A Comparison Involving the Number of, and Relationship Between, Testers in Evaluating Inbred Lines of Maize

KENNETH R. KELLER

There are differences of opinion among maize breeders on the type of tester best suited to evaluate inbred lines of maize. The choice of a tester depends upon the use to be made of the lines. A suitable tester should detect inherent differences in the combining ability of the lines. The use of two or more testers in evaluating a group of lines permits comparisons of (a) their ability to rank the lines similarly and (b) their within tester × line variances.

Lindstrom (15) suggested four limitations in explaining the failure to obtain inbred lines approximating open-pollinated varieties in vigor: (a) a very large number of genes involved, (b) the masking effects of environment, (c) a complex and intricate system of gene interaction, and (d) inadequate methods of isolating and evaluating lines. The data presented in this paper are applicable to the fourth limitation.

Review of Literature

Numerous workers have presented information on the productivity and association of characters of inbred parents in relation to their hybrid offspring (4, 6, 12, 13, 14, 16, 17).

The apparent inconsistency of correlation between characters of the inbreds and their performance in F1 crosses and the difficulty of making all possible combinations among a large number of lines suggested other methods for evaluating lines. The top-cross test discussed in detail by Jenkins and Brunson (9) has become widely accepted as a means for evaluating combining ability. Johnson and Hayes (10) studied the reliability of top crosses to determine the combining ability of inbred lines of sweet corn. They reported that inbred lines that gave high yields in top crosses were more likely to produce better single crosses. The same authors (11) later reported on the combining ability of inbreds developed by inbreeding first generation hybrids and concluded that combining ability was an inherited character. Cowan (1) and Green (3) reach a similar conclusion. Jenkins (7) suggested that inbred lines acquired their individuality for combining ability very early in the inbreeding process and remained relatively stable thereafter. Sprague (19) concluded that the greater variance for “among” as contrasted to “within” families provided an indication of the accuracy of the first period of testing in isolating new lines. Green (3) suggested the use of a covariance analysis. The 1947 yields were computed from the field weights of the ear corn in pounds adjusted for stand differences and for parts of the experiment by waterspillage. The 1947 yields were computed from the field weights of the ear corn in pounds adjusted for stand differences and for missing hills. All yields were converted to bushels containing 15.5% moisture. Correlation analysis in estimating the inter-relationship of testers for combining ability.

Materials and Methods

A bulk planting of F2 seed from a single cross was made in 1941. Selected plants were selfed simultaneously to the parental and to an unrelated tester (R4 × Hy). Top cross yield trials of 98 individual F3 crosses with the parental and unrelated testers were conducted in separate experiments the following year. The top-cross trial included the 98 individual F3 plants (R4×ITE701), an entry from the bulk F2 population, and a single cross. The top-cross test with the unrelated tester, the 98 F3 plants × (R4×Hy), the F1, and the double cross (R4×ITE701) × (R4×Hy). The field designs were double lattice designs six replications.

From frequency distributions for yield in the seriated sample of 17 lines covering the yield range of 1944 yields in bushels per acre were computed from the field weights of the ear corn in pounds adjusted for stand differences and for missing hills. All yields were converted to bushels containing 15.5% moisture. Correlation analysis in estimating the inter-relationship of testers for combining ability.