Journal of Plant Protection and Pathology

Journal homepage: www.jppp.mans.edu.eg
Available online at: www.jppp.journals.ekb.eg

Varietal Susceptibility of some Tomato and Pepper Cultivars Against Root – Knot Nematode, *Meloidogyne javanica*

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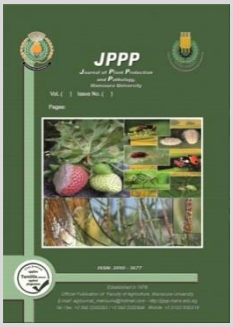

ABSTRACT

Four cultivars of tomato viz. Super strain B, Vacolta 38, Ko186 and Login and pepper viz. California wonder, Boulnder A, Marconi and Maor were screened to root –knot nematode *Meloidogyne javanica* at inoculum level (1000 J_2) in pots experiment under field condition at the Experimental Farm, Faculty of Agriculture, Shebin El- Kom. Obtained results showed highly significant differences among tomato and pepper cultivars under study. Sensitive tomato cultivar Super strain B was significantly higher than those of other cultivars over all mean of *M. javanica* J_2 population density, egg masses and number of root galls (2391: 30.7 and 37.5) respectively. Contrariwise occurred with the resistant cultivar Vacolta38 (1576; 13.4 and 6.7) which attained the least population density of *M. javanica* J_2, egg masses and number of root galls, respectively. Conspicuous effectiveness is very emphasizes for Vacolta38 in improvement plant parameters such as plant high; shoot weight and root weight showed results (56.8; 69.7 and 17.6), respectively. Pepper susceptible cv. Moar seemed to be the most favorable and more sensitive to *M. javanica* J_2 infection, egg masses and number of root galls (2436; 71.4 and 80.2), respectively, while resistant cultivar Boulnder A against *M. javanica* population; egg masses and number of root galls supported the least (1698; 11.7 and 8.0), respectively. The plant parameters also improved over the rest varieties. It could be recommendable hence forward to introduce dual tomato and pepper resistant cultivars Vacolta38 and Boulnder A against *M. javanica* infection in breeding and integrated nematode management programs.

Keywords: Tomato and pepper cultivars , root-knot nematode, gall index and growth parameters.

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is one of the most popular vegetable crops all over the world because of its high nutritive value and diversified use (Mukesh and Dhirendra, 2019). In Egypt, sweet pepper (*Capsicum annum* L.) is considered one of important truck crops for local consumption and exportation. The economic importance of the pepper might be explained by its nutritional value of antioxidants, vitamins and some other compounds (Abada and Ahmed, 2014).

Globally, an extremely important limiting factor in vegetable production is plant-parasitic nematodes. Root-knot nematode disease is considered as one of the serious diseases worldwide (Jones *et al.*, 2013).

The short life cycle, 6 to 8 weeks, enables root– knot nematode populations to survive well in the presence of a suitable host and their populations build up to maximum usually as crops reach maturity. The genus *Meloidogyne* occurs on a very wide range of crops causing annual loss of 157$ billion globally (Abad *et al.*, 2003). The four most commonly occurring species are *Meloidogyne incognita* , *M. arenaria* , *M. javanica and M. hapla* (Hunt *et al.*, 2005)

Obviously, using nematicides is considered as the shortest way to obtain efficient results for disease management. On the other hand, these components have hazard effect on human health and useful microorganisms in soil. Researchers concerns about use of resistant varieties as environment friendly methods to manage root-knot nematode. According to Liu et al. (2015) and Molinari (2011) the most effective and economical methods is the use of resistant cultivars or its hybrids because of the low efficiency of chemical control and it could be use as sources for breeding programs.

Bello *et al.* (2015) evaluated in pots experiment seven varieties of pepper and tomato for resistance degree to *Meloidogyne* spp. The results showed that varieties were rated resistant, susceptible or tolerant. Also, ŧDarban *et al.* (2003) recorded on the basis of root-knot nematode *M.incognita* there are a resistance and susceptibility response in seven tomato cultivars. Response of 25 genotypes of pepper to *M. incognita* race 3, *M. javanica* and *M. entrolobii* were tested. Genotypes were classified to five types susceptible, slightly resistant, moderately resistant, resistant and high resistant (Renato *et al.*, 2018).

Therefore, the present study aimed to evaluate four cultivars of each tomato and pepper for their response to *Meloidogyne javanica* infection.

