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An ecofriendly root- knot nematode pest management strategy on sugarbeet

2- Using some amino and organic acids

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Abstract

Four amino and organic acids, L-arginine, L-glutamic (as amino acids), ascorbic and salicylic (as organic acids) solution applied as soil drench in three concentration levels to evaluate for nematicidal effects against root-knot nematode, *Meloidogyne javanica* infecting sugarbeet. Their effects on sugarbeet yield and its components and quality parameters were determined. All of the tested compounds reduced the number of juvenile larvae in soil, immature stages, mature females in root, final nematode population as well as reproduction factor, comparison to the check treatment. These compounds were mostly variable in their effectiveness in reducing nematode infesting or reproduction factor and enhancing plant yield and quality according to compounds type and concentration level used. Then, the percentage of reduction in nematode parameters or/and the increases in crop parameters increased by increasing the concentration level of each tested compound.

The ascorbic acid was more effective in reducing nematode fecundity, final nematode population and reproduction factor followed by salicylic acid, L-arginine acid and L-glutamic acid in a descending order. Also, the ascorbic acid component showed the best results in improving leaves, roots, sugar yields and quality parameters of sugarbeet in comparison with the other tested compounds. In comparing between the effects of both ascorbic acid and nematicide, Oxamyl on nematode development and reproduction factors as well as productivity of sugarbeet, the ascorbic acid recorded reduction in juveniles larvae in soil, final population number and reproduction factor with values of 76.3, 71.6% and 2.1 fold, respectively as well as increases in root yield and sugar yield with values of 65.73 and 126.51%, respectively, however, Oxamyl recorded reduction to 73.6, 77.3% and 1.9 fold in juveniles in soil, final population number and reproduction factor, respectively as well as increases to 68.09 and 124.12% in root and sugar yield, respectively.

The problems associated with nematicides application turned the workers view to focus on new strategies or use new safe components or chemicals for nematode management program. On the other hand, it was obvious from the obtain data, the

results suggest that using of ascorbic acid (at 4000 ppm rate) could be recommended as instead of chemical nematicide to be a main nematode management approach, whether using as part of an integrated management programs or as sole control component.

Key wards: Amino acids, organic acids, *Meloidogyne javanica*, root-knot nematode, sugarbeet, Oxamyl.

Introduction

The genus *Meloidogyne*, the root-knot nematode, is one of the major biological constrains around the world in most all types of crop plants and causes sever losses in the productivity of sugarbeet in Egypt (**Gohar, 2003; Gohar and Maareg, 2005; Maareg and Hassanin, 1992; Maareg *et al*., 2005).** Chemical nematicides, due to their high availability and easy applicability, are generally preferred for their control; however, their excessive and continuous use was reported to have resulted in development of nematicides resistance, caused direct toxicity to predators, pollinators, fish and man, had adverse effects on soil health and environment, and cause poor soil health, fertility, productivity and pesticide residues in products. The problems associated with nematicides application turned the workers view to focus on new approaches that might be adopted to develop non traditional nematicides or use new safe chemicals for nematode management programs. Many research workers studied the effects of some amino and organic acids on plant growth and yield of many crops such as cowpea, soybean, sunflower and tomatoes, as well as their effects on reproduction and development of many nematode species like *Helicotylenchus mannus*, *Heterodera rostochiensis*, *H. schachtii*, *Meloidogyne* spp. and *Rotylenchus renoformis* **(Osman, 1993; Al-Sayed & Montasser, 1986; Al- Sayed & Thomason, 1988; Al-Sayed, 1990; 1991; 1992; Hassan, 1999; Klessig *et al*., 2000; Nandi *et al*., 2002; Sirohi & Rohatgi, 2006 and Sirohi *et al*., 2008).**

The aim of this study was to evaluate the nematicidal of some amino and organic acids (as safe chemicals) against *M. javanica* infecting sugarbeet. Also, the effects of all treatments on sugarbeet yield and its components and quality were undertaken.

