Edible Australian Acacias, A "New" - "Old" Food For Semi Arid Zones

Tony Rinaudo

Few food crops are as well adapted as millet and sorghum to the harsh conditions found in southern, semi-arid Niger. Even so, as rainfall continues to decrease and become less reliable, even these staples are not producing enough grain to meet the needs of the people. To counter the unreliable production of these annual crops, we began a search for perennial plant species which produced edible, storable seed. Perennials have the advantage of an established root system that can take up water from light or heavy rains and take advantage of out-of-season rains.

A possible solution, edible acacia seed, came from the semiarid zone of Australia (my home country). The seed of some fifty Australian dry-zone acacia species are a traditional food of Australian Aboriginal people. In Australia they have not been domesticated and until recently have had a low status as "outback bush plants." The Commonwealth Scientific and Industrial Research Organization of Australia (CSIRO) has spent over A$500,000 on research, making sure that these Australian acacias are safe to eat and searching for more suitable seed provenances [Ed: this word means something similar to the word "varieties"]. (Seed of most African acacias is highly toxic to humans. Do not promote species for food which are either not already a regular part of the diet of local people or for which there is no documentation.) Research has revealed that the Australian acacias have low levels of toxic and anti-nutritional factors and are safe to eat. Even so, if acacia seed is going to be a major food source, it is recommended that acacia flour make up not more than 25% of the food components in a recipe.

Species showing the most promise in Niger include *A. colei*, *A. tumida*, *A. elacantha*, and *A. torulosa.* Much is yet to be discovered about the optimal growing requirements of this group of acacias. In the semi-arid conditions of Niger these acacias produce a nutritious and tasty seed, which is high in protein, carbohydrates and fat. Seed of these species can be used in most local dishes as well as in non-traditional or "European" foods such as bread and biscuits. They even can be used as a coffee substitute.

A. *colei* has excelled in trials of acacia species in Maradi (southern, central Niger) showing the most potential for use as a new crop plant. Here are some details of our work with this species.

Advantages and limitations of A. *colei:* *A. colei* germinates easily, has a high survival rate after transplanting, has rapid early growth even under difficult conditions, is hardy enough to withstand drought and can thrive on wasteland. It

can give high yields of very nutritious seed that can be stored for years.

The short life span of the tree (6 12 years) is a limitation. However, a consistent seed harvest could be ensured by planting a number of replacement trees each year. The extensive shallow root system of A. *colei* competes with crops planted near by, particularly in low rainfall years. This has scared many farmers from planting *A. colei* on cropland. Because of this limitation, plantings should be concentrated on farm borders, wastelands and areas not suitable for cropping. Yet another limitation is that A. *colei* is prone to wind damage as the plant gets older or when stressed.

Under Niger's conditions, direct seeding in the field has not been successful, but it has worked in Senegal where rainfall is higher. Thus, propagation has been limited to the expensive and labor-intensive process of raising trees in a nursery. *A. colei* withstands hot, (over 40° C/104°F) dry conditions, being able to set seed with only 200 mm (8 in) of rain per year. Growth rates of 3-4 m (10-13 ft) within 2-3 years on infertile, sandy soils with 200-500 mm (8-20 in) rainfall and dry seasons of up to 8 months have been recorded.

Soils: *A. colei* grows on a wide variety of soils from pure sand to heavy clay. It tends not to do well on shallow lateritic soils (soils with oxides of iron and/or aluminum), especially when rainfall is limited. A. *colei* thrives on wasteland and hardpans where regular crops cannot be grown. In drier areas receiving less than 250-350 mm (9.813.7 in) of rainfall, they do best planted along flow lines where runoff water passes. Placement of trees along water flow lines greatly increases growth, vigor and seed yield compared to all other treatments.

Planting distance and fertilizing:*A. colei* has an extensive shallow root system and will be severely stressed if planted too close together. When severe moisture stress occurs, closely planted A. *colei* fails to grow or set seed. The planting distance recommended in Niger is 10 m (33 ft). *A. colei* has been observed doing well at closer spacing in Northern Nigeria where rainfall is greater than 450 mm (18 in). Potential competition should be considered when deciding how close to plant acacias to traditional crop plants. Farmers will not be happy to plant trees that threaten to reduce crop yields.


Acacia colei, Coiled-Podded Acacia

A. colei responded more favorably to light applications of rock phosphate than NPK or Superphosphate fertilizers in the first year of trials. The effect of nodulating *A. colei* with nitrogen-fixing rhizobia is currently being tested. During the rainy season there seems to be a definite positive response. It is critical to use viable

rhizobia of a type suitable for acacias and which have not been damaged by exposure to heat. Inoculated acacias in Asia have shown significant growth rate increases after inoculation.

Cultivation: Edible acacia trees will not set seed if weed competition is too great. It is critical to give two to three cultivations in the rainy season, especially in drier climates. Cultivation in the dry season may also be helpful as flowering and seed set occurs after the rainy season. Regular cultivation of newly planted acacias has been shown to be far more critical for survival and healthy and rapid growth than any fertilizer regime.

