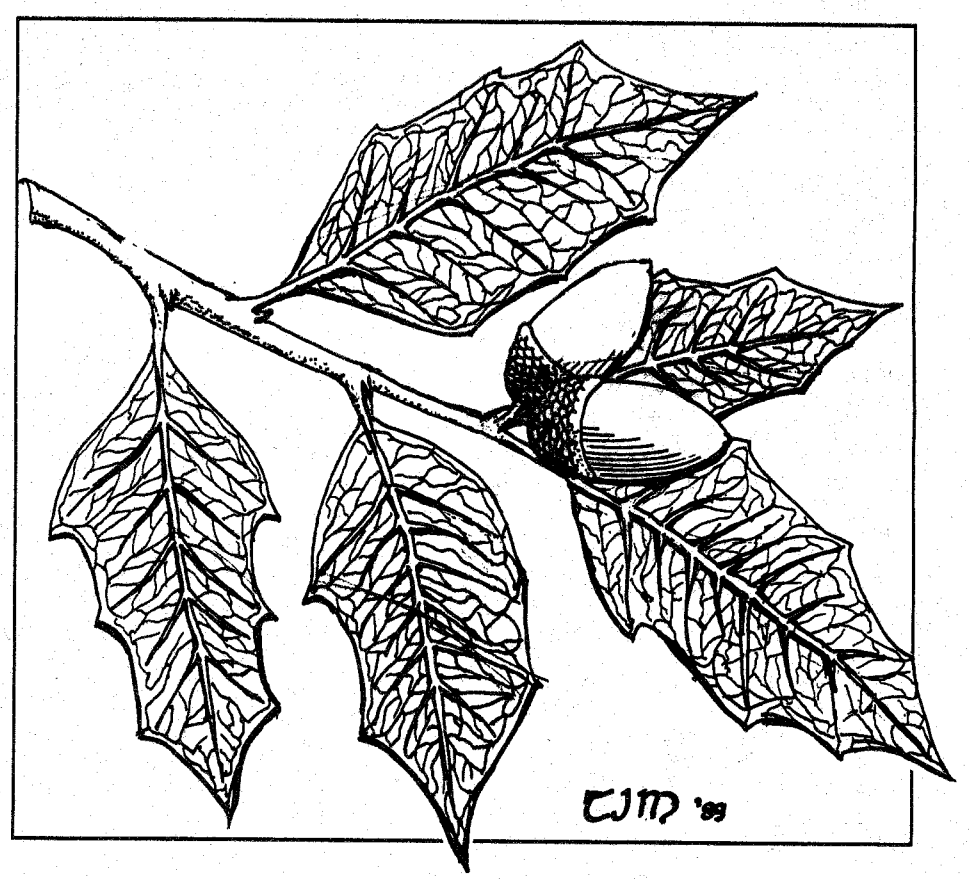
Multi-purpose Tree Crops for Drylands

By David A. Bainbridge

Multipurpose tree crops are extremely valuable in the drylands of the world. Agroforestry systems including multipurpose trees increase productivity both above and below ground by increasing resource utilization. Deeply rooted trees help minimize the risk of crop failure and can provide a wide range of products for use and for sale by the dryland farmer or rancher.

While most attention and investment for forestry in drylands has focused on single purpose trees either for fuel or pulp, multipurpose trees are obviously preferable. Two of the more promising trees in this regard are the oaks and mesquites. The oaks are a larger group and will fit a wider range of environments but mesquites should be considered in areas where they will grow. Both trees were critical components of traditional agricultural systems in the southwestern United States.



THE OAKS (*Quercus spp.*)

The oak is perhaps the most neglected multipurpose tree. Oaks produce food, oil, fodder, timber, fuel, insulation (cork), tannin, and dyes; serve as a food source for silk- and sugar-producing insects; and can be used as a major green manure (as they have been in China). Oaks are adapted to a wide range of soils and climates, and include species that can grow in sea water, survive very cold temperatures, and endure drought. Although oaks are often portrayed as incredibly slow-growing, some species will grow 6 feet per year with adequate water. Yet, despite centuries of use and acceptance in the MidEast and Asia, oaks have been ignored by Western foresters, and because of their impact, by foresters throughout the World.

The oak seeds, acorns, have been used as food by *homo sapiens* for thousands of years virtually everywhere oaks are found. They were once a staple food in Europe, Asia, North Africa, the Mid-East, and North America. Acorns made up half of the diet of many of the Native American tribes in California. Acorns provided 25% of the diet of some people

(continued page 6)

Multi-purpose Tree Crops

(continued from page 1)

in Spain and Italy as recently as 1900. They are still harvested on a commercial scale for food in both Korea and China, where they are also used to brew alcohol. Acorn foods are available at Korean food stores and alternative markets in many major American cities. They potentially have a much wider market.

