EVALUATION OF FUSARIUM WILT (RACE 3)—TOLERANT TOMATO LINES

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Additional index words. Lycopersicon esculentum, fruit yield, disease resistance.

Abstract. Four large fruited tomato Lycopersicon esculentum (Mill.) lines, developed at the Gulf Coast Research and Education Center (GCREC) and tolerant to Fusarium wilt caused by F. oxysporum (Schlect.) f. sp. lycopersici (Sacc.) Snyder and Hansen race 3, were compared for yield to susceptible cultivars, ‘Sunny’ and ‘Bonny Best’ and to US 629, a tolerant line obtained from Australia and parent of three of the GCREC lines. All plots were treated with 350 lb/acre of a methyl bromide 67%:chloropicrin 33% fumigant. Two-weeks later, one-half of each plot was infested with race 3 Fusarium and 20 seedlings were transplanted 12 inches apart into each whole plot. One week before the first harvest, the percentages of diseased plants in infested subplots were 15, 10, 50, and 38 for GCREC lines 494, 505, 498, and 510, respectively, as compared to 2.5, 100, and 98% for US 629, ‘Bonny Best’, and ‘Sunny’ respectively. Race 3 reduced total yields of GCREC lines 494, 505, 498, 510 and of US 629, ‘Sunny’, and ‘Bonny Best’ by 9, 12, 25, 0, 69, and 90%, respectively. Total yields from noninfested plots of GCREC lines 494, 505, 498, 510 were as great as yields from noninfested plots of ‘Sunny’ and far superior to yields from noninfested plots of US 629. Also total yields from infested plots of all GCREC lines were much greater than total yields from infested plots of ‘Sunny’ and US 629 or from noninfested plots of US 629. ‘Bonny Best’ yields from noninfested plots were low and from infested plots practically nonexistent. Average fruit sizes from noninfested plots were 3.8, 3.4, 4.1, 3.7, 2.5, 4.3, and 2.3 oz for 494, 505, 498, 510, US 629, ‘Sunny’ and ‘Bonny Best’ respectively. Several of the GCREC race 3-tolerant lines appear to be approaching commercial acceptability and could be released soon as breeding lines for further refinement.

Fusarium wilt of tomato caused by race 3 of the soil-borne fungus, Fusarium oxysporum f. sp. lycopersici was first reported in Australia (1). A few years later it was identified in the Tampa Bay area of Florida (6). A helicopter survey, conducted by the Florida Division of Plant Industry, determined that approximately 27% of the fields in the Manatee-Ruskin area were affected with race 3 (3). In a few fields, the disease was extensive causing up to 80% plant loss (3). However, in most fields disease incidence was minimal.

A breeding program was started immediately to locate resistance and tolerance genes and to incorporate them into breeding lines adapted to Florida’s subtropical climate. Subsequently, race 3-tolerant tomato lines were obtained from Australia (4) and crossed into Florida lines. This resulted in the development of several large-fruited race 3 wilt-tolerant lines, four of which were evaluated, along with US 629 (the tolerant Australian parent of three of them) and two susceptible cultivars (‘Sunny’ and ‘Bonny Best’), for yield, fruit size, and disease reaction when grown in race 3-infested and noninfested soil.

Material and Methods

The seven tomato lines and cultivars used in the Spring 1987 experiment included four tolerant GCREC lines (494, 505, 498, 510); US 629, a tolerant line obtained from Australia (5); and two susceptible cultivars, ‘Sunny’ and ‘Bonny Best’. GCREC lines 494, 505, and 498 were derived from US 629; GCREC line 510 was derived from BTN 472, another tolerant line obtained from Australia (5).

A split plot design was used with four replications: whole plots consisted of tomato lines, subplots of infestation procedure. All plots of Myakka fine sand were treated with 350 lb./acre of a methyl bromide 67%:chloropicrin 33% fumigant and immediately covered with 1 mil black polyethylene mulch. Two weeks later, one-half of each whole plot was infested with race 3, the remaining half plot was not infested. The next day 20 seedlings were transplanted 12 inches apart into each whole plot (10 plants/subplot). The race 3 Fusarium used to infest the soil was cultured 10 days at 82°F on vermiculite saturated with a liquid medium high in ammoniacal nitrogen and micro-nutrients (2). One-hundred ml of the race 3-infested vermiculite, containing approximately 90 million microspores, were added to each of 10 plant holes per whole plot. Seedlings of the seven tomato lines were raised in container trays and transplanted to the field 3 Mar. 1987. Raised 6 inch high beds, 30 inches wide, on 4.5 ft centers, were fertilized with 1850 lbs./acre of 18-0-21-1.2 N-P-K-Mg distributed in 2 bands 18 inches apart. The full bed was dressed with 18-0-21-1.2 N-P-K-Mg at 329 lb./acre and super-phosphate (0-8.7-0 plus FN 503 oxide micronutrients at 80 lb./ton) at 600 lb./acre. Standard pest control practices were used except that no chemicals were applied for leafminer control.

