I N 1959 the barley yellow dwarf disease caused widespread damage to oats in the North Central states (5). The loss was particularly heavy in Missouri where the yellow dwarf virus was disseminated by the greenbug, *T. graminum* (Rondani) (9). In the oats breeding nurseries on the Missouri Agricultural Experiment Station, Columbia, a heavy barley yellow dwarf epiphytotic was present and the reactions of many varieties were compared from visual estimates of the percent of total leaf area damaged by the disease.

Seltchel et al. (7) have reported on the leaf damage and yield of oats varieties grown at Columbia in the 1959 epiphytotic. Least damaged were C.I. 7448, a selection from the cross [*(Victoria × Hajira-Ajax) × (Victoria × Hajira-Ajax)] × Mo. 0-205*, and the variety Tonka, with 15% of the leaf area damaged in each. C.I. 7447, a selection from the same cross as C.I. 7448, had 35% damage; Nodaway, 65%; and C.I. 7235, from the cross Rodney × (Landhafer-Forvic), 90%. Yields varied from 48 bushels for C.I. 7448 to 12 bushels for C.I. 7235, with a correlation coefficient for percent of leaf area damaged versus yield of \(-0.871 \pm 0.087\).

These differences in tolerance to barley yellow dwarf gave encouragement to possibilities of breeding for resistance. The F<sub>2</sub> generation of crosses previously made which involved the above 5 varieties had been grown in 1959. This material was considered suitable for studying the inheritance of tolerance to the barley yellow dwarf virus in oats.

No previous studies on the inheritance of reaction to barley yellow dwarf virus in oats has been reported. Suneson (8) has reported that the resistance of Rojo barley in the cross Rojo × California Marigold was due to a single recessive gene. Rasmussen and Schaller (6) have reported one incompletely dominant gene which conditioned a high level of tolerance to the barley yellow dwarf disease in C.I. 1227, C.I. 1237, C.I. 2376, and Atabe varieties of barley. The tolerance in the latter varieties would assure a fair grain yield under a severe yellow dwarf epiphytotic according to the authors.

MATERIALS AND METHODS

Five crosses were selected for this study which involved the 5 parental varieties reported on above. On the basis of the 1959 observations the strains were rated for reaction to barley yellow dwarf as follows: C.I. 7448 and Tonka, tolerant; C.I. 7447, intermediate; and Nodaway and C.I. 7235, susceptible. However, throughout this experiment reaction of Tonka to barley yellow dwarf was relatively more severe than in the field in 1959 and it must be rated here as susceptible. The crosses chosen and the reaction of the parent varieties are as follows:

<table>
<thead>
<tr>
<th>Cross</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.I. 7235 (susceptible) × Nodaway (susceptible)</td>
<td>C.I. 7448 (tolerant)</td>
</tr>
<tr>
<td>C.I. 7235 (susceptible) × C.I. 7447 (intermediate)</td>
<td>C.I. 7448 (tolerant)</td>
</tr>
<tr>
<td>C.I. 7235 (susceptible) × C.I. 7448 (susceptible)</td>
<td>C.I. 7447 (intermediate)</td>
</tr>
<tr>
<td>Tonka (susceptible) × C.I. 7447 (intermediate)</td>
<td></td>
</tr>
<tr>
<td>Tonka (susceptible) × C.I. 7448 (tolerant)</td>
<td></td>
</tr>
</tbody>
</table>

The F<sub>2</sub> generations of these crosses had been grown at Columbia in 1959. The F<sub>3</sub> population of each cross and the parents were space planted 1-foot apart in rows 1-foot wide at Columbia on April 8, 1960. Each F<sub>3</sub> population and its parents were grown in adjacent rows, each row containing approximately 60 plants, and the groups of F<sub>3</sub> and parent rows were randomized within each block, utilizing a randomized block design with four blocks.

The F<sub>3</sub> and parent populations were inoculated with barley yellow dwarf virus by placing viruliferous aphids on each plant. A culture of *Rhopalosiphum padi* (Linn.), the bird-cherry oat aphid, infected with the barley yellow dwarf virus strain, Champagnie 6, was obtained from H. Jedlinski, Urbana, Illinois, in March, 1960. The barley yellow dwarf virus strain, Champagnie 6, was originally isolated from oats grown in the area of Urbana, Illinois, by R. M. Fedor.

The viruliferous aphids were multiplied on unvernalized plants of Hudson winter barley in the greenhouse. The Hudson variety was used because it is a susceptible barley yellow dwarf virus and being a winter barley it would remain in the vegetative state for a longer time than would a spring variety. This procedure permitted a rapid increase in the aphid population and also resulted in a pure population of aphids feeding and virus injury. The aphids were confined by placing cages constructed of 32-mesh-per-inch copper wire screen around the pots containing the barley.

After multiplication the viruliferous aphids were transferred to new plantings of Hudson barley in the 4-leaf stage. After feeding for five days the aphids were destroyed with a dilute malathion spray. Eighteen days later healthy barley plants were pulled and discarded and only plants with distinct barley yellow dwarf symptoms were retained. During this period additional barley plants were increased and were subsequently transferred to the diseased barley plants where they were allowed to multiply until sufficient numbers were obtained for field inoculations. This procedure, as outlined by H. Jedlinski, assures that all aphids used for field inoculations have fed on plants showing distinct barley yellow dwarf symptoms.

The F<sub>3</sub> and parent oat plants in the field were inoculated in the 3- to 4-leaf stage, 5 weeks after planting by placing 5 to 10 viruliferous aphids on each plant with a camel's hair brush. The aphids were destroyed with a dilute malathion spray after feeding for four days. One week later symptoms of barley yellow dwarf were visible on the oat plants in the field.

Injury to individual oat plants was recorded from visual estimates of the percentage of the leaf area damaged by the barley yellow dwarf disease. Readings were made on June 2 and June 10 and an average of the 2 readings is reported here. Plants producing seed were harvested, tagged, and tied in bundles. Seed from individual plants was used for growing the F<sub>4</sub> population.

Because of limited greenhouse space, F<sub>4</sub> generations of only three crosses were studied. These crosses C.I. 7235 × Nodaway, C.I. 7235 × C.I. 7447, and C.I. 7235 × C.I. 7448, and their respective parent strains, were grown in the greenhouse during the winter of 1960-61. These represent crosses between the most susceptible parent, C.I. 7235, with parents which were susceptible (Nodaway), intermediate (C.I. 7447), and tolerant (C.I. 7448). For greenhouse plantings 50 F<sub>4</sub> lines were selected at random from F<sub>3</sub> plants harvested from each of the 3 crosses. Obviously, it was not possible to include progenies of susceptible F<sub>3</sub> plants which were so severely damaged that no seed was produced. In addition to the F<sub>4</sub> lines, seed harvested in 1960 from 20 plants selected at random from each parent was planted. Ten seeds from each selected F<sub>3</sub> and each parent plant were planted in 6-inch clay pots in November 1960. Each pot was later thinned to 5 healthy seedlings except in instances where fewer than 3 seedlings were present. The pots containing the F<sub>3</sub> lines and the parents were arranged into a randomized block design with two blocks.

After 4 weeks of growth the F<sub>4</sub> and parent plants were inoculated in the 4- to 5-leaf stage with viruliferous aphids which had

1 Contribution from the Field Crops Department, University of Missouri, Columbia, and Agricultural Research Service, USDA. Approved for publication as Missouri Agricultural Experimentation Station Journal article No. 2358. Part of a thesis submitted by the senior author in partial fulfillment of requirements for the M.S. degree. Received Sept. 20, 1961.

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259 Published May, 1962