Tepary Beans, O'odham Farmers, and Desert Fields

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It is fitting that the Papago's mythological world has an abundance of beans in the heavens and on earth. The Desert People were long ago nicknamed the Babavi or Babavi Oodham [Tepary Bean People] by their Pima-speaking relatives, because they grew and ate so many beans. This term Papavi Oodham was reshaped into Papabota by the first European tongues that tried to mutter those native sounds, and later the utterance was simplified to Papago.

While many popular publications give the impression that maize was the foremost staple of all native American agriculturists, this may not have been true for the Papago. As early as 1716, Padre Luis Velarde commented that the principal harvest of the Papagos living on the "sterile lands" west of the Rio Santa Cruz was the "beans called papavi," [Wyllys, 1931]. Two centuries later, an Indian Agent to the Papago reported that their production of legumes far and away surpassed that of corn:

"Last year the rainfall was abnormally light, yet these arid-land agriculturists, ever fighting the desert, which is always seeking its own, succeeded in forcing the desert to yield 300,000 pounds of corn, 1,800,000 pounds of beans, and about $25,000 in value of pumpkins, squash, watermelons, and garden truck." (McDowell, 1919).

As late as the 1940s, "an average Papago" was consuming about 300 g of beans daily [Ross, 1944]. This level of legume consumption probably gives the Papago the dubious distinction of being the "bean-eatingest" people in the New World [Nabhan, Berry and Weber, 1979], if we compare it to published levels of legume consumption by other ethnic groups [Aykroyd and Doughty, 1964].

Today, interest in Papago teparies goes far beyond their desert homeland. A number of publications within the last five years have suggested the feasibility of transferring this Sonoran Desert germplasm to other arid lands where farmers are in need of crops better adapted to environmental stress [National Academy of Sciences, 1979; Theisen et al., 1978]. Yet despite the growing worldwide awareness of teparies, there has been remarkably little literature providing a sense of the context in which these beans have been nurtured over centuries. Much of their evolution as a crop has taken place in the modest monocropped desert fields such as those of the Papago—data from growth chambers, greenhouses, and rain-sheltered experimental fields in humid areas don't give as good a notion of their performance. If teparies are to be introduced into new areas in developing countries, their native context may provide guidelines so that inappropriate conditions will not be chosen, and the introductions won't be as likely to fail.

Realizing this, we decided to spend time with the real tepary bean experts—elderly Papago farmers of the Arizona-Sonora borderlands. They agreed to let us document the practices which have enabled their culture to produce these nutritious food plants in a water-limited environment that may well be as arid as any that unmechanized agriculture ever ventured into [Nabhan and Hutchinson in prep.]. An Indian agent to the Papagos wagered a challenge in the 1880s:

"... place the same number of whites on a barren, sandy desert such as they live on, and tell them to subsist there; the probability is that they would become extinct (Howard, 1887).

The following photographs and descriptions are a result of our firsthand observations of tepary beans in Papago fields, gardens and kitchens, from 1975 to 1982. Occasionally, we...
Wild teparies are usually gray in color with brownish
venation or mottling, and are smaller than domesticated
white tepary beans. The photogram shows their actual size.

will refer to former practices we have learned of through oral
history interviews. However, for additional details regarding
historic Papago bean cultivation, we refer readers to Castetter
and Bell [1942], and the report of the Applied Remote Sensing
Program [1982].

Field Preparation

*Oidag cikpan*, as the Papago call farmwork, begins long
before tepary beans are ready to plant. During the pre-season
drought months, we have often found our Papago friends
working the early morning hours in their fields, in preparation
for the rains. Fences must be mended, tools repaired, and
residues from the previous crops must be cut, burnt, or
disked-under.

The timing of these activities and others depends upon the
kind of field to be planted, its location, and the seasonal
scheduling associated with it. In irrigated fields such as those
at San Xavier, and in a few select runoff fields such as those at
Topawa, an early crop of teparies can be planted in late
February or early March, if ditches are functioning. Histor-
ically, such early plantings allowed two “summer” crops at a
number of Papago localities [Wilson, 1983]. However, most
Papago farmers only plant teparies once, with late summer
rains capable of producing runoff, which have an average
arrival time in Sells during the week of July 20-27.

