EDN ECHO Development Notes

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Edited by Martin Price
and Dawn Berkelaar

ECHO is a Christian non-profit organization whose vision is to bring glory to God and a blessing to mankind by using science and technology to help the poor.

Issue Highlights

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The ECHO Agriculture Conference Will Be Held during a DIFFERENT MONTH in 2008 and 2009

This year's ECHO Agriculture Conference will be held **December** 9 to 11, 2008. Until this year, the conference has been held annually in November. We had to change to December this year, because the hotel we have been using is having difficulties and the only other hotel large enough for our conference could not guarantee reservation of enough rooms for us in November. We now have a contract with a great hotel with plenty of rooms for sleeping and meetings. It is also walking distance to many retail outlets and restaurants, which will be especially helpful for our overseas delegates who often need to purchase items while they are in the USA.

ECHO is offering an optional post-conference workshop on Friday, December 12. The topic, Farming God's Way (FGW), will be taught by Grant Dryden from South Africa. The FGW approach to farming, covered in *EDN* 98, combines spiritual principles with sound agriculture practices. The hope of FGW is that small-scale farmers would increasingly move toward sustainable profitability while bringing glory to God as they practice being faithful stewards of their lives, families and land. An FGW workshop was taught after the 2006 ECHO conference and was very well-received. The fee for the extra day of the workshop is $30. Check our events website (www.echoevents.org) for more details.

Rapid Multiplication of Banana and Plantain Plants

By Darren Boss

At ECHO's November 2007 Agriculture Conference, Darren demonstrated a technique for rapid multiplication of banana and plantain plants. He learned the technique at the Centre Africain de Recherches sur Bananiers et Plantains (CARBAP). CARBAP's website is www.carbapafrica.org/index.php.

The technique described in this article is very practical and applicable in certain situations. For example, it is becoming very useful for us here in Gamboula, Central African Republic (CAR), to produce planting material to distribute to our agroforestry cooperatives. It would also be helpful as a method to rapidly multiply disease-resistant cultivars that could take years to establish and multiply in an area if using traditional means of multiplication.

The technique requires no specialized equipment and does not require aseptic conditions. In fact, the only tool needed for this technique is a knife. (You will also need a bucket or other container to hold the banana or plantain sucker while it sprouts.) Thus the technique can be reproduced by small-scale farmers with locally available materials. (Note that juice from banana plants stains permanently, so wear clothes that are dark in color or can otherwise be stained.)

In *Fruits of Warm Climates*, Julia Morton makes reference to "A greenhouse technique [involving] cleaning and injuring a corm to induce callus formation from which many new plants will develop. As many as 180 plantlets have been derived from one corm in this manner." This is a good, condensed description of the technique

I learned at CARBAP. It is not unusual for CARBAP to produce more than 100 plantlets from a single corm, but each cultivar responds differently. To date, they have successfully used this technique to propagate over 40 cultivars of bananas and plantains.

In the CAR there is one potentially serious problem that may limit the usefulness of the technique for small-scale farmers. Marketing the product could be difficult, particularly if a farmer's production exceeds the local demand. The infrastructure in western CAR is such that marketing the product outside one's own village would pose a great challenge. In a slightly more developed area or country, such as Cameroon, access to other markets is possible because of the improved transportation infrastructure.

Below I describe the technique in terms of seven steps: pup selection; phase I conditioning; phase II conditioning; placement of conditioned pups (explants) in the germination bed; root and plantlet development; excision, reactivation and replanting; and planting and hardening of plantlets.

1. Pup Selection

Bananas are propagated from rhizomes called pups. The ideal pup is a sword sucker that has 5 to 40 cm of stem (actually it is a pseudostem—not a true stem—but we will call it a stem for simplicity's sake) extending above the surface of the soil. [Sword suckers have narrow sword-shaped leaves (Figure 1), in contrast to water suckers that have broad leaves]. I prefer to harvest pups in the 30 to 40 cm range, especially if the banana mat is no more than one to two years old. Generally speaking, the larger the pup's corm, the greater the number of plantlets that pup is capable of producing—although there are other factors involved that influence a pup's potential to produce plantlets. Furthermore, in my limited experience, dessert banana pups seem to have a smaller corm than plantain pups. Pups that have a bulbous/spherical corm are desired over those with a thin, elongated corm, although both forms are acceptable.

Figure 1. Sword sucker.

