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SUSCEPTIBILITY OF NINE GRAPE CULTIVARS TO THE ROOT-KNOT NEMATODE, *Meloidogyne incognita* AND RENIFORM NEMATODE, *Rotylenchulus reniformis*

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ABSTRACT

The susceptibility of nine grape cultivars (Bez Alanza, Early Sweet, Flame Seedless, Mangawy, Queen, Red Globe, Romy Red, Sperior and Thompson Seedless) were tested for the two nematode species (root-knot nematode, *Meloidogyne incognita* and reniform nematode *Rotylenchulus reniformis*) under greenhouse conditions. The results indicated that both nematode species reproduced well on all tested grape cultivars, also grape cultivars were different in their susceptibility to both nematode species. The cultivars were ranked for their susceptibility against *M. incognita* as follows: two cultivars, Mangawy and Queen were categorized as very resistant to the nematode. Red Globe and Thompson Seedless cultivars were considered as slightly resistant. On the other hand, five cultivars Bez Alanza, Early Sweet, Flame Seedless, Romy Red and Sperior were graded as susceptible. As for the response of these grape cultivars to the *R. reniformis* Bez Alanza, Mangawy, Queen and Romy Red were categorized as highly resistant. Only Sperior was rated as resistant. Early Sweet, Red Globe and Thompson Seedless were considered as less susceptible. In contrast, one cultivar Flame Seedless was ranged as highly susceptible. Plant growth parameters of tested grape cultivars were also discussed.

Keywords: Grape, Root-knot nematode, *Meloidogyne incognita*, Reniform nematode, *Rotylenchulus reniformis*, Screening cultivar.

INTRODUCTION

Grapevine (Vitis vinifera L) cultivation for wine and tablegrape production is one of the most extensive fruit-crop systems grown under temperate and Mediterranean climates worldwide. In Egypt, *Meloidogyne incognita* and *Rotylenchulus reniformis* are two of the predominant plant-parasitic nematodes associated with all grape cultivars. Both nematode species depend on successful formation of feeding sites in roots that serve to nourish the nematodes.

Screening of grapevine cultivars for resistance and susceptibility to several nematode species have been studied by many investigators (Rohde, 1960; Oteifa & Tarjan, 1965; Riad, 1974; Ferris & Hunt, 1979; Wachtel, 1986; Hardie & Cirami, 1988; Edwards, 1988 & 1989 ;Melakeberhan *et. al.*, 1990; Mortensen *el* a*l*., 1994 ;Kesba, 1999 and McKenry *et. al*., 2001). Studies by Chitambar and Raski (1984) found that *M. incognita, M. javanica* and *M. arenaria* were able to produce galls and eggmasses in Harmony at the high soil temperature 36° C. Stirling and Cirami (1984), Wachtel (1986) and Hardie and Cirami (1988) reported that Ramsey *(Vifis champinii)* was highly resistant to a wide range of *Meloidogyne* populations and cultivars of *Vitis vinifera* were susceptible. Sultan (1987) screened five American cultivars (Delight , Fiesta , Freedom, Harmony and Ruby) , three Egyptian cultivars (Baladi , Bez—Alanza , and Fayumi) and four Palestinian cultivars (Al—Zeiny , Black—Zeiny , Beitony and Chamey) were tested for the three nematode species(*M. incognita*, *R. reniformis* and *T*. *semipentrans*) . It is pointed out that , the twelve grape cultivars were different in their susceptibility to each nematode species . In 1997, Walker reported that *V. vinifera* Colombard susceptible to *M. incognita* and *M. javanica,* and *V. champinii*, Ramsey susceptible to *M. incognita* but resistant to *M. javanica* and *M. hapla*. Lately, McKenry *et al.* (2001) graded 1613c, Dog Ridge, Freedom, Harmony, Telekic and Ramsey grape cultivars as susceptible to *M. arenaria*.

