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the Seedhead News

In Situ Conservation Of Native Crop Diversity in the U.S./Mexico Borderlands

(This is a summary of an invited address given by Gary Nabhan for the symposium "Ethnobotany of the Greater Southwest," at the Twenty-Fifth Annual Meeting of the Society for Economic Botany, June 1984, held at College Station, Texas.)

The conventional method of dealing with genetic erosion of a region's crop diversity is by ex situ conservation. Seeds from crops are collected from farmers and gardeners still growing once-common varieties and placed in seed banks and botanical gardens for propagation. The drawback of these seed increase gardens is that they often are not in the same climatic zone, and growing conditions may be very different from those in the original location of seed collection. Selection pressures or contamination by other varieties pollinating in the same growout location may select out portions of this germplasm after a few generations.

In addition to working with seedbanks and botanical gardens, Native Seeds/SEARCH recognizes the need for continuing to grow crops in situ, or "on location" within their original cultural ecological context. In situ conservation enables existing genetic diversity to continue to evolve and further diversify, particularly where crops are enriched by gene exchange with their wild relatives.

The region of importance to Native Seeds/SEARCH is southwestern North America. This area we define as reaching north to Durango, Colorado, south to Durango, Mexico, west to Las Vegas, New Mexico, and east to Las Vegas, Nevada. This roughly corresponds to the Chihuahuan and Sonoran Deserts, with adjacent uplands. Archaeological evidence indicates that this is a region which may be considered a center of crop diversity distinct from that of the Mississippi Valley or the Meso American centers of Latin America. At least 20 domesticated plant species were cultivated here by native cultures in prehistoric and protohistoric periods within the Greater Southwest. Certain of these, such as Sonoran panic grass, a millet-like grain, appear to have been domesticated entirely

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within this region. Other domesticates derived from elsewhere, evolved within the arid environment into new locally adapted varieties, called ecotypes.

Within this region, certain crops such as domesticated amaranth, chiles, and striped cushaw squash continue to exchange genes through cross pollination with their wild relatives which occur on the margins of native fields. A great diversity of wild and domesticated tepary beans have also evolved here.

Some crops such as jack beans fell out of cultivation before modern times, although most of the genetic erosion in the region has occurred since 1920, when the advent of mechanized irrigation dramatically changed the agricultural economy. Increased water supplies temporarily lessened the need for drought-hardy, locally adapted varieties. Since the region's water problems have again deepened, interest has been renewed in using remaining native crops directly or as plant breeding material. However, for these crops, in situ conservation is an endeavor which is complicated by the humans upon which they depend.

Native crops are culturally selected, domesticated plants cultivated prehistorically or protohistorically within a region and adapted to the agroecosystems of that region. They are plants directly dependent upon management by man. They have evolved within the influences of particular cultures and their agroecosystems. Native crop diversity is part of the living heritage of a region's cultural diversity. Socio-cultural issues make it impossible to view these resources merely as a set of genes that can simply be conserved by sticking them in a gene bank. If isolated from the folk science and traditional uses of the cultures which have nurtured them, they lose part of their value or cultural-historical meaning.

The reason usually given for genetic conservation is to make pest and disease resistant genes available for future generation's commercial crops. There are other reasons which take into account the ecological adaptations and cultural heritage of traditional crops:

1. Native crops may be vital to the continuance of an indigenous people's agricultural system, given their special adaptations to local climate, soils, water availability, co-evolved biota, and management practices.

2. Native crop diversity may be vital to the health of an indigenous people, providing a variety of nutrients as well as dietary fiber to control nutritional diseases to which native Americans are vulnerable when they adopt Euro-American, highly processed diets.

3. Native crops and foods may be symbols of cultural identity, and as such, may reinforce an indigenous community's persistence.

4. Native crops in arid America, by virtue of their relative drought and heat tolerance and water use strategies, may help conserve hydrological resources that are in scarce supply and subject to profound intercultural conflicts.

5. Where indigenous varieties are favored, they reduce farmers' dependence on having to buy seedstocks (and food!) from suppliers outside their locality.

Because of these additional reasons, there are now a number of organizations, agencies and tribal communities that are evaluating in situ conservation approaches. Farming community members should become more aware that such options are available to them.

