Screening of Cherry Tomato Genotypes for Resistance to *Meloidogyne incognita* and *M. javanica*


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The resistance of twelve tomato accesses to *M. incognita* race 3 and *M. javanica* was assessed in a greenhouse experiment with eight replicates in a completely randomized design. Tomato accesses used in this study were: 05 (Indiana 73), 82 (Sweet Cherry), 11 (VR Sugar), 16 (Starfine), 25 (B/E – 1260-1-1), 40 (PI – 262910 CGS), 50 (UENF 201), 71 (ACC HIGH Pigmelt line / ACC 2343), 78 (cherry small elongated format – collected at Brazilian SE), 79 (Ales cherry pear-form), 80 (cherry large rounded – collected at Brazilian SE) and 51 (UENF 202 – KC 46[2]2). Each plant was inoculated with 5,000 eggs + second stage juveniles. Tomato ‘Santa Clara’ was used as control. Host suitability was designated based on the percentage of the reproduction, i.e., 0-25% = highly susceptible (HS), 26-50% = susceptible (SU), 51-75% = low resistant (LR), 76-95% = moderately resistant (MR), 96-99% = resistant (RE), 100% = highly resistant (HR) or immune (IM). The great majority of accesses was SU or HS to both nematode species as did tomato ‘Santa Clara’. The accesses 05 and 82 were LR to *M. javanica*. The results obtained from the present study indicate that there are few resistance genes in commercial tomato cultivars and uncultivated tomato to *M. javanica* and *M. incognita*.

Key words: resistance, root-knot nematode, tomato


Neste estudo foram avaliados doze acessos de tomateiro ao parasitismo de *Meloidogyne incognita* raça 3 ou *M. javanica*, em experimento conduzido em casa de vegetação em delineamento inteiramente casualizado com oito repetições. Os acessos de tomateiro foram: 05 (Indiana 73), 82 (Sweet Cherry), 11 (VR Sugar), 16 (Starfine), 25 (B/E – 1260-1-1), 40 (PI – 262910 CGS), 50 (UENF 201), 71 (ACC HIGH Pigmelt line / ACC 2343), 78 (cereja pequeno formato alongado – coletado na região Sudeste do Brasil), 79 (Ales cereja piriforme), 80 (cereja redondo grande – coletado na região Sudeste) e 51 (UENF 202 – KC 46[2]2), além de cultivar Santa Clara (padrão de suscetibilidade). Cada planta foi inoculada com 5.000 ovos + juvenis de segundo estádio. Tomando por base o percentual de redução do FR, os acessos foram classificados da seguinte forma: 0-25% = altamente suscetível (AS), 26-50% = suscetível (SU), 51-75% = pouco resistente (PR), 76-95% = moderadamente resistente (MR), 96-99% = resistente (R), 100% = altamente resistente (AR) ou imune (I). A maioria dos acessos foi SU ou AS a ambas as espécies de nematóides, assim como o tomateiro Santa Clara. Os acessos 05 e 82 foram PR à *M. javanica*. Os resultados obtidos à partir deste estudo indicam que existem poucos genes de resistência em cultivares de tomateiros comerciais e tomateiros não cultivados a *M. javanica* e *M. incognita*.

Palavras-chaves: resistência, nematoides-das-galhas, tomateiro.
**Conteúdo**

Tomato (*Solanum lycopersicon*) is one of the most popular vegetables in Brazilian cuisine. In 2007, Brazil produced 3,356,456 tons of tomato in 56,275 ha. Goiás and São Paulo states are the largest national producers (IBGE, 2008). Diseases are one of the major factors for tomato yield losses. According to Lopes & Santos (1994), more than two hundred of biotic and abiotic diseases can decrease tomato yield. Root-knot nematodes, particularly *M. incognita* and *M. javanica*, are the most important pathogens to tomato because they are dispersed around the world and, depending on the susceptibility of plant and infestation level, they can cause considerable damage to tomato plants, mainly when temperature and humidity are elevated (Ali & Gad El-Hak, 1994; Lopes & Santos, 1994; Campos, 1999; Church et al., 2004).

The plant-parasitc nematode management includes mainly chemical and cultural control (Johnson, 1985; Campos, 1999), however genetic resistance in plants is currently the method of choice for controlling *Meloidogyne incognita*. (Jacquet et al., 2005). Sometimes, the use of resistant cultivars to root-knot nematodes associated with some other management practices can substitute or reduce the nematicide applications, chemical pesticides expensive and harmful to the environment (Wanderley et al., 2007, Charchar et al., 2007).