In Egypt, the local *V. vinifera* cvs. were tested by El-Gindi *et al.* (1976), Riad (1980), Ibrahim *el al.* (1989) and Afia (1997) to *R. reniformis* and *T. semipenetrans.* The two nematode species were able to develop and reproduce on vines with various degrees of reproduction and consequently different rates of susceptibility. Lately, Kesba (1999) tested fourteen cultivars of grapes according to the joint effect of nematode reproduction and host growth response to the infection with either *M. incognita, R. reniformis* or *T. semipenetrans,* it can be concluded that *R. reniformis* and *M*. *incognita* were highly destructive to most cultivars which were ranked as follows: Early Sperior, Flame, Perlette and Thompson seedless were highly susceptible, while Black rose, Emperor were tolerant, Cardinal and Early muskat were susceptible to both nematode species. Amerald, King ruby were tolerant, Dattier, Gold and Italy were susceptible to M *incognita.* Monukka, Gold and Italy were tolerant, King ruby and Dattier were highly susceptible to *R. reniformis*.

The objectives of this study were to compare the susceptibility of nine commercially grape cultivars in Egypt to *M. incognita* and *R. reniformis* nematodes.

MATERIALS AND METHODS

A greenhouse test was conducted to evaluate the relative susceptibility of nine grapevine rootstocks to the root-knot nematode, *M. incognita* and the reniform nematode, *Rotylenchulus reniformis*. These grapevine rootstocks were: Bez Alanza, Early Sweet, Flame Seedless, Mangawy, Queen, Red Globe, Romy Red, Sperior and Thompson Seedless. Healthy seedlings of nine grape cultivars one year old were singly transplanted in 20 cm diameter clay pots filled with sandy loam soil (1:1v/v) .Three weeks later, seedlings were inoculated with approximately 3000 newly hatched juveniles of *M. incognita* or 1000 immature females of *Rotylenchulus reniformis* per plant by pipetting the nematode suspension in holes around the root system. Inocula of each nematode species were obtained from available pure stock culture maintained on suitable hosts in a greenhouse. Each plant species was replicated three times for both *M. incognita* and

Rotylenchulus reniformes and equal number of untreated (control) served as check. All pots were arranged on a greenhouse bench at 32 ± 5°C receiving the same horticultural treatments. Four months after inoculation, all plants were harvested and the root system of each plant was carefully removed from soil by tap water and stained in lacto phenol acid fuchsine (Franklin and Goodey, 1959), length and fresh weights of both shoots and roots were estimated. The number of juveniles in soil, root galls, developmental stages, egg-masses per root were counted and the eggs were also counted from five randomly selected egg-masses of each root system. The rates of nematode reproduction were calculated by dividing the nematode final population by the nematode initial population. Root gall index values were estimated according to the following scale: (0 = 0 galls; 1 = 1-2 galls; 2 = 3-10 galls; 3 = 11-30 galls; 4 = 31-100 galls and 5 =>100 galls (Taylor and Sasser, 1978). Susceptibility of the tested cultivars to root knot nematode, *M. incognita*, based on root gall index ranges was determined according to (Hadisoeganda and Sasser,1982) as follow: 0- 1.0 = highly resistant (HR); 1.1-3.0 = very resistant (VR); 3.1-3.5 = moderately resistant (MR); 3.6-4.0 = slightly resistant (SR) and 4.1-5.0 = susceptible (S). Suitability of the tested grape cultivars to *R. reniformes* based on percentage of egg production was estimated according to (Montasser,1986): 0% =immune (I); 1-10% = highly resistant (HR); 11-20% = resistant (R); 21-40% = less susceptible (LS); 41-60% = moderately susceptible (MS) and 61-100% = highly susceptible (HS). Data were then, analyzed following standard procedures for analysis of variance by Duncan`s multiple range test (1955).

RESULTS AND DISCUSSION

1) Response of different grape cultivars to M. incognita:

Resistance and susceptibility level of grape cultivar was differed with the basis of classification i.e. root galls, nematode juvenile in soil per pot, nematode developmental stages, eggmasses per root, eggs per eggmass and the nematode final population. The results in Table (1) revealed that, none of the cultivar showed immune and highly resistant reaction. However, the Queen and Mangawy cultivars were recorded least number of galls (12.00 and15.00 galls/plant, respectively). Followed by Thompson Seedless, Red Globe, Sperior, Bez Alanza and Flame Seedless (89, 93, 96,132 and 208 galls/plant, respectively), while Early Sweet was calculated highest (325 galls/plant).

