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Susceptibility of some Plant Cultivars Cucumber and Watermelon to Root- Kont Nematode, *Meloidogyne javanica* under Greenhouse Conditions

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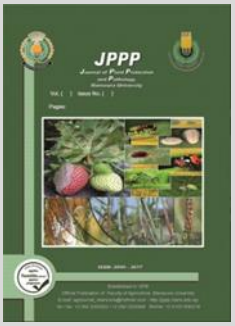

ABSTRACT

Thirteen cultivars of cucumber *Cucumis sativus* and eight cultivars of watermelon *Citrullis vulgaris* were evaluated for their host response to *Meloidogyne javanica*. The nematode succeeded in developing and multiplying on all most tested cultivars from Cucurbitaceae plants. Cucumber cultivars Hisham, Waffir and Beitalpha the highest rate of nematode reproduction more than the rest of cultivars Emparator, Hayel and Sinai1 were classified as slightly resistant (SR). While cultivars cucumber Bahy, BashaF1,Beitalpha, Ellama, Eshrak1, Fahd, HadyF1, Hisham,Paracoda, Waffir were classified as susceptible (S) hosts to *M. javanica.* Also, results showed that some of tested watermelon cvs Aswan F1, Giza 1, Giza 21 and Sugar Baby were classified as slightly resistant (SR) , and four cvs Al-Fahd, Al-Gawhra ,Charleston Gray123 and Crimson Sweet were classified as susceptible(S) hosts. Moreover, there were significant reduction in both shoot and root fresh weights of the tested all cultivars infected.

Keywords: *Meloidogyne javanica* , Cucurbitaceae, Susceptibility, Cucumber, Watermelon, Cultivars

INTRODUCTION

Root-knot nematodes, *Meloidogyne* spp. are important plant pathogens, attacking a wide range of crops (Wesemael *et al.*, 2011), including more than 2000 plant species (Gugino *et al*., 2008), it's recognized as one of the most damaging agricultural pests cause crop losses throughout the world (Huang *et al.*, 2014).Cucurbitaceae plants cultivars are highly susceptible to root- knot nematodes (*Meloidogyne* spp (Oda *et al*. 1997) . In an early study Udalova (1980) tested 92 cultivars of cucumber for their resistance to *M. incognita.* Although no resistant cultivars were found, one fourth of the tested cultivars were tolerant to the nematode infection. Later, tested 45 varieties and hybrid of cucumber for their resistance to *M. incognita*, and found that none of the cultivars showed any resistance to the nematode, however, 4.3% of the tested cultivars were reacted as tolerant hosts to the nematode infection. The cucumber is one of the most affected vegetable crops with problems caused by the root- knot nematodes (Wehner *et al.*, 1991). Montalvo and Esnard (1994) evaluated ten cultivars of watermelon for their response *M. incognita* under greenhouse conditions and reported that all tested cultivars are susceptibility to inoculated with *M. incognita* in a different degree of tolerance were host category degradation between lowest susceptibility to most susceptible (López-Gómez *et al.*, 2016). Mahrous (1976) tested sixteen cultivars of different cucurbitaceous plants against *M. javanica* infection. And classified them into four categories: tolerant as cantaloupe cv. local, less susceptible as cucumber cv. I.T., susceptible host as melon cv. Gamosi. The aim of this research paper was to test the susceptibility of cultivars available to some Cucurbitaceae plants to root – knot nematode *M. javanica* recommend the cultivation of resistant varieties as a mean of agricultural control.

MATERIALS AND METHODS

A pure stock culture of the root-knot nematode, *Meloidogyne javanica* was prepared from naturally infected Cucurbitaceae plants roots collected from an infested field in Assiut province. Individual egg-masses with their mature females were removed from root tissue. Each egg-mass was placed in a small glass capsule containing fresh water. The female from which egg-masses were taken preserved in 4 % formaldehyde solution in glass capsules for nematode identification. Each egg-mass was transferred to a 25 cm clay pot filled with steam sterilized sandy loam soil and growth with a seedling of tomato cv. Rutgers Inoculated pots were placed in a greenhouse and watered when needed. After two months of inoculation, infected roots were then chopped and used as sources of inoculation for other series of clean cv. Rutgers tomato seedling. By repeating this procedure enough quantities of inoculation from stock cultures were obtained on tomato cv. Rutgers. Identification of *Meloidogyne* spp was examined by microscope. Females were gently picked up and placed over a drop of lactophenol on a clean slide. Female posterior tail was cut with help of a sharp knife. Females were identified on the basis perineal pattern system according to (Eisenback *et al*.,1981), and (Taylor *et al.*, 1955)