MATERIALS AND METHODS

Second stage juveniles of the root- knot nematode, *Meloidogyne javanica* were obtained from the pure culture reared on black nightshade, *Solanum nigrum* plants. Roots with *M. javanica* were washed with tap water to remove adhering soil particles, cut into small pieces (approximately

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DOI: 10.21608/jppp.2021.188648

1-2 cm) and vigorously shaken in a bottle containing 0.5% NaOCl for 3 min according to Hussey and Barker(1973). The eggs were collected on 38 µm sieve and washed in a beaker. The egg suspension was transferred to Baermann trays with soft tissue paper at room temperature to allow egg hatching. After 96 hours, the freshly hatched second stage juveniles were standardized and concentrated in the Nematode laboratory of the Entomology and Zoology Department of Faculty of Agriculture , Menoufia University.

Four tomato cultivars (Super strain B, Vacolta 38, Ko186 and Login) and four pepper cultivars (California wonder, Boulnder A , Marconi and Maor) were tested for their response to *M. javanica* infection. Seedlings (five weeks old) of each cultivar were planted in plastic pots (25 cm diameter) filled with 4 kg of sterilized soil clay-sand mixed soil (1:1, v/v) under field conditions at the Experimental Farm, Faculty of Agriculture, Menoufia University, Shebin Elkom, Egypt. After one week, for seedling adaptation, 1000 J_2 of *M. javanica* were added by pipette into three holes around the growing plants. A randomized complete blocks design with four replicates was used. Each replicate consisted of six plants, for each cultivars arranged in three pots (two plants in each pot). Pots were irrigated as needed and fertilized every three weeks with NPK solution (50 ml / 10 liters water) either added to the soil or sprayed on the leaves (50 ml per pot). The experiment was terminated 60 days after planting. At the end of the experiment, roots and shoots fresh weight and plant height were recorded.

From each treatment, 250 ml soil was processed for nematode extraction. About 300-400 ml of water were added to the soil in a glass beaker (1000 ml) and the mixture was agitated by fingers, after few seconds the suspension was poured onto a 60 mesh-sieve and passing suspension was collected in another clean glass beaker. Materials caught on the 60 mesh-sieve were discarded, while the collected suspension was then poured onto a 200 mesh-sieve. Materials remain on the sieve were thoroughly washed by a gentle streamed of water into a 200 ml beaker. The resulting suspension containing nematodes was then transferred to a Modified Baermann pan fitted with soft tissue paper for the separation of active nematodes from debris and fine soil particles. After 72 hrs nematode water suspension was collected and concentrated to 20 ml in a vial by using a 350 mesh-sieve. An aliquant of 1 ml each of nematode suspensions were pipetted off, placed in a Hawksley counting slide and examined by using a stereomicroscope.

Root system of plants were stained with a 0.015% phloxine B to count egg masses according to Holbrook et al.(1983).

The response of cultivars to nematodes infection was rating based on number of galls scale (Table 1) according to Taylor and Sasser (1978).

Table 1. Galls scale and cultivars resistance rating

Number of galls	Galling index	Resistance rating
0	0	Immune
1-2	1	Highly resistant
3-10	2	Resistant
11-30	3	Moderately resistant
31-100	4	Moderately susceptible
>100	5	Susceptible

Statistical analysis:

The obtained data were subjected to analysis of variance (ANOVA) using CoStat Software, Version 6.4 (2008). The mean differences were compared by Least Significant Difference (L.S.D. 5%).

RESULTS AND DISCUSSION

Results

As showed in Table (2), there are a significant differences in soil population juveniles of *Meloidogyne javaniva* between tomato cultivars. Super strain B cultivar recorded the highest population (1732 , 2476 and 2967 / 100 g soil at 30, 60 and 90 days, respectively), while Vacolta 38 cultivar recorded the lowest population (1241, 1608 and 1879 / 100 g soil at 30 , 60 and 90 days, respectively). With regard to egg masses and number of galls the cultivars significantly differed (Table 3). Maximum number of egg masses (30.7) and galls number (37.5) was found in Super strain B cultivar which was classified as moderately susceptible based on root gall index. Contrariwise, minimum number of egg masses (13.4) and galls number (6.7) was recorded by Vocalto 38 cultivar which was classified as resistant.

Table 2.Population density of root knot nematode, *Meloidogyne javanica* infecting four tomato cultivars cultivated in pots under field condition.

Cultivars	Average number of *Meloidogyne javanica* juveniles / 100 g soil			
	30 Days	60 Days	90 Days	Over all mean
Super strain B	1732.0^{a}	2476.0^{a}	2967.0^{a}	2391.7^{a}
Vacolta38	1241.0^{d}	1608.0^{d}	1879.0^{d}	1576.0^{d}
Ko186	1694.0^{b}	2176.0^{b}	2849.0^{b}	2239.7^{b}
Login	1481.0^{c}	1904.0^{c}	2397.0^{c}	1927.3^{c}
LSD 5%	9.4	9.5	9.4	9.5

Means in each column followed by the same letter (s) are not significantly different at 5% level.