A reciprocal gene exchange between gene banks and farmers should be established. Community leaders should be able to request the return of subsamples of seedstocks collected from their villages long ago if the stock has been locally lost in the meantime. Agricultural education programs should include presentations by tribal elders on traditional seed propagation, selection, and saving. A tribe's folk science should be taught alongside Western science.

Indigenous foods, seeds and farming practices should be encouraged as part of tribal cultural revival movements, health programs, and educational efforts. New cultural and economic incentives for diversified, regionally adapted agriculture should be considered.

These suggestions emphasize a community commitment to in situ conservation. Native Seeds/SEARCH is now working with both community programs and individual farmers to foment discussion and refinement of this approach. Hopefully, our work will also encourage scientists to recognize the immense value of both regional plant and human diversity.

Gary Nabhan
Karen Reichhardt

Mexicans Receive Seed Collection

During a recent visit to Tucson, Ing. Jose Muruaga Martinez was presented with a collection of seeds for the Mexican government Genetic Resources Unit. The collection, prepared by Mahina Drees and Karen Reichhardt, is comprised of bean, squash, grain and chile seeds, many from remote locations in Mexico. This is part of our effort to provide our seeds to long-term conservation programs of institutions, tribal agencies, and botanical gardens serving our binational region.

Pictured is Gary Nabhan giving the collection to Jose Muruaga.

Seedkeepers In Their Own Right

For Laura Merrick, each summer workday begins before dawn, as she travels to the University of California Davis Agricultural Experiment Station. She arrives for a morning of pollinating a field of squash blossoms, assuming the labors normally reserved for the bees. Laura, who is studying the relationship between domesticated and wild Mexican cucurbits, is a Cornell University Ph.D. candidate at the L. H. Bailey Hortorium in Ithaca, New York. Her degree will be in Systematic Botany, with a minor in Plant Breeding and Ecology. For the past 1-1/2 years her studies have brought her to the Vegetable Crops Department at UC Davis, where she is an associate.

At Davis, Laura is growing and studying a group of squashes and gourds which are closely related to one another, called the Sororia group. This group is comprised of 5 or 6 wild gourds, including Cucurbita sororia, and the domesticated cushaw squash, Cucurbita mixta, which reached its northern limits prehistorically in the southwest U.S. The more distantly related Cucurbita moschata, or butternut squash, is also included in this study. Laura's dissertation will cover the diversity of the Sororia group in Mexico and the Southwest U.S. The ethnobotany, geographic distribution, taxonomy, systematics and evolutionary relationships within the Sororia species will be included, as well as this group's relationships with other species, wild and cultivated. She supports her academic studies by increasing seeds of the Sororia group for the USDA, and through a recently received NSF grant.

During two collection trips in 1981-82, Laura searched throughout Western, Central and Eastern Mexico where Cucurbita mixta types are grown, or where the wild species of the group occur naturally. Collections were made from farmers, fields, markets, natural wild populations, and others sent from NS/S accessions. Over 200 different types of these squashes are now planted at the UC

Davis Experiment Station, with three plants for each type. To keep the genetic lines pure for seed increase and to control breeding crosses for experimental purposes, Laura hand-pollinates each female flower. Squashes have separate female and male flowers on each plant. Pollination is usually done by bees in the early morning. However, if the 200+ types of squashes were left for open pollination by bees in Laura's plots, the results could be a geneticist's nightmare.

I asked Laura to describe for our readers her daily routine of plant breeding. In late afternoon or evening, she looks for male or female flowers which are relatively large, swollen, and turning yellowish--signs that they will unfold the following morning. A white flag is placed next to each of these new flowers, and a twister tie (intended for plastic bags) is tied around the petals so they cannot open. An equal number of males and females have to be tied in this manner for as many flowers as can be found during the evening.

At dawn she finds and removes the male flowers of each plant which were tied the previous evening. On the same plant, she then pollinates female flowers with the pollen from the male flowers. For each plant, she removes all petals from a male. Then the female flower is opened and the male pollen is swabbed over the female stigma (the flower part which receives the pollen). After fertilizing the female flower, petals are carefully re-tied, and the white marker is exchanged for a colored one. All pollinated female flowers are identified with a tag which indicates date of pollination and type of plant. If pollen was from another type of plant, this genetic "cross" is indicated. These same records are recorded in her field notebook.

