The Effect of Bunt Incidence on the Yield of Wheat in Eastern Washington

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S TINKING smut or bunt of wheat (Tilletia caries (DC.) Tul. and T. foetida (Wall.) Liro) is the most important disease of wheat in Eastern Washington. Bunt losses arise from (a) reduction in yield, (b) dockage due to smutty grain, and (c) cost of seed treatment. Recently, increased interest in bunt has developed because of large acreages of susceptible varieties. The purpose of this study was to determine the effect of bunt incidence on yield losses under Eastern Washington conditions.

LITERATURE REVIEW

Yield reduction in wheat caused by bunt varies widely, depending upon the variety and type of reaction involved. It has been rather generally accepted that in highly susceptible varieties reduction in yield is approximately proportional to percentage of smutty heads, whereas in some resistant varieties an inverse relationship exists.

Heald and Gaines (4) compared wheat yields from tests having 1 to 30% smutty heads with those having 31 to 71% smutty heads. Results showed that an average difference of 25.8% bunt infection reduced yield 23%.

Flor, et al. (2) studied the effect of bunt incidence on yields of three varieties: Hybrid 128, susceptible; Turkey, moderately susceptible; and Ridit, resistant. An average of 16.2% bunt infection in Hybrid 128 caused a 20.5% reduction in yield, while an average of 30.3% bunt infection in Turkey reduced the yield by 23.1%. In Ridit, an average of 1.13% bunt infection decreased yield by 11.3%.

Leuel (6) found that an average of 39% bunt infection reduced yield 32 per cent.

MATERIALS AND METHODS

Elgin (C.I. 11775) and Federation (C.I. 4734) wheat varieties and their backcross derivatives, Elmar (C.I. 12392) and Federation 41 (C.I. 12250), respectively, were used in this study. Yield differences under disease-free conditions between original varieties and back-cross derivatives obtained from them usually are not significant. Presumably, the main differences between the original varieties employed and their back-cross derivatives were in their bunt reactions to specific races. Variations in the level of bunt incidence were obtained by mixing the susceptible variety and the resistant back-cross derivative in 10% increments from completely susceptible to completely resistant, and then inoculating the mixtures with the bunt race or races which attacked only the susceptible component. It was assumed further that there was no competition between the components of the mixtures. Elgin-Elmar mixtures were used for fall seeding and Federation-Federation 41 mixtures were used for spring seeding.

Heald (3) and Mackie and Briggs (7) had shown earlier that 1 gm. of freshly ground smut per 100 gm. of seed was sufficient to produce maximum infection. This proportion of bunt to seed was used in the trials reported here. The race or races of bunt used with each pair of varieties was selected from table 5 of Rodenliner and Holton (8). Races were used which produced a high level of bunt infection in the susceptible variety but little or none in the resistant back-cross derivative.

A preliminary trial with Federation-Federation 41 mixtures, inoculated with race L-9 of bunt, was planted in the spring of 1951. The seed was planted early and fairly deep in order to get maximum infection. This nursery was seeded in 14-foot single row plots with border rows of Marfed to provide constant competition on each side of the plot. Twelve feet were harvested in each plot. The numbers of smutty and healthy heads were counted prior to threshing. The grain weight of individual plots was recorded after threshing.

An Elgin-Elmar nursery was planted at Pullman in the fall of 1951. These mixtures were inoculated with race L-9 of bunt. The border rows consisted of Brevo. Individual plots were 10-foot single rows from which an 8-foot length was harvested for smut counts and yields. This plant procedure was followed in all nursery trials conducted in 1953.

In the fall of 1952 Elgin-Elmar mixtures were planted at Pullman, Pomeroy, Walla Walla, and Fairfield. Mixtures in these nurseries were inoculated with a composite of races, L-1, L-8, T-1, T-14, and T-16. Elgin is highly susceptible to these races, while Elmar is resistant. Federation-Federation 41 mixtures, inoculated with race L-10 of bunt, were planted at Pullman and Lind in the spring of 1953.

Plots in the outlying nurseries were cut at harvest and wrapped in paper to prevent shattering and loss of heads. The nurseries were arranged in a balanced incomplete block, Cochran and Cox (1), plan 11.20, and were analyzed without recovery of inter-block information. The treatment variation was partitioned into a linear regression component and deviations therefrom.

The regression coefficient (b) for each nursery was calculated, using the average percentage of smut for each treatment as the independent variate (X), and the average yield in grams for the corresponding treatments as the dependent variate (Y). Snedecor (9) the regression coefficients were converted from grams per plot to bushels per acre. Confidence limits at the 5% level were calculated for each regression coefficient.

RESULTS

The linear regression of yield on percentage of smut for each of the nurseries is presented in figure 1. The analysis