

Response of cultivars and breeding lines of *Lycopersicon* spp. to *Septoria lycopersici*

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From 1987 to 1992 more than 700 tomato cultivars, breeding lines, and accessions of related species, were evaluated for resistance to septoria leaf spot, caused by *Septoria lycopersici* Speg. The levels of resistance for selected test lines are reported here.

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Entre 1987 et 1992, plus de sept cents cultivars de tomate, lignées généalogiques et d'obtentions d'espèces apparentées ont été évalués pour leur résistance à la tache septorienne causée par le pathogène *Septoria lycopersici* Speg. Les niveaux de résistance de ces lignées sélectionnées figurent dans ce rapport.

Introduction

Septoria leaf spot of tomato (*Lycopersicon esculentum* Mill.) has been, and continues to be, an important disease in eastern Canada and the United States (MacNeill, 1950; Ferrandino and Elmer, 1992). While fungicides have been routinely used to control this and other foliar fungal diseases of tomato (Brammall, 1993), there is increasing interest in reducing the dependence on agricultural chemicals because of concern for environmental quality. Development of cultivars resistant to septoria leaf spot and their use in commercial tomato production would be the most effective means of controlling this disease.

Moderate resistance to septoria leaf spot, which is controlled by a single dominant gene, has been identified in *L. pimpinellifolium* (Jusl.) Mill. line, PI 422397 (Barksdale and Stoner, 1978). Resistance from this line, however, has not been incorporated into any commercially grown cultivar due to its moderate level and association with small fruit size and lateness. The identification of other sources of resistance could provide a broader genetic base to facilitate the development of resistant cultivars. This report contains the results from a series of screening trials which evaluated more than 500 tomato breeding lines, accessions, and cultivars, along with more than 200 wild species accessions or interspecific breeding lines for resistance to septoria leaf spot.

Materials and methods

Each year 80 to 180 selected lines were screened for resistance in a greenhouse chamber similar to that described by Gardner (1990) for screening for early blight resistance. For each screening trial 100 plants were sown in a checkerboard design, in 200 cell trays (Plastomer, Co., Barrie, Ont.) to facilitate inoculation and disease rating.

Twenty plants per line were evaluated in each of two to four replications. A susceptible control, Heinz 2653, was sown at both ends of each tray to serve as a spreader. Inoculum (10^6 spores/mL water) was prepared as previously described (Tu and Poysa, 1990). When the plants were 4-5 weeks old, the last fully expanded leaf was rubbed between thumb and forefingers to break foliar trichomes and reduce surface tension of epicuticular wax, permitting uniform spread of the spore suspension on the leaf surface. Inoculum was sprayed on to run-off, and the leaves were rubbed again. The plants were placed in a plastic-covered chamber and were intermittently misted by a cool-mist humidifier to maintain near 100% relative humidity. From the second to the fifth day after inoculation, the plastic sides of the chamber were raised and the humidifier turned off for a 12 hour light period to allow the plants to dry during the day. The high humidity regime was reestablished each night. Disease reaction was determined 7-10 days after inoculation, based on the size and number of lesions on the inoculated and adjacent leaves. Disease severity was rated on a 1 to 9 scale: 1=asymptomatic; 2=few small lesions; 3=moderate number of small lesions; 4=several small lesions, <10% leaf infected; 5=10-20% leaf infected; 6=21-50% leaf infected; 7=51-80% leaf infected; 8=81-99% leaf infected; 9=plant dead.

A score of 1 to 3.9 represents a high level of resistance: plants with this level of resistance would not develop the disease in the field. A score of 4.0 to 5.9 represents a moderate level of resistance: plants with this level of resistance would not normally suffer yield losses due to septoria leaf spot in the field. Scores from 6.0 to 9.0

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represent moderate to high levels of susceptibility. Any material rated resistant (disease rating < 6) was reevaluated to verify the level of resistance. Data reported in the tables are averages over all tests in which each line occurred.