Acorn composition is shown in Table 1. The structure of acorn starch falls between that of corn and potatoes. Acorns also contain Vitamins C andA; just twenty-seven grams of acorns would meet the 5,000 IU suggested daily requirement for vitamin A. This could be of considerable importance in very poor areas of the world where vitamin A deficiencies are common. Thorough testing of the full range of oak species may well discover standouts for these and other vitamins, trace elements, and amino acids.

Table 1: Acorn Composition 18 species.

Fraction	Range in percent
Protein	2.3--8.6
Fat	1.1--31.3
Carbohydrate	32.7--89.7
Tannin	0.1--8.8
KCAL/100 gms	265--577

Acorn oil has been used as a cooking oil in Algeria, Morocco, and parts of the U.S. Some species contain up to 30% oil, comparable to the best olive varieties, and the oil is similar to olive oil in composition, cooking quality, and flavor.

Acorns have been used to feed domesticated animals for thousands of years. Most varieties can furnish up to 20% of the diet of chickens and other animals, more if the acorns are leached. The acorn/pig interaction is particularly harmonious. Oak leaves are an important fodder in many regions of the world; in Iraq, *Q. infectoria* is favored for this purpose. In addition, acorns are an essential food for many species of wildlife.

Many of the oaks have high quality wood, prized because it is hard, tough, durable, and resilient. It is widely used for flooring, veneer, furniture, boats, barrels, and many other products. By the time today's plantings mature, the world hardwood market will have changed drastically because the flood of low cost hardwoods resulting from the devastation of tropical forests will be past.

Most of the oaks produce excellent fuelwood, which has contributed to oak decline. At the beginning of the industrial revolution, oak wood was a primary fuel. For example, in the middle of the 18th Century, two English iron smelters at Sheffield and Worth were consuming 15,000 tons of oak per year. In developing and developed countries where oak forests remain, oak is still a preferred fuel wood. The predominant use of oak in California is still for fuel wood; 160,000 cords with a retail value of more than $20 million dollars are sold each year.

Cork, an oak product, is an excellent natural insulation material and could be used extensively in place of plastics. Cork is currently used for insulation, flooring, wine stoppers and a variety of other purposes. The preferred cork tree, *Quercus suber*, is a major commercial crop in the Mediterranean region. Cork oaks have prospered in California and survive as far north as Puget Sound, Washington.

Oaks are intimately related with many fungi. The very valuable truffle ($300 /per pound) grows on oak roots and oak plantations have been planted in Europe for truffle production. Truffle production is also beginning in the Northwest U.S., with Oregon truffles fetching $50 lb. *Shittake* mushrooms are grown on oak logs in both Japan and the United States.

THE MESQUITES (*Prosopis spp.*)

Nitrogen fixing trees are especially valuable for agroforestry systems in drylands, where nitrogen is often a limiting factor. Nitrogen fixing trees grow well without expensive and energy intensive inputs of manufactured nitrogen, and they improve the soil in their vicinity. One of the most promising groups of nitrogen fixing trees is the mesquite family.

Mesquites produce effectively in drylands because they are adapted to heat, drought, and salinity. Some species are able to tolerate 36,000 ppm of sodium chloride, the equivalent of seawater. In addition, mesquite roots are fast growing and will reach very deep for ground water, to 200 feet or more. Seedlings send roots down quickly as the watertable drops after the wet season. This remarkable deep rooting and salt tolerance, combined with drought tolerance and nitrogen fixation, makes mesquite a useful crop in areas where few other useful plants will grow.

Mesquites have been used for hundreds of years by people in many of the world's drylands. They were important in maintaining fertility in Mesopotamia for 5,000 years. Mesquite trees produce nutritious edible pods that are high in sugar and can be eaten without cooking. Mesquite pods were a staple for the native inhabitants of many drylands of the Americas as well as being eaten in some areas of India, Pakistan, Iran, and Mexico. Mesquite trees are highly productive and many pounds of pods can be harvested each hour, but the harvester has to be quick because mesquite pods are avidly consumed by wildlife.

The development of mesquite foods for modern times is very promising. Taste-testing conducted in 1984 showed that mesquite pods could be competitive on the market. Mesquite/corn chips were judged better than pure corn chips for all taste criteria. (A mesquite/acorn chip might be even better.)

Table 2: Mesquite Composition

	Exo and Meso Carp	Pod
	percent	percent
Protein	6--11	8.0--15.0
Fat	0.8--4	n.a.
Sugars	25--58	6.8--15.8

Their high sugar content makes mesquite pods a good base for alcohol, and mesquite beer and wine should be ex-

cellent. Mesquite pods could probably be fermented to make tempe like *Leucaena* pods, or like soybeans to make tofu.

Some mesquite species also produce a quality gum, similar to guar gum, that may be economically valuable. Mesquite may also have medicinal uses.

Mesquite pods are widely used as fodder. Although too high a percentage of mesquite pods disrupts normal cellulose digestion in cows, sheep are well-adapted to eating whole pods, and remarkable mesquite plantations in the salt flats in Chile support large sheep ranching operations. Mesquite leaves from some species are also edible--although the American species are not recommended.

