Short Communication

Foliar Reaction to *Phytophthora infestans* in Inoculated Potato Field Trials in Michigan

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ABSTRACT

Late blight, caused by *Phytophthora infestans*, is the most important disease of potato worldwide and foliar resistance is an important component of managing late blight in the field. The objective of this research was to identify germplasm for use in breeding cultivars with foliar resistance to *P. infestans*. More than 500 clones were tested from 1997 to 2002 in inoculated (US8 genotype) field experiments conducted at the Michigan State University Muck Soils Research Farm in Bath, Michigan. All of the current commercial cultivars tested were classified as susceptible to *P. infestans*. The most resistant clones were A90586-11, AWN86514-2, B0718-3, Jacqueline Lee (MSG274-3), MSI152-A, MSJ307-2, MSJ317-1, MSJ453-4Y, MSJ456-2, MSJ456-4, MSJ461-1, MSK101-2, MSK128-1, NY121, LBR8, LBR9, Tollocan, and Torridon. Some of these resistant selections were from crosses with B0718-3, Jacqueline Lee, and Tollocan suggesting that the resistance to *P. infestans* was transmissible. These resistant clones will provide the opportunity to breed late-blight-resistant cultivars from a diverse pool of cultivated germplasm. Consistent foliar reaction to *P. infestans* over years suggested that the Michigan State University Muck Soils Research Farm is a valuable location for North American breeders to assess the reaction of potato germplasm to the US8 genotype of late blight.

INTRODUCTION

Potato late blight, caused by *Phytophthora infestans* (Mont.) de Bary, re-emerged in the mid-1980s and 1990s as a threat to cultivated potato (*Solanum tuberosum* L.) production (Fry and Goodwin 1997). The most prevalent genotype of *P. infestans* in the USA is currently US8 (Fry and Goodwin 1997); however, genotypes such as the original, metalaxyl-sensitive US1 and the metalaxyl-resistant US11 also are found, particularly in California, Washington, and Oregon (Dorrance and Inglis 1998). Currently, in the eastern USA, the US8 genotype dominates, although US11 was identified in Michigan in 1996 (Kirk unpublished data) and US17 in 1997 (Mayton et al. 2000).

One of the major goals of potato-breeding programs is to introduce new market-quality cultivars with levels of late blight resistance that exceed what is currently available (Douches et al. 1998). These cultivars also must possess agronomic qualities such as high yield, early or moderate maturity, unblemished internal flesh, high specific gravity, and be attractive in appearance (Dean 1994).

Field screening can be an effective method to evaluate foliar reaction to *P. infestans*. The Muck Soils Research Farm, located at Bath, Michigan, is the designated location for potato late blight research at Michigan State University (Figure 1). This location has been an ideal testing site for foliar reaction to *P. infestans* because (1) of its isolation from potato-production regions, (2) of a humid microclimate that is conducive to the development and spread of late blight disease, and (3) of consistent *P. infestans* infection levels over years. The purpose of this paper is to report on six years of evaluating foliar reaction to *P. infestans* in advanced potato germplasm.

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ADDITIONAL KEY WORDS: *Solanum tuberosum*, late blight
(advanced breeding clones and cultivars) from various potato breeding programs using the US8 genotype of *P. infestans*.

**MATERIALS AND METHODS**

**Germplasm**

More than 500 clones were evaluated between 1 and 6 years. The germplasm included (1) clones from National Late Blight Trial (Haynes et al. 1998); (2) susceptible commercial cultivars; (3) European cultivars with reported resistance to late blight; (4) advanced breeding clones from North American university breeding programs; and (5) International Potato Center (CIP) R gene-free late-blight-resistant selections obtained from the NRSP-6 US Potato Genebank, Sturgeon Bay, Wisconsin.

**Preparation of *P. infestans Inoculum***

Isolates of *P. infestans* were collected from foliar tissue sent by growers to the Michigan State University Late Blight Pathology Laboratory for examination. Michigan *P. infestans* isolates 95-7, 97-2, 98-2, 99-9, 00-4 (all US8, A2 mating type, insensitive to metalaxyl [Goodwin et al. 1995]) were maintained on rye agar at 18 C. These Michigan isolates, used for inoculation in each year of the field study, overcame R genes either alone, or in combination (Table 1), as determined in laboratory detached-leaf tests (data not shown). A zoospore suspension of the selected isolates of *P. infestans* was prepared from cultures grown for 14 days on rye agar plates (Deahl et al. 1995) in the dark at 18 C. Prior to inoculation, the concentration was adjusted to $1 \times 10^6$ zoospores mL$^{-1}$ based on hemacytometer readings. The inoculum suspension was administered (100 mL 7.5 m$^{-1}$ row) through the field's irrigation system in late July (See Table 1 for inoculation dates).

**Field Evaluation**

Field tests were conducted from 1997 to 2002 at the Michigan State University Muck Soils Research Farm, Bath, Michigan. Planting date, inoculation date, and trial size are summarized in Table 1. Advanced breeding clones and cultivars were arranged in a randomized complete block design with three replications. Each 1.5-m plot contained four plants at 30-cm spacing, with eight plots per row. Following inoculation, plants were mist-irrigated frequently with a sprinkler system to prevent foliage from drying and to promote humidity within the canopy.

Percent foliar infection was visually assessed every 2 to 4 days following inoculation. Each year the evaluations continued for 28 to 39 days, concluding when the susceptible lines reached 100% infection. To compare the reactions of the potato lines across years, the relative area under the disease progress curve (RAUDPC) was calculated for each line.

**FIGURE 1.**

Michigan State University Muck Soils Research Farm, Bath, Michigan, (star) shown in relation to major potato production areas in the state. Counties with 1000 acres of potato production (2000-2001 mean acres planted, NASS) or greater are shaded.

**TABLE 1—Overview of late blight field trial experiments conducted at the MSU Muck Soils Research Farm, Bath, MI.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Planting date</th>
<th>Date of inoculation</th>
<th>No. of clones evaluated</th>
<th>Length of rating period (days)</th>
<th>Isolates used and avr genes absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>3 June</td>
<td>23 July</td>
<td>170</td>
<td>33</td>
<td>95-7*, 1, 2, 3, 4, 5, 6, 7, 10, 11</td>
</tr>
<tr>
<td>1998</td>
<td>5 June</td>
<td>22 July</td>
<td>150</td>
<td>28</td>
<td>95-7, 97-2, 1, 2, 3, 4, 5, 8, 11</td>
</tr>
<tr>
<td>1999</td>
<td>27 May</td>
<td>22 July</td>
<td>170</td>
<td>28</td>
<td>95-7, 98-2, 1, 2, 3, 4, 5, 7, 10, 11</td>
</tr>
<tr>
<td>2000</td>
<td>9 June</td>
<td>26 July</td>
<td>214</td>
<td>39</td>
<td>95-7, 99-9, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>2001</td>
<td>14 June</td>
<td>28 July</td>
<td>206</td>
<td>34</td>
<td>95-7, 00-4, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11</td>
</tr>
<tr>
<td>2002</td>
<td>7 June</td>
<td>26 July</td>
<td>160</td>
<td>36</td>
<td>95-7, 1, 2, 3, 4, 5, 6, 7, 10, 11</td>
</tr>
</tbody>
</table>

* 95-7 used each year. The avr genes of additional isolates are described.