Ontogenetic Predisposition of Tomato Foliage to Race O of Phytophthora infestans

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ABSTRACT

Seven resistant and six susceptible tomato lines were tested for reaction to *Phytophthora infestans* (tomato race O) at five dates, 43 to 99 days after planting, and three leaf positions, using detached leaves and standard inoculum concentrations. Lines showed greatest susceptibility in the youngest plants. Resistance in resistant plants increased with maturity. Susceptible lines were least susceptible at an intermediate stage of growth, after which susceptibility tended to increase slightly. Lower leaves of a given plant were most susceptible and the upper leaves were most resistant.

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Additional key words: physiological plant age, epidemiology, chronological plant age.

Late blight caused by *Phytophthora infestans* (Mont.) de Bary is a destructive disease of both tomato (*Lycopersicon esculentum* Mill.) and potato (*Solanum tuberosum* L.). The potato has stages of susceptibility that differ from emergence to maturity (2, 6). Young and old plants show high susceptibility, whereas plants of intermediate age show reduced susceptibility (2). Within the same plant, the lower leaves are the most susceptible with resistance increasing in an acropetal direction (4, 5). Similar work has not been done with tomatoes, but some evidence suggested that plants decrease in resistance during senescence (11). The present experiment was conducted to determine if resistance to race O of *P. infestans* in tomatoes was influenced by either leaf position or stage of growth.

MATERIALS AND METHODS.—Greenhouse experiments were conducted using six susceptible lines (*ph* gene) and seven resistant lines (*Ph* gene) hypersensitive to tomato race O (9). Plants were sown on five dates at 2-week intervals starting 4 May. Three plants per genetic line per sowing date were transplanted into 18-cm diameter pots. The pots were arranged in a split-split plot design. Treatments were replicated three times. Disease reaction was assessed using detached leaves (8). Leaf sampling was repeated on five occasions 43 to 99 days after planting. At each sampling, a single leaflet was taken from the top, middle, and bottom sections of each plant. Inoculum was produced from 21-day-old cultures of *P. infestans* growing on sterilized wheat seed. The inoculum was kept at 10 C for 5 hours prior to inoculation to promote zoospore formation. Approximately 940 viable sporangia/cm^2 were applied to the upper surface of detached leaves with an atomizer. The leaves were incubated 6 days in a humid atmosphere at 21 C. Degree of infection was based on lesion size (10) and leaf area infected. Area infected was assessed, using an adaptation of the British Mycological Society key (1).

Results were analyzed statistically using a combined analysis of variance; treatment means were compared by means of an L.S.D. at $P = 0.05$.

RESULTS.—Measurements of susceptibility by leaf area infected and lesion size showed very close agreement.

Consequently, all results are expressed only in terms of mean class for area of the leaf infected.

Physiological plant age.—Irrespective of the chronological age, lines increased in resistance from the lower to the upper leaves, with the top leaves showing the greatest resistance (Fig. 1). These differences were consistent and significant for both resistant and susceptible lines. Differences in resistance among the three leaf positions on the resistant plants were small. Large differences were observed among leaf positions on the susceptible lines, with the lower leaves having more than five times the necrotic area of the upper leaves.

Chronological plant age.—Resistant lines showed a consistent decrease in the necrotic area with increasing maturity (Fig. 2). Greatest resistance was found in the older plants and greatest susceptibility in the youngest plants. The extent of the difference between the most resistant and the most susceptible plants was small, but significant. This small variation in susceptibility is consistent with expectations for resistant plants.

Among the susceptible lines, greatest susceptibility was also observed in the youngest plants. There was a significant decrease in susceptibility as the plants became older, with maximum resistance being observed in the 71-day-old plants (Fig. 2). Further increase in age tended to increase susceptibility once more, but this trend was not significant. In general, the period of maximum resistance coincided with the period of initial fruit set.

