JOHP
Journal of Ornamental and Horticultural Plants
*Available online on: www.jornamental.com*
*ISSN (Print): 2251-6433*
*ISSN (Online): 2251-6441*

# Susceptibility Assessments of Tomato Genotypes to Root-Knot Nematodes, *Meloidogyne javanica*

M. Nasr Esfahani[1*], A.R. Ahmadi[2] and K. Shirazi[3]
[1]Plant Pests and Diseases Research Division, Agriculture and Natural Recourse Research Center, Isfahan, Iran
[2]Plant Pests and Diseases Research Division, Agriculture and Natural Recourse Research Center, Ahvaz, Iran
[3]Plant Pests and Diseases Research Division, Agriculture and Natural Recourse Research Center, Isfahan, Iran.

Received: 3 February 2011 Accepted: 19 May 2012
*Corresponding author's email: mne2011@gmail.com



Abstract

Root-knot nematodes, *Meloidogyne spp*., are one of the important plant parasitic nematodes of tomato in the world. The most suitable control method of plant parasitic nematodes is the use of resistance sources and tolerant cultivars. In the earlier studies, the results showed thatonly 2% (19 out of 537 varieties) were resistant and tolerant to the root knot nematodes. In the supplementary studies, the susceptibility of these 19 tomato cultivars were reassessed again, against *M. javanica*, in the two completely randomized design experiments in the greenhouse and field conditions for the two continuous years. The tomato plants were evaluated 70 days after inoculation on the basis of the gall indexes (GI), final populations (Pf), reproduction factors (Rf) and the root and or the stem weights. The results showed that, the cultivars No. 136 and 109 with GI=2, Rf=4.68 and GI=2.25, Rf=28.4 are tolerant cultivars to the nematode, *M. javanica* in the greenhouse respectively. Also, the cultivar No. 100 was considered to be a susceptible one, with GI= 3.25 and Rf= 0.97. Whereas, in the field conditions, the cultivars 136 and 109 proved to be tolerant with GI, 1.9 and 1.6 respectively.

**Keywords:** Cultivars, Resistance, Root- knot nematode, Tomato, Susceptibility.

## INTRODUCTION

Tomato (*Lycopersicon esculentum* Miller, 1768) is one of the vegetable crops, which is used in various ways, such as souse and or etc. Tomatoes are planted in 110,229 hectares in Iran and have 27 tone/hectare average yields. Root-knot nematodes, *Meloidogyne* spp., are the most important tomato parasitic nematodes in Iran and the world. Seven species and five races of these nematodes have already been identified in Iran. *M. javanica* is the most and well distributed one in tomato and other field crops (Akhiyani *et al*., 1984; Mehdikhani *et al*., 2003; Janar Dhanan, 2002; Mojtahedi and Santo, 1994; Razaz Hashemi, 2005; Razaz Hashemi, 2006). The infection of the tomato cultivar, Red Cloud VF was reported to be 37% with 20 eggs and larva, as the primary inoculums per gram of soil, in the micro plot in Isfahan. Resistance and susceptible cultivars, offer effective control against these nematodes (Webster, 1972). So, different cultivars of tomatoes were offered to farmer in different countries. Gold set, Nematex and Small Early cultivars were reported as resistant sources to *M. incognita* in Canada. In USA VFN-8, Rossel, Patirot, Healani, Atkinson, Anaha, Nemared were resistant cultivars to M .incognita and M. javanica (Taylor and Sasser, 1978). In Italy Roma VFN, VFN-77-177-1, VFN-77-92-2, Stumae Ronita were resistant cultivars to root knot nematode (Vito and Lamberti, 1976). In Egypt, Small Early VFN-8 and Ronita were reported as resistant cultivars to root knot nematodes (Akhiyani and Mortazavi, 1992). In India, Pusa-120 and CLL 303-BCI were reported as resistant cultivars to *M. javanica* and race 1 to 4 of *M. incognita* (Prasad *et al*., 1964). Pelican cultivar was resistant to race 1, 2 and 4 and was susceptible to race 3 of *M. incognita* (Rao *et al*., 1975). Bush-VFN and VFN-8 were resistant to all races of *M. incognita* and *M. javanica* (Singh and Choudhury, 1974). Kaur *et al*. (1994) studied the reaction of 25 F1 generation hybrid of tomato, which were resistant to *M. incognita* in Ludhiana area in India. Hybrid cultivars which were gained from Castly Roch* 1792 and Ronita * Rio Grande were highly resistant, Ronita* F24-C8 and EC 119192* KF15 was resistant too. Hybrid of Rio Grand * Ronita and Pujab Chhuhara* Ronita were moderately resistance to M. incognita. Akhiyani (1981) examined 72 seeds from 1982 to find resistant or moderately resistant tomatoes during 1982-1986. Akhiyani selected 19 lines and collected seed. Also, 91 tomato cultivars were sent by Gene bank. Akhiyani and Mortazavi (1992), evaluated 537 cultivars of tomato in order to find resistant cultivars to *M. javanica* based on international project standard of root knot nematodes. Out of these cultivars, 98 % were susceptible, and also some of the cultivars, which were reported as resistant to *M. javanica*, were found to be susceptible. Out of 11 cultivars in final tests, 7 cultivars were determined to be resistant and others were susceptible.

