Inheritance of Reaction to Dwarf Bunt, Race T–16, and a Hybrid Race in Winter Wheat Crosses

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The soil-borne dwarf bunt (Tilletia caries (DC.) Tul.) was first recognized in the Cache Valley section of Utah about 1930, although farmers had observed it some 10 years earlier. No other race of Tilletia has been so difficult to germinate or to study. The conditions causing its development are not well known. This smut is favored by early fall emergence of wheat. It seldom appears in late-sown winter wheat and never in spring-sown wheat.

The spread of dwarf bunt has been phenomenal, and since it is soil-borne, the only effective remedy is the growing of resistant varieties. Several attempts have been made to study the inheritance of resistance to dwarf bunt, but due to lack of infection or unfavorable environmental and seasonal conditions, satisfactory data were not obtained until 1946.

At the present time nearly all winter wheat varieties grown in northern Utah are resistant to dwarf bunt, and soil infestation by this fungus is likely to decline. If this smut should be eliminated from the soil, further testing for resistance would be very difficult unless a race of bunt (smut) can be found that is controlled by the same resistance factors. Such a race would be of greatest value if infection resulted from seed-borne inoculum. It would greatly facilitate the breeding of winter wheat varieties that are resistant to dwarf smut.

The early breeding of such resistant wheats was conducted at the Utah Agricultural Experiment Station by D. C. Tingey. Pathological investigations of dwarf bunt were conducted by H. A. Rodenhiser and C. S. Holton of the U. S. Dept. of Agriculture.

Material and Methods

Three winter wheat crosses made in 1943, namely, Cache × Utah Kanred, Relief × Requa, and Cache × Brevon, were grown under irrigation in 1944–45 with the F2 plants spaced a foot apart each way. The resulting large plants produced sufficient seed for division into four lots of 100 to more than 200 progenies each. One lot of each of the three crosses was seeded in September 1945, on soil known to be infested with dwarf bunt. Seed of a second lot of the cross Cache × Utah Kanred was inoculated with race T–16 and sown on the irrigated farm at North Logan in September 1946. A third lot of this cross was seeded in September 1946, on naturally infested soil which received an additional 2 grams of dwarf bunt inoculum per square foot. Seed for 100 F3

hybrid 119. This hybrid smut, a race of Tilletia produced by C. S. Holton and thought to be similar to the dwarf bunt organism. These were seeded in September 1946. The parent rows have been under dry farm conditions for periods of years in various locations, most of which were naturally infested soils. Only average and highest percentages of smut were listed since the parent varieties were grown during each year of these studies. When fully ripened smut-free heads in each of these crosses were recorded and compared with sound heads in lightly infected rows were counted. These estimates were checked by counting occasional rows. Each F3 row of the cross Cache was further classified as: (a) resistant, (b) segregating, or (c) susceptible to smut. In rows classified as susceptible, the smut rows might show nearly complete infection. In segregating, smutty plants were interspersed among the sound heads of the 6-foot rows. Usually 25 to 300 heads were counted in each 6-foot row.

Experimental Results

Dwarf bunt spores have been shown to be very difficult to germinate artificially, yet the seedling can be grown in naturally infested soil some 5 days prior to sowing and obtained 50 to 90% dwarf bunt. The results with artificial soil inoculation can be secured in about 1 year out of 3.

As shown in Table 1, the parents of the three crosses differed in their reactions to dwarf bunt. Utah Kanred Cross grown on dwarf bunt inoculum gave 368 F3 rows smutty to 166 rows sound. The smutty rows were placed into two distinct groups by C. A. Suneson and Woodward. The 136 F3 rows were susceptible, and 231 rows showing 1 to 60% infection were classified as segregating or heterozygous. The data indicate that resistance was controlled by a single genetic factor.

In the cross Requa × Relief a total of 445 rows grown in the same block of land as was the previously mentioned cross. Of these 445 rows, 18 were classified as smutty, while 322 rows were sound. In the smutty rows the percentage of infected heads ranged from 1 to approximately 15% with an occasional row reaching 25%.

The third cross, Cache × Brevon, consisted...