This procedure is repeated for many flowers for several hours each morning. By midday the flowers will have wilted, rendering them useless for additional fertilization. (Laura mentioned that these steps can be followed by any gardener wishing to increase squash seed and keep the variety pure. This is of special importance when planting more than one variety of the same species of squash from which seed will be saved.)

The interrelationships between these various "species" will be better understood from the results of the artifical cross-pollinations. Laura's studies will likely result in a new classification of the Cucurbita sororia group. They will also provide new insights regarding the evolution and conservation of striped cushaws of the Cucurbita mixta type, the most desert-adapted squashes known to man.

Karen Reichhardt

Book Review

EL FIN DEL PRINCIPIO, Las semillas y la seguridad alimentaria

Written by David Barkin and Blanca Suarez. 1983. Paperback published for Centro de Ecodesarollo by Edictiones Oceano, Av. de las Granjas, No. 82, Col. Sector Naval, Delegacion Azcapotzalco, 02080 Mexico, D.F., Mexico. 187 p. 500 pesos, plus postage.

"We will begin to say that it is in the seed where everything starts and finishes," a farmer from Chiapas told the authors. "In the seed is the beginning and the end." On this ominous note, Barkin and Suarez open their socio-economic history of the seed industry in Mexico, with its impact on food production, nutrition, and genetic vulnerability. They explain how Mexican farmers developed a rich heritage of locally adapted seedstocks over 10,000 years.

This is the first Spanish language book to initiate discussion of the relationship between genetic diversity and stability of food supplies. It also questions the ownership of genes in the Meso-American area of crop origins. The authors offer a plan of action to promote genetic conservation, including further efforts to dispel the myth that native seeds are unequivocally "inferior" to introduced hybrids. They support both national and international germplasm banks.

Gary Nabhan

Keeping Squash Seedstocks Pure

To assure that each kind of squash maintains its own unique genetic characteristics or "purity," do not plant seedstocks of cross-compatible varieties in plots near one another. Varieties of the same species (listed below) can certainly fertilize one another via pollination by bees, which can carry squash pollen as much as a mile, though bees transport most of it only sixty to seventy yards. When cross-pollinated, certain Cucurbita mixta and C. moschata varieties apparently produce fertile offspring, so these two species should not be planted together if "seed saving" is the goal. The following chart provides a key to seed characteristics of the various species. This will help you identify which squashes are of the same ilk.

Mahina Drees
Karen Reichhardt

Species Name	Seed Description	Seed Illustration	Names of Common Types
Cucurbita pepo	Oblong and white, including margin, smaller in modern squash, i.e., zucchini		pumpkin zucchini yellow crookneck patty pan multi-colored gourds acorn
Cucurbita maxima	thick and brownish, smooth, thin cellophane coating, cream margin		banana turban white giant hubbard
Cucurbita moschata	dark beige margin, not wrinkled, smaller		big cheese butternut
Cucurbita mixta	white, wrinkled with cracks in middle, pale margin, cellophane coating, sometimes brown tinge		striped cushaw silver-seeded
Cucurbita ficifolia	black or buff colored		Malabar gourd fig-leaf gourd

The Squash That Ate New York

The Sinahuisa ecotype of Cucurbita maxima, or Mayo White Giant squash as it is called on the SEARCH seed listing, could have at least one other name . . . The Blusher. It slowly turns a lovely peach pink when it is fully ripe.