When removing the pup from the mother plant, dig around the pup while being careful not to injure its corm. Sever the pup as close to the corm of the mother plant as possible. If possible, sever the pup in a single motion to minimize damage. Wash excess soil from the pup. Remove any dead, dried leaves.

2. Phase I Conditioning

Using a sharp knife, peel away 2 to 5 mm of the corm's cortex (the outer layer of tissue), including the roots. Begin peeling at the point where the outermost leaf sheath connects to the corm. If necessary, you can peel deeper, but try to leave at least a thin layer of cortex surrounding the central cylinder. Cut away any obvious signs of weevil or nematode damage. The most obvious sign of nematode damage is a red discoloration in and around the root channels. If this red discoloration is found, trim the roots right down to the level of the central cylinder. Dip the corms in a nematicide if one is available, but this is not necessary. Reduce the length of the corm to 10 cm. The corm of the pup should be completely white (Figure 2), although it will quickly turn brown on contact with air (due to oxidation). From this point on, do not allow the pup to contact soil that could potentially be infected with nematodes.

Figure 2. Sword sucker with pared corm

The point at which the banana leaf sheath connects to the corm is called a 'node' or the 'transition zone' (Figure 3). It is usually an obvious line, although it may be difficult to identify on the outermost leaf sheath due to the paring process described above. Once you identify the transition zone of the outermost leaf sheath, locate the "V" formed by the two edges of the outermost leaf sheath (Figure 3). Using a sharp knife and beginning at one edge of the "V," make a cut around the circumference of the stem, through the width of the outermost leaf sheath at a point 2 mm above the transition zone. Remove and discard the cut leaf sheath.

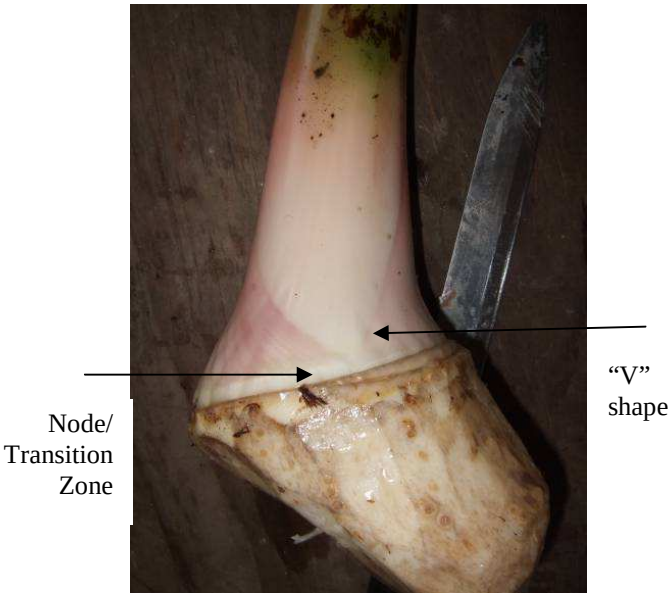

Figure 3. Node and "V" shape formed by a leaf sheath.

Locate the transition zone and "V" of the next leaf sheath and repeat the above process. If the transition zone is obscured and you are unable to identify a point 2 mm above it, make your cut 2 mm above the point at which you removed the first leaf sheath.

Remove 2 to 5 leaf sheaths in total, following the above procedure. The number of leaf sheaths you can remove will be dependent on the size of the pup. A rule of thumb is to stop removing leaf sheaths when it becomes difficult or impossible to visualize the "V" formed by the edges of the leaf sheaths.

Next, reduce the height of the remaining stem to approximately 2 cm above the point at which you removed the last leaf sheath (Figure 4). The net effect of this process is that you have a small "staircase" with each step being 2 mm in height, with the last step being 2 cm in height.

Figure 4. End of phase I conditioning.

Finally, place the pup in a location that receives filtered sun (shade cloth that lets through 50% or less of the light is recommended). Typically, pups are left to dry in the shade for about 48 hours, although leaving the pups for an extra 24 hours is acceptable. This step stresses the plant and also makes the pup easier to work with because it dries a bit.

3. Phase II Conditioning

Take your pup that was air-drying for the past two to three days (Figure 5) and begin reducing the height of the remaining stem in very small increments (i.e. 1 to 2 mm or less).

Figure 5. Start of phase II conditioning.

