THE APPLICATION OF RECIPROCAL SELECTION FOR INCREASING YIELDING ABILITY OF A MAIZE DOUBLE CROSS

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Prima facie it appears that single cycle of reciprocal selection was not effective in improving the yield of a good double cross hybrid as proposed by the authors of the scheme. However, being at par in this regard, it has the added advantage of easy utilization on commerical scale.

While suggesting the reciprocal recurrent selection method for simultaneous improvement of general as well as specific combining ability, Comstock *et al.* (1949) discussed theoretical aspects of the use of the method for the improvement of an adapted double cross hybrid. Based on the fact that advanced generation of single crosses of a double cross produces as good combinations as the single crosses themselves, it was visualized that reciprocal selection applied to such generations would improve the hybrid. Lonnquist *et al.* (1956) extended the use of the method for the improvement of synthetics and practised several selection cycles. Douglas *et al.* (1961) described the procedure as the most promising method for increasing the gene frequencies in a heterozygous population. Thomas and Grissom (1961) obtained greater mean values of the two populations of popcorns for yield, popping volume and lodging resistance. The present paper reports a similar study for the improvement of a well adapted commercial double cross hybrid No. 59.

MATERIAL AND METHODS

Single cross parents (S. C. 93 and 85) of the double cross No. 59 were selected in F_2 generation to serve as the source material for reciprocal selection. One hundred plants were selected, on the basis of desirable characters, from each source. Reciprocal selection cycle was run as suggested by Comstock *et al.* (1949). The selected plants were simultaneously selfed and out-crossed to 5 plants taken at random. Giving allowance for the mortality and other factors, only 80 selfed plants along with their respective out-crosses were harvested after maturity from each source. The seed of the 5 out-crosses was mixed and 81 representative samples (including one check) from the respective sources were taken for field evaluation. A yield trial was laid out in a quasi-factorial design, to test the combining ability of each source. Data on yield

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per plant (dry grains) were recorded and analysed statistically.

The selfed parents of the 10 top yielding hybrids of each source were selected to build up the two parental stocks, for the development of a hybrid, taking one source as male and the other as female. The hybrid thus obtained was tested against regular hybrid No. 59 and the local open pollinated maize variety.

EXPERIMENTAL RESULTS AND DISCUSSION

(1) Grain yield for top crosses between F_2 of single cross 85 and single cross 93.

In the frequency distribution (Fig. 1), mean value of the check 1.75 pounds per plot was used as the zero class value, and the other classes were separated by the critical differences at 5 per cent each side. The distribution showed that all, but three top crosses, had better yield than the check by an amount greater than one time the critical difference. Ten of the top crosses showed an increase of yield by an amount greater than twice the critical difference over the check yield. Twenty-three crosses differed by an amount up to two times the critical difference and the remaining surpassed by an amount up to one critical difference. On the basis of good performance (Fig. 2), the top ten Nos. 65, 55, 11, 41, 5, 42, 19, 49, 43 and 25 were selected to build up the first synthetic source material "A'.

(B) Grain yield for top crosses between F_2 of single cross 93 and single cross 85.

The mean value of check in the frequency distribution (Fig. 3) was 2.07 pounds, which represented the zero class value. The distribution showed that 74 crosses had greater yield by an amount over one time the critical difference and seven had lower yield by similar difference. The top yielding ten crosses, namely Nos. 81, 77, 19, 63, 57, 58, 53, 54, 55, and 61, the values of which were more than four times the critical difference over the check (Fig. 4) were selected for source material "B".

The dry grain yield per plot and per acre for the synthetic hybrid developed after reciprocal selection and double cross hybrid No. 59 and the local open pollinated variety are detailed in Figures 5 and 6. The analysis showed that the differences of means between hybrids and the local variety were highly significant. The highest grain yield 22.40 lb. per plot (or 3713.60 lb/acre) was recorded in regular double cross hybrid No. 59 which was at par with the synthetic hybrid which yielded 22.16 lb per plot (3472.80 lb per acre). Both the hybrids were significantly better than the local open pollinated variety which yielded 17.90 lb per plot (3086.40 lb per acre).

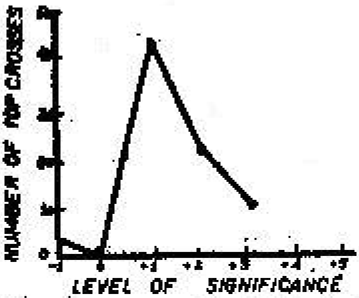

Fig. 1. Frequency distribution for the grain yield of 81 top crosses (SC 85 × 93)

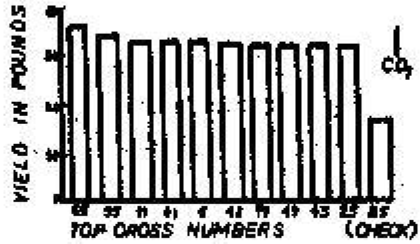

Fig. 2. Yield of selected ten lines for source material "A".

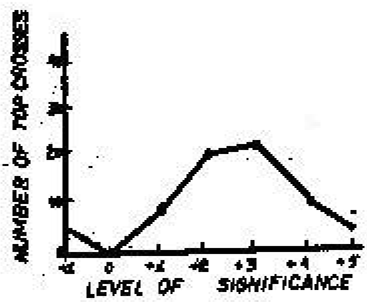

Fig. 3. Frequency distribution for the grain yield of 81 top crosses (SC 93 × 85).

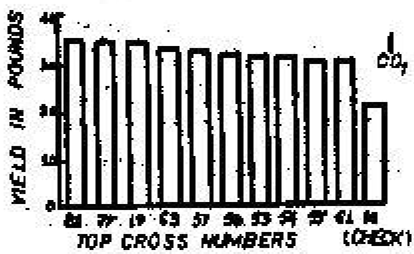

Fig. 4. Yield of selected ten lines for source material 'B'.

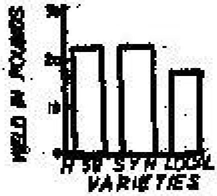

Fig. 5. Dry grain yield per plot in pounds.

Fig. 6. Dry grain yield per acre in pounds.

Jenkin (1940) proposed the method for the production of synthetic by evaluating the lines in top cross performance. This method was further adapted by Hayes *et al*. (1944), Kinman and Sprague (1945) and Lonnquist (1949) with positive results. Lonnquist and McGill (1956) further tried to improve the synthetics by running reciprocal selection cycle and concluded that the productivity could be maintained in the advanced generations.

In the present studies the synthetic hybrid developed after reciprocal selection was almost as productive as the double cross No. 59 and both the hybrids significantly outyielded the local open pollinated variety. The results are in agreement with those obtained by Garber (1931), who compared the synthetic with local open pollinated variety and found it superior by +16.5 per cent. Kiesselbach (1930) compared the synthetic in F_1 and F_2 with a local open pollinated variety and found it superior in both the generations. Lonnquist *et al*. (1956) stated "although several hybrids were higher yielding than the "Davis synthetics "but none was significantly high yielding." Hayes *et al*. (1944) reported similar results about "Minhybrid" which was found equal to synthetic in yield and other characters. The present studies confirm these findings. The evidence leads to the conclusion that synthetic hybrid developed after one cycle of reciprocal selection from advanced generation single crosses, was equal in performance to Hybrid No. 59 developed from fresh F_1 single crosses.

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