The highest values of the nematode final populations (49011, 44031, 22202, 12771 and 10836 individuals per 250 g soil) were observed on Romy Red, Early Sweet, Flame Seedless, Sperior and Bez Alanza grape cultivars, respectively. Followed by Thompson Seedless and Red Globe (7723 and 4751 individuals). On the other hand, the lowest population densities were detected on Queen and Mangawy cultivars (1219 and 1981 individuals). Among the tested cultivars based for their susceptibility to the nematode as follows: very resistance cultivar was two Queen and Mangawy. Thompson

Seedless and Red Globe were slightly resistant. Other cultivars were found to be susceptible (Figs, 1 & 2).

Table (1): Development and reproduction of the root-knot nematode, *Meloidogyne incognita* as influenced by nine grapevine cultivars under greenhouse conditions.

Cultivars	No. of galls/ root	Nematode counts				Nematode Final Population (P_f)	Rate of build up (P_f/P_i)
		J. in soil/ pot	Develop. stages / root	Egg-masses / root	Eggs /egg-mass		
Bez Alanza	132 d	563 e	226 d	50 c	201 c	10836	3.61
Early Sweet	325 a	1456 a	851 a	183 a	228 b	44031	14.68
Flame seedless	208 c	860 d	354 c	99 b	212 bc	22202	7.40
Mangawy	15 f	286 f	31 g	13 e	128 e	1981	0.66
Queen	12 f	103 g	19 g	9 e	133 e	1219	0.40
Red Globe	93 e	650 e	170 f	39 d	177 d	7723	2.57
Romy Red	264 b	277 f	526 b	184 a	262 a	49011	16.33
Sperior	96 e	1075 b	195 e	53 c	217 bc	12771	4.25
Thompson Seedless	89 e	969 c	174 ef	51 c	71 f	4751	1.58
LSD 0.05	14.99	98.44	22.28	9.41	20.72		

Values in a column followed by the same letter (s) are not significantly by ($p \leq 0.05$) according to Duncncan`s multiple-range test.

Plant growth response due to nematode infection was determined through the estimation of the percentage reduction in plant high and dry weights of shoots and roots table (2). Data in general reveal that the nematode significantly ($p \leq 0.05$) reduced the growth of most the tested cultivars. Reduction was much more pronounced in shoots than in roots. Generally, plant growth of Bez Alanza, Early Sweet, Flame Seedless, Romy Red and Sperior cultivars were highly affected since the reduction was significant in both their shoots and roots. In this relation-ship, Queen and Romy Red grape cultivars caused the highest means of shoot length (56.0 and 70.0 cm, respectively) compared with control , the remaining cultivars gave the moderate Early Sweet, Bez Alanza and Sperior(70.0, 33.0 and 30.0 cm, respectively). Other cultivars were found to be lower values of such criteria.