Material and Methods

Propagation of *Meloidogyne javanica* nematode stock culture

Heavily galled sugarbeet roots var. Helios were collected and carefully washed from the adhering soil particles with tap water. The eggmasses from the egglaying females which were previously identified as *M. javanica* were picked up from the infested roots and singly inoculated into soil planted with 45-days-old tomato seedlings (*Lycopersicon esculentum* L.) in 1 m^2 lysameters filed with stemsterilized sandy loam soil, and watered as needed regularly. The infested tomato roots which contained females with their eggmasses were used to renew the stock culture. The pure stock culture in this respect was prepared from infested tomato roots through extraction by the Baermann-pan technique according to **Southey (1970).**

Inoculation procedures

In greenhouse experiments, the inoculation was achieved by pouring the second stage juveniles (J_2) water suspension into four holes (3-5 cm) depth around the sugarbeet root system which were immediately covered and mixed with soil. Each pot was inoculated with 2000 fresh J_2 at the fourth leaf stage seedlings.

Organic and amino acids tested

Two organic acids (ascorbic and salicylic acids) and two amino acids (L-arginine and L-glutamic acids) were tested to their effects against *M. javanica* nematode infecting sugarbeet plants and their effects on plant yield components and quality parameters. These compounds were used as soil drench at the concentration levels of, 1000, 2000 and 4000 ppm (1, 2 and 4 g liter^{-1}) and carried out twice, the first time at the fourth leaf seedling stage and the second one a month later.

Nematicide, Oxamyl 10% G {N- N- dimethyl– 2– methylcarbamoyl oxyimino – 2- (methylthio) acetamide} was used as a comparable treatment with amino and organic acids tested. Mixed with soil at concentration levels of 1, 2 and 4 g pot^{-1} which were applied one time at the fourth leaf seedling stage.

Experimental design

The experimental soil was calcareous loamy sand with electrical conductivity (E. C) of 1.2 ds/ m, pH of 8.4, OM of 1.1%, $CaCo_3$ of 28.3%, soluble cations (Ca^{++} 7.5, Mg^{++} 1.7, Na^{+} 9.6 and K^{+} 4.5, mq l^{-1}) and soluble anions ($CO3^{--}$0.0, $HCO3^{-}$ 8.8, $SO4^{--}$ 6.9 and Cl^{-} 8.0 mql^{-1}) at the 0- 30 cm depth. The soil was air-dried and sieved to pass through a 2mm. Sieve.

The pot experiment was conducted in the greenhouse under controlled conditions (23 ± 5ºC and 65 ± 5 HR). Seeds of sugarbeet var., Helios were sown in 40 cm diameter clay pots. Each pot was filed with about 7 kg of the sterilized experimental soil in October. After germination and at fourth leaf stage, seedlings were thinned to one vigorous plant pot^{-1} one week later, plants were inoculated with freshly 2000 hatched juveniles (J_2) of root-knot nematode, *Meloidogyne javanica.* Several treatments were applied to control the *M. javanica* population as shown in Table (1).

Each treatment level was replicated eight times. The experiment included 16 pots (8 pots inoculated with nematode only and 8 pots free of nematode or any treatment) as control, 48 pots of amino acids, 48 pots of organic acids and 24 pots of nematicide, oxamyl. All pots were arranged in a randomized pattern on a bench in a greenhouse. Pots were watered daily with tap water. The experiment lasted six months.

At the end of experimental period, the soil of each pot was well irrigated before removing the plant. Roots were washed in a gentle flow tap water. Fresh weights of leaves and roots were recorded (as growth parameters). However, the quality parameters in sugarbeet roots included sucrose percentage determined according to **Le-Docte (1927),** total soluble solids (TSS) percentage was measured using hand refractometer, juice purity percentage was determined as a ratio between sucrose and TSS % according to **Carruther and Olfield (1961)** and sugar weight plant^{-1} was calculated (root weight X sucrose %). Also, infested plant roots were examined for developmental stages after staining by lactic acid- fuchsin **(Byrd *et al*., 1983)** and recorded. Number of *Meloidogyne javanica* in soil was also determined by extracting through sieve and modified Baermann- pan technique **(Goodey, 1957)** and recorded. The nematode reproduction factor and reduction% were calculated. Data analysis statically using the least significant differences **(Steel and Torrie, 1987)**.