In the present studies, the reaction of 19 tomato cultivars with the high quantity and quality properties were evaluated against *M. javanica* in comparison to the controls, for the two continuous years in the green house and the field conditions.

## MATERIALS AND METHODS

### Evaluation of the cultivars reaction to nematode in the greenhouse conditions

The 20 tomato cultivars were planted in plastic pots filled with 1.5 lit of soils, with the mixture of sand and pasteurized peat with 1:2:1 ratio. Cultivars reaction to *M. javanica* was rated on each tomato plant, infected with the numbers of 5000 eggs and larva as the primary inoculum. Pots were placed in greenhouse at about 25°c for 70 days. Plants were uprooted and gall indexes, number of nematodes per root and soil, reproduction factors and growth conditions of the plant, including root and stem weights were assessed in the complete block designs, indicating 20 treatments and 4 replicates each. The average means were compared based on Duncan Multiple Test Ranges (DMRT).



 

## Planting tomato seeds in micro plots

Tomato seeds were planted in the micro plots, and after rising of the seedlings, the even size and strong ones were transferred in to the field.

## Selecting infested field to nematode

The fields which were highly infested to *M. javanica* with the mean numbers of 30 eggs and larva per gram of soil selected in the regions, Vilashahr, Najafabad, in Isfahan province, which then, divided into plots, according to the numbers of treatments and replicates.

## Evaluation of tomato cultivars reaction to nematode in infested fields

Tomato seedlings were transferred into the infected fields. Sampling was done from 0 to 30 cm depths in order to determine the primary inoculum of nematodes. After, 4 months, all the plants, 30 plants from each replicates were uprooted and assessed based on 0 to 5 scoring scales (Tayler and Sasser, 1978). Nematode numbers in the roots and the soils from every plot were calculated, in order to determine reproductive factor (RF) (Oostenbrink, 1966). Evaluation of resistance, tolerance, susceptible and hypersensitive reactions of the tomato cultivars were assessed based on Canto-Sanz (1983) method. Tolerance cultivars with the RF >1 and GI <2, the resistant ones RF <1 and GI <2, susceptible cultivars GI>2 and RF >1 and hypersensitive RF<1 and GI>2 (Canto-Saenz, 1983).

## Statistical analysis

The experiments were based on the complete block designs with 20 treatments, tomato cultivars and 4 replicates each. Average mean comparisons were performed based on Duncan tests. Statistical analysis of variance was done with MSTATC computer software (SAS Institute. 1996).

## RESULTS

## Evaluation of tomato cultivars reaction to nematode in greenhouse conditions

The means of gall indexes, nematode populations, reproduction factors, root and stem weights of the 20 tomato cultivars to the root knot nematodes have been presented in table1and 2, along with the means of statistical grouping, based on Duncan tests.

The means of gall indexes showed 9 different significant groups. Variations in gall indexes were between 2 (cultivar No. 134) to 5 (control). Dornus X New gaeker and cultivars No. 20, 14, 109 and 178 had gall indexes of 2.5, 2.75, 2, 2.25 and 2.75, respectively. Control cultivar had gall index 5 (Table 1). Cormello T.M.V.F.N.S. X Tina, Delta X Chef, Delta X Chef and 140 had gall indexes of over 4. So, these results indicating that, these cultivars are susceptible to the root knot nematodes in these experiments (Table1).