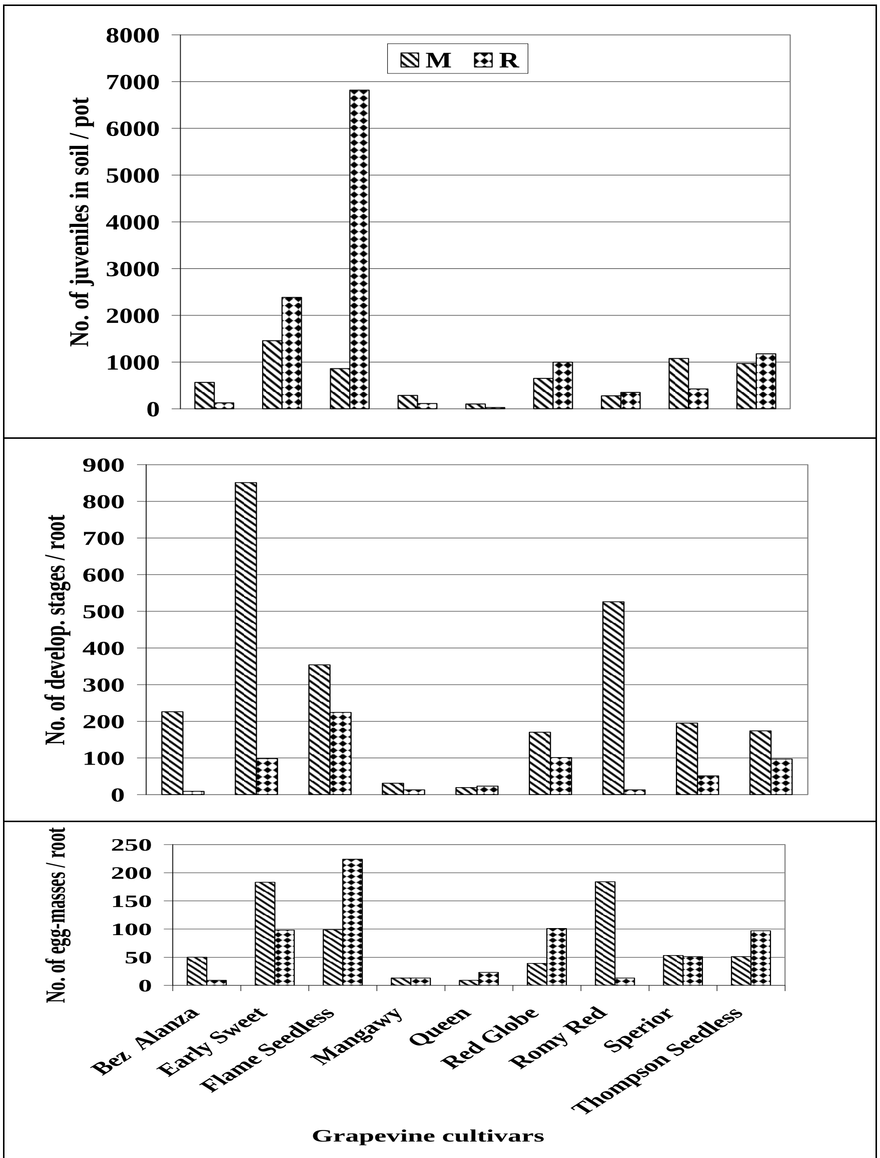

Fig. (1): The number of juveniles in soil per pot, developmental stages per root and the number of egg-masses per root in nine grapevine cultivars as influenced by *Meloidogyne incognita* and *Rotylenchulus reniformis*.