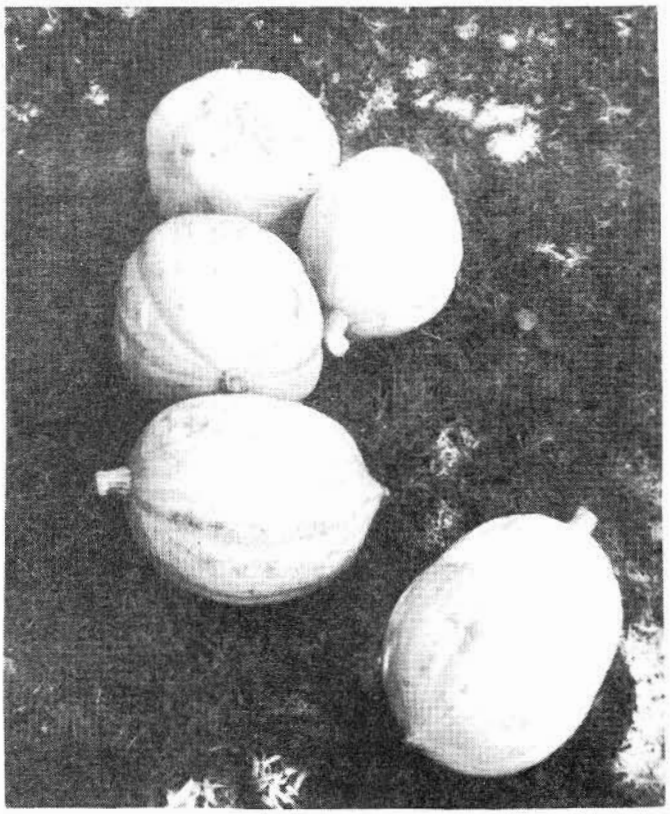
This squash is very prolific in both large leaves and basketball-size fruit. The small immature fruit can also be eaten as a summer squash. In Tucson, because of its leaf area and the extended length of its growing season, it is not a very drought hardy plant. However, planted in fertile basins as soon as the frost is past and timed so that when the vines are large the rains will have begun, it can be a good producer in desert areas.

Its flesh is golden, and the large seeds, when dry, turn brown, with a thin encircling band or margin of cream. It is deliciously sweet as a winter squash and very good in pies. It has a slightly unusual but tasty flavor as a summer squash.

Native Seeds/SEARCH acquired this accession from Rosaria Valenzuela, a Mayo Indian who lives in Sinahuisa, a village about 20 miles south of Navajoa, Sonora, Mexico. She has a lovely, medium-size garden of tomatoes and onions and cabbage, besides her squash. She also has many flowers. We have purchased these same seeds in the Navajoa public market, but germination was poor so we decided to increase this variety in Tucson, much to our delight.

After it is sprawled out, this maxima seems to have an ability to survive some squash vine borer infestations, by laying down roots from its nodes. (Barney calls it the squash that ate New York because of its rampant growth and our garden's location on New York Drive.)

Mahina Drees



The basketball-size fruit is a lovely peach pink when fully ripe.

SEARCH Recognized For In Situ Conservation

SEARCH is listed in a U.S. government publication as one of three organizations carrying out localized activities for in situ genetic conservation. The report is titled United States Activities Related to In Situ Conservation of Genetic Resources. It was prepared by the U.S. Department of State, Bureau of Oceans and International Environmental and Scientific Affairs, Office of Food and Natural Resources, and is dated February 1984.

The reports' purpose is to document the "wide range of public and private U.S. efforts related to conservation of genetic diversity." It will be used by the U.N. Environment Program to provide background for U.S. "strategies to conserve biological diversity in developing countries."

New Grant For

Native Corn Collection

How does corn seed which has been preserved in seed banks and sporadically grown out in increase gardens compare genetically with the same race of corn grown continuously ("in situ") by native peoples? A recent grant of $2,500 provided for public interest research via Pioneer Hi-Bred International will enable five associates of SEARCH to collect native corns of the U.S. Southwest and northwest Mexico during fall 1984. Our collections will be used in the pioneering study of the changes in crop genetic variability through time.

Field collection efforts will be spearheaded north of the border by Charlie Miksicek and south by Barney Burns. They will in part recollect areas for which the USDA and the Mexican-based CIMMYT (International Improvement) have collections obtained 15-40 years ago. These older collections have been sporadically regrown, but in far-from-ideal conditions, and were often contaminated. They have been recently analyzed for within-population isozyme variation using plant "fingerprinting" (electrophoresis) techniques.

Using the same techniques, our new collections will be fingerprinted by Dr. Major Goodman of North Carolina State University and Dr. John Doebley of Texas A & M University. The genetic variation still available in the new collection of native races of corn from Indian fields can then be compared with the existing older collection. We may then interpret whether more genes have been lost due to contamination or genetic drift in seedbank growouts or due to genetic erosion in the field over the last few decades.

In addition, we will assist Goodman and Doebley by collecting a continuum of corns from Uto-Aztecan language tribes on both sides of the border, from Hopi to Tepehuan. This will help to form a picture of how both cultural and natural geography affect corn variation.

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Editor, Karen Reichhardt. Contributing Editors, Barney T. Burns, Mahina Drees, Gary Nabhan. Write the editor if you wish to order back issues or contribute an article.

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