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EVALUATION OF CERTAIN SUGARBEET VARIETIES FOR THEIR PRODUCTIVITY AND SUSCEPTIBILITY TO *Meloidogyne javanica* ROOT-KNOT NEMATODE

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ABSTRACT

Seventeen varieties of sugarbeet either as monogerm or multigerm were screened for their productivity and susceptibility or resistance against the infection by *Meloidogyne javanica*. All the tested varieties varied in the degree of nematode development and reproduction. Statistical differences in sugarbeet varieties are found between infected and non infected plants in yields of roots, leaves and sugar except, Barca, Pamela and Toro varieties which were not significantly damaged in all these parameters. All evaluated sugarbeet varieties were also significant decreased in percentages of sucrose, total soluble solids and purity except, Esperanza and Toro varieties which were not significantly decreased in total soluble solids and purity percentages, respectively. Four host categories systems were suggested in this study. Root damage index is an average of gall index, gall size and gall area. The combination of the nematode reproduction and root damage index is termed as susceptibility rate. Host vigor percentage is an average of root yield potential and sucrose and total soluble solids percentages. However, host-parasite index as a new term is suggested which expresses the amount of crop damage in yields (roots, leaves and sugar) and quality characters (sucrose, total soluble solids and purity percentages) by nematode infection. The host-parasite index is more suitable because of the generally high correlation between these parameters and crop damage. Thus the Barca and Gloria varieties were rated as a tolerant and Hilma and Helios as highly susceptible, 8 as moderately susceptible and 5 as low susceptible to M*. javanica* root-knot nematode infection in this investigation.

Keywords: sugarbeet varieties, *Meloidogyne javanica*, root-knot nematode, susceptibility, host-parasite , host vigor, root damage

INTRODUCTION

Sugarbeet (*Beta vulgaris* L.) plant is a vital crop as source of high energy pure food. It ranks the second sugar crop after sugarcane in Egypt and serves as a part of the diet for animal production in many countries. Plant parasitic nematodes, especially the root-knot nematodes (*Meloidogyne* spp.) are known among the most serious pests of sugarbeet in many countries (Singh & Misra, 1970; Janati *et al.*, 1982; Arnold, 1984). In Egypt, the root-knot nematodes of *Meloidogyne javanica* and *M. incognita* have been reported as major pests of sugarbeet (Ibrahim, 1982; Oteifa and El-Gindi, 1982; Abd El-Massih *et al.*, 1986; Maareg *et al.*, 1988; Ismail *et al.*, 1996; Maareg *et al.*, 1998, 1999 & 2005; Maareg & Badr, 2000; Gohar, 2003 and

Gohar & Maareg, 2005). The average annual loss in yield of sugarbeet due to *M. incognita* in different states of the U.S.A was estimated to be as high 10 – 50% and in Italy as 5 – 15% (Alteman & Thomason, 1971). D`Herde (1965) reported that the reduction in sugarbeet yield by about 60% in fields heavily infested by *M. nassi* in Belgium as compared to nematode free fields. The sugar content of the root juice was 14.1% in uninfected and 12.2% in nematode infected sugarbeet. Heavy infestation by *M. nassi* can reduce the yield by nearly 60% and sugar content by 13.0% (Weischer & Steudel, 1972). In Egypt, Gohar (2003) and Gohar & Maareg (2005) reported a reduction in root yield of about 58% and sugar content by 34% in sandy soil field heavily infested with *M. javanica* as compared to field free of this nematode. Otiefa and El-Gindi (1982) found that most varieties of sugarbeet reached as moderately susceptible hosts of *M. incognita*, except for Vivoka variety which was rated as highly resistant. Ismail *et al.*, (1996) found ten sugarbeet varieties out of 26 as moderately susceptible to *M. incognita*. Some varieties were ranked as tolerant, and highly susceptible. The remaining varieties were ranked as low susceptible depending on their growth response and technological characters. Also, Maareg *et al.*, (1986, 1998 & 2005) found that some varieties of sugarbeet were rated as resistant, some as susceptible, some as moderately susceptible and some as highly susceptible to the root-knot nematodes (*M. incognita* or *M. javanica*) depending on nematode parameters. Similarly, El-Nagdi *et al.*, (2004) reported that one sugarbeet variety out of thirty was rated as highly susceptible, 9 as susceptible and 20 as moderately resistant to *M. incognita* nematode infestation based on nematode parameters, quantitative and qualitative yield characteristics.

