Host Range of a Taiwanese Isolate of *Peronosclerospora sacchari*

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ABSTRACT

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Sixty-six plant species representing 31 genera within eight grass tribes were tested for susceptibility to systemic infection after conidial inoculation with an isolate of *Peronosclerospora sacchari* from Taiwan. All susceptible species were members of the genera *Andropogon* (two species), *Bothriochloa* (five species), *Eulalia* (one species), *Saccharum* (one species), *Schizachyrium* (four species), and *Sorghum* (two species) of the tribe Andropogoneae; and *Tripsacum* (one species) and *Zea* (one species) of the tribe Maydeae. Not all species tested in these genera were susceptible, and in many instances only a small percentage of the plants of a susceptible accession became infected. Some susceptible species are common perennial grasses in the continental United States. These, and perhaps other closely related plants, might allow *P. sacchari* to overwinter if the pathogen were to spread to the United States. Oospores were not detected.

Additional key words: downy mildew, maize, *Sclerospora sacchari*, sugarcane

Sugarcane downy mildew of sugarcane (*Saccharum officinarum* L.) and sugarcane downy mildew of maize (*Zea mays* L.), both caused by *Peronosclerospora sacchari* (T. Miyake) Shirai & K. Hara (= *Sclerospora sacchari* T. Miyake), have never been reported in North America but have been serious diseases in southeastern Asia. In Taiwan in 1964, 70% of the popular maize variety Tainan No. 5 grown in the Chiayi-Tainan area was affected (11). Since 1964, sugarcane downy mildew on these crops has decreased markedly, primarily because of the development of resistant sugarcane and maize varieties. However, maize varieties currently grown in the United States are highly susceptible to *P. sacchari*, and American breeding lines that are highly resistant to *P. sorghi* in the United States are highly susceptible to *P. sacchari* (Bonde, *unpublished*).

The reported host range for *P. sacchari* is narrow. Besides maize and sugarcane (8), *P. sacchari* has been reported to infect only *Euchlaena mexicana* Schrad. (= *Zea mays* L. *mexicana*) (8), *Saccharum barberi* Jeswiet (4), *S. robustum* Brandes and Jeswiet ex Grassl (4), *S. sinense* Roxb. (4), *Sorghum bicolor* Moench (7,11), *S. vulgare* var. *technicum* (Koern.) Jav. (3), and *Tripsacum dactyloides* L. (3).

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We conducted a host range study to determine whether *P. sacchari* could infect alternative hosts that might act as sources of inoculum. Information from the study, besides having epidemiologic significance for U.S. and foreign agriculture, can help to resolve confusion over the taxonomy of *Peronosclerospora* spp. (1). For the latter purpose, we included plant species that, although not common in the United States, might be useful in differentiating species of *Peronosclerospora*.

MATERIALS AND METHODS

The culture of *P. sacchari* used was isolated in 1975 from infected sugarcane sets from Taiwan. Seeds of test species were planted in pasteurized soil in 10-cm-diameter clay pots. Several days after emergence, seedlings were sprayed with a suspension of conidia (collected by the technique of Schmitt and Freytag [9] from *Zea mays* 'Pioneer 3369A' or 'DeKalb XL43') at 5.0×10^4 conidia per milliliter of suspension, 1 ml/pot of seedlings. A highly susceptible maize hybrid, Pioneer 3369A or DeKalb XL43, was included as a control.

In a separate experiment, sugarcane sets (buds about to break) in 15-cm-diameter clay pots were sprayed with 1 ml of suspension containing 5.0×10^3 conidia per milliliter. Inoculated plants were incubated overnight in a dew chamber (21–22 C) and then placed in a greenhouse (21–27 C) for disease development. All plants were examined for at least 30 days after inoculation and compared with uninoculated controls. Most plants were examined for at least 6 wk and some for several months.

To verify infection, we placed plants with symptoms of systemic infection in dew chambers overnight and later examined their leaf surfaces for the presence of conidia and conidiophores typical of *P. sacchari*. In addition, leaf pieces with systemic symptoms were placed in the whorls of maize seedlings in dew chambers under conditions favorable for sporulation. Plants were incubated overnight, and subsequent disease development in maize confirmed the presence of downy mildew in the other hosts.

Plants lacking systemic symptoms were also placed overnight in dew chambers and examined for conidial formation to verify that they were not infected.

Diseased plants were examined for the presence of oospores. Leaf pieces displaying systemic symptoms were collected from upper, middle, and lower leaves of plants at or near maturity and were fixed in absolute ethanol:acetic acid (2:1, v/v). After at least 18 hr in the fixative, the pieces were cleared 24 hr in lactophenol, stained 24–72 hr with Sudan III in lactophenol (time depending on the specific lot of commercial stain), mounted in lactophenol on glass slides, and observed microscopically.

RESULTS AND DISCUSSION

Sixty-six plant species representing 31 genera within eight grass tribes were tested for their susceptibility to *P. sacchari* following conidial inoculation. In some instances, several accessions of the same species were inoculated. Twenty-two accessions of *Sorghum bicolor* were inoculated, of which 14 developed systemic infection.

