EDN

ECHO DEVELOPMENT NOTES

17391 Durrance Road, North Fort Myers, FL 33917-2239
Phone: (239) 543-3246, Fax: (239) 543-5317 USA
E-mail: echo@echonet.org, Web site: http://www.echonet.org

ISSUE 61 **AUGUST 1998** **EDITED BY MARTIN L. PRICE**

FROM THE EDITOR. This issue may have a different "feel" to you than past issues because most of the space is devoted to two important, longer features. **Tony Rinaudo** shares details of his work with edible-seed acacias in Niger and **Dr. Darrell Cox** brings us up to date on the science and controversy of the new "terminator gene" seed technology.

Registration has begun for our **Fifth Annual Agricultural Missions Conference** to be held November 10-12 of this year at ECHO. Contact ECHO for a registration form or download it from our Web site (http://www.echonet.org). We have confirmed a few "resource speakers." **Dr. Ed Nesman** will speak on how to evaluate your agricultural project. This will be followed by an afternoon workshop for those wanting to delve more deeply into this important area. Dr. Nesman has extensive experience in consultation and project evaluation. **Roland Bunch,** author of *Two Ears of Corn*, will speak on sustainability of the development process and recent work in Central America with small-scale water harvesting and green manures. **Dr. Jonathan Crane**, tropical fruit researcher and extensionist with the University of Florida, will discuss matching fruit species with environmental niches and managing the grove. **Dr. David Askin**, an agricultural missionary from New Zealand working in Papua New Guinea, will share from his broad experience, especially concerning small animals. **Francisco Juarez**, director of a Nicaraguan institute that specializes in small animal projects for people with little land, will share what he has learned from several years in this work.

The **Conference for Christian Workers In East Africa** is also approaching. The conference will be held October 12-15, 1998 at the Limuru Conference Center, Limuru, Kenya. I look forward to meeting many of you either at our Kenya conference in October or here in Florida in November.
Martin Price.

EDIBLE AUSTRALIAN ACACIAS, A "New" - "Old" Food For Semi Arid Zones. *by Tony Rinaudo, SIM agriculturalist in Niger, West Africa.*

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 semi-arid 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

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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 (9.8-13.7 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

Acacia colei, Coiled-Podded Acacia

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.

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.

crop

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 non-irrigated 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 coiled-podded *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. torulosa*, 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 co-workers 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.

"TECHNOLOGY PROTECTION SYSTEM" OR "TERMINATOR GENE?" *By Dr. Darrell Cox, ECHO Director of Educational Programs***.**

The two names being used for a new seed technology, the first cold and technical, the second graphic and ominous, reflect the battle raging in the press and on the Internet over a new technology. You will be hearing a lot about this technology, so we are giving considerable space to it in this issue.

What exactly is the technology? On March 3, 1998, an American cotton seed company, Delta & Pine Land Co., and the U.S. Department of Agriculture (USDA) announced they had received a patent on a technique that genetically disables a seed's capacity to germinate when planted again. U.S. Patent No. 5,723,765 covers the use of this technology for potentially all cultivated crops.

The technology is complicated and difficult to explain without biotechnology jargon. Here is an attempt: Scientists (genetic engineers) have identified specific genetic material (we do not know what type of creature is the source) that can be incorporated into the genetic material of different species of plants. Seed companies would presumably spend much money developing a superior variety, then pay the patent holder to allow them to insert this genetic material into their new variety. Plants of this engineered variety would (we assume) be able to grow and produce seed generation after generation on the seed company's farms. The seed that is about to be sold, however, would be treated with a certain chemical. This chemical interacts with the engineered genetic material in such a way as to cause a small but permanent change in the plant's chromosome (DNA) at a key point. The seed company would sell this seed to the farmer, who would want the variety because he believes the extra yield will pay for the expense of buying new seed each year. The altered gene would not affect the crop, which grows normally from the treated seed. The difference is that as the next generation of seed matured in the farmer's field, the now-altered DNA would cause a protein to be produced that somehow destroys the ability of the seed to germinate. The developers of this technology have named it "technology protection system."

Under a research agreement with the USDA, the Delta & Pine Land Co. has the exclusive right to license the new technology to others. While only cotton and tobacco seeds have been shown to respond to the new technique, the company plans to have the technology ready for a much wider range of crops shortly after the year 2000.

What do opponents of the technology fear? Rural Advancement Foundation International (RAFI), a non-profit international civil society organization headquartered in Canada, published a press release in mid-March that condemns the new technology because of its potential to significantly limit the ability of farmers to save their own seed. RAFI's Research Director, Hope Shand, dubbed the technology the "Terminator Technology." RAFI and other NGOs are calling for a global ban on the use of this technology. In the succeeding paragraphs some of their major objections are summarized.

