



ARIDUS

Bulletin of the Desert Legume Program of the Boyce Thompson Southwestern Arboretum and The University of Arizona

Volume 2, Number 1

February 1990

Mesquite - A World Food Crop

A Bitter Discovery

It is early morning in front of the research station at Bikaner in western Rajasthan. The camel's nose is right in front of a mesquite branch with pods. Camera ready, I patiently wait for her to start eating the pods, but she holds her nose high and steadfastly ignores the mesquite.

It took me a while to learn that India got the wrong mesquite, one with bitter, inedible pods shunned by most domestic animals. No wonder I received so little interest when I gave seminars at universities and research institutes in India exhorting the value of mesquite as a potentially important agronomic food crop.

A thorny, scruffy form of mesquite, originally from the New World, has come to dominate the landscape across much of the arid area of India, which extends over about one fourth to one third of the subcontinent. Today it seems as if the people cannot live with or without this mesquite. They depend upon it for cooking. For many millions of women across India an increasingly difficult task is to obtain fuel to cook food for their families. Mesquite wood is superior

cooking fuel, preferred by rich and poor, from Bikaner to Beverly Hills.

Apart from fuelwood, this particular mesquite is of little value. Neither the foliage nor the pods are suitable for forage. Dense growth of this weedy mesquite has rendered vast tracts of India of little use for anything else.

Mesquite was purposely introduced into India, some accounts say from Hawaii, others say from the New World. Mesquite in Hawaii, now well-established in the warm, dry parts of the islands, it apparently *Prosopis pallida*, a species native to South America. It produces pods suitable for livestock feed, so I don't think that the present-day mesquite in India came from Hawaii. Of course, there undoubtedly was more than one introduction into India, most likely in the late nineteenth and early twentieth centuries.

The Genus *Prosopis*

The genus *Prosopis*, in the mimosoid subfamily of the Legume Family, includes nearly 50 species in hot, arid and semi-arid regions of the world. The genus is divided into five

distinctive sections, three in the New World and two in the Old World. The trees and shrubs we call mesquite and their closest relatives belong to Section *Algarobia*. This section includes about a half dozen species in North America, two dozen species in

— Continued on page 2

Table of Contents

| | |
|--|---|
| Mesquite - A World Food Crop | 1 |
| Staff and Volunteers in Action | 4 |
| The Collection | 5 |
| Editor's Column | 6 |
| Program Support Opportunities | 7 |
| Interesting Reading | 7 |
| Focus on Species of Interest | 8 |

South America, and one in Central America and the Caribbean Region.

There are four Old World species of *Prosopis* including *P. cineraria*, or Khejari, which is native from Saudi Arabia to India. This species is in Section *Prosopis*. It is a handsome tree of lacy green foliage and a well-formed trunk. Compared to the mesquites, khejari is much slower-growing, the pods are small, and the yields apparently are not high, although the pods are edible. Khejari leaves are a valuable source of high-quality fodder and forage, either fresh or dry, and are often collected and sold in western India for animal feed. In contrast, mesquite leaves are palatable only when first emerging and still young and tender, and even then the leaves are not high-quality livestock feed. Mesquite foliage contains toxic secondary compounds - chemical compounds that discourage herbivores.

For many years the several kinds of mesquite in southwestern United States and northwestern Mexico were considered to be *P. juliflora* or varieties of that species. The work of Marshall Johnston of the University of Texas and the Argentine botanist Arturo Burkart showed that *P. juliflora* does not occur in the Southwest, but is a tropical species that bridges the gap between the North American and South American species of Section *Algarobia*. Unlike most of the North and South American species, *P. juliflora* has inedible, bitter pods. It occurs in hot, semi-arid coastal regions, often growing just inland from the mangroves, and extends northward on the Pacific Coast of Mexico to mid-Sinaloa and southward to northern South America. Perhaps the introduced, weedy mesquite in India is derived from *P. juliflora* or a hybrid thereof. The

native species of *Algarobia* in Arizona, Velvet Mesquite (*P. velutina*) and Western Honey Mesquite (*P. glandulosa* var. *torreyana*), have sweet, edible pods although there is much individual variation.

Mesquite Resources

In earlier times the pods of many North and South American species were utilized as a major food staple by native Americans. On average, mesquite pods are approximately 50 percent mesocarp tissue (pulp) and 15 percent seed, by weight, but these ratios can vary greatly from tree to tree, from species to species, and perhaps from year to year. The mesocarp of the pods provided a major carbohydrate or calorie-rich component of native diets. It often was consumed as an atole or porridge, or prepared into cakes. The seeds, high in protein content, apparently were not widely utilized. Each seed is enclosed in a tough, inedible, leathery pit, or endocarp, which must be opened or split in order to free the seed. However, some people utilized the seeds in quantity, developing special techniques to separate and process them. When fully ripe, the seeds are very hard. They were parched, ground into flour and consumed, either with or without being mixed with mesocarp flour.

What are some of the special qualities of mesquite that make it so desirable as a future agronomic crop? Foremost it is a nitrogen-fixing legume. Mesquite thrives in regions too arid for most traditional agriculture and can utilize subsurface water as well as deep groundwater. Rains from one season may soak deep into the ground and be usable by mesquite during another season, although remaining unavailable to conventional annual crops. Mesquite

thrives in hot climates with a short monsoon and a long dry season. Under these conditions, which prevail over a substantial part of the world, the pods ripen at the end of the pre-summer drought, just before the summer rains begin. This is often a season of hardship, a time when feed for domestic animals is in short supply. Subsistence farmers in western Rajasthan told me that if they can keep their animals alive through the pre-monsoon drought then they, too, can survive.

