Acequias, GMOs and bioregional autonomy | Report on the condition of agriculture in Costilla County, Colorado – PART 2

With special reference to center of origin land race cultivars and GMO crops
PART 2 | THE CULEBRA CENTER OF ORIGIN AND DIVERSITY

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Moderator's Note: This is the second in a three part series plus a source bibliography. The author is Co-Founder and President of The Acequia Institute and prepared this report during August-September 2015. The report is intended as a contribution to local agricultural, scientific, and environmental education for Costilla County residents, farmers, and public officials. The information or views presented in this report do not reflect the official views or policies of The Acequia Institute or its Board of Directors and Officers or the University of Washington.

What we are working to protect. Culebra-Gallegos maíz de concho grown at Acequia Institute farm in Viejo San Acacio.
Photograph by Devon G. Peña

The Culebra Center of Origin and Agrobiodiversity

The acequia farmers of the southern SLV (Costilla and Conejos counties) are among the oldest non-tribal indigenous family farmers in the U.S. and are renowned for unique place-adapted heirloom land race maize, bean, and pumpkin/squash varieties.

These native crops are considered part of the land race populations of the extended Mesoamerican Center of Origin. The concept of 'center of origin' was first developed by the Russian scientist Nicolai Vavilov who identified several distinct biogeographical regions across the globe that are home to the wild ancestors of crops domesticated and diversified by indigenous farmers over millennia *and remain places where the co-evolution of crops and wild ancestors persists as a direct result of surviving indigenous cultural selection and agroecological practices* [our emphasis].i[i]

According to noted ethnobotanist, Gary P. Nabhan:

In the U.S. Southwest and northwestern Mexico, much of the land is arid. Indigenous agriculture persists here, in some places beyond where conventional modern agriculture is successful. In addition to the reason usually given for genetic conservation to preserve for future generations genes that may make commercial crop varieties less vulnerable to stresses and maladies there are others worth considering with regard to native crops of this binational region. (1985: 387-8).

Nabhan illustrates how "Aridoamerica" is an overlooked center of origin and diversity. Vavilov's travels included vast stretches of Aridoamerica where he searched for and identified dozens of native land race crops developed and sustained by indigenous farmers with at least 25 plant species in advanced stages of domestication cultivated since well before European invasion and conquest (Nabhan 2011).

Centers of origin are also centers of diversity. We propose that this includes the San Luis Valley. Nabhan appears to include the Upper Sonoran desert country of the San Luis Valley (SLV) as a northern periphery sub-basin of Aridoamerica (1988: 393). More recent scientific research by Matsuoka, et al. (2002) squarely places the SLV within the center of origin and diversity of maize; see Figure 5 below.

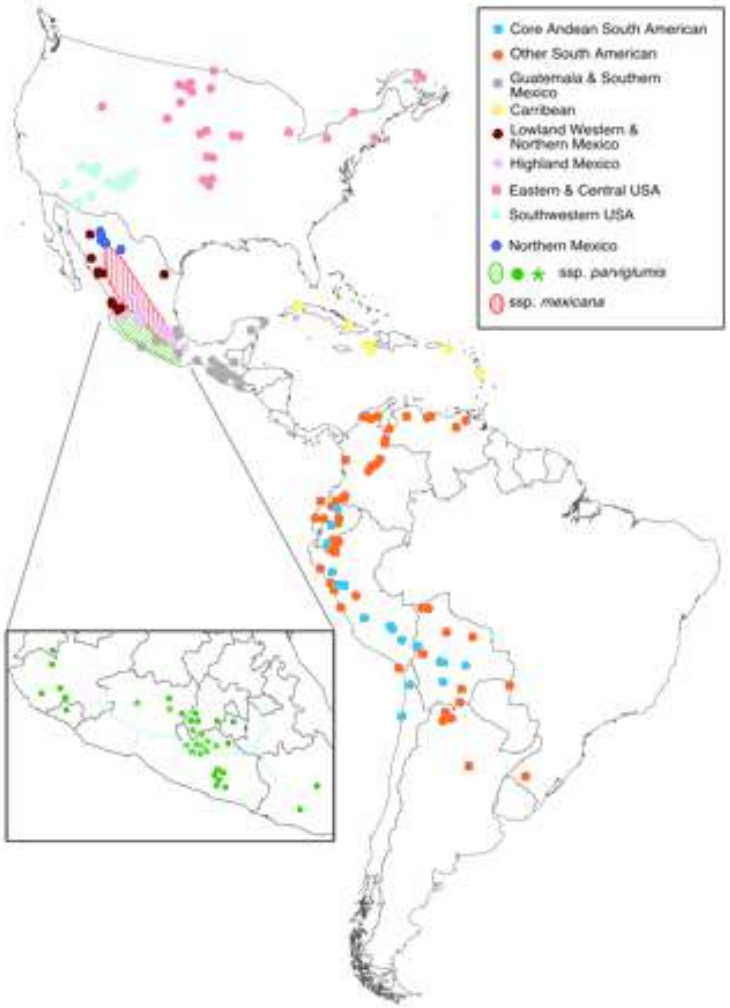

Fig. 5. **Center of origin teocintle and maize land race populations.** The light blue dots include accessions from northern New Mexico and the San Luis Valley in Colorado. *Source:* Matsuoka, et al (2002).