Results and discussion

The levels of resistance to septoria leaf spot for the commercial cultivars evaluated all exceeded 7.0, indicating that these materials were quite susceptible to the pathogen (Table 1). Several breeding lines and plant introductions had disease ratings between 4.0 and 5.9 and thus had moderate levels of resistance, suggesting that these could be used by breeders in developing resistant cultivars. Several of these lines had levels of resistance similar to the previously reported (Barksdale and Stoner, 1978) *L. pimpinellifolium* line, PI422397, combined with improved fruit size and fruit yield, relative to PI422397. The majority of Harrow (HRS) *L. esculentum* breeding lines evaluated were rated >5.0 and have not been reported.

The disease severity rating for twenty-two accessions of related species, especially *L. hirsutum* and *L. peruvianum*, were between 2.0 and 3.9, indicating that they were more resistant than PI422397 (Table 2). In addition, useful levels of resistance were also found in *L. pennellii*, *L. pimpinellifolium*, *L. chilense*, and *L. esculentum* var. *cerasiforme*. Although the most resistant lines were accessions of *L. hirsutum* and *L. peruvianum*, some lines of these species were moderately to highly susceptible.

High levels of resistance were retained in six interspecific breeding lines with *L. hirsutum* accessions (Table 3). These six lines, however, had one or more undesirable agronomic

traits, such as being indeterminate, late maturing, and relatively low yielding. Thirty-one interspecific breeding lines derived from several wild species exhibited moderate levels of resistance with ratings between 4.2 and 5.5, indicating that they might be potential sources of resistance for breeding programs. The more than 100 interspecific breeding lines from the Harrow program (HRS lines) with disease ratings over 6.0 are not reported.

These results suggest that the testing procedures can provide an estimate of resistance to septoria leaf spot in a range of plant material currently available for commercial development. The results also provide information on sources of resistance that could be useful to breeders and seed companies in their development of tomato cultivars resistant to septoria leaf spot.

Literature cited

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Table 1. Response of *L. esculentum* breeding lines, accessions, and cultivars to *Septoria lycopersici* infection.

Disease Severity Rating' (1-9 scale)	Line ²
1.0 - 1.9	
2.0 - 2.9	
3.0 - 3.9	
4.0 - 4.9	PI111406, HRS84-297, HRS84-303, HRS84-311, HRS84-312, HRS84-316, HRS84-317, HRS84-319, HRS84-314, HRS85-261, HRS85-271, HRS85-282
5.0 - 5.9	PI372364, PI427149, PI438875, PI97321, PI262892, PI270418, PI312188, PI452027
6.0 - 6.9	PE-58, PE-59, PE-60, PI142698, PI201266, PI268407, PI309690, PI311115, PI311279, PI270407, PI270149, PI414164
7.0 - 7.9	Ohio 832, Ohio 8245, FM6203, PE-57, PI270403,
8.0 - 8.9	Purdue 812, Heinz 2653, Ohio 7814, TH 318, PI201476
9.0	

¹ Based on a 1-9 scale, where 1=asymptomatic; 2=few small lesions; 3=moderate number of small lesions; 4=several small lesions, <10% leaf infected; 5=10-20% leaf infected; 6=21-50% leaf infected; 7=51-80% leaf infected; 8=81-99% leaf infected; 9=plant dead.

² PI lines obtained from the Plant Introduction Station, USDA, Geneva, N.Y.; HRS lines from V. Poyasa, Agriculture Canada, Harrow Research Station, Harrow, Ontario; PE lines obtained from Dr. J. Cuartero, CSIC, Malaga, Spain.

Table 2. Response of related *Lycopersicon* spp. to *Septoria lycopersici* infection.

