CIMMYT®

International Maize and Wheat
Improvement Center
Centro Internacional de
Mejoramiento de Maíz y Trigo

Director General Iwanaga Gives CIMMYT's Position on Issue of Transgenes in Mexican Landraces and Implications for Diversity Worldwide

5 December 2002

El Batan, Texcoco, Mexico—CIMMYT's host country, Mexico, is the center of origin and genetic diversity of maize. Mexico has been a focal point of the debate over transgenic food crops since late 2001, when genes from transgenic (genetically modified) maize were reportedly found in Mexican landraces. Landraces—the maize races developed and maintained by small-scale farmers over the centuries—have evolved and been selected to thrive under particular environmental conditions and to meet local food preferences. Consequently, landraces often possess unique traits, which they carry and exchange through their genes. Given the large number of landraces in the world, especially in Latin America, the diversity of traits and genes is enormous.

Reports of transgenes in Mexican maize landraces have caused people to fear that a resource of immense practical and cultural value has been lost.

As an international maize research institution charged with holding maize genetic resources in trust for humanity, CIMMYT wishes to recapitulate its position on the many questions surrounding the issue of transgenes in maize landraces. Why are landraces an important resource? Has this resource been lost? What happens in farmers' fields in Mexico and other developing countries when transgenic varieties are present? What steps have been taken with regard to the maize varieties in CIMMYT's genebank?

First, however, it is important to know one basic fact about how maize plants reproduce. Unlike many crop species, maize plants are not self-fertilizing. They reproduce by crossing with other maize plants, a process that can cause the genetic makeup of maize plants to change dramatically from one generation to the next. If two distinct varieties of maize—a hybrid and a landrace, for example—grow in neighboring fields and flower at the same time, it is entirely possible that they will cross and that some of their offspring will possess characteristics from both varieties. Obviously this fact of maize reproduction has implications for the flow of genes between transgenic and non-transgenic varieties.

Why do we care about landraces?

CIMMYT has an international responsibility to conserve maize landraces from all parts of the world. One of the first activities of CIMMYT's founders was to collect and conserve an enormous number of maize landraces, many of them from Mexico. We have continued this activity for more than three decades to ensure that the irreplaceable diversity represented by maize landraces is conserved for all people, everywhere. The genetic diversity in hundreds of these landraces has enabled CIMMYT and partner organizations to develop maize varieties that resist insects and diseases and tolerate drought, saline and infertile soils, and other stresses. Varieties possessing these traits are essential for helping people in the developing world to feed their families and improve their economic well-being.

Apdo. Postal 6-641, Col. Juárez,
Deleg. Cuauhtémoc, CP 06600,
México, D.F., **MEXICO**

Fax: (52) 5804-7558/59
Email: cimmyt@cgiar.org
http: //www.cimmyt. cgiar.org

Telephone: Mexico, D.F. (52) 5804 2004
Texcoco (5) 952-1900

CIMMYT also works in rural communities to understand how farmers manage and breed landraces and thus manage genetic diversity. The landraces that farmers grow today are often somewhat different from those collected in the same communities decades ago, and they are certainly different from those grown centuries ago, precisely because they have continued to evolve under the combined influence of farmers and the environment. Mexico is not a center of diversity for maize simply because many landraces are "found" in Mexico. In reality, those landraces are the products of farmers' continuing desire to maintain a great deal of diversity in the maize they grow. For this reason, we feel it is extremely important to study the dynamic conservation of landraces in farmers' fields as well as the relatively more static conservation of landraces in genebanks.

Understanding what happens in farmers' fields

In Mexico there is a moratorium on planting transgenic maize, but Mexico imports large quantities of maize grain from the USA to be ground into flour for tortillas. Sources at the US Department of Agriculture report that 34% of the US maize area was planted to transgenic maize in 2002, and it is quite possible that some of the maize imported into Mexico was transgenic. Simply by looking at the grain, it is impossible to identify it as transgenic. It has been hypothesized that transgenic maize could have entered farmers' fields if someone unwittingly purchased transgenic maize grain and, instead of eating it, planted it, just to see what might happen. Traditional farmers continually experiment with their maize landraces, crossing them with other maize varieties to see if they can improve their maize crop.

When transgenes are present in Mexican maize landraces grown by farmers, does this mean that an important resource is lost forever? As scientists, we would answer "no," because the landraces may have changed, as they do all the time, but they have not disappeared. On the contrary, with the addition of a transgene, they could actually be considered more diverse. This additional diversity may not be desirable, however. It is precisely this issue that the Mexican government must resolve.

For Mexico the course of action with regard to transgenic maize will be particularly sensitive because of the desire to conserve maize landraces and because of the perception by some that landraces cannot be traditional and transgenic at the same time. A critical issue for Mexico at this juncture is to determine what occurs when transgenic maize enters farmers' fields.

How would a transgenic maize hybrid, adapted to conditions in a developed country with a temperate climate, survive in subsistence farming systems in the tropics or subtropics? Would the transgenic variety and the local landraces even flower at the same time? If a transgenic and landrace variety cross, would their progeny have characteristics that appeal to farmers? Or would the resulting plants be so disappointing that farmers would gradually eliminate them? CIMMYT has repeatedly urged that research be conducted on these issues, not only in Mexico but also in other countries, to provide data for informed decisions. In 1995, the year that commercial transgenic maize was first released in the USA, we raised these questions at an international forum and have persistently sought funding and partner institutions to answer them.