Opponents of this technology fear that farmers, especially in the developing world, may no longer be able to save seed or breed improved varieties. According to USDA spokesman Willard Phelps, the primary targets for the Terminator are "Second and Third World" markets. Priority crops include rice, wheat, sorghum, and soybeans – crops largely ignored by agribusiness breeders because they are not readily hybridized (a tried-and-true biological means of forcing farmers back into the seed market every year).

The opponents of the technology accurately point out that seed companies have shunned crops that are not readily hybridized. Seed companies have had little incentive to devote research to these crops (i.e., self-pollinated crops such as wheat and rice) because their returns do not match those for hybrid crops like maize and many vegetables. Farmers regularly purchase new seed of hybrids every year whereas they save their own seed for replanting of crops that are not readily hybridized. With the patent announcement, the world's two most critical food crops – rice and wheat, staple foods for three-quarters of the world's poor – potentially

enter the realm of commercial interest by private agribusiness. Both systems, hybrids and technology protection, ensure that the farmer returns to the seed company on an annual basis to purchase seed if he/she wants to plant the variety again. The consequence of not doing so is significantly reduced yield in the first case (hybrids) and no yield in the second case (technology protection system). [Note: Although hybrid seed and varieties protected by the terminator technology both promote a strong seed industry, they do differ in one significant aspect. Hybrids are more productive than the inbred lines from which they are produced. Self-pollinated varieties carrying the technology protection system are not inherently more productive than those without it.]

Another fear concerning this technology is that farmers might lose their ability to develop their own locally adapted varieties. This is seen as both a threat to the environment (i.e., reduced genetic diversity) and to long-term food security. Farmers throughout history have functioned as plant breeders by selecting the best seeds every year from the varieties they plant. Over time, through this process of mass selection, the varieties can be significantly altered and improved. If varieties carrying the terminator technology are widely adopted by local farmers, it poses a threat to the culture of seed selection and exchange that occurs among farmers. In addition, it would also increase crop uniformity and vulnerability to pests and climatic extremes.

There also may be significant consequences upon public breeding endeavors. RAFI's Hope Shand believes "there will be enormous pressure on public breeders to adopt the technique in order to feed cash-starved governments and university research departments with corporate dollars." Edward Hammond of RAFI concurs, "biotech companies that are already patenting specific crop genes and traits will probably insist that other breeders licensing their germplasm use the Terminator to protect their monopoly."

Biosafety issues also are a concern. There are differing views on this, but the concern is that the sterility trait will infect neighboring fields of the same crops and/or wild relatives of a crop through pollen that is produced by plants carrying this technology. So the perceived threat here is that the technology would escape and result in the production of sterile seed beyond the boundaries of the fields planted to these protected varieties.

Is this truly a doomsday technology? The patent's defenders acknowledge that the technology will mean an increase in seed costs as farmers who now buy seed only when they change varieties will be forced to make annual purchases. They defend higher seed prices by saying that farmers will opt for the "sterile" seeds only if they offer a big advantage in yield or quality. Will the up to 1.4 billion resource-poor farmers in the South dependent on farm-saved seed and seeds exchanged with farm neighbors as their primary seed source soon be forced to purchase seed yearly?

We need to remember that varieties produced and treated with the technology protection system will not be inherently more productive than other varieties. New varieties produced via this technology will be most attractive when they are superior in yield. Only when farmers are able to recoup considerably more than the added cost of annual seed purchases will they choose to plant varieties with the technology protection system. Otherwise, farmers will stay with crop varieties for which they can save their own seed. In addition, farmers will continue to be plant breeders, both by saving seed of indigenous land races or varieties and improving these genotypes through mass selection.

Whether or not this technology is widely used will greatly impact its profitability for Delta & Pine Land Co. Normally one might question whether a company would wish to share coveted technology with others. However, because the trait does not improve the quality (or quantity) of recipient varieties, it is in the interest of its owner to sell as many licenses for the technology as it can. RAFI quotes an USDA spokesman as saying "the USDA wants the technology to be widely licensed and made expeditiously available to many seed companies. The goal is to increase the value of proprietary seed owned by U.S. seed companies and to open up new markets in Second and Third World countries."

As was stated earlier, Delta & Pine Land Co. has the exclusive option to license the patented technology to other seed companies. Since the patent was announced in March, Delta & Pine Land Co. has been purchased by Monsanto. Furthermore, it was recently announced that American Home Products would be acquiring Monsanto to produce the largest agrochemical/life industries company in the world. Seed companies purchasing a license from Monsanto also will profit as the technology is more widely used, and they can take a longer perspective on the profitability of a variety because seed must be purchased every year over the lifetime of the variety. Patents for this technology have been applied for in at least 78 countries according to an article printed in the 1998 Summer Edition of the Seed Savers Newsletter (Decorah, Iowa, USA).

