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IMPACT OF CERTAIN BIOFERTILIZERS AND *Serratia marcescens* ON *Meloidogyne incognita* INFECTING PEACH PLANTS.

Mostafa, Fatma A.M., A. G. El-Sherif, A. R. Refaei and A. H. Nour El-Deen
Nematology Research Unit, Agric. Zoology Dept. Fac. of Agric. Mansoura Univ., Mansoura, Egypt

ABSTRACT

The effect of four soil biofertilizers, i.e., Biogine, Phosphorine, Rhizobacterine, and Microbine and the bacterium, *S. marcescens* applied singly or in combinations with oxamyl on *M. incognita* infecting peach plant as well as N, P, and K status and total chlorophyll content was carried out. All materials tested were variable in improving growth of peach seedlings infected by *M. incognita. S. marcescens* alone significantly surpassed other treatments in increasing number of shoot branches and leaves, percentages of whole plant fresh weight and shoot dry weight with values of 10.0 and 245.7; 99.5 % and 112.7 %, respectively. Among the four biofertilizers studied, Biogine was ranked first but second to *S. marcescens* in increasing growth of whole plant fresh weight and shoot dry weight, followed by oxamyl. Whereas, Rhizobacterine alone gave the least values of such criteria (1.2 % and 2.9 %, respectively). Single application of Oxamyl and Phosphorine significantly performed the highest values of nitrogen (N) in peach plant infected with *M. incognita,* whereas greater increase in potassium content (K) was recovered with oxamyl , Biogine or *S. marcescens*. Microbine alone gave the highest value in phosphorus (P) (0.412 ppm). All materials used significantly induced high total content in chlorophyll values within the treated peach plants. However, Rhizobacterine singly or integrated with oxamyl overwhelmed all treatments in suppressing population densities of *M. incognita*, followed by *S. marcescens* or Biogine when applied singly or integrated with oxamyl. Moreover, all treatments significantly suppressed number of galls and egg masses. It was concluded that Biogine applications achieved the remarkable values for controlling *M. incognita* as well as improving peach plant growth parameters.

Keywords: biocontrol, biofertilizers, *M.incognita*, peach plant, *S. marcescens,*

INTRODUCTION

Peach (*Prunus persica,* L. Batsch) is one of the most important commercially deciduous fruit trees in Egypt. Plant parasitic nematodes especially root-knot nematodes, *Meloidogyne* spp are considered among the most destructive pests of peach trees. Synthetic chemical pesticides have generally represented a major problem encountering crop production. Soil nematicides that applied for nematodes control may exhibit side and deleterious effects in the environment (Cohen *et al.*, 1984; Cheng, 1990; and Wauchope *et al.*, 1994). Recently biological fertilization plays a major role in crop production and yield improvement (Butorac *et al.*, 1995 a & b; Sultan *et al.*, 1999; and Hassanein and Hassouna, 2000). On the other hand, some biofertilizers have shown nematicidal activity against plant parasitic nematodes (Hassan, 1999 and Ismail and Hasabo 2000) . A large number of non-parasitic rhizobacteria including *Serratia* spp. are known to reduce nematode populations by colonizing the rhizosphere of the host plants (Siddiqui and Mahmood, 1999). Application of 6 new commercial Egyptian biofertilizers; Nitrobien, Rhizobacterine, Microbine, Phosphorine, Cerealine and a nitrogen fixing blue green alga [cyanobacterium], as well as the biological nematicide, Nemaless (containing *Serratia marcescens*) reduced *M. incognita* counts and increased the plant growth parameters (Ismail and Hasabo, 2000).

Therefore, the present work was carried out in order to investigate the role of four Egyptian soil biofertilizers, i.e. Biogine, Phosphorine, Rhizobacterine, and Microbine as well as the prokaryotic rhizobacterium, *S. marcescens* applied singly or in combinations with oxamyl on *M. incognita* infecting peach seedlings and the resulting effect on plant growth parameters under greenhouse conditions.

MATERIALS AND METHODS

The effect of four biofertilizers; i.e Biogine, Phosphorine, Rhizobacterine and Microbine; and a rhizobacterium *S. marcescens* applied alone or in combination with oxamyl were evaluated against *M. incognita* infecting peach seedlings under greenhouse conditions. The tested biofertilizers were obtained from Agricultural Research Center, Giza, Egypt. However, strains of the bacterium, *S. marcescens* were obtained as liquid cultures from Agric. Microbiology Dept., Soils, Water and Environmental Inst., Agric. Res. Center,Egypt. The strains of bacteria were NRRL.B. 959, BJL. 200, and YPL. 1 . Origin culture of each strain contained 10^9 cfu/ml was diluted just before inoculation to be 10^8 cfu ml^{-1} .