Results

Two organic acids (ascorbic and salicylic acids) and two amino acids (L-arginine and L-glutamic acids) solution applied as soil drench in three levels (1000, 2000 and 4000 ppm) were tested for their effectiveness against root-knot nematode, *Meloidogyne javanica* infecting sugarbeet plant. Their effects on sugarbeet yield and its components and quality parameters were determined.

Effects of selected organic and amino acids on development and reproduction of root-knot nematode, *Meloidogyne javanica* infecting sugarbeet

The effect of ascorbic, salicylic, L- arganine and L- glumatic acids on development and reproduction of *M. javanica* root-knot nematode are summarized in Table (1). The data indicate that the effect of the tested materials on reduction of *M. javanica* nematode parameters varied according to the chemical itself and concentration level used. All of treatments exhibited significant reduction in members of J_2 in soil pot^{-1}, immature stages and mature females root^{-1} system as well as final nematode population and reproduction factor compared to the check treatment. Remarkable differences in nematode suppression were noticeable among the tested concentration levels. Then, the reduction of nematode numbers and fecundity increased by increasing the concentration of each tested organic or amino acid. At a concentration level of 4000 ppm for all tested organic and amino acids, the reduction nematode population and fecundity were evident.

Among the tested materials, the ascorbic acid achieved a higher reduction in all nematode parameters at all concentration levels compared to the other tested materials and the check treatment. At the 4000 ppm concentration level, ascorbic acid yielded the highest reduction in all nematode parameters compared to the check treatment with 2498 J_2 pot^{-1}, 1663 and 280 ind. $root^{-1}$ of immature stages and mature females, respectively. Salicylic acid achieved its highest results with 2730 J_2 pot^{-1}, 1653 and 290 ind. $root^{-1}$ system of the immature stages and mature females, respectively. Inimical effects were also achieved by L-arginine acid followed by L-glutamic acid at their highest concentration level (4000 ppm) as shown Table (1).

The results presented in the same Table clearly revealed that the highest reduction in nematode final population, 74.6 % was achieved when using the nematicide, Oxamyl at its highest concentration level. Ascorbic acid, salicylic acid and L-arginine acid followed by L-glutamic acid caused reduction in final nematode population with 71.6, 68.0, 53.6 and 39.7%, respectively, at their highest concentration levels.

Nematode reproduction factor was significantly decreased by acid solution treatments at all concentration levels compared to the check. The highest reduction in nematode reproduction factor was achieved using the highest solution levels. The lowest reproduction factor value of *M. javanica* (1.9 fold) was achieved with the nematicide, oxamyl even at its highest levels, followed by ascorbic, salicylic L-arginine and L-glutamic acids at their highest levels with an average of 2.1, 2.3, 3.4 and 4.4 fold, respectively at their highest concentration levels.

In short, the plants received the nematicide, Oxamyl and organic compounds, ascorbic acid treatments at their highest concentration levels achieved the highest reduction% of J_2 population in soil and final population number and lowest reproduction factor with values of 73.6, 74.6% and 1.9 fold for Oxamyl, and 76.3, 71.6% and 2.1 fold for ascorbic acid, respectively

Effects of selected organic and amino acids on growth and quality parameters of sugarbeet infecting by root-knot nematode, *Meloidogyne javanica*

Data of sugarbeet growth and quality parameters as influenced by amino and organic acids are shown in Table (2 and 3). The results in Table (2) shows positive relationship among all the organic and amino acid treatments and both plant leaves and root as well as sugar yields. It was observed that all treatment of concentration levels caused significant increase in weights of leaves, root and sugar when compared to the check treatment.

In case of leaves weight, a significant increase was observed in leaves weight especially at all application concentration levels of all the tested compounds. The maximum increments as compared to check treatment were achieved when using amino or organic acids at their highest concentration levels. The greatest leaves weight (228.82 g $plant^{-1}$) as compared to the check treatment (156.28 g $plant^{-1}$) was achieved when using ascorbic acid at its highest level followed, by salicylic, L-arginine and finally L-glutamic acids at their highest levels with values of 226.07, 197.77 and 192.97 g, plant^{-1}, respectively.