Pruning: Branches of *A. colei* are brittle when stressed and strong winds have been known to completely uproot trees of age three years and older. However, A*. colei* responds positively to pruning at the onset of the rainy season. Trees should be pruned at breast height at the onset of the rainy season once they reach 33 months of age or whenever loss of vigor or die back occurs. Regrowth is enhanced when a number of smaller (finger diameter) branches are left on the pruned trees. After the first pruning, vigorous new branches will grow to 2-3 m (6.5-9.8 ft) in just six months and flowering and seed set can be heavy on this new growth. Pruning also helps reduce dieback and wind damage. However, pruning trials are in process, and it seems that A. colei can withstand may be only 2 or 3 heavy prunings in the life of a tree.

Harvesting seed: *A. colei* is an early and heavy seed bearer. Two and three year old trees produced up to 6 kg (13.2 lbs) of seed with under 400 mm (15 in) of rain while two year old trees produced up to 3.5 kg (7.7 lbs) of seed with only 296 mm (11.6 in) of rainfall.

The seed ripens in March (in Niger) when no other nonirrigated crops are growing. Seed ripening occurs within a 4 week period. Coiled-podded acacia, *A. colei var. ileocarpa*, does not shatter as much as other species and the seed is firmly held in the pod by a thread-like aril. This reduces the problem of seed shattering, which makes it difficult to harvest seed before it falls to the ground. The clusters of bean-like seedpods can easily be harvested by hand.

We have recently learned that for food purposes it is OK to pick the pods just as they begin to turn brown or later when they have dried on the tree (though for reproduction purposes the seeds should probably remain on the tree until dry). This also helps reduce the shattering problem, and the problem of an extended ripening period, which necessitates multiple forays to the trees to harvest all available seed. Protective glasses should be worn if possible while harvesting dry seeds, which cause irritation to the eyes on contact. Occasionally a seed has fallen into a worker's eye and caused great pain. Seeds picked early will not be likely to shatter and fall like this.

Once the seed is dried, it can be removed from the pod by threshing with a mortar and pestle. Threshing should be done on a windy day, as the dust from pods is irritating to the nose and throat, causing sneezing and a runny nose.

In their native habitat, trees are easily harvested by placing a sheet on the ground and beating the branches with a stick. The extended ripening period in some species and provenances of acacias seems to be more of a problem in Niger than in Australia.

Grinding Acacia coffee

Grain storage: Seed may be stored for many years without deterioration, though the aril is susceptible to weevil attack. Periodic winnowing reduces the weevil population. The weevils do not damage the grain unless their numbers are allowed to build up to the point where their wastes cause spoilage.

Food processing: The seed is washed, dried and ground to flour. As much of the black seed coat as possible is removed by sieving through a fine mesh sieve. The flour is then used in traditional recipes, being mixed with the flour that would be used for a particular recipe (e.g. wheat flour for pancakes, millet flour for traditional porridge, etc.) at a rate of no more than 25% acacia flour to 75% of other ingredients. The acacias are tasty and versatile and have gained wide acceptance and usage in many different dishes including the traditional porridge, bean cakes and pancakes. The seed can also be roasted and ground to make a substitute for coffee.

Other Uses: Acacias also fix nitrogen and produce timber for light construction or firewood. If planted in rows, they can form effective windbreaks. Dried leaves of A. colei can be used as low-grade animal fodder. Other species such as *A. ampliceps* and *A. victoriae* are good browse species. Some types of *A. colei* exude sap that has been used for starching clothes. *A. colei* is a very good colonizing species

which can be used to reclaim waste land. Shed leaves can help build up the soil if spread on the field or placed in zai holes. [See ECHO's book Amaranth to Zai Holes: ideas for growing food under difficult conditions, p. 133.]

Other Species: As there are some fifty different acacia species with food potential, it is well worth trying as many as possible for your region. Even two provenances of the same species may perform quite differently at the same site. Thus trials should also be replicated over a number of sites. For example, in the same region, a species might be written off on one trial site that has sandy soil, and yet thrive on a heavy clay soil.

A. tumida has grown well in Niger but it usually aborts flowers before seed set. Under slightly higher rainfall conditions, this species might thrive. One provenance from Kununurra in Australia (800 mm or 30 in rainfall) grew extremely rapidly in the first year but failed to set large quantities of seed. *A. tumida* has large seed which is easy to harvest and process and is balanced better nutritionally than *A. colei* seed.

A. elantha grew very well and gave good growth rate and higher seed yields than *A. colei* on many occasions. The drawbacks with the provenance used were the long ripening period and shattering of seed from the pod. Its tall size also made harvesting difficult. Now that we know that pods picked for food can be picked just as they begin to turn brown, the first two problems can be eliminated. Also, we are finding that with judicial pruning, the problem of the seed bearing branches being too high is largely overcome: the new branches are flexible enough to be pulled down for harvesting. In fact, *A. elantha* is a vigorous tree and produces a lot of biomass and strong poles that are 3 4 meters (10 13 ft) long. But my preference is still the coiledpodded *A. colei*, because its lack of shattering gives the farmer more time to finish the harvest.