Since the nematicidal approaches in nematode management are not economical to the farmers, one of the best methods to reduce nematode damage is to develop and use resistant varieties of sugar beet against nematode infection. The present study was carried out to evaluate the relative resistance / susceptibility, losses in yield and technological parameters of 17 imported sugarbeet varieties due to infection of *M. javanica* root-knot nematode.

MATERIALS AND METHODS

Seeds of seventeen important sugarbeet varieties (6 with monogerm and 11 with multigerm seeds) were planted separately in 50 cm diam. clay pots with steam sterilized sandy loam soil (obtained from Banger-El-Soukar district) in October 2006. After germination and at fourth leaf stage, seedlings thinned to one vigorous plant per pot. For each variety, ten pots with similar plants in their growth were selected and five of those were inoculated with 2000 newly hatched active second stage juveniles *M. javanica* that were obtained from a pure stock culture. The other five pots were kept without inoculation as check or control. All pots were arranged in a completely randomized block design in a glasshouse at 20±5°C and all pots were irrigated as needed, and nutrients were applied at the rates required for normal plant growth. Six months after nematode inoculation, plants were harvested and fresh weight of both leaves and root per plant of each variety were determined. Also, the percentage yield potential was calculated for root weight of each infected plant. The second stage juveniles (J_2) were then extracted from the soil by centrifugal flotation and from roots by Baermann pan technique. Also, each root system was examined to determine the other nematode stages (J_3, J_4 and females) by staining using the method of Byrd *et al.* (1983). Nematode counts from soils and roots were estimated as final population (P_f). The counts of J_2 in soil and P_f were log-transformed before analyzing statistically. The technological characters in sugarbeet roots included sucrose percentage (S%) determined following Le-Docte (1927), total soluble solids percentage (TSS%) was measured in the fresh root using hand refractometer and juice purity percentage (P%) was determined as a ratio between S % and TSS % according to Carruthers and Oldfield (1961) as well as sugar yield per plant was calculated for each variety.

As for the sugarbeet plants which inoculated with *M. javanica*, root gall index (GI), gall size (GS), gall area (GA) and root damage index (DI) were estimated according to Sharma *et al.*, (1994). Sugarbeet varieties were categorized based on damage index (DI) which is the average of GI, GS and GA. The susceptibility rate (SR), host vigor percentage (HV%) and host-parasite index (HPI) of the varieties were also calculated to compare our rating systems with the DI of Sharma *et al.*, (1994).The susceptibility rate was also calculated as an average of reproduction factor (RF) following Oostenbrink (1966) and the root damage index (DI) as follows:

$SR = (RF + DI) \div 2$, where $RF = P_f / P_i$ (Oostenbrink, 1966).

$DI = (GI + GS + GA) \div 3$ (Sharma *et al.*, 1994).

Host vigor percentage was calculated as average percentages of root yield potential, sucrose and total soluble solids as follow:

HV% = (root potential % + S % + TSS %) ÷ 3 (El-Nagdi *et al.*, 2004)

Sugarbeet varieties with HV ≤ 30 % are considered as highly affected (HA) and 31-50% as moderately affected (MA).

However, the host parasite index (HPI) is a new susceptibility or tolerance value which states the amount of damage in plant yields and technological characters caused by nematode infection. It is calculated by dividing a gross average of reduction percentages in leaves, root and sugar yields per plant and in all technological characters (S, TSS and P%) by susceptibility rate according to the following formula:

$HPI = 4 [R_{yi} + R_{tech}] \div SR \times P_{yi + tech}$

where R_{yi} = reduction in yield parameters

R_{tech} = reduction in technological parameters

$P_{yi + tech}$ = number of yields and technological parameters

Sugarbeet varieties with HPI $\leq$ 4.0 are considered as tolerant, 4.1-6.0 as low susceptible (LS), 6.1-8.0 as moderately susceptible (MS) and > 8.1 as highly susceptible (HS). Least significant differences (LSD) and a paired T-test at 0.05 and 0.01 were performed for all data.