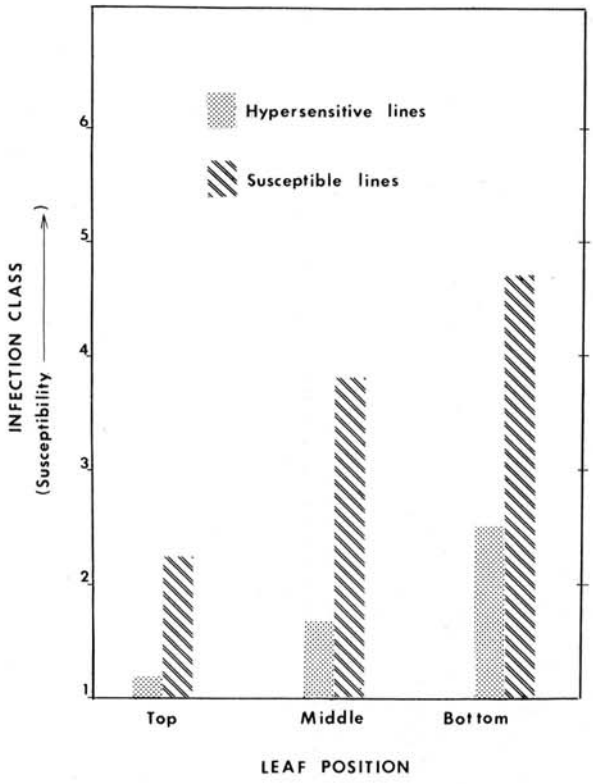

Fig. 1. Influence of leaf position on susceptibility of detached tomato leaves to infection with *Phytophthora infestans* in resistant and susceptible lines. Mean of five chronological ages. Infection classes are: 1 = 0%, 2 = 0.1-1%, 3 = 2-5%, 4 = 6-25%, 5 = 26-50%, 6 = 51-75%, and 7 = 76-100% of leaf area necrotic.

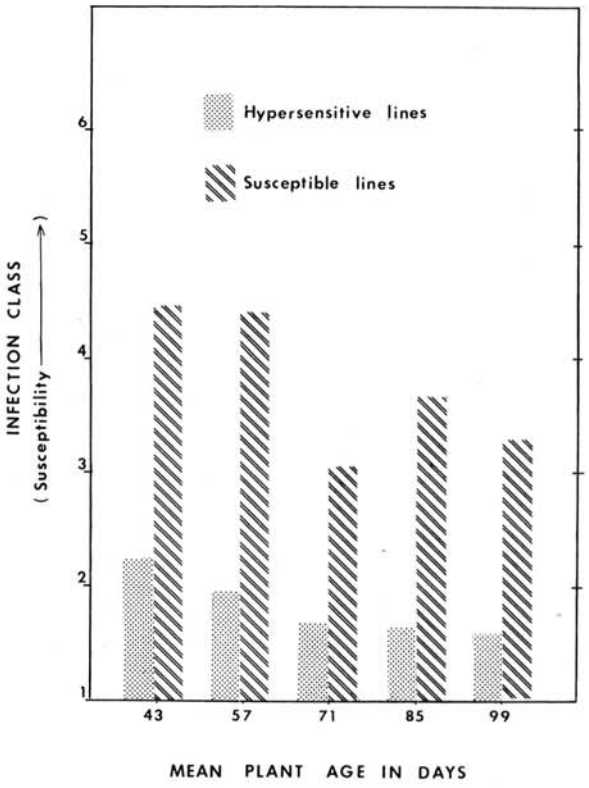

Fig. 2. Influence of plant age on susceptibility of detached tomato leaves to infection with *Phytophthora infestans* in resistant and susceptible lines. Mean of three leaf positions. Infection classes are: 1 = 0%, 2 = 0.1-1%, 3 = 2-5%, 4 = 6-25%, 5 = 26-50%, 6 = 51-75%, and 7 = 76-100% of leaf area necrotic.

DISCUSSION.—The decreased resistance of physiologically older leaves was similar to results obtained from experiments with potato (3, 4, 5). Differences in resistance among leaf positions were observed at all stages of growth and in all genetic lines.

In susceptible lines there was a significant decrease in susceptibility with the onset of fruiting, with no significant increase in susceptibility on further aging. The pattern of susceptibility in tomatoes seems similar to that of potatoes at young and intermediate stages of growth. However, our results show that in the later stages of growth, susceptible tomato lines do not increase in susceptibility to the same extent generally reported for the potato (2, 7). In the field, epidemiological factors, such as inoculum potential and climatic conditions, could result in larger susceptibility ratings at the end of the growing season than those we obtained.

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