EDN ECHO Development Notes

October 2002
Issue 77

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

Note our new area code
ECHO
17391 Durrance Rd
North Ft. Myers, FL 33917
USA
Phone: (239) 543-3246
Fax: (239) 543-5317
echo@echonet.org
http://www.echonet.org

From the Editors

In most issues of *EDN*, we include a long feature article followed by several shorter articles. In this issue, the first three articles all deal with a similar theme—the benefits of using plants that are not typical cash crops and that in some cases are considered weeds.

In the first article, Tony Rinaudo (Program Officer for World Vision projects in Ethiopia and Kenya) discusses the importance of using crops that are appropriate for the climatic conditions of an area. In the second article, we abstract information from *Economic Botany* about the value of weeds in a cornfield, including some information about the economic benefit of saving and using weeds once a corn crop is well-established. In the third article, we describe the deliberate use of certain grass species, both in and around corn fields, in order to control stemborers and striga.

The Green Famine

By Tony Rinaudo
World Vision

In many marginal farming areas of developing countries, people are going hungry unnecessarily. Often drought and pests have become scapegoats for the many woes people suffer, but a closer look at the problem may reveal other causes. For example, it is not uncommon for people to rely on crops that are not the most suitable for their region. In 1999, famine affected over 78,000 people in Humbo district (400 km South of Addis Ababa, Ethiopia)[1].

[1] Conditions improved, but were still serious for 53,700 people in 2001 and 23,000 people in 2002.

The staple crop, maize[2] had shriveled up in 1999, due to low rainfall and poor distribution of rainfall, yet other vegetation remained green. In fact World Vision (WV) staff called it a "green famine." Interestingly, in the small, non-irrigated household gardens, sweet potato, cassava, moringa (an indigenous tree with nutritious edible leaves), paw paw (papaya) and many other edible plants were thriving! When people settled into this part of the hot, semi-arid Rift Valley some 30 years ago, they brought their maize with them. Year after year the crop has failed, simply because maize is not suitable for the unreliable and erratic rainfall patterns characteristic of the area. Instead of seeing that maize is not a suitable crop for the normal rainfall pattern, blame is placed on "poor" weather for its failure to produce grain[3].

Interestingly, this concept is not unique to developing countries. Until very recently in Australia, drought

[2] Drought-stressed areas devoted to maize production in Ethiopia occupy 38 to 42% of the total maize-growing area but contribute only about 17% of total maize production. Drought-stressed areas constitute about 46% of all arable land in Ethiopia where 25% of the population live and maize is one of the most widely grown food crops in these regions. [Nigussie, M, et al. Maize Breeding for Drought Stressed Areas Of Ethiopia: A Review. In *25 years of Research Experience in Lowland Crops. Proceedings of 25th Anniversary of Nazareth Research Center*. 22-23 Sept. 1995. Melkassa, Ethiopia]

[3] In fact, there are good reasons why people prefer maize. It gives the highest yield per unit area when seasons are good, maize husks provide protection against birds and rain, it is easy to harvest and shell, it does not shatter, it can be harvested over a long period, and people prefer the taste of maize over other foods.

was widely considered an *unusual 'natural disaster'* and both farmers and pastoralists routinely expected the government to provide them with compensatory payments to tide them over exceptional drought periods. This view of drought has now been displaced in official policy by the much more realistic idea that *drought in Australia is not exceptional, but normal* and farmers are being encouraged to *work with the environment, not against it* [4].

In some more fortunate situations, the problem can be solved by building irrigation systems, or by introducing more hardy varieties of the same crop. Both of these options should certainly be pursued, but they have limits and will not benefit the majority of people for whom there is no irrigation potential, or where the climate is simply too extreme for even the best varieties.

Hunger in this case has resulted from reliance on a crop that is unsuitable for the climate and because people are not accustomed to treating other crops (which do well in the region) as staple foods. Many factors contribute to this lack of interest in and familiarity with other crops, including people's taste preferences, history with the crops, and bad experiences with them. For example, alternative crops that thrive under the same conditions in which maize failed may also have limitations. It is well known that sorghum is one of the most drought resistant crops available, but it appears to be very susceptible to bird damage, and so is not widely grown. Cassava is also extremely drought resistant and suffers no damage from birds, but its tubers do not store well. The same is true of sweet potato.

Ingrained likes and dislikes run deep. Despite recurring food shortages, the community at Humbo has not adopted teaching on how to chip and dry cassava and sweet potato, which would enable these tubers to be stored for long periods. Instead, at harvest time, when a 100 kg sack of sweet potato tubers is worth just US$0.12, tubers are trashed!

