PIONEER HI-BRED CORN COMPANY
Department of Plant Breeding
Johnston, Iowa

1. Fertility restorer genetics.

Three progenies from the S_1 of the backcross: WF9(WF9 x KY21) have been obtained which when crossed to the male-sterile line $SK2^T$ give all fertile progeny but which when crossed to the male-sterile line $WF9^T$ give all male-sterile progeny. This is a confirmation of the hypothesis (Duvick, in Genetics 41:544-565, 1956) that fertility restoration in T cytoplasm depends upon the simultaneous presence of at least two dominant genes, either of which, if present as a homozygous recessive, can cause sterility. Thus, the genotypes of the various lines involved herein are presumed to be as follows:

SK2	$rf_1rf_1Rf_2Rf_2$
WF9	$rf_1rf_1rf_2rf_2$
KY21	$Rf_1Rf_1Rf_2Rf_2$
Selected S_1 of BC	$Rf_1Rf_1rf_2rf_2$

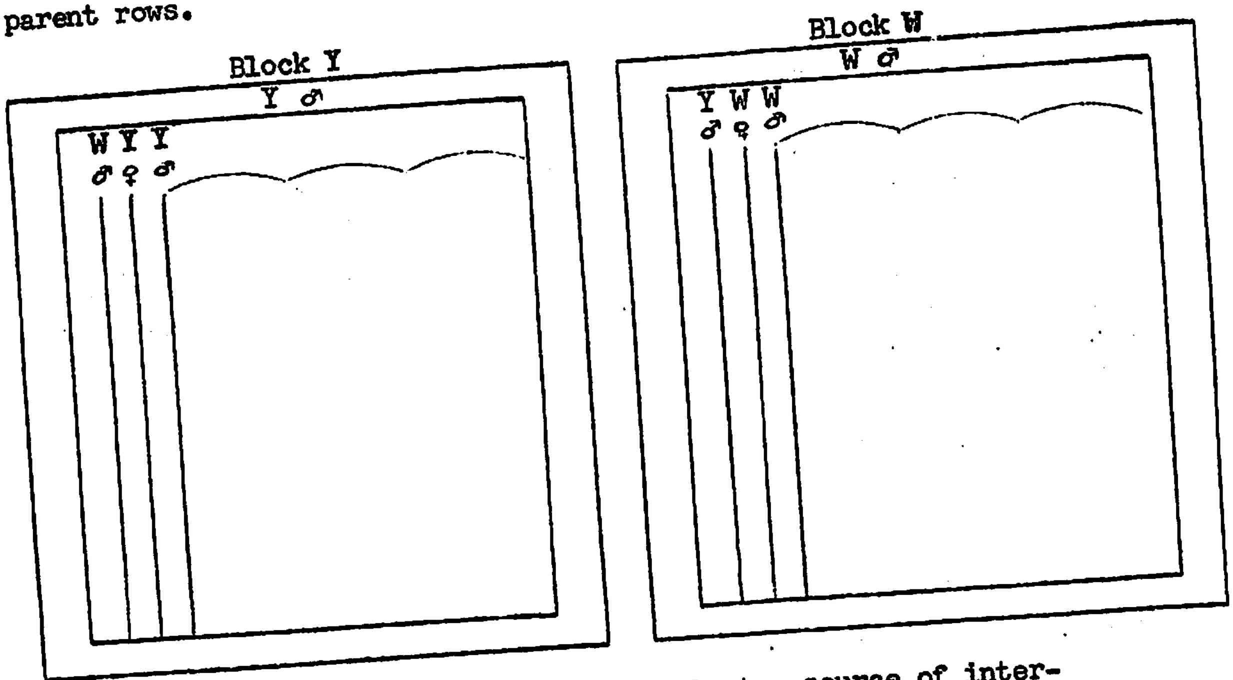
Donald N. Duvick

2. Rapid recurrent and reciprocal selection.

By use of genetic markers displaying incomplete dominance of simply inherited kernel characteristics, it should be possible to complete cycles of selection requiring progeny tests in less time than hitherto reported (see Hull, Agron. J. 1945 and Comstock et al., Agron. J. 1949). This modification of conventional recurrent and reciprocal methods is herein outlined and designated as the rapid method.

Three crop generations are ordinarily required per cycle in conventional recurrent or reciprocal selection for yield in corn. These consist of (1) making test crosses, (2) growing test crosses, and (3) intercrossing the parent lines of the best test crosses. The rapid method hinges on the ability to separate outcrossed and intercrossed seed on single ears or groups of half sib ears (half sib ears are from sister plants pollinated by non-sister plants). This separation of seed effectively allows the combining of crop generations (1) and (3) above. The following example utilizes endosperm color as a marker in a reciprocal selection program. The rapid method for recurrent selection would be similar but requiring only one isolation plot.