Currently all the commercially available root-knot resistant cultivars carry the dominant Mi-1 gene, which confers resistance to the three major root-knot nematodes species, *Meloidogyne arenaria*, *M. incognita* and *M. javanica* (Jacquet et al., 2005). This gene was detected in unculivated species of *Solanum peruvianum* (Frazier & Denett, 1949), located in chromosome 6 (Gilbert & McGuire, 1955), and incorporated in commercial cultivars of *S. lycopersicon* (Thomason & Smith, 1957).

The difference in host reactions to *Meloidogyne* spp has been observed among genotypes of tomato. For instance, Trifonova & Vulkova (2007) reported that the tomato hybrids n° 9-4, 9-6 and 9-8 are highly resistant to *M. incognita* whereas 12 hybrids were susceptible. Likewise, the tomato cultivar Mini Roma was the least susceptible to *M. incognita* while Moneymaker and Roma the most susceptible (Singh & Khurma, 2007). Ali & Gad-El-Hak (1994) evaluated the reaction of 12 commercial tomato cultivars screened for resistance to *M. javanica* and concluded that five were tolerant and seven were susceptible.

In this study, we evaluated the resistance of 12 cherry tomato accesses to *Meloidogyne incognita* race 3 and *M. javanica* as an attempt to find source of resistance for further use in tomato breeding programs.

The study was carried out at the Agrarian Science Center, Federal University of Espirito Santo, municipality of Alegre (ES) Brazil. The twelve tomato accesses of Cherry group (*Solanum lycopersicon* and *S. lycopersicon* var. *cerasiforme*) used were: 05 (Indiana 73), 82 (Sweet Cherry), 11 (VR Sugar), 16 (Starfine), 25 (B/E – 1260-1-1), 40 (PI – 262910 CGS), 50 (UENF 201), 71 (ACC HIGH Pigmet line / ACC 2343), 78 (cherry small elongated format – collected at Brazilian SE), 79 (Ales cherry pear-form), 80 (cherry large rounded – collected at Brazilian SE) and 51 (UENF 202 – KC 46[2]2).

The isolates of *M. incognita* race 3 and *M. javanica* were reared on tomato ‘Santa Clara’ cultivated in bags containing a mixture of soil and sand 1:1 (v:v), previously sterilized in autoclave (121 °C / 2 h in three consecutive days) (Zauza et al., 2007), maintained in greenhouse. Species identifications were performed by analysis of esterase isozyme. Eggs were extracted from roots using the method described by Hussey & Barker (1973) modified by Boneti & Ferraz (1981). Tomato seeds were placed in trays of 128 cells containing an organic-mineral substrate. Twenty days after germination, seedlings were transplanted to plastic bags containing 2,000 cm$^3$ of soil and sand 2:1 (v:v) sterilized in autoclave as described above. Each seedling was inoculated with 5,000 eggs + second-stage juveniles (J$_2$) of *M. incognita* race 3 or *M. javanica* at transplant. Plants were maintained in a greenhouse in a completely randomized design with eight replicates. The tomato ‘Santa Clara’ was used as control. The air temperature was registered during the experimental period at the greenhouse where the work was carried out.

Thirty days after inoculation, root systems were carefully washed and egg extracted from the roots as described previously. The reproduction factor (Rf) was
calculated by dividing the final number of eggs obtained from each genotype by initial number of eggs \((RF = Pf / Pi)\). Host suitability was designated according to Moura & Regis (1987) (Table 1).

All accesses were SU to \(M. \) incognita race 3 (Table 2), except the accesses 11, 78 and 80, which were HS. Similar results were reported by Trifonova & Vulkova (2007). These authors found that hybrids of \(Solanum\) spp. were also susceptible to \(M. \) incognita. In another study, six tomato cultivars, i.e., Moneymaker, Beefsteak, Roma, Summertaste, Mini Roma and Smallfry were tested for their susceptibility to \(M. \) incognita. The cultivars Moneymaker and Roma were the most susceptible whereas Mini Roma, the least susceptible (Singh & Khurma, 2007).

