Changes in Pathogenicity of *Drechslera teres* Relating to Changes in Barley Cultivars Grown in Western Australia

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ABSTRACT

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Fifty-two isolates of *Drechslera teres* collected since 1976 were tested in the glasshouse on differential barley (*Hordeum vulgare*) cultivars at 20/15 C (day/night) under natural daylight conditions. A new group of isolates was identified that were incapable of attacking Beecher, a previously widely grown cultivar susceptible to *D. teres*. Such isolates have emerged to become the dominant population of the pathogen in less than a decade, presumably in response to changes in the host cultivars grown in Western Australia. The Beecher cultivar had been replaced mainly by the cultivar Dampier, but now the cultivar Clipper, which is resistant to *D. teres*, is the major cultivar being grown in Western Australia.

Pathogenic races in the *Drechslera teres* (Sacc.) Shoem. conidial state of *Pyrenophora teres* Drechsler causing net blotch in barley (*Hordeum vulgare* L.) were first reported by Pon (5). Subsequently, whereas Frecha (8) in Argentina and Roth and Schafer (6) in Indiana failed to detect any pathogenic variation, direct evidence for pathogenic races has been indicated from North Dakota (9), Montana (7), Western Australia (3), and Poland (2) for three to 10 races. Although Afanasenko and Levitin (1) reported 80 races from various regions of the U.S.S.R., they showed that only one race predominated of five that appeared at the end of the growing season. Indirect evidence through comparative examination of reports originating from various countries also reveals differences in the pathogen population (8).

Studies in Western Australia during 1965–1968 (3) identified three pathogenic races on two differential barley host cultivars (Table 1). The commercial cultivars Dampier, Prior, and Beecher were susceptible to all the isolates of *D. teres*. This study reports changes in the pathogencity of the *D. teres* population observed in a similar study conducted during 1976–1980.

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MATERIALS AND METHODS

Clumps of five plants of each of the barley cultivars CI 1179, CI 7584, CI 5791, Beecher, Atlas, Clipper, and Dampier were grown in a circular arrangement within a single, 15-cm pot at 20/15 C (day/night) temperatures under natural daylight conditions. Two replicates were allowed for each isolate. Ten-day-old seedlings were uniformly sprayed with a conidial suspension standardized at 10,000 conidia per milliliter that was prepared from 2-wk-old subcultures grown on V-8 juice agar at 15 C.

Inoculated plants were maintained at 100% relative humidity (± 5%) for the first 48 hr after inoculation. Host reaction to the pathogen was scored on a 1–4 scale (3,4): 1 = resistant, 2 = moderately resistant, 3 = moderately susceptible, and 4 = susceptible to *D. teres*. Reactions within an isolate × cultivar interaction ranging from 1–3, 2–3, or 1–4 were scored as intermediate (I) in resistance to *D. teres*.

Table 1. Reaction of barley cultivars to 52 isolates of *Drechslera teres* collected in Western Australia during 1976–1980

Isolates (no.)	Previously described race group	Differential cultivars used, 1965–1968		Other cultivars				
		CI 1179	CI 7584	Beecher	Atlas	Dampier	CI 5791	Clipper
33	WA-1[a]	R-MR[b]	R-MR	R-MR	R-MR	S	R	I
5	Inconclusive	I	I	R-MR	R-MR	S	R	I
9	WA-1[c]	R-MR	R-MR	S	S	S	R	I
1	WA-2	S	R-MR	S	S	S	R	I
4	Inconclusive	I	I	I	I	S	R	I

[a] WA-1 = Race 1 in Western Australia of *D. teres* avirulent on Beecher.
[b] R = resistant, MR = moderately resistant, S = susceptible, I = intermediate in resistance to *D. teres*.
[c] Race 1 in Western Australia of *D. teres* virulent on Beecher.

RESULTS

Of the 52 isolates of *D. teres* collected since 1976 from all over Western Australia, 73% were not pathogenic on Beecher, 19% were pathogenic on Beecher, and the remaining 8% were inconsistent between and within replicates (Table 1). Reactions of Beecher and Atlas were almost identical. The CI 5791 cultivar was resistant and the Dampier cultivar susceptible to all 52 isolates of *D. teres*. Clipper, which showed intermediate reactions to the pathogen ranging from moderately resistant to moderately susceptible in the glasshouse, showed resistance to *D. teres* in the field. Observations in the field confirmed the differential reaction of Beecher to *D. teres*. An examination of isolates originating from known host cultivars revealed that all *D. teres* isolates that were not pathogenic on Beecher were isolated from Dampier, and those isolates pathogenic on Beecher were isolated either from Beecher or Atlas.

On the basis of their reaction on CI 1179 and CI 7584, 80% of the isolates of *D. teres* conformed to the race formerly described as race 1 in Western Australia (WA-1). Only one isolate conformed to race WA-2, and this isolate also attacked the Beecher cultivar (Table 1). The remaining isolates showed variable reactions on the above cultivars and were classified as inconclusive (Table 1).

To reconfirm the pathogenicity of isolates collected during 1965–1968 on Beecher, 20 freeze-dried isolates were regenerated by subculturing on V-8 juice agar and were inoculated on the Beecher, Atlas, and Dampier cultivars. All 20 isolates were pathogenic, producing susceptible reactions to *D. teres* on all three cultivars.

DISCUSSION

The predominance of a new group of isolates incapable of attacking Beecher barley and the almost exclusive prevalence of isolates representing formerly described race WA-1 (with only one exception) suggest a major shift in the pathogenic characteristics of the *D. teres* population in Western Australia in less than a decade. This period has also seen major changes in the varieties of barley grown. Beecher, which occupied more than 75% of the state's barley area, declined rapidly in popularity and now occupies less than 15% of the barley growing area. Dampier, also susceptible to *D. teres*, became the most popular cultivar and remained so until 1976. A cultivar resistant to *D. teres*, Clipper, was introduced in the early 1970s and has now become the major variety in use in Western Australia.

Change in pathogenicity to the barley cultivars in the *D. teres* population reported here were apparently related to the dominance of Dampier as the major cultivar grown in Western Australia and to a decline in the areas sown to Beecher. Isolates of *D. teres* isolated from Beecher appeared to have a low fitness on Dampier, as was evident from the fact that none of the isolates collected from Dampier were pathogenic on Beecher. The lower fitness of isolates pathogenic on Beecher may be related to the genes for virulence in *D. teres*, which may no longer be necessary for the pathogen to attack the Dampier cultivar. Such variation in fitness of various pathogenic groups on a host genotype with no gene for resistance to the pathogen is known to occur (10).

The appearance and prevalence of spot-type net blotch in the northern wheat belt of Western Australia has recently been shown to be related to the dominance of Clipper, which is resistant to the net-type isolates of *D. teres* that cause net-type net blotch in barley (T. N. Khan and A. Tekauz, *unpublished data*). Cultivar-induced changes such as this and the one described in this paper demonstrate the plasticity of the net-blotch pathogen and introduce a note of caution regarding the long-term future of cultivars resistant to *D. teres*.

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