You will eventually come to a point where a small dot at the center of the surface you are cutting becomes slightly translucent (clear). Stop cutting at this point, which will usually be within 1 to 5 mm of the last leaf sheath you removed during phase 1 of the conditioning process (Figure 6).

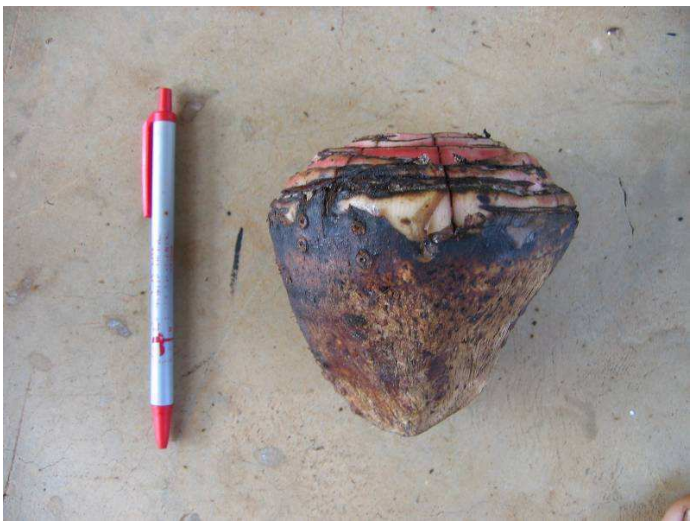

Figure 6. Phase II conditioning showing stem that has been further reduced.

Locate the "axis of growth" of the pup; that is, find the orientation or side of the pup from which it was growing from the mother. Make a crosswise incision, 3 cm deep, across the

width of the pup along the axis of growth that transects the translucent point described above. Make another crosswise incision perpendicular to the first. The point of these incisions is to try to damage the growing tip (apical meristem), not to destroy it. It may be worthwhile to make a third crosswise incision to make sure you cut the apical meristem (Figure 7). Damaging the apical meristem will break apical dominance (hormonal control over the other buds) and will allow the lateral buds to push and form new plantlets. The conditioned pup is now called an "explant." Set the explant aside for 2 to 3 hours in the shade.

Figure 7. End of phase II conditioning. The conditioned pup is now called an "explant."

4. Placement of Explants in the Germination Bed

After 2 to 3 hours, place the explant (conditioned pup) in a germination bed where it will have time and space for banana plantlets to develop. The germination bed can be any type of container, as long as it is deep enough; it could be a simple bucket, or it could be a cement or brick structure. It needs to be well drained and deep enough to contain 5 to 10 cm of substrate (planting material) below the explant, plus the height of the explant, plus an additional 4 to 5 cm above the explant. The preferred planting material is fine sawdust. If you try using soil or compost, sterilize the material first.

The germination bed must be covered with clear plastic so as to create a greenhouse effect (uniform higher than ambient temperatures and humidity). The germination bed needs to be located in approximately 50% shade. The ideal temperature within the germination bed is 30 to 34ºC (86 to 93ºF). If temperatures exceed 34ºC, you may have problems with burning the leaves of the small plantlets. If temperatures are likely to exceed 34ºC, you can remove the plastic cover during the hottest part of the day.

When the explants are first introduced into the germination bed, the substrate should be completely dry. As stated above, you should have approximately 5 to 10 cm of substrate below the explant. The top of all the explants should be at the same level in the germination bed. The explants can be packed close together with no more than 2 to 3 cm separating one from another. The explants are then completely covered with substrate to a depth of 4 to 5 cm. Leave the explants in the dry substrate for 24 hours; then thoroughly water the germination bed. After the first watering, the substrate will settle and should cover the explants to a depth of 2 to 3 cm.

The germination bed should be periodically watered to maintain a constant level of moisture. The substrate should not be saturated, nor should it be allowed to dry out. When a handful of substrate is squeezed in your hand, you should not be able to squeeze out more than a few drops of water.

5. Root and Plantlet Development

New roots will begin growing within 8 to 15 days and may be visible on the surface of your substrate. Within 16 to 22 days, internodal buds start pushing and some growth may also be visible in the region of the apical meristem (growing tip). After 4 to 6 weeks you should see plantlets growing through the surface of your substrate.

6. Excision, Reactivation and Replanting

Somewhere between 6 and 8 weeks you should have a number of plantlets with 2 to 5 leaves. At this point, carefully remove the entire explant from the germination bed and gently remove or wash away any substrate that is attached to it.