Although the Papago are best known for their *ak-ciñ* (arroyo
mouth) fields where stormwaters naturally spread out over a
cultivated alluvial fan, they irrigate their crops in other ways
as well. Other field types include:

1. Ditch diversion from a wash channel to a floodplain field
   (at Fresnal Village, Ak-Ciñ, Topawa and elsewhere);
2. Stormwater collection in a *charco* (dirt tank) reservoir, for
   later diversion onto fields (at Little Tucson, Big Fields and
   Plenty Dogs);
3. Through-flow impeded by water-spreading berms or
   brush weirs (at Big Fields, Little Tucson, Topawa and elsewhere);
4. Ditch diversion from spring-fed oases (at Quitovac, and
   formerly Quitobaquito);
5. Ditch diversion from earthen-or-masonry-dammed reser-
   voir (at Pia Oik and Menager’s Dam);
6. Pumped groundwater irrigation (at San Xavier, Santa
   Cruz, Ak-Ciñ, and Kohadk).

Each of these field systems is managed differently, and
preparation/maintenance time varies. Communal work neces-
Delores Lewis is a Papago farmer in Big Fields (Ge Oidag) village, where he plants teparies in two fields irrigated by storm runoff.

Sary for maintaining ditches to several fields is seldom done today, and most remaining fields are isolated from one another. Only four percent of the runoff field acreage used in 1913 in nine villages just west of the Baboquivaris is cultivated today (Reichhardt, in Applied Remote Sensing Program, 1982). Some former Papago fields in Mexico, like that at Suvuk in the extremely arid Pinacate Desert, are now being used intermittently by Mexican farmers (Nabhan and Hutchinson, in prep.). Many Papago farmers have instead taken up faucet-fed gardening in the last decade. Here we will focus on the work associated with the fields which utilize flowing floodwaters, including the classic ak-ciñ and arroyo diversion fields that characterize the great dying farming heritage of the Papago.

Floodwater farmers must learn to read how a wash is changing, whether it is meandering or deepening. They then must modify their water control structures to slow or heal erosion, to minimize meanders that might leave their fields high and dry, or to more evenly spread water out around their crops. They do this by carefully positioning low (0.3-1.5 meter) earthen berms, as well as brush weirs in strategic locations.

The brush weir is constructed of 1-2 m. tall mesquite posts planted in the ground 1-2 m. apart in a line 5-20 m. long; mesquite branches and snakeweed brush are woven in between the posts. Called sai'iida koli, (brush fences), these water spreaders form a permeable filter that dissipates the energy of floodwaters, and allows the water and associated floodwashed humus to be deposited just downstream from the weir. In this way, field soils are renewed with moisture, nutrients and water-holding organic matter while the erosive force of the flood is softened.

When fences, weirs, tools and ditches have been repaired, the farmers return to their larders or storage sheds where heirloom, hand-selected seeds for planting have been kept. The seeds remain covered and the sowers stay in waiting, in the shade of ramadas, until the summer rains begin.

**Planting and Cultivating**

When . . . the rain moistens the earth, bury them four together and watch them . . . not letting animals eat or trample them, or grass or weeds come up. —Juan Dolores, in Saxton and Saxton (1973).

By late June, soil moisture is greatly depleted in the Sonoran Desert; surface soil temperatures in Papago fields reach above 50°C. The first rain of the season does not always drench and cool the soil enough to satisfy Papago farmers. Some believe
A summer storm over Kitt Peak brings welcomed rain and floodwaters to Papago fields, washes and charcos.

The water-flattened grass is evidence of sheet flooding slightly upstream from a tepary field at Kohadk.
A brush weir on an arroyo at Fresnal Village (Jiawuli Dak). Instead of water being diverted into the ditch in the left background, it flows to the right, past the broken-down weir.

A brush weir was built incorporating an overhanging mesquite branch, at Fresnal Village (jiawuli Dak).
In Pia Oik (Pi Ooik), this charco reservoir is seldom empty, but during June, 1977, it was completely dry after a spring drought.

The same reservoir is full after the summer rains, as seen in August 1977.
While one man guides the plow, another leads the horses. Rows are plowed about 3 meters apart, and turned towards the middle.
A check dam of low mesquite posts and interwoven cross-branches spreads water and detritus evenly over this field section at Ge Oidag.

that the heat stored below the soil surface will dry out and negate the effects of the first rain, so that it is preferable to plow and plant after the second drenching rain. Sometimes a storm misses a field, but washes flowing from the mountains upstream bring enough water to allow for planting. Papago farmers would formerly make torches, and go out into fields at night to direct such mountain storm flows into their fields with spadework.