There are ways of getting around these problems. In the Makueni district of Kenya where maize crops have repeatedly failed due to drought, farmers are returning to their traditional crops of millet and sorghum. They are finding that when a large enough area of sorghum is planted, bird damage on any one plot is minimized. [Editors: If readers have information on reducing bird problems through altering sowing times, using mixed cropping or using other means, please write to us so we can share the information with Tony and others in our network.]

In Kaloleni, a coastal district near Mombasa, Kenya, cassava thrives. Yet it is not valued, but is stigmatized as a poor man's crop. It is seen as a *famine food*, one that is eaten as a last option during hunger spells. Farmers sell this abundant food at very low prices in order to buy expensive processed foods (maize and wheat flour, deep-fried potato crisps, etc.).

In collaboration with the Kenyan Government's "Farm Training Centre" in Mombasa, WV Kenya is helping people to value cassava by teaching new ways of cooking and processing it. Chapatis (a type of pancake) are a popular food, but are usually made with expensive wheat flour. WV facilitators have taught community members how to make cassava flour and mix it in a 1:2 ratio with maize flour for making chapatis. Thus, a monetary saving is made and the end product is actually preferred, being less gluey. Nobody dreamed that cassava could be made into deep-fried chips, which is another popular food. The cassava roots are boiled, the stringy vein is removed and then the root is deep-fried. Mothers are packing these "new" foods in school lunches – and the kids are asking for more! Previously, when children brought boiled cassava to school they were ashamed and afraid of ridicule. Now, children beg their mums to pack extra, so that they can share it with their friends! A type of cassava rissole (fried mash, similar to a hash brown) is also prepared, using mashed cassava roots and leaves (the latter of which happen to be high in protein and vitamins). Simply by changing people's perceptions of cassava, and offering new ways of processing it to produce tastier foods, a whole community is on its way to becoming self-sufficient in food.

A lot of time, money and suffering could be saved in many food-deficient areas. While all avenues should be pursued to alleviate the situation (including irrigation and crop introduction for example), we should not overlook what may be staring us in the face. Often, the most suitable crops for the area are already present, but they are undervalued. Small adjustments in the farming method used or a change in the way foods are prepared, coupled with community education, could make a big difference to winning the battle against hunger.

An Echo From Our Network

Paul Woods read Tony's article and responded to him with the following e-mail:

"It was great to hear your story…about food security and maize. Your thoughts could not have been more appropriate – would you believe I have just been grappling with the same issues! In a northern province of Mozambique (Nampula), people are saying they are on the verge of starvation, but it's in the middle of the wet season and the grass is 1.5 m high alongside the road!

"It set me thinking about what is really going on here. I can see there is food around, such as vegetables (pumpkins, cucumbers, tomatoes that are for sale along the road, as well as freshly harvested groundnuts) but people are claiming to be short of food. OK, there is a region wide shortage of maize and the price is high.

"[In] Tete Province (Central western area) where the average rainfall is lower, it's much the same story, although there is less grass growth. We did a short walk to a farmer's field that had been planted to the staple maize crop. It was a failed crop (out of reach of grazing animals such as goats) but the growth

[4] Mercer. D, Whatever happened to ESD? In *Groundwork* 1(4), June 1998.

of native annual shrubs was luxuriant and the soil was moist and soft, having been ploughed by animal traction for the maize crop.

"I got hold of the recent rainfall records for Tete and also learned of the long term average for a station that is not too far away from Cahorra Bassa. [Based on that information,] I think the failure of the maize crop was a result of a dry February this year. Maize is very reliant on rainfall at the right time (for pollination). Other than that (and floods in Feb 2001), rainfall in the preceding months was not unusual – November, December and January were 'right on average.'

"I also realized when I was in Tete (Cahorra Bassa area) that we can't assume farming systems in these communities are well adapted to the prevailing climatic and ecological conditions. The reason for this is the disruptions and dislocation caused by colonialism and the civil war, and the resulting reliance on food aid. The communities I held consultations with last week are comprised of (1) people who come from the same area, but who returned to their traditional land after 10 to 20 years in refugee camps in Malawi or Zimbabwe, (2) people who more or less stayed around their own lands, and (3) those who came from other places, via refugee camps or directly.

"These are therefore 'hybrid' communities that have been reliant (to varying degrees) on food aid and relief for up to 20 years (a whole generation). World Vision's main operations in Cahorra Bassa until 1995 were relief oriented. I wonder whether people's preference for maize is partly because that was the predominant form of food aid in the region for 20 years. I really concur with Tony's statement [about the unsuitability of maize in many regions]."

