EDN ECHO Development Notes

July 2003
Issue 80

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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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Borates for the Control of Termites

By Darrell Cox, Ph.D.

An article in the March 1998 issue of *The IPM Practitioner* featured the use of borates to protect wood against termites, wood-boring beetles, carpenter ants and decay fungi. "Boric acid and its salts, the borates, have been used for wood protection in Australia and other countries since the 1940s," states the author. Because boric acid is widely available and relatively inexpensive, this information should be relevant to many in our network.

Borates are salts with chemical structures closely resembling boric acid. For example, borax is a sodium salt [in Fort Myers, Florida, borax sells for approximately US$0.63/lb or US$1.39/kg]. Other formulations will be less available in developing countries, but you may want to be aware of them; they include disodium octaborate tetrahydrate (DOT) and zinc borate. DOT is highly soluble and has been used by the lumber industry in conjunction with the dip-diffusion method for lumber protection. Zinc borate is much less soluble and therefore is less likely to enter ground water when used as an insecticide (i.e. uses other than wood treatment).

Borates can be used against termites in several ways: (1) as insecticides (killing termites on contact), (2) as antifeedants (making treated material unappealing for insects to eat), (3) as a digestive poison, and (4) as repellants. Borate treatments kill termites by direct contact when concentrations are at least 0.5% w/w (where "w" equals weight, i.e. 5 grams of borate per kg of material being protected). They act as antifeedants when concentrations are greater than 0.25% w/w. Concentrations of borates that are too small to act as antifeedants are able to poison the termite digestive process over an extended period of time.

(This paragraph is for those who want more detail and who know some chemistry). Different borate compounds have different molecular weights. Unless you happen to be using boric acid, a good portion of the weight of the molecule will come from the part of the molecule other than borate. All borate compounds will contain the same amount of borate if expressed as "borate equivalent weights." Multiply the grams per kilogram in the previous paragraph by the molecular weight of the borate compound and divide by the weight of the borate anion. For example, the molecular weight of zinc borate (ZnB_2O_4) is 250.9. The weight of the borate anion ($B_2O_4^{2-}$) is 85.6. A concentration of 0.5% w/w would contain 14.66 g of zinc borate (5 g/kg x 250.9 /85.6 = 14.66 g/kg).

Treated wood possesses repellant properties. When structural lumber used in new house construction is pretreated with borates, houses are termite resistant. "In Australia, where termites seem to be found everywhere, this treatment is required by the building codes for Eucalyptus timbers in the states of New South Wales and Queensland." Even older houses can be made more termite resistant by remedial treatment with borate sprays. In this case, termites already existing in timber are hesitant to "tube over" treated areas. Effectiveness of spray treatments is dependent in part on how well the spray penetrates wood. Borates that are readily soluble in water, like borax or DOT, rapidly penetrate when applied to bare wood. This eliminates active infestations of termites near the surface of the timber.

Freshly cut wood for new construction also can be treated. According to the *IPM Practitioner* article, "Borates applied

right after fresh boards are produced can protect wood for a lifetime. One easy treatment method is dip-diffusion. No elaborate equipment is needed…Since borates penetrate wet wood better than dry, freshly cut wood averaging about 70% moisture is easy to protect…Boards are dipped for about a minute in a 130°F (50°C) solution of 25% DOT, then are stored from 2 to 8 weeks to allow borate diffusion into the wet wood."

Very small doses of borates can poison termites. Borates inhibit many enzymes. The enzyme cellulase is particularly important for termites, because it allows them to digest wood cellulose. Termites either secrete cellulase themselves or have access to a ready supply through intestinal protozoa that produce cellulase. Small doses of borates cause termites to starve, because they no longer are able to digest cellulose. In one study, all eastern termites were killed within two weeks and all Formosan termites within three weeks of being fed a diet of cellulose with 0.0625% boric acid equivalent by weight. At this lower dose, termites still ate wood and therefore benefits were not seen immediately.

Borates can act as rather long-lasting "antifeedants" when used at a higher dose. An antifeedant is a chemical that deters feeding. Many of the studies listed in the article reported antifeedant properties when doses were within the range of 0.25% to 1.0% boric acid equivalent by weight [that is, a solution of 0.25% to 1.0% boric acid by weight]. In one test, "about 1% boric acid concentration kept the amount of pine eaten by the termites *Coptotermes lacteus* and *C. acinaciformis* to 5% or less, while 80% or more of untreated wood was consumed."