On the same Table there are a variations in plant parameters between cultivars. The heights plant height (56.8), shoot weight (69.7) and root weight (17.6) were reported by Vocalto 38 cultivar while the lowest plant height (44.7) , shoot weight (58.6) and root weight (11.2) were found in Super strain B cultivar.

Table 3. Effect of population density of root- knot nematode *Meloidogyne javanica* on egg masses production and root gall index in tomato cultivars..

Cultivars	Plant height (cm)	Shoot weight (g)	Root weight (g)	Number of egg masses	Number of galls	Root gall index	Resistance rating
Super strain B	44.7^{d}	58.6^{c}	11.2^{c}	30.7^{a}	37.5^{a}	4.0^{a}	Moderately susceptible
Vacolta38	56.8^{a}	69.7^{a}	17.6^{a}	13.4^{c}	6.7^{d}	2.0^{c}	Resistant
Ko186	48.5^{c}	50.7^{d}	14.0^{b}	16.2^{bc}	18.5^{c}	3.0^{b}	Moderately resistant
Login	51.3^{b}	64.9^{b}	15.1^{b}	17.9^{b}	25.7^{b}	3.0^{b}	Moderately resistant
LSD 5%	2.3	3.5	1.9	2.8	4.5	0.4	-

Means in each column followed by the same letter (s) are not significantly different at 5% level.

Significant differences were found among the studied cultivars of pepper in population density of *M. javanica* juveniles as showed in Table (4). The highest number (1805, 2491 and 3012 / 100 g soil at 30, 60 and 90 days, respectively) were reflected by Maor cultivar. On the other hand, the lowest number (1421, 1769 and 1904 / 100 g soil at 30,60 and 90 days, respectively) occured by Boulnder A cultivar.

Data presented in Table (5) show that pepper cultivars significantly differed in egg masses and galls number. The greatest number of egg masses (71.4) and galls (80.2) were obtained in Maor cultivar while the lowest number of egg masses (11.7) and galls (8) were found in Boulnder A cultivar.

Table 4. Population density of root- knot nematode, *Meloidogyne javanica* infecting four pepper cultivars cultivated in pots under field condition.

Varieties	Average number of *Meloidogyne javanica* juveniles/ 100 g soil			
	30 Days	60 Days	90 Days	Over all mean
California wonder	1575.0^{c}	1864.0^{c}	2017.0^{c}	1818.7^{c}
Boulnder A	1421.0^{d}	1769.0^{d}	1904.0^{d}	1698.0^{d}
Marconi	1743.0^{b}	2167.0^{b}	2931.0^{b}	2280.3^{b}
Maor	1805.0^{a}	2491.0^{a}	3012.0^{a}	2436.0^{a}
LSD 5%	9.4	9.4	9.4	9.5

Table 5. Effect of population density of root- knot nematode *Meloidogyne javanica* on egg masses production and root gall index in pepper cultivars.

Cultivars	Plant height (cm)	Shoot weight (g)	Root weight (g)	Number of egg masses	Number of galls	Root gall index	Resistance rating
California wonder	30.5^{ab}	35.4^{a}	4.9^{ab}	21.4^{c}	18.2^{c}	3.0^{c}	Moderately resistant
Boulnder A	33.7^{a}	36.5^{a}	6.1^{a}	11.7^{d}	8.0^{d}	2.0^{d}	Resistant
Marconi	29.4^{b}	31.7^{b}	4.2^{ab}	34.6^{b}	45.5^{b}	4.0^{b}	Moderately susceptible
Maor	26.9^{b}	27.8^{c}	3.1^{b}	71.4^{a}	80.2^{a}	5.0^{a}	Susceptible
LSD 5%	3.6	3.2	2.3	2.1	5.3	0.9	-

Means in each column followed by the same letter (s) are not significantly different at 5% level.

Regarding plant growth parameters (plant height, shoot weight and root weight) it was observed that the resistant cultivar Boulnder A showed the highest values (33.7 , 36.5 and 6.1) of plant height , shoot weight and root weight, respectively. On the other hand, the susceptible cultivar Maor showed the lowest values (26.9cm,27.8g and 3.1) of plant height, shoot weight and root weight, respectively.