Much of the plant breeding effort that has occurred in self-pollinated crops in the 20th century has occurred in the public sector, within national and international agricultural research centers. I believe this will continue to be the case at least to some degree. However, as the partnership between public and private sectors grows and public funding for plant breeding declines, the mandate and the clientele of public research institutions will be in flux. The current trend of seed company consolidation, coupled with rapid declines in public sector breeding, mean that farmers are increasingly vulnerable and will have far fewer options in the marketplace. One thing we can do is to lobby for more

government support for breeding non-hybrid, non-terminator varieties; without this support our public breeding programs will languish or be drawn to the private sector for funding.

Some of those contacted by RAFI see benefits to the new technology. "For the first time, private companies will be encouraged to invest in the world's most vital food crops. We can look to a new flow of investment into crops whose yields have stagnated or even declined in the '90's. Now such 'poor people's crops' as rice and wheat will get the research support they so desperately need," one crop economist advised.

Finally, I doubt that there is much biosafety risk associated with this technology. An escape would be most likely to occur within a species rather than across species. For example, the natural outcrossing rate for some self-pollinating crops can be up to 5%. If two rice fields, one planted to a variety carrying the technology protection and the other planted to a conventional variety, were planted adjacent to one another you could expect a small percentage of outcrossing which would result in seed produced on the conventional variety that is sterile. For this to happen, the fields must be planted in close proximity and the flowering dates must be similar. The likelihood of the trait being passed to another species is even lower because normally foreign pollen is unable to fertilize an unrelated species. Even when an escape does occur, it should be self-limiting because the progeny are sterile and the trait should not be passed throughout another population of plants.

For those of our network that are interested in learning more about the terminator technology, you can request a copy of ECHO's technical note entitled "Protection of Plant Genetic Resources." This technical note includes RAFI's press release in its entirety, as well as the above review of this technology and a development worker's perspective on the implications of this technology for farmers in developing nations. In addition, section 2 of the note discusses law pertaining to how plants and plant varieties are protected and the sovereign rights of countries over the plant material in their country.

BOOKS AND OTHER RESOURCES

CTA PUBLISHES A NEW WEBSITE.

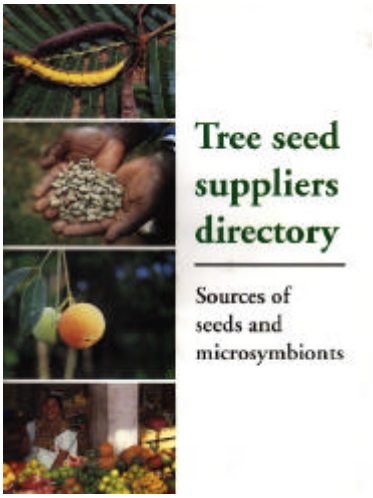
In our book *Amaranth to Zai Holes: ideas for growing food under difficult conditions*, we mention the Technical Centre for Agricultural and Rural Cooperation (CTA) and their excellent publication *Spore*. CTA is a Netherlands-based agriculture development research organization working for development of African, Caribbean, and Pacific (ACP) nations. *Spore*, a bi-monthly newsletter published in English, French and Portuguese, is highly recommended to EDN readers.

Spore is available upon request free of charge from CTA to those working in agricultural and rural development in Africa, Caribbean, and Pacific and EU countries. Those wishing to receive Spore should write to CTA [address below]. *Spore* always contains articles about development, news of research in international agriculture, reviews of new books and other publications such as newsletters, or rural radio scripts (some of the most useful of these publications are published by CTA) as well as notices of upcoming conferences, courses, and seminars. It is on ECHO's "must read" list.

CTA has recently come out with a new website at http://www.cta.nl. From the site you can read the latest issues of *Spore* (back issues reportedly will also be available in 1999), search a publications catalog for titles available from CTA, and locate agriculture centers in ACP countries where CTA cooperates with research. If you work in rural radio, you can even download rural radio audio files to be played over the air.

If you do not have world-wide web browsing capabilities but would like to contact CTA about their research or publications, contact CTA (Postbus 380, 6700 AJ Wageningen, The Netherlands; tel. +31 317 460067, e-mail: cta@cta.nl).

TREE SEED SUPPLIERS DIRECTORY: SOURCE OF SEEDS AND MICROSYMBIONTS. 411 pages, ICRAF, 1997.