Potential pod yields are high, certainly high enough under agricultural conditions to compete with modern agriculture - probably at least several thousand kilograms of pods per hectare per year. The pods are large, tend to ripen simultaneously (there is considerable variation in this character), and fall when fully ripe. The pods are suitable for manual or mechanized harvesting, either from the shrubs and trees or from the ground soon after falling. Significantly, the pods are indehiscent - they do not split open at maturity - so the contents are not lost. There is much variation which gives ample genetic material from which to choose desirable characteristics; hybridization and selection potentials are high. Propagation is relatively easy, either from seed or vegetatively by cuttings to produce selected clones and presumably also by grafting. Under forced greenhouse conditions, a generation can be produced in one year. The time to full production is probably similar to that of most permanent tree crops, or perhaps a bit shorter - about half a dozen years. Mesquites are long-lived and production should increase with age.

The pods can readily be ground in a commercial mill such as a hammer mill. They are best ground when

thoroughly dry, preferably to less than 5 percent moisture. For instance, this level of dryness can be achieved by spreading them on a tin roof in the desert summer. The hammer mill opens and separates the leathery endocarps from the seeds; the exocarp (hull), mesocarp, and seeds are then reduced to a fine flour suitable for processing into a wide variety of foods including beverages and breads. This method results in a flour with high fiber (the exocarp), rich in both carbohydrate (the mesocarp) and protein (the seed). The flour should be stored in a manner that prevents insect infestation, for example in tight containers. It is crucial to recognize that to be palatable and marketable for present-day human consumption the flour must be finely ground. In contrast, coarsely ground pods are ideal for livestock feed.

No major crop is without pests; whenever there is something good to eat, there is something to eat it. Certain large sucking insects can damage the pods, bruchid beetles can infest the seeds, and psyllids can deform new growth. However, rational pest management should be no more difficult with mesquite than with other legume or tree crops.

Mesquite - Present and Future

Recently established cooperatives in north-central Mexico are processing more than 100 tons per year of wild-harvested, hand-picked pods for animal feed. Studies and experience have shown that properly prepared mesquite flour is marketable and highly acceptable for human consumption. However, domestication, including selection and breeding, methods of cultivation, and mechanically-assisted harvesting techniques, have yet to be developed.

Perhaps, under agronomic conditions, it would be desirable to severely coppice the plants at harvest-time to maintain a high root-to-shoot ratio and facilitate picking. Most mesquites have sharp spines, and developing spineless food-producing forms would be desirable--some wild and horticultural forms are nearly spineless.

Mesquite, especially certain South American forms and hybrids, are extensively planted for fuel-wood production and as ornamental shade trees in urban settings. There are other uses for mesquite, including cordage, dye, gum, and medicine. Improved, selected mesquites would be suitable for intercropping and agroforestry, and multi-purpose production for small- to large-scale agriculture.

Hot drylands of the world can become major food producing regions with the development of suitable crops. Mesquite, for one, could flourish with minimal or no irrigation in many regions devastated by desertification including the southwestern United States, much of Mexico, parts of South America such as northeastern Brazil, the arid zones of the Indian subcontinent, the Sahel and many others throughout Africa. In my opinion mesquite will join the ranks of the world's most important food crops.

Richard S. Felger
Director, Drylands Institute
2509 North Campbell #176
Tucson, AZ 85719

Selected References:

- Bainbridge, D.A. 1989. Multi-purpose tree crops for drylands. *Sustainable Living in Drylands* no. 9:1, 6 & 7.
- Burkart, A. 1976. A monograph of the genus *Prosopis* (Leguminosae subfam. Mimosoideae). *Journal Arnold Arboretum* 57:219-249, 450-525.
- Felger, R.S. 1977. Mesquite in Indian cultures of southwestern North America. pp. 150-176. In: Simpson. *Mesquite* (see below).
- Felger, R.S., L.S. Leigh, S.L. Buchmann, D.O. Cornejo, M.A. Dimmitt, D. Johnson Gordon, C. Nagel, L. Ratener & C.A. Stigers. 1981. Inventorying the World's Arid Lands for New Crops: A model from the Sonoran Desert. pp. 106-116. In: H.G. Lund, ed. *Proceedings of Arid Lands Resource Inventories Workshop*. USDA Forest Service General Technical Report WO-28.
- Felker, P. 1979. Mesquite: An all-purpose leguminous arid land tree. pp. 89-132. In: G. Ritchie, ed. *New Agricultural Crops*. AAAS Selected Symp. 38.
- Johnston, M.C. 1962. The North American mesquites *Prosopis* sect. *Algarobia* (Leguminosae). *Brittonia* 14(1):72-90.
- Meyer, D. 1984. Processing, utilization and economics of mesquite pods as a raw material for the food industry. Diss. ETH-7688, Swiss Fed. Inst. Tech. Juris Druck & Verlag. Zurich
- Simpson, B.B., ed. 1977. *Mesquite*. Dowden, Hutchinson, & Ross. Stroudsburg. 287 pp.
- Rzedowski, J. & G. Calderón de Rzedowski. 1988. Análisis de la distribución geográfica del complejo *Prosopis* (Leguminosae, Mimosoideae) en Norteamérica. *Acta Botanica Mexicana* 3:7-19.
- Silbert, M.S. 1988. Mesquite pod utilization for livestock feed: An economic development alternative in Central Mexico. Thesis. Univ. of Arizona