If you have plantlets with 2 to 5 leaves that are less than 1.5 cm in diameter at their base, you can cut them from the explant with a small, sharp knife or scalpel. When cutting out a plantlet, be careful not to damage neighboring plantlets or developing buds. The plantlet you are removing should be cut out with a very small amount of the explant's corm still attached to it. The plantlet that you cut out need not have any roots.

Once you have cut out all plantlets with 2-5 leaves and reactivated all large plantlets (see next paragraph), you place the explant back into the germination bed at the same depth as before. After 24 hours you may water the germination bed if necessary.

If a plantlet's stem has a diameter of 1.5 cm or larger, it is a candidate for reactivation. Basically this means that while the plantlet remains attached to the original explant, you remove several of the sucker's leaf sheaths and cut it again as you did the explant (as shown in Figure 7), to disorganize its apical meristem. This in turn allows the lateral buds that are present on the suckers to begin growing, because apical dominance has once again been broken.

Here are more detailed instructions for reactivation. Remove 2 to 4 leaf sheaths from the plantlet with a small, sharp knife, razor blade or scalpel while the plantlet remains attached to the explant. The point at which you begin removing leaf sheaths is important. When looking at the plantlet to be reactivated you will notice that the plantlet did not initially

grow straight up, there will be a slight curve at its base. Follow the inside of the curve and identify the point at which the curve ends and vertical growth begins. Measure 2 cm up from the point at which vertical growth begins and decapitate the stem of the plantlet (that is still attached to the explant). Beginning at the top edge of the curve, remove the first leaf sheath. Remove another 1 to 3 leaf sheaths if possible. The remaining stem is then reduced to a few millimetres above the point at which you removed the last leaf sheath. You will not likely see the translucent centre portion referred to in the section on phase II conditioning. Crosswise incisions are made as described in that section (and as shown in Figure 7), but only to a depth of 2 to 2.5 cm. Make sure that the first crosswise incision is made parallel to the axis of growth. Dry substrate is then sprinkled over the freshly cut tissue.

You can continue the process of removing explants from the germination bed, excising and reactivating plantlets, and placing the explant back into the germination bed for 4 to 10 cycles. Eventually, the energy stores of the explant will be depleted and it will stop producing pups. At this point the explant will become noticeably soft and may begin to rot.

7. Planting and Hardening of Plantlets

The recommended media for planting the plantlets is a 40/60 mixture of sand and organic matter such as coffee, cacao or rice hulls. If using compost or soil as your organic matter, the ratio is 50/50, but the compost or soil should be sterilized to destroy any nematodes that may be present.

When looking at your banana plantlets you will see that a portion of the stem is green and a portion is white. The white portion is the part that was under the substrate in the germination bed and the green portion was growing above the surface and exposed to light. Plant the plantlets in a one-gallon pot or sac to the depth of the white portion of the pseudostem. Place the sacks/pots in 50% shade and keep them well watered. After 6 to 8 weeks in 50% shade, the plantlets should be large enough and sufficiently hardened off to move them into direct sunlight.

Notes

Single Plantlet Developing from the Explant's Apical Meristem

During phase II conditioning, if you successfully wounded the explant's apical meristem, many plantlets should develop from the damaged tissue. If you only see one large plantlet developing, you probably missed cutting the apical meristem with your crosswise incisions. You need to remove a few leaf sheaths from the developing plantlet, reduce the stem and make fresh crosswise incisions. Basically, you follow the steps for reactivation, except you begin removing leaf sheaths 0.5 to 1 cm up the plantlet's stem. There is no need to identify the curve, because the plantlet should already be growing vertically. Make your 0.5 to 1 cm measurement from the surface of the explant.

Fake Malaria Drugs in SE Asia

By Martin Price

In *EDN* 95 (April 2007) we mentioned that an advantage of growing your own artemisia (*Artemisia annua*) plants to make an anti-malarial tea is that commercial medicines often are fakes. The February 16, 2008 issue of *New Scientist* (www.newscientist.com) tells how Interpol, the World Health Organization and the Chinese government located one of two suspected factories producing fake drugs and arrested two key suspects.

The bad news is that (1) the other most important fake drug "factory" that is believed to operate in China has not been located, (2) the owner of the company that was located has disappeared and (3) there is reason to suspect that the illicit drug trade (i.e. narcotics) is involved and that they will regroup.