RESULTS

Screening the sugarbeet varieties according to nematode parameters and damage in quality characters and yields are presented in Tables, 1, 2 and 3.

Table (1) : Nematode parameters of sugarbeet varieties as influenced by root-knot nematode, *Meloidogyne javanica*.

Sugerbeet varieties	J_2 In soil	log	No. of different stages in root system				Total (P_f)	log	RF (P_f/P_i)	GI	GS	GA
			J_2	J_3	J_4	Females						
Monogerm:												
Avantaje	13732	4.14	2003	385	320	221	16661	4.22	8.3	7.7	8.0	7.3
Cesira	14490	4.16	4270	235	226	232	19453	4.29	9.7	8.0	7.0	5.9
Esperanza	9479	3.98	3002	371	337	412	13601	4.13	6.8	7.8	6.5	5.0
Helsinka	17874	4.25	5957	450	271	280	24832	4.40	12.4	8.0	7.1	7.0
Hilma	13637	4.13	6642	598	318	240	21435	4.33	10.7	9.0	8.7	9.0
Soccara	11639	4.07	6751	300	279	371	18340	4.26	9.1	8.0	7.0	5.9
Multigerm:												
Barca	6985	3.84	3692	268	192	172	11309	4.05	5.7	7.3	5.6	5.4
Gloria	9362	3.97	3049	430	233	250	13324	4.12	6.7	8.7	9.0	6.3
Helios	10151	4.01	5152	417	540	392	16652	4.22	8.3	8.0	8.0	8.2
Kawemira	9787	3.99	6369	437	262	213	17068	4.23	8.5	8.0	6.3	6.1
Lados	9960	4.00	6675	498	301	215	17649	4.25	8.8	8.3	7.7	7.0
Monte-Bianco	11138	4.05	4327	555	208	240	16468	4.22	8.2	8.2	7.0	6.3
Oscarpoly	9189	3.96	4628	537	335	450	14468	4.16	7.2	7.3	6.1	5.0
Pamela	7605	3.88	1152	340	220	180	9497	3.98	4.7	6.0	5.5	5.0
Raspoly	10249	4.01	7188	355	240	217	18249	4.26	9.1	7.0	6.0	7.7
Top	12475	4.10	2999	498	281	219	16472	4.22	8.2	9.0	8.3	9.0
Toro	8231	3.92	1064	256	208	183	9942	4.00	5.0	7.7	6.3	5.0
LSD = 0.05		0.03						0.11	3.2	0.9	3.2	2.4
LSD = 0.01		0.05						0.21	4.8	1.4	4.1	3.2

As regards the nematode parameters in the varieties, significant differences (P= 0.05 and 0.01) were found in reproduction factor (RF), gall index (GI), gall size (GS) and gall area (GA). The values of RF ranged from 4.7 for Pamela variety to 12.4 for Helsinka variety.

Generally, the varieties i.e. Esperanza, Helsinka, Hilma Soccara and Raspoly had the highest RF, while, Barca, Pamela and Toro varieties attained the lowest RF. Also, the GI values ranged from 6.0 for Pamela variety to 9.0 for both Hilma and Top varieties. The GS range was from 5.5 to 9.0, with Pamela having the lowest and Gloria the highest values. The GA values ranged from 5.0 in Esperanza, Oscarpoly, Pamela and Toro to 9.0 in Hilma and Top varieties (Table, 1).

Statistical differences (P= 0.05 and 0.01) are found between infected and non infected plants within varieties of sugarbeet in percentages of sucrose (S), total soluble solids (TSS) and purity (P), as shown in Table, 2. The ranged reduction in S was from 12.6 % in Esperanza to 38.8% in Hilma. The TSS reduction ranged from 4.1% in Barca to 32.6 % in Hilma. In P the ranged reductions varied from 1.1% in Toro to 19.7 % in Hilma (Table, 2).

