AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

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1. SUBJECT CLASSIFICATION

A. PRIMARY: Agriculture — AF30-0120-0000

B. SECONDARY: Plant breeding--Cereals--Maize

2. TITLE AND SUBTITLE

Method for improving high-lysine populations of maize

3. AUTHOR(S)

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4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1972	5p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS

Purdue

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*

9. ABSTRACT

10. CONTROL NUMBER

PN-RAA-531

11. PRICE OF DOCUMENT

12. DESCRIPTORS

Lysine
Maize
Selection

13. PROJECT NUMBER

14. CONTRACT NUMBER

CSD-2809 Res.

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

METHOD FOR IMPROVING HIGH-LYSINE POPULATIONS OF MAIZE [1]

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ABSTRACT

This method combines half-sib selection for yield and S_1 selection for more vitreous endosperm and high levels of lysine. One begins with a sample of ears from an opaque-2 population with ample genetic variability. Seed from each ear is used as one entry in a yield trial at three locations and for one corresponding row in the breeding nursery. Plants in the rows of the breeding nursery are self-pollinated. Families are selected on the basis of the yield trial. Within selected families, selection is for more vitreous kernels and higher lysine.

Additional index words: *Zea mays* L., protein quality, selection, opaque-2, modifier genes.

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[1] Contribution from the Purdue University Agr. Exp. Station, West Lafayette, Indiana 47907. Journal paper No. 4933. This research is supported by the U. S. Agency for International Development through a contract entitled Inheritance and Improvement of Protein Quality and Content in Maize. Received for publication

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A number of different recurrent selection procedures have been proposed for the improvement of populations of maize (*Zea mays* L.). A summary of these procedures and the expected gain from each was presented by Empig, Gardner and Compton (2).

In 1964, Mertz, Bates and Nelson (4) reported the effect of the gene *opaque*-2 on the nutritional quality of maize protein. Numerous subsequent studies have confirmed the reduced zein levels, increased lysine and tryptophan levels, and improved nutritional value to humans and other nonruminant animals. This was reviewed by Harpstead (3). However, most *opaque*-2 varieties and hybrids developed to date compared to their normal counterparts tend to be lower yielding, more susceptible to ear rot, higher in moisture content at harvest, with relatively soft, "chalky" endosperm which may contribute to harvesting, storage and handling problems. This soft endosperm is also a major barrier to acceptance in areas where people are accustomed to flint and semi-dent types of maize (5).

The existence of modifying factors which reduce the soft, chalky characteristics and contribute to a more dense and vitreous kernel have been noted in a number of maize populations (1). It has also been found that some of these modifiers have little if any effect on lysine levels and nutritional quality, but others cause a reversion to near normal. Simultaneous selection for yield, vitreous kernels and high lysine levels appears to be the most promising approach.

The breeding scheme outlined here combines half-sib family selection for yield (and/or other important agronomic traits) and S_1 selection for more vitreous endosperm type and higher lysine level. Only two generations are required per selection cycle so that with a winter nursery, a cycle may be achieved every year. The general method might be best illustrated by the following specific example:

1. A random sample of 192 ears is chosen from an intermating population homozygous for opaque-2. Each ear will become an entry in a yield trial with one replicate planted in each of at least three locations distributed in the region for which adaptation is desired.
2. A 14 × 14 triple lattice design is suggested with plot size and shape conforming to the individual researcher's usual system. The original population and three locally adapted hybrids or varieties are used as checks. Any normal (non-opaque-2) checks should be carefully detasseled just prior to pollen shed.
3. One 20-plant row from each of the 192 ears is also planted in the breeding nursery. Twelve to 15 selected plants are self-pollinated in each row so that 10 ears can be harvested and dried.
4. The best 48 families (25%) are chosen in the yield trials. From each of the corresponding 48 rows in the breeding nursery, 4 self-pollinated ears with the most vitreous kernels

are visually selected.

5. A sample of each of the selected ears is analyzed for lysine (or tryptophan) and a short row of each (5 to 9 plants) is planted in the winter nursery. The analyses must be completed before pollination. Of the 4 rows representing each of the 48 families, the 2 with lower lysine are eliminated from the winter nursery. The researcher may wish to eliminate a few families entirely and compensate from other families. The remaining families are inter-pollinated.

6. At harvest of the winter nursery, 2 ears are selected from each of the remaining 96 rows and the next cycle initiated with these 192 ears.

Obviously the system is quite flexible. The basic number of families and number of testing locations may be changed. The selection intensity may be varied based on the yield trials, the visual selection for vitreous type or the lysine analyses. However, the final number of families and ears selected in each cycle should be great enough to avoid rapid loss of variability and excessive inbreeding.

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