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FRED N. BRIGGS[3]

INTRODUCTION

TURKEY is the name most commonly applied to the Crimean group of hard red winter wheats grown in the United States. In 1924, according to Clark and his co-workers,[11] the hard red winter wheats comprised 41.4 per cent of the total wheat acreage in this country; and Turkey, including Kanred, made up 91.7 per cent of the acreage devoted to hard red winter wheat. At that time, therefore, over 36 per cent of the entire wheat acreage was devoted to Turkey. This type of wheat was first brought to the United States in 1873 and was grown in Kansas.[8] Since that time numerous introductions have been made both by private and by public agencies. Other names that have been applied to the type are Alberta Red, Argentine, Bulgarian, Crimean, Defiance, Egyptian, Hard Winter, Hundred-and-One, Hungarian, Improved Turkey, Kharkoff, Lost Freight, Malcome, Malakof, Minnesota Red Cross, Minnesota Reliable, Pioneer Turkey, Red Russian, Red Winter, Romanella, Russian, Taurenian, Theiss, Turkey Red, Turkish Red, Ulta, Wisconsin No. 18, and World's Champion.

Recently certain strains of Turkey wheat have been distributed under other varietal names based on performance records and slight morphological differences. It has been long recognized that there are both morphological and physiological differences between certain of these Turkey strains. Sherman[9] and Oro[10] are two such wheats.

The Turkey wheats have been an important source of varieties resistant to bunt (*Tilletia tritici*), for genetic studies and for the production of other resistant varieties. Of the 17 most resistant varieties discovered by Tisdale and his co-workers,[14] 11 were Turkey wheats. Two others, Banner Berkeley and Ridit, resulted from hybrids that had Turkey for

[19]

one parent. Kiesselbach and Anderson[12] isolated 12 resistant lines from
Turkey (South Dakota 144) wheat. Other lines showed varying amounts
of smut up to more than 90 per cent.

The genetics of bunt resistance has been studied by the present writer[7]
in 9 resistant varieties of wheat. Four of these—Turkey 1558, Turkey
3055, Sherman, and Oro—have been Turkey types. Two of the three
genetic factors found are represented in these wheats. Sherman has the
Martin factor,[7] whereas Oro, Turkey 1558, and Turkey 3055 have the
Turkey factor.[7]

TABLE 1

ANNUAL PERCENTAGES OF BUNT INFECTION AT DAVIS, CALIFORNIA, IN THE PARENT
WHEAT VARIETIES DURING THE YEARS INDICATED

Parent variety	Percentage of bunted plants						
	1929	1930	1931	1932	1933	1934	Average
Turkey 1558B...............	0.0	1.1	0.0	1.9	0.0	0.8	0.6
Turkey 2578................	0.0	2.9	1.9	0.0	0.0	1.3	1.0
Turkey 3055................	0.1	2.0	1.2	1.8	0.1	0.3	0.9
Martin.....................	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Selection 1403..............	....	0.0	0.0	0.0	0.0	1.4	0.3
Baart......................	....	....	47.2	85.5	66.0	84.4	70.8
White Federation...........	78.6	59.3	43.0	73.2	59.9	73.7	64.7

The inheritance of resistance to bunt has been studied in hybrids in-
volving two other resistant varieties of the Turkey type—namely, Tur-
key 1558B and Turkey 2578. The former is from a pure-line selection
made at Moro, Oregon, by Carleton R. Ball. The history of Turkey 2578
is unknown to the present writer.

EXPERIMENTAL RESULTS

The parental material and hybrid populations were grown in the field
at the University Farm, Davis, California. The methods of handling and
the inoculum used have been described in previous publications.[2-6] The
collection of bunt has been designated as physiologic race III of *Tilletia
tritici* by Reed[13] and physiologic form VIII by Bressman.[1]

The percentage of bunt infection in the parent varieties may be seen
in table 1.

The percentage of bunted plants in each case is based on 2 or more rod
rows. Usually 30 or more rows of the susceptible parent were grown, and
frequently 10 or more rows of the resistant parent were included. There
were 30 to 70 plants per row. The difference between resistant and sus-
ceptible parents is very marked.

Turkey 1558B and Turkey 2578 were crossed with Baart to determine

the number of bunt-resistant factors in each of these two resistant varieties. Crosses using these were also made with Martin, Turkey 3055, and Selection 1403 to test for the presence of the Martin, Turkey, and Hussar factor respectively. The last-named cross was grown only in F_2.

F_1 seeds were not inoculated, because of the small number available. Where F_2 plants were being grown as a source of seed to be inoculated in F_3, they were kept free from bunt in order to prevent the elimination of susceptible progeny by bunt in F_2.

