Maize Diversity in Oaxaca, Mexico: Simple Questions but No Easy Answers

The basic question underlying the Oaxaca Project (see p. 32) is simple, says Julien Berthaud**,** a CIMMYT population geneticist: "Can the genetic diversity of maize be maintained or increased in smallholders' fields while enhancing the welfare of the farmers?"

As scientists searched for answers to this question, from farmers' silos to ultra high-powered statistical computer packages, it became clear that they would not find a single, straightforward answer. In fact, says Berthaud, "Our inquiry has led to more questions whose answers turn out to be enormously complex."

What Are We Conserving?

For starters: What is a landrace? Although a landrace is generally assumed to be a local "variety" produced over time through selection by farmers, Berthaud contends that in the Oaxaca study area, the landraces do not meet the basic criteria of a variety: that they be distinct, uniform, and stable.

So what are we trying to conserve, if not landraces? "The active flow of genes," answers Berthaud, "which carries traits that are of value now or may be found to have value in the future." Sustaining gene flow in farmers' fields may not require maintaining landraces. By trying to retain landraces in their current form, we may doom conservation to failure.

"A decade ago," says Berthaud, "most people's vision of *in situ* conservation was to put up a fence, keep the farmers and the variety in a state of suspended animation, and figure that everything would stay as it was. But this will not work. People have needs that may change with the market—say, an emerging preference for floury rather than flinty kernels—or with the environment. For example, a series of dry years will affect the supply of maize seed and what is preferred for planting. The study area is a dynamic environment, with new genes and traits flowing in and out of it, even under the most traditional systems."

Another reason that gene flow may be required to maintain diversity, Berthaud explains, is the accumulation of deleterious mutations. Small-scale farmers select their own seed. Often they choose the best ears at harvest and save seed from only a few cobs—a logical approach but one that increases deleterious mutations. As defects accumulate, the variety loses its genetic value.

"We know farmers are putting new diversity into the system and in the process losing some of the old alleles and traits," Berthaud observes, "which raises several other questions. Is this dynamic process in balance? And will the current flow maintain the valued genetic diversity?"

Tracking Gene Flows and Diversity

Berthaud and graduate students Gael Pressoir and Fabiola Ramírez Corona (all supported by France's Institut de Recherche pour le Développement) are using two strategies to track gene flows and determine genetic diversity in the study area. In the first strategy, they collected "seed lots"—a "lot" is a set of seeds that a farmer regards as belonging to the same variety—from randomly selected farmers in six communities. The lots have undergone molecular analysis to measure their diversity.

Berthaud: A static maize seed system leads to a dead system.

"One possibility is that if everybody keeps seed only from his or her own fields, the seed lots will be quite different from farm to farm. The other possibility is that there are many seed exchanges, so everything is basically about the same. We're trying to figure out, at the genetic level, where we are in this broad range of possibilities."

Another strategy for tracking gene flows takes the team back to the farmers who purchased local improved varieties at project demonstrations in 2000 and 2001. What happened to that seed? Did farmers store some for future use? Mix it with their own varieties? Lose it? Exchange it with other farmers? "As we trace the history of the seed lots," Berthaud says, "we hope to develop an image of the evolution of diversity."

Knowledge of what is coming into and going out of Oaxacan farmers' maize fields will allow Berthaud to develop a model to determine whether the genetic diversity in the system is shrinking or expanding, and whether it is stable and sustainable. It would also help guide future efforts to enhance *in situ* conservation. "If you want to maintain some traits or diversity in general," says Berthaud, "you need to understand the big picture. If you play with only a part of the system, you are almost certain not to achieve the results you are seeking."

"Julien Berthaud's work has established that a static maize seed system leads to a dead system and that, in a dynamic system, new materials need to be brought in," says project leader Maurcio Bellon. "Perhaps farmers know this, too, as some of them will bring in seed from other regions when they observe that their 'plants are getting tired.' We had some appreciation of these dynamics, but we didn't understand all the implications. Julien's work brings us an added scientific perspective."

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