Seeds of Balady Peach cv. Meet-Ghamr were dipped for 24 hr. in a fungicide (Vetafax 200), stratified in polyethylene bags filled with mixture of peat moss and sand (1:1, v:v) and kept in refrigerator. Three months later, seeds were sown in plastic pots 25 cm-d. (one seed/pot) containing steam sterilized sandy loam soil (1:1,v:v).

Pots receiving *S. marcescens* treatments were inoculated three times at the rate of 100 ml/pot as follows: the first time with NRRL.B.959 strain after 45 days from planting, the second time with BJL.200 strain after 10 days from nematode inoculation, and the third time with YPL.1 strain after 40 days from nematode inoculation.

Pots received biofertilizers were separately treated with Biogine, Phosphorine, Rhizobacterine or Microbine at the rate of 2 gm/pot after 45 days from planting. Tested biofertilizers were incorporated into soil around the seedlings. Two weeks later, *M. incognita* inocula were introduced to all pots, except those served as a check treatment at the rate of 6 egg masses per pot . Ten days after nematode inoculation, oxamyl (Vydate 10% G) Methyl-N'N'- dimethyl – N [(methyl) carbamyloxy]–1- thioxamidate) was added at the rate of 0.6 gm/ pot in single application or at a half dose (0.3 gm/pot) when combined with biofertilizers or *S. marcescens*. Therefore, the treatments were as follows:

1. *S. marcescens* +*M.incognita*
2. Biogine + *M.incognita*
3. Phosphorine + *M.incognita*
4. Rhizobacterine + *M.incognita*
5. Microbine + *M. incognita*
6. Oxamyl + *M. incognita*
7. *S. marcescens* + Oxamyl+ *M.incognita*
8. Biogine + Oxamyl + *M. incognita*
9. Phosphorine + Oxamyl + *M. incognita*
10. Rhizobacterine + Oxamyl + *M. incognita*
11. Microbine + Oxamyl + *M. incognita*
12. Nematode alone and
13. Uninoculated and untreated plants (CK).

Each treatment was replicated three times and all pots were randomly arranged on a greenhouse bench at 30$\pm$5°C. Plants were watered regularly receiving conventional pesticides to control mites and insects as needed. After 90 days from nematode inoculation, plants were harvested. Data dealing with lengths and diameters of shoot and root, and fresh weights of shoot and root as well as shoot dry weight were recorded. Number of branches, number of leaves and weights of 10 leaf discs were determined. Infected peach roots were stained in 0.01 hot lactic acid fuchsin (Byrd et al., 1983) and examined for the numbers of developmental stages, females, galls and egg-masses. *M. incognita* (J_2s) were then extracted from soil by sieving and modified Baermann technique (Goodey, 1957), counted and recorded. N, P and K values were determined in a 0.2 gm of dry weight of peach shoot using the standard chemical analysis (Jakson, 1967 & A.O.A.C., 1980). Chlorophyll content was spectrophotometrically measured in the leaves of the harvested plants according to Fadeel's method (1962). The chlorophyll concentrations were calculated using Wellburn method (1984). The content of chlorophyll was then expressed in µg./g. F.wt. of the leaves. Statistically, the obtained data were subjected to analysis of variance (ANOVA) (Gomez and Gomez, 1984) followed by Duncan's multiple range test to compare means (Duncan, 1955).

RESULTS AND DISCUSSION

Data in table (1) represent effect of four soil biofertilizers, i.e., Biogine, Phosphorine, Rhizobacterine, and Microbine and *S. marcescens* applied separately or in combinations with oxamyl on peach plant growth infected with *M. incognita*. Results indicated that all materials tested were variable in improving growth of *M. incognita*- infected plants. *S. marcescens* alone significantly surpassed other treatments tested in increasing number of shoot branches number of leaves, percentages of increase in whole plant fresh weight and shoot dry weight averaging 10.0 , 245.7, 99.5 % and 112.7 %, respectively.