Although borate-treated wood possesses repellant properties, borates in general should not be considered repellants. For example, tunneling by termites in treated sand (0.5% to 1.5% boric acid) was not inhibited. In contrast, borates *are* contact insecticides. In another study, "all eastern subterranean termites exposed for one minute to boric acid died within 8 days … Though boric acid dust is an effective termiticide upon direct contact, a large proportion of a termite colony has to be exposed to achieve acceptable control levels."

Strategies devised to take advantage of the various termite control properties of borates include dusting galleries. "One possible method of control for both subterranean and drywood termites involves injection of finely powdered poisonous [borate] dust into their galleries with a dust gun. Since termite biology involves extensive social grooming, if a small percentage of a gallery can be dusted, potentially the whole nest can be destroyed." Field tests of this method against subterranean termites were not very successful, especially when the wood was damp. Other researchers believe that injection of insecticidal dust into galleries is unlikely to result in contamination of a sufficient number of individuals to control ground-nesting species of termites. This difficulty can be avoided by using the "Trojan termite" approach. "Small colonies of subterranean termites can be destroyed by presenting poisoned termites as gifts to the termite colony. The poisoned termites are welcomed and groomed, and the poison on one termite kills at least 10 others. If a persistent poison such as a borate is used, it can be spread further through cannibalism. Theoretically, if 25,000 termites were caught in traps, dusted with borates, then released back into their shelter tubes, a nest of 250,000 subterranean termites could be destroyed. Zinc borate may be more useful for this purpose, as it is less water soluble." Successful bait must be both non-repellant to promote feeding and slow acting so the poison can be distributed throughout the termite colony. In addition, bait formulations must be attractive if they are to be effective. One such bait is composed of sawdust (cellulose) and boric acid mixed with honey and molasses. The honey and molasses may act as a "sticker," increasing the adhesion of boric acid to the termite.

There are a few cautions. Water-soluble borates should not be used as a ground treatment because they are moderately toxic and persistent, and can pollute groundwater. High doses of borates are poisonous to humans when ingested or inhaled. Therefore adequate care, including use of goggles and gloves, is recommended when a borate dust or solution is applied. Absorption through the skin is negligible unless there are abrasions or other breaks in the skin. Masks for respiratory protection should be used in confined spaces where ventilation is poor.

Additional Uses for Boric Acid

By Dawn Berkelaar

In addition to controlling termites, boric acid can be used to control cockroaches and ants. The following "recipes" from a file in our library might be helpful to some of you. Note that any recipe containing boric acid is poison and should be kept out of reach of children, infants and pets.

House ants: Mix 1 level teaspoon (5 ml) of boric acid and 2 ½ fluid ounces (75 ml) of corn syrup or honey over heat until the boric acid dissolves. Dilute the bait with an equal volume of water and mix thoroughly. Place two drops of the bait on a strip of white paper and put it where you tend to see ants. Keep the bait moist by adding water or by replenishing the bait (ants seek both moisture and sugar). Borax washing powder can be used instead of boric acid. The bait takes a few weeks to work, so don't give up if you don't see an immediate reduction in the number of ants.

Cockroaches: Cream ¼ cup (60 ml) of shortening (or bacon drippings) and 1/8 cup (30 ml) of sugar. Mix 8 oz (240 ml or 1 cup) of powdered boric acid (or borax), ½ cup (120 ml) of flour, and ½ of a chopped small onion. Add to the sugar and shortening mixture. Blend well, then add water to form a soft dough. Shape the mixture into small balls. Replace them when they are brick hard. If you keep them in open plastic sandwich bags when baiting, they will stay soft longer. Another recipe included slightly different proportions and/or ingredients: 16 oz (2 cups) boric acid, 1 cup (240 ml) flour, ¼ cup (60 ml) sugar, 1 onion (shortening or bacon drippings omitted).

Fire ants: An article in the *Journal of Economic Entomology* (volume 90, number 2, pp. 488-491) described an experiment

testing the effectiveness of boric acid in killing fire ant colonies (*Solenopsis invicta*).

Boric acid was dissolved in a sugar bait (10 g of sugar per 100 ml of water) to make solutions of 0.25%, 0.50%, 0.75% and 1.00% (wt:vol).

After six weeks, all of the colonies that were given boric acid were reduced in size (i.e. in number of workers and in amount of brood) by more than 90%. By the sixteenth week, there was a 99% reduction in the number of workers, no brood was present, and any queens that were still alive were small and were no longer producing eggs. The control colonies, on the other hand, grew in size throughout the course of the experiment.

Although the high doses of boric acid currently used in baits are designed to eliminate ants quickly, the authors point out that a high dose increases the likelihood that ants will learn to avoid the bait. Because a high dose kills ants quickly, it also reduces the passing of food from one ant to another (which could ensure that many more ants encounter the poison).