The nematode populations in the roots and related soils of the 20 tomato cultivar were divided into the six distinct and significant statistical groups. Cultivar No. 100 had the least egg and second stage of larvae populations. Delta X Chef cultivar had the maximum No. of eggs and second stage larvae populations. Delta X Chef and Cormellxo T.M.V.F.N.S. X Tina had more nematode populations in comparison to control treatments (Table1). Means of nematode reproductions also, showed five significant statistical groups. Cultivar No. 100, Dornus X New gaeker, cultivar No. 136 and Dornus X New gaeker had RF 0.97, 2.32, 4.68 and 4.96, respectively. Cultivar No. 100 had RF <1. This scale in Delta X Chef, Cormello T.M.V.F.N.S. X Tina and cultivar No. 140 was more than control treatment. So, these results showed that, these cultivars are highly susceptible to these nematodes.

Means of root weights showed six variable and different statistical groups. Control and cultivar No. 182, 26 had the most root weights respectively. Whereas, the means of stem weights divided the cultivars into eight distinct and significantly different statistical groups. Cultivars No. 182, 27 and 136 had the maximum stem weights respectively (Table1).

**Evaluation of tomato cultivars reaction to nematode in infested fields**

Gall indexes, nematode populations per root and soil and reproduction factors of 20 tomato cultivars with the treatments and replications in the field have already been summarized in table 2. Variance analysis showed that, here also the tomato cultivars are significantly different. And, there are differences when, the cultivars are compared with each others and or with the controls. Mean comparison of the gall indexes, nematode populations per root and soil and reproduction factors of the tomato cultivars root and statistical grouping of the means are also presented, based on Duncan tests. Here, the mean comparison of the gall indexes showed nine different group and the range of variations in the gall index was 1.6 (cultivar No. 109) and 4.25 (control). Cultivar No. 109 and 136 had the least gall index, 1.6 and 1.9 respectively, whereas control had gall index 4.25 (Table 2).

Mean comparison of reproduction factors showed 4 different and significant groups. Cultivar No. 136 and 26 had the least reproduction factors in comparison to control which had the most reproduction factors (Table 2).

Reaction of the cultivar No. 100, 136 and 109 in greenhouse and field conditions show that, the cultivar No. 100 was highly susceptible in greenhouse and susceptible in field. Cultivar No. 136 was tolerance in greenhouse and field. Cultivar No. 109 was susceptible in greenhouse and tolerance in field.



## DISCUSSION

Resistance in tomato cultivars to root-knot nematodes has the same genetic origins and is controlled by a dominant gene, Mi, which located on the chromosome No. 6 (Harada, 1996; Gilbert and McGurive, 1956; Liharska, 1998). This gene was transferred from the wild tomato (L. *peruvianum*) to some commercial cultivars, and it can be used efficiently against M. incognita, M .arenaria and *M. javanica* (Canto-Saenz, 1983; Canto-Saenz, 1985, Fassuliotis, 1979). In this study, without considering, Mi genes in view, the reactions of 19 tomato cultivars were evaluated against *M. javanica* in which, the different characters, such as the potentiality of the reproduction factors were taken into accounts by several workers (Khan and Khan, 1991; Oostenbrink, 1966). Here also, the potentiality of the reproduction factors in the tomato cultivars were compared with the potentiality of the reproduction factors in susceptible ones (Taylor, 1967) and also, egg mass indexes and or gall indexes (Taylor and Sasser, 1978), complexes of nematode reproductions and crop losses were taken into considerations (Canto-Saenz 1983; Castagnon-Sereno *et al*., 1994) . Based on recent factors in greenhouse tests, about 85% of the cultivars were susceptible to nematode with GI > 2 and R > 1 indexes. Cultivar No.136 with GI= 2 and R= 4.68 was tolerant and cultivar No. 100 with GI= 3.25 and R= 0.97 was hypersensitive. In this cultivar RF < 1 and GI >2, indicating that, the nematode arrives to the tomato root system, but the resistance of the host prevents the reproductively of the nematodes. Cultivar No. 109 (wild tomato) was comparatively tolerant (Table 1). Cultivars 136 and 109 were introduced tolerant cultivar in the field conditions. About 85-90% of the tomato cultivars were susceptible to M. javanica, which is unlike the Akhiyani's report, that they were tolerant and resistant cultivars. Probably different factors had already interfered in this case. Nematode populations influenced the decrease in resistance of the tomato cultivars to root knot nematodes. Economic threshold level of root knot nematode is 0.005-2 egg and larvae per gr of soil (Araujo *et al*., 1982; Barker, 1976; Ferris, 1978). In the field experiments, the limitations to select the nematode infested soil could be a factor, because the initial population's density of nematode was 30 eggs and larvae per gr soil. Therefore, reproduction in the large scale caused the breaking of the resistance in some cultivars. Cultivar No. 109 was susceptible in greenhouse and tolerant in the field conditions. This cultivar is a wild one, and it grows with a well developed root in the field. So, this character having a great affect on the reaction of this cultivar (Hashemi and Winstead, 1959).

