POTENTIAL OF *AZOSPIRILLUM BRASILENSE*, *BACILLUS MEGATHERIUM*, *GLOMUS MOSSEAE* AND *TRICHODERMA VIRIDE* SINGLY OR CONCOMITANTLY FOR CONTROL OF ROOT-KNOT NEMATODE, *MELOIDOGYNE JAVANICA* INFECTING SUGAR BEET

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Abstract

Potential of *Azospirillum brasilense*, *Bacillus megatherium*, *Glomus mosseae* and *Trichoderma viride* were evaluated singly or concomitantly for control of root-knot nematode, *Meloidogyne javanica* infecting sugar beet plants grown in pots. Results showed that *A. brasilense* significantly suppressed number of nematode galls and eggmasses on sugar beet roots as well as increased sugar beet plant growth, quality characters, nitrogen content and sugar yield compared to nematode inoculation and other microbial treatments. Among the concomitant microbial treatments, *A. brasilense* , *B. megatherium G. mosseae* and *T. viride* treatment gave better results than single ones. Therefore, significant improvement in plant growth (by 56 % in fresh and dry of roots), total N, P and K content (by 38.73, 31.03 and 29.87 %, respectively) , quality characters (by 38.00 in sucrose and 22.30 in purity %) and sugar yield by 173.9 %, as well as suppressed number of galls and eggmasses by 90.7 and 89.4 %, respectively. This makes the combined use of the four tested microbial promising biocontrol method for root–knot nematodes in agriculture and may be considered in integrated nematode management (IPM) programs.

INTRODUCTION

The root-knot disease caused by *Meloidogyne* spp. occurs widespreadly on a vast number of plant species in the tropic, subtropic and moderate regions. Among the more susceptible hosts for these nematodes is sugar beet, *Beta vulgaris* L. This crop is ranked as the second sugar crop in Egypt. Little is known about the biocontrol by vesicular-arbuscular mycorrhizal (VAM) fungi and bacteria on these plants could affect nematodes. Both VAM fungi and root-knot nematodes are obligatory dependent groups. They depend on host for feeding and reproduction.

Numerous studies have reported that VAM fungi increased host tolerance to many plant nematodes (Ingham 1988, Smith, 1988 and Osman *et al.*, 1990). Some mycorrhizal may be antagonistic to nematodes apart from their effects on plant nutrition, and others may reduce the reproduction of nematodes that infecting certain plant species (Rao *et al.*, 1997 and Nagesh *et al.*, 1999). *Bacillus* spp are obligate pathogens of some plant-parasitic nematodes (Stirling, 1984 and Brow *et al.*, 1985). Studies on the role of *Trichoderma* specis for the management of plant- parasitic nematodes have been undertaken by several reporters (Khan and Saxena, 1997; Latha and Sivakumar, 1998; Maareg *et al*, 2000 and 2005; Badr, 2001; Maareg and Badr, 2003 and Gohar, 2003).

The present study was conducted to determine whether *Azospirillum brasilense*, *Bacillus megatherium* (as bacteria), *Glomus mosseae* and *Trichoderma viride* (as fungi) were effective singly or integrated for control of *Meloidogyne javanica* infecting sugar beet plant in west Nubaryia region.

MATERIALS AND METHODS

Two experiments were carried out at west Nubaryia region during 2003/2004 and 2004/2005 seasons in potted sugar beet plants. The randomized complete block design was used. The pot size was 30 cm in diameter, each containing 15 kg autoclaved sandy loam soil were planted with sugar beet cv. Hilma on the 5th and 7th Sept. in the first and second seasons, respectively. At fourth leaf stage, seedlings were thinned to one plant per pot. Pots were divided into 17 groups (Table 1), each contained eight replicates. (The tested two fungi were identified as *G. mosseae* (Mycorrhiza) and *T. viride* and the two bacteria were *A. brasilense* and *B. megatherium,* these microbes were isolated from sugarbeet fields, identified and preserved through Sugar Crops Pathology Lab., Sugar crops Inst.). At inoculation time, one week after thinning, 10 ml (in single treatments), and 5 ml (in combined treatments) of suspension of each of tested fungi and bacteria was mixed thoroughly and incorporated into the soil either alone or in combined treatments (Table, 1). Inocula of *A. brasilense*, *B. megatherium G. mosseae* and *T. viride* were 15×10^5, 21×10^5, 12×10^5 and 12×10^5 spore/ml, respectively. At the same time, the soil in each pot was inoculated with 2000 newly second stage juvenile larvae of *M. javanica*. Eight pots were inoculated with nematodes only and another eight were left without any treatment to serve as control. All pots were watered and received the normal agricultural practices. Five months later, plants in pots of each treatment were uprooted. Roots were cleaned and examined for nematode assessment. Fresh and dry weight of both leaves and roots were recorded and total N, P and K % in leaves and roots were determined by the method of Jackson, 1958. Data (as combined analysis of two seasons) were subjected to analysis of variance using MSTAT computer program.