Table (2) : Technological characteristics of sugarbeet varieties as influence by the infection of root-knot nematode, *Meloidogyne javanica*.

Sugerbeet varieties	Sucrose %			Total Soluble Solids %			Purity %		
	Con.	Inf.	R%	Con.	Inf.	R%	Con.	Inf.	R%
Monogerm:									
Avantaje	17.8	14.3**	19.7	24.7	22.0*	10.9	72.1	65.1*	11
Cesira	17.8	15.5*	12.9	22.7	20.7*	8.8	78.4	74.9*	4.5
Esperanza	17.5	15.3*	12.6	22.1	20.5	7.2	79.2	74.6*	5.8
Helsinka	16.6	12.7**	23.5	19.2	16.7*	13.0	86.4	76.0**	12.0
Hilma	17.8	10.9**	38.8	22.3	17.0**	32.6	79.8	64.1**	19.7
Soccara	18.2	15.3**	15.9	21.9	20.0*	8.7	83.1	76.5**	8.5
Multigerm:									
Barca	17.5	15.6*	22.3	22.0	21.1*	4.1	79.6	73.9**	7.2
Gloria	16.3	13.6**	16.6	20.2	17.4**	13.9	80.7	78.2**	3.1
Helios	17.4	11.8**	32.2	23.1	18.6**	19.5	75.3	63.4**	15.8
Kawemira	17.8	13.5**	26.4	24.7	19.5**	21.1	72.0	65.9**	8.5
Lados	16.5	11.9**	27.9	23.1	18.3**	20.8	71.4	63.3**	11.8
Monte-Bianco	17.3	12.6**	27.2	22.6	19.3*	14.6	76.5	65.3**	14.6
Oscarpoly	15.9	11.4**	28.3	21.8	17.8**	18.3	73.0	64.0**	12.3
Pamela	17.8	15.5*	24.2	23.4	21.1*	9.8	76.1	73.5*	3.4
Raspoly	16.6	12.0**	27.7	22.6	18.2**	19.5	73.5	65.9**	10.3
Top	18.0	12.6**	30.0	25.6	19.7**	23.0	70.3	64**	9.0
Toro	18.0	15.9*	22.9	21.6	19.3*	19.0	83.3	82.4	1.1

Con = non infected plant Inf = infected plant R= Reduction

Also, significant differences (P= 0.05 and 0.01) are found between infected and non infected plants within the screened sugarbeet varieties in root, leaves and sugar yields as shown in Table, 3.

Table (3): Root, leaves and sugarbeet yields and root weight potential of sugarbeet varieties as influenced by the infection of root-knot nematode, *Meloidogyne javanica*.

Sugerbeet varieties	Root yield/plant (g)			Leaves yield/plant (g)			Sugar yield/plant (g)			Root weight potential
	Con.	Inf.	R%	Con.	Inf.	R%	Con.	Inf.	R%	%
Monogerm:										
Avantaje	772.5	550.0**	28.8	320.0	195.0**	39.1	137.5	78.7**	42.8	75.3
Cesira	725.0	585.0*	19.3	240.0	175.0**	27.1	129.1	90.7*	29.7	80.1
Esperanza	865.7	642.5**	25.8	322.5	212.6**	34.1	151.5	98.3**	35.1	73.1
Helsinka	780.0	517.5**	33.7	280.2	172.5**	38.4	129.5	65.7**	49.3	70.8
Hilma	747.8	445.0**	40.5	340.3	170.7**	49.8	133.1	48.5**	63.6	60.9
Soccara	777.4	560.9**	27.8	330.1	225.7**	31.6	141.5	85.8**	39.4	76.8
Multigerm:										
Barca	715.5	671.8	6.1	289.2	264.1	8.7	125.2	96.4	23.0	91.9
Gloria	865.6	730.7**	15.6	297.9	262.0**	12.1	141.1	99.4**	29.0	100
Helios	798.3	450.0**	43.6	347.8	227.3**	34.6	138.9	53.6**	61.4	61.6
Kawemira	788.1	652.2**	17.2	372.9	304.8*	18.3	140.3	88.0*	37.3	89.3
Lados	779.8	641.1**	17.8	338.9	264.6*	21.9	128.7	76.3**	40.7	87.7
Monte-Bianco	853.8	666.1**	22.9	277.9	200.9**	27.7	147.7	86.4**	43.2	91.2
Oscarpoly	689.2	564.4**	18.1	296.5	259.6*	12.4	109.6	64.3**	41.3	77.2
Pamela	637.8	592.9	7.0	314.4	304.8	3.1	113.5	91.9	19.0	81.1
Raspoly	835.3	689.8**	17.4	333.7	262.1*	21.5	138.7	82.8**	40.3	94.4
Top	761.0	622.6**	18.2	312.8	227.3**	27.3	137.0	75.4**	42.8	85.2
Toro	726.4	662.2	8.8	252.7	227.3	10.4	130.8	105.3	19.5	90.6

