Race Structure of *Pyrenophora tritici-repentis* Isolates Obtained from Wheat in South America

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Abstract

Knowledge of genetic variation in a pathogen population contributes to breeding for disease resistance. The fungus *Pyrenophora tritici-repentis*, cause of tan spot of wheat, is an important foliar pathogen worldwide. Currently, eight races have been identified in the fungal population prevalent on wheat and alternative hosts. Races 1 through 6 have been observed in North America. However, the fungal population from South America has not been characterized as to race. In this study, 48 single-spore isolates of *P. tritici-repentis*, recovered from wheat, were obtained from Argentina (10), Brazil (23), and Uruguay (15). Isolates were tested by inoculating individually on 2-leaf stage seedlings of the wheat differentials Glenlea, Katepwa, ND495, 6B365, M-3, and Salamouni in the greenhouse. They were grouped into different races based on necrosis and chlorosis induction on the differentials. Isolates from Argentina were grouped into races 1 and 7; from Brazil into races 1 and 8; and, from Uruguay into races 1 and 2. Results indicate that *P. tritici-repentis* has a diverse population on wheat in South America. More isolates are under investigation to obtain a comprehensive virulence pattern of the pathogen population in South America. Wheat lines should be screened against all known races to achieve durable resistance in a cultivar release program. The *P. tritici-repentis* race structure on wheat in Europe needs to be determined, as the pathogen has become a concern for wheat breeders and pathologists.

Keywords: *Triticum aestivum*; yellow spot

INTRODUCTION

The fungus *Pyrenophora tritici-repentis*, cause of tan spot, is an important foliar pathogen of wheat worldwide.The fungus produces oval shaped necrotic lesions with a chlorotic halo in susceptible wheat genotypes. The fungus is equally pathogenic on all types of wheat (DE WOLF *et al.* 1998). Yield losses caused by tan spot has been reported ranging from 3–50%. The disease can be managed by using fungicides, crop rotation, and resistant cultivars; however, resistant cultivars look more promising for tan spot management, as they do not require additional inputs and are environment friendly.

Knowledge of pathogen variation in virulence and/or aggressiveness is an important component in developing durably resistant cultivars to combat plant diseases. Physiological variation in virulence and/or aggressiveness in *P. tritici-repentis* population, prevalent on wheat and alternative hosts, have been reported (ALI & FRANCL 1998, 1999, 2002; ALI *et al.* 2002; DE WOLF *et al.* 1998; STRELKOV *et al.* 2002). This virulence variation has been measured using both quantitative and qualitative rating scales (DE WOLF *et al.* 1998). Two qualitative types of symptoms, tan necrosis (nec+) and extensive chlorosis (chl+) induced by *P. tritici-repentis*, were identified by LAMARI and BERNIER (1989). Based on these two types symptoms, fungal isolates have been grouped so far into eight races (ALI & FRANCL 1998, 1999, 2002; ALI *et al.* 2002; LAMARI & BERNIER 1989; STRELKOV *et al.* 2002). The objective of this study was to characterize *P. tritici-repentis* population for its race structure prevalent on wheat in South America.

MATERIALS AND METHODS

Leaf samples and fungal isolations. Fifteen diseased leaf samples were collected from Argentina (*n* = 5), Brazil (*n* = 4), and Uruguay (*n* = 6). The leaf samples collected from Argentina and Brazil were of cultivars Prointa Federal and Embrapa 120,

Table 1. Reaction of wheat differentials to *P. tritici-repentis* races (ALI & FRANCL 2002)

Race	Wheat differentials					
	Glenlea	Katepwa	ND495	6B365	Salamouni	M-3
1	necrosis	necrosis	necrosis	chlorosis	avirulent	avirulent
2	necrosis	necrosis	necrosis	avirulent	avirulent	avirulent
3	avirulent	avirulent	avirulent	chlorosis	avirulent	avirulent
4	avirulent	avirulent	avirulent	avirulent	avirulent	avirulent
5	avirulent	chlorosis	avirulent	avirulent	avirulent	avirulent
6	avirulent	chlorosis	unknown	chlorosis	avirulent	unknown
7	necrosis	necrosis	necrosis + chlorosis	chlorosis	avirulent	avirulent
8	necrosis	necrosis	necrosis	necrosis	necrosis	avirulent

respectively. The fungus was recovered from the leaf samples as described by ALI and FRANCL (2001). One hundred- forty isolates were recovered from the samples and stored at –20°C by following the procedure described by JORDAHL and FRANCL (1992), until they were race typed.

Inoculum production, inoculations and race characterization. Inoculum was prepared from the isolates stored at –20°C throughout the experiment. Forty-eight of 140 *P. tritici-repentis* isolates were grouped into appropriate races by inoculating them individually on the wheat differential set developed by LAMARI and BERNIER (1989) (Table 1). Two wheat genotypes, ND 495 and M-3 were included with the differentials to enhance the chances of detecting more variants of races in the fungal population. Inoculum production and inoculations were done as described in ALI and FRANCL (2001). The inoculated seedlings were rated for symptom development 8 days post inoculations, and the isolates were grouped into appropriate races based on their ability to produce tan necrosis and chlorosis on appropriate wheat differential (LAMARI & BERNIER 1989).

RESULTS AND DISCUSSION

Pyrenophora tritici-repentis was recovered from 12 of 16 leaf samples at a frequency 3 to 100% (Table 2). Most of the leaf samples were also infected with *Cochliobolus sativus* (data not recorded). All five samples obtained from Argentina harbored the fungus. The fungus was recovered at low frequency from the samples obtained from Brazil as compared to Argentina and Uruguay. The differences in fungal recovery frequency among these three countries could be due to variability in susceptibility of the cultivars used and/or variability in the pathogen population.

Table 2. Recovery of *P. tritici-repentis* (*Ptr*) from 15 wheat leaf samples obtained South America (ALI & FRANCL 2002)

Country	# of samples analyzed	Samples with *Ptr*	Infection incidence[a]
Agrentina	5	5	65–100
Brazil	4	3	3–73
Uruguay	6	4	45–100

[a] percent of leaf pieces that yielded *P. tritici-repentis* from 40 pieces/leaf sample

Isolates from Argentina were grouped under races 1 and 7, from Brazil races 1 and 8, and from Uruguay races 1 and 2. (Table 3). Race 1 was observed in all the three countries and seemed to be the most prevalent race in the region. These findings are in agreement with previous studies (ALI & BUCHENAU 1992; ALI & FRANCL 1998; LAMARI & BERNIER 1989). They also found race 1, the most prevalent race in North America. Races 7 and 8 have never been reported elsewhere in the world (ALI & FRANCL 1998; ALI *et al*. 1999). Addition of two wheat genotypes to the differential set helped in discriminate more variants. The results indicate that *P. tritici-repentis* has a diverse population in the region. More number of isolates are

Table 3. *Pyrenophora tritici-repentis* races identified in South America (ALI & FRANCL 2002)

Country	Isolates tested	Percent races recovered			
		1	2	7	8
Agrentina	10	70.0	0.0	30.0	0.0
Brazil	23	65.0	0.0	0.0	35.0
Uruguay	15	60.0	40.0	0.0	0.0

under investigation to obtain a comprehensive picture of the fungal race structure in the region. All wheat lines should be screened with all races prevalent in the region prior to their commercialization. The fungal population on wheat in Europe also needs to be determined, as the pathogen has become a concern for wheat breeders and pathologist.

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