Cultivar No. 136, which was tolerant to *M. javanica* in the field and greenhouse conditions, could be planted in some regions where, the temperatures reach to and or below 28°C. Usually, in these regions tomatoes are planted in winter and fall where, the temperatures are less than 28°C (Araujo, *et al*., 1982; Dropkin, 1969; Netscher, 1977). Cultivar No. 136 can be introduced as a tolerant cultivar.

Involving mechanisms in resistant plants could be the production of toxic from the root exudates, the lack of an attractant or the hatching factor in the exudates, a barrier for penetration or the failure of nematodes to develop within plant tissues, the production of lignin and synthesis toxin including phytoalexines (Jenkins and Taylor, 1967; Favery *et al*., 2001; Jaubert *et al*., 2002).

Ascorbic acid is generally considered to provide resistance in plants to various pathogens. Low levels of ascorbic acid in tomato cultivars were associated with their susceptibility to *M. incognita* attack. The results showed that, ascorbic acid increase production of hydroxy prolin which lead to increase activity of resistant respiratory Cyanide (Arrigoni *et al*., 1979; Brueske, 1980). All evidences have shown that, the root cells of resistant plant react against nematode via increase in NADPH oxidase activity. The production of superoxidase in plant cells directly or indirectly may cause the death in hypersensitive cells and as a subsequent to these reactions, establish resistance in plants. Previous studies have indicated that, respiratory resistant cyanide and superoxidase induce the phytoalexin synthesis, then establish resistance in plant during infection process (Favery *et al*., 2001; Semblat *et al*., 2001; Semblat and Castagnone-Sereno, 2001).



**Literature Cited**

Akhiyani, A., 1981. Studies on the root-knot nematode. Annul Report of Plant Pests and Diseases Research Division of Esfahan Agricultural Research Center. 110-120.

Akhiyani, A., Bagheri, F. and Ahmadi, A.R. 1992. Distribution and identification of root knot Nematodes in Tomato and Brinjal Fields of Hormozgan Province. Proc. 1 st. Vegetable Research Seminar, Karaj, Iran: 7-8.

Akhiyani, A., Akhiyani, A., Mojtahedi. H. and Naderi, A. 1984. Speceis and physiological races of root-knot nematodes in Iran. Iran. J. Plant Pathol. 20: 57-71.

Araujo, M. T., Dickson, D. W., Augustine, J. J. and Bassett, M. J. 1982. Optimum initial inoculum levels for evaluation of resistance in tomato to *Meloidogyne* spp. at two different soil temperatures. J. Nematol. 14: 536-540.

Barker, K. R., Shoemaker, P. B. and Nelson, L. A. 1976. Relationships of initial population densities of *Meloidogyne incognita* and *Meloidogyne hapla* to yield of tomato. J. Nematol. 8: 282.

Brueske, G. H. 1980. Phenlalanine ammonia lyase activity in tomato root infected and resistant to the root-knot nematode, *Meloidogyne incognita*. Physiol. Plant Pathol. 16: 409-414.