RESULTS AND DISCUSSION

Results concerning effects of the microbes, *A. brasilense* (Ab), *B. megatherium (Bm)*; *T. viride* (Tv) and *G. mosseae* (Gm) as single or combined microbial treatment on development of *M. javanica* (Mj) infecting sugarbeet are presented in Table (1). It was noticed that the number of root galls and eggmasses of *M. javanica* decreased significantly compared with Mj only treatment when the tested bacteria and fungi treatments were added to the soil as single or combined treatment at the time of nematode inoculation.

In single microbial treatments, Mj + Ab treatment achieved the highest significant reduction (80.6 %) in the number of galls of *M. javanica* infecting sugar beet plants followed by Mj + Gm (67.6 %), Mj + Bm (59.3%) then Mj + Tv (30.6%), respectively without significant difference between Mj + Gm and Mj + Bm treatments. Also the reduction percentage in the number of nematode, Mj eggmasses/root followed the same trend with those microbial treatments, respectively.

The data also indicated that when each two different microbes were mixed together, the corresponding effects on the reduction of Mj population were significant ($P < 0.01$) comparing with Mj treatment (nematode only). Among all the two microbial mixtures tested, the highest reduction % in galls mumber/root was achieved by Mj + Ab + Gm (75.9 %), followed by Mj + Ab + Bm (67.6 %). The lowest % reduction (37.0 %) occurred by Mj + Ab + Tv treatment. The % reduction in number of eggmasses due to these treatments followed the same trend.

When three different microbes were added together, the resultant mixture caused reduction of Mj galls and eggmasses and a significant reduction ($P \leq 0.05$) between each mixture and Mj only. The highest significant % reduction in the numbers of galls and eggmasses (76.9 and 82.4, respectively) were achieved by the Mj + Ab + Bm + Gm treatment. The lowest % reduction in both galls and eggmasses numbers (63.0 and 70.6%, respectively) was obtained by Mj + Ab + Bm + Tv treatment. Generally, Mj + Ab + Bm + Gm + Tv treatment was ranked the first among all microbial treatments in reducing the number of nematode galls (90.7 %) followed by Mj + Ab (80.6 %), Mj + Bm + Gm (76.9 %) and Mj + Ab + Gm (75.9 %). Also, the highest % reduction in the number of eggmasses (89.4 %) was recorded with Mj + Ab + Bm + Gm + Tv followed by Mj + Ab + Bm + Gm (82.4 %), Mj + Ab + Gm (81.2 %) and Mj + Ab (78.8) treatments, respectively. All these microbial treatments caused reduction in nematode galls and eggmasses over than 75 %.

Results in Table (2) indicated that nematode inoculated sugar beet plants exhibited decline in fresh and dry weight roots and leaves compared with the control. However different microbial treatments caused increase in fresh and dry weights of root and leaves compared with Mj only. The effect of microbial treatments on fresh and dry weights of roots, and dry weight of leaves only was significant, while fresh weight of leaves was insignificantly affected. Amongst the single microbial treatments, Mj + Ab achieved the highest significant increase in mean dry weight of leaves and roots as well as mean fresh weight of roots only, followed by Mj + Gm, Mj + Bm and Mj + Tv, respectively. The highest percentage of increase in mean weight of fresh, dry roots and dry leaves averaged 54.2, 54.5 and 57.4%, respectively in comparison to those of Mj. In the combined microbial treatments, Mj + Ab + Bm + Gm + Tv treatment, also, achieved the highest significant increase in mean fresh weight of roots and dry weight of leaves and roots of sugar beet plants compared with other treatments. The increase percentage in mean root fresh weight, root dry weight and leaves dry weight of sugar beet plants averaged 56.1, 56.0 and 68.9 % than these of Mj. Likely, Aly (2003) reported that *A. brasilense* and *B.* megatherium significantly increased fresh and dry weight of roots and leaves of sugar beet plant.