Regarding the root weight, proportional effects were observed among the tested materials concentration levels and the root weight. A positive correlation between root weight and amino or organic acid concentration levels was evident. Ascorbic acid at a level of 4000 ppm yielded 717.93 g plant^{-1} in root weight, while salicylic acid at the same level yielded 678.83 g plant^{-1} followed by L-arginine and L-glutamic acids with values of 656.57 and 590.11 g plant^{-1}, respectively.

Concerning sugar yield, results indicate a positive correlation between sugar yield plant^{-1} and amino or organic acid concentration level. The highest increases compared to the check treatment were achieved at the highest concentration level of each amino or organic acid. For instance, solution of ascorbic acid at the concentration level of 4000 ppm yielded 137.77 g plant^{-1} in sugar yield, while, solution of salicylic acid at the same concentration level yielded 127.69 g plant^{-1} followed by L-arginine and L-glutamic acids with values of 118.18 and 104.87 g plant^{-1}, respectively.

Generally, Oxamyl as comparable treatment at level of 4 g pot^{-1} yielded 265.14 g plant^{-1} in leaves, 728.13 g plant^{-1} in root and 136.31 g plant^{-1} in sugar plant^{-1}.

The data on sugarbeet quality as influenced by amino or organic acid are shown in Table, (3). Generally, positive relations occurred between the compounds treatments, and quality parameters at all application. The greatest increases in sucrose, TSS and purity percentages were observed at the highest levels of all treatments compared to the check treatment. Based on sucrose percent, the most effective treatment was observed with ascorbic acid at maximal level, yielding a percent of 19.19%. This was followed by salicylic, L-arginine and L-glutamic acids at their maximum levels with values of 18.81, 18.0, and 17.77 %, respectively. Furthermore, at the highest levels of tested organic and amino acids, TSS and purity% were also increased compared to the check treatment. For instance, Ascorbic acid yielded 23.2 and 82.72 % in TSS and purity%, respectively followed by Salicylic, L-arginine and L-glutamine acids with values of 22.8, 22.05 and 22.0 in TSS, 82.50, 81.63, and 80.77in purity%, respectively. While the comparable nematicide, Oxamyl achieved the highest increase even at the highest level with values of 18.72, 22.06 and 84.86%, in sucrose, TSS and purity, respectively. Significant differences were detected among the compounds treatments. Generally, in comparing between the amino and organic acid compounds, the second compounds were more effective than the first ones.

Finally, the nematicide, Oxamyl and organic acid, ascorbic at their highest concentration levels showed the best results in improving root and sugar yield plant^{-1} with values of (68.09 & 124.12%) and (65.73 & 126.51%), respectively.

Table (1): Effect of selected organic and amino acids on the development and reproduction of root-knot nematode, *Meloidogyne javanica* infecting sugarbeet.

Treatments	Level	J_2 in soil pot^{-1}		In root system				Final Population (P_f)		RF
		No.	R %	Immature stages	Mature females	Total	R %	No.	R %	
Organic acids										
Ascorbic (ppm)	1000	5869	44.3	2311	410	2721	33.1	8590	41.2	4.3
	2000	3678	65.1	1846	340	2186	46.3	5864	59.9	2.9
	4000	2498	76.3	1363	280	1643	59.6	4141	71.6	2.1
Mean		4015	61.9	1940	343.3	2283.3	43.9	6298.3	56.9	3.2
Salicylic (ppm)	1000	6350	39.8	2803	386	3189	21.6	9539	34.7	4.8
	2000	4005	62.0	2060	351	2411	40.7	6416	56.1	3.2
	4000	2730	74.1	1653	290	1943	52.2	4673	68.0	23
Mean		4361.7	58.6	2172	342.3	2514.3	38.2	6876	52.9	3.4
Amino acids										
L-arginine (ppm)	1000	7540	28.5	2926	300	3226	20.7	10766	26.3	5.4
	2000	6237	40.8	2283	391	2674	34.3	8911	39.0	4.5
	4000	4209	60.1	2273	301	2574	36.7	6778	53.6	3.4
Mean		5993.7	43.1	2494	330.7	2824.7	30.6	8818.3	39.6	4.4
L-glutamic (ppm)	1000	8241	21.8	3061	501	3562	12.4	11803	19.2	5.9
	2000	7820	25.8	2370	441	2811	30.9	10631	27.2	5.3
	4000	6142	41.7	2249	411	2660	34.6	8802	39.7	4.4
Mean		7401.0	29.8	2560	451	3011.0	26.0	10412	28.7	5.2
Nematicide										
Oxamyl (g pot^{-1})	1	5864	44.4	1508	300	1808	55.6	7672	47.5	3.8
	2	4328	58.9	1236	252	1488	63.4	5816	60.2	2.9
	4	2784	73.6	760	164	924	77.3	3708	74.6	1.9
Mean		4325.3	59.0	1168	238.7	1406.7	65.4	5732	60.8	2.9
Check		10540	0.00	3320	0.00	4068	0.00	14608	0.00	7.3
$LSD_{0.05}$ between treatment (A)		139.5		98.1	73.7	121.3		197.4		0.1
between levels (B)		98.7		69.4	52.1	85.8		139.6		0.07
A × B		170.9		120.2	90.3	148.6		241.8		0.1