Among the four biofertilizers tested, Biogine was ranked first over the others as it achieved remarkable increase in percentages of whole plant fresh

Table (1): Impact of four soil biofertilizers and a bacterium, *Serratia marcescens* applied singly and in combination with oxamyl on growth of Balady peach cv. Meet-Ghamr infected with *Meloidogyne incognita* under greenhouse conditions.

Treatments	Plant growth response													
	Length (cm)		Fresh weight (g)		Diameter (cm)		No. of shoot branches	No. of shoot leaves	Wt. Of 10 leaf discs (g)	Fresh wt. of the whole plant (g)	Increase %	Shoot dry weight (g)	Increase %
	Shoot	Root	Shoot	Root	Shoot	Root							
S. marcescens + *M. incognita*	69.5 bc	32.8 cd	25.9 a	22.68 a	0.38 a	0.37 a	10.0 a	245.7 a	0.132 e	48.5 a	99.5	11.06 a	112.7
Biogine+ *M. incognita*	73.2 ab	37.5 abcd	19.2 abcd	14.7 bc	0.29 ab	0.31 a	6.0 b	124.7 f	0.140 ab	33.9 bcde	39.3	10.15 a	95.2
Phosphorine+ *M. incognita*	64.5 bc	36.8 bcd	16.8 bcd	10.5 c	0.27 b	0.35 a	2.7 de	144.0 ef	0.135 d	27.3 cdef	12.2	6.56 bc	26.3
Rhizobacterine+ *M. incognita*	62.6 bc	32.0 cd	14.5 cd	10.1 c	0.25 b	0.27 a	4.7 bcd	148.3 def	0.138 bc	24.6 f	1.2	5.35 c	2.9
Microbine+ *M. incognita*	65.7 bc	46.7 a	13.6 cd	11.8 bc	0.26 b	0.32 a	2.7 de	135.3 ef	0.138 bc	25.4 def	4.5	5.46 c	4.9
Oxamyl+ *M. incognita*	63.3 bc	40.4 abc	19.9 abc	12.1 bc	0.28 ab	0.35 a	2.3 e	150.7 de	0.137 cd	32 bcdef	31.6	8.98 ab	72.7
S. marcescens + Oxamyl+ *M. incognita*	73.2 ab	40.4 abc	23.5 ab	13.6 bc	0.32 ab	0.37 a	6.3 b	181.3 c	0.123 f	37.1 bc	52.6	9.60 ab	84.7
Biogine + Oxamyl+ *M. incognita*	84.1 a	40.5 abc	21.9 ab	15.4 b	0.32 ab	0.40 a	3.0 cde	130.3 ef	0.142 a	38.3 bc	53.4	9.01 ab	73.3
Phosphorine + Oxamyl+ *M. incognita*	60.4 c	44.0 ab	22.7 ab	12.5 bc	0.28 ab	0.35 a	6.3 b	170.7 cd	0.142 a	35.2 bcd	44.9	9.17 ab	76.4
Rhizobacterine + Oxamyl+ *M. incognita*	60.3 c	40.3 abc	23.4 ab	11.7 bc	0.28 ab	0.31 a	6.3 b	206.0 b	0.130 e	35.2 bcd	44.7	8.77 ab	68.6
Microbine + Oxamyl+ *M. incognita*	63.1 bc	40.2 abc	23.4 ab	10.1 c	0.30 ab	0.30 a	5.0 bc	139.7 ef	0.140 ab	33.5 bcdef	37.8	10.26 a	97.3
Uninoculated and untreated plant	71.6 bc	30.1 d	26.0 a	12.8 bc	0.32 ab	0.28 a	4.7 bcd	220.7 b	0.140 ab	38.8 b	59.6	10.93 a	110.1
Nematode alone	59.9 c	38.3 abcd	12.7 d	11.6 bc	0.26 b	0.29 a	5.7 b	206.7 b	0.123 f	24.3 ef	---	5.20 c	---

Each value presented the mean of three replicates.
Means in each column followed by the same letter(s) did not differ at P< 0.05 according to Duncan's multiple-range test.

weight and shoot dry weight, followed by oxamyl. However, Rhizobacterine alone gave the least values of these two criteria which were 1.2 and 2.9 %, respectively.

Concerning the integration of oxamyl at the half dose rate (0.3 gm) with each biofertilizer or bacterium, the obtained data revealed that application of *S. marcescens* plus oxamyl achieved the highest percentages of increase in whole plant fresh weight (52.6 %) and shoot dry weight (84.7 %) when compared with those of other combinations.

