Evaluation of Brinjal Cultivars (Solanum Melongena) Against Root-Knot Nematode Meloidogyne Spp.

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Abstract

An experiment on screening trial was set in the net house of the Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh with seeds of thirteen different brinjal cultivars namely BARI Begun-7, BARI Begun-9, BARI Begun-10, BARI Begun-4, Tobla, BARI Begun-5, Irri, Deshi, Mollika, BARI Begun-1, Khotkhotia, Shingnath varieties were screened as highly susceptible varieties. BARI Begun-1, Khotkhotia, Shingnath varieties were screened as susceptible where number of egg mass/root were 208.60, 161.00, 143.20, number of egg/egg mass were 186.10, 238.60, 503.20, total no of egg mass/root system (x10³) were 39.35, 35.88, 31.65, no of J2/4kg soil were 25.60, 18.00, 17.20, total no of population/pot (x10³) were 29.53, 20.67, 24.37 and RF were 29.53, 20.67, 24.37. One brinjal verity Uttora was found mordarately resistant, three verities BARI Begun – 1, Khotkhotia and Shingnath were exhibited susceptible, nine varieties BARI Begun -7, BARI Begun -9, BARI Begun -10, BARI Begun -4, Tobla, BARI Begun -5, Irri, Deshi and Mollika were found to be highly susceptible for Meloidogyne species.

Key words: Solanum melongena L; Meloidogyne; Root knot, Tolerance, Susceptible

Introduction

The vegetable brinjal, Solanum melongena L. (Solanaceae), is referred to as Bagoon in Bangladesh the second most important vegetable crop next to potato which is typically grown per year in South Asian regions because of weekly harvestable fruits. In Bangladesh root knot may cause up to 27 % loss in fruit yield in brinjal (Bari, 2001). Among the root-knot nematodes (Meloidogyne incognita (Kofoid and white) Chitwood and Meloidogyne Javanica (Kofoid and white) Chitwood) are considered to be the major nemic pests of the crops (Timm and Ameen, 1960; Mian, 1986; Mian and Tsuno, 1988). Root-knot nematode larvae infect plant roots causing the development of giant cells, root galls through hypertrophy and hyperplasia. Infestation of young plants may be lethal, while infection of mature plants causes decrease in growth yield (Stirling et al., 1992). Root knot nematodes cause approximately 5% crop loss globally including advanced countries. In vegetables the loss is very high. Root knot nematode is the most important plant parasitic nematodes in Bangladesh (Timm and Ameen, 1960; Talukder, 1974). At least four species of root knot nematodes are associated in occurring root knot in different crops in Bangladesh. They are Meloidogyne incognita, M. javanica, M. graminicola and M. arenaria among which, M. incognita is most frequently occurring plant parasitic nematode (Mian, 1986). Various researchers have reported the management of root-knot nematode on brinjal and other vegetable crop by many workers (Rekha and Gowda, 2000; Rehman et. al., 2006; Malhotra...
et. al., 2012). Due to worldwide distribution, affinity with other pathogens and serious destruction to vegetables and field crops, it is necessary to find out the most effective and feasible management of root knot nematodes. Among different nematode management strategies, chemical control has proved generally effective (Barker and Koenning, 1998) but being highly expensive, toxic to plants, livestock, soil micro-flora and fauna (Jairajpuri et al., 1990), removal of key nematicides from the market (Veremis and Roberts, 1996) and development of resistance in pathogen against these chemicals, governments today demand environmentally safe chemicals with low toxicity, short term persistence, low mobility to avoid ground water contamination and limited effects on non-target organisms. Therefore, the development and implementation of alternative control strategies are needed.

Methods

The thirteen brinjal verities viz. BARI Begun-7, BARI Begun-9 , BARI Begun-10 , BARI Begun-4, Tobla, BARI Begun-5 , Irri, Deshi, Mollika, BARI Begun-1, Khotkhotia, Shingnath, Uttora to be screened against Meloidogyne spp. Sterilized seed of different verities sown in plot. Germinated seedlings were transferred into earthen pots containing four Kg. sterilized soil. After seven days, freshly hatched J2 larvae inoculated into pots @ 10000 nematode juveniles per plant in the root zone. Uninoculated seedling served as control. Each treatment was replicated five times. The experiment was terminated after 60 days of inoculation. Data Shoot length, Shoot weight (fresh and dry), Root length, Root weight (fresh), Number of leaves/plant, Number of galls/root system, Number of egg masses per root, Number of eggs per egg mass, Number of eggs per root system, Number of juveniles per 100g soil, Number of juveniles and eggs per 4kg soil (per pot), Reproduction factor, Rootknot index (R.K.I) (Bridge and Page; 1980) and host Susceptibility rating (Salawu, 1978) were observed for present investigation.