J= Juveniles R= reduction RF = reproduction factor

Table (2): Effect of selected organic and amino acids on leaves, root and sugar weights of sugarbeet infecting by root- knot nematode, *Meloidogyne javanica*.

Treatments	Level	Leaves plant^{-1}		Root plant^{-1}		Sugar plant^{-1}	
		g.	Inc. %	g.	Inc. %	g.	Inc. %
Organic acids							
Ascorbic (ppm)	1000	202.23	29.40	600.11	38.54	102.61	68.70
	2000	215.33	37.78	661.01	52.59	121.81	100.28
	4000	228.82	46.42	717.93	65.73	137.77	126.51
Mean		215.46	37.87	659.68	52.29	120.73	98.50
Salicylic (ppm)	1000	198.19	26.82	579.81	33.85	98.57	62.07
	2000	213.93	36.89	634.07	46.38	115.65	90.15
	4000	226.07	44.66	678.83	56.71	127.69	109.95
Mean		212.73	36.12	630.90	45.64	113.97	87.39
Amino acids							
L-arginine (ppm)	1000	171.23	9.57	545.69	25.97	89.22	46.70
	2000	184.06	17.78	564.26	30.26	98.29	61.61
	4000	197.77	26.55	656.57	51.57	118.18	94.31
Mean		184.35	17.97	588.84	35.93	101.90	67.54
L- glutamic (ppm)	1000	164.64	5.35	509.20	17.55	84.18	38.40
	2000	180.76	15.66	544.13	25.61	92.52	52.12
	4000	192.97	23.48	590.11	36.23	104.87	72.43
Mean		179.46	14.83	547.81	26.46	93.86	54.32
Nematicide							
Oxamyl (g pot^{-1})	1	177.27	13.43	508.76	17.45	84.42	38.80
	2	214.41	37.20	555.54	28.25	96.50	58.67
	4	265.14	69.66	728.13	68.09	136.31	124.12
Mean		218.94	40.09	597.48	37.93	105.74	73.86
Check		156.28	0.00	433.18	0.00	60.82	0.00
Healthy		252.69	61.69	746.77	72.39	136.74	124.82
$LSD_{0.05}$ between treatments (A)		4.71		12.67		2.39	
$LSD_{0.05}$ between levels (B)		3.08		8.29		1.56	
A × B		5.77		15.52		2.92	

Inc.= Increase

Table (3): Effect of selected organic and amino acids on quality parameters of sugarbeet infecting by root-knot nematode, *Meloidogyne javanica*.