Accordingly, it seems that oxamyl may inhibit the impact of *S. marcescens* on *M. incognita* infecting peach plants, whereas it activate the biofertilizers for suppressing the nematode . Therefore, a synergistic action was obviously noticed in combined treatments of the biofertilizers plus oxamyl resulted in improving plant growth criteria than those of alone treatments.

Likely, Sultan *et al.* (1999) reported that Azotobacterine biofertilizer significantly increased root length and diameter of sugar beet plants. These results are also in agreement with the findings of Maareg and Badr (2000) who found the biofertilizers, Phosphorine and Cerealine applied alone or in combination with the nematicide, Fenamiphos significantly increased growth characters of infected sugar beet plants when compared to those of *M. incognita*- infected plants only or even those of untreated ones. As for the effect of the materials tested on N, P and K status and chlorophyll content in peach seedlings, data in table (2) show that single application of oxamyl or Phosphorine significantly increased nitrogen content more than that of the check. Application of Rhizobacterine or *S. marcescens* achieved the least values. No significant differences were however detected among the treatments tested and the check one in phosphorus contents. Although Microbine gave the highest value in phosphorus content (0.412 ppm), when applied alone, it gave its least value (0.243 ppm) when applied plus oxamyl. With respect to potassium (K) content, it increased remarkably in peach seedlings treated with oxamyl (48.59 %) or Biogine (45.80 %) or *S. marcescens* (42.77 %) in single applications, while the least values was recorded by Rhizobacterine (21.88 %) and Phosphorine plus oxamyl (29.88 %) treatments.

Regarding chlorophyll content, it was evident that all materials tested significantly increased value of total chlorophyll with various degrees as compared with that of untreated - uninoculated plants. However, a remarkable increase in total chlorophyll was recovered in peach plant due to *M. incognita* infection. Oxamyl integrated with Rhizobacterine or with *S. marcescens* achieved the highest value of total chlorophyll content (2532.0 and 2295.0) in comparison to that of the nematode alone treatment or of the healthy plants. The least values of chlorophyll content was resulted by Phosphorine applied either singly or in combination with Oxamyl (Table 2). The present findings agreed with those of Hassan (1999) who stated that Rhizobacterine induced the highest content of chlorophyll than Cerealine or Phosphorine on sugar cane infected with *M. javanica*

Data presented in table (3) show the impact of the four soil biofertilizers, *S. marcescens* or oxamyl when applied singly or in combinations with oxamyl on root galling, egg masses number and

Table (2) N, P and K concentrations, and chlorophyll content in shoot dry weight of peach plant cv. Meet-Ghamr infected by *M. incognita* and treated with four soil biofertilizers and S. marcescens separately or in combination with oxamyl under greenhouse conditions.

Treatments	N	P	K	Chlorophyll content		
	mg/g	Ppm	ppm	A µg/g	B µg/g	Total µg/g
S. marcescens + *M. incognita*	21.37 c	0.370 a	42.77 abc	889.5 bcd	496.5 ab	1386.0 abcd
Biogine+ *M. incognita*	31.73 abc	0.330 a	45.80 ab	878.7 bcd	570.0 ab	1449.0 abcd
Phosphorine+ *M. incognita*	39.67 ab	0.349 a	38.24 abcd	779.5 bcd	454.3 ab	1234.0 bcd
Rhizobacterine+ *M. incognita*	21.30 c	0.271 a	21.88 ef	947.7 bcd	583.7 ab	1531.0 abcd
Microbine+ *M. incognita*	27.03 bc	0.412 a	31.97 cde	1148.0 abcd	646.4 ab	1794.0 abcd
Oxamyl+ *M. incognita*	44.33 a	0.386 a	48.59 a	809.4 bcd	429.0 ab	1238.0 bcd
S. marcescens + Oxamyl+ *M. incognita*	23.20 c	0.351 a	35.64 bcd	1234.0 abc	1061.0 a	2295.0 ab
Biogine + Oxamyl+ *M.incognita*	24.17 c	0.300 a	34.13 cd	1262.0 abc	812.0 ab	2074.0 abcd
Phosphorine + Oxamyl+ *M. incognita*	22.93 c	0.269 a	29.88 de	638.7 cd	325.3 b	964.0cd
Rhizobacterine + Oxamyl+ *M. incognita*	29.77 abc	0.346 a	32.15 cde	1594.0 a	937.7 ab	2532.0 a
Microbine + Oxamyl+ *M. incognita*	28.00 bc	0.245 a	36.84 bcd	1007.0 abcd	743.5 ab	1750.0 abcd
Uninoculated and untreated plant	40.17 ab	0.244 a	38.46 abcd	541.7 d	372.0 b	913.7 d
Nematode alone	21.2 c	0.231 a	14.80 f	1354.0 ab	857.5 ab	2212.0 abc

Each value presented the mean of three replicates.