Host Susceptibility designation

0/no gall, Immune (0), 1-2 gall Resistant (1), 3-10 gall moderately resistant (2), 11-30gall susceptible (3), above 31 gall highly susceptible (4)

Results

In case of number of egg masses per root system, the highest was found in BARI begun-10 (438.40) which was statistically similar with BARI begun-4 (417.60) and the lowest was recorded in Uttora (80.80). Number of eggs/egg mass was found to be the highest in Shingnath (503.20) which was closely followed by BARI begun-10 (293.80) and the lowest number of eggs/egg mass was recorded in Mollika (180.10) preceded by BARI begun-1 (25.60×10^2) and the lowest was in Uttora (12.80). All were statistically similar with each other. The highest total number of nematode population/pot was found to be in BARI begun-5 (272.40×10^2) which was followed BARI begun-4 (269.90×10^2) and the lowest number was in Uttora (13.10×10^3) (Table 3).

Table 1. Influence of brinjal cultivars on number of egg mass/root, number of egg/egg mass, total number of egg/root system, and total number of nematode population/pot of Meloidogyne spp.

<table>
<thead>
<tr>
<th>Brinjal cultivars</th>
<th>Number of egg mass/root</th>
<th>Number of egg/egg mass</th>
<th>Total number of egg/root system (×10^2)</th>
<th>Number of J2/4 kg soil</th>
<th>Number of population/pot (×10^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BARI Begun-7</td>
<td>296.80 bcd</td>
<td>269.90 b</td>
<td>34.12 bc</td>
<td>28.00 a</td>
<td>25.37 abc</td>
</tr>
<tr>
<td>BARI Begun-9</td>
<td>214.20 cdef</td>
<td>202.60 cd</td>
<td>44.03 ab</td>
<td>22.00 a</td>
<td>26.40 abc</td>
</tr>
<tr>
<td>BARI Begun-10</td>
<td>438.40 a</td>
<td>293.80 b</td>
<td>12.94 c</td>
<td>14.00 a</td>
<td>26.94 abc</td>
</tr>
<tr>
<td>BARI Begun-4</td>
<td>417.60 ab</td>
<td>292.50 b</td>
<td>27.43 bc</td>
<td>20.80 a</td>
<td>31.64 a</td>
</tr>
<tr>
<td>Tobla</td>
<td>347.80 abc</td>
<td>260.80 bc</td>
<td>49.89 ab</td>
<td>18.40 a</td>
<td>16.74 de</td>
</tr>
<tr>
<td>BARI Begun-5</td>
<td>306.80 abcd</td>
<td>273.40 b</td>
<td>66.81 a</td>
<td>18.40 a</td>
<td>15.99 de</td>
</tr>
<tr>
<td>Irri</td>
<td>272.40 cde</td>
<td>289.10 b</td>
<td>51.22 ab</td>
<td>26.80 a</td>
<td>16.48 de</td>
</tr>
<tr>
<td>Deshi</td>
<td>183.60 def</td>
<td>245.20 bcd</td>
<td>45.40 ab</td>
<td>14.00 a</td>
<td>20.51 cd</td>
</tr>
<tr>
<td>Mollika</td>
<td>202.00 def</td>
<td>180.10 d</td>
<td>36.67 bc</td>
<td>23.60 a</td>
<td>27.26 abc</td>
</tr>
<tr>
<td>BARI Begun-1</td>
<td>208.60 cdef</td>
<td>186.10 d</td>
<td>39.35 bc</td>
<td>25.60 a</td>
<td>29.53 ab</td>
</tr>
<tr>
<td>Khotkhotia</td>
<td>161.00 def</td>
<td>238.60 bcd</td>
<td>35.88 bc</td>
<td>18.00 a</td>
<td>20.67 cd</td>
</tr>
<tr>
<td>Shingnath</td>
<td>143.20 ef</td>
<td>503.20 a</td>
<td>31.65 bc</td>
<td>17.20 a</td>
<td>24.37 bc</td>
</tr>
<tr>
<td>Uttora</td>
<td>80.80 f</td>
<td>180.80 d</td>
<td>30.17 bc</td>
<td>12.80 a</td>
<td>13.10 e</td>
</tr>
<tr>
<td>LSD</td>
<td>125.7</td>
<td>87.03</td>
<td>24.02</td>
<td>14</td>
<td>6.215</td>
</tr>
</tbody>
</table>
Gall formation in root system of different brinjal cultivars as influenced by incubation of Meloidogyne spp.