[Editor (MLP): Those of us from temperate climates sometimes forget that some vegetables are perennials that often provide food long after the "vegetable season" is over. I recall touring gardens in Port-au-Prince, Haiti at the season when most vegetables had stopped producing. To the uninitiated the gardens appeared to no longer be productive. But most gardens had large leafy bushes called the "Basket Vine" along the side of the garden. The leaves of this drought-resistant plant provide a highly valued and tasty cooked green. People may also be using some of the weeds left in the garden. See the next article.]

The Value of Weeds in a Corn Field

Abstracted by Martin Price, Ph.D.

Reference: L. Vieyra-Odilon and H. Vibrans. 2001. Weeds as Crops: the value of maize field weeds in the valley of Toluca, Mexico. *Economic Botany* 55(3): 426-443.

When I was a child growing up in Ohio, my parents relied heavily on the summer garden to feed our family through the year. I noticed that they kept it well weeded until a certain time, then let the weeds grow. We had all the tomatoes, peppers, potatoes and cucumbers we could eat, even if we had to look through some weeds to find them. Farmers in the Toluca valley in Mexico do the same thing in their cornfields, but not merely to save labor. The weeds themselves are a surprisingly valuable commodity. The authors of this article did an exceptionally extensive study of the practice and economics of growing corn—and of selling or using the weeds.

During one rainy season, they regularly interviewed 24 families in the village and 10 vendors at a regional market about type and quantity of weed use. Also the weed vegetation was surveyed and 49 farmers were interviewed concerning their farming practices and costs. All of the 74 weed species found in cornfields were useful, whether as a forage, a potherb (an edible annual plant), or a medicinal or ornamental plant.

Within the village, 11 species were eaten. The average family consumed 4.5 kg of wild potherbs per month during the rainy season. In the market at Ixtlahuaca, 2,150 kg of 10 species were sold as potherbs, worth US$611. For quantity and gross economic value, plants used as forages were much more important. On the average 1 hectare of corn produced a harvest of 1.5 tons of green forage, worth about 25% of the gross value of the corn harvest and 55% of its net value. The combination of corn interspersed with forage weeds that can be fed to stabled animals constitutes an interesting integrated farming system. The weeds increase the useful biomass of the field, improve nutrition of the farmers, do not reduce the yield of the main crop (because the fields are kept weed-free during the critical period) and provide erosion control, shade and green manure. The use of weeds in cornfields is facilitated by the fact that one can walk around in a cornfield without damaging the crop, which is not possible in, for example, a wheat or oat field.

Some species of gathered potherbs (mainly *Chenopodium berlandieri* and *Amaranthus hybridus*) arrive daily at the large wholesale market of Mexico City by the truckload, and are widely available in city supermarkets as well as in the traditional weekly markets in Central Mexico. Other species are marketed on a more local scale. Edible herbs enter trade primarily in the highland and humid tropics, less so in arid regions. Feeding cornfield weeds to domestic animals is a common practice in the whole central highlands of Mexico.

The study area was located in the south-center of Mexico, at about latitude 19° N. There was a summer rainy season, then a dry season. Frosts were frequent at night from November-February.

Corn was sown sometime between early March and mid-May (depending on the variety). Corn was spaced at 3-6 cm planting distance within the row and 80 cm between rows. Farmers cultivate with a cultivator for the first time at the three-leaf stage near the beginning of the rainy season; the second cultivation, with a plow, follows 20-25 days later when the plants are 35-50 cm tall; sometimes there is a third cultivation.

The cornfields are virtually weed free until about June. By that time, the corn forms a dense cover, the critical phase of competition is over and the weeds that subsequently germinate are traditionally left to grow freely. It has been shown

repeatedly—and it is common knowledge among farmers—that application of herbicides at this stage does not improve the yield. Even so, today herbicides are sprayed in many areas to make harvesting easier (reduction in spines, stickers etc.). However, even where herbicides are used, owners of animals will leave an adequate surface untreated to use the weeds later as forage or potherbs. Often weeds are left to grow near the field margins, as they are easier to transport from there.

A look at the economics of growing corn in the study area shows that weeds can be very valuable. The total cost for growing one hectare of corn is US$367 using a tractor and US$319 using animal traction. The sales price of the harvested corn was US$600-800, based on a yield of 3-4 t/ha and a price of US$200 per ton (for an average income per ha of $700). The authors found that the average yield of forage per household was 2661 kg, valued at US$346 (US$111 per hectare). So on the average, the weeds were worth 33% of the gross value of the corn harvest ($111÷($700-$367)=33%).

For some farmers, the weed harvest was worth far more than half of the maize harvest. In regions with a less productive agriculture, or in years with lower maize prices, these percentages easily could be even higher.