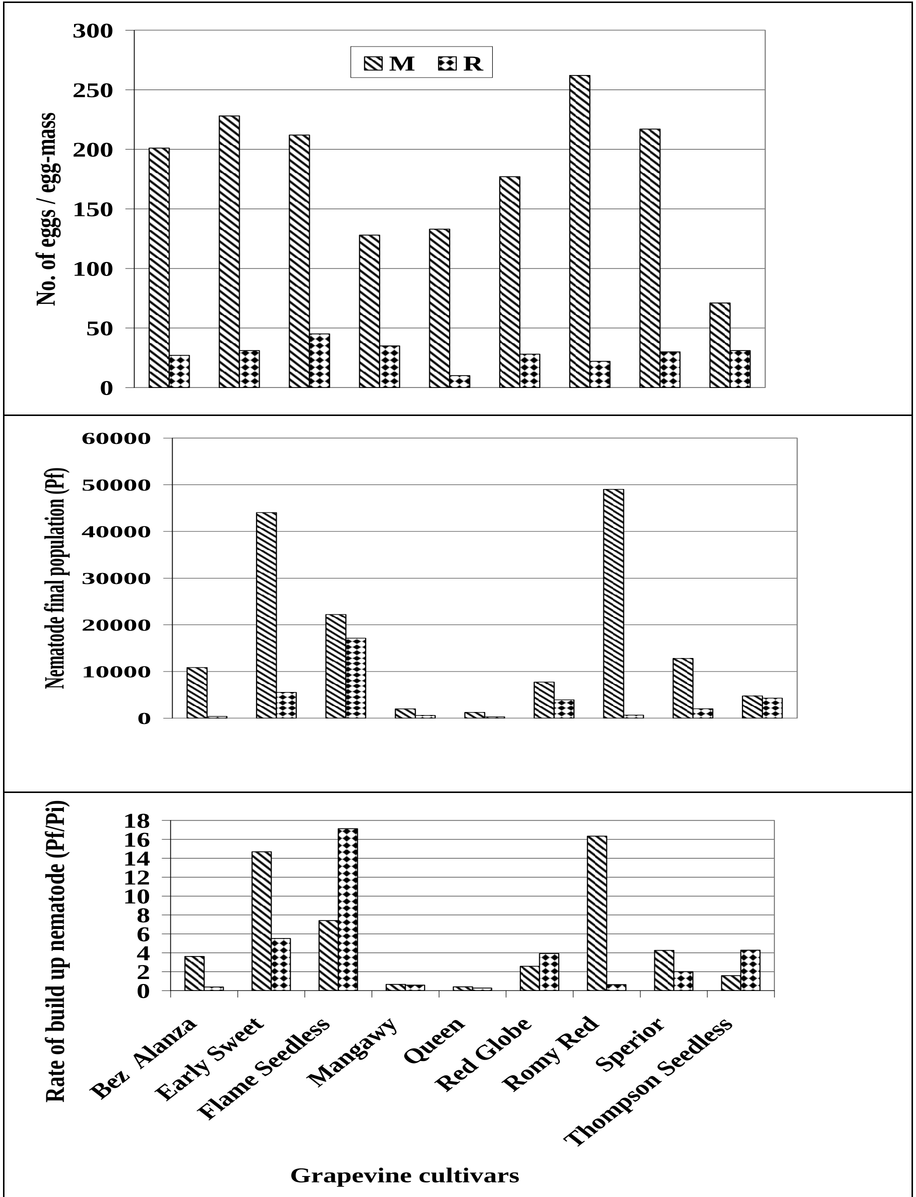

Fig. (2): The number of eggs per egg-mass, nematode final population and rate of build up nematode in nine grapevine cultivars as influenced by *Meloidogyne incognita* and *Rotylenchulus reniformis*.

Table (2): Development and reproduction of the reniform nematode, *Rotylenchulus reniformis* as influenced by nine grapevine cultivars under greenhouse conditions.

Cultivars	Nematode counts				Nematode Final Population (P_f)	Rate of build up (P_f/P_i)	*Egg production%	Degree of resistance
	J. in soil/ pot	Develop. stages / root	Egg-masses / root	Eggs /egg-mass				
Bez Alanza	125 f	9 d	9 d	27 cd	377	0.38	2.41	HR
Early Sweet	2382 b	98 b	98 b	31 bc	5518	5.51	30.13	LS
Flame seedless	6816 a	224 a	224 a	45 a	17120	17.12	100.0	HS
Mangawy	113 f	13 d	13 d	35 b	581	0.58	4.51	HR
Queen	26 f	23 d	23 d	10 e	279	0.27	2.28	HR
Red Globe	998 d	101 b	101 b	28 cd	3927	3.92	28.05	LS
Romy Red	350 e	13 d	13 d	22 d	649	0.64	2.83	HR
Sperior	424 e	51 c	51 c	30 bc	2005	2.00	15.17	R
Thompson Seedless	1176 c	97 b	97 b	31 bc	4280	4.28	29.83	LS
LSD 0.05	**110.74**	**14.31**	**14.31**	**5.93**				

***Egg production (%) =** $\frac{(\text{Eggmasses} \times \text{eggs, test plant})}{(\text{Eggmasses} \times \text{eggs, Flame seedless cultivar})} \times 100$

Values in a column followed by the same letter (s) are not significantly by ($p \leq 0.05$) according to Duncncan`s multiple-range test.

2) Response of different grape cultivars to R. reniformis:

Data in Table (3) and Figs (1 & 2) revealed that, none of the cultivar showed immune and highly resistant reaction. The highest values of the nematode final populations were recorded in Flame Seedless cultivar (17120 individuals). Followed by Early Sweet, Thompson Seedless, Red Globe and Sperior (5518, 4280, 3927 and 2005 individuals). In contrast, the lowest population densities were detected on Queen, Bez Alanza, Mangawy and Romy Red cultivars (279, 377, 581 and 649 individuals per 250 g soil). The tested cultivars could be categorized for their susceptibility to the nematode as follows: Queen, Bez Alanza, Mangawy and Romy Red were rated as highly resistant. One cultivar Sperior was categorized as resistant to the nematode. Three cultivar s Early Sweet, Thompson Seedless and Red Globe were graded as less susceptible (LS).Only Flame Seedless cultivar was rated as highly susceptible to the nematode infection.