Year 1. Two isolation plots (herein designated Y and W) will be necessary. Isolation may be spatial or bordered by pollen parent rows.



Y ♀ = detasseled yellow endosperm plants, source of intercross and tester ovules in Y block.
W ♀ = detasseled white endosperm plants, source of intercross and tester ovules in W block.
Y ♂ = normal yellow endosperm plants, source of tester pollen in W block and intercross pollen in Y block.
W ♂ = normal white endosperm plants, source of tester pollen in Y block and intercross pollen in W block.

The only operation necessary during the pollination season will be the detasseling of female rows. Hand pollinations will <u>not</u> be necessary.

Only ears from female rows will be harvested. The seed will be divided as follows:

Block Y { pale endosperm = test cross (Y x W) seed
yellow endosperm = intercrossed (Y) seed

Block W { pale endosperm = test cross (W x Y) seed
white endosperm = intercrossed (W) seed

It is necessary to label seed from each ear or from groups of half-sib ears in order to later retrieve selected remnant intercrossed seed.

Year 2. Two field trial comparisons of the progeny resulting from Year 1 will be conducted; i.e. one trial for testcross progeny (pale seed) from Block Y and a trial for test cross progeny (pale seed) from Block W. As previously indicated individual entries may consist of either seed from individual ears or bulked seed from groups of half sib ears. After scoring the test crosses for yield or other agronomic characteristics one cycle has been completed.

Year 3, 4, 5. Another cycle may be initiated by utilizing superior (on the basis of Year 2 field trials) remnant intercrossed seed from Year 1 (yellow endosperm from Block Y and white endosperm from Block W). Additional cycles would be warranted as long as sufficient variability remains in the two populations.

Selection pressure per cycle is reduced in this rapid method as compared to the conventional reciprocal method due to selection only upon the seed parents in a given cycle. Essentially the selection of the pollen parent lags one cycle behind that of the seed parent. With random pollination, the genotypes of each cycle will average midway between the mean of its preceding cycle and the mean of the selected female parents.

Ultimate gain may be favored by the rapid method due to delayed selection on the pollen parent. This delay allows a more thorough "mixing" of germ plasm and therefore more recombinations and slower fixation than the conventional recurrent and reciprocal method involving selfing at the time of outcrossing. Furthermore, the absence of selfing would allow a prescreening of maternal plants on the basis of their individual or half sib group performance in the isolation blocks. This selection would be primarily for favorable dominant and additive effects.

Pollination expenses would be reduced with the rapid method as would gross mechanical errors, due to the elimination of hand-bagged pollinations. Efficient breeding nurseries are predesigned to make the most pollinations in the least amount of time. Time is more critical during the pollinating season than any other comparable period throughout the year. In addition, the chance for gross mechanical errors (misguided pollinations) is materially reduced. The conventional reciprocal method offers appreciable chance for mechanical error.

Winter programs are in use by most organizations having programs involving reciprocal and recurrent selection. By growing a winter crop the three year program per cycle required by the conventional methods may be reduced to two years which is the minimum since the progeny test must be grown in the area of expected use of the developed hybrid. By the rapid method a cycle may be completed in one year by growing the isolation blocks for test and intercrossing during the winter.

If the breeder chooses to select on the basis of female plant or plants performance in the inter- and testcrossing blocks a maximum of only two years per cycle is involved.

Preliminary to the initiation of a program utilizing the rapid method, the following projects are planned:

1. To observe and test reciprocal crosses of white inbreds of different origin with yellow inbreds of different origin to examine the complexities of separating intercrossed and testcrossed seed.

2. To measure the combining ability of crosses within and among yellow and white lines to determine the relative merits of these sources of germ plasm.

A. Forrest Troyer

UNIVERSITY OF PRETORIA
Pretoria, Union of South Africa
Department of Genetics

1. Cytoplasmic factors and pollen tube growth of *Zea mays*, L.*

Competition of pollen tube growth is provided by making use of pollen mixtures from yellow and white sources (M. N. L. 1958). In this investigation the reaction of cytoplasm of the well known American Inbred 33-16 was subjected to further tests. Evidence obtained from the testing of pollen originating from single crosses where 33-16 functioned respectively as maternal and pollen parent, support the assumption previously made (M. N. L. 1958), that the deficiency in the performance of 33-16 pollen tubes in pollen mixtures is due to cytoplasmic factors. A significant heterogeneity in the ratios realized was observed when different maternal parents were used suggesting a strong maternal effect. This was also apparent, but to a lesser extent within inbreds of long standing which could be regarded as having attained a high degree of homozygosity. This study has revealed that pollen tubes are very sensitive to conditions in maternal tissue and thus may be a means to study the relative homogeneity of inbreds.

Similar results were obtained in the study of the inbred Mexico 155 and a local inbred C56.

* (In press, Proceedings of the First South African Genetic Congress, University of Pretoria, 1958).

J. D. J. Hofmeyr