Data presented in Table (3) represents nitrogen (N), phosphours (P) and potassium (K) contents of sugar beet plant (roots and leaves) as affected by nematode inoculation and different microbial treatments. The results revealed that the inoculation with nematode, *M. javanica* caused significant decrease in N, P and K contents only in sugar beet roots. The percentage of this decrease was 47.01, 3.45 and 19.48 % of N, P and K contents, respectively. Also, the results indicated that application of microbial treatments mostly led to increment in the amount of N, P and

K uptake over those in the control. Type of microbe played vital role in the amount of nutrient uptake.

Concerning nitrogen content, all microbial treatments had no significant effect on nitrogen content only in leaves. In single microbial treatments, all treatments except Mj + Bm treatment, caused significant increase than MJ. The highest significant increase (60.18 %) was achieved by Mj + Ab treatment, followed by Mj + Gm (52.05 %) and Mj + Tv (38.01 %) without significant difference between Mj + Gm and Mj + Tv treatments. In combined microbial treatments, all treatments except Mj + Gm + Tv and Mj + Bm + Gm + Tv caused significant increase in N-content in root in comparison with Mj only. The treatment, Mj +Ab + Bm achieved the highest significant increase in N-content (72.21 %) in roots, followed by Mj +Ab +Bm +Tv (62.55 %). However, the Mj + Gm + Tv treatment achieved the lowest significant increase (8.13 %) in N-content in root. The increase in root N-content due to nitrogen fixation from bacteria may be attributed to increase in efficiency of sugar beet plants in the soil. The obtained results are in line with these of Khalil *et al* (2002) and Aly (2003) who reported that inoculation with *A. brasilense* and *B. megatherium* on sugar beet increased in N-content in roots.

Data in Table (3), also, cleared that phosphorus content in leaves was not significantly affected by all microbial treatments. In roots, the microbial treatments except, Mj + Ab +Tv, had significant effect on P-content. In the single treatments, Mj + Gm treatment achieved the highest significant increase (24.14 %) followed by Mj + Bm (17.24 %), while Mj +Ab treatment achieved the lowest significant increase (3.45%). In combined microbial treatments, Mj +Ab +Bm + Gm +Tv was ranked the first in increasing P-content in roots, followed by both Mj +Bm + Gm and Mj +Ab + Bm + Gm treatments. But Mj + Gm +Tv achieved the lowest significant increase, compared with Mj treatment.

Potassium content in leaves also, was not significantly affected by microbial treatments, however, in roots, there was significant effect. In the single microbial treatments, Mj + Gm treatment only had significant effect on K- content in roots, but the other single treatments had no significant effect. Combined microbial treatments of Mj +Ab + Bm, Mj + Ab + Tv , Mj + Bm +Gm and Mj +Bm + Tv had no significant effect compared with Mj treatment, but the other combinations had significant effects. The treatment Mj + Ab +Bm + Gm +Tv achieved the highest increase

(29.87%), while the Mj +Ab + Gm treatment achieved the lowest one (18.18%) as shown in Table, 3.

Regarding the quality characters and sugar yield, the results in Table (4) indicated that the total soluble solids (T.S.S), sucrose and purity in root juice percentages and sugar yield were significantly affected by microbial treatments. In single microbial treatments, Mj + Ab treatment ranked the first in increasing percentage of T.S.S, sucrose and purity in juice of sugar beet roots, as well as sugar yield/plant followed by Mj + Gm, Mj + Jm then Mj + Tv treatments, respectively, compared with Mj treatment. In combined microbial treatments, Mj + Ab + Bm + Gm + Tv treatment achieved the highest increase in all mentioned traits, compared with other ones. The increase in T.S.S %, sucrose % and purity % in juice root of sugar beet as well as sugar yield were 12.7, 38.0, 22.3 and 173.9 %, respectively.