Discussion

Root-knot nematode *Meloidogyne* spp are associated with pepper and tomato as with other plants. These nematodes occur with plants with varying population densities and frequency of occurrence according to plant resistant rating. In this study tomato and pepper cultivars showed significant differences against root-knot nematode *Meloidogyne javanica* (formation of galls, population density and egg masses) as well as their growth parameters (plant height, shoot weight and root weight). The resistant rating in tomato cultivars was between resistant and moderately susceptible while pepper cultivars was between resistant and susceptible.

According to Chen *et al.* (2004) the susceptibility of plant to root-knot nematode depends on the penetration of the plant roots by nematode juveniles and causes the formation of giant cells which led to the appearance the galls on the roots. In resistant plants juveniles are unable to penetrate the roots or fie after penetration or failed to complete their development or females are unable to reproduce (Sunil and Khurma, 2007)

The resistance of tomato and pepper plants to root-knot nematode may be due to genes action (*Me* 7 and *Mi* gene) or produce some toxic in root exudates which reduce juveniles penetration and development of nematode in plant tissues. (Pinheiro *et al.,* 2015 and Kamran *et al.,* 2012). According to Esfahani *et al.* (2012) root cells of resistant plants react against nematode via increase NADPH oxidase activity led to reduce the juveniles penetration. Renato *et al.* (2018) evaluated thirteen genotypes of pepper in their response to root-knot nematodes *M . incognita* race 3, *M. javanica* and *M. enterolobii* . The genotypes showed different response. These differences may be explained to *Me* 7 gene actions.

Finally, it could be discussed and worthy of the four cultivars for each of tomato and pepper are commercial and commonly used in the Egyptian market. It is necessary to shed light on potentiality application of dual resistant cultivars tomato (Vacolta 38) and pepper (Boulender A). Hence, these two cultivars are inimitable in its practicality and potentiality application against *M. javanica* with highly qualification, aptly and prosperity in controlling root-knot nematode in breeding programs.

REFERENCES

Abad, P.;Favery,.B; Rosso,M.N and Castagnone-Sereno,P (2003). "Root-knot nematode parasitism and host response: Molecular basis of a sophisticated interaction," Molecular Plant Pathology. 4:217-224.

Abada K. A. and Ahmed, M.A (2014) Management *Fusarium* wilt of sweet pepper by *Bacillus* strains. American Journal of Life Sciences , 2: 19-25.

Bello, T.T.; Fawole, B. and Abiodun, C. (2015). Suceptibility of seven varieties of pepper and tomato to root-knot nematodes (*Meloidogyne* spp) in Ibadan, Nigeria. Journal of Agriculture and Veterinary Science. 8(10):79-82

Chen, Z.X., Chen, S.Y. and Dickson, D.W. (2004). Nematology advances and perspectives Vol. 2, Nematode Management and Utilization. Tsinghua University press China, Chilean Journal of Agricultural Research 78(1) : 78-85.

Darban, D. A., Pathan, M.A., Jiskani, M.M and Wagan, K.H. (2003). Response of some tomato cultivars to root-knot nematodes, *Meloidogyne incognita*.

Pakistan Journal of Agriculture, Agricultural Engineering and Veterinary Science. 19:36-38.

Esfahani, M.N; A.R Ahmadiand and Shirazi, K. (2012). Susceptibility assessments to tomato genotypes to root-knot nematodes, *Meloidogyne javanica*. Journal of Ornamental and Horti. Plants. 2 (2): 113 – 121.

Holbrook, C.C.; D.A. Knauft, and D.W. Dickson (1983). A technique for screening peanut for resistance to *Meloidogyne incognita*. Plant Disease, 57: 957 – 958.

Hunt, D.J., Luc, M. and Manzanilla-Lopez, R.H. (2005). Identification, morphology and Biology of Plant Parasitic nematodes. In: Luc, M., Sikora, R.A. and Bridge, J. (Eds). Plant parasitic nematodes in subtropical and tropical agriculture. 2nd edition, CABI publishing, 11-52.

Hussey, R.S. and K.R. Barker (1973). A comparison of methods of collection inocula of *Meloidogyn*e spp. including a new technique. Plant Disease Reporter, 57: 1025 – 1028.

Jones, J.T., Hargeman, A., Danchin, E.J., Gaur, H.S., Helder, J. and Jones, M.G.K. (2013). Top 10 plant-parasitic nematodes in molecular plant pathology. Molecular Plant Pathology 14:946-961.

Kamran, M.; S.A. Anwar ; N. Javed,;S.A. Khan ; Imran, Haq and Ihsan, Ullah (2012). Field evaluation of tomato genotypes for resistant to *Meloidogyne incognita*. Pakistan Journal of Zoolagi, 44 (5): 1355 – 1359.