According to the article, up to 52 per cent of tablets sold across the region including Cambodia, Laos, Vietnam, Burma and Thailand contain no artesunate (a drug made by slightly altering artemisinin so that it is soluble and can be given by injection as well as by mouth). Fake drugs are being seen in Africa, probably coming from these same sources. Some even have elaborate packaging with fake holograms that were designed to prevent counterfeiting.

In some of the fake drugs, investigators found safrole, a precursor of the illegal drug ecstasy. That is one reason that they believe the illicit drug trade is involved. Some of the fake drugs contained an analgesic (a painkiller) that eases symptoms causing patients to wrongly conclude that they are getting better.

Here at ECHO we were encouraged to see how well our artemisia plants did during the hot, humid summer season last year (we are at 26 degrees north latitude). Many temperate plants do not survive tropical or subtropical heat and humidity, so I had not expected the artemisia plants to survive. They actually had very high leaf production and grew to be quite bushy shrubs, reaching around seven feet tall. Late in the summer they went to seed and died. Was this caused by the decreasing day-length? As we mentioned in our article, once a plant goes to seed it dies. We are finding that new plants can be very easily started from cuttings with four to five nodes. If material for making cuttings is limited, we can use pieces with as few as two nodes. When we have done this, however, these smaller cuttings produced fewer roots than did the larger cuttings by the time we transplanted them to the field.

For Your Interest

Malaria Vaccine Development. The Malaria Vaccine Initiative (MVI; www.malariavaccine.org) is a program with a mission "to accelerate the development of promising malaria vaccines and ensure their availability and accessibility in the developing world." MVI announced late in 2007 that preliminary trials in Mozambique demonstrated that the RTS,S vaccine being developed by GlaxoSmithKline (GSK)

Biologicals is both safe for infants and reduced the incidence of malaria in the test population. The results were published by the British medical journal *The Lancet* (www.malariavaccine .org/files/101707/MalariaEOPUKpress.pdf).

If further study and evaluation are favorable, the vaccine could be submitted to regulatory authorities in 2011.

For more information see the Malaria Vaccine Fact Sheet online at www.malariavaccine.org/files/101707/RTS_S_fact_sheet_Oct 15_FINAL%20version%202.pdf.

ECHOES FROM OUR NETWORK

FGW Feedback

Werner Ristow, working in South Africa, wrote to us about the article on FGW in *EDN* 98. "My first contact with this method of production was through Pastor August Basson in Lesotho in the village of Tebellong. The production season 2006/2007 was characterized by extreme drought in many parts of Southern Africa. Lesotho is receiving disaster assistance from the FAO. Despite this, I believe that some farmers at Tebellong were able to sell maize to the FAO for use in the programme. In our work we are testing FGW, but I must admit that we are not giving it the spiritual attention which it deserves."

Martin Price wrote back to ask whether or not, during the drought, there was any significant difference in productivity between farmers using FGW and the others who used normal techniques.

Werner Ristow asked August Basson to address the question, and also commented, "Our results with basin planting this year are beyond expectation. At this stage it would not be correct to call our practices FGW (Farming God's Way)—we need a Pastor to help us with the non-agricultural part."

Mr. Basson wrote, "I am amazed at the report over the news of drought and food insecurity. If you want a simple answer to your question: there is a huge difference in yield between FGW and traditional methods. The reasons for this are the following:

"1. Farmers who plough wait for the rain and then, when it comes, they start to plough and the poor tractor owner cannot keep up. This year all the tractors broke and we were the only ones continuing planting at the optimum planting time. So the BIGGEST contributing factor is early and timely planting. We have the advantage of using the moisture to its optimum. This year we planted our last maize the 15th of November. The government still planted at 18 December. Needless to say this is too late.

"2. The next contributing factor was that the FGW farmers used fertilizer. Their yields were 5 times the country's average. (2000 kg versus 400 kg).

"3. The other thing was that our farmers' organic matter is increasing on top of the soil. The water penetration has increased tremendously. We therefore have a bigger chance to use all the erratic rainfall.

"4. We are also able to survive at least 2 weeks longer before a dry period hits us.

"5. When all of this is said and done, if our farmers do not weed their field and if they plant late they do not get any of these benefits.