Our Papago acquaintances were accustomed to plowing their fields using a team of mules or horses and moldboard plow. If draft animals were unavailable, a tractor might be rented from a neighbor. As the walking plow opened a 15-25 cm. deep furrow, 4 [to 8] seeds were tossed into it by the plowman or someone a few paces behind him. These clusters of seeds were spaced roughly 1 m. apart in several fields; however, some Papago farmers now prefer continuous row or bed planting. On the next circuit with the team, the plow buried the seeds as it turned the soil from the adjacent row onto them.

Usually 4-12 rows of teparies are planted as a block on either side of a block of Papago sixty day flour corn, sweet cane sorghum, red or pinto beans. White teparies are usually planted
Seeds are planted on the slope of the freshly turned, moist soil. Usually they are sown by hand while walking behind the plow.
Papago fields at Menager's Dam Village.

Fields at Pia Oik (Pi O'oik) after summer rains.
After five weeks, tepary seeds are already developing inside bean pods. Note that the leaves are solar-tracking (angling toward the sun).
Tepary beans, black-eyed peas, wild amaranths and lovegrass compete for moisture in the late summer at Ge Oidaq.

Six to eight weeks after planting, the tepary plants have ripened pods. They turn yellow, dry further, then sometimes split.
A traditional, circular bean threshing floor has been prepared at Cold Fields [S-hepi Oidag] village.

A mixture of white and yellow-brown tepary beans are found under a pile of partially threshed vines at Kohadk.
Phillip Saucedo pulls the tepary bean plant up by its roots, and turns it upside down for drying.

Phillip Saucedo's cousin Dora Mariano helps him "beat the beans" at Menager's Dam.

Teparies are crudely winnowed a first time in the wind to separate pods and sticks from beans.

in separate patches from mixtures of red, tan, beige and brown teparies, although they are sometimes adjacent to one another. Watermelons, domesticated white-seeded devil's claw (a basketry fiber plant), and green striped cushaw are usually planted at the head of a field, or in the sandier soil. Melons, black eyed peas or other squashes are infrequently grown.

Teparies emerge from hot, moist desert soils in four to eight days after planting in July or August. Within 4-6 weeks they begin to set small, white or lilac-colored flowers, which are predominantly self-pollinated. Nodules can be found on tepary roots at the time of flowering, but it is not known if the Rhizobia bacteria making these nodules fix much nitrogen under desert conditions. Although tepary plants are indeterminate, and have the ability to vine out into runners, most plants in Papago fields remain compact unless watered frequently over a long season. When they do vine out, they occasionally crawl out to twine around a corn or sorghum stalk in an adjacent patch. More frequently, the bean vines climb up the stem of one of the volunteer plants that can be found scattered across the fields. Over eighty genera of disturbance-loving wild and weedy plants have been identified by one of us (G.N.) from 15 fields cultivated in the summer by Papago farmers. This may initially sound like an enormous weed problem, but few of these species ever emerge in dense enough numbers to seriously compete with Papago crops for moisture and light. Papago farmers hoe weeds away from clumps of crops two to five times a season, and sometimes gather certain herbaceous annuals to eat as cooked greens or to use as medicinal herbs. One particularly competitive weed, cuhukkia 'i:waki (Amaranthus palmeri) is still harvested in quantity both for human food and for hay to be dried and later fed to livestock. Where present in Papago fields, amaranths may also serve to reduce insect damage to the bean crop, since it has been documented elsewhere that their foliage is preferred to bean vines by black cutworms, a widespread crop pest (Genung, 1959). Tepary bean, insect and weed interactions deserve further study in the Sonoran Desert setting.

Crop Success or Failure?

The unpredictability of rains in the desert makes floodwater farming a gamble. Over the centuries, however, both the Papago and their teparies have developed ways to minimize the risk of drought. The Papago have buffered themselves against the unpredictability through their learned knowledge or folk science of desert farming, which provides guidelines for the optimal time and place for planting. The beans, through both natural and cultural selection, have evolved adaptive features that over time have become genetically predominant.

By channelling the runoff of a large watershed onto a small field, Papago farmers effectively "multiply" the rainfall available to plants in their cultivated plots. Additionally, they sometimes modify watercourses or clear shrubby vegetation upstream from their fields (Cooke and Reeves, 1977), increasing runoff yields per unit area. By planting as soon as the soil approaches field capacity, they also minimize the potential of soil water deficits during the period of emergence and early growth. Unfortunately, we have no idea how much soil moisture is utilized by teparies over a growing season under such conditions, nor are estimates of the amount of runoff available to Papago fields very definitive (Applied Remote Sensing Program, 1982).

