A Close Association of Stem and Crown Rust Resistance in ‘Ukraine’ and ‘Rosen’s Mutant’ Oats

R. I. H. McKenzie, G. Fleischmann, and G. J. Green

IN 1961 a biotype of oat stem rust, *Puccinia graminis* Pers. f. sp. *avenae* Erikss. & E. Henn., designated as race 6AF was obtained that could attack all widely used hexaploid sources of resistance (4). Green and McKenzie (4) tested 4533 entries from the USDA World Oat Collection with this culture and found a number of entries with moderate resistance. These included ‘Ukraine’ (C.I. 3259) and Rosen’s Mutant (C.I. 8159). Ukraine is one of the standard differential host varieties for the identification of races of crown rust *Puccinia coronata* Cda. var *avenae* Frazer & Led, and has been reported as having one (1) or two genes (2, 7) for resistance. Rosen’s Mutant was reported by Rosen (6) to be immune to a number of crown rust races in Arkansas, while Wahl and Tobolsky (9) reported that it was resistant to race 6 of oat stem rust in Israel.

This study was undertaken to determine the mode of inheritance of stem and crown rust resistance in Ukraine and Rosen’s Mutant and to establish whether these varieties possessed any of the identified stem rust resistance genes.

**MATERIALS AND METHODS**

Single plant progenies of Rosen’s Mutant and Ukraine, homozygous for moderate resistance (type 2 reaction) to stem rust race 6AF, and good resistance (type O; reaction) to crown rust races 293 and 325, were crossed and backcrossed to ‘Victory’ which is susceptible to both rusts. Rosen’s Mutant was also crossed with ‘Exeter’, ‘Rodney’, and ‘C.I. 6829’ which have stem rust resistance genes A, B, and H respectively. Ukraine was crossed with C.I. 6829.

Approximately 30 seeds of each *F₂* line and *F₂* backcross family were planted for seedling tests with the stem and crown rusts. Some of the seed germinated poorly. In some instances replanting of larger quantities of seed and retesting was necessary to establish clearly the classification of a family or line. The *F₂* families from the backcross of Ukraine to Victory were also tested in the adult stage. Seedling and adult plants were inoculated with oil suspensions of rust spores, and incubated at high humidity under a polyethylene cover for a minimum of 24 hours.

**RESULTS**

**Stem Rust**

*Rosen’s Mutant*. Seventy-three *F₂* backcross families were tested in the seedling stage with pure cultures of races 6AF and 6F. Twenty-four families segregated for resistance to these races and 49 were susceptible (Table 1). This is a very poor fit to a one-factor ratio. However, tests of *F₂* lines from crosses of Rosen’s Mutant with Victory, female parent for the backcross to Victory, appear that the failure of the backcross ratio of 1 segregating:1 susceptible is not significant.

Thirty-three *F₂* lines from the cross of Rosen’s Mutant × C.I. 6829 were all resistant to race 6AF. Rosen’s Mutant like C.I. 6829 has gene *H*.

**Crown Rust**

The *F₂* families from the backcross of Ukraine to Victory were tested in the seedling stage with races 293 and 325. All the families that had segregated to 6AF stem rust also segregated to both crown rust races (2, 7) and all the families that were susceptible were also susceptible to crown rust. Either gene conferred resistance to both rusts or two genes were responsible for these results.

The *F₂* families from the backcross of Rosen’s Mutant to Victory failed to segregate in the expected ratio for stem rust and crown rust resistance. The segregation for crown rust reaction with the *F₂* families was close to the 3:1 ratio expected if the mutant gene was segregating (Table 2) in the *F₂* families, and Ukraine backcrosses to Victory.

A number of strains reported by Green (4) to have resistance to race 6AF were races 293 and 325 of crown rust (Table 3). These strains were known to have gene *H* for stem rust.

**Table 1. Reaction to race 6AF of oat stem rust and crown rust races 293 and 325**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rosen’s Mutant × Victory*</td>
<td><em>F₂</em></td>
<td>24</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>Rosen’s Mutant × Victory</td>
<td><em>F₂</em></td>
<td>17</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Rosen’s Mutant × Rodney</td>
<td><em>F₂</em></td>
<td>8</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Rosen’s Mutant × ‘Exeter’</td>
<td><em>F₂</em></td>
<td>20</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

* Tests with race 6F showed the same results.