ECHO® Development Notes

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Tire Contaminants from a Container Gardening Perspective

by Ben Fisher and ECHO staff

Introduction

When trying to find affordable planting containers in the developing world, organizations and workers all over have promoted the use of a readily-available waste resource: tires. Over the years, many have asked whether or not tires contain harmful chemicals that could potentially be taken up by your crops. This article is written to communicate what we found from our search of literature on this topic.

Figure 1: *ECHO's urban garden demonstration uses tires to plant a variety of vegetables (like this hot bush pepper,* Capsicum frutescens *'Indian Firecracker') and fruit trees (source: ECHO staff).*

Much of the literature on the subject pertains to tires that have been recycled into small particles. In comparison to the side wall of a tire container, the tire surface area in contact with growing media is much greater with small chunks of rubber. Much of the information available also pertains to toxins in the ash of burnt tires, or those leached from tire material subjected to strongly acidic solutions. Tire garden containers, of course, are not being converted to ash. Furthermore, the media used to grow plants in tires is not nearly as acidic as the solutions often used to study contaminants in tire leachate.

Nevertheless, tires do contain trace amounts of four metals that are known to be toxic to humans. Most of the discussion below relates to metallic elements, but there is also brief discussion of organic contaminants. The article concludes with suggested practices to make tire gardening as safe as possible. This write-up is not meant to be exhaustive or definitive. Depending on feedback and what we learn going forward, we are open to follow-up articles.

Trace Metals

Cadmium

Cadmium can be highly toxic to humans. Fortunately, in tires, it is only found in trace amounts if at all. In a study in the UK, fragments of tires made by ten different companies were exposed to an acid (pH of 2.5) solution to see how much of each of the metals would leach out (Horner 1996). In that study, the concentration of cadmium in the leachate was considered negligible, ranging from 0 to 3 ppm. In a study done in Nepal, the ash of burnt tires from a company in China (Yin Zhu) contained considerably more (27 ppm) cadmium (Shakya *et al.* 2006); it was the only one of tires from four Asian companies with ash concentrations of cadmium above 0.1 ppm. Note that even soils with no industrial pollutants contain some cadmium. Concentration of cadmium in agricultural soils of the United States---where there is no metal contamination from pollutants---varies from about 0.1 to 1.0 ppm (Holmgren *et al.* 1993). Soils near industrial sites often contain 24 or more ppm cadmium.

In a study done at Redeemer University College, a tire sample was found to contain 0.9 ppm cadmium. However, tire fragments soaked in solutions with pH ranging from 3 to 8 did not leach measurable amounts of cadmium over a period of six weeks (Berkelaar 2016). Also, lettuce plants (known for their ability to readily accumulate cadmium) growing in hydroponic growth solutions containing tire fragments did not contain more cadmium than plants growing in solutions with no tires. Basically, while tires contain some cadmium, there was no evidence that it could easily leach out of tires or be taken up by plants—at least for the time frame of the study.

Chromium

Chromium also can have negative human health impacts. Its toxicity depends on the form (valence state) in which it exists.

Featured in this EDN

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ECHO
17391 Durrance Road
North Fort Myers, FL 33917 USA
p: 239-543-3246 | f: 239-543-5317
www.ECHOcommunity.org

Weathering of minerals results in naturally-occurring Cr^{3+} (Ahmad *et al.* 2013). Of greatest concern is chromium as Cr^{6+}, which results from industrial activity (dyes, paints and the tanning of leather) and is mobile in soil. This metal was not even mentioned in the UK study (Horner 1996). In the Nepal study, chromium in tire ash was considered low (0.14 to 1.18 ppm). In non-contaminated soil, chromium occurs at concentrations from 10 to 50 ppm (Risikesh Thankur *et al.* 2016). Soil organic matter is able to bind (adsorb) and/or convert (reduce) Cr^{6+} to the less toxic Cr^{3+} (Bartlett and Kimble 1976; Lee *et al.* 1999).

Lead

Lead is more concentrated (8.1 to 22.33 ppm according to Horner, 1996) in tires than cadmium or chromium. Its concentration in soils ranges from 10 to 50 ppm, with much higher amounts possible (150 to as high as 10,000 ppm) in urban areas (Stehouwer and Macneal 2016) due to historical burning of leaded fuels. Only a small fraction of lead in soils is available for plants (Porrut *et al.* 2011). It has no essential function in plants but can be absorbed from the soil solution through the roots. In the previously referenced UK study, the amount of lead found in the leachates was considered negligible; however, they measured 1160 ppm lead in the soil of a tire dump site. This fact is something to consider because it is likely the eventual breakdown and severe degradation of the tires are the source of this contamination. Plants are able to take up some forms of lead and will sometimes start to show toxicity symptoms themselves, so that is something to look out for. It also remains to be seen how available the lead is to the plants. To complicate matters, plants can contain concerning amounts of trace elements and not show toxicity.