"Just a footnote. We call it FGW (Farming God's Way) because it describes it so well and our African people really like it, but we also call it CA, Conservation Agriculture, or No-till. The principles stay the same, but the way we communicate it…might differ a little from the secular models. But we all have the same purpose, to transform people's lives, clean up the muddy rivers and let the restoration process take hold of the land and people's lives.

"We firmly believe just another agricultural method will not transform lives. A new worldview will change people and therefore we work very hard to help people see themselves differently. For more information go to our website (www.tebellong.givengain.org). It is a bit old, but does have great information."

Tips for Planting Small Seeds

August Basson also shared a technique that can be used for planting small seeds in a no-till situation. "We stick small seed crops to a piece of newspaper with white wood glue. You can do this in a strip or on little pieces. Then you take this and stick it into a little slot in the soil. It works great. The glue dissolves and seeds germinate.

"This was developed by a school girl somewhere in South Africa. I wish I had her contact details.

* Cut a strip of newspaper 1.5 to 2 cm wide. [Editor: If newspaper is not available, one might substitute dried leaves, perhaps of banana.]
* Take wood glue (white) that will dissolve in water. Put a small drop in the middle of the strip of paper with a nail, piece of wood or the spout of the glue bottle. [Editor: You could try to make your own glue (paste) by heating refined wheat flour in water.]
* Space the drops of glue as far apart as you would like to plant the seeds. For example carrots need to be spaced every 4 fingers (or 6 cm) apart.
* Put one seed on each drop of glue and leave it to dry.
* When dry, you can roll up the piece of paper and store it for months before you need to plant it. The amazing thing is each seed germinates and you do not lose 90% of your carrot seeds.
* You do not need to dig up the soil. Use your no-till method and just open a small slot in the soil with a spade. Slide the piece of paper into the slot and close it up. Leave a small piece of the paper above the soil. This will help to

know where to water the seeds. The paper must be planted vertically in the soil.
* Any small seed crops can be planted this way.
*With crops like tomatoes and cabbage you can cut the paper in 3 cm pieces. Put the seed in the middle and just plant this small piece of paper in the right spot in the soil, water it and see what happens.

"Benefits:

* Every seed counts. People with little money do not have money to buy lots of seeds. In one small packet of carrots there are 1000 seeds. Each one can germinate in this way.
* The planting depth can be determined and very accurately followed.
* You see the top of the paper and can see where to water the planted seeds."

[Ed: My one concern is that the paper sticking up out of the soil could act as a wick to dry out the seed.]

FROM ECHO'S SEED BANK

Highlights of Dr. Brewbaker's Leucaena Tree and Sweet Corn Breeding Programs

By Dr. Tim Motis
ECHO Seed Bank Director

We were privileged to have Dr. James Brewbaker as a speaker at our annual conference in November 2007. As a plant breeder at the University of Hawaii, Dr. Brewbaker has devoted many years of scholarly research to the leucaena tree and to sweet corn. He has always had a strong interest in ways that his work can benefit smallholder farmers. This article will highlight seeds he donated to ECHO's seed bank, along with key points from his presentations, his conversations with ECHO staff, and his publications.

Leucaena leucocephala, frequently referred to as 'Leucaena' (in Australia and the United States) and Ipil ipil (in the Philippines) is a long-lived, fast-growing, leguminous, multi-purpose agroforestry tree. Uses include reforestation, fuel wood, shade crop for coffee and cacao, green manure, and fodder. As fodder, leucaena has nutritional value that can be comparable to that of alfalfa. It can be toxic to non-ruminant animals, and to ruminants (cows, goats) that do not have appropriate ruminant bacteria (*Synergistes jonesii*; often already present in ruminant animals in the tropics). The toxic effect is due to mimosine, an unusual amino acid present in the leaves and seeds.

Leucaena originated in Central America and Mexico. Early in the 16th century, Spanish traders brought what is now referred to as 'common' (also known as 'Hawaiian') leucaena to the Philippines. Common leucaena plants are shrubby and tend to be weedy. Nonetheless, the agroforestry potential of the plant was widely recognized and common leucaena spread to most of the tropics, thriving in low-elevation areas with slightly alkaline soils.

Figure 8. Leucaena leucocephala foliage (left) and firewood (right). Photos by Tim Motis.