Teparies are usually classified as a drought-escaping ephemeral crop, since they are capable of completing their life cycle prior to most late season droughts, which at Sells begin an average of eight weeks after the first summer floods. They
begin to fruit in less than 45 days after planting, and may have
nearly all their pods ripe in less than 70 to 75 days, when
pintos under the same conditions have most of their pods still
green [Nabhan et al., 1980; Nabhan and Hutchinson, in prep.].
When soil moisture is available, tepary leaves track the sun
more continuously and have higher noon transpiration rates
than pinto beans, which appear to close their stomata and
angle their leaves perpendicular to the sun during intense
midday heat [Dubetz 1969; Nabhan and Hutchinson in prep.].
Such responses (as those of teparies) are characteristic of
summer desert ephemerals that maintain high photosynthetic
rates which enable them to rapidly mature [Ehleringer and
Forseth, 1980].

If they fail to escape drought, desert ephemerals have gener-
ally been regarded to be as vulnerable as mesophytes to water
deficits. This is not true for teparies, which are also capable of
dehydration postponement, and ultimately, relative dehydra-
tion tolerance. By rapidly rooting to greater depths than do
other beans, teparies essentially postpone water stress by tapp-
ing a greater reservoir of soil moisture [Thomas and Waines,
1981; Thomas, 1983]. In the Pinacate, as soil moisture was
depleted, more and more tepary leaves in a canopy changed
their angle perpendicular to the sun’s rays, thereby slowing
transpirative losses. As a drought ended the Pinacate growing
season, the matured teparies had essentially the same midday
water potential (of -15 bars) as the immature pinto beans
[Nabhan and Hutchinson, in prep.]. Yet because teparies can
adjust osmotically to maintain higher cell turgor and continue
growing at the same water potential as other beans [Parsons
and Howe, 1980], the same drought theoretically may not have
affected their internal water status to the same extent. Overall,
teparies maintain steadier photosynthetic and respiratory
rates under high water deficits than do drought-susceptible
common beans [Coyne and Serrano, 1963].

Despite these advantages which keep teparies from failing
as frequently as pinto or red beans, they are not invincible.
Early season droughts can deplete surface soil moisture to the
extent that seedlings of all crops wilt and die. More frequently,
desert cottontails, black tailed jackrabbits, sphinx moth lar-
vae and cattle are responsible for tepary crop failures in Papago
fields. In minor droughts that allow germination of plants in
water-supplemented fields, but not as much elsewhere, these
animals are attracted to the relative greenery of fields for their
forage. Rabbits and hares apparently prefer tepary vines over
other crop plants.

When teparies do survive such climatic and biological
assaults, Papago fields yield the equivalent of 200 to 900 kg/ha
(roughly the same as pounds per acre), with their wide plant
spacing the key variable in yield per unit area. Our oral inter-
views and observations corroborate numerous reports that
teparies will produce a modest crop even in drought years
when pinto or red beans fail. According to several sources, four
out of five plantings produce harvestable tepary yields [Nab-
han et al., 1979].

**Harvesting and Cleaning**

*When they ripen, pull them up and pile them where you’ve cleared a
place. Then get a stick to beat them with. The seed will be removed.
When the wind blows, you will take them in your hands and throw
them up, and it will blow away the stalks and leave the seed.*

—Juan Dolores, in Saxton and Saxton (1973).

Go out to a Papago field in October or early November, and
you will see the straw-colored roots of teparies, bottom up to
the sun. After being hand-pulled, piled and dried like this for
4-7 days, one of two kinds of threshing (mohonakud) may

Dona winnows teparies over a Papago basket for a second
cleaning to remove small chaff.

Teparies are given a last, fine winnowing to remove dust and
leaf particles.
Roasted corn (gai'wsa), and tepary beans sit in open containers for three to four days to dry further.

To completely clean this basket-full of beans, Dora worked less than ten minutes.

After drying, the beans are put away in containers, here in an old hardpaper detergent can with a clamp-on lid.
Unlike some common beans, teparies do not necessarily require presoaking. They look like this after ten minutes in water.