Root length was significantly decreased in grape cultivar Flame Seedless (32.0 cm) followed by Romy Red (32.0 cm), Red Globe (55.0 cm) and Early Sweet (63. 0 cm) as compared to control (Table, 4). The results showed that root weight was also decreased in Thompson Seedless (41.00 g) followed by Romy Red (17.29 g), Flame Seedless (16.80 g) and Red Globe (35. 28 g) as compared to control. No obvious significant reductions were found in shoot as well as root parameters of Bez Alanza, Mangawy, Queen and Sperior. Also, shoot length was decreased in Flame Seedless (41.0 cm) and Early Sweet (45.0 cm) followed by Thompson Seedless (45.0 cm) as compared to control. While in shoot weight, Flame Seedless cultivar was observed the highest of reduction in these criteria (15.27 g) followed by Early Sweet and Romy Red (18.27 and 25.02 g), respectively.

Table (3): Plant growth response of nine grapevine cultivars to the infection with *Meloidogyne incognita* under greenhouse conditions.

Grapevine cultivars	Length (cm)				weight (gm)				Host Category
	Shoot		Root		Shoot		Root		
	Infected	Non infected	Infected	Non infected	Infected	Non infected	Infected	Non infected	
Bez Alanza	70	115 *	41	51 *	28.34	37.10	30.74	37.65 *	S
Early Sweet	33	55 *	45	54 *	12.20	17.61	29.40	37.25 *	S
Flame Seedless	43	61	54	75 *	20.02	29.82 **	40.42	56.07 *	S
Mangawy	36	20	33	36	15.44	18.55	25.10	27.25	VR
Queen	45	56 **	41	43	21.81	32.84 **	8.58	9.32	VR
Red Globe	45	50	51	88 *	40.72	48.56	19.39	23.49	SR
Romy Red	41	70 **	33	44 *	22.51	36.19 *	19.49	28.78 *	S
Sperior	32	66 *	49	59 *	25.24	33.50	49.58	57.24 *	S
Thompson Seedless	51	45	59	50	20.07	26.47	51.30	52.70	SR

*** = Significant at level 0.05 of probability. ** =High Significant at level 0.01 of probability.**

Table (4): Plant growth response of nine grapevine cultivars to the infection with *Rotylenchulus reniformis* under greenhouse conditions.

Grapevine cultivars	Length (cm)				weight (gm)				Degree of resistance
	Shoot		Root		Shoot		Root		
	Infected	Non infected	Infected	Non infected	Infected	Non infected	Infected	Non infected	
Bez Alanza	60	61	75	90	25.35	27.49	45.74	56.07	HR
Early Sweet	45	55 **	63	71 *	18.27	22.98 *	42.42	47.58	LS
Flame Seedless	41	115 **	32	51 **	15.27	37.10 **	16.80	33.32 *	HS
Mangawy	36	18	47	36	8.69	3.88	11.15	5.10	HR
Queen	63	56	43	43	25.77	25.36	5.64	5.63	HR
Red Globe	64	50	55	88 *	37.97	28.49	35.28	48.56 *	LS
Romy Red	67	70	32	44 *	25.02	36.19 *	17.29	28.78 *	HR
Sperior	72	66	59	59	55.11	33.50	78.85	54.24	R
Thompson Seedless	45	60 *	50	52	26.47	29.74	41.00	51.30 **	LS

*** = Significant at level 0.05 of probability . ** = High Significant at level 0.01 of probability .**

DISCUSSION

The assessment of susceptibility and resistance of the vine cultivars to the infection with each of *M. incognita* and *R. reniformis* were evaluated according to the joint effect of the nematode reproduction and plant growth response. It can be concluded that reaction of the tested cultivars was variable according to the host type and nematode species. *M. incognita* and *R, reniformis* tend to have excessive growth, reproduction and were highly destructive on most of the vine cultivars. Geible (1974) stated , in general, a plant resistant to nematode resists attack or exhibits little damage and reduce nematode populations.

However, the result of this study indicates that some grape cultivars could be considered. Mangawy and Queen cultivars were highly resistant and very resistant to infection by *R, reniformis* and M*. incognita* nematode, respectively .While, Early Sweet and Flame Seedless were the most susceptible ones to both nematode species .On the other hand, the remaining tested grape cultivars were statistically different in their susceptibility for each of the nematode species . These cultivars are arranged statistically in a decreasing susceptibility order.