If harvesting weeds is so profitable, why do many farmers now use only part of the wild plants that grow in their fields, and spray herbicides on the rest? The authors speculate that (1) there is an upper limit to how many animals can be looked after in periods of high labor demand; (2) costs for feed during the dry season may be too high for most farmers to afford [Editor (MLP): numbers of animals on a farm are limited by the amount of feed at the END of the dry season, so an abundance of feed at one season is not a predictor of how many animals the farmer can keep.]; (3) techniques for conserving fodder are not known (hay-making, silaging); (4) harvesting weeds is hard physical labor; and (5) cheap external labor is not available on a consistent basis.

Protecting Maize with "Weeds"

By Dawn Berkelaar

In eastern and southern Africa, stemborer insect larvae and striga (*Striga hermonthica,* a parasitic weed) cause huge losses in maize yields. Together, the two pests can destroy an entire crop. A habitat management system to control stemborers and striga has been developed by the International Centre of Insect Physiology and Ecology (ICIPE), along with Kenya's Ministry of Agriculture, the Kenya Agricultural Research Institute (KARI), and IACR-Rothamsted of the UK. The system is called a 'push-pull' strategy. Trap crops that are attractive to stemborers, such as Napier grass (*Pennisetum purpureum*) and Sudan grass (*Sorghum vulgare sudanense*), are planted around a maize field to 'pull' stemborers away from the maize. Napier grass produces a sticky substance that attracts the stemborer larvae, then traps and kills them. Meanwhile, plants that repel stemborer, like desmodium species (such as forage silverleaf, *Desmodium uncinatum*) and molasses grass (*Melinis minutiflora*), are used as an intercrop to 'push' stemborers away from the maize. Molasses grass also attracts a parasitic wasp that is a natural enemy of stemborers.

Several other benefits result from the use of these plants. For one thing, each of them can be used for fodder. For another, *Desmodium* species fix nitrogen and can improve the soil. *Desmodium* also suppresses *Striga hermonthica*, a parasitic plant often referred to as 'witchweed.' When maize was intercropped with *Desmodium*, striga was suppressed 40-fold compared to a maize monocrop.

This 'push-pull' habitat management system has been tested on more than 2000 farms in Kenya and in six districts. Farmers are enthusiastic; farmers in two different districts have reported maize yield increases of 18-20% and 20-25%. Some farmers are also generating extra income by growing desmodium seed to meet the high demand!

In the Suba district of Kenya, use of the 'push-pull' plants for forage has also resulted in higher milk production. The number of improved dairy cattle in the district increased from only a handful in 1997 to 220 in 2000.

Economic analysis of on-farm trials showed that planting maize, Napier grass and desmodium together led to a return of US$2.30 for every $1.00 invested. When maize was planted as a monocrop, the return was only $1.40. The 'push-pull' system does not require expensive inputs like pesticides or fertilizers. Special seeds are also unnecessary; the conventional hybrid seeds used by many farmers work well in the system.

If you want to try this 'push-pull' habitat management technique, you should be aware that Napier grass can become invasive, especially in areas of high rainfall.

For more information, contact the International Centre of Insect Physiology (ICIPE), P.O. Box 30772, Nairobi, Kenya. E-mail: icipe@icipe.org. Website: http://www.icipe.org

We read about this management system in the following publications: *LEISA* 17(4): 17-18; *Appropriate Technology* 28(3): 5-7; *New Scientist* 24: 25; *Footsteps* Sept. 2001.

The Sustainable Village

By Dawn Berkelaar

The Sustainable Village is an organization that promotes "critical thinking, appropriate technology and strategic action for sustainability projects worldwide." According to their web site, The Sustainable Village "seeks to provide solutions to global problems using renewable energy and appropriate technology. They help with projects in developing countries that relate to energy generation and usage, safe water, remote medicine, long-distance communications, sustainable agriculture and micro enterprise employment. They provide the "hard technology" for these projects, including design and engineering, equipment and parts supply, international delivery, training and installation. They also do print production, web site development and marketing consulting for organizations involved with sustainable development."

Steve Troy, founder of the Sustainable Village, also founded Jade Mountain and co-founded Real Goods. Over the past 35 years, he has served over 100 different relief groups in 131 countries, supplying, designing and delivering renewable energy equipment.

The Sustainable Village has an extensive catalog (over 192 pages long) containing more than 8000 products from over 1000 manufacturers. The catalog covers water, energy, lighting, tools, appliances, heating, cooling, and instructional books. You can download a PDF version of the catalog (though it is a large file) from <http://www.thesustainable village.com/products/catalogs/index.html>. You can also browse the web site catalog (though this is more difficult than reading through the PDF version) by visiting <http://www. thesustainablevillage.com/products/prod_category.html> and clicking on a topic. Alternatively, you can request a hard copy of the catalog, but you should be aware that you will need to pay the overseas shipping costs (US$15). A hard copy can be sent for free to a US postal address.

