب النيمبسيدين مع الكادوسافوس أعلى معدل نسبة خفض لنفس القياسات السابقة حيث كانت (٥١,١١ % و ٥٦,٢٧ % و ٥٩,٩٦ % & ٥٠,٢٨% و ٥٤,٦٢ % و ٧٠,٨٧%) على التوالى.

٢- أيضا لوحظ أنه عند خلط مبيد الكادوسافوس مع المركبات الحيوية حدث خفض فاعلية مبيد الكادوسافوس ضد النيماتودا عما إذا إستخدم هذا المبيد منفردا.

٣- فى جميع المعاملات السابقة أظهرت النتائج تحسن عام فى نمو نباتات الباميا المصابة بنيماتودا تعقد الجذور عند معاملتها بالمركبات الحيوية أو مبيد الكادوسافوس وذلك عند مقارنتها بالنباتات المصابة ولم تعامل.