Building on our previous research, and thanks to newly available funding, CIMMYT is initiating a study to give decision makers better information on how small-scale farmers manage and select seed and thus influence how genes (including transgenes) flow into and between landraces. Key related questions include: How may

Apdo. Postal 6-641, Col. Juárez,
Deleg. Cuauhtémoc, CP 06600,
México, D.F., **MEXICO**

Fax: (52) 5804-7558/59
Email: cimmyt@cgiar.org
http: //www.cimmyt. cgiar.org

Telephone: Mexico, D.F. (52) 5804 2004
Texcoco (5) 952-1900

the diffusion of transgenic varieties affect the livelihoods of small-scale farmers? Can this process and its impacts be managed or, if need be, reversed? What are the implications for wild relatives of transgenic food crops? Appropriate policies and regulations will be difficult to develop or promote successfully in the absence of detailed information from farmers' fields and communities.

Finally, the perception that transgenic maize is reducing diversity must not obscure the very real need for research to mitigate the many confirmed threats to maize diversity. Every day, diversity is eroded by habitat destruction, human migration from rural to urban areas, and the irreparable loss of traditional maize seed and knowledge as the farming population ages. The present concern about transgenic maize may only add to these threats. If farmers and consumers are convinced that landraces are "contaminated" by transgenes and therefore unsafe to grow or eat, farmers will have even fewer incentives to preserve landraces in their fields.

Could maize landraces in the CIMMYT genebank contain transgenes?

Because of threats to diversity in farmers' fields, CIMMYT maintains one of the world's largest collections of maize and wheat seed. We hold these collections in trust for humanity under an agreement with the Food and Agriculture Organization of the UN. Seed held in trust is conserved for the long term and remains exempt from intellectual property protection.

CIMMYT has taken several preventive measures to ensure that the seed of maize landraces stored in our genebank is not transgenic. Our approach for the genebank, like the multi-layered security system of a conventional bank, comprises a series of firewalls, each reinforcing the other, making the introduction of transgenes into the landraces in the genebank unlikely.

First, during collection, seed samples are examined for obvious physical indications that they are true landraces and not the descendents of a modern variety. Next, the seed samples undergo molecular characterization, which means that their genetic makeup is analyzed for the presence of transgenes. As an internal check on the validity of the molecular analysis, the seeds from those samples are planted and grown out in a CIMMYT greenhouse. The resulting plants are sprayed with herbicides that the majority of commercial transgenic varieties are known to resist, because they were either developed to possess herbicide resistance or because the herbicide resistance gene was used as a marker gene. If a plant survives the herbicide treatment, it is assumed to contain a transgene, which should also have been identified with the molecular tests. To date, none of our samples of landrace seed have tested positive for transgenes.

Once a seed sample is accepted for the genebank collection, tight quality control measures ensure that the seed sample is not mixed with seed from other samples and that its collection history is preserved. All seed samples are electronically tracked with bar codes and put into long- and short-term storage. In long-term storage, seeds are preserved in foil packets at –18ºC. In short-term storage, seeds are kept in tightly capped plastic jars at low temperature and humidity. Access to the seed storage vaults is restricted to authorized personnel.

To maintain sufficient stocks of landrace seeds, genebank curators must periodically plant stored seed and grow it to maturity to maintain viability and produce more seed, a process known as regeneration.

Apdo. Postal 6-641, Col. Juárez,
Deleg. Cuauhtémoc, CP 06600,
México, D.F., **MEXICO**

Fax: (52) 5804-7558/59
Email: cimmyt@cgiar.org
http: //www.cimmyt. cgiar.org

Telephone: Mexico, D.F. (52) 5804 2004
Texcoco (5) 952-1900

Regeneration offers a potential opportunity for transgenes to cross into landraces. Here again CIMMYT has erected rigorous barriers to prevent such occurrences. During regeneration, landraces are pollinated by hand. Each maize tassel is covered to ensure that only pollen from that tassel will be used to pollinate the ears. Pollen is collected from the covered tassels and then dusted carefully onto silks that were also previously protected from inadvertent pollination. The pollinated ears are finally enclosed in a special breeding bag to guarantee that no extraneous pollen can pollinate the silks. To further ensure that extraneous pollen is kept out, buffer zones that isolate the regeneration areas from other maize plants are strictly enforced.

It is highly unlikely that all of these systems would simultaneously fail and thus allow transgenes to enter CIMMYT's maize landrace collection. Along with taking measures to screen new seed samples, we continue to screen older samples for the presence of transgenes, especially those collected or regenerated since 1995, when commercial Bt maize was first released. The methods and results of these studies are made available to the public through the CIMMYT website.

Research must inform the debate

CIMMYT believes that no single technology will alleviate hunger, reduce malnutrition, and overcome many crop production problems, but all options should be brought to bear on these critical challenges. Transgenic wheat and maize offer tremendous opportunities in this regard, but it is clear that genetically modified varieties—or any given modern variety, for that matter—will not be appropriate for every farm setting in every part of the world. The debate about Mexican landraces, genetically modified organisms, and genetic diversity has raised scientific questions that have implications around the world as countries wrestle with the many issues related to genetically modified crops. We urge national authorities to ensure that decisions with respect to genetically modified crops are based on factual information and involve consultation with a wide range of concerned individuals and groups. Through our research, we at CIMMYT strive to bring clarity and scientific fact to these deliberations. We are grateful to the organizations that have recognized the need for continued research and appeal to the international development community to support these important efforts.

This document was prepared in English, and a Spanish translation has been prepared for informational purposes. In the event of any inconsistency between the different versions, however, the English version should be considered the authoritative text.

Apdo. Postal 6-641, Col. Juárez,
Deleg. Cuauhtémoc, CP 06600,
México, D.F., **MEXICO**

Fax: (52) 5804-7558/59
Email: cimmyt@cgiar.org
http: //www.cimmyt. cgiar.org

Telephone: Mexico, D.F. (52) 5804 2004
Texcoco (5) 952-1900