
Introduction of Maize Hybrids to Areas Currently Using Open-Pollinated Varieties

Darrell Cox and Martin Price

One of the services ECHO provides to missionaries and development workers is a question & answer service. We recently received the following request from Kevin Sanderson, the country director for World Relief Nicaragua. [I am in need of] “a written technical opinion on the effect of introducing hybrid maize seed [*Zea mays*, corn] in areas where farmers normally use open-pollinated seed and save their seed from one year to the next.”

In the following paragraphs, you will find the technical reply that we pulled together as well as get an idea for how we utilize various resources to develop replies to questions that come from you (our network). In this case we phoned scientists at U.S. universities to supplement our in-house knowledge.

Kevin’s concerns are related to the potential impact cross-pollination between hybrid and open-pollinated varieties could have. As a part of the Hurricane Mitch recovery effort, a U.S. sponsored program was tasked with bringing in seed of basic grains for the spring planting season in response to the expected shortfall in available seed. The program decided to bring in hybrid white maize seed as a part of an assistance package to be distributed in a variety of areas to farmers who lost their seed due to the hurricane. This meant that hybrid white maize planted by farmers affected by the hurricane would be grown in proximity to open-pollinated maize being grown by other farmers.

Improved open-pollinated varieties of maize have been introduced to Nicaraguan farmers over the past few years to enable the farmers to benefit both from the higher yields and the ability to save seed that can be planted in a subsequent season (without having to purchase new seed from a dealer). This is in contrast to hybrid varieties for which it is recommended that new seed be purchased every year because there is a yield decline when saved seed is planted. Development organizations have a legitimate interest in preserving high yielding varieties whose seed can be saved by any farmer for planting in the next season.

It was expected that the hybrid seed would be distributed to six to ten thousand farmers. Several NGO’s working with small farmers were concerned that cross-pollination occurring between the hybrid maize variety and existing open-pollinated varieties would reduce yields of both traditional varieties and the new, improved open-pollinated varieties in subsequent years.

[Open-pollinated maize refers to a “population” of maize plants that has been grown together for some time. Individual plants are not genetically identical. This is important because if a new disease or insect pest appears, some of them may have resistance. Agronomists call this “population buffering.”]

We contacted Dr. Rex Bernardo, a maize breeder at Purdue University, to get a reading on the potential impact of cross-pollination on the improved open-pollinated varieties. He said that there certainly would be “contamination” of existing maize varieties if they were grown close to the hybrid maize. However, the word “contamination” is from a geneticist’s point of view, meaning only that genetic material will be shared between the populations. It does not mean disaster—the local open-pollinated varieties should not become weak. It could even add new genetic material to the open-pollinated varieties that would prove beneficial.

Dr. Bernardo recommended that some fields of the open-pollinated varieties be grown in isolation to maintain the existing genetic characteristics of these populations. The recommended isolation distance is 150 m (500 feet). (See *Amaranth to Zai Holes* p. 320 for more perspective on this.)

We realize that not every farmer could do that, but certainly with some planning many fields could be kept in isolation for the production of seed maize. Other fields that could not be protected could be harvested for food and feed. He also recommended harvesting maize from the outside rows for eating and from the interior of the field for seed.

We also called a former board member of ECHO, Dr. David Unander, a plant breeder who is now a biology professor at Eastern College. When we explained the situation, his immediate concern was the source of donated seed. Would it be adapted to production in Central America? If it was seed developed for the USA, it likely would not perform well under tropical conditions. We contacted Kevin again to ask about the adaptation of the seed and were pleased to learn that it was developed for production in that region of the world.

Dr. Unander also said he did not think it should be too difficult to maintain the improved open-pollinated varieties. Indigenous Indian cultures commonly kept five to six distinct maize varieties going. It was not unusual for a village or individual to be assigned responsibility for growing a particular maize variety for seed. Indian groups in our country discarded any ears that had multi-colored kernels because clearly they had been cross-pollinated. Interestingly, he said the Indians would sell these discarded ears to the settlers as interesting “Indian maize,” while their varieties were actually uniform in color.

We also asked Dr. Arnel Hallauer, maize breeder at Iowa State University, for his take on this situation. He replied, “I don’t have data for direct comparisons between open-pollinated varieties and varieties that have been crossed with hybrids. Hence, my comments are based on past evidence and conjecture.”

Dr. Hallauer felt that if local producers desire to keep their open-pollinated varieties pure, then the use of hybrids in adjacent fields would not be desirable. New genetic material could be introduced into the open-pollinated varieties through the pollen of the hybrid variety. To reduce the chances of cross-pollination between open-pollinated varieties and hybrids, he indicated that fields should be separated by at least 200 meters (650 ft). This is the distance recommended for maize varieties that

have similar kernel types and colors. If traits between the local variety and the hybrid differ greatly (e.g. if varieties have different kernel types and colors) then isolation should be greater, say 300 meters (980 ft). [If white maize is pollinated by yellow maize, this year's harvest will have some colored kernels. The opposite, yellow maize pollinated with white, will all be yellow.] Some cross-pollination could occur with these distances (e.g., wind, humidity, air currents, etc.), but it would be minimal.

However, the immediate effect from the introduction of genetic material through the pollen will be negligible assuming the hybrids and open-pollinated varieties have the same kernel color or if the local variety is colored.

According to Dr. Hallauer, "Throughout the evolution of maize in the Western Hemisphere, improvements have usually been realized from wide crosses of different races, varieties, and strains. If the local growers continue to practice selection within their local open-pollinated cultivars at harvest each year, I do not believe there would be any decline in the performance of their local varieties. In fact, the introduction of new genetic material may provide further genetic variation to enhance future selection to improve the performance of the local open-pollinated varieties."

If the donated hybrid seed was developed through breeding programs that included evaluation trials to identify superior hybrids for the environments of Central America, then the introduction of pollen from hybrids may have a positive effect on the open-pollinated varieties.

(On the subject of developing new lines of maize, see *Amaranth to Zai Holes* p. 77, 78. This is a report by Bob Short about how he teaches Mexican farmers to develop their own lines of maize.)

ECHO's recommendation was based on the consensus we observed in the opinions stated above. Assuming that the new hybrid was adapted to the growing conditions in Nicaragua, growing it should not result in a disaster—in fact it may confer some genetic material to existing varieties that will prove beneficial. In addition, by taking some precautions with planting distances it should be possible to maintain the distinct identities of the open-pollinated varieties by planting them in isolation.