As a center of origin and agrobiodiversity, the Culebra watershed acequia farms are recognized, above all, for their contributions to heirloom maize diversity and for sustaining several vanishing artisan production methods and practices involving the use of native crops. This is especially true of a maize white flint variety known as *maíz de concho*.

The ethnobotany of this white flint maize, which is used to make *chicos del horno* (adobe oven-roasted corn), is still a matter of research in-progress and only a very few published sources are available (for e.g., see Peña 2015). The Upper Rio Grande Hispano Farms study (1995-99) — co-directed by Dr. Devon G. Peña with funding from the National Endowment for the Humanities (NEH Grant RO-22707-94) and the Ford Foundation — included what is likely the first scientific field and lab research on the local white flint maize grown by acequia farmers in the Culebra watershed of Colorado.

The maize geneticist Ralph Bertrand-García of Colorado College did the field study in 1995. Bertrand-García (in-press) found that the white flint maize produced by the Corpus A. Gallegos

family in San Luis is a highly in-bred parent line, implying genetic purity and an absence of genes from commercial conventional hybrids. We note that when the field study was done there were no commercial plantings of GMO maize in the SLV.

Bertrand-García further suggests (in personal communication to the author) that Culebra maíz de concho shares morphological qualities and possibly gene sequence patches derived from ancient Anasazi corncob remnants found at sites across the desert Southwest (Mesa Verde, Chaco, Grand Gulch). Bertrand-García's study supports oral histories in Costilla County declaring that the local white flint maize originally came from Anasazi ancestral maize populations via the modern-day Taos, San Juan, San Idelfonso, Picuris, and other northern Pueblos (Corpus A. Gallegos interview with Devon G. Peña, July 18, 1996; archived at The Acequia Institute). Today, seed exchanges with indigenous farmers in those communities continue.

The principal traits identified by Bertrand-García include three that are adaptive responses to conditions in high altitude cold desert environments with short growing seasons and late spring and early fall frosts. These include: (1) rapid development with average of 74-80 days to maturity (between sowing and harvesting); (2) resistance to desiccation and tissue damage from intense UV solar radiation at high altitude and early or late frosts; and (3) adaptation to diurnal temperature extremes with a daily average range between lows of 40°F and highs of 80°F during the growing season.

These qualities are significant traits, especially given the context of today's climate change challenges. It would seem that the genomic integrity of the Culebra bioregional land race maize populations could be recognized as a national agrobiodiversity conservation priority.

Santistevan (2003) also describes the specific heirloom white flint used by acequia farmers as maíz de concho. Adopting the scientific name *Zea mays clibanus* for this population, he notes that the heirloom variety is grown in rotation or intercropped with *maíz de diente*, another local flint so named because farmers describe the kernels as "horse's teeth".

In our own field observations, we are seeing a variety of inbred parent lines as well as a constantly shifting mosaic of native chimera varieties incorporating morphological, adaptive, forage/biomass, nutritional, and culinary qualities valued by acequia communities. Some chimeras of two or more parent lines from local land races often have features expected separately in flint, dent, and flour maize land races. One of our own heirloom varieties, gifted to The Acequia Institute by Joe Gallegos of San Luis, Colorado, can be described as a "floury flint" because it can be used, depending on the timing of harvest, to produce chicos or pozol (hominy) as well as corn meal for *masa harina* through a process known as nixtamalization.ii[ii]

Chicos del horno has been listed by Slow Food USA as an endangered food in the Ark of Taste project. This designation includes concern for disappearing artisan craft skills to construct and maintain the crucial adobe ovens and place-based knowledge required to prepare the oven-roasted chicos for consumption or sale. Chicos remain a significant part of our "First Foods" and as an icon of our heritage cuisine. As such, chicos sit at the center of the ethnic foodways of bioregional *acequiera/o* culture.

Finally, maíz de concho varieties bred and sown by the acequia farmers of Costilla County bear living evidence of genetic affinity with wild ancestral forms. During the 2010 harvest cycle of maíz de concho at *Almunyah de las Dos Acequias*, the home of the Acequia Institute's farm school and grassroots agroecological and permaculture field station, we sowed a seventh generation of Gallegos family heirloom white flint, the same parent line studied by Bertrand-García (in-press); we found two stalks that produced tunicate florescence instead of whole cob alignments of the maize kernels.