Con = non infected plant Inf = infected plant R= Reduction

Percentage reduction in root yield ranged from 6.1 in Barca to 43.6 in Helios. Reduction in leaves yield ranged from 3.1% in Pamela to 49.8 % in Hilma, and in sugar yield from 19.0 % in Pamela to 63.6% in Hilma. Eventually, the Avantaje, Esperanza, Helsinka, Hilma, Soccara (as monogerm) and Helios (as Multigerm) attained the highest reduction in root, leaves and sugar yields but Barca, Pamela and Toro (as Multigerm) varieties had the lowest ones.

Categorization within the 17 screened sugarbeet varieties according to the damage index (DI) of Sharma *et al.,* (1994), the susceptibility rate (SR), the host vigor (HV) and the host parasite index (HPI) in this study is shown in Table, 4. The DI categorized the tested varieties into one as moderately susceptible, 14 as susceptible and 2 as highly susceptible to *M. javanica* infection. The SR gave 3 moderately susceptible, 8 susceptible and 6 highly susceptible to *M. javanica* infection. The HV categorized the same varieties into 15 as moderately affected and 2 as highly affected. However, the HPI categorized the same mentioned varieties into 2 as tolerant, 5 as low susceptible, 8 as moderately susceptible and 2 as highly susceptible to *M. javanica* infection. While each of Avantaje, Esperanza, Monte-Bianco, Oscarpoly, Raspoly and Top was susceptible according to both DI and SR, they were moderately affected and moderately susceptible in AV and HPI systems, respectively. Also, Cesira and Soccara were susceptible according to DI, highly susceptible in SR, moderately affected in HV but only low susceptible in HPI ratings. Helsinka and Lados were susceptible in DI, highly susceptible in SR, moderately affected in HV but moderately susceptible in HPI system. However, Hilma and Helios varieties were highly susceptible in DI, SR and HPI systems and highly affected in HV. As regards Barca variety, it was susceptible in DI, moderately susceptible in SR, moderately affected in HV but tolerant in HPI system. Gloria variety was susceptible in both DI and SR systems, moderately affected in HV, while it was tolerant in PHI. Also, Kawemira variety was susceptible in both DI and SR systems, moderately affected in HV, while it was low susceptible in HPI rating. Pamela variety was moderately susceptible in both, DI and SR ratings, moderately affected in HV but low susceptible in HPI system. However, Toro variety was susceptible in DI, moderately susceptible in SR, moderately affected in HV, while it was low susceptible in HPI system. The DI and SR systems result in more susceptible and highly susceptible ratings, the HV and HPI systems gives more moderately affected and moderately susceptible ratings more than the other systems.

Table (4): Different host categories of 17 sugarbeet varieties to *Meloidogyne javanica* root-knot nematode infection.

