T1980BRE28

EARLY SELECTION ON SUNFLOWER LINES USING MARKER GENES AND CROSS POLLINATION RATE

E. ALBA *

Hybrid seed production is one of the major goals in sunflower breeding. consequently, the selection of inbred lines on the basis of their combining ability, is the most delicate and important operation for breeding work.

For maize breeders, the early testing of the inbreds for combining ability first suggested by Jenkins (2) and later confirmed by Sprague (3), and Weilhausen (8), is of great interest.

Other workers (4, 6) expressed some doubts about the early testing procedure and asserted that selection during early generations, on the basis of top-cross tests, may cause an early elimination of lines which later could prove to be excellent. despite such contrasting opinions, early testing is being used extensively in maize for eliminating lines of low value.

In sunflower, the possibility of making early selection has been proposed by Shein (5). He showed that early testing enables identification of lines that may yield inbreds with good combining ability. the breeding method proposed by Jenkins has never been used for sunflower due to the different flower structure. for this reason, either the chemical emasculation method or male-sterile lines have been used so far. since the results obtainable by the former are quite uncertain and by the latter is expensive and labour-demanding, a simpler method is here envisaged for early testing.

The method is based on the use of a pollinating tester having a broad genetic base (either composite or synthetic) whose original lines are car riers of the gene couple (TT) conferring an anthocyanic colour to the seedlings even in the heterozygous state. hence exploi-

* Institute of Plant Breeding
University of Bari, Italy

ting the cross-pollination rate of this species, the lines (so-1) to be evaluated are sown a part in single rows. these must be alternate —at certain given ratios— with the tester rows. Upon flowering, all the plants in the fields are allowed to intercross freely (Fig. 1).

The ratio between the row lines for evaluation and the row tester may be established by a preliminary study of the amount of outcrossing occurring in the environment where testing will be carried out.

Naturally one has to consider that the amount of outcrossing may vary according to flowering time, pollen vectors and crop density.

The plants of thelines to be evaluated must be regarded as recipient plants from which seed for subsequent progeny tests have to be collected. progeny plots, replicated in the field and at different localities, are arranged in a way that the number of seeds placed in each hole is in agreement with the earlier estimated rate of outcrossing. Upon emergence, progeny plants with an anthocyanic colour are to be regarded as F_1 's, whereas normal plants are discarded. The data collected in the field on F_1 plants from emergence in harvesting, and later on in the laboratory, are then analyzed for estimating the lines combining ability. Consequently the best lines may be selected and used for successive inbreeding generations. A final evaluation and selection can then be made by means of *ad hoc* experimental designs.

It is also understood that the S_0 lines directly selected within populations can be used directly to obtain improved populations. Finally, using as a tester a good inbred line, possessing restorer and marker genes, it might be possible to select from among normal inbred lines those that possess high G.C.A. to which the male sterility can be transfered. Final male sterile lines could then be combined with the tester to produce new hybrids.

CONSIDERATIONS

Through the proposed method it should be possible to:

1) perform an early screening for G.C.A. among the initial (S_0-S_1) lines that were selected according to their phenotypic appearance;

2) perform a recurrent selection in order to improve populations that are believed to be of greater;

3) selected the best lines to which male sterility could be transferred and thereafter to combine them with the tester for hybrid production.

The method that can be applied to every outcrossing species with

good marker genes certainly recommends itself as being time-and money-saving. Infact, it enables work to be carried out on very many lines without making use of either male sterility or chemical emasculation method and avoiding therefore a lot of hand work for crossing and bagging the plants.

The success of the method obviously depends on the amount of outcrossing, the use of a good pollinating tester, and the lack of possible complementary gene action (among the lines being evaluate) with a phenotypic effect similar to that of marker genes. If complementary gene action is pressent it may become apparent at emerging time in the field. A high ratio of marked plants to normal plants in some of the progenies versus the average ratio of other progenies in the field may provide a valuable test.

Work supported by the National Research Council Finalized Project "Plant Breeding" - Subproject "Sunflower".

ABSTRACT

A method for early selection of sunflower lines without using male sterility or chemical emasculation or hand-made crosses and bagging heads before flowering, is reported.

The method is based on the pollination of the lines in evaluation with a good tester having dominant marker genes.

The resulting progenies are evaluated for yield and general agronomic performance.

Lines with poor combining ability are discarded and only the promising lines are inbred further.

REFERENCES

ALBA E., CARROZZO, G., 1979. Hybrid seed percentage in sunflower lines by means of a genetic marker. Ann. Fac. Agr., Bari (in press).

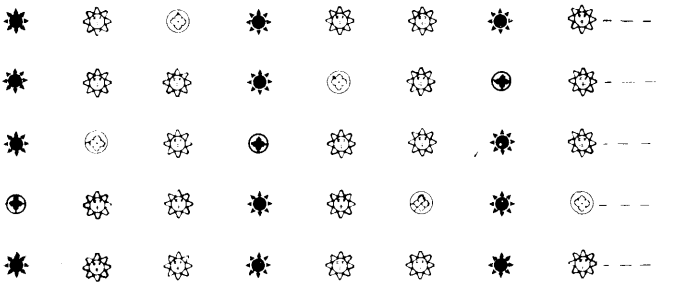
JENKINS M. T., 1935. The effect of inbreeding and of selection within inbred lines of maize upon the hybrids made after successive generations of selfing. IoWa State Coll. Jour. Sci. 3: 429-450.

LONNQUIST J. H., 1950. The effect of selection for combining ability within segregating lines of corn.
Agron. Jour.: 503-508.

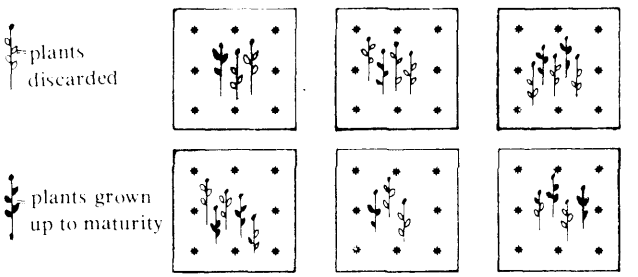
PAYNE K. T., and H. K. HAYES, 1949. A comparison of combining ability in F_2 and F_3 lines of corn.
Agron.[3] Jour., 41: 383-388.

SHEIN, S. E., 1978. An evaluation of early generation testing for general combining ability in sunflower.
Proc. 8th Int. Symp. Conf.: 432-436.
SINGLETON W. R., and O. E. NELSON, 1945. The improvement of naturally cross pollinated plants by selection in self-fertilized lines. IV. Combining ability of successive generations of inbred sweet corn. Conn. Agric. Exp. Sta. Bull. 490: 458-598.
SPRAGUE G. F., 1946. Early testing of inbred lines of corn.
Jour. Amer. Soc. Agron., 38: 108-117.
WELLHAUSEN E. J., and L. S. WORTMAN, 1954. Combining ability of S_1 and derived S_3 lines of corn.
Agron. Jour., 46: 86-89.

2 —*Cross pollination* between lines (So-S_1) ✿ and tester ✸ (having stored seeds of each line)



3 —*Progeny test trials.* Seeds of each cross (line x tester) are sown in replicated plots.



4 —The stored seeds of the lines selected on the G.C.A. basis are used for further breeding.

Figura 1.— Scheme for early of sunflower lines based on The use of marker genes and cross pollination rate.