Means in each column followed by the same letter(s) did not differ at $P<0.05$ according to Duncan's multiple – range test .

Table (3) Effect of four soil biofertilizers and a bacterium, *S. marcescens* applied singly or in combination with oxamyl on *M. incognita* infecting Balady peach cv. Meet-Ghamr under greenhouse conditions.

Treatments	Nematode population in			Total	Reduction %	No. of galls	Reduction %	RGI*	No. of Egg-masses	Reduction %	EGI*
	Soil	Root									
		Developmental stages	Females								
S. marcescens	0.0 e	229.0 e	323.0 cd	552.0 ef	90.10	348.0 cde	67.2	5.0	5.0 b	95.8	2.0
Biogine	0.0 e	335.7 b	325.3 cd	661.0 ef	88.10	546.0 bc	48.5	4.7	9.7 b	91.8	2.3
Phosphorine	1075.0 b	104.7 ij	171.0 e	1351.0 c	75.66	114.7 e	89.2	4.7	4.0 b	96.6	1.3
Rhizobacterine	0.0 e	114.0 hi	336.0 cd	450.0 f	91.89	315.0 cde	70.3	5.0	7.3 b	93.8	2.3
Microbine	808.7 d	111.3 hij	144.0 e	1064.0 d	80.83	251.0 de	76.3	4.7	4.3 b	96.4	2.0
Oxamyl	0.0 e	143.3 g	647.0 b	790.3 e	85.76	284.3 de	73.2	5.0	21.7 b	81.7	2.7
S. marcescens + Oxamyl	0.0 e	259.3 d	374.7 c	634.0 ef	88.60	410.3 cd	61.3	5.0	40.3 b	66.1	3.3
Biogine + Oxamyl	0.0 e	184.3 f	383.0 c	567.3 ef	89.78	215.0 de	79.7	5.0	4.0 b	96.6	1.3
Phosphorine + Oxamyl	906.0 cd	384.0 a	567.7 b	1858.0 b	66.53	689.7 b	35.0	5.0	37.7 b	68.2	3.0
Rhizobacterine + Oxamyl	0.0 e	131.3 gh	308.0 cd	439.3 f	92.10	205.7 de	80.6	4.7	8.7 b	92.7	2.3
Microbine + Oxamyl	1003.0 bc	90.33 j	227.3 de	1321.0 c	76.20	133.0 e	87.5	4.7	5.3 b	95.5	1.7
Nematode alone	3494.0 a	299.3 c	1757.0 a	5551.0 a	0.00	1061.0 a	---	5.0	118.7 a	---	5.0

Each value presented the mean of three replicates.
Means in each column followed by the same letter(s) did not differ at P (0.05 according to Duncan's multiple-range test.
*Root gall index (RGI) or Egg-mass index (EGI): 0 = no galling or egg-masses; 1= 1-2 galls or egg-masses; 2= 3-10 galls or egg-masses; 3= 11-30 galls or egg-masses; 4= 31-100 galls or egg-masses and 5= more than 100 galls or egg-masses.

population densities of *M. incognita* infecting Balady peach cv. Meet-Ghamr. Results indicate that all treatments significantly reduced the total number of galls, egg masses and nematode population densities when compared to those of the check. Among the materials tested, Rhizobacterine alone or plus oxamyl overwhelmed other treatments in reducing nematode counts on peach, followed by treatments of either *S. marcescens*, Biogine combined with oxamyl, bacterium plus oxamyl and Biogine alone, where they achieved percentage reductions in nematode counts averaging 92.1 , 91.89 , 90.1, 89.78 , 88.6 and 88.1 %, respectively. These results agreed with those of Ismail and Hasabo (2000), who reported that highest reduction in counts of *M. incognita* infecting sunflower was observed with Rhizobacterine which reduced juveniles in soil, egg masses per plant and rate of build-up. The suppressive effect of Rhizobacterine or Biogine on nematode may be attributed to the presence of nitrogen fixing bacteria and to the production of some growth regulators involving in root absorption area. The nematicidal properties produced by *S. marscecens* against nematode are volatile toxic substances mainly ammonia which significantly reduce nematode population. In addition, the exogenous microbial chitinase may cause premature hatch of nematode eggs (Zavaleta-Mejia, 1985; and Mercer *et al*, 1992). Application of oxamyl at a half dose inhibited the impact of Phosphorine, Microbine on *M. incognita* infection to peach with low values of percentages in nematode population reduction, as they were 9.13 and 4.63 %, respectively. However, the full dose of oxamyl achieved 85.76 , 73.2 and 81.7 % reduction in nematode population densities, root galling and egg masses number, respectively (Table 3).