The concentrations of boric acid used in this experiment are much less than the concentration that is currently being used or recommended in ant baits. The authors concluded, "We suggest that if it is used at lower concentrations, boric acid has great potential for control of *S. invicta*."

Especially for Sub-Saharan Africa: Mother and Baby Maize Variety Trials

By Dawn Berkelaar

If you are doing agricultural development work in Africa, you will want to read about—and perhaps become involved in—an exciting program that includes agriculturalists and farmers in maize variety trials. CIMMYT (the International Center for the Improvement of Maize and Wheat, based in Mexico) is working with collaborators in southern Africa to test and introduce improved, open-pollinated (i.e. not hybrid) varieties of maize. The varieties were developed through SADLF, the Southern African Drought and Low Soil Fertility Project, which is working to provide smallholder farmers with stress-tolerant maize varieties. Of particular importance are varieties that are tolerant of drought and poor soils.

For example, a few years ago, several new open-pollinated varieties of maize were evaluated. Some of these open-pollinated varieties (ZM421, ZM521 and ZM621) were selected by farmers for their superiority during these trials and have been released in several Southern Africa Development Community (SADC) countries (Angola, Malawi, RSA, Tanzania and Zimbabwe). Varieties ZM421 and ZM521 yielded 30-50% more than other current varieties under conditions of drought and poor soil fertility. Some hybrid varieties that show even bigger gains have also been developed. The people involved in the trials decide which varieties will be tested, once they have received information about the respective merits of open-pollinated and hybrid varieties. Often a combination of hybrids and open-pollinated varieties is chosen.

Testing of new varieties is done in communities through what have been referred to as Mother and Baby Trials. Here is how they work. A Mother Trial is managed by a researcher but seeds are planted by partners (e.g. people working in the area of agricultural development, such as a missionary, Peace Corps worker, or NGO agriculturalist). In the trial, between ten and sixteen cultivars are evaluated under two different levels of fertilizer; an optimal level (according to the extension services in the area) and a suboptimal level. The Mother Trial includes three replicates of each cultivar and permits evaluation of the cultivars under controlled conditions.

Baby Trials are grown by at least six farmers in the same community, with each farmer growing four cultivars. Farmers are selected by the community. They receive seed (free of charge) in color-coded bags. Stones painted the same colors are used to mark rows and distinguish between varieties. The field layout of the trials is simple. For example, here is how the farmers' involvement was described to us: "Farmers are asked to grow the Baby Trial using their usual management practices, and are requested to treat the four cultivars uniformly. Plot size in the Baby Trial is determined by the amount of seed: 650 seeds per cultivar. Farmers are asked to plant the seed using a plot length of about 15 meters, but choosing their own planting distance between hills and rows."

At the individual country level, the National Maize Program coordinates local partnership in the trials, while CIMMYT provides the regional technical backstopping.

Currently, Mother and Baby Trials are being done in nine SADC countries, involving up to 83 partner organizations (research institutions, agricultural extension systems, NGOs, schools, farmer associations, etc.). 153 communities and over 1000 farmers are involved.

The Mother and Baby Trial system has many positive features that have made it very successful. Scientists and researchers work together with extensionists and development agents, and both parties recognize their responsibilities in the trials and the benefits that they will receive. The trials are very cost-effective, because they are managed by local people. In addition, varieties are tested in a number of different environments (under the very conditions in which they will likely be grown), and they are managed by many different farmers. This means the average performance of a variety can be better assessed. Farmers can compare varieties based on seeing and working with them through a whole growing season. Consequently, improved varieties are adopted more quickly by farmers than they often are otherwise. In some cases, adoption of new varieties occurs as research is being conducted, and this can help direct future research. Both researchers and farmers are gratified that seed becomes available much more quickly after a new variety is released.

We found a contact for the Mother and Baby Trials, and asked if it would be helpful for us to write about the trials in *EDN*, in

case some of you in our network want to become involved. Mick Mwala, Regional Coordinator of the trials in the Southern Africa Development Community Region, responded: "The proposal you are making is very much welcome. As you will see, the trial scheme depends on active partnership to be efficient and effective. To this end the interest and possible involvement of some of your members is definitely welcome."

If you are working in sub-Saharan Africa and would like to find out more about these trials, contact Mick Mwala at <m.mwala@cgiar.org> or (if you do not have access to e-mail) write to us and we will forward your address to him. To read more about the Mother and Baby Trials, you can visit the following web page: http://www.cimmyt.org/whatiscimmyt/AR99-2000/survival /farmers_voices/farmers%20voices.htm.

Leaf Protein Concentrate from Chaya Leaves?