Canto-Saenz, M. 1983. The nature of resistance to *Meloidogyne incognita* (Kofoid & White, 1919) Chitwood. 1949, PP. 160, In proc. Third Res.& Plann. Conf. On Root-Knot Nematodes, *Meloidogyne* spp., March 22-26, 1982, ed C.C. Carter. International Meloidogyne Project, Lima, Peru. 233. Be corrected.

Canto-Saenz, M. 1985. The nature of resistance to *Meloidogyne incognita* (Kofoid & White, 1919) Chitwood. 1949, PP. 225-231, In J. N. Sasser and C. C. Carter(eds.). An. Advanced Treatise on Meloidogyne Vol.1 Biology and Control. North Carolina State University Graphics. Raleigh, North Carolina. Be corrected.

Castagnon-Sereno, P., Bangiovanni, M. and Dalmasso, A. 1994. Reproduction of virulent isolates

of *Meloidogye incognita* on susceptible and Mi-resistant tomato. J. Nematol. 26: 324-328.
Dropkin, V. 1969. The necrotic of tomato and other plants resistant to Meloidogyne reversed by temperature. Phytopathol. 59: 1632-1637.
Fassuliotis, G. 1979. Plant breeding for root-knot nematode resistance. PP. 425-453, In F. Lamberti and C. E. Taylor (eds.). Root-knot nematodes (*Meloidogyne* species). Systemics, biology and control. Academic Press. New York. USA. Be corrected
Favery, B., Ryan, E., Foreman, J., Linstead, P., Boudonck, K., Shaw, P., Steer, M. and Dolan, L. 2001. KOJAK is a cellulose synthase-like gene required for root hair cell morphogenesis in Arabidopsis. Genes Dev. 15: 79-89. Be Corrected
Ferris, H. 1978. Development of nematode damage functions and economic threshold using *Meloidogyne incognita* on tomatoes and sweet potatoes. J. Nematol. 10: 286-287.
Gilbert, J. C. and Mcguire, D. C. 1956. Inheritance of resistance to severe root-knot from *Meloidogyne incognita* in commertial type tomatoes. Proc. Am. Soc. Hort. Sci. 68: 437-442.
Harada, S., Nakata, K., Tanaka, H., Ishiguro, Y., Ito, T., and Takagi, M. 1996. PCR- based selection for the root—knot nematode resistance in tomato. Breeding Science. 46: 133-136.
Hashemi, S.R.D. and Winstead, N.M. 1959. Studies on resistance in tomato to root-knot nematodes and/or the occurrence of pathogenic biotypes. Phytopathol. 49: 716- 724.
Janar Dhanan, K. 2002. Diseases of major medicinal plants. Daya Publishing House. Delhi. 202 pp.
Jaubert, S., Ledger, T.N., Piotte, C., Abad, P., and Rosso, M.N. 2002. Direct identification of stylet secreted proteins from root-knot nematodes by a proteomic approach. Molecular and Biochemical Parasitology, 121, 205-211.
Kaur, S., Padmanabhan, S. Y. and Kaur, P. 1994. Screening of some F1 hybrids of tomato against root-knot nematode, *Meloidogyne incognita*. Pest management and Economic Zoology. 2: 95-96.
Khan, A.A. and Khan M.W. 1991. Response of tomato cultigens to *Meloidogyne javanica* and races of *Meloidogyne incognita*. J. Nematol. 45: 598-603.
Liharska, T.B. 1998. Genetic and molecular analysis of the tomato root-knot nematode resistance Locas Mi-1. Wageningen Agricultural University, Wageningen, the Netherlands: 95 P.
Mehdikhani, E., Kheiri, A., Eshtiaghi, H. and Okhovvat, M. 2003. Three new records of Meloidogyne species for Iran. J. Plant Pathol. 39: 69-71.
Mojtahedi, H. and Santo, G.S. 1994. A new host of *Meloidogyne chitwoodi* from California. Plant Dis. 18: 1010(Abstr.).
Mortazavi Bac, A. 1992. Resistance sources of tomato varieties to root- knot nematodes in Iran. Proc.1 st. Vegetable Research Seminar, Karaj, Iran:4.
Netscher, C. 1977. Observation and preliminary studies on the occurrence of resistance breaking biotypes of *Meloidogyne* spp. on tomato. Cah ORSTOM Ser. Biol. 11: 173-178.
Oostenbrink, M. 1966. Major characteristics of the relation between nematodes and plants. Medd. Land Bouwhogesch. Wageningen. 66: 4(Abstr).
Prasad, S.K. and Das Gupta, D.R. 1964. Varietal susceptibility of commercial tomatoes to the attack of root-knot nematodes, *Meloidogyne* spp. Indian Journal of Entomology, 26(2):235238.
Rao, V.R. and Tikoo, S.K. 1975. Resistance of tomato cultivars to the root-knot nematode, *Meloidogyne incognita*. Current Science 44(8): 282 - 283.
Razaz Hashemi, S.R. 2005. Identification of root-knot nematode from *Calendula* medicinal plant. Proc. National Congress in Sustainable Development of Medicinal Plants. 271-272.
Razzaz Hashemi, S.R. 2006. Identification of main parasitic nematodes in *Ricinus* medicinal plant in Qazvin Province. Proc. 17 th. Plant Prot. Cong. 276.
SAS Institute. 1996. SAS/STAT user's guide. Ver.6.4. SAS Inc. Cary, NC.
Semblat, J.P. and Castagnone-Sereno, P. 2001. Lack of correlation between (a) virulence and phylogenetic relationships in root-knot nematodes (*Meloidogyne* spp.) as inferred from RAPD and AFLP analysis. Genet. Sci. Evol. 33: 545-557.