We first learned about the Sustainable Village when we received a booklet from them. The booklet contains ideas for several microenterprise projects, and includes a list of items that could help you get started with such a project. Examples of microenterprise projects include a village grinder, an appropriate technology village water collection and treatment system, a village dehydrator, and a well drilling pump installation service. Information about these microenterprise projects is also found on the web at <www.thesustainable village.com/microenterprise/_micro.html>

Contact information for this organization is: The Sustainable Village; 717 Poplar Ave.; Boulder, CO 80304; USA; Phone: (303) 998-1323; Fax: (303) 449-1348; Web site: www. sustainablevillage.com; E-mail: info@sustainablevillage.com

SRI Update

The July/September 2001 issue of *Appropriate Technology* (Volume 28, No. 3) included several articles about SRI (System of Rice Intensification; see *EDN* 70).

One article stated that scientists at the International Rice Research Institute (IRRI) have examined the components of SRI. Many of the components are already used, they say, in parts of Asia. IRRI scientists concur that "SRI can substantially boost rice yields in certain areas." However, they have not actively promoted it in Asia for a number of reasons: it is very labor intensive; it requires careful water management; many of the components have already been adopted by rice farmers in Asian countries; and even in Madagascar (where the technology was developed), the technology has not been widely adopted by farmers.

However, work to demonstrate the benefits of SRI has continued. In another article in the same issue, Dr. Norman Uphoff described an experiment done in Madagascar by Jean de Dieu Rajaonarison and his advisor, Professor Robert Randiamiharisoa, in the Faculty of Agriculture (ESSA) at the University of Antananarivo. Two rice varieties—a high-yield variety and a traditional local variety—were compared. Both showed the same patterns of response.

Uphoff wrote, "The SRI practices compared against conventional methods were: age of transplanting (8 days v 16 days); number of plants per hill (1 v 3); water management (aerated soil v flooded soil); and fertilization – compost v NPK (16-22-11) v no fertilization.

"The high-yielding variety produced 2.4 times more rice with SRI practices compared to conventional methods. The local variety yielded 2.8 times more. These results can be analyzed several ways to ascertain how much contribution each practice made to yield differences, other things being equal, under these particular soil, climatic and other conditions.

"For these particular varieties and for these particular growing conditions, **planting young seedlings** contributed most to yield: an extra 1.35 t/ha. **Careful water management**, using a minimum of water and keeping soil well drained and aerated, was next most important, adding 0.85 t/ha. Planting **single seedlings** added 0.46 t/ha. **Using compost** increased yield by 0.27 t/ha over what was obtained, on average, using NPK fertilizer.

"That adds up to a total of just under 3 t/ha increase in yield, but when the four practices were used altogether yields increased by 4 t/ha. This shows…an interaction effect or synergy of over 1 t/ha. It is, therefore, in the farmer's interest to use all the SRI practices, instead of picking and choosing."

Sesbania rostrata update

In issue 75 of *EDN*, we included an article about *Sesbania rostrata*. We mentioned in that article some confusion about whether or not the same inoculant could be used for the root and stem of *S. rostrata*. Craig Elevitch with AgroForester Tropical Seeds recently sent us an e-mail on the topic. He had just gotten a response from a University of Hawaii scientist, saying that almost all *Sesbania* inoculant is capable of forming both stem and root nodules in *S. rostrata*.

Can You Help Us?

Do you have seeds of moringa or jatropha? ECHO is collaborating with researchers at The Institutes for Applied Research at Ben Gurion University in Israel on projects involving moringa (*Moringa oleifera*) and physic nut (*Jatropha curcas*). We plan to evaluate samples of these species from around the world for seed and leaf production. Do either of these species grow widely in the area where you work? If so, are you able to collect seeds and mail them to ECHO? If you are able to send us seeds, please contact us beforehand to request a seed import permit. We will send you a permit that must be mailed with the seeds. Please send correspondence to Dr. Edward Berkelaar, Research Director; ECHO; 17391 Durrance Rd.; N. Ft. Myers, FL 33917 (fax: 941-543-5317; e-mail: echo@echonet.org). We are not interested in seed of trees that originally came from ECHO.

Book Review: CD-ROM Reprint of *Food from Dryland Gardens*

Published by ECHO, 2002
Reviewed by Martin Price, Ph.D.

Most publications review the most recent books. I have found that the most useful books are not necessarily the most recent—in fact, they are sometimes out of print.