While studying the effect of gall formation in root system the highest number of galls was found in Deshi (9.00) and the lowest was recorded in Uttora (2.60). (Figure 5.)

![Figure 5. Gall formation in root system of different brinjal cultivars as influenced by incubation of Meloidogyne spp. Vartical bars represent mean ± Standard Error (SE).](image)

Reproduction factor of Meloidogyne spp as influenced by different brinjal cultivars.

The highest number of reproduction factor was found in BARI begun-4 (31.64) and the lowest was recorded in Uttora (8.24). (Figure 6)

![Figure 6. Reproduction factor of Meloidogyne spp as influenced by different brinjal cultivars. Vartical bars represent mean ± Standard Error (SE).](image)

Reaction of galls formation per root system of different brinjal cultivars as influenced by incubation of Meloidogyne spp.

Host susceptibility designation was determined according to salawu (1986). The greatest number of galls in root system was in Deshi (45.59) followed by BARI Begun-4 (43.3) and the lowest in Uttora (9.81) preceded by Singnath (26.93) (Table 4.).
Table 4. Reaction of thirteen brinjal (Solanum melongena) cultivars to Meloidogyne spp.

<table>
<thead>
<tr>
<th>Brinjal cultivars</th>
<th>No of galls/root system***</th>
<th>Grading of variety</th>
<th>Varietal Reaction***</th>
</tr>
</thead>
<tbody>
<tr>
<td>BARI Begun-7</td>
<td>35.33 cd</td>
<td>4</td>
<td>HS</td>
</tr>
<tr>
<td>BARI Begun-9</td>
<td>34.12 d</td>
<td>4</td>
<td>HS</td>
</tr>
<tr>
<td>BARI Begun-10</td>
<td>42.54 abc</td>
<td>4</td>
<td>HS</td>
</tr>
<tr>
<td>BARI Begun-4</td>
<td>43.3 ab</td>
<td>4</td>
<td>HS</td>
</tr>
<tr>
<td>Tobla</td>
<td>37.26 c</td>
<td>4</td>
<td>HS</td>
</tr>
<tr>
<td>BARI Begun-5</td>
<td>33.8 de</td>
<td>4</td>
<td>HS</td>
</tr>
<tr>
<td>Irri</td>
<td>33.13 de</td>
<td>4</td>
<td>HS</td>
</tr>
<tr>
<td>Deshi</td>
<td>45.59 a</td>
<td>4</td>
<td>HS</td>
</tr>
<tr>
<td>Mollika</td>
<td>35.74 cd</td>
<td>4</td>
<td>HS</td>
</tr>
<tr>
<td>BARI Begun-1</td>
<td>30.28 fg</td>
<td>3</td>
<td>S</td>
</tr>
<tr>
<td>Khotkhotia</td>
<td>30.61 f</td>
<td>3</td>
<td>S</td>
</tr>
<tr>
<td>Shingnath</td>
<td>26.93 fg</td>
<td>3</td>
<td>S</td>
</tr>
<tr>
<td>Uttora</td>
<td>9.81 h</td>
<td>2</td>
<td>MR</td>
</tr>
</tbody>
</table>

*** Averages of 5 replications

Grading of varieties was based on gall index values,
where 0 = No gall = Immune,
1 = 1-2 galls = Resistant,
2 = 3-10 galls = Moderately resistant,
3 = 11-30 galls = Susceptible,
4 = 31 galls and above = Highly susceptible, Salawu (1978).

Discussion

The number of root-galls was significantly increased in brinjal variety Deshi followed by BARI Begun-10, BARI Begun-4 as compared to Uttora that was decreased in brinjal variety Shingnath.

The greater number of egg masses per root system was obtained in brinjal variety BARI Begun-5 followed by Irri and minimum was recorded in BARI Begun-10 respectively. Maximum number of eggs per egg mass was found in brinjal variety Shingnath followed by BARI Begun-10 as compared to Mollika, BARI Begun-1 and Uttora.

Greater number of females, galls and eggs per plant was found in susceptible cultivars inoculated with Meloidogyne spp as compared to moderately resistant cultivars (Roberts and May, 1986). Although Meloidogyne spp multiplied on all brinjal cultivars but there was variability in pathogenicity, which might be due to presence of nematode resistant gene (Hadisoeganda and Sasser, 1982; Roberts and Thomson, 1986). These genes made the plant less attractive for attacking nematodes.