Singh, B. and Choudhury, B. 1974. Screening tomato cultivars for resistance to *Meloidogyne* species. Pest Articles and News Summaries 20(3):319-322.

Taylor, A. L. 1967. Introduction to research on plant nematology. FAO. UN, Pub. No. PL: CP/5.

Taylor, A.L. and Sasser, J.N.1978. Biology, identification and control of root – knot nematodes (*Meloidogne* spp.) IMP Publication, Raleigh, North Carolina.

Vito, N.D. and Lamberti, F.1976. Reaction of tomato varieties to populations of *Meloidogyne* spp. in the glass-house. Nematologia Mediterranea. 4(2): 211-215.

## Tables

Table 1. Means of gall index, nematode population, reproduction factor of *M. javanica*, root and stem weight of tomato in greenhouse conditions

| Treatment[1] | Gall index | Nematode population per g. of root & soil | Reproduction factor[2] | Stem weight (g) | Root weight (g) | Reaction |
|---|---|---|---|---|---|---|
| Ricraude X SP-100 | 3.75abcde[3] | 234920c | 46.98abc | 43.75de | 20bc | Susceptible |
| Delta X Chef | 4.75ab | 246875c | 49.37abc | 49cde | 19.5bc | Susceptible |
| Delta X Chef | 4.25ab | 552257a | 107.95a | 46.75cde | 22.25bc | Susceptible |
| Cormello T.M.V.F.N.S.X Tina | 4.5abc | 537960a | 107.59a | 60abcde | 31ab | Susceptible |
| SP-100 X Castlerd (1-13) | 3.5abcd | 127430d | 25.48c | 63.5abcde | 14.5c | Susceptible |
| Delta X Chef | 3.75abcde | 123951d | 24.79c | 64.5abcde | 25.25abc | Susceptible |
| Dornus X New geaker | 3.5abcde | 24826e | 4.96c | 42.75de | 20.5bc | Susceptible |
| Dornus X New geaker | 2.5de | 11257e | 2.32c | 43.25de | 12.75c | Susceptible |
| Dornus X New geaker | 3bcde | 72743de | 14.45c | 40.5e | 23.5bc | Susceptible |
| 20 | 2.75cde | 67144de | 12.93c | 54.25bcde | 18.25bc | Susceptible |
| 26 | 3.5abcde | 123181d | 14.23c | 79.5ab | 26.75abc | Susceptible |
| 66 | 3.75abcde | 124168d | 24.83c | 63.75abcde | 25.5abc | Susceptible |
| 100 | 3.25abcde | 4861e | 0.97c | 58.25abcde | 23bc | Hypersensetive |
| 136 | 2e | 23409e | 4.68c | 75.5ab | 25.75abc | Tolerant |
| 140 | 4.25abcd | 441927b | 88.38ab | 69abc | 25.25abc | Susceptible |
| 170 | 3bcde | 93056de | 18.61c | 77ab | 26abc | Susceptible |
| 109 | 2.25e | 142014d | 28.4bc | 71abc | 22.5bc | Tolerant |
| 178 | 2.75cde | 57625de | 15.12c | 67abcd | 17.5bc | Susceptible |
| 182 | 3.5abcde | 265503c | 53.1abc | 83a | 31.25ab | Susceptible |
| Control | 5a | 326389c | 65.28abc | 67.25abcd | 29a | Susceptible |