Sugerbeet varieties	Damage Index (DI)	Host category	Suscep-tibility rate (SR)	Host category	Host vigor %	Host category	Host-Parasite index (HPI)	Host category
Monogerm:								
Avantaje	7.7	S	8.0	S	37.2	MA	6.3	MS
Cesira	6.7	S	8.2	HS	38.8	MA	4.6	LS
Esperanza	6.4	S	6.6	S	41.2	MA	6.2	MS
Helsinka	7.4	S	9.9	HS	33.4	MA	6.5	MS
Hilma	8.9	HS	9.8	HS	29.6	HA	8.7	HS
Soccara	7.0	S	8.1	HS	37.4	MA	5.8	LS
Multigerm:								
Barca	6.1	S	5.9	MS	42.9	MA	4.0	T
Gloria	8.0	S	7.4	S	43.7	MA	3.9	T
Helios	8.1	HS	8.2	HS	30.7	HA	8.4	HS
Kawemira	6.8	S	7.7	S	40.8	MA	5.9	LS
Lados	7.7	S	8.3	HS	39.3	MA	6.8	MS
Monte-Bianco	7.2	S	7.7	S	41.0	MA	6.7	MS
Oscarpoly	6.1	S	6.7	S	35.5	MA	6.8	MS
Pamela	5.5	MS	5.1	MS	39.2	MA	5.0	LS
Raspoly	6.9	S	8.0	S	41.5	MA	6.1	MS
Top	7.7	S	8.0	S	39.2	MA	6.3	MS
Toro	6.3	S	5.7	MS	41.9	MA	4.5	LS

S = susceptible MS = moderately susceptible HS = highly susceptible
LS =low susceptible T=tolerant MA= moderately affected
HA = highly affected

DISCUSSION

The present study revealed that all the screened sugarbeet varieties (either as monogerm or multigerm), which were infected with *M. javanica* root-knot nematode varied in the degree of nematode development, reproduction and root galling symptoms.

Statistical differences (P= 0.05 and 0.01) in varieties were found between infected and non infected plants in various quality and yield parameters. Also, this study indicated that all the evaluated sugarbeet varieties to nematode infection had significantly decreased in percentages of sucrose, total soluble solids and purity, except for Esperanza and Toro varieties were not significantly decreased in total soluble solids and juice purity percentages, respectively as well as in yield of roots, leaves and sugar, except for Barca, Pamela and Toro varieties which were not significantly decreased in all yield parameters.

Our result also, indicated that the tested sugarbeet varieties varied in their susceptibility or resistance against *M. javanica* infection. The reduction in quality characteristics (sucrose, total soluble solids and purity %) or/ and yields (roots, leaves and sugar) of each variety positively correlated with the degree of resistance against nematode infection. However, it is interesting to note that sugarbeet var. Avantaje was categorized as susceptible to *M. javanica* according to both DI and SR systems, although it was higher in reduction in its yields (28.8, 39.1 and 42.8 % in roots, leaves and sugar, respectively) and quality characters (19.7,10.9 and 11.0% in sucrose, TSS and purity, respectively). Cesira variety was categorized as susceptible and highly susceptible to *M. javanica* according to DR and SR systems, respectively, although it was lower in reduction in its yields and quality parameters than Avantaje variety. Also, Barca, Pamela and Toro varieties were categorized as susceptible in DI and moderately susceptible in SR, and they were significantly decreased in quality parameters and not significantly decreased in yields. On the other hand, all the tested sugarbeet varieties were rated as moderately affected except Hilma and Helios varieties were rated as highly affected according to HV system.

Oostenbrink (1996) rated the responses of plant to nematode infection only on the basis of nematode reproduction factor (RF= P_f / P_i). Similarly, the scale suggested by Sharma, *et al.*, (1994) was based on root damage index (DI) which is an average of GI, GS and GA. The average of these two factors (i.e. the nematode reproduction on the plant "RF" and the symptoms of root galling which it causes DI) is here termed susceptibility rate (SR). In spite of the importance of the scale in expressing the differences in the degrees of nematode development, reproduction and damage index, the results indicated that this scale does not take into consideration the evaluation of real damage occurring in yields and quality characteristics of nematode-infected plant. Host vigor percentage (HV%) is calculated as an average of percentages root yield potential and sucrose and total soluble solids only. However, host-parasite index (HPI) as a new term is suggested to express the amount of damage rather than nematode symptoms; in yields of roots, leaves and sugar and quality characters of sucrose, total soluble solids and purity percentages that caused by nematode infection. Hence, the HPI system gives a better evaluated and a clear high correlation between these parameters and crop damage rather than nematode symptoms only. These results are in conformity with Ismail *et al.* (1996). Plant resistance could be attributed to the prevailing nematode species, some physiological and chemical factors of the plant (Winstead and Barkan, 1957; Riggs and Winstead, 1959 and Mohamed *et al.*, (1999) and soil temperature (Ammati *et al.*, 1986; Griffin and Gray,1995).

