Presentación del libro:

Origen y diversificación del Maíz. Una revisión analítica.

Auditorio Jaime Torres Bodet / Museo de Antropología / 1 de octubre de 2009

Words by Dr. Major Goodman

This impressive report, prepared by a committee of experts, describes the origin, differentiation, and dispersion of maize throughout Mexico. While there will remain differences of opinions about details, the review clearly establishes that maize collection and, especially, maintenance in Mexico are less than ideal and have been so for a very long time. I suspect that most of the facts about maize preservation reported here were factual in the 1960s, and perhaps earlier.

The revision concludes that *Tripsacum* has not been involved with the origin or differentiation of maize, while teosinte is currently considered the progenitor of maize. While these conclusions are most likely valid (and are certainly valid for *Tripsacum*), and are very widely held, it must be remembered that the Mangelsdorfian tripartite hypothesis (correctly dismissed herein) appeared, essentially unchallenged, in text books for 30 years. (Here, I might add that one of the first to challenge the tripartite hypothesis was a young Mexican professor [S. Miranda C.] from the Colegio de Postgraduados - in 1966). As Garrison Wilkes once commented to me, there are those who mention an hypothesis in Paper I. In Paper II, the hypothesis has become a theory. In Paper III, the theory has become a fact, despite no more real evidence than that presented in Paper I. Despite all the reviews and all the evidence, including much impressive molecular genetics and cytogenetics, we are still at the hypothesis stage when it comes to the origin of maize. Its wide diversification in Mexico alone lacks a currently-credible hypothesis, although the multicentric origins advocated here certainly come closer to explaining the widespread diversity found in Mexican maize than does the unicentric hypothesis of Doebley et al.

As clearly stated in the report, teosinte survives only in areas where farming and grazing practices permit, and this process has clearly resulted in eliminating and diminishing teosinte populations. The same situation holds for indigenous Mexican races of maize; they have been all but eliminated from areas of intensive, "industrial," farming (farms of 50+ hectares, for example, often with irrigation) and persist on family plots of less than 5 hectares, often in horticultural milpas of a hectare or so. These small farmers are stewards of Mexico's existing maize diversity. Much of Mexico, where maize is grown on a large scale, basically has little, if any, indigenous maize left to collect. In those regions, a widely successful new hybrid, with or without transgenes, presents little threat to Mexico's maize heritage. Any maize displaced would be commercial, not indigenous. Furthermore, the international purveyors of transgenic hybrids have little interest in small farmers or small geographic regions. The purveyors of transgenic maize (Monsanto, Pioneer, Syngenta, Dow, perhaps BASF and Bayer) are not interested in selling a hybrid unless there are sales enough to plant 30,000 hectares of it annually, *given that research, sales, agronomic support, advertising, etc. are all in place*. From experience in the US, such companies are reluctant to invest in new hybrid development in an area unless the farmer-base in the area grows at least 800,000 hectares of maize. Note that these are not company-

provided figures (the companies consider such data to be trade secrets), but they are easily inferred from company practices. Thus, the large companies will only be interested in selling hybrids, transgenic or not, in Mexican areas already dominated by hybrids and having few, if any, native varieties.

However, in regions where small farmers persist (and plant as much as 70% of Mexico's maize hectarage), a widely successful Mexican hybrid produced by a small, local company could have a major impact on local maize diversity. If that hybrid carried a transgene that local farmers found helpful (say, Round-Up resistance, if Round-Up were adequately cheap), then it would be even more of a threat to "sweep-out" local maize varieties (and perhaps many other milpa cultivars as well). The spread of hybrid corn across the US was not accomplished by large companies, it was done though collaboration among small companies (Pioneer probably had less than 5 employees in the early 30s), land-grant universities (Iowa State, etc.), and the USDA. Mexico has no equivalent system - the universities here have not typically been developers of inbred lines; INIFAP has been relatively ineffective in that arena, perhaps largely for lack of funds, perhaps for lack of interest. CIMMYT's real center of activity is in Africa, where the Gates Foundation largely finances the work. There is no effective maize extension program in Mexico.