In issue 50 of EDN (A-Z p. 106) we reviewed the *Multipurpose Tree and Shrub Directory* from ICRAF (International Centre for Research in Agroforestry). That volume has now been greatly expanded and reprinted. Those searching for forestry and/or agroforestry seed and inoculant sources will find it a very useful reference. There are 147 pages of tree species listed along with information about seed sources for each species. Another table lists where to find inoculant for each tree species listed.

Other tables list synonyms for species names, further information about each seed supplier, addresses of suppliers grouped by nation, number of seed per kg, seed type (orthodox, intermediate, recalcitrant), and recommended seed treatment.

ICRAF has announced plans to release a version of the book on CD-ROM. The data is also easily accessed via the Internet at http://198.93.235.8/cfdocs/examples/treessd/treessd.htm. To order, contact Roeland Kindt, PO Box 30677, Nairobi, Kenya; e-mail: r.kindt@cgnet.com; fax+254 2 521001.

TRADITIONAL VETERINARY MEDICAL PLANTS IN SUB-SAHARAN AFRICA ONLINE DATABASE.

The following notice appeared in the *Indigenous Knowledge Development Monitor* July 1998. "The database *Traditional veterinary medical plants in sub-Saharan Africa* contains information on thousands of plants used for treating animals in rural areas in different regions of Africa. Each listing includes, among other things, the plant's botanical name, the African countries where the plant is used for veterinary purposes, and the animal disease it is used for. The database is intended for researchers, veterinarians, and educators. It gathers together information from various sources and presents it in a compact, accessible way."

"The full database is available via the Internet. It can be found at http://pc4.sisc.ucl.ac.be/prelude.html in both English and French. To search the database, one can use a set of keywords and symbols to enter either the name of a plant or the name of a disease."

CHICK PRODUCTION AND HEALTH: GUIDE TO IMPROVING SMALL-FARM FLOCKS IN THE TROPICS. Dr. John Bishop, 1997.

John Bishop, DVM, Ph.D., was mentioned in issues 50, 52, and 54 of *EDN* as a source of the Triple Production Red breed of chickens and author of various technical notes on natural incubation and protected free-range chicken pasturing. Now Dr. Bishop has integrated his technical notes into one booklet titled *Chick Production and Health: guide to improving small-farm flocks in the tropics*. The booklet covers everything discussed in previous technical notes mentioned in *EDN*: natural incubation and brooding, protected free-range management, and fundamental disease control. Included are plans for building simple protected free-range equipment, basic nutrition and disease control information. *Chick Production and Health* is being distributed by Heifer Project International (P.O. Box 808, Little Rock, AR 72203 USA; phone: 1-800-422-1311, e-mail: exchange@heifer.org) for US$3.00.

UPCOMING EVENTS

New Crops & New Uses: Biodiversity & Agricultural Sustainability; 8-11 November 1998, Phoenix, Arizona, USA. "New Crops & New Uses: Biodiversity & Agricultural Sustainability" is the theme of a conference to be held 8-11 November 1998 in Phoenix, Arizona, USA. Sessions will be held that address strategic opportunities in new crops, new uses for crops, strategies for commercializing new crops and perspectives on the uses of plant introductions. A wide diversity of plant species will be included during the presentations including fruit and nut crops, oilseeds and industrial crops, vegetables and nutriceuticals, fiber and energy crops, and aromatic spices and medicinals.

Registration materials can be obtained from The Association for the Advancement of Industrial Crops, c/o U.S. Water Conservation Laboratory, 4331 East Broadway Road, Phoenix, AZ 85040-8807, USA. In addition, you can contact David Dierig, AAIC, at tel. 602-379-4356 ext. 265 or ddierig@uswcl.ars.ag.gov for conference information. Additional conference information can be viewed at the AAIC website- http://www.aaic.org or Purdue University Center for New Crops & Plant Products website- http://www.hort.purdue.edu/newcrop.

International Course on Farmer-Led Extension. 16 November - 4 December 1998, Y.C. James Yen Center, Silang, Philippines. This course is designed to advance rural development objectives through improved agricultural extension practice. Conventional, ministry-driven, technology transfer-oriented agricultural extension has failed to promote rural development in much of the world, particularly in agroecologically diverse, resource poor and risk-prone regions. Additionally, there is an ongoing "search" for institutional arrangements which will foster (1) greater sustainability, (2) increased participation of rural communities, (3) the capacity to address equity issues within service provision, and (4) the incorporation of indigenous technical knowledge into agricultural research and development strategies. Thus, there is a need to consider alternatives within changing environments. Examining alternative extension approaches provides a wealth of lessons and opportunities for understanding, comparing and contrasting farmer-led extension programs.

For more information and application forms, contact: Mae S. Arevalo, Education and Training Division, IIRR, Y.C. James Yen Center, Silang 4118, Cavite, Philippines; e-mail: etd@cav.pworld.net.ph.