ECHO reprinted a few valuable but out-of-print books over the years (*Edible Leaves of the Tropics*; *Growing Vegetables in Fiji*), but we had to print so many copies to keep the price low that we ended up with a 10-year supply. With advances in technology and decreases in cost for production of CD-ROMS, ECHO is now undertaking a program to "reprint" CD-ROM versions of some carefully selected useful books. Though the cost of labor is higher than reprinting a book, we can produce a few at a time and sell them for much less than if we had printed the book. For our overseas network, the savings in postage can be $20 or more when buying a large book.

The latest CD book is *Food from Dryland Gardens* by David Cleveland and Daniela Soleri. The authors combine hands-on style with top academic training. Dr. Cleveland did his Ph. D. studies with small-scale farmers in NE Ghana and Dr. Soleri with maize farmers in Mexico. Both are co-directors of the Center for People, Food and the Environment and teach at the University of California in Santa Barbara. They have lots of hands-on gardening experience in Arizona and New Mexico where they worked with Hopi and Zuni Indian tribes.

This large, 386-page book is filled with helpful illustrations. Surprisingly, there do not seem to be many books of a practical nature written on this important topic. It was written for field workers, extension agents, students, project workers, program planners and, of course, gardeners. The authors write from personal experience working in dryland Africa and in the North American Southwest. It is both a beginners guide and a reference for those with more experience. It helps the reader learn to observe and work with local people and to ask appropriate questions about the community, the environment, and the potential for gardens to improve nutritional, economic and social well-being.

If you have access to the web, you can read the entire table of contents by looking up the book in our on-line bookstore. The book is divided into four main sections: Household Gardens as a Development Strategy, Garden Management, Garden Harvest, and Resources. Here are a few interesting "tidbits" from the chapter on "How Plants Live and Grow," to give you a feel for the book. In a section on how plants cope with drought, the authors point out that "drought-adapted plants either escape drought or resist it in some way. Drought-escaping plants have short, rapid life cycles, allowing them to take advantage of the brief period of rains. "Famine" crops like short-season millet and tepary beans are examples.

"Drought-resistant plants, on the other hand, use one of two strategies: either they avoid drought or they tolerate it. Drought avoidance means more efficient use of water so that the plant will not experience water stress. For example, during periods of drought cowpeas avoid water stress by changing the orientation of their leaves in relation to the sun, minimizing the amount of heat they receive and thus reducing loss of water by transpiration.

"Distinguishing between heat tolerance and drought adaptation is useful. In most drylands hot daytime temperatures are very common and so heat tolerance is a desirable characteristic. However, in gardens that receive a regular supply of water, drought adaptation may not be necessary. This is especially true if other varieties or different crops will give a bigger and better harvest with the same amount of water and other inputs."

The *Food from Dryland Gardens* CD-Rom can be purchased from ECHO for $10.95 plus shipping ($2.00 to locations in North America; $5.00 to locations elsewhere).

New ECHO Technical Note: *Papaya Leaf Tea as a Malaria Prophylactic?*

Compiled by Dawn Berkelaar
Published by ECHO, 2002
Summarized by Dawn Berkelaar

In *ECHO Development Notes* Issue 69 (September 2000), we asked if any in our network had heard of the use of papaya leaf tea for the treatment and/or prevention of malaria. We mentioned Dr. David Drake's informal observations, made when he was head of a mission hospital in Zimbabwe. Beginning in the early 1990s, many missionary families and African staff took papaya leaf tea regularly. They did not come down with malaria, even during seasons when many others in the area did.

The questions we asked in *EDN* 69 were: *Do you drink the tea yourself or know people who do? How do you make the tea? How often do you drink it? Do you know of people who drink the tea regularly and still get malaria?*

We received responses from more than a dozen people. Many more people wrote to ask us what we had learned. We have compiled the information into a Technical Note, using the questions as categories. Below is a brief summary of what we learned.

We heard back from people in many parts of the world. We learned that individuals in Brazil, Malawi, Togo, and Irian Jaya had heard of the use of papaya leaf tea to prevent malaria. Miriam Gebb wrote that it is given to schoolchildren in Irian Jaya twice a week, and the incidence of malaria has decreased. Fred and Paula Boley in Brazil wrote, "We are the only people we know who drink it regularly. We

haven't had malaria since starting to drink it." Donna Evans wrote that in Sulawesi, Indonesia, where she lived for nine years, local people make papaya leaf tea as a malaria preventative. She now lives in the Philippines, and said, "locals here have not heard about papaya leaf tea for malaria prevention."

Individuals from Togo, Tanzania, and Ghana also wrote to tell us that they had not heard of drinking papaya leaf tea to prevent malaria.