Most of the mesquite trees are small-statured, but the hardwood is usable for tiles, tools, and furniture. The wood is very dense: 0.7, twice as hard as oak, and has very balanced shrinkage on drying. These properties make it excellent for woodworking. Several species are favorable for wood production. In Argentina, there are mesquites with straight boles of 20 m. Excellent timber cultivars could be developed by hybridization and selection within other species as well.

Plantings of mesquite for fuelwood have been evaluated in many drylands of the world, including India, South America, Africa, and the U.S, with encouraging results. These studies show that mesquite trees may produce as much as 7 tons per acre per year. This level of productivity is particularly impressive in the difficult conditions of the drylands.

Mesquite has outyielded Eucalyptus in trials on sodic soil and may often do as well or better than single purpose trees such as Eucalyptus under non-fertilized, non-irrigated plantation conditions. The ability of mesquite to stump sprout makes it well suited for fuelwood coppice. Mesquite, like oak, could be grown with coppice with standards for eventual harvest of timber and continuous pod yield.

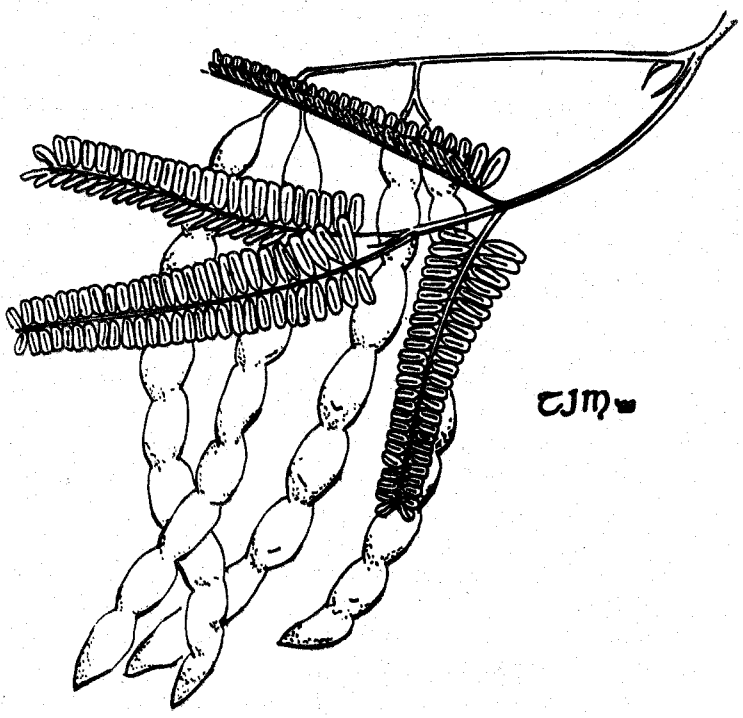
The thornier species of mesquite make attractive living fences. Dead branches may also be interwoven as natural barbed-wire fences.

A management system of intercropping annual crops with mesquite should receive priority. One such system is used in the Rajasthan area of India. Intercropping corn, grains, and vegetables would maximize use of the biologically fixed nitrogen. To increase nitrogen availability for other crops, the leaves (up to 4% N) and stems of the mesquite can be composted when the trees or branches are harvested for fuel.

Summary

Oaks and mesquites should be considered for use in agroforestry systems. In areas where both trees grow, they may make an excellent intercrop, because mesquite pods are limited in Vitamin A but high in sugar while oaks are low in sugar and high in Vitamin A. Both trees are deep rooted and strongly mycorrhizal, and living bridges may be established that transfer nitrogen to the oaks from the mesquite.

Although further research is needed on optimal techniques for establishment, management, and use of these enough is already known to begin using them. Research and development of management systems should emphasize ecological considerations including symbiont effects and interactions in polyculture assemblages. Native species should receive emphasis in this research and the wisdom of indigenous people and traditional farmers should be sought.



Further Reading:
Bainbridge, D. A. 1985. Acorns as Food: Oak Bibliography #1. Sierra Nature Prints, P. O. Box 634, Twain Harte, California 95383, 23 p.
Bainbridge, D. A. 1985. The Rise of Agriculture: A New Perspective. Ambio. 12(3): 148-151.
Bainbridge, D. A. 1986. Quercus, A Multipurpose Tree for temperate Climates. International Tree Crops Journal 3(4): 291-298.
Felger, R. S. 1979. Ancient Crops for the 21st Century. In: New Agricultureal Crops. Westview Press, Boulder, Colorado. pp. 5-20.
Felger, R. S. 1977. Mesquite in Indian Cultures of Southwestern North America. In: Mesquite: Its Biology in Two Desert Scrub Ecosystems. Dowden Hutchingson and Roos, Stroudsberg, Pennsylvania, pp. 150-176.
Meyer, D. 1984. Processing, Utilization, and Economics of Mesquite Pods, Swiss Federal Institute of Technology, Zurich. 159 pp. trees,