In conclusion, among the four biofertilizers tested, Biogine singly or integrated with oxamyl (0.3 gm/pot) accomplished better increment in plant growth of fresh weight of whole plant (39.3% or 53.4%) with a remarkable suppression of total nematode population (88.10% or 89.78%). However, Rhizobacterine applied singly or mixed with oxamyl gave good performance than Biogine in nematode control , but with the lowest values of plant growth criteria .The prokaryotic bacterium *S. marcescens* could act as a biofertilizer and a biocontrol agent against *M. incognita*

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تأثير بعض المخصبات الحيوية وبكتيريا السيراتيا ماركينس على اصابة نيماتودا تعقد الجذور ميلودوجين انكوجنيتا لنباتات الخوخ.

فاطمة عبد المحسن مصطفى – احمد جمال الشريف – عبد الفتاح رجب رفاعى- احمدحماد نور الدين

وحدة بحوث النيماتودا- قسم الحيوان الزراعى – كلية الزراعة- جامعة المنصورة

تم دراسة تأثير أربع مخصبات حيوية وهى البيوجين والفوسفورين والرايزوباكتيرين والميكروبين وكذلك معلق بكتيريا السيراتيا كل على حدة أو مع مبيد الأوكساميل على نيماتودا تعقد الجذور التى تصيب نباتات الخوخ وكذا محتوى عناصر النيتروجين والفوسفور والبوتاسيوم والكلوروفيل تحت ظروف الصوبة. وقد أسفرت النتائج عن أن كل المعاملات قد نتج عنها تحسين نمو نباتات الخوخ إلى حد معين وأن البكتيريا بمفردها قد تفوقت معنويا على كل المعاملات من حيث زيادة عدد الأفرع والأوراق وكذلك زيادة الوزن الرطب والوزن الجاف للمجموع الخضرى بقيم ١٠,٠ و ٢٤٥,٧ ، ٩٩,٥ %و ١١٢,٧ % على التوالى. وقد جاء مركب البيوجين فى المرتبة الأولى بين كل المخصبات الحيوية وفى المرتبة الثانية بعد البكتيريا فى زيادة نسب الوزن الكلى الرطب والوزن الجاف للمجموع الخضرى ، بينما أعطى مركب الرايزوباكتيرين اقل القيم فى زيادة تلك المقاييس النباتية بمعدل ١,٢ % ، ٢,٩ % على التوالى. ولوحظ أيضا أن إضافة البكتيريا مع المبيد قد أعطت أعلى قيم لزيادة الوزن الرطب للمجموع الخضرى (٥٢,٥ %) وكذلك الوزن الجاف (٨٤,٧ %). إن استخدام مركب الرايزوباكترين بمفرده أو مشتركا مع المبيد قد تفوق على كل المعاملات الأخرى فى تقليل تعداد النيماتودا ويليه البكتيريا على حدة ثم البكتيريا أو البيوجين مشتركا مع المبيد ثم البيوجين على حدة. وقد قللت كل المعاملات أعداد العقد النيماتودية وكذلك أعداد كتل البيض المتكونة على المجموع الجذرى لنباتات الخوخ بدرجة معنوية. وقد لوحظ أيضا أن النباتات المعاملة بالمبيد أو بمركب الفوسفورين كل على حدة قد أعطت أعلى نسبة للنيتروجين من الأوراق وكذلك فقد أعطى المبيد أعلى نسبة للبوتاسيوم فى النباتات يليه البيوجين ثم البكتيريا. كما أعطى الميكروبين أعلى نسبة للفوسفور (٤١٢,. %) .كما إن قيم المحتوى الكلى للكلوروفيل قد زادت فى النباتات المعاملة عن النباتات السليمة (غير المعاملة وغير المصابة بالنيماتودا).