By Dawn Berkelaar

[Reader: please note that this article does not apply to people eating cooked chaya leaves. Boiling the leaves destroys the harmful substances mentioned. Boiled chaya leaves have been eaten in Central America and southern Mexico for centuries.]

In response to the articles on leaf protein concentrate and on chaya in *EDN* Issue 78, a reader asked whether or not leaf protein concentrate (LPC) could safely be made from chaya. As we mentioned in that issue, chaya leaves contain varying levels of hydrocyanic glycosides. These glycosides can be toxic if eaten in sufficient amount, because they can release hydrogen cyanide inside the digestive system. Fortunately the cyanide is driven from the leaves during the normal boiling process. Since the process of making LPC does not include boiling for longer than a few seconds, the question is whether the cyanide-containing compounds might end up in the LPC. Have most of the compounds been discarded when the liquid is discarded—or might they be concentrated in the LPC? We have found some helpful information and done a few experiments that will be described below.

LPC has been made from chaya leaves, according to an article about chaya in *Economic Botany*, Volume 56, Number 4 (Winter 2002). Armed with that knowledge, I tried making some myself. I tested both the fresh leaves and the LPC for cyanide content, using a cyanide testing kit developed by Dr. Howard Bradbury of the Australian National University (details about his easy-to-use cyanide testing kits will follow in a future issue of *EDN*). According to my results, fresh ground chaya leaves from a plant on ECHO's farm contained between 30 and 50 ppm of cyanide on a fresh weight basis [ppm stands for 'parts per million'; another way of saying it is 30 to 50 mg of cyanide per kg of leaves]. LPC contained 10 ppm, or 10 mg of cyanide per kg of wet LPC.

I asked Dr. Bradbury what these values mean in terms of the possible toxicity of the leaves and of LPC. Regarding the leaves, he said, "If you got a value of 50 ppm, then if you ate 1 kg of raw leaves you would intake 50 mg of cyanide which would correspond to about 0.7 mg per kg for a 70 kg adult. This could be a lethal dose!" However, an adult would probably not eat uncooked leaves and certainly would not eat that much—at most 250 grams which would only be one quarter of the amount of cyanide intake. Dr. Bradbury concluded, "Nevertheless, it could lead to acute intoxication (i.e. headaches, dizziness, stomach pains, vomiting, etc.)"

Dr. Bradbury said that in general, 50 ppm is considered an intermediate level and 100 ppm is considered dangerous. The World Health Organization has a safe level of 10 ppm for cassava flour [which is used as a staple and consumed in large quantities in many areas]. For more information about the health effects of exposure to cyanide, see the article on this subject in our book *Amaranth to Zai Holes: Ideas for Growing Food under Difficult Conditions* (available on our web site). The article is titled "Toxicity and Food Security: A Review of Health Effects of Cyanide Exposure from Cassava and of Ways to Prevent these Effects." According to that article, the body of a normal adult with adequate protein in his or her diet can detoxify up to 10 mg of cyanide per day with no harmful effects.

Regarding our result of 10 ppm of cyanide in LPC, Dr. Bradbury wrote, "A value of 10 ppm is the top of the WHO safe level and I would think it would be quite okay. Extra heating [for example, if LPC were added to a dish that was then cooked further] could remove any free cyanide present as hydrogen cyanide (HCN), which is a gas with a boiling point of 27°C. However, the remaining cyanide might not be present as HCN, but as a cyanide compound not broken down by heating."

Also, keep in mind that people don't tend to eat pure LPC. It is usually used as an ingredient in a dish (pasta, for example). I looked through some recipes from the *Leaf Protein Concentrate Manual* and found that, in general, LPC makes up one-fourth or less (sometimes much less) of the total ingredients (by volume). For example, pasta can be made from one cup of LPC per six or seven cups of flour (plus a teaspoon of salt).

[As a side note, the 'whey' produced when making LPC (i.e. the liquid that is usually discarded) is not acceptable in the human diet because of the concentrations of nitrates, oxalic acid, and other anti-nutrients. Just for interest's sake, I tested the whey for cyanide content and found it at a level of 10 ppm. The fiber (removed during the first step of making LPC) contained 20 ppm of cyanide. Often the fiber is used for animal feed. Dr. Bradbury said that animals should be fine with 20 ppm of cyanide in the fiber.]