The book *Edible Leaves of the Tropics* contains some information about papaya leaves. It says the leaves may be cooked as a green vegetable. They should not be eaten raw because of the possible danger from both an alkaloid carpaine and the enzyme papain. Older leaves should be thoroughly boiled, changing the water at least twice. Younger leaves are not harmful. Upon cooking, the leaves have a pleasant color and retain their form and texture. They have a strong, bitter taste that is disagreeable to some people.

Several of the "recipes" we received for papaya leaf tea were very similar and can be summarized as follows:

Pick a papaya leaf (medium-sized; new; from near the top of the tree; one woman said to cut or tear it up) and boil it in enough water to cover the leaf (one person wrote that she uses two quarts of water). Bring it to a boil and let it steep (recommendations ranged from 5 minutes to 15 minutes). Drink ¼ cup of the tea, sweetened or unsweetened, twice a week. There was remarkable consensus among three correspondents on the amount to drink. Even a paper in ECHO's files by C.K. Dresser, MD, lists papaya leaf tea at a dose of 50 to 60 ml, twice a week, as a malaria prophylaxis. He added, "The choices are many. None is 100% sure of success." The paper, called "Malaria Therapy," was written in Indonesia in May 1994.

There were some variations in people's "recipes." We were told that some people in Indonesia and Irian Jaya eat young papaya leaves as a vegetable 2-3 times a week and report an anti-malarial effect. One couple told us that they eat dried, ground papaya leaf rather than drinking papaya leaf tea. They take a half teaspoon of finely ground dried papaya leaf twice a week.

Dr. Drake no longer lives in Zimbabwe, but he still uses papaya leaf tea when he travels. He has used papaya leaf powder bought in tea bags at health food stores in the U.S., and has also made the tea himself using a healthy dried green papaya leaf. He wrote, "We usually prepared the tea from a quarter teaspoon or one tea bag of dried crumbled papaya leaf, in a cup of hot water. We used it twice a week. It can be sweetened to taste, as it is slightly bitter." Dr. Drake emphasizes that in his experience, papaya leaf tea is only effective if it is taken consistently. It cannot be taken at random intervals.

Not everyone who has tried using papaya leaf tea has found it to be successful in preventing malaria. Some who have tried it still got malaria and moved on to other medications for future prophylaxis.

Sometimes even when papaya leaf tea has not completely prevented malaria, people have found that they experienced a greatly reduced incidence of the disease. For example, one couple in Togo ate dried, ground papaya leaf twice a week beginning in December 1999. They have had only one bout of malaria between them since that time, but had twelve bouts in the previous twelve months when they were using no malaria prophylaxis.

Two letters that came to us suggested that papaya leaf tea could be used as a treatment for malaria.

We are still looking for more information. As mentioned in *EDN*, a laboratory analysis showed that quinine was not present in papaya leaves, despite the bitter taste of the leaves and tea. Andrew Hanibelsz, a journalist based in Hong Kong, suggested in a recent e-mail (June 2002) that papaya leaf tea might act as a mosquito repellant. He received the following information from a vet who has worked on numerous islands in Indonesia and with many different populations. Hanibelsz said that the tea works because the active compound is perspired through the skin, and that an unpleasant bitterness can be tasted on the skin as a result. He warned that papaya leaf tea may possibly cause liver damage after prolonged use, so the people there only use it when they go into the forest. He also advised that sugar should be avoided in malaria areas, as sweet sweat is said to attract mosquitoes.

We would like to hear from more people. In their e-mail, Fred and Paula Boley told us, "A few years ago, SIL came out with a publication by one of their missionaries in the Philippines who discovered a tribe that didn't get malaria while others around were getting it. They found that the tribe members were drinking this tea. It would be good if you could contact SIL to get a copy of this article. I don't have the specifics on it." Have any of you heard of the publication mentioned here? We have not been able to locate it.

To receive a copy of the (longer) Technical Note, write to us with your full name and address. If you are a member of our network, you can request a free copy. Otherwise please send $2.00 to cover postage and copying costs. If you are able to receive Word attachments over e-mail, we could also send the document that way. Be sure that you specify in your e-mail that you can receive attachments. You can also download the document from the web (http://www.echonet.org/tropicalag/technote.html).

Disclaimer: ECHO does NOT recommend that anyone stop taking their antimalarial medicine in order to try this treatment. The only evidence for the effectiveness of papaya leaf tea in the prevention of malaria is anecdotal. No studies have been done to scientifically demonstrate its effectiveness. (However, this would be a great research project for a medical mission or medical school.)

Partial Control of Bacterial Wilt of Tomato with Chinese Chives

By Edward Berkelaar, Ph.D.