Treatments	Level	Sucrose		TSS		Purity	
		%	Inc. %	%	Inc. %	%	Inc. %
Organic acids							
Ascorbic (ppm)	1000	17.10	21.79	21.09	16.39	81.08	4.64
	2000	18.43	31.27	22.24	22.74	82.87	6.95
	4000	19.19	36.68	23.20	28.04	82.72	6.76
Mean		18.24	29.91	22.18	22.39	82.22	6.12
Salicylic (ppm)	1000	17.00	21.08	21.10	16.45	80.58	3.99
	2000	18.24	29.91	22.49	24.12	81.10	4.67
	4000	18.81	33.97	22.80	27.48	82.5	5.09
Mean		18.07	28.32	22.23	22.68	81.04	4.58
Amino acids							
L-arginine (ppm)	1000	16.35	16.45	20.52	13.25	79.68	2.83
	2000	17.42	24.07	21.85	20.58	79.73	2.90
	4000	18.00	28.21	22.05	21.69	81.63	5.35
Mean		17.26	22.91	21.47	18.51	80.35	3.69
L- glutamic (ppm)	1000	16.53	17.74	20.52	13.25	80.56	3.96
	2000	17.00	21.08	21.00	15.89	80.95	4.47
	4000	17.77	26.57	22.00	21.41	80.77	4.24
Mean		17.10	21.79	21.17	16.85	80.76	4.23
Nematicide							
Oxamyl (g pot^{-1})	1	16.59	18.16	19.81	9.33	83.74	8.08
	2	17.37	23.72	20.47	12.97	84.86	9.51
	4	18.72	33.33	22.06	21.74	84.86	9.52
Mean		17.56	25.07	20.78	14.68	84.49	9.04
Check		14.04	0.00	18.12	0.00	77.48	0.00
Healthy		18.31	30.41	22.00	21.41	83.23	7.42
$LSD_{0.05}$ between treatments (A)		0.111		0.167		0.881	
$LSD_{0.05}$ between levels (B)		0.073		0.109		0.577	
A × B		0.136		0.204		1.079	

Inc. = Increase

Discussion

With respect to the tested organic and amino acids under greenhouse conditions viz. ascorbic, salicylic, L-arganine and L-glutamic acids, they had a negative effect on the development and reproduction of *Meloidogyne javanica* on sugarbeet var. Helios. This was indicated by the lower population density of M. *javanica* juveniles in soil and root system, and other developmental stages as well as reproduction factor. This coincided with improvement in plant growth and quality of the treated pots and an increase in leaves, roots and sugar weights. These findings are in agreement with those of **El-Sayed (1986); Al-Sayed and Thomason (1988); Osman (1993); Hassan (1999) and Nandi *et al.*, (2002)** who found that solutions of some organic and/or amino acids suppressed the numbers of second stage juveniles, females, egg-masses, root galls of *M. incognita* and *M. javanica,* root-knot nematode on other hosts.

Arrigoni *et al.*, (1979) suggested that ascorbic acid plays a key role in defense mechanism of plants to pathogens such as root-knot nematodes. The amount of ascorbic acid in susceptible tomato cultivars was reported to be lower than in resistance cultivars. A decrease in plant ascorbic acid content can reduce the resistance of tomato plants to nematode infection **(Mellilo *et al.* 1983). El-Sayed (1989)** reported that ascorbic acid was more effective than L-arginine in reducing nematode, *M. incognita* on tomato plant. However, **Osman (1993)** found that L-arginine acid reduced nematode population and affected maturity and fecundity of *M. javanica* females in tomato roots.

Also, the data revealed that salicylic acid was found to reduce the number of nematode second stage juveniles, other developmental stages and consequently lowering reproduction factor of M. *javanica.* These results are in agreement with those obtained by **Hassan (1999) and Nandi *et al.* (2002)** who reported that the application of salicylic acid significantly suppressed population of *M. incognita* and *M. javanica* on cowpea and cucumber plants. Salicylic acid is known to play a critical signaling role in the activation of plant defense responses after pathogen attack **(Klessig *et al.*, 2000).** The mode of action of salicylic acid i.e. enhance defense mechanisms in the plant tissue **(Canet *et al.,* 2010)** and increased resistance against *Meloidogyne* spp. **(Siddique and Shaukat, 2004 & 2005 and Sirohi and Rohatgi, 2006).**

In short, in comparing between the effects of nematicide, Oxamyl and ascorbic acid on development and reproduction factors as well as sugarbeet productivity (Tables, 1, 2 and 3), the results [v] suggest that using of ascorbic acid (at 4000 ppm rate) could be recommended as instead of chemical nematicides to be a main nematode management approach, whether using as part of an integrated management program or as sole control component.