TABLE 2

PERCENTAGE OF BUNTED PLANTS IN THE PARENTS AND IN F_2 OF THE CROSSES NAMED; DAVIS, CALIFORNIA, 1934

Parent or cross	Number of plants grown	Number of plants bunted	Per cent of plants bunted
Turkey 1558B	1,276	12	0.9
Baart	2,155	1,822	84.5
Turkey 2578	1,197	17	1.4
Martin	432	0	0.0
Selection 1403	345	5	1.4
Turkey	391	1	0.3
Turkey 1558B × Baart	711	236	33.2
Turkey 1558B × Martin	1,066	71	6.7
Turkey 1558B × Turkey 3055	389	4	1.0
Selection 1403 × Turkey 1558B	481	61	12.7
Turkey 2578 × Baart	827	310	37.5
Turkey 2578 × Martin	825	33	4.0
Turkey 2578 × Turkey 3055	811	27	3.3
Selection 1403 × Turkey 2578	501	48	9.6

F_2 populations of all the crosses were inoculated and grown in 1934 along with the F_3. Although F_2 data do not permit a complete Mendelian analysis, they do indicate the number of resistant factors present as well as their identity and effect.

The F_2 data, accordingly, are also included in table 2.

The classification of the F_2 plants on the basis of the bunt obtained in F_3 rows gives much more satisfactory data. These rows contained from 30 to 70 plants, usually about 50. In most cases this classification is certain and reliable. Concerning a few rows that fall near the minima there is some uncertainty; but these rows are relatively few (table 3).

The rows in the 0–5 per cent class for bunt infection were subdivided into those without any bunt and those with 1–5 per cent.

The hybrids with Turkey 1558B may be considered first. The distribution of rows in Turkey 1558B × Baart is shown in figure 1. The number of rows under the three modes is very near the 1:2:1 ratio. Accepting 12.5 and 47.5 as minima, there are 60 resistant, 123 segregating, and 62 sus-

TABLE 3

DISTRIBUTION OF PARENT AND F₃ ROWS OF THE CROSSES NAMED INTO 5 PER CENT CLASSES FOR BUNT INFECTION; DAVIS, CALIFORNIA, 1934

Parent or cross	Distribution of rows having a bunt infection (per cent) of —																					Total number of rows
	0	1-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100	
Turkey 1558B	8	8																				16
Turkey 2578	7	9																				16
Baart															2	1	6	8	18	6	1	42
Martin	8																					8
Turkey 3055	7	1																				8
Turkey 1558B × Baart	52	29	18	12	13	27	30	21	18	6	4	7	6	10	8	12	8	6	3			245
Turkey 1558B × Turkey 3055	50	40	16	3	1	1	3	1	1	0	1	2	0	0	0	1						113
Martin × Turkey 1558B	14	23	16	8	7	5	20	19	18	9	11	10	5	14	8	6	7	2				118
Turkey 2578 × Baart	69	21	22	11	11	20	30	19	18	9	11	10	5	14	8	6	7	2				255
Turkey 2578 × Turkey 3055		37	10	3	2	2	0	1	0	3	0	0	0	0	0	1						121
Martin × Turkey 2578	48	24	21	16	1	1	0	0	0	0	1	1	0	0	0	1						119

ceptible rows where 61.25, 122.5, and 61.25 are the numbers expected. Turkey 1558B therefore differs from Baart in one major factor for resistance to bunt. Both F_2 and F_3 data indicate that resistance is incompletely dominant.

The identity of the factor for resistance to bunt in Turkey 1558B is established by the cross with Turkey 3055, the tester for the Turkey factor. No susceptible rows occurred in a population of 113 rows which
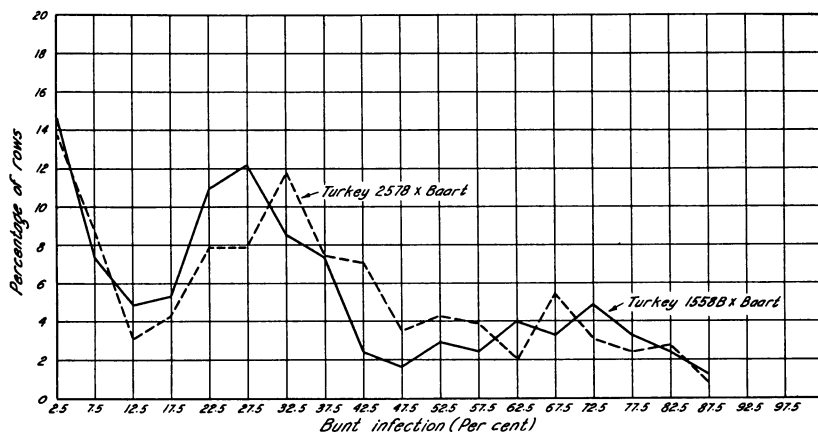

Fig. 1.—Distribution of F_3 rows of Turkey 1558B × Baart and Turkey 2578 × Baart into 5 per cent classes of bunt infection.

shows that Turkey 1558B is identical with Turkey 3055 as regards its major factor for resistance to bunt and therefore has the Turkey factor for resistance.