Furthermore, the legal situation has changed greatly since the initial development of corn hybrids. It effectively limits the types of collaboration that occurred in earlier decades. In the 1930s, companies and universities freely traded or exchanged lines. Today, it takes a half-dozen lawyers two years to decide if one such exchange can occur, and should it occur, then what is "our" share of the imagined profits. The large companies became large, not from developing their own inbreds (all companies had access to the same inbreds until almost the 1960s), but from service and wide-scale testing. Pioneer's early advantage appears to have been good cold-germination testing, which meant that their seed grew well when some others' seed (including both hybrid and open-pollinated varieties) did not - and not because of their exclusive, privately-developed germplasm. That came later.

Despite such differences in legal and intellectual property landscapes, hybrids for small, but important, maize growing areas in Mexico are being developed and will be developed by Mexican entrepreneurs. It is this development of locally-adapted, successful maize hybrids which could - and probably will - displace local varieties. While Fernando Castillo of the Colegio de Posgraduados has shown that improvement of local maize – without loss of diversity – is readily possible and cheap (including yield increases on the order of 25%), the lack of an effective extension service limits generalized implementation. Jesus Sanchez of the University of Guadalajara, who has studied the distribution of various gametophyte alleles, has demonstrated rather convincingly that hybrids developed by the smaller companies are more often based on

local germplasm. And it will need to be local germplasm to be effective in the marketplace of rainfed, local/indigenous maize-growing regions. In any case, it is the threat of a sweep-out of local varieties - or of small-scale, local farmers - that is the major threat to Mexico's - and the world's - maize germplasm. Transgenes are simply the frosting on the cake.

At present, we simply do not have a rational explanation for the diversity found in maize - it exceeds that of any other species on the planet. Keep in mind that humans are also cross-pollinating, and have existed far longer than domesticated maize, but have much less variation. Perhaps dogs are the domesticate most comparable in range of variation to maize, and it is generally accepted that dogs were domesticated long before agriculture appeared and that multiple instances of canine domestication occurred.

We simply cannot say with certainty where maize originated, nor how many independent times. Clearly, the origin was Mexican, it was long ago - well before Tehuacan, and today's maize and today's teosintes shared a common ancestor (Weatherwax may have been right!). We know even less about the history and early distribution of teosinte. Presumably, it had a much broader distribution before cattle, horses, sheep, and - especially - goats roamed the countryside. Simply suggesting that a wild maize (presumably closely related to the teosintes of its day) was domesticated and later became extinct does not provide an answer to the riddle of the extreme diversity found in maize today. While only better archeology can definitely refute or resuscitate the idea of a wild maize, citing an extinct, wild maize as the progenitor of today's maize simply pushes the diversity problem back one speciation event - and does not solve it.

There is much archeology to be done. There is much maize germplasm maintenance to be done. Neither of these is terribly expensive, relative to the care and feeding of a single molecular genetics laboratory. Furthermore, the return on investment is virtually guaranteed in the former cases, while most molecular genetics labs are long-shot investments, more likely to fail than to succeed.

It is in local areas, where small farmers persist, that there is risk from wholesale introduction of new germplasm, whether that germplasm is from CIMMYT, INIFAP, Monsanto, Ceres, Chapingo, Saltillo or Texcoco. Or whether it carries transgenes or not. These areas of small farms are the centers of diversity for maize today. Presumably, they were also centers of maize diversity in the 1400s and long before, but only more complete archeology can definitely answer that question. Genetics and molecular markers can tell us a great deal about current relationships, but very little indeed about relationships or especially distributions 500 or 5,000 years ago.

There is another threat to the maize diversity that is protected and preserved by local Mexican farmers. That threat is the potential extinction of the farmers themselves (by aging-out, migration or economic forces beyond their control). Certainly, the TLC has contributed to the loss of local farming, as the cheap price of imported maize has made Mexican maize agriculture into a very dubious career path. I am not qualified to debate the net effects of the TLC (they must be positive in some areas of the economy or the treaty would not exist), but for maize farmers in Mexico, it clearly does not stand for its English acronym, "Tender, Loving Care."