Different plant responses to nematode infection were observed. Compatible and incompatible reactions may be due to the presence of resistant genes which are activated as a result of nematode invasion and some visible reactions can be observed in the plant cells (Williamson, 1999; Davis et al., 2000; Williamson and Kumar, 2006)

Number of J2/4 kg soil was significantly increased in variety BARI Begun-7 followed by Irri, BARI Begun-1 and that were decreased in Uttora.

Rao et al. (1998) found post-penetration of second stage larvae of M. incognita in tomato hybrid FM-2 and Pusa Puby before and after transplanting.

BARI begun-9, Tobla and Deshi was found to be tolerant to the attack of root-knot nematodes. It gave maximum increase in plant height and minimum increase in fresh and dry shoot weight with gall index of (4). The results on the occurrence of Meloidogyne spp in brinjal are inconformity with screening trial of sunflower (Krishnappa & Setty, 1983; Montasser et al., 1985; Zazzerini & Tosi, 1997).

Deshi, BARI Begun-4, BARI Begun-10, Tobla, BARI Begun-7, BARI Begun-9, BARI Begun-5, Irri were highly susceptible with gall index of (4). Khotkhotia, BARI begun-1 and Shingnath were categorized as susceptible on the basis of gall index (3) and Uttora was categorized as Moderately resistant on the basis of gall index (2) (Salawu, 1978).

Naresh Nayak and J. L. Sharma (2013) obtained that among 16 brinjal variety Pusa purple long was recorded highly susceptible having root gall index 5.0. Six verities which showed resistant and moderately resistant to root-knot nematode having root gall index between 0.1 to 2.0 under pot trial. Vijay and Annamalai showed resistant. It was also observed that among the remaining 10 verities were moderately susceptible, susceptible and highly susceptible to root-knot nematode with root gall index between 2.1 to 5.0. Pusa Purple long was reported as slightly susceptible against M.incognita (Haider et al., 2001), Jain et al. (1983) discussed as slightly resistant to M. javanica. Syamala was found moderately resistant by Harinath Naidu et al. (2006). Vijay and Annamalai reported as resistant by many workers (Haider et al., 2001; Nandwana et al., 1980) but discussed as susceptible by many workers (Sharma et al., 1988; Parvatha Reddy et al., 1986).

In the moderately resistant plants nematodes fail to produce enough functional feeding sites in the host after invasion due to hypersensitive responses which leads in failure to develop subsequently as reproducing females (Williamson and Kumar, 2006). Two types of mechanisms for root knot nematode resistance in plants have been reported including pre-infection resistance against root knot nematodes is due to presence of toxic or antagonistic chemicals in root tissue which
prevent the entry of root knot nematodes in roots (Haynes and Jones, 1976; Bendezu and Starr, 2003) while in pots-infection resistance, nematodes penetrate roots but fail to develop. It is often associated with an early hypersensitive reaction due to the death of the cell in root tissue around the nematode. This mechanism prevents the formation of a developed feeding site leading to resistance. Resistant brinjal plants show typical hypersensitive reaction upon a virulent root knot nematode infection (Dropkin, 1969; Williamson, 1999).

It was reported that resistant cultivars have gene of resistance in their gene pool that confers resistance to Meloidogyne spp (Boiteux and Charechar, 1996). In the resistant roots, catalase activity is decreased as a result of root knot nematodes attack. There is a possible role of alkaloids or phenolics that may inhibit the synthesis of these enzymes and act as an elicitor of resistance in plant attacked by Meloidogyne species.

Development and reproduction of Meloidogyne spp was reflected by resistance and susceptibility of the plant (Cook and Evans, 1987; Khan et al., 2004) as our results indicated on cultivar Uttora reproductions factor (Pf/Pf) of nematodes was lowered as compared to other cultivars. This study contributed information on the reaction of various brinjal cultivars to Meloidogyne spp.

The gall index and root weight was not directly related to egg masses. But final population was directly proportional to rate of reproduction (Pathan et al., 2004; Sharma et al., 2005). It was observed that an increase in the inoculum level resulted in a progressive increase in the host infection as indicated by number of galls, gall index and egg masses per root system. The statistical analysis indicated that there was a direct relationship between root gall and production of egg masses. Gall index and total plant fresh weight showed inverse relationship. The nematode multiplication was the maximum at initial inoculum level and then started decreasing at highest inoculums levels. It might be due to the intra specific competition among nematodes for food (Seinhorst, 1961).

The result of the pathogenecity study revealed that Meloidogyne spp suppressed the brinjal growth with the increase in inoculum level and corresponding reduction in the growth. Damage caused by Meloidogyne spp increased by increasing inoculum level so there was increasing plant damage between increasing population and plant growth. In such situations, degree of damage depends upon the susceptibility and tolerance of the host plant (Seinhorst, 1965).

References

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