The hybrids with Turkey 2578 may now be considered briefly. The distribution of rows in Turkey 2578 × Baart (fig. 1) resembles that of Turkey 1558B × Baart. If we accept 12.5 and 47.5 as minima, the agreement with the 1:2:1 ratio is very close. There is not a very clear-cut minimum at 47.5. In practically all other crosses between resistant and susceptible varieties, however, there has been a fairly well-defined minimum in this region. If the susceptible and segregating rows are added together, a very good 3:1 ratio is obtained. Further evidence that the resistance of Turkey 2578 results from a single factor is furnished by the cross with Martin. There are 3 susceptible rows in a population of 119—a satisfactory agreement with the 15:1 ratio. The value of P is between 0.1 and 0.2. The segregation is similar to that obtained in the cross of Martin × Turkey 1558B and in other crosses where the Martin and Turkey factors were present. In view of these considerations, the

data indicate that Turkey 2578 differs from Baart in one major factor for resistance to bunt. Here again, resistance is incompletely dominant.

The identity of the factor for resistance to bunt in Turkey 2578 is established by the cross with Turkey 3055. There were no susceptible rows in a population of 121 rows.

DISCUSSION AND SUMMARY

Both Turkey 1558B and Turkey 2578 were found to depend on the Turkey factor only for their resistance to bunt. This now makes a total of five varieties found to have the Turkey factor.[7] All are of the Turkey type of wheat.

One variety, Sherman, of the Turkey type has been found to have the Martin factor for resistance. Thus two of the three major factors discovered by the writer[7] are known to be present in Turkey wheats. It should be relatively easy, accordingly, to combine these into a single variety of the Turkey type.

LITERATURE CITED

[1] BRESSMAN, E. N.
    1931. Varietal resistance, physiologic specialization and inheritance studies in bunt of wheat. Oregon Agr. Exp. Sta. Bul. **281**:1–44.

[2] BRIGGS, F. N.
    1926. Inheritance of resistance to bunt, *Tilletia tritici* (Bjerk.) winter, in wheat. Jour. Agr. Research **32**:973–90.

[3] BRIGGS, F. N.
    1930. Inheritance of the second Hussar factor for resistance to bunt, *Tilletia tritici*, in Hussar wheat. Jour. Agr. Research **40**:225–32.

[4] BRIGGS, F. N.
    1930. Inheritance of resistance to bunt, *Tilletia tritici*, in White Odessa wheat. Jour. Agr. Research **40**:353–59.

[5] BRIGGS, F. N.
    1931. Inheritance of resistance to bunt, *Tilletia tritici*, in hybrids of White Federation and Banner Berkeley wheats. Jour. Agr. Research **42**:307–13.

[6] BRIGGS, F. N.
    1932. Inheritance of resistance to bunt, *Tilletia tritici*, in crosses of White Federation and Turkey wheats. Jour. Agr. Research **44**:121–6.

[7] BRIGGS, F. N.
    1934. Inheritance of resistance to bunt, *Tilletia tritici*, in Sherman and Oro wheat hybrids. Genetics **19**:73–82.

[8] CLARK, J. ALLEN, JOHN H. MARTIN, and CARLETON R. BALL.
    1923. Classification of American wheat varieties. U. S. Dept. Agr. Dept. Bul. **1074**:1–237.

[9] CLARK, J. ALLEN, H. H. LOVE, and E. F. GAINES.
    1926. Registration of improved wheat varieties. Jour. Amer. Soc. Agron. **18**:922–35.

[10] CLARK, J. ALLEN, J. H. PARKER, and L. R. WALDRON.
    1928. Registration of improved wheat varieties, III. Jour. Amer. Soc. Agron. **20**:1318–22.

[11] CLARK, J. ALLEN, *et al.*
    1929. Distribution of the classes and varieties of wheat in the United States. U. S. Dept. Agr. Dept. Bul. **1498**:1–68.

[12] KIESSELBACH, T. A., and ARTHUR ANDERSON.
    1930. Breeding winter wheats for resistance to stinking smut. Nebraska Agr. Exp. Sta. Research Bul. **51**:1–22.

[13] REED, G. M.
    1928. Physiologic races of bunt of wheat. Amer. Jour. Bot. **15**:157–70.

[14] TISDALE, W. H., *et al.*
    1925. Relative resistance of wheat to bunt in the Pacific Coast states. U. S. Dept. Agr. Dept. Bul. **1299**:1–22.