Inheritance of Powdery Mildew Resistance in Hybrids Involving a Common Wheat Strain Derived from *Triticum timopheevi*

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ALLARD and Shands (1) reported that the resistance of the common wheat strain C.I. 12633 to race 5 of powdery mildew was controlled in the seedling stage by a single partially dominant gene, and in the adult stage by two other linked genes. The genes governing adult mildew reaction were either the same two genes which governed stem rust resistance or were individually closely linked to them. However, in a reinvestigation of the stem rust inheritance, Nyquist (6) found that the rust resistance was governed by either one or two linked genes, and that differential fertilization was involved to different degrees in different hybrids. Because of the close linkage between stem rust and mildew resistance, a study of these materials for mildew reaction provided an opportunity to investigate the unusual stem rust results (6) in another way, and also to study the action of the mildew genes in two stages of growth to another physiologic race of mildew. Resistance on the leaf sheath as well as on the leaf blade also was studied in both growth stages.

**MATERIALS AND METHODS**

The resistant strain C.I. 12633 of common wheat, *Triticum aestivum* L., used in these studies derived its mildew resistance from *T. timopheevi* Zhuk (1). The susceptible parents used were Ramona (C.I. 8241–1), White Federation (C.I. 4981), Chinese Spring (C.I. 6223), and 2666A2–15–6–3, which was a selection developed by the Wisconsin Agricultural Experiment Station from the cross Illinois No. 1 × Chinese Spring, and was the common wheat parent of the interspecific cross from which C.I. 12633 was derived. The powdery mildew, *Erysiphe graminis* L. sp. tritici Em. Machal, was a new race called the Norita race (5).

All tests for mildew reaction were conducted in the greenhouse during the winter. When conditions permitted thermostatic control, temperatures were maintained at about 17° to 18° C; at other times the maximum day temperature reached 30° or more.

Plants were inoculated at the 1-leaf stage, the 3-leaf stage, or both stages by dusting daily with conidia from previously infected, potted plants. In the 1-leaf stage, inoculation began when the first leaf blade was about 3 inches long, and continued for either 4 or 5 days. In the 3-leaf stage, inoculation began when the third leaf was well developed and the fourth leaf blade had begun to emerge, and was continued for either 4 or 5 days. Mildew reaction was read on both the leaf sheath and leaf blade about 11 to 13 days after the start of inoculation. Susceptible plants in the 1-leaf stage were individually marked to permit correlation of the reaction in the 1-leaf stage with that in the 3-leaf stage.

No general, numerical scale was used to classify the type of reaction on the leaf sheath. Classification of reaction on the leaf blade was as follows: 0, immune, no visible signs of infection; 0·5, highly resistant, necrotic flecks present with no visible development of mycelium; 1, very resistant, slight development of mycelium but with little or no sporulation; 2, moderately resistant, moderate development of mycelium with slight production of conidia; 3, moderately susceptible, moderate to abundant development of mycelium accompanied by moderate sporulation; 4, very susceptible, abundant mycelium with large pustules profusely sporulating, no chlorosis or necrosis. The use of plus and minus signs indicated a quantitative increase or decrease in the infection type.

The resistant parent, C.I. 12633, exhibited a brown necrotic, flecking reaction with no visible signs of mycelium on both the sheath and blade in the 1-leaf stage (type 0); it was immune on both the sheaths and blades in the 3-leaf stage (type 0). The susceptible parents were susceptible on both the sheath and blade in both growth stages. Ramona and White Federation were very susceptible (type 4), and Chinese Spring and 2666A2–15–6–3 were intermediate between a moderately susceptible and a very susceptible reaction (type 3–4).

**RESULTS**

**Inheritance in the one-leaf stage**—Two easily separable reactions were observed on the first leaf sheath in the segregating generations: (1) Resistant—usually exhibiting no visible signs of infection or only brown necrotic flecks, but occasionally showing a slight development of mycelium with brown necrotic flecks beneath the mycelium; (2) Susceptible—moderate mycelial development with only moderate sporulation to very abundant mycelium with heavy sporulation; brown, necrotic flecks were not observed in the development of the mycelium was variable in this susceptible class.

On the first leaf blade 3 main infection classes were observed in the segregating generations: (1) Type 0—like C.I. 12633; (2) Types 1 and 2; and (3) Types 3 and 4. Most of the individuals in the last class showed type 3 susceptibility. The first two classes constituted the resistant group, and the last class was the susceptible group.

The mildew reaction-group was the same for both the sheath and blade of individual plants. The results presented in Table 1 indicate that one almost completely dominant gene, symbolized *Ml* (temporary symbol only), governs the resistance of C.I. 12633 to mildew on the sheath and blade in the one-leaf stage.

**Inheritance in the three-leaf stage**—On the leaf sheath especially the sheath of the first leaf, much the same mildew classes were observed in segregating generations as in the one-leaf stage. The main difference was lower frequency of resistant plants with brown necrotic flecks.

On the leaf blades 5 infection classes were observed in the segregating generations: (1) Type 0—like C.I. 12633 itself; (2) Type 0·5; (3) Types 1 and 2 (mostly type 1); (4) Type H (heterogeneous), with mildew development (type 2+); on the distal 1- to 3-inch portion of the leaf blade which emerged during inoculation; (third or fourth) greater than on other blade areas (types 1 and 2); and (5) Types 3 to 4—like the susceptible parents. Individuals in the first four classes were considered resistant and those individuals in the last class susceptible.

All populations except Chinese Spring × C.I. 12633, which were inoculated in the 1-leaf stage (Table 1) were inoculated again in the 3-leaf stage. All plants which were resistant on the leaf sheath and blade in the 1-leaf stage continued to manifest resistance in the 3-leaf stage. However, some susceptible plants developed resistance on the leaf blade but continued to show susceptibility on the leaf sheath. Other susceptible plants remained susceptible. These results in the 3-leaf stage from such dual-inoculated populations as well as other populations inoculated only in the 3-leaf stage are given in Tables 2 and 3.

Data from observations on the leaf sheath for the F2 generation are given in Table 2, and data for the F3 a