The present study clarifies the potential of Ab, Bm and Tv for the microbial control of the root-knot, nematode, *M. javanica* infecting sugar beet plants. The four microbial treatment, Ab + Bm + Gm +Tv gave best results in controlling the nematode and improved growth and quality of sugar beet plants as well as sugar yield. The efficiency of Ab as a nonsymbiotic bacterium in that respect could be due to its ability in fixing nitrogen in soil which leads to produce excess ammonia, as reported by Alam (1991), where ammonia decreased the population of certain plant parasitic nematodes in soil and improved the plant components. *B. megatherium* is considered a microorganism capable of dissolving the unavailable phosphorus compounds in soil rendering them available for growing crops (Radwan, 1983). Increased phosphorus concentration may lead to reduction density of the root-knot nematode on tomato plants. Youssef *et al.* (1998) found that *B. megatherium* increased yield of tomato plants with decreasing pathogenicity of *M. incognita* which, also agreed with present data on sugar beet plants treated with Bm + Mj or Bm plus Ab + Gm + Tv as combined treatment compared with reduction by Bm as single treatment. The reduction in nematode in mycorrhizal treatments my be accounted on the basis that the plant parasitic nematodes and vesicular arbuscular mycorrhiza (VAM) fungi occupy the same area on the root system, hence the direct competition for hebetating the same space occurs (Butool and Haseeb, 1996) the enhancement of sugarbeet growth also could be due to that mycorrhization of sugar beet roots by Gm which increased the uptake of water and nutrients by the network of fungal hyphae (Hussey and Roncadori, 1982). In the obtained data there may be some degree of antagonism between the active principals of the different microbes tested, and mixing them together decreased their effectiveness on the % reduction of *M. javanica* galls and eggmasses. (An example to such a case is *A. brasilense* when it was mixed with *T. viride).*

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Table (1): Effect of different treatments bacteria (*Azospirillum brasilense* and *Bacillus megatherium*) and fungi (*Glomus mosseae* and *Trichoderma viride*) on root galling and eggmasses production on root of sugar beet plants infected with *Meloidogyne javanica* root-knot nematode.

	Galls/root		Eggmasses/root	
	Number	Reduction%	Number	Reduction%
Control	00.00	00.00	00.00	00.00
Mj	108	00.00	85	00.00
Mj+Ab	21	80.6	18	78.8
Mj+Bm	44	59.30	41	51.8
Mj+Gm	35	67.60	29	65.9
Mj+Tv	75	30.60	50	41.20
Mj+Ab+Bm	35	67.60	23	72.9
Mj+Ab+Gm	26	75.90	16	81.20
Mj+Ab+Tv	68	37.00	49	42.40
Mj+Bm+Gm	50	53.70	36	57.60
Mj+Bm+Tv	62	42.60	40	52.90
Mj+Gm+Tv	61	52.80	40	52.90
Mj+ Ab+Bm+Gm	25	76.90	15	82.40
Mj+ Ab+Bm+Tv	40	63.00	25	70.60
Mj+ Ab+Gm+Tv	28	74.90	19	77.60
Mj+Bm+Gm+Tv	37	65.70	21	75.30
Mj+ Ab+Bm+Gm+Tv	10	90.70	9	89.4
L.S.D at 0.05 %	11.0		9.0	

Mj= *Meloidogyne javanica* Ab=*Azospirillum bracilense* Bm=*Bacillus megatherium*
Gm=*Glomus mosseae* Tv=*Trichoderma viride*

Table (2): Effect of different treatments bacteria (*Azospirillum brasilense* and *Bacillus megatherium*) and fungi (*Glomus mosseae* and *Trichoderma viride*) on fresh and dry weight (gm) of sugar beet plants infected with *Meloidogyne javanica* root-knot nematode

Treatments	Root / Plant				Leaves/ plant			
	fresh weight	Increase %	dry weight	Increase %	Fresh weight	Increase %	dry weight	Increase %
Control	469.30	27.80	84.50	27.80	361.40	35.50	72.20	36.20
Mj	367.00	00.00	66.10	00.00	266.80	00.00	53.00	00.00
Mj+Ab	566.00	54.20	102.10	54.50	417.70	56.60	83.40	57.40
Mj+Bm	523.90	42.80	91.80	38.90	388.20	45.50	77.30	45.80
Mj+Gm	537.80	46.50	96.80	46.40	383.10	43.60	78.60	48.30
Mj+Tv	509.90	38.90	89.50	35.40	379.00	42.10	75.80	43.00
Mj+Ab+Bm	402.00	9.50	72.40	9.50	294.10	10.20	58.80	10.90
Mj+Ab+Gm	399.10	8.70	71.90	8.80	301.00	12.80	60.20	13.60
Mj+Ab+Tv	437.10	19.10	78.70	19.10	317.10	18.90	63.40	19.60
Mj+Bm+Gm	439.00	19.60	79.00	19.50	303.60	13.80	60.70	14.50
Mj+Bm+Tv	411.10	12.00	74.00	12.00	310.90	16.50	60.00	13.90
Mj+Gm+Tv	419.10	14.20	75.60	14.40	298.00	11.70	59.50	12.30
Mj+ Ab+Bm+Gm	488.20	33.00	87.90	33.00	377.90	41.60	75.50	42.30
Mj+ Ab+Bm+Tv	500.30	36.30	90.10	36.30	401.00	50.30	77.20	45.70
Mj+ Ab+Gm+Tv	501.10	36.50	90.20	36.50	410.00	53.80	81.00	52.80
Mj+Bm+Gm+Tv	497.40	35.50	88.20	33.40	429.00	60.80	85.80	61.90
-Ab+Bm+Gm+Tv	573.00	56.10	103.10	56.00	447.00	67.50	89.40	68.90
L.S.D at 0.05 %	46.90		17.30		N.S		26.50	