Seeds of each plant cultivars were sown in 20 cm diameter pots filled with autoclaved soil mixture of 1:1(v:v) sandy and clay. The pots were arranged on greenhouse bench at35± 5 °C in a randomize complete block design receiving similar treatments of watering. Two weeks after sowing, seedlings were thinned to two/pot was inoculated

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with 2000 newly hatched second stage larvae of *M. javanica* per pot was pipetted into five holes in the root zone. Nematode treatments and plants non- inoculated served as control was replicated 4 times. Before planting with the mentioned cultivars ten days after emergence, one healthy seedling was maintained in each pot. The experiment was terminated 60 days after inoculation. The roots were then cut into small pieces and nematode eggs were extracted from roots using NaOCl method and counted(Hussey and Barker,1973).while the root gall index (RGI)and egg- mass index (EI) were estimated according to the scale given by Taylor and Sasser(1978) as follows: 0=no galls or egg-masses,1=1-2galls or egg-masses,2=3-10galls or egg-masses,3=11-302galls,4= 31-100 2galls or egg-masses and5= > 100galls or egg-masses. Host susceptibility was measured according to Hadisoeganda and Sasser (1982).As the following: 0.0= Immune (I) , 0.0-1.0= 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). Numbers of galls developmental stages with females, egg masses in the root system and numbers of eggs /egg mass, rate of nematode bulid-up were determined for each cultivars –nematode treatment processed for nematode extraction (Southey 1964).Fresh and weights of the root and shoot systems as well as there were determined.

$$\text{Egg production \%} = \frac{\text{No. of egg masses/root} \times \text{No. of eggs/egg mass of test cultivar}}{\text{No. of egg masses/root} \times \text{No. of eggs/egg mass of highest cultivar}} \times 100$$

An analysis of variance (ANOVA) was applied to test (Gomez and Gomez, 1984). Comparison between means of each factor was carried out using - range tests (Duncan, 1955).

RESTULTS AND DISCUSSION

Results

A- Screening of some cucumber cultivars against the root - knot nematode, *Meloidogyne javanica.*

Thirteen cultivars of cucumber (Cucumis sativus) were tested from Cucurbitaceae for their resistance degree and susceptibility to the infection with the root knot nematode, *Meloidogyne javanica* succeeded in developing and multiplying on all most tested cultivars plants. Table (1) showed that plant cucumber ten cvs (Hisham,Waffir, BashaF1,Beitalpha,El lama ,Eshrak1 ,Bahy , HadyF1,Fahad and Paracoda) susceptible(S),while cvs (Emparator, Hayel and Sinai1) slightly resistant(SR). The highest values rate of nematode reproduction and percentages of egg production for cvs (23.37&100%) Hisham, (19.70& 83.90%) Waffir and BashaF1 (18.30&78.o6%) while other tested cultivars cucumber the recorded moderate values of reproduction factor and egg production were for cvs (17.87&76.84%) Beitalpha, (13.57 &57.88%) El-lama, (11.81&50.32%) Hady F1, and (11.37&48.33%) Fahd respectively. On the other hand, Sinai1, Hayel and Emparator cultivars had the lowest values of nematode criteria.

Table 1. Susceptibility of some cucumber cultivars to the root- knot nematode *Meloidogyne javanica* under greenhouse conditions.

Cultivars	No. of galls/root system	Nematode counts				Egg production %	Nematode final population(pf)	Rate of nematode reproduction (Pf/pi)	Galling index
		No. of juveniles in soil/pot	Developmental stages/ root	No. of egg masses/ root	No. of eggs/egg mass				
Bahy	113fg	169de	226 de	131d	194ab	55.25	25809	12.90	4.7
Basha F1	231c	247c	460 b	187b	192ab	78.06	36611	18.30	5.0
Beitalpha	123f	148e	264 cd	189b	187b	76.84	35755	17.87	5.0
El-lama	187d	198d	329 c	153c	174bc	57.88	27149	13.57	5.0
Emparator	98g	123f	201 dc	95e	86e	17.76	8498	4.24	4.0
Eshrak 1	180d	207d	397 b	153c	171bc	56.88	26767	13.38	5.0
Fahd	140e	206d	317 c	130d	171bc	48.33	22753	11.37	5.0
Hady Fl	171de	186de	299 c	142cd	163bc	50.32	23631	11.81	5.0
Hayel	86h	112fg	172 de	73f	114d	18.09	8606	4.30	4.0
Hisham	253b	267b	501 ab	219ab	210a	100	46758	23.37	5.0
Paracoda	156e	164de	244 cd	88ef	197ab	37.69	17744	8.87	5.0
Sinai 1	60i	46g	144 e	61f	188b	65.81	30458	5.82	4.0
Waffir	268a	294a	534 a	227a	170bc	83.90	39418	19.70	5.0