Why would LPC contain so much less cyanide than fresh leaves? Quite likely much of the cyanide is removed with the fibrous portion of the leaves and in the discarded water (whey). Additionally, the blending or grinding done in the first step of making LPC reduces the toxicity significantly. (Usually there are special enzymes in leaves that release cyanide from cyanogenic glucosides. They are in a separate part of the leaf cell to keep them from releasing the cyanide

right on the plant. When an insect or mammal chews the leaves, the structures keeping the enzyme and glucoside apart are destroyed and a dose of cyanide is released in the stomach.) In an article in our files (from the publication *Mandioca EM FOCO*, Numero 4, Outubro 1994), the author seems to confirm that blending or grinding greatly reduces the toxicity. The author reported results of a study on cassava leaf flour. Blending fresh leaves in a blender reduced the level of HCN by up to 90% compared to leaves that were dried first and then ground. (However, according to the above-mentioned article on chaya in *Economic Botany*, blending leaves was sufficient to remove the HCN *IF* it was left to sit for several hours, but the normal LPC procedure does not sit that long.)

Another likely reason for the lower level of cyanide in LPC is the heating and pressing involved in later steps. According to David Kennedy's *Leaf Protein Concentrate Manual*, heating the leaf juice to boiling (which is typical when making LPC) and pressing the curd very well should remove about 95% of hydrocyanic acid.

Though not related to the cyanide question, we came across an article with some additional helpful information about making LPC (Nagy, S., *et al*, 1978, *Journal of Agricultural Food Chemistry* 26(5): 1016-1028). The article includes cassava and chaya plants in a list of 19 leaves that have protein content higher than 30% (i.e. crude protein contents as a percentage of dry matter). To make LPC, the authors ruptured the plant cells (this is often done by grinding, beating or blending the leaves) and then added water at a ratio of 1:1 of water and leaves (i.e. equal volumes of each). Soft succulent leaves are easier to extract than those that are dry and fibrous. In leaves containing high proportions of acid, the juice also tended to be acidic and the protein tended to precipitate along with the fiber. It was better to make the pulp slightly alkaline (around pH 8.2). The yield of protein was less from juice that was allowed to remain at room temperature for extended periods before processing, due to actions of proteolytic and lipoxidase enzymes.

Can You Help Us?

Some of the most important information that we share with our readers comes from people in our network. We would like to get your input on the following two topics. If we receive enough feedback, we will compile the information in an article for EDN (as we did for the recent article on chaya in Issue 78). Please help us if you have information on the following:

Bananas and plantains. If bananas and plantains are grown in your area, do farmers face banana disease problems? If you can specify which diseases and what impact they have, that would be helpful. Are bananas and/or plantains grown as a cash crop or for home consumption?

We mentioned FHIA banana varieties at various times in *EDN*, and have distributed them at our conference. Have these varieties been grown in your area? If so, for how long have they been established there? Did they come from ECHO, Dr. Rowe in Honduras, or elsewhere? How have the FHIA banana hybrids performed in your area? What is their general acceptance by the local population? Please comment on the individual varieties (e.g. FHIA-1, FHIA-3, etc.)—their performance, use, acceptance or lack thereof.

How do the FHIA varieties compare to local varieties, in terms of yield, acceptance, disease resistance, commercial potential, etc.? Which FHIA varieties, if any, are farmers beginning and/or continuing to plant? Finally, what is your honest evaluation of their overall success, continued use, acceptance, and impact in your area?

Soybeans in the Tropics. We would like to hear from our network about raising soybeans in the tropics. Do soybeans grow in your area, or have they been grown? If so, what varieties have done well? Are they used for human food or animal feed? What problems do farmers face? If soybeans are used as a human food in your area, do people like them? How do they eat them (i.e. as tofu, tempeh, soy milk, etc.)? How are they processed? If you write to us with information about soybeans, please include the approximate latitude and altitude at which you work.

ECHOES FROM OUR NETWORK

Update on Papaya Leaf Tea

By Dawn Berkelaar

In the article about papaya leaf tea that was published in *EDN* Issue 77, we did not mention the possibility that regular ingestion of the tea could lead to side effects (because we had not heard of any). Since we published that article, a few items have come to our attention that we would like to share.

Dr. Phil Thuma with the Macha Malaria Research Institute in Zambia read our article and pointed us to some literature about papaya seeds. The abstracts that he sent indicated that papaya seed extract has been found to lower sperm count in rats (this was a reversible effect, and sperm counts gradually increased when the rats were no longer fed papaya seed extract). Papaya seeds have also been used by some women to induce abortions, though we do not know how many seeds were used or if the seeds actually caused an abortion. In addition, some studies suggest that consumption of unripe papaya fruit (which contains a high concentration of latex) can induce abortion, and that consumption of ripe fruit can act as a contraceptive. (References for the abstracts can be sent upon request). For perspective, however, we note that green papaya fruit is commonly eaten in many countries.