Liu, B., Ren, J., Zhang, Y., An, J., Chen, M., Chen, H., (2015). A new grafted rootstock against root-knot nematode for cucumber, melon, and watermelon. Agronomy for Sustainable Development 35:251-259.

Molinari, S. (2011). Natural genetic and induced plant resistant, as a control strategy to plant- parasitic nematodes alternative to pesticides. Plant Cell Report, 30: 311 – 323.

Mukesh,K.P. and Dhirendra,K. N(2019). Screening and evaluation of tomato varieties against root-knot nematode, *Meloidogyne incognita*. Journal of Entomology and Zoology Studies 2019; 7(3): 820-823.

Pinheiro, J.B., Boiteux, L.S., Almeida, M.R.A., Pereira, R.B., Galhardo, L.C.S., and Carneiro, R.M.D.G. (2015). First report of *Meloidogyne enterolobii* in *Capsicum* rootstocks carrying the Me1 and Me3/Me7 genes in central Brazil. Nematropica 45:184-188.

Renato ,S., Edgard ,H., Roberta, L., Willame , D., Carolina Andrade, F., Francisco, J. and Leila Trevisan, B.(2018) Response of *Capsicum annuum* L. var. *annuum* genotypes to root-knot nematode infection. Chilean Journal of Agricultural Reseaech 78(1): 78-85.

Sunil K. Singh and Uma R. Khurma (2007) Susceptibility of six tomato cultivars to the root-knot nematode, *Meloidogyne incognita*. The South Pacific Journal of Natural Science, 13, 73-77

Taylor A.L.and J.A. Sasser (1978). Biology.Identification and Control of Root-knot Nematodes (*Meloidogyne* spp.). Coop Publ. Dep. Plant Pathology North Carolina, State University and US. Agency Int. Dev. Raleigh, NC.111 pp.

حساسية بعض أصناف الطماطم و الفلفل لنيماتودا تعقد *Meloidogyne javanica*

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أربعة أصناف من الطماطم وهي (Super strain B, Vacolta 38, Ko186 and Login) مع أربعة أصناف أخرى من الفلفل وهي (California wonder, Boulnder A, Marconi and Maor) قد أختبرت بواسطة نيماتودا تعقد الجذور *M. javanica* باصابة على مستوى 1000 يرقة عمر ثاني وذلك بإجراء تجربة في أسس تحت ظروف الحقل في مزرعة كلية الزراعة بشبين الكوم. من النتائج المتحصل عليها تبين وجود فروق معنوية عالية بين أصناف كل من الطماطم والفلفل تحت الدراستز مسجلاً صنف الطماطم الحساس Super strain B أعلى الأصناف إصابة بالنيماتودا عن بقية الأصناف الأخرى في كل من الكثافة العددية ليرقات النيماتودا وأعداد كل من كتل البيض والعقد الجذرية بنتائج (2391.7 يرقة/100جم تربة & 30.7 & 37.5) على التوالي. وعلى العكس مما سبق صجل صنف الطماطم المقاوم38 Vacolta أقل الأعداد من حيث الكثافة العددية ليرقات النيماتودا وأعداد كل من كتل البيض والعقد الجذرية مسجلاً (1576 يرقة/100جم تربة & 13.4 & 6.7) على التوالي. وكانت قياسات النباتات تؤكد نجاح الصنف في تأثيرة المحقق على الصفات النباتية المذكورة كصنف مقاوم وبنتائج محسنة لهذة الصفات وهي ارتفاع النبات ووزن المجموع الخضري ووزن الجذور (56.8 & 69.7 & 17.6) على التوالي. وفي الفلفل كان الصنف الحساس Maor أعلى الأصناف كثافة ليرقات النيماتودا وعدد كل من كتل البيض والعقد الجذرية بنتائج (2436 يرقة/100جم تربة & 71.4 & 80.2) على التوالي . بينما كان الصنف المقاوم Boulnder A أقل الأعداد من حيث الكثافة العددية ليرقات النيماتودا وأعداد كل من كتل البيض والعقد الجذرية بنتائج (1698 يرقة/100جم تربة & 11.7 & 8.0) على التوالي. وقد تحسنت الصفات النباتية مقارنة بالأصناف الأخرى. ومن ثم يمكن التوصية بإدخال صنفي الطماطم والفلفل (Boulnder A & Vacolta 38) مستقبلا في برامج التربية والمكافحة المتكاملة للنيماتودا وذلك لمقاومتهما للإصابة بنيماتودا تعقد الجذور *M. javanica*