Figure 6 and 7 below present two images: First is a diagram from the classic study by Noble Laureate geneticist George W. Beadle (1980) on "The Ancestry of Corn". In the diagram, (a) and (b) are designated 'teocintle'; (c) is designated as a 'tunicate' (a mutation in which individual kernels remain aligned in separate single- or double-file instead of clustered on a cob); (d) is designated as a 'primitive' ear, and (e) is designated as 'modern' maize. Second is a photograph of the tunicate florescence that we keyed as an example of a tendency in our maíz de concho to revert back to wild ancestral forms. These occurrences are indicative of the close genomic affinity our in-bred land race varieties have with wild and intermediary relatives.

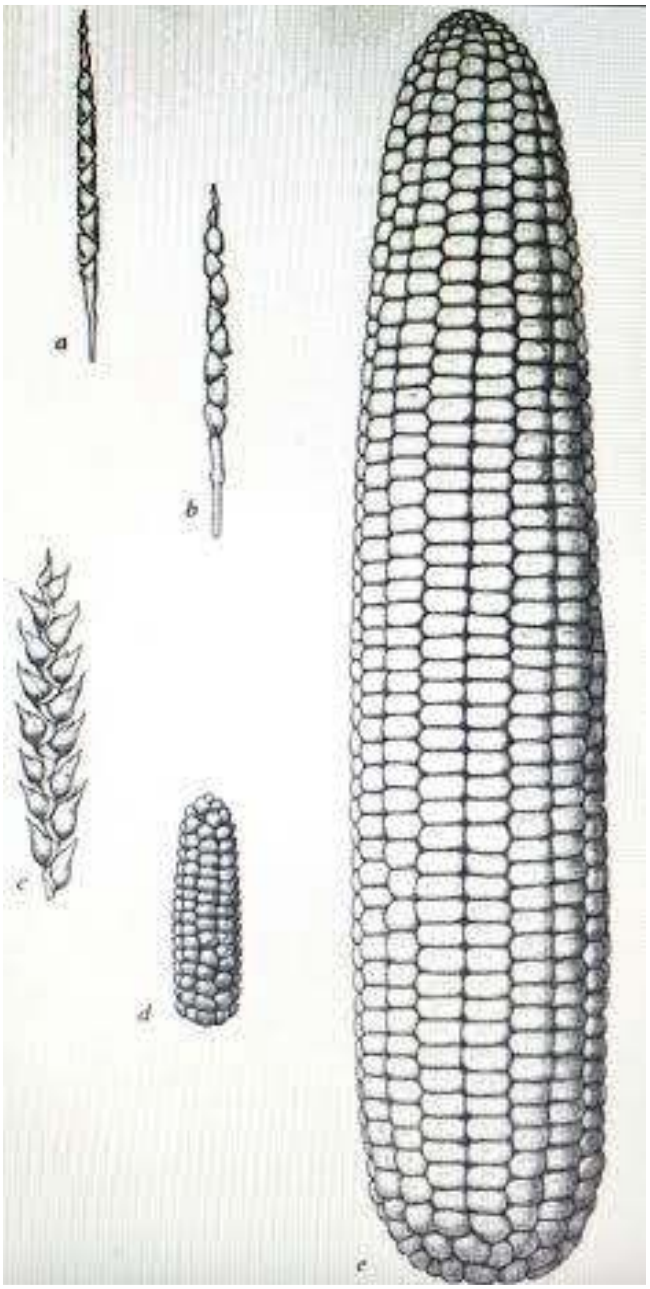

Fig. 6. **Diagram of teocintle, tunicate, primitive, and modern maize.** *Source:* Beadle (1980).

Fig. 7. Tunicate white flint. From 2010 harvest at Almunyah Dos Acequias.
Viejo San Acacio, CO. Compare with (c) in Fig. 6. *Photograph by D. G. Peña*

The photograph in Fig. 7 above shows the tunicate white flint mutation from our own accession of the Gallegos family parent line of Culebra maíz de concho and was collected during the 2010 harvest at Almunyah de las Dos Acequias Farm in Viejo San Acacio. Comparing this mutation with Beadle's 1980 diagram suggests that the occurrence depicted in Fig. 7 above is an example of the regression/mutation of a local land race to an intermediate wild stage. This is substantive evidence of the legitimacy of center of origin land race status for Costilla County maize varieties like Culebra-Gallegos maíz de concho.

Local youth participate in the production of chicos del horno at Corpus A. Gallegos Ranch. San Luis, CO
Photograph by Devon G. Peña

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i[i] See Nabhan 2011 for a detailed study of Vavilov's journey through northwestern Mexico and the American Southwest, a bioregion Nabhan describes as "Aridoamerica".

ii[ii] A process for the preparation of maize in which the grain is soaked and cooked in an alkaline solution, usually limewater, and hulled; the process makes the lysine and other essential amino acids available to the human digestive system, maximizing the nutritional value of maize consumption, a point overlooked by many scientific specialists studying maize who repeat the mythic refrain about the malnourished state of so-called maize-dependent consumers.