The above information applies specifically to papaya seeds and fruit, not to tea made from papaya leaves. However, Dr. Thuma felt that a caution was in order, and commented, "It could well be that papaya leaves are safe—

but given the data on papaya seeds, I think we need to be cautious on recommending the leaves, until someone has shown that the leaves are also safe!"

He added, "I think we have to be careful with people saying papaya leaf worked for them to prevent malaria—especially in areas where there is not very high transmission of malaria! Since even in very high transmission areas, only about 2 to 4 % of female Anopheles mosquitoes actually carry malaria (*Plasmodium falciparum*), it could be just by chance that someone drinking papaya leaf tea never contracted malaria—and it might have nothing to do with drinking the tea!"

We also heard from Christine Wiltse, working in Ghana, who shared that she and her husband began drinking papaya leaf tea in January 2002. She wrote, "We drank two cups weekly and were free from malaria for two months or so. That's good for us. After the first bout we couldn't stop it. Let me mention—we were very diligent in drinking our tea. Then we missed one week. That's the mistake we made. A week later we both fell sick.

"Thinking the dried leaves may not be powerful enough, we changed to fresh picked and boiled leaves. I can't say they stopped us from getting malaria. So we tried three cups a day for three to five days (depending on symptoms) as a treatment. That didn't really work either. What it **did** do was hold the malaria back. This is also very helpful if a bout of malaria wouldn't fit into our schedule (if we were traveling or hosting guests, etc.). A bout of malaria can take you out of action for a few days. So we'd brew some fresh tea leaves and hold it off. Three cups a day usually did the trick. When the symptoms began to rise we'd drink a cup. Within minutes they would subside.

"After our 'program,' travels or whatever, we'd stop the tea and let the malaria come to a head—usually one day is all it took. Then we took a regular treatment (chloroquine, fansidar, etc.)…the tea didn't necessarily stop or cure our malaria. It was effective in holding back an untimely attack. We were pleased with that. Although it's bitter on the palate it's **not** bitter to the stomach.

"There is one concern I personally have with drinking the tea. It made my hair fall out. I wasn't bald but I was shedding **far** more than the daily norm. If we had any kind of plumbing system, the local plumber would be a rich man.

"Needless to say my hair made me question what the tea was actually doing inside me. I had the same effect several years ago while taking Paludrine daily."

We continue to hear from people about the use of papaya leaf tea in relation to malaria. Christine Leonard, working with SIL in Cameroon, wrote that she uses papaya leaf tea to test for malaria at the onset of "mild" symptoms (headache, nausea or a low-grade fever). She commented that malaria is a severely mismanaged disease, with people generally treating it too late for a variety of reasons. These include uncertainly if the illness is malaria, hesitancy to send in a blood test if symptoms are mild (because of the expense of the test and the chance of false "negatives"), and a reluctance to use harsh medicines when they may be unnecessary.

In her e-mail, Ms. Leonard wrote, "We are translators with SIL in Cameroon and have been using papaya leaf [tea] for prophylaxis, and occasional treatment for mild malaria, for approximately four years. Also, over the years I've developed a way of using papaya leaf [tea] to test for malaria."

"As soon as you recognize mild malaria-like symptoms, or whenever you have a persistent headache, stomach upset, or slight temperature, drink [tea made from] 1 to 2 leaves throughout the day (1 leaf for a child). Repeat the following day or two until you are feeling better. If you notice you are feeling better within half a day or within 24 hours, this could mean one of two things: a) you only had a 24-hour flu (or the like), or b) you do have malaria and the papaya leaf is knocking it out. At this point you can either:

"1) Treat for malaria. Continue drinking tea made from two leaves a day for 3-5 days (if you can stand it—it's bitter) to see if you can completely knock it out. [Later in this article, Ms. Leonard describes her method of preparing papaya leaf tea.] However, if symptoms return one or two weeks later, you should take a regular malaria treatment. In my experience, papaya leaf can work for treating mild malaria, but it is not 100% [effective]. (It seems to work well for the Baka who have tried it as a treatment; perhaps it works better for them because they have more immunity than we do. Whenever they appear to have malaria (not too severe) and tell me they have no money for a treatment, I give them two papaya leaves and tell them to get four more and keep drinking [tea made from the leaves] until the symptoms have been gone for a few days--it's a treatment that anyone can afford!)

"2) Complete the malaria test by continuing to drink leaf [tea] until symptoms are gone (1 or 2 days), then stop and see if the symptoms come back (this could take from half a day to a week or two depending on the concentration of parasites in your body). If the symptoms don't come back, you probably didn't have malaria. If the symptoms do come back, chances are you have malaria and should treat it (either use papaya if symptoms are very mild, or a regular treatment).

