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A SYSTEM FOR DIFFERENTIATING RACES OF PUCCINIA STRIIFORMIS IN THE UNITED STATES[1]

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Abstract

A system for differentiating races of Puccinia striiformis in the United States is proposed. It uses the numbers 1 to 7 to represent seven differential cultivars of wheat and a slash (/) to separate cultivars on which the pathogen is avirulent from cultivars on which the pathogen is virulent. Thus race 2, 5, 6, 7, 8/1, 3, 4 is avirulent on cultivars 2, 5, 6, 7 and 8 and virulent on cultivars 1, 3 and 4. The system is open-ended and is intended to complement systems used at various locations in the United States.

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Races of Puccinia striiformis West. f. sp. tritici Eriks. & E. Henn. are identified in Europe by using a standard set of differential wheat cultivars (2, 3). The European set of differential cultivars, however, does not effectively differentiate the predominant races of P. striiformis in the United States. Investigators in Montana, Oregon, and Washington have identified collections of P. striiformis with different patterns of pathogenicity. They have used their own sets of differential cultivars inoculated and grown under various environmental conditions (1, 6, 8, 9). Therefore, results from the various locations are not easily compared.

In 1969, the authors met with Dr. J. C. Zadoks of the Laboratorium Voor Fitopathologie at Wageningen, Netherlands, and Frl. Dr. E. Fuchs of the Biologische Bundesanstalt für Land und Forstwirtschaff at Braunschweig, Germany (investigators working with races of P. striiformis in Europe) to discuss aspects of race identification and to formulate a uniform system to identify and describe races of P. striiformis in the United States. The system agreed upon is described in this report.

PROPOSED SYSTEM FOR RACE DIFFERENTIATION

Seven cultivars of wheat (Table 1) were selected for differentiating races of P. striiformis in the United States. The seven cultivars were selected because they have effectively differentiated collections of rust from Idaho, Montana, Oregon, Utah, and Washington (1, 6, 8, 9). Investigators may continue to use their own systems of identifying and classifying pathogenic cultures which they encounter and therefore will have their own systems of naming races; however, whenever possible, they should include the cultivars in Table 1 to describe the races.

We propose that the races be described by using the differential numbers that represent the cultivars in Table 1. A slash (/) is used to separate numbers that represent cultivars on which the race is avirulent from numbers that represent cultivars on which the race is virulent. The numbers of the differential cultivars on which the race is avirulent are to the left of the slash, and the numbers for cultivars on which the race is virulent are to the right of the slash. Thus, race 2, 4, 5, 6, 7/1, 3 is avirulent on Chinese 166, Moro, Suwon 92/Omar, Druchamp, and Riebesel 47-51 and virulent on Lemhi and Heines VII; race 2, 5, 6, 7/1, 3, 4 is avirulent on Chinese 166, Suwon 92/Omar, Druchamp, and Riebesel 47-51 and virulent on Lemhi, Heines VII, and Moro. The pathogen is considered avirulent on the host if there are no symptoms, or if the symptoms consist of flecks or of necrotic or chlorotic blotches without sporulation (or with only a trace to slight sporulation). If there is more than a trace of sporulation, with or without chlorosis or necrosis, the pathogen is considered virulent. Thus, infection types designated by the symbols 0 and 1 used by Hungerford and Owens (4); i, oo, 0, and 1 used by Gassner and Straib (3); and 0, 1, 2, 3, and 4 reported by McNeal, et al. (7) are considered avirulent. Infection types designated by the symbols 2, 3, and 4 by Hungerford and Owens(4); II, III, and IV used by Gassner and Straib (3); and 6, 7, 8, and 9 reported by McNeal, et al. (7) are considered virulent. When possible, the cultivars used to identify the collections of rust should be listed according to infection type, with the lowest infection type to the left and the highest infection type to the right.

In addition to use of the seven cultivars and the infection types described above, the following procedures are proposed in order to standardize the identification of U.S. races so that results can be compared. Infection types will be determined on the first, or on the second, or on both first and second leaves of seedlings. If the infection types on the first and second leaves differ, the infection type on the second leaf will be used. Seedlings should be grown before and after inoculation in 12 hours of dark and 12 hours of light (1000 ft-c or higher) at

Table 1. Differential cultivars for identifying races of Puccinia striiformis West. in the United States.

Differential No.	Cultivar	CI or PI no.
1	Lemhi	11415
2	Chinese 166	11765
3	Heines VII	201195
4	Moro	13740
5	Suwon 92/Omar	13749
6	Druchamp	13723
7	Riebesel 47-51	295999

temperatures programmed to change gradually from a minimum of 2°C during the dark period, to a maximum of 18°C during the light period and programmed to change gradually from the maximum temperature in the light to the minimum temperature in the dark.

To illustrate the systems of identifying races of P. striiformis in the United States, there may be a race identified at Pullman, Washington, designated as PNW-8, a race at Corvallis, Oregon, designated as CSE-17, and a race at Bozeman, Montana, designated as MAES-20. Under the proposed system all three races may be described as U.S. race 6, 7/1, 2, 3, 4, 5. Each of the collections from the three locations may have certain unique characteristics based on the system used at those locations, but all have certain characteristics in common according to the system that is proposed here.

DISCUSSION

The seven cultivars and the procedures for using them to identify races of P. striiformis in the United States as described here are by no means to be considered permanent. The list of differential cultivars must be open-ended, so that cultivars can be added to or deleted from the list whenever more information on the pathogenicity of P. striiformis in the United States is available. Revisions should be made after evaluation by the investigators concerned, and reported in an appropriate journal.

As far as possible, single genes having major effects on resistance should be utilized in the differential cultivars. Resistance of cultivars with several additive genes may be influenced greatly by temperature (5). Attempts to obtain cultivars with single genes for resistance, by developing near isogenic lines in a Lemhi background, are underway. We hope that they may be utilized as differential lines in the future.

This system proposed for the identification of races of P. striiformis is not intended only for the purpose of identifying races. It is also intended as a means of presenting information on genes for virulence in P. striiformis and on corresponding genes for resistance in wheat. This should lead to a more rapid accumulation of information on such factors as mechanisms of variation, distribution and origin of different pathogenic entities, and breeding of cultivars with resistance to rust.

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