Zinc

The final trace metal is found in the greatest concentrations and has been found to be a significant pollutant and leachate from tires: zinc. Zinc is found in considerable quantities in tires, ranging from 2524-6012 ppm in the UK study. The Nepali study also found very large amounts of zinc. Zinc is actually an essential micronutrient for plants and for human beings; in humans, it has been shown to help fight the common cold and to have other health benefits. Zinc can be toxic to humans, but in my research I found that those amounts have to be quite high (e.g., more than 50 mg/day according to Brown *et al.* 2001), and symptoms will retreat by simply discontinuing consumption of excessive amounts, due to the fact that people are able to metabolize zinc. In a study looking at leachates from ground-up rubber tires, zinc was said to be present in amounts that may be harmful to plants but the study authors concluded that toxicity to humans was unlikely (EHHI 2007).

How much of an element in soil is considered unsafe?

It was difficult to glean exact values from the literature as to what constitutes safe or unsafe soil concentrations of each the trace metals discussed above. In large part, this is because the uptake of metals by plants varies with a number of soil-related factors including pH, organic matter, temperature and concentration of other soil minerals such as phosphorus or calcium. Grubinger and Ross (2007), however, provided values from the New York Department of Environmental Conservation (December 2006) that can serve as a starting point in assessing the upper acceptable limit of each element for agricultural land use. Those values, in mg/kg (ppm), are: 0.43 (cadmium); 11 (chromium); 200 (lead) and 1100 (zinc). Recognize that 1) some metals may be naturally present in the soil placed in tires; 2) some contaminants, especially near roadsides or in urban areas, may be from other sources besides the tires; and 3) guidelines for other regions and countries may differ.

Organic contaminants

These include carbon disulfide, toluene, phenol and benzene. In a separate review of research on tire contaminants, Sullivan (2006) cited several World Health Organization documents in stating that tires do contain potentially harmful organic substances, but toxicity to humans would be unlikely in amounts leached from rubber. Sullivan stated that organic contaminants are most likely to leach at high soil pH.

Best practices to reduce risk

Taking all these things into consideration, here are some recommendations regarding the use of tires as planting containers:

1) First of all, do not use tires that are heavily degraded. It is probably just fine to use tires that have been disposed of because of balding of the tread, but avoid those that are crumbling or tearing into pieces.

2) Avoid soil contact with cut surfaces, since leaching will more likely occur along those surfaces than others. If avoiding cut surfaces is difficult, the tire could be lined with some sort of material to help minimize contact.

3) Consider your crop selection. Trace metals are most likely to concentrate in the roots, with less in the leaves and stems, and even less in the fruits and flowers. Other than the fact that root vegetables are already difficult crops to grow in the limited space of the tire, this may be another reason to grow fruiting vegetables instead. Also, if concerned about toxicity, avoid brassicas (e.g. cabbage, broccoli, cauliflower), which readily accumulate trace metals.

4) Use non-acidic media with plenty of organic matter. At a soil pH near neutral (7.0), most trace metals are less available to plants, and organic contaminants are also less likely to leach. Organic materials such as composted leaves and manure have an abundance of negatively-charged exchange sites that bind positively-charged metal ions, preventing them from being taken up by plants.

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Cyantesmo Paper for Detecting Cyanide

by Tim Motis

Introduction

Some tropical crops contain cyanogenic glycosides, toxic substances that release hydrocyanic acid (HCN; also referred to as cyanide or prussic acid) when cells are crushed. Consuming these plants without cooking them can cause cyanide poisoning, with varying effects depending on cyanide levels and how long a person or animal has been eating that plant. Cassava roots and leaves contain cyanogenic glycosides, so people whose diets are heavily dependent on cassava are especially at risk. Traditional methods to process and detoxify cassava roots include fermentation, prolonged soaking and boiling. Chaya leaves also contain cyanogenic glycosides; it is best to cook chaya leaves before eating them, to boil off the HCN rather than ingesting it. ECHO has previously written about cyanide in food plants (see the Further Reading section at the end of this article).

To determine if a plant is safe to consume, either by humans or livestock, a simple cyanide screening test is very helpful. At the 2014 ECHO International Agriculture Conference in Florida, Dr. Ray Smith provided ECHO with sample strips of Cyantesmo paper for screening plant material for HCN. A 2.5 cm (1 in.) strip of this paper is all that is needed to detect the presence of cyanide in a sample of plant material. Cyantesmo paper is available in a 5-m long roll for 49.50 US dollars from CTI Scientific (item 90604). One roll supplies enough 2.5-cm long paper strips for 200 tests. The paper does not have to be kept in a freezer, although Smith recommends that it be refrigerated.

Steps in carrying out a test

Dr. Smith supplied a set of instructions written by himself and Drs Cindy Gaskill and Michelle Arnold (all at the University of Kentucky). Those steps, outlined below, are reprinted with permission from Dr. Smith.

1. Collect a large handful of leaves to be tested. (Note: if testing plant material to be used for animal forage, such as the leaves of Johnsongrass or sorghum-sudangrass, collect the whole plant that the animal will likely consume. Young shoots are the most toxic.)