Mj= *Meloidogyne javanica* Ab=*Azospirillum bracilense*
Bm=*Bacillus megatherium* Gm=*Glomus mosseae* Tv=*Trichoderma viride*

Table (3): Effect of different treatments bacteria (*Azospirillum brasilense* and *Bacillus megatherium*) and fungi (*Glomus mosseae* and *Trichoderma viride*) on nitrogen, phosphorus and potassium contents of sugar beet plants infected with *Meloidogyne javanica* root-knot nematode.

Treatment	Nitrogen content				Phosphorus content				Potassium content			
	Root		Leaves		Root		Leaves		Root		Leaves	
	%	Inc. %	%	Inc. %	%	Inc. %	%	Inc. %	%	Inc. %	%	Inc.%
Control	47.03	47.01	117.15	1.47	0.30	3.45	0.32	6.67	0.92	19.48	2.69	7.17
Mj	31.99	00.00	115.40	00.00	0.29	00.00	0.30	00.00	0.77	0.00	2.51	0.00
Mj+Ab	51.64	60.05	136.43	18.22	0.30	3.45	0.32	6.67	0.90	16.88	2.62	4.38
Mj+Bm	40.19	25.63	131.53	13.98	0.34	17.24	0.36	20.00	0.88	14.29	2.74	9.16
Mj+Gm	48.64	52.05	128.97	11.76	0.36	24.14	0.38	26.67	0.91	18.18	2.90	15.54
Mj+Tv	44.15	38.01	126.80	9.88	0.31	6.90	0.35	16.67	0.90	16.88	2.55	1.59
Mj+Ab+Bm	55.09	72.21	120.80	4.68	0.33	13.79	0.35	16.67	0.87	12.99	2065	5.58
Mj+Ab+Gm	41.38	29.35	129.33	12.07	0.36	24.14	0.39	30.00	0.91	18.18	2.61	3.98
Mj+Ab+Tv	47.98	49.94	129.47	12.19	0.29	00.00	0.32	6.67	0.83	17.79	2.71	7.97
Mj+Bm+Gm	49.93	56.08	124.00	7.45	0.37	27.59	0.36	20.00	0.88	14.29	2.67	6.37
Mj+Bm+Tv	41.56	29.92	111.13	3.70	0.35	20.69	0.37	23.33	0.88	14.29	2.65	5.58
Mj+Gm+Tv	37.79	18.13	118.00	2.25	0.32	10.34	0.38	26.67	0.93	20.78	2.63	4.78
Mj+ Ab+Bm+Gm	43.69	36.57	131.17	13.67	0.37	57.59	0.40	33.33	0.99	28.57	2.80	11.55
Mj+ Ab+Bm+Tv	52.00	62.55	129.13	11.90	0.34	14.24	0.33	10.00	0.93	20.78	2.77	10.36
Mj+ Ab+Gm+Tv	47.33	47.95	142.07	23.11	0.33	13.79	0.38	26.67	0.93	20.78	2.70	7.57
Mj+Bm+Gm +Tv	34.59	8.13	140.97	22.16	0.35	20.69	0.39	30.00	0.99	28.57	2.79	11.16
Mj+Ab+Bm+G +Tv	44.38	38.73	139.07	20.51	0.38	31.03	0.41	36.67	1.00	29.87	2.76	9.96
L.S.D at 0.05 %	8.44		N.S		0.01		N.S		0.14		N.S	

Table (4): Effect of different treatments bacteria (*Azospirillum brasilense* and *Bacillus megatherium*) and fungi (*Glomus mosseae* and *richoderma viride*) some quality characters and sugar yield of sugar beet infected with *Meloidogyne javanica* root-knot nematode.

