The Use of F₂ Lines in Predicting the Performance of Selections in Two Barley Crosses

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The bulk hybrid and pedigree methods of plant breeding both have been used extensively in the development of small grain varieties. The bulk hybrid system involves selection between a series of crosses on the basis of their bulk yield performance in early generations. This is followed by selection within the desired crosses in later generations. Its success as a plant breeding method is controversial (1,4,5). In contrast the pedigree method involves visual selection between strains within crosses until the F₄ and F₅ before yield tests are conducted. Obviously a great deal of time is spent in taking notes upon and propagating many poor yielding strains in the first five generations. So each method has its shortcomings: the bulk hybrid method is not always successful and the pedigree method involves the waste of considerable effort spent in propagating poor yielding strains. A modified plant breeding procedure involving the desirable features of each method would be highly beneficial to small grain breeders.

The study reported herein was designed to determine the relationship between the performance of F₂ derived lines and random selections from them in two barley crosses. The criteria of performance were yield, test weight, heading date and plant height.

MATERIALS AND METHODS

Two barley crosses, Kindred × Bay and Stewart × Bay, were made in the field in 1948 and the F₁ plants grown in the greenhouse. The F₂ plants grown in the field in 1949 were harvested and threshed individually. F₃ progenies from the Kindred × Bay cross were tested for stem rust reaction, and 39 homoyzous for resistance were retained. In the Stewart × Bay cross, 51 randomly selected F₂ progenies were retained. In 1950, each of the 90 F₃ progenies from the two crosses were planted in a row of 25 space-planted seeds. Three randomly selected F₄ plants from each row were harvested and threshed individually, and the remaining plants in each row were bulk threshed to continue the F₅ derived lines. In 1951, 90 F₅ derived lines (now in the F₆ generation) plus Bay and Kindred varieties each entered three times, Stewart twice and Montcalm and Moore each once, were planted in a randomized block design with four replications. Plots were single rows 8 feet long, spaced 1 foot apart. The F₆ selections were planted to increase the seed supply of each.

In 1952, the same 100 entries grown in 1951 plus 270 F₅ derived lines (in the fifth generation) were planted in a split plot randomized block design with four replications. The major plots, each containing an F₆ derived family were divided into four subplots of 1 by 8 feet. The F₇ derived line and three F₅ derived lines in each family were assigned at random to the subplots.

Yields were recorded in grams per plot and plant heights as the number of inches from the ground surface to the awn tips. Date of heading was recorded when 50% of the plants had completely emerged. In this study, test weight refers to weight of grain in grams in a level full 25 ml beaker. Relative values not directly comparable to pounds per bushel.

Experimental Results

In the 1951 test, except for yield in the Kindred × Bay cross, there was significant variation among parental varieties for characteristics in both crosses. Similar results were obtained between families in the 1952 test. The differences among F₂ derived lines within families were significant in the Stewart × Bay cross and for test weight of heading in both crosses, but not for yield in the Kindred × Bay cross or plant height in either cross.

In analyzing the 1952 experiment, several methods of comparison that could have been used to determine whether the performance of F₂ derived lines could be used to predict the performance of selections made within them. The method selected divided the F₂ derived lines into four groups on the basis of a two-way classification of the most desirable parental value for each characteristic, i.e. yield, test weight, etc., was chosen as the dividing line between desirable and undesirable performance strains.

Another arbitrary dividing line could have been made by using the parental value seemed to be the most practical. This method of comparison is illustrated for the Stewart × Bay cross in table 1. Bay variety yield of 122 grams per plot was the highest yielding variety. The sets of F₂ derived lines were divided on the basis of this value into plus and minus groups according to the F₂ derived lines from which they were selected. Those lines with yields lower than Bay, the three F₃ derived lines were placed in the plus group while for one yielding less than Bay, the three F₃ derived lines were placed in the minus group.

The F₃ derived lines so placed in each group were divided on the vertical axis on the basis of the parental value and the F₆ derived line.

Table 1.—Classification of the yields of F₂ lines and F₆ derived lines from the Stewart × Bay cross in relation to the yield of Bay variety.

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