The accesses 51, 78, 79 and 80 were HS, the accesses 05 and 82 LR and the other accesses SU to \(M. \) javanica (Table 2). Ali & Gad-El-Hak (1994) found that out of 12 commercial tomato cultivars screened for resistance to \(M. \) javanica, seven were susceptible and five tolerant. Perhaps the access 05 and 82 could be used in breeding programs aiming the introduction of resistance genes against \(M. \) javanica in commercial cultivars and reduce yield losses caused by this nematode species in the field (Charchar et al., 2003).

The maximum, mean and minimum air temperature during the experimental period were 31.6, 25.3 and 20.5 °C, respectively. Perhaps the high temperature affected the resistance in some tomato genotypes used in this study. According to many authors, temperature higher than 28 °C break the resistance of gene \(Mi\) present in tomato plants (Dropkin, 1969; Araújo et al., 1982; Ammati et al., 1986; Inomoto et al., 1995; Alves & Campos, 2001). In order to confirm the results, this experiment should be carried out again.

The results obtained from this and other previously published studies indicate that there are few resistance genes in commercial tomato cultivars and uncultivated tomato to \(M. \) javanica and \(M. \) incognita.

<table>
<thead>
<tr>
<th>%R</th>
<th>Host reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-25</td>
<td>Highly susceptible (HS)</td>
</tr>
<tr>
<td>26-50</td>
<td>Susceptible (SU)</td>
</tr>
<tr>
<td>51-75</td>
<td>Low resistant (LR)</td>
</tr>
<tr>
<td>76-95</td>
<td>Moderately resistant (MR)</td>
</tr>
<tr>
<td>96-99</td>
<td>Resistant (RE)</td>
</tr>
<tr>
<td>100</td>
<td>Highly resistant (HR) or immune (IM)</td>
</tr>
</tbody>
</table>

Table 1 - Scale of the percentage of reproduction (%R), according Moura & Regis (1987) and used in this study.

<table>
<thead>
<tr>
<th>Accesses</th>
<th>RF</th>
<th>%R</th>
<th>Reaction¹</th>
<th>Accesses</th>
<th>RF</th>
<th>%R</th>
<th>Reaction</th>
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<tbody>
<tr>
<td>40</td>
<td>5.85</td>
<td>47.86</td>
<td>SU</td>
<td>05</td>
<td>13.78</td>
<td>73.26</td>
<td>LR</td>
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<tr>
<td>50</td>
<td>6.23</td>
<td>44.47</td>
<td>SU</td>
<td>82</td>
<td>24.61</td>
<td>52.26</td>
<td>LR</td>
</tr>
<tr>
<td>05</td>
<td>6.45</td>
<td>42.51</td>
<td>SU</td>
<td>11</td>
<td>26.45</td>
<td>48.69</td>
<td>SU</td>
</tr>
<tr>
<td>25</td>
<td>6.66</td>
<td>40.64</td>
<td>SU</td>
<td>16</td>
<td>30.31</td>
<td>41.21</td>
<td>SU</td>
</tr>
<tr>
<td>51</td>
<td>6.96</td>
<td>37.97</td>
<td>SU</td>
<td>25</td>
<td>31.61</td>
<td>38.68</td>
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</tr>
<tr>
<td>71</td>
<td>7.20</td>
<td>35.83</td>
<td>SU</td>
<td>40</td>
<td>32.47</td>
<td>37.01</td>
<td>SU</td>
</tr>
<tr>
<td>82</td>
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<td>35.29</td>
<td>SU</td>
<td>50</td>
<td>33.59</td>
<td>34.84</td>
<td>SU</td>
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<tr>
<td>79</td>
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<td>34.14</td>
<td>SU</td>
<td>71</td>
<td>34.02</td>
<td>34.01</td>
<td>SU</td>
</tr>
<tr>
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<td>48.69</td>
<td>5.55</td>
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<td>HS</td>
<td>80</td>
<td>41.35</td>
<td>19.80</td>
<td>HS</td>
</tr>
<tr>
<td>Santa Clara</td>
<td>8.76</td>
<td>21.93</td>
<td>HS (C)</td>
<td>Santa Clara</td>
<td>51.55</td>
<td>0.00</td>
<td>HS (C)</td>
</tr>
</tbody>
</table>

Table 2 - Reproduction factor (RF), percentage of the reproduction (%R) and suitability of 12 tomato accesses to Meloidogyne incognita race 3 or \(M. \) javanica.

¹HS = highly susceptible, SU = susceptible, LR = low resistant, MR = moderately resistant, RE = resistant, HR = highly resistant, IM = immune, C = control.
Literature Cited