Leucaena plantings were mostly free of pests until late in 1982 when the leucaena psyllid (*Heteropsylla cubana*) began to spread beyond its native territory in Central America to parts of the world where there were no insect predators to keep it in check. There it caused major damage to existing plantings. Urgent research efforts led to new types of *L. leucocephala* that were selected from extensive collections at the University of Hawaii and other institutions. Types have been identified that are resistant to psyllids and are better suited to forage (Peru type) and timber [Salvador (Hawaiian giant) type] production. ECHO currently carries seed of K6 (Peru), K8 (Salvador), K67 (Salvador; heavy seeder), K500 (cross of Peru and Salvador types; excellent for forage), and K636 (Hawaiian giant; cold tolerant and psyllid resistant).

Dr. Brewbaker emphasizes that there are at least 21 other leucaena species besides *L. leucocephala*, and that some of these possess traits that provide plant breeders with even greater ability to address the problems mentioned above. *L. diversifolia* (ECHO carries seeds of K156 and K784), for example, provides genes for cold tolerance. *L. pallida* has resistance to psyllids and low seediness. Crossing *L. leucocephala* with *L. pallida* resulted in a hybrid (KX2-Hawaii) that tolerates cool weather, has psyllid resistance, and is low in mimosine. At the November 2007 conference, Dr. Brewbaker provided ECHO's seed bank with KX2-Hawaii seeds. See the final paragraph of this article for information on how to request a trial packet of seed.

Concerning seed propagation of KX2, Dr. Brewbaker mentioned that the traits of this hybrid can be maintained over successive generations of seed saving as long as seed is collected from more than just two or three trees. He recommended establishing leucaena "orchards" as living seed banks, and suggested eliminating off-types. An off-type of KX2, for instance, would be a tree that is shrubby and produces numerous seed pods in large bunches. True-to-type, less-seedy KX2 trees produce just a few pods that usually occur singly in the tree canopy. (Leucaena trees can produce so many seeds that they become a weed problem. Consequently, types that produce much fewer seeds are desirable).

Dr. Brewbaker also spoke about his efforts to develop sweet corn varieties that perform well in the tropics. North American sweet corn varieties typically fail in the tropics, largely because day length in the tropics is shorter than an average summer day in the northern hemisphere. Pests such as earworms can also significantly harm the plants.

An open-pollinated sweet corn variety that Dr. Brewbaker developed is called 'Hawaiian Supersweet'. He provided us with seeds of both a yellow- and white-kernelled form of this variety. ECHO has carried the yellow-kernelled type in the past; the type with white (also called silver) kernels is a new addition.

Brewbaker continually "massages" 'Hawaiian Supersweet' by growing it out and selecting ears from the best plants. The seeds he gave us during the 2007 conference are thus an improvement over seeds we have carried in the past. He also gave us seeds of 'Sweet Sarah', a hybrid with very tightly wrapped husks that prevent earworms from being able to find their way to the cobs and eat the kernels.

Members of our overseas network may request (email: echo@echonet.org) a packet of one or several of the leucaena or sweet corn varieties mentioned above. For more information on leucaena, request or download (www.echotech.org) a copy of our "Leucaena" Technical Note, written by Dr. Brewbaker.

UPCOMING EVENTS

Sixth Central American and Caribbean Agricultural Conference (CARCECA)
El Salvador
July 22 to 24

The conference will start on Tuesday morning so we recommend arriving on Monday afternoon, preferably before suppertime. The projected cost is 40 US dollars per person. For more information feel free to contact Ernest Glick, Apartado Postal 94, Santa Ana, El Salvador. Tel. (503) 7824-2383 Email: netoglick@telemovil.net. The Conference will be held in Spanish.

THIS ISSUE is copyrighted 2008. Subscriptions are $10 per year ($5 for students). Persons working with small-scale farmers or urban gardeners in the third world should request an application for a free subscription. Issues #1-51 (revised) are available in book form as *Amaranth to Zai Holes: Ideas for Growing Food under Difficult Conditions*. Cost is US$29.95 plus postage in North America. There is a discount for missionaries and development workers in developing countries (in North America, US$25 includes airmail; elsewhere $25 includes surface mail and $35 includes air mail). The book and all subsequent issues are available on CD-ROM for $19.95 (includes airmail postage). Issues 52-99 can be purchased for US$12, plus $3 for postage in the USA and Canada, or $10 for airmail postage overseas. ECHO is a non-profit, Christian organization that helps you help the poor in the third world to grow food.