Bacterial wilt is a disease that affects many different crops, including tomato, potato, tobacco, pepper, the curcurbits (cucumber, cantaloupes, squash, and pumpkins) and some forage crops. The disease is caused by a number of different bacterial organisms. In tomato, the disease is caused by *Pseudomonas solanacearum.* This article describes some aspects of bacterial wilt in tomato.

The disease is more prevalent in hot, humid conditions. Under these conditions, *P. solanacearum* and other disease organisms thrive, making it more difficult to grow certain vegetables in the tropics than in areas where the growing season is somewhat cooler and less humid.

As its name implies, wilting is the main symptom of bacterial wilt. At first symptoms are localized, but they eventually spread throughout the whole plant before finally killing it. Prior to wilting, plants may be stunted and leaflets and leaf stalks may curl downwards. The wilting appears to be caused by clogging of the water conducting tissues in plant stems. If the stems are cut horizontally at ground level, the water conducting tissues located within the stem have a brown discoloration. The disease can be diagnosed by cutting infected stems and suspending them in clean water. If the disease is present, a white milky stream of bacterial cells and slime will flow from the plant's conducting tissues into the water.

Control of bacterial wilt is difficult. As with many plant diseases, prevention is important. Use disease-free transplants and clean equipment. Rotate tomato crops with non-solanaceous species (something other than pepper, potato, eggplant, etc.). Remove diseased plants from the field and burn the plant material if possible. In some studies, it was observed that organic amendments provided some protection against bacterial wilt. The best protection was observed when soils were amended with bagasse (sugarcane fibrous waste), sorghum green manure (i.e. young plants), soybean oilcake or semidried sewage sludge. Tomato cultivars differ in their susceptibility to bacterial wilt.

We recently learned of a simple technique that may reduce bacterial wilt in tomatoes. Interplanting (or pre-planting) Chinese chive with tomato results in allelopathic suppression of the organism responsible for bacterial wilt. Allelopathy occurs when a chemical produced by one type of organism has a negative impact on another organism. In this case, a chemical (or chemicals) secreted from living Chinese chive roots protect tomato by inhibiting *P. solanacearum* in some way. In experiments done by Jing Quan Yu at Zhejiang University in China (reported in *J. Chem. Ecol.* 25(11): 2409-2417), six tomato plants were grown in a 40 cm by 60 cm by 10 cm box, with or without 16 Chinese chive plants. When Chinese chive plants were included, seedlings were transplanted in three rows (about 10 cm by 10 cm spacing) three months before tomato plants were transplanted. The tomato seedlings were placed between rows of Chinese chive. In the absence of *P. solanacearum*, the presence of Chinese chive did not affect vegetative growth of tomato; fruit yield was not measured. In the second experiment, when *P. solanacearum* was added to soil containing only tomato plants, 100% of the tomato plants wilted after 10 days. In a separate treatment, *P. solanacearum* was added to soil containing tomato plants with Chinese chive. In this case, fewer than 40% of the tomato plants had wilted after 14 days.

In a third experiment, two boxes of soil, one with no plants and a second with Chinese chives, were inoculated with *P. solanacearum* and left for a year. After a year, tomato seedlings were transplanted into each box. All the tomatoes growing in the box without Chinese chive were dead after 20 days, while only 22% of the plants transplanted into the box with Chinese chive were dead. Researchers attributed the latter beneficial effect to a drop in the population of *P. solanacearum.* Clearly, if bacterial wilt is a problem, there is a benefit from planting Chinese chive as much in advance of tomato planting as possible.

Chinese chive (*Allium tuberosum*) is also known as Chinese leek, garlic chive, oriental chive, oriental garlic, or flowering leek. It is closely related to onion and garlic. It can grow in a wide range of climatic conditions (hardiness range 3A-10A) and is thought to have originated in Southeast Asia. Chinese chive is a perennial that grows 30 to 45 cm (12 to 18 in) in height [it seems to stay shorter, around 15 to 20 cm (6 to 8 in) at ECHO]. It grows in clumps of four to ten bulbs, and is spread by rhizomes. Leaves are flat (rather than round) and can be eaten green or blanched. Bulbs may be used like garlic. Martin Price, ECHO's executive director, adds that the leaves of this plant add a garlic flavor when added to other food. Above ground leaves can be harvested and will regrow within days, while harvesting the root bulb will of course kill the clump. At ECHO, Chinese chive thrives year-round.

Trial packets of Chinese chive seeds are available from ECHO. Those working not-for-profit in developing countries may request one sample packet free of charge. All others may purchase seed for $3.50/packet (includes shipping).

ROM for $19.95 (for development workers; $29.95 for others). Issues 52-77 can be purchased for US$8, including air postage. ECHO is a non-profit, Christian organization that helps you help the poor in the third world to grow food.