"Remember, the key to avoiding severe malaria, is to drink a leaf AS SOON AS YOU NOTICE ANY SYMPTOMS OF ILLNESS. If you take the leaf right away, it will keep your symptoms from getting unmanageable during the process of determining whether or not you have malaria. If I'm not mistaken, every case of severe malaria that we've seen. . .was a result of waiting too long to treat. The beauty of this method is that, with the papaya leaf [tea], we can treat for malaria right away, or prevent malaria from occurring with other illnesses, and thus not allow symptoms to get out of control. I've been using this method for a couple of years now, even with the children, and am very satisfied with it.

"The ECHO article explains many ways to prepare a papaya leaf, but I'll share with you what works for us. You can use any kind of leaf (take the entire "hand", not just a "finger"), dead, brown, yellow, or green. I don't like using dead leaves because they break up too much when you wash them. Yellow ones seem to be less bitter, but I wonder if they are less effective (my house help seems to think so but I have not noticed this). Wash it and stuff it into a pot (you can rip the leaf up a bit). Cover with water (just enough to cover the leaves--remember the more water you add the more you have to drink!) Boil for approximately 15 minutes. Pour through a sieve [and collect the liquid]. When the leaf is cool, squeeze out liquid and pour through sieve as well. [My husband] Yves and I like to refrigerate it and drink it cold because this way we can drink it fast and get it over with quicker. For the kids we add lemon and sugar.

"A note about drinking papaya leaf [tea] for prophylaxis: Yves has been drinking it weekly for four years, myself for two. I think it works very well when taken every 7 days or less. It passed the Kribi test when we were eaten alive by mosquitoes for 7 days. The drawback to papaya leaf [tea] for prophylaxis is that it is more work than just popping a pill. Sometimes it hasn't been convenient to get and prepare a leaf, so I put it off for a day or two. When I did this too often, Yves started to get headaches after day 7 which would go away after he drank the leaf [tea], but return again every 7th day (mild malaria). I think ideally, a smaller amount of papaya leaf tea should be drunk twice a week instead of once."

When I asked where she and her husband had heard about papaya leaf tea, Ms. Leonard wrote, "We first heard about papaya leaf tea from a Catholic sister who has been working in our area for 25+ years. She started drinking it as a last resort when she had continued bouts of resistant malaria and was forced to leave the country. Her testimony is that it has kept her clear of malaria to the degree that she could continue working in Cameroon." Ms. Leonard does not know of anyone else who uses papaya leaf tea to test for malaria.

BOOKS, WEB SITES & OTHER RESOURCES

Helpful Resources on the Web

By Edward Berkelaar, Ph.D.
ECHO Staff

ECHO's technical staff recently learned about some excellent technical resources on the web that we wanted to share with our readers.

The NewCROP™ web site:
<www.hort.purdue.edu/newcrop>

This user-friendly web site hosted by Purdue University contains a database with a great number of common and uncommon food crops. An index containing both Latin and common names brings you to individual web pages containing a list of different names the species is known by and a list of on-line publications on that species. Information typically included relate to taxonomy, geographical distribution, yield ranges, pests and diseases, and information relating to planting density and fertilizer requirements.

Fruits from America: An Ethnobotanical inventory:
<www.ciat.cgiar.org/ipgri/fruits_from_americas/frutales/fruits_from_america.htm>

This web site contains an inventory of more than 1100 tropical fruits native to the Americas. Fact sheets are accessed either from a list of available fact sheets (alphabetized by Latin name) or from a table of family names, so to access individual fact sheets, you need to have some knowledge of classification or at least need to know the Latin name of the species you are interested in.

Farming Solutions: Success stories for the future of agriculture:
<www.farmingsolutions.org>.

In the Introduction, the authors of the web site state: "Farming Solutions brings examples of successful, environmentally responsible farming systems to life from all over the world, illustrating how farmers can protect the environment while at the same time increasing food supply where it is most needed."

The web site contains background information about world hunger, as well as data on population, food security, foreign debt, migration, land use, and biodiversity of the world's countries.

The most interesting information on the web site is listed under the heading "Success Stories". Under that heading, listed by different regions of the world (e.g. Asia, or sub-Saharan Africa), are many stories of progress made in some aspect of food security. An example story is: "Using Tithonia concoctions for termite control: As part of the Kenya Woodfuel and Agroforestry Programme (KWAP) farmers in the Busia District of Western Kenya are taking part in an on-farm experiment in pest control."

By clicking on this link, a full-length story is opened up describing the results of on-farm trials testing various formulations of leaves of *Tithonia diversifolia*, *Cassia spectabilis* and *Cassia siamea* to control termites.