In short, using the HPI system, Barca and Gloria varieties could be ranked as a tolerant and Hilma and Helios as highly susceptible varieties to *M. Javanica*. Also, 5 out of 17 varieties (Cesira, Soccara, Kawemira, Pamela and Toro) were rated as low susceptible, and the remaining as moderately susceptible.

In conclusion, sugarbeet varieties, Barca, Gloria, Kawemira, Pamela and Toro (Multigerm seeds), Cesira and Soccara (monogerm seeds) could be used as commercial varieties in infested newly reclaimed soils.

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تقييم بعض أصناف بنجر السكر من حيث أنتاجيتها ومدى قابليتها للأصابة بنيماتودا تعقد الجذور ميليدوجين جافانيكا *Meloidogyne javanica*

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تم تقييم سبعة عشر صنفاً من بنجر السكر (ستة أصناف وحيدة الأجنة وأحدى عشر صنفاً عديد الأجنة) لأنتاجيتها ومدى قابليتها للأصابة بنيماتودا تعقد الجذور "ميليدوجين جافانيكا" وأوضحت النتائج أن جميع الأصناف المختبرة تختلف فيما بينها فى تطور وتكاثر النيماتودا عليها وهناك فروق جوهرية بين نباتات بنجر السكر المعداوة بالنيماتودا والغير معداة داخل كل صنف فى محصول الجذور ومحصول العرش ومحصول السكر بأستثناء الأصناف بركه و باميلا وتورو لم تتأثر في مكونات المحصول نتيجة الأصابة بالنيماتودا. كما وجد أن جميع صفات الجودة (نسبة السكروز ونسبة المواد الصلبة الذائبة الكلية ونسبة النقاوة) للأصناف المختبرة قلت معنوياً نتيجة الأصابة بالنيماتودا بأستثناء صنفى أسبرانز وتورو لم تتأثر نتيجة الأصابة بالنيماتودا فى نسبة المواد الصلبة الذائبة الكلية ونسبة النقاوة على التوالى.

كما تم مقارنة أربع أنظمة للتمييز ما بين الأصناف من حيث مدى قابليتها للأصابة بالنيماتودا وهى دليل الضرر الذى يصيب الجذر (وهى عبارة عن متوسط دليل التعقد ومساحة وحجم التعقدات الجذرية التى تسببها النيماتودا على الجذر) ومعدل الحساسية للعائل (وهو متوسط دليل الضرر ومعدل التكاثر للنيماتودا على الجذر) و نسبة قوة العائل (وهو متوسط مجموع النسب المئوية لمحصول الجذور المتوقع ونسبة السكروز ونسبة المواد الصلبة الذائبة الكلية) ودليل العلاقة مابين العائل والطفيل النيماتودى المستحدث يعبر عن العلاقة ما بين قيم الفقد فى المحصول (محصول الجذور والعرش والسكر) وصفات الجودة والضرر الناتج عن أصابة الجذر بالتيماتودا وتكاثرها عليها. وقد وجد أن أفضل الأنظمة هو المقياس المستحدث لأنه يحقق العلاقة الفعلية مابين الفقد فى المحصول وصفات الجودة والضرر الناتج عن الاصابة بالنيماتودا. وعليه فقد وجد أن كل من الصنف بركه وجلوريا كان متحملاً للأصابة بتيماتودا "ميليدوجين جافانيكا" وكل من الصنف هلما وهليوس عالية الحساسية وثمانية اصنافأ اخرى متوسطة الحساسية وخمس اصناف منخفضة الحساسية لهذه النيماتودا فى هذه الدراسة.