All plants were examined weekly for Fusarium wilt symptoms, starting 24 Mar. 1987 and continuing to 19 May. However, only the 19 May 1987 data are presented. Plants of all lines were harvested mature green three times starting 28 May and ending 9 June 1987. An analysis of variance was performed on all data presented and means were separated by calculating a least significant mean difference.

Results and Discussion

One week before the first harvest, the percentages of wilt-diseased plants in infested subplots were 15, 10, 50, and 38 for GCREC lines 494, 505, 498, and 510, respectively (Table 1). Only 2.5% of the plants of US 629 (tolerant line from Australia) were diseased, whereas 100% and 98% of the ‘Bonny Best’ (susceptible) and ‘Sunny’ (susceptible) plants, respectively, were diseased. At this time, none of the plants of GCREC 494, 505, 498, and US 629 in noninfested soil exhibited wilt symptoms and only 2.5%
Table 1. Effect of Fusarium oxysporum f. sp. lycopersici race 3 on the incidence of Fusarium wilt, total fruit weight, and fruit size of several tomato stocks.

<table>
<thead>
<tr>
<th>Tomato stock</th>
<th>Race 3 reaction</th>
<th>% Fus. wilt</th>
<th>Total yield (lb.)</th>
<th>Avg fruit size (oz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Non-infest.</td>
<td>infest.</td>
<td>Non-infest.</td>
</tr>
<tr>
<td>GCREC 494</td>
<td>Tol.</td>
<td>0.0</td>
<td>15.0</td>
<td>355.8</td>
</tr>
<tr>
<td>GCREC 505</td>
<td>Tol.</td>
<td>0.0</td>
<td>10.0</td>
<td>349.5</td>
</tr>
<tr>
<td>GCREC 498</td>
<td>Tol.</td>
<td>0.0</td>
<td>50.0</td>
<td>300.0</td>
</tr>
<tr>
<td>GCREC 510</td>
<td>Tol.</td>
<td>2.5</td>
<td>37.5</td>
<td>398.4</td>
</tr>
<tr>
<td>US 629</td>
<td>Tol.</td>
<td>0.0</td>
<td>2.5</td>
<td>94.5</td>
</tr>
<tr>
<td>Sunny</td>
<td>Susc.</td>
<td>7.5</td>
<td>97.5</td>
<td>395.3</td>
</tr>
<tr>
<td>Bonny Best</td>
<td>Susc.</td>
<td>92.5</td>
<td>100.0</td>
<td>44.2</td>
</tr>
<tr>
<td>LSD .05</td>
<td></td>
<td>10.1</td>
<td>10.1</td>
<td>56.0</td>
</tr>
</tbody>
</table>

In general, the greater the incidence of Fusarium wilt, the greater the fruit loss in weight. This loss was not directly linear, however. A 50% disease incidence with GCREC 498 resulted in only a 25% yield loss, whereas a 100% disease incidence in 'Bonny Best' resulted in a 90% yield loss. Diseased plants of 'Bonny Best' were much more severely affected by race 3 than were plants of any of the GCREC lines. Fruit size was not adversely affected in regard to any of the tolerant lines although 50% and 37.5% of the GCREC lines 498 and 510, respectively, were diseased in infested plots.

These results clearly demonstrate that the yields of 'Sunny' in weight and size were greatly reduced by Fusarium wilt caused by race 3. Many growers have expressed the opinion that race 3 did not materially reduce yields and that the disease was of little concern. However, race 3 can and does result in serious economic loss and growers should adopt practices that will prevent its spread and reduce its severity.

Without doubt several of the GCREC race 3-tolerant lines are approaching commercial acceptability and could be released soon as breeding lines for further refinement.

**Literature Cited**