Disease Severity Rating' (1-9 scale)	Line ^{2*}
1.0 - 1.9	
2.0 - 2.9	LA2100 ^a , LA2650 ^a , LA2204 ^a , PE-36 ^a , LA1675 ^b , LA1360 ^b , PI251307 ^b , PE-33 ^b , PI270435 ^b , PI390655 ^b , PE-44 ^b
3.0 - 3.9	LA1366 ^a , LA2124 ^a , LA1910 ^b , LA1292 ^b , LA1304 ^b , LA1365 ^b , LA255 ^a , PI128654 ^b , PI390671 ^b , PI365951 ^b , PE-32 ^b
4.0 - 4.9	PI422397 ^d , PI365934 ^a , PE-34 ^a , PI390513 ^a , PI251305 ^a , PI415127 ^b , LYCA/66 ^d , PE-8 ^d , PE-12 ^d , PE-22 ^b , PE-31 ^b , PE-48 ^b , PE-49 ^b , LA1723 ^b , PI306811 ^b , LA1960 ^e , LA2404 ^e , LA1983 ^b
5.0 - 5.9	PE-3 ^d , PE-14 ^d , PE-47 ^c , PE-64 ^f , PE-69 ^f , PE-78 ^f , LA1929 ^b , LA2326 ^b , LA2573 ^b , LA2581 ^b
6.0 - 6.9	PE-2 ^d , PE-63 ^f , PI379014 ^a , PI390667 ^b , PI438880 ^f , PI438888 ^f
7.0 - 7.9	PE-73 ^f , LA751 ^c , LA1299 ^c , LA1303 ^c , PI129144 ^b , PI375937 ^d
8.0 - 8.9	LA1920 ^c , PI251312 ^b , PI379017 ^b , PI308183 ^b
9.0	

¹ Based on a 1-9 scale, where 1=asymptomatic; 2=few small lesions; 3=moderate number of small lesions; 4=several small lesions, <10% leaf infected; 5=10-20% leaf infected; 6=21-50% leaf infected; 7=51-80% leaf infected; 8=81-99% leaf infected; 9=plant dead.

² LA lines obtained from Dr. C. Rick, Tomato Genetics Resource Center, Davis, California; PI lines obtained from the Plant Introduction Station, USDA, Geneva, N.Y.; PE lines obtained from Dr. J. Cuartero, CSIC, Malaga, Spain.

* Superscripts following each line indicate the species: ^a *L. hirsutum*; ^b *L. peruvianum*; ^c *L. pennellii*; ^d *L. pimpinellifolium* ^e *L. chilense*; ^f *L. esculentum* var. *cerasiforme*.

Table 3. Response of interspecific hybrids to *Septoria lycopersici* infection.

Disease Severity Rating ¹ (1-9 scale)	Line ^{2*}
1.0 - 1.9	
2.0 - 2.9	HRS90-189 ^a , HRS90-301 ^a , HRS90-303 ^a
3.0 - 3.9	HRS90-304 ^a , HRS90-305 ^a , HRS90-306 ^a
4.0 - 4.9	HRS84-305 ^b , HRS84-307 ^b , HRS84-308 ^b , HRS85-262 ^b , HRS85-266 ^b , HRS85-267 ^b , HRS85-268 ^b , HRS85-278 ^b , HRS86-212 ^b , HRS88-368 ^c , HRS88-376 ^a , HRS88-378 ^d , HRS88-350 ^e , HRS88-354 ^e , HRS88-358 ^e , HRS88-353 ^f , HRS88-372 ^f , HRS88-365 ^d , HRS88-370 ^g , HRS88-373 ^e , HRS88-364 ^d , HRS90-108 ^a , HRS90-109 ^a , HRS90-302 ^a , HRS90-307 ^a , HRS-SRPR-1 ^c
5.0 - 5.9	PI298934 ^c , HRS86-207 ^b , HRS88-357 ^g , HRS88-155 ^b , HRS88-366 ^d
6.0 - 6.9	
7.0 - 7.9	
8.0 - 8.9	
9.0	

¹ Based on a 1-9 scale, where 1=asymptomatic; 2=few small lesions; 3=moderate number of small lesions; 4=several small lesions, <10% leaf infected; 5=10-20% leaf infected; 6=21-50% leaf infected; 7=51-80% leaf infected; 8=81-99% leaf infected; 9=plant dead.

² PI lines obtained from the Plant Introduction Station, USDA, Geneva, N.Y.; HRS lines from V. Poysa, Agriculture Canada, Harrow Research Station, Harrow, Ontario.

* Superscripts following each line indicate the related species involved in the cross: ^a *L. hirsutum*; ^b *L. pimpinellifolium*; ^c *L. peruvianum*; ^d *pimpinellifolium/hirsutum*; ^e *L. pennellii*; ^f *L. esculentum* var. *cerasiforme*; ^g *peruvianum/pimpinellifolium*.