All susceptible plant species were in eight genera of the subfamily Panicoideae: *Andropogon, Bothriochloa, Eulalia, Saccharum, Schizachyrium,* and *Sorghum* of the tribe Andropogoneae; and *Tripsacum* and *Zea* of the tribe Maydeae (Table 1). Not all species within these genera were susceptible, and in several instances only a small percentage of the plants of an accession became systemically infected, which indicated low susceptibility to *P. sacchari*. If more individuals of some of the apparently unsusceptible accessions had been tested, one or more plants might have developed systemic infection.

The following plants were not susceptible to systemic infection by *P. sacchari*: *Agrostis canina, A. gigantea, A. stolonifera, A. tenuis, Alopecurus*

Table 1. Plants susceptible to an isolate of *Peronosclerospora sacchari* from Taiwan

Plant species	Susceptibility[a]
Tribe: Andropogoneae	
Andropogon gerardii Vitm.[b]	3/24
Andropogon hallii Hack.	4/15
Bothriochloa hassleri (Hack.) Henrard	16/43
Bothriochloa ischaemum (L.) Keng var. *ischaemum*	28/58
Bothriochloa perforata (Trin. ex Fourn.) Herter	7/84
Bothriochloa springfieldii (Gould) Parodi	19/35
Bothriochloa woodrowii (Hook f.) A. Camus	9/25
Eulalia fulva (R. Br.) Ktze.	3/42
Saccharum officinarum L. 'CP-44-101'	6/43
Schizachyrium cirratum (Hack.) Woot & Standl.	2/14
Schizachyrium hirtiflorum Nees	3/3
Schizachyrium microstachyum (Desv. ex Hamilt.) Roseng., Arr. & Izog.	1/92
Schizachyrium scoparium (Michx.) Nash	2/111
Sorghum[c] *bicolor* (L.) Moench[d]	90/659
Sorghum propinquum (Kunth) Hitchc.	1/46
Tribe: Maydeae	
Tripsacum dactyloides (L.) L.[b]	25/29
Zea mays L. subsp. *mays*	90/91
Zea mays subsp. *mexicana* (Schrad.) Iltis[b]	46/54

[a] Number of plants systemically infected/number inoculated. Susceptibility of each accession was confirmed by observing sporulation on the host and transferring infection to maize.
[b] Two accessions tested.
[c] The taxonomic system described by J. M. J. De Wet (5) was used for species of *Sorghum* section *Sorghum*. This system combined 48 previously separate species with *S. bicolor*.
[d] Fourteen accessions of *Sorghum bicolor* developed systemic infection and the data were pooled.

aequalis, A. pratensis, Calamagrostis canadensis, and *Phleum pratense* of the tribe Agrostideae; *Andropogon distachyus, A. ternarius, A. ternatus, Arthraxon hispidus, Bothriochloa caucasica, B. insculpta* (two accessions), *B. intermedia, B. laguroides, B. odorata, B. radicans, Capillipedium venustum, Heteropogon contortus* (three accessions), *Schizachyrium condensatum, Sorghum* × *almum, S. bicolor* (eight accessions), and *S. halepense* of the tribe Andropogoneae; *Avena fatua, A. sativa,* and *Holcus lanatus* of the tribe Aveneae; *Bouteloua curtipendula, Eleusine indica,* and *Schedonnardus paniculatus* of the tribe Chlorideae; *Bromus erectus, B. inermis, Festuca ovina, F. rubra* subsp. *rubra, Poa compressa, P. nemoralis,* and *P. trivialis* of the tribe Festuceae; *Agropyron cristatum, A. repens, A. sibiricum, Lolium multiflorum, L. perenne,* and *Triticum aestivum* of the tribe Hordeae; *Coix lacryma-jobi* of the tribe Maydeae; and *Digitaria sanguinalis, Panicum miliaceum, P. virgatum, Pennisetum americanum, P. macrourum,* and *Setaria faberi* of the tribe Paniceae.

In these tests, *P. sacchari* had a narrow host range; the pathogen has been reported to infect only plants in the tribes Andropogoneae and Maydeae (3,7,8,11). Nevertheless, it is significant that several species of *Andropogon, Bothriochloa,* and *Schizachyrium* that were susceptible in this study are common perennial forage and wild grasses in the United States (6). Big bluestem (*A. gerardii*) and little bluestem (*S. scoparium*) are perhaps the most prevalent constituents of wild hay in the prairie states (6). These perennial grasses could serve as reservoir hosts for *P. sacchari* if it entered the United States.

Oospores were not detected in leaf tissue of any of the systemically infected plants, even when infected plants were held to maturity. However, the production of oospores in sugarcane has been reported (10). Although we did not detect oospores with this isolate, we have observed them on sugarcane with an isolate of *P. sacchari* from the Philippines.

American maize varieties are highly susceptible to *P. sacchari*, and moisture and temperature conditions in the continental United States are apparently favorable for sporulation and initiation of infection of maize (2). In addition, potential collateral hosts exist in the United States that might allow the pathogen to overwinter in some regions. *P. sacchari* could be a problem to maize production if this pathogen entered the country and became established. Studies are needed to determine the survivability of *P. sacchari* in perennial weeds under winter conditions common in various regions of the United States.

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