Means in each column followed by the same letter are not significantly different by (P≤0.05) according to Duncan's multiple range test.

$$\text{Egg production \%} = \frac{\text{No. of egg masses/root} \times \text{No. of eggs/egg mass of test cultivar}}{\text{No. of egg masses/root} \times \text{No. of eggs/egg mass of highest cultivar}} \times 100$$

The influence of root-Knot nematode *M. javanica* on cucumber plant growth (expressed here as root and shoot fresh weight) tabulated in Table (2) the nematode *M. javanica* succeeded to develop and multiply on all tested cucumber cultivars The highest reduction shoot length were recorded in Paracoda (36.5%), El-lama(35.1%), Eshrak1(33.3%), Waffir (33.1%) and only (10.2 %) HadyF1and Hayel while the highest reduction percentages the root length in HadyF1 33.9%, BashaF1 33.1%, Eshrak1 29.4% , Paracoda 27.8%, Waffir 26.4%and only12.1%Hisham. As for the effect of nematode infection on the weights of shoots and roots cucumber cvs Eshrak (40.9%&34.1%), El-lama(40.4% &39.2%),Wiffir (37.8% & 28.3%), Paracoda (32.3%&26.1%). It could be observed that Emparator (7.1 %&16.5%), Hayel (10.1 % &18.5 %) and Sinai1 (11.1 % &17.1%)).Were lowest significantly reduction in of shoots and roots weights. Growth parameters reduced than of non-infected (control).

Table 2. Plant growth of cucumber cultivars as influenced by the infection with the root- knot nematode, *Meloidogyne javanica* under greenhouse conditions

Cultivars	Length (cm)						Weight (g)						Host Category
	Shoot			Root			Shoot			Root			
	Infected	Non infected	Reduction %	Infected	Non infected	Reduction %	Infected	Non infected	Reduction %	Infected	Non infected	Reduction %	
Bahy	24.1**	30.3	20.4	19.6**	26.2	25.1	19.5**	26.3	25.8	16.8**	23.0	26.9	S
Basha F1	18.5**	27.4	32.4	10.5**	15.7	33.1	18.2**	21.1	27.4	8.2**	12.9	36.4	S
Beitalpha	20.7**	26.1	20.7	10.7**	14.2	24.7	19.0**	26.9	29.3	9.6**	13.2	27.3	S
El-lama	15.2*	23.4	35.1	9.2**	13.4	31.3	11.5**	19.3	40.4	6.8**	11.2	39.2	S
Emparator	49.3*	55.8	11.6	18.7*	21.5	13.1	34.2*	36.8	7.1	17.1*	20.5	16.5	SR
Eshrak 1	16.8**	25.2	33.3	10.8**	15.3	29.4	13.7**	23.3	40.9	8.7**	13.2	34.1	S
Fahd	30.6**	43.8	30.2	14.5**	18.0	19.4	29.1**	41.5	29.9	13.2*	16.2	18.5	S
Hady Fl	18.2*	23.2	10.2	10.3**	15.6	33.9	16.2**	20.7	21.7	9.2*	14.0	34.2	S
Hayel	47.3**	52.7	10.2	16.4*	19.6	16.3	32.1*	35.7	10.1	15.8*	19.4	18.5	SR
Hisham	16.8**	24.2	29.6	8.3*	14.2	12.1	10.7**	14.6	26.8	6.3**	10.8	37.0	S
Paracoda	13.0**	20.5	36.5	9.6**	13.3	27.8	11.3**	16.7	32.3	8.5**	1105	26.1	S
Sinai 1	12.8*	14.5	11.7	10.3*	12.4	16.9	13.6*	15.3	11.1	8.2*	9.9	17.1	SR
Waffir	13.8**	20.6	33.1	10.3	14.0	26.4	11.8**	19.0	37.8	5.8**	8.1	28.3	S

=* Significant at 0.05 level of probability =Highly significant at 0.05 level of probability S = Susceptible SR = Slightly Resistant.**

$$\text{Reduction \%} = \frac{\text{Untreated plants(Control) - Treated plants}}{\text{Untreated plants(Control)}} \times 100$$

B- Screening of some Watermelon cultivars against the root - knot nematode, *Meloidogyne javanica.*

Table (3) found that M. javanica succeeded in developing and multiplying on all tested watermelon cultivars reported that Al-Gawhra cultivar the highest values of rate nematode reproduction and percentages of egg production (18.43 &100%) follows that Sugar Baby (6.46&34.76%), AswanF1 (6.39&34.25%), Crimson sweet (6.38&33.89%), Charleston-Gray123 (5.82&31.25%) and Al Fahd (5.60&30.70%). Also, their calculated lowest values of nematode reproduction and percentages of egg production were Giza1 (4.53&24.10%) and Giza 21(2.88&15.22%)

Table 3. Susceptibility of some watermelon cultivars to the root- knot nematode *Meloidogyne javanica* under greenhouse conditions.