In all, there are probably over one hundred different stories. The majority of them share successes in developing countries. The site also has a good search engine. If a search for information on "cover crops" is done, the search turns up a list of links to success stories involving cover crops, plus the country and region of the world in which the story is set.

Appropriate Technology Magazine

By Dawn Berkelaar

Appropriate Technology magazine has been described as "the quarterly magazine for practical change in the developing world." Issues are usually 72 pages long, with sections that include material from GATE (the German

Appropriate Technology Exchange Department of GTZ); ITDG briefs (published by the Intermediate Technology Development Group); health; agroforestry; water/sanitation and renewable energy. This is one magazine that I (DRB) likt to read cover to cover.

If you belong to any of the following categories, you qualify for the personal subscription rate to *AT* (the personal rate is cheaper than the institutional rate): development worker, fieldworker, policy advisor, consultant, researcher, project manager working for an NGO, aid agency, international organization or government worker. The personal subscription rate is £48/US$84 for one year, or £90/US$149 for two years (includes airmail shipping). Payment can be made by check/money order (in £ or US$), bank transfer, or credit card (Visa/Mastercard/American Express).

You can view a sample copy of *Appropriate Technology* in Adobe Acrobat format from the web site at <www.appropriatechnology.com> (be very careful of the spelling!). More information about starting a subscription can be obtained by contacting Research Information Ltd.; 222 Maylands Avenue; Hemel Hempstead, Herts; HP2 7TD; UK. Telephone: +44 (0) 20 8328 2471. Fax: +44 (0) 1442 259 395. E-mail: info@researchinformation.co.uk.

FROM ECHO'S SEEDBANK

Strawberry Tree

By Krista Pendergrass

The Strawberry Tree (*Muntingia calabura*), also known as Jamaica Cherry, is a multipurpose tree that quickly grows to 8 to 13 meters in height. The tree produces a small red fruit, but is largely valued for its wood. It is remarkably fast-growing for a tree having such hard wood.

The wood of the Strawberry Tree is esteemed mostly for its use as firewood. The wood, when dry, ignites quickly, producing intense heat and a high flame with very little smoke. Julia Morton, in her *Fruits of Warm Climates*, writes that Jamaicans prefer the Strawberry Tree wood to any other wood when cooking. The wood is also strong and light in weight, making it easy to work with and durable for indoor carpentry use. The bark produces a fiber for twine and ropes. Enough cellulose is contained in the fiber to make it a potential source of paper pulp.

The one-centimeter round fruit is best when eaten fresh out-of-hand. At ECHO, no form of cooking the fruit has been palatable, although other sources say it can be used in tarts and jams. Fruits are produced during all but the coldest winter months at ECHO and subtropical areas, but should produce year-round in tropical climates. Fruits are produced only 1.5 to 2 years after seeding. An infusion of leaves can also be drunk as an herbal tea.

Another important use of the Strawberry Tree is to provide shade for nursery plants, agricultural crops, livestock, and urban areas. The tree grows tall with spreading, almost horizontal branches. The dark green leaves and white flowers that resemble strawberry blossoms make it an attractive addition to homes and gardens (Figure 1).

Figure 1: The Strawberry Tree produces white flowers that resemble strawberry blossoms. Photo by Angela Nelson.

The Strawberry Tree can grow at altitudes up to 760 meters, even at 1300 meters in Colombia. The tree is drought resistant, but grows best with 1000 to 2000 mm (40 to 80 inches) of rain per year. It does well in poor soils and can tolerate acid or alkaline soils, but is not salt-tolerant.

Native to southern Mexico, Central America, tropical South America, and several islands in the Caribbean, it is now cultivated in Hawaii, some Pacific islands, and Southeast Asia to the extent that many people consider it native. It is also considered a weed in some countries due to the spreading of the tiny seeds by birds and bats.

The tree can be cultivated by cuttings or by the hundreds of small seeds in each fruit. At ECHO, we cultivate the tree for our Edible Landscape Nursery by using seed fresh from the fruit. No experimentation at ECHO had been done using dry seeds until this year. We have found that when the [incredibly tiny] seeds are cleaned, dried, and put in storage, they are viable for up to four months. This knowledge now allows us to send Strawberry Tree seeds out to our network.

If you are working not-for-profit in a developing country, you may request one sample packet of strawberry tree seed free of charge. All others may purchase seed for $3.50/packet (includes shipping). Note that the seeds are so tiny that special care will be needed to start them. Directions on how to clean your own seed and a plant information sheet containing information about how to care for a young plant will be sent along with the seed packet.