A Study of the Combining Abilities of Corn Inbreds Having Varying Proportions of Corn Belt and Non-Corn Belt Germ Plasm

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CORN breeders have frequently suggested that the degree of heterosis is to some extent proportional to the genetic divergence of the parent inbreds. If this hypothesis is correct, increasing the genetic divergence of the inbreds by deliberate introduction of a certain proportion of exotic (non-corn belt) germ plasm should increase the hybrid yields. Relatively few studies have considered this possibility. The reason, perhaps, is the common belief that outcrossing elite corn belt inbreds to exotic material results in the reduction of standards for various agronomically important characteristics, thus making the modified material unacceptable for commercial use.

The problem of the utilization of non-corn belt germ plasm will be considered from the following viewpoints: (1) Can inbreds whose germ plasm is wholly or partially non-corn belt contribute to high yielding hybrids? (2) Can the general combining ability of a corn belt inbred be increased by the inclusion of some exotic germ plasm? (3) To what extent are certain agronomic characteristics altered in modified lines and their F1's? In other words, can a gain in general combining ability be made in a corn belt line by the inclusion of exotic germ plasm without drastic reduction of standards of important agronomic characteristics?

Generalizations concerning all aspects of the problem cannot be made from one experiment. Estimates of general and specific combining ability, for example, are made with respect to the particular lines studied. However, the results of this experiment do suggest that the problem is worthy of further consideration.

Three different classes of inbreds are used. The three classes are characterized by differing amounts and kinds of non-corn belt germ plasm. They are as follows: (1) Cycled lines—those utilizing only corn belt inbreds as primary source material; (2) Brazilian lines—those aclimated inbreds developed entirely from Brazilian material; (3) Exotic lines—those selections resulting from outcrossing corn belt inbreds to various Mexican varieties. For the experiment reported herein, three lines were chosen from each of three inbred classes, and the performance of the nine inbreds and all possible F1's was studied.

Choice of the three cycled lines was based to some extent on unpublished yield trial data of the late Dr. E. W. Lindstrom. No testing for combining ability was performed during the formation of these lines.

The three Brazilian lines were chosen from partially inbred material given to the Iowa State College Genetics Department in 1947 by Dr. Americo Groszmann, who had been inbreeding this material at the Escola Superior de Agricultura, Viçosa, Minas Gerais, Brazil. Since 1947 the Brazilian lines have been inbred at Ames. Only a few of the lines have survived, and of these, three of the best appearing were included in this experiment. The exact origin of the material is unknown. It is probable that the bulk of the germ plasm traces back to southern United States dent corn inbred into Brazil, aclimated to Brazilian conditions, and contaminated to various degrees by native corn types.

The three exotic lines represent the best appearing lines resulting from outcrossing corn belt inbreds to exotic material, a relatively small program initiated by Dr. Lindstrom.

The cycled and exotic lines have been synthesized from various sources of germ plasm as indicated in table 1. In order to elucidate the fractions in table 1, consider the formation of lines C1 and E1. In both C1 and E1, the second cycle line KR(OST) was used as a recurrent parent. It was formed as follows: the F1 between Krug 187, (KR), and OST 420, (OST), was backcrossed to KR. The successive progeny were selfed or sibbed to form the second cycle line KR(OST). KR(OST) was then outcrossed to 38-11 in the case of C1, and to Mex V in the case of E1. Both F1's were backcrossed to KR(OST) and the progenies were inbred. Assuming that selection during the inbreeding phases did not materially change the relative proportions of the various germ plasm entering into the composition of the third cycle lines, we find the fractions of the different germ plasms as those given in table 1.

The experimental design consisted of six randomized blocks, each containing one plot of each inbred and all possible F1's. The inbreds were restricted to a small sub-block which was randomly situated in the larger F1 block. The inbreds were bordered by Golden Bantam sweet corn, and the F1's were bordered by a commercial double cross. Each plot contained 12-13 plants and the stand was exceptionally good. The plants were spaced singly about 1 foot apart. This allowed individual plant data to be taken. The ears were air-dried to constant humidity in the fall and winter of 1951 and shelled the following spring.

EXAMINATION OF DATA

Comparisons of Yields of Hybrids Having Different Proportions and Kinds of Non-Corn Belt Germ Plasm

The first question considered, can inbreds whose germ plasm is wholly or partially non-corn belt contribute to high yielding hybrids, received a partial answer in a comparison of the yields of hybrids involving different proportions and different kinds of exotic germ plasm.

An examination of yields of the inbreds themselves (see table 2) shows: (1) considerable variation in yield occurs between lines within groups; (2) inbred yields between groups overlap; and (3) inbreds E1 and E2 rank first and third respectively among the inbreds tested, indicating that the exotic inbreds can be relatively good yielders.

An examination of the rankings of the F1 yields (see table 3, column 3) shows that 13 out of the 14 highest ranking F1's have at least one exotic inbred (E1, E2, or E3) as a parent. Of these 13 F1's, 12 (those with ranks 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, and 14) have either E1 or E2 as at least one parent.