The beans are washed, then simmered for two hours. Then a heaping tablespoon of lard and an even tablespoon of salt are typically added as the only seasoning.
Dora Mariano and her sister enjoy a typical Papago meal at Menager's Dam, in the southwestern corner of the reservation.

Ladies from the arts and crafts co-op in Sells share a delicious lunch of teparies, salad, chile and tortillas.
At large community feasts in Papago villages today, teparies have been replaced by pintos, and chile formerly made with carne seca is now made with fresh or canned chunk or ground beef.

Occur. If there is a large crop, a 3-5 m. diameter depression near the field will be slightly moistened and tamped down; then the vines will be spread around a post sunk in the middle of the circle. This kind of threshing floor was introduced by the Spanish, and is called an era by Sonorans. A mule or horse is roped to the center post and driven around over the vines and pods. When most of the pods have been popped or crushed open, the workers toss shovels-full into the breeze, and the lighter chaff blows away. For smaller batches, the pods are walked on by a child, or beat with a flail made of a strong saguaro rib or mesquite branch.

The next step is the finer winnowing [giki] that is usually done with the traditional sifting baskets. Deft Papago women can shake baskets in such a way as to winnow off all the remaining chaff, even in the lightest breeze.

After drying several days in the sun, in buckets or basins, the seeds are stored in gunny sacks, jars or lard cans. Occasionally, planting seed [kaicka] is selected out and stored in a safer place. Teparies appear to be more resistant to bruchid beetle infestation than are peas, pintos or cowpeas. They generally store well, maintaining viability for 3-5 years, but older, hard-seeded teparies become difficult to germinate.

Cooking

Teparies have a mild but distinctive flavor. In an informal test, four out of five Papagos recognized the particular tastes and textures of the two different varieties even when blindfolded! Dry teparies are always boiled, usually for more than 3 hours, sometimes all day. The taste of teparies in Papago clay bean pots is still praised. Today, they are prepared mostly for special family occasions. In 1979, Nancy Garcia wrote down this traditional recipe for posol [posole] from her family elders [Meals for Millions/Save the Children, 1979]:

1 cup yellow tepary beans
1 cup whole parched corn
beef chicharrones (pre-cooked)
1 teaspoon salt
1 clove garlic
4 cups water
1 red chile (if you like)

Put all the ingredients except meat in a large pot and boil for about 3 hours. The last 1/2 hour, add the chicharrones. Serve, adding chiltepines [fitoi ko'okol] to taste.

Teparies, cooked by themselves, are often eaten with wheat tortillas and chile as part of several consecutive meals.
Still favored by many Papago, tepary beans are not always commercially available to them. Mary Eleando buys the last bags at "Low Store" in Sells.

reheating). There is among some families a taboo against giving dogs brown teparies as part of the kitchen scraps; the dog would get sick otherwise.

Today, with the aid of food stamps, many Papago families buy their pinto and tepary beans at trading posts. The tepary price is often double or triple that of pinto beans, but pinto beans are also distributed to low income families through the federal commodities program so that not all Papago need to buy them. Sonoran-grown teparies, red and sulfur beans are also sold at The Gate, a restricted border crossing and weekend food market on the western slope of the Baboquivaris.

Because of the ready availability of beans from many sources, there has been until recently little economic incentive for the Papago to grow their own beans. Nevertheless, the Papago Nutrition Improvement Program and the Meals for Millions Foundation have distributed true Papago tepary varieties and Mr. Hood’s tepary selections to many families in villages on the reservation, some of whom have been encouraged to plant their runoff fields and gardens. On the west side of the reservation, the Papago Small Farms Project grew 10,000 pounds of teparies at the irrigated Santa Cruz farm in 1982, selling half of them to reservation customers [Anonymous, 1982]. Labelled “Papago Beans” (although they include teparies from the Colorado River Reservation and from Mr. Hood instead of just true Papago tepary seedstocks), the brand is one of the first “new”, quality commercial products from the reservation in years. The BIA is funding a training program at Santa Cruz, to provide young Papago with the skills needed to grow teparies and other food crops on their own land. As an issue of the Papago Runner reported, “This is one idea people are hoping will amount to a hill of beans.”

Literature Cited

Anonymous. 1982. They’re betting that their idea will amount to a big hill of beans. Papago Runner. December 23, p. 3.
Tepary beans, Emory's oak acorns (bellotas), chile, and Mexican-American medicines were formerly featured in the window of Casa Valenzia in Coolidge.