Treatment	T.S.S		Sucrose		Purity		Sugar yield/plant	
	%	Increase %	%	Increase %	%	Increase %	gm	Increase %
Control	19.30	6.60	16.90	19.00	87.40	11.20	69.20	68.80
Mj	18.10	0.00	14.80	0.00	78.60	0.00	41.00	00.00
Mj+Ab	19.50	7.70	18.60	31.00	95.00	20.90	99.70	143.20
Mj+Bm	19.00	5.00	18.00	26.70	94.70	20.50	94.30	130.00
Mj+Gm	19.10	5.50	18.10	27.50	94.80	20.60	97.30	137.30
Mj+Tv	18.70	3.30	17.70	24.60	94.70	20.50	90.30	120.20
Mj+Ab+Bm	19.80	9.40	16.10	13.40	81.30	3.40	70.30	71.50
Mj+Ab+Gm	19.00	5.00	16.00	12.70	84.20	7.10	53.80	31.20
Mj+Ab+Tv	19.00	5.00	15.10	6.30	79.40	1.00	52.30	27.60
Mj+Bm+Gm	18.90	4.40	15.00	5.60	79.40	1.00	46.50	13.40
Mj+Bm+Tv	19.30	6.60	16.10	13.40	83.70	6.50	55.50	35.40
Mj+Gm+Tv	19.20	6.10	18.00	26.80	93.80	19.80	71.10	73.40
Mj+ Ab+Bm+Gm	20.00	11.10	17.70	20.40	88.50	11.80	75.90	85.10
Mj+ Ab+Bm+Tv	19.80	9.40	16.60	16.90	83.80	6.60	68.00	65.90
Mj+ Ab+Gm+Tv	19.70	8.80	17.90	26.10	90.70	15.40	81.30	98.30
Mj+Bm+Gm+ Tv	19.90	9.90	17.90	26.10	89.90	14.40	84.90	107.10
Mj+Ab+Bm+Gm v	20.40	12.70	19.60	38.00	96.10	22.30	112.30	173.90
L.S.D at 0.05 %	0.80		0.80		5.70		6.90	

Meloidogyne javanica Ab=*Azospirillum bracilense*
Bm=*Bacillus megatherium* Gm=*Glomus mosseae* Tv=*Trichoderma viride*

دور ***Azospirillum brasilense*** و ***Bacillus megatherium*** و ***Glomus mosseae*** و ***Trichoderma viride*** منفردة أو فى خلائطها في مقاومة نيماتودا تعقد الجذور ***Meloidogyne javanica*** التي تصيب بنجر السكر

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تم تقيم فاعلية *Azospirillum brasilense* و *Bacillus megatherium* و *Glomus mosseae* و *Trichoderma viride* منفردة أو مخلوطة في مقاومة نيماتودا تعقد الجذور *Meloidogyne javanica* التي تصيب بنجر السكر و أوضحت النتائج :

١- أن بكتيريا *Azospirillum brasilense* منفردة كان لها تاثير معنوي علي خفض عدد تعقدات الجذور و أكياس البيض علي جذور بنجر السكر كما كان لها تأثير معنوي علي زيادة نمو النبات و صفات الجودة ونسبة النيتروجين في الجذور وكذلك محصول السكر مقارنة بالكنترول و باقي الميكروبات الاخري المدروسة .

٢- اما من حيث تأثير الخلائط المختلفة لهذه الميكروبات وجد أن المخلوط المكون من الكائنات الأربعة المدروسة أعطي أعلى زيادة معنوية عن تأثير الكائنات المنفردة و الخلائط الثنائية و الثلاثية علي نمو النبات و محتواه من النيتروجين والفوسفور و البوتاسيوم كما حسن معنويا من الصفات التكنولوجية وأعطي اعلي محصول سكر كذلك حقق أعلى خفض معنوي في تعداد تعقدات الجذور و أكياس البيض للنيماتودا علي جذور بنجر السكر وكان الخفض يصل الي ٩٠,٧% و ٨٩,٤% علي التوالي .

ومن هذه النتائج يمكن استخدام هذا المخلوط للكائنات الحية الأربعة كطريقة حيوية أو كعنصر من عناصر المكافحة المتكاملة في برنامج إدارة محصول بنجر السكر بعد اختبارها حقلياً .