A. corriacea is a highly esteemed food of the Aboriginal people. Growth rates for *A. corriacea* in Niger have been disappointingly low, but after four years, the first trees planted where the water table is high are starting to seed. *A. corriacea* reportedly lives for 30 50 years. Its needle-like leaves and light canopy give low shading, and the deep taproot should not interfere with nearby crops.

Mature *A. torulosa* trees seen at the ICRISAT research station in Niger showed no signs of stress and carried a heavy seed crop after a low rainfall year. Right alongside these *A. torulosa* trees were rows of *A. colei* which bore very few seed and showed severe stress through yellowing of leaves and leaf loss. Plantings of *A. torulosa* at Maradi in 1997 showed high survival rates after planting out.

For alkaline and salt affected areas, *A. ampliceps, A. victoriae*, and *A. stenophylla* should be tested. These occur naturally in salt-affected and high water table sites and have done well in trials in Africa and Asia.

Final thoughts: A recent highlight for missionaries and farmers was a visit by Aboriginal women from Australia who routinely cook with the Australian acacia seed. The visit was a very important closing of the circle as the Africans saw that black people had developed this food. Dr. Chris Harwood of CSIRO reports that the Australian women are now trying some of the recipes they tasted in Africa.

However, wherever possible one should try to improve yields of existing crops before trying to introduce exotic ones. Dietary habits are one of the last things that people want to change. Unless a new food is easier to process, is tasty or is

perceived as having some higher status, it is unlikely to be accepted. Initially at least, acacias are being accepted in Niger because of the constant shadow of hunger as millet continues to fail to produce. Fortunately, acacias taste good and are versatile, as they can be used in nearly any traditional dish. We concentrate acacia planting on wastelands where farming is not practiced. We aimed not to replace traditional crops, but to increase biodiversity and thus food security.

Dr. Chris Harwood, one of the collaborating research scientist at CSIRO in Australia, adds this additional caution.


Trees planted along water flow lines

"Please note that *Acacia colei, A. elachantha* and *A. torulos*a, the most promising species in Niger, are adapted to tropical semi-arid climates (annual rainfall 350 800 mm). They are not suitable for wetter tropical climates, where they might die of disease or in some cases spread as weeds, or locations more than about 25 degrees from the equator which have a cool winter with frosts. They grow best on sandy soils, not heavy clay soils. Examples where *Acacia colei* or its close relative *A. holosericea* show potential to become a weed include Sabah (Malaysia) and parts of India; other acacia species have become very serious weeds in parts of Australia and South Africa."

Weediness has not been a problem in Niger, however. I have seen no more than ten self-sown plants there, having visited thousands of adult trees.

The traditional knowledge of the Aboriginal peoples of Australia has been freely shared with various researchers over the years. Without their knowledge and willingness to share it, there would almost certainly be no testing going on with acacias for human food today. I am indebted to Dr. Chris Harwood and Dr. Lex Thomson of the CSIRO, and Dr. Steve Adewusi of Obafemi Awolo University, Nigeria who have encouraged this work. They spent many hours visiting, giving advice, securing research funds and ensuring that essential nutritional and toxicological research be completed. Without their extensive knowledge, expertise and enthusiasm the acacia work would be very haphazard and delayed at best.

ECHO has seed of *A. colei, A. elacantha, A. tumida* and *A. torulosa* and can provide a small packet of each or any of these species for you to evaluate. However, if you want to do a more serious trial, it is strongly recommend that you write to Dr. Chris Harwood at CSIRO. They are especially happy when they receive feedback on how well the seeds do. The advantage of going through CSIRO is that they can send seed from a specific area which best matches the target areas' climates, soils and

latitudes, etc. Chris and coworkers visit many parts of the world. From my experience, I think they would be happy, when possible, to visit people who have shared their results with them.

Dr. Harwood affirms this in recent communication with ECHO. "As Tony says, here at CSIRO we are quite happy to send small quantities (up to about 50 grams) for testing by bona-fide NGO's and government agencies who are working in developing countries through our 'Seeds of Australian Trees' project funded by the Australian Government. We are also happy to write to give people technical advice. For example, most people would not be aware that you need to put the acacia seeds in boiling water for one minute to break their dormancy before you sow them in the nursery. We keep in touch with people to learn the results they obtain and help them with problems that arise." If you are doing community work in developing countries, you can request seeds by contacting Dr. Chris Harwood at CSIRO, Forestry and Forest Products, PO Box E4008, Kingston A.C.T. 2604, Australia; fax: +61-26-2818266, e-mail: chris.harwood@ffp.csiro.au. You could also write to the Australian Tree Seed Centre (P.O. Box 4008, Queen Victoria Terrace, Canberra, A.C.T. 2600 Australia). Larger quantities of seed can be purchased from the ATSC or from reputable seed companies in Australia to which they can refer you.

ECHO thanks Tony for taking time to share with our readers such a detailed report on a fascinating project.

 http://edn.link/7znw4p