Cultivars	No. of galls/ root system	Nematode counts				Egg production %	Nematode final population (pf)	Rate of nematode reproduction (Pf/pi)	Galling index
		No. of juveniles in soil/pot	Developmental stages/ root	No. of egg masses/ root	No. of eggs/egg mass				
Al-Fahd	95c	191a	155c	100c	109c	30.70	11219	5.60	4.7
Al-Gawahra	194a	295a	335a	184a	197a	100	36878	18.43	5.0
Aswan F1	95c	145b	232b	128b	97cd	34.25	12793	6.39	4.0
Charleston Gray 123	134b	10c7	207bc	118bc	96cd	31.25	11642	5.82	5.0
Crimson Sweet	142b	124c	255b	105c	117b	33.89	12769	6.38	5.0
Giza 1	99c	132bc	204bc	84d	104c	24.10	9072	4.53	4.0
Giza 21	71d	89d	165c	60e	92d	15.22	5774	2.88	4.0
Sugar Baby	93c	131bc	190bc	120b	105c	34.76	12921	6.46	4.0

Means in each column followed by the same letter are not significantly different by (P≤0.05) according to Duncan's multiple range test.

$$\text{Egg production \%} = \frac{\text{No. of egg masses/root} \times \text{No. of eggs/egg mass of test cultivar}}{\text{No. of egg masses/root} \times \text{No. of eggs/egg mass of highest cultivar}} \times 100$$

The influence of nematode on plant response based on its effect on fresh weigh of roots and shoots on the test cultivars was presented in Table (4). The highest reduction in roots and shoots fresh weights were recorded in Al-Fahd (39.03%&41.95%), Charleston Gray 123 (30.65%&32.89%), Crimson Sweet (28.43%&25%). Whilst, Giza 1 (8.37%&7.46%), Giza 21(3.24%&12.0%) only the cultivar Sugar Baby has a moderate value (9.46%&15.82%).

Table 4. Plant growth of watermelon cultivars as influenced by the infection with the root- knot nematode, *Meloidogyne javanica* under greenhouse conditions.

Cultivars	length (cm)						Weight (g)						Host Category
	Shoot			Root			Shoot			Root			
	Infected	Non infected	Reduction %	Infected	Non infected	Reduction %	Infected	Non infected	Reduction %	Infected	Non infected	Reduction %	
Al-Fahd	65.9*	94.6	30.33	14.0**	21.1	33.64	20.3**	33.3	39.03	10.1**	17.4	41.95	S
Al-Gawhra	76.1*	95.5	20.31	16.1**	21.1	23.69	29.3**	46.1	36.44	14.9**	18.6	19.89	S
Aswan F1	65.4*	73.2	10.65	17.5*	22.2	13.36	28.8*	32.1	2.79	17.5*	20.5	14.63	SR
Charleston Gray 123	75.2**	101.7	26.05	20.0**	28.5	29.82	36.2**	52.2	30.65	15.3**	22.8	32.89	S
Crimson Sweet	77.8**	105.9	26.5	23.3**	30.4	23.35	38.5**	53.8	28.43	18.2**	24.4	25.40	S
Giza 1	83.3*	90.1	7.54	15.2**	21.4	28.97	36.1*	39.4	8.37	18.6*	20.1	7.46	SR
Giza 21	86.4*	93.5	7.59	16.7**	22.8	23.24	38.8*	40.1	3.24	19.8*	22.5	12.00	SR
Sugar Baby	39.3*	44.6	11.88	9.9*	11.1	10.81	30.6*	33.8	9.46	11.7*	13.9	15.82	SR

=* Significant at 0.05 level of probability =Highly significant at 0.05 level of probability S = Susceptible SR = Slightly Resistant**

$$\text{Reduction \%} = \frac{\text{Untreated plants(Control) - Treated plants}}{\text{Untreated plants(Control)}} \times 100$$

On the other hand Aswan F1cultivar had the lowest value of weight shoot (2.79%&14.63%) when compared with those of the other tested cultivars values. The tested watermelon cultivars could be classified as follows Aswan F1, Giza 1, Giza 21 and Sugar Baby cultivars were classified as slightly resistant (SR) hosts to root knot nematode infection Al-Fahd, Al-Gawhra ,Charleston Gray 123 and Crimson Sweet cultivars were classified as susceptible(S) vegetative results could be arranged the tested cultivars for their resistant to nematode infection from high to low.

