Inheritance and Heritability of Greenbug Resistance in a Common Wheat Cross

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Dickinson Selection 28A, a common wheat selected by Dahms et al. (6), provided a source of resistance to the greenbug, *Toxoptera graminum*. Although Dickinson Selection 28A has a high degree of resistance, it is not immune to damage from the pest and can be killed by greenbug infestations created in the greenhouse or insectary. The resistance found in this spring wheat is now being used to develop greenbug resistant winter wheats for the Southern Great Plains where the aphid often causes severe damage. The mode of inheritance of this resistance appears to be simple or at least not highly complex. However, conflicting results have been obtained concerning gene number and dominance relationships.

Painter and Peters (8) and Daniels and Porter (7) found resistance to be determined by a single recessive factor pair but the latter authors suggest that modifying factors may be involved. Curtis et al. (5) concluded that a single recessive gene pair, which they designated gb gb, controlled greenbug resistance in Dickinson Selection 28A as well as in C.I. 9058. However, they found F1 plants involving Dickinson Selection 28A lived an average of 7.6 days longer than the susceptible parents Ponca, Concho, and Crockett which lived 12.8, 14.8, and 12.7 days, respectively. F1 plants involving C.I. 9058 lived an average of 13.9 days longer than the susceptible parents. They interpreted the F1 data as indicating a lack of complete dominance of susceptibility. Chada et al. (4) concluded, on the basis of F2 data, that resistance was conditioned by a single factor pair, although they state that enough conflicting data were obtained to cast some doubt on such a simplified explanation. They reported that resistance appeared to be dominant. The conflicting results may be due to differences in testing methods. It is also possible that different biotypes of the greenbug, one of which has been recently isolated by Wood (12), were used in the tests.

Monogenic ratios in the above studies were obtained after classifying plants either resistant or susceptible or by arbitrarily classifying plants given a low damage rating as resistant and those with higher ratings as susceptible. The authors, who followed the latter method in previous studies, found considerable variation in damage among plants within resistant and susceptible groups and observed that ratings and groupings tended to intergrade with one another. The study reported herein was conducted to determine to what extent small increments of variation were due to genetic differences and to determine the heritability of resistance when selection was made throughout the entire range of variation.

**MATERIAL AND METHODS**

Crosses between the greenbug-susceptible variety Concho (C) and the resistant parent Dickinson Selection 28A (D) and the backcrosses of the F1 to both parents were made in 1955 and 1956. The parents, F1, F2, and backcrosses were tested in a triplicated greenhouse experiment in 1957. Each replicate was enclosed in a 16"x20" flat with a plastic cage. Plot size was a single row of 12 to 15 plants. Each replicate included 1 plot of the F1 and each of the backcrosses and 4 plots each of the F2 population and parents. Each replicate was infested with approximately 500 greenbugs 2 days after the plants emerged. The plants were rated 5 to 6 weeks after infestation, at which time most of the plants of Concho were severely damaged or dead. A rating scale was established using plants out of the test to represent ratings of 1 to 10. Ratings were based on the amount of chlorotic and dead tissue. A rating of 1 indicated no more than 10% leaf damage and ratings of 2 through 10 indicated progressively greater damage with a 10 rating indicating more than 90% damage. No plants rated number 1 were obtained in the first test but the class was retained to permit a rating of 1 should such plants be found in subsequent tests.

Thirty F1 families, progenies of uninfested F1 plants grown in the greenhouse, were tested in 3 tests during 1958-59. In 1 triplicated greenhouse test, 12 plants of each F1 family and parents were grown in 9-inch pots and caged with a ½-gallon glass jar from which the bottom had been removed and the top covered with 70 mesh screen. Each pot was infested with 10 greenbugs 2 days after the plants emerged. The second triplicated greenhouse test was conducted in flats in a manner similar to the test of earlier generations. The third, a duplicated test, was conducted in flats in the insectary described by Daniels and Porter (7). Twenty-three of the F3 lines were included in all tests.

Thirty of the F3 families and 8 F3 progeny lines from each F1 family and the 2 parents were tested in a 6'x6' uncaged subirrigated flat in the greenhouse in 1960. The F3 lines originated from head selections made from the F2 families grown in the field from fall seeding. A single row of 15 plants of each F3 family and F1 progeny line and 8 rows of each parent were randomized in this unreplicated test. The quantity of F3 seed was sufficient to plant only a single plot of each F3 family. The replicated tests of the F2 families and the test of the F3 lines were terminated and individual plants of families and lines were rated as described for the test of earlier generations.

The greenbugs used were progeny of greenbugs collected in the field near Bushland, Texas.

Heritability and gene number estimates are based on average within plot variances of the F2 test. The data of the 23 F1 lines and parents included in all tests were analyzed as a single test of 8 replications since variances were homogeneous and the family X test interaction was not significant.

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