Our results come along with those of Sultan (1987), Hardie and Cirami (1988), Ibrahim *et al.* (1989), Melakeberhan *et al.* (1990), Mortenseny *et al.* (1994), Goumas & Tzortzakakis (1998), Kesba (1999), Anwar & McKenry(2000) and McKenry *et al.* (2001). Delayed penetration of a resistant cotton cultivar has also been reported (Anwar *et al*., 1994). Differential penetration by nematodes of roots of resistant and susceptible cultivators of soybean (Dropkin and Nelson, 1960), cotton and grape rootstocks (Ferris *et al*., 1982) have been reported. The reduced number of J2 in resistant compared to susceptible cultivars indicates that resistance is largely attributable to reduced penetration by J2. The induction of differential biochemical changes in susceptible and resistant cultivars is related to establishment of parasitic relationships by J2 (Potenza *et al*., 1996).

These differences may be attributed to nematode species, pathotype, environmental factors, soil type, inoculation level used, time of the experiment, rate of scaling or even the geographic and genetic origin of The grapevine varieties. Since Thompson seedless is Midwestern in origin (Ferris and Hunt, 1979), it has similar quantitative relationships with *M. incognita* and *R. reniformis.* Host plant resistance restricts or prevents nematode reproduction by activating resistance mechanisms in response to nematode infection. By contrast, susceptible plants lack resistance or tolerance or both, making them good hosts for pathogen reproduction (Trudgill, 1991). Resistance that deters root-knot nematode can involve pre- or post-infection mechanisms (Huang, 1985). Pre-infection resistance may occur at the root surface or within the rhizosphere thereby influencing nematode penetration. Plant produced root exudates can also attract or repel root-knot nematodes. Post-infection resistance mechanisms can involve physiological processes within the roots which: 1) deter nematode feeding; 2) deter the establishment of feeding sites, 3) delay or prevent nematode development, or 4) inhibit reproduction (Trudgill, 1991).

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حساسية تسعة أصناف من العنب لكلا من نيماتودا تعقد الجذور و نيماتودا القطن الكلوية

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قسم الحيوان الزراعى والنيماتودا – كلية الزراعة – جامعة الأزهر بالقاهرة *

معمل النيماتودا – قسم امراض النبات – المركز القومى للبحوث**

استهدف البحث دراسة حساسية تسعة أصناف عنب وهى بزالعنزة وإيرلى سويت و فليم سيدلس و منجاوى و كوين و رد جلوب و رومى أحمر و سبريور و طومسون سيدلس لكلا من نيماتودا تعقد الجذور *Meloidogyne incognita* ونيماتودا القطن الكلوية *Rotylenchulus reniformis* تحت ظروف الصوبة.

ولقد دلت النتائج على أن كلا من نوعى النيماتودا يتكاثر جيدا على الأصناف المختبرة، أيضا كل الأصناف إختلفت حساسيتها لكلا من نوعى النيماتودا. تم تصنيف الأصناف طبقا لحساسيتها لنيماتودا تعقد الجذور كالآتى: الصنفين منجاوى و كوين كانت عوائل مقاومة جدا للنيماتودا. رد جلوب و طومسون سيدلس أعتبرت أصناف قليلة المقاومة للنيماتودا. من ناحية أخرى ، كانت خمسة أصناف و هى بزالعنزة وإيرلى سويت و فليم سيدلس و رومى أحمر و سبريور عوائل حساسة للنيماتودا.

بالنسبة لإستجابة هذه الأصناف لنيماتودا القطن الكلوية فكان بز العنزة وإيرلى سويت و فليم سيدلس و رومى أحمر و سبريور عوائل مقاومة جدا للنيماتودا. الصنف سبريور فقط كان عائل مقاوم للنيماتودا. إيرلى سويت و رد جلوب و طومسون سيدلس صنفت كعوائل قليلة الحساسية للنيماتودا. فى المقابل، كان الصنف فليم سيدلس عائل عالى الحساسية للنيماتودا. أيضا تم مناقشة قياسات النمو النباتى.

قام بتحكيم البحث

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