[1] Data are means of four replicates.
[2] Initial population was 500 egg & second stage juveniles.
[3] Means in columns followed by a similar letter are not significantly different at 5% level by DMRT.

Table 2. Means of gall index, nematode population and reproduction factor of *M. javanica* in the field conditions.

| Treatment | Gall index | Nematode population per g. of root & soil | Reproduction factor | Reaction |
|---|---|---|---|---|
| Ricraude X SP-100 | 3.85ab | 4902cd | 163c | Susceptible |
| Delta X Chef | 3.9ab | 8669bcd | 289bc | Susceptible |
| Delta X Chef | 3.45ab | 7669bcd | 256bc | Susceptible |
| Cormello T.M.V.F.N.S.X Tina | 4.02ab | 15458bcd | 515bc | Susceptible |
| SP-100 X Castlerd (1-13) | 4.02ab | 21745b | 724b | Susceptible |
| Delta X Chef | 4.1ab | 8943bcd | 248bc | Susceptible |
| Dornus X New geaker | 3.92ab | 12941bcd | 431bc | Susceptible |
| Dornus X New geaker | 3.47abc | 16110bcd | 537bc | Susceptible |
| Dornus X New geaker | 3.7ab | 7651bcd | 255bc | Susceptible |
| 20 | 4.07ab | 8775bcd | 293bc | Susceptible |
| 26 | 2.93bcd | 2362cd | 79c | Susceptible |
| 66 | 4ab | 8061bcd | 326bc | Susceptible |
| 100 | 4.02ab | 9626bcd | 321bc | Susceptible |
| 136 | 1.9de | 1588d | 53c | Tolerant |
| 140 | 4.25a | 23703bc | 378bc | Susceptible |
| 170 | 2.42cde | 5088bcd | 169c | Susceptible |
| 109 | 1.6e | 3162cd | 105c | Tolerant |
| 178 | 3.52abc | 6171bcd | 206c | Susceptible |
| 182 | 3bc | 6703bcd | 223c | Susceptible |
| Control | 4.25a | 38583a | 1286a | Susceptible |

[1]Data are mean of four replicates.
[2] Initial population was 30 egg & larvae per gr. of soil.
[3] Means in columns followed by a similar letter are not significant at 5% level.

Table 3. Analysis of variance of tomato cultivars to root knot nematodes, M javanica.

| Variable sources | CV | SS | MS | F | Prob |
|---|---|---|---|---|---|
| Gall index (G.H) | 31.37 | 50.638 | 2.665 | 2.59** | 0.01 |
| Reproduction factor (G.H) | 10.38 | 85679.79 | 4509.46 | 3.16** | 0.0005 |
| Nematode. population * (G.H) | 89.69 | 215904.6 | 113634.7 | 3.15** | 0.001 |
| Root weight | 37.83 | 2755 | 145 | 1.83** | 0.042 |
| Stem weight | 24.41 | 13358.8 | 703.09 | 3.16** | 0.0004 |
| Gall index (F) | 20.22 | 45.19 | 2.38 | 4.69** | 0.005 |
| Repro duction factor (F) | 82.76 | 5789027.7 | 304685.7 | 3.78** | 0.0001 |
| (F) Nematode. population | 24.46 | 5893.01 | 31015.1 | 3.25** | 0.0004 |

G- Green house. F- Field. *- Nematode population per gr. of root & soil.
- The df, for blocks, treatments and the error are the same for all, i.e. 3, 19 and 52 respectively.
**- Significant at 1% level of probability.