Discussion

Management of plant parasitic nematodes is complicated by the complexity of the soil environment (Norton1978).Chemical, biological, and cultural methods along with the use of host plant resistance comprise management strategies that have decreased the risk of damage by many nematode species (Starr and Roberts, 2004). The most effective and economical method is the use of resistant cultivars , and growing resistant cultivars of crops in crop rotations is economical for the farmers for reducing nematode populations gradually in the infested fields (Mukhtar *et al*., 2013).

Reproduction root-knot nematode on plant, the infective second stage juveniles must be attracted to host roots, penetrate the epidermis and migrate through the root cortex to establish a feeding site in the vascular parenchyma that provides sufficient nutrition for development and egg production (Abad *et al*., 2008). which means that such cultivars are not efficient hosts for nematode reproduction and , as regards the horticultural parameters, inoculation with the root-knot nematode caused a greater than healthy plants. This was consistent with Shane and Barker (1986).Tested eighteen varieties of cucumber, *Cucumis sativus*, fifteen varieties of watermelon, *Citrullus vulgaris*, and six varieties of squash, *Cucurbita moshata* and. *C. maxima* for their susceptibility to three species of root knot nematodes, and reported that all tested cultivars were susceptible to *M. incognita* but thirty three cultivars out of the total were susceptible to *M. javanica.*

All cucumber, watermelon and squash cultivars were susceptible to *M. hapla.* The other cultivars, however, differed in their reactions. While, Thies and Levi (2003) reported that Root knot nematodes *Meloidogyne arenaria* , *Meloidogyne incognita* , and *Meloidogyne javanica* are serious pests of watermelon and not resistance were noted of these cultivars agents nematode pests. (López-Gómez *et al*., 2015). Our results showed that one of muskmelon cultivars, Ideal was moderately resistance it results agree with Krusberg, (1963).

Generally, Cucurbitaceae plants (i.e. cucumber and watermelon) were susceptible in all the tested populations to previous speices of root knot nematodes (Thies and Levi, 2003).Finally, In spite of the high susceptibility of Cucurbitaceae family tested cultivars, including watermelon and cucumber to root knot nematodes of the genus *Meloidogyne* it is the most commercially available, while, the resistant cultivars are not commercially available (Pofu *et al.*, 2012).

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حساسية بعض أصناف نباتات العائلة القرعية للإصابة بنيماتودا تعقد الجذور*Meloidogyne javanica* تحت ظروف الصوبة الزراعية

أنس فرج المسلمى[١] ، نشأت عبد العزيز محمود[١] ، عبد المنعم السعيد العنانى[٢] و عاطف محمد الصغير[١]

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تعتبر النيماتودا أحد أهم العوامل الضارة بإنتاج محاصيل الخضر كماً ونوعاً وخاصة العائلة القرعية ، ولهذا تم اختيار عدة أصناف تجارية من نباتات الخيار والبطيخ لمعرفة مدى استجابتها للإصابة بنيماتودا تعقد الجذور من النوع ميلودوجينا جافانكا (*Meloidogyne javanica*) داخل الصوب الزراعية , حيث تم تقييم ثلاثة عشر صنفاً من الخيار وثمانية أصناف من البطيخ. وقد أشارت النتائج إلى قابلية جميع الأصناف المختبرة للإصابة بنيماتودا تعقد الجذور من النوع ميلودوجينا جافانكا (*M. javanica*) غير أن العقد الجذرية المتكونة والأعداد النهائية ومعدل التكاثر قد تفاوت تبعاً لنوعية الأصناف. كنتيجة لإستجابة تللك الأصناف سجل الصنفين إمبراطور وهايل وسيناى من أصناف الخيار كعوائل قليلة المقاومة لنيماتودا التعقد. بينما سجلت جميع أصناف البطيخ كعوامل قابلة للإصابة وكان أقلها حساسية للإصابة الأصناف أسوان , جيزة ١ وجيزة ٢١ وشوجربيبى. كما وجد أن نمو النباتات لجميع تلك الأصناف قد تأثر بالإصابة بهذه الآفة بدرجات متفاوتة تبعاً لطبيعة الأصناف .