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الملخص العربي

إستراتيجية إدارة مكافحة نيماتودا تعقد الجذور على بنجر السكر بوسائل صديقة للبيئة
2 – استخدام الأحماض الأمينية والعضوية

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نظرًا لافتقار المقاومة في معظم أصناف بنجر السكر لنيماتودا تعقد الجذور والتي تسبب أضرارًا اقتصادية وخسائر فادحة في محصول الجذر والسكر الناتج، ولما كانت المبيدات النيماتودية عالية التكاليف من الناحية الاقتصادية وذات تأثير ضار على البيئة وصحة الإنسان والحيوان فإن الاتجاهات الحديثة هو البحث عن وسائل صديقة للبيئة وبدائل لهذه المبيدات الكيمائية المخلقة صناعيًا والغالية الثمن لحل المشاكل الناجمة عن هذه الآفة.

ومن هذه الوسائل استخدام بعض الأحماض الأمينية والعضوية ولذا تم تقييم فاعلية أربعة أحماض، اثنان من الأحماض الأمينية وهى حمض ل– أراجانين، ل– جلوتامين واثنان من الأحماض العضوية وهى حمض الأسكوربيك، وحمض السالسليك ضد نيماتودا تعقد الجذور النوع مليدوجين جافانيكا التي تصيب محصول بنجر السكر.

ولقد استخدمت هذه المواد بثلاث تركيزات: ١٠٠٠ &٢٠٠٠ & ٤٠٠٠ جزء في المليون مضافة للتربة مقارنة بالمبيد الكيميائي أوكسامايل وقد وجد أن هذه المركبات تختلف من حيث تأثيرها على النيماتودا والمحصول من حيث نوع المركب والتركيز المستخدم.

وقد وجد عمومًا أن الخفض في تعداد النيماتودا ومعدل تكاثرها والزيادة في المحصول وجودته تزيد مع زيادة التركيز المستخدم لكل مركب، وأوضحت الدراسة أن كل المركبات المستخدمة أحدثت خفضًا معنويًا في أعداد الأطوار المختلفة للنيماتودا في التربة والجذر والتعداد النهائي ومعدل تكاثرها، كما أحدثت زيادة معنوية في الصفات المحصولية والجودة مقارنة بمعاملة الكنترول. كما وجد أن حمض الأسكوربيك أكثر المركبات فاعلية في خفض تعداد الأطوار المختلفة للنيماتودا وتعدادها النهائي ومعدل تكاثرها يليه حمض السالسليك ثم حمض ل– أراجانين وأخيرًا حمض ل– جلوتامين. كما وجد أن حمض الأسكوربيك أعطى أعلى زيادة في محصول الأوراق والجذور والسكر وصفات الجودة (نسب السكر والمواد الصلبة الذائبة الكلية والنقاوة) مقارنة بالمركبات المختبرة الأخرى.

وفى مقارنة بين فاعلية حمض الأسكوربيك وفاعلية المبيد النيماتودى أوكسامايل في التأثير على تطور النيماتودا ومعدل تكاثرها وكذلك التأثير على إنتاجية محصول بنجر السكر وجد أن حمض الأسكوربيك خفض كل من تعداد النيماتودا في التربة والتعداد النهائي لها إلى ٧٦,٣% & ٧١,٦% ومعدل تطورها إلى ٢,١ مرة وحقق زيادة في محصول الجذور والسكر إلى ٦٥,٧٣ & ١٢٦,٥١% على الترتيب. أما المبيد أوكسامايل فقد حقق ٧٣,٦ & ٧٧,٣% & ١,٩ مرة في تعداد الطور المعدي في التربة والتعداد النهائي ومعدل التكاثر للنيماتودا وزيادة في محصول الجذور والسكر ٦٨,٠٩ & ١٢٤,١٢% على الترتيب.

ونظرًا للمشاكل المصاحبة لتطبيق المبيدات النيماتودية أدى إلى التوجه إلى البحث عن وسائل أو مركبات آمنة صديقة للبيئة لاستخدامها في برامج مكافحة النيماتودا ومن النتائج المذكورة عالية يمكن استخدام حمض

الأسكوربيك بتركيز ٤٠٠٠ جزء في المليون بديلاً عن المبيدات الكيميائية المختلفة أو استخدامه في برامج المكافحة المتكاملة للآفات النيماتودية.