2. Tear leaves/forage into small pieces; also mash the plant material to cause additional plant cell injury. (You are simulating how plant material turns "mushy" when fresh leaves and stems are chewed.)

3. Place the sample into a heavy-duty quart-sized zip-lock baggie (if these are not available, find a similar-sized container that seals well) containing a 2.5 cm (one-inch) strip of Cyantesmo paper taped to the inside of the bag toward the top (tape the paper at just one end of the strip; if tape covers the entire strip, you don't get color change). Use gloves [e.g., disposable latex or nitrile gloves] in handling the paper. The bag should be approximately half full. Keep the plant material from directly contacting the paper strip, so that you can easily evaluate the strip for color change.

4. Some plant juice should squeeze out when you mash the leaves. If the sample material is dry, you will need to add about 15 ml (1 tablespoon) of water to the baggie—enough water to dampen the material.

5. Seal the baggie and place it in a warm area, such as on the hot hood of a vehicle directly in the sun. Often, just placing the baggie in direct sunlight will heat it enough to release cyanide gas, if the latter is present in the plant material. This field test should be performed outdoors in a well-ventilated area.

6. Wait 10 minutes, and then evaluate the color of the test strip.

7. If the strip turns dark blue, the sample is positive for cyanide. If the strip is the same very light green color as before adding the sample, the sample is negative for cyanide. Any blue color change indicates that some cyanide is present.

8. This test is simply a screening test to determine whether or not cyanide can be generated from the sample being tested. The exact concentration of cyanide cannot be accurately measured using this method, but a sample that quickly turns the strip dark blue indicates that the plant could pose a significant risk for cyanide poisoning. As long as the sample is damp "to the touch" when placed in the baggie, a lack of color change in the test strip after 30 minutes means the sample poses minimal risk of cyanide poisoning.

Figure 2: *Photo of leaves that were chopped (left) prior to boiling (right) (source: Tim Motis).*

Note: The shade of blue can darken over time, indicating that trace amounts of cyanide are being generated. Test strips should be evaluated after 30 minutes, if possible, to detect trace amounts of cyanide.

Multiple samples (3 to 4 is probably the most practical) should be tested to get a good representation of the field or source.

Disposal: The sealed baggie can be discarded in the garbage, or the baggie can first be opened and ventilated outdoors in a well-ventilated area. Do not breathe the fumes from the baggie, as cyanide gas could be released as soon as you open it. Emptied and rinsed clean baggies can be reused as long as they still seal well. The paper itself should not be handled without wearing disposable gloves.

A simple ECHO trial

Methods

To gain some first-hand experience using Cyantesmo paper, I (Tim Motis) followed the steps above for cassava ('Negrita') and chaya ('Estrella') leaves. I probably collected more leaves per sample than necessary (filling a whole bag versus half a bagful). Also, I chopped the leaves (Fig. 2) but did not mash them, since I would not normally mash chaya leaves before boiling them for a meal. Each sample consisted of enough leaves to fill a quart-size ziplock bag, amounting to 85 g of fresh leaves. I inserted a piece of Cyantesmo paper into each bagful of leaves, waiting at least 10 minutes before I removed the test strip to take photos.

After testing raw chaya and cassava leaves, I collected, chopped, boiled and then tested additional samples—a fresh batch of leaves for each 5 minute increment of boiling time. At the end of each boiling period, I emptied the pan of leaves into a strainer placed underneath a faucet in a kitchen sink, passing cold water over the leaves to immediately remove the heat. I increased the boiling time until cyanide was no longer detected, for a total of 8 batches of cassava leaves and 5 batches of chaya leaves (Fig. 3).

Results

With raw cassava and chaya leaves, the strips turned a dark blue color almost immediately, a strong indicator of the presence of cyanide (Fig. 3). For both crops, the shade of blue lightened considerably between 10 and 15 minutes of boiling time. However, it took 15 minutes longer for cassava than for chaya to reach the point where no blue color could be seen on a test strip.

Discussion

What does this mean? The results indicate that cassava leaves are safe to consume after 35 minutes of boiling time, and that chaya leaves can be eaten after 15-20 minutes of boiling. These results are hardly definitive, since only one sample was prepared for each boiling time. Still, these observations are comparable to other research findings. The 15-20 minute time frame for chaya is consistent with research showing that a boiling time of 15 minutes lowers HCN content to safe levels (Ross-Ibara and Molina-Cruz 2002). Also, many people boil chaya leaves for 15-20 minutes to reach a preferred level of tenderness. Where cassava leaves are eaten in West Africa, the young tender leaves are typically pounded and then boiled for up to 30 minutes (FAO 1999). The combination of pounding and boiling effectively reduces cyanide in the leaves to safe levels. In this experiment, the test strip after 30 minutes of boiling was surprisingly dark, which could have something to do with the ratio of older to younger leaves (assuming they differ in cyanide levels) in the sample.

Practical uses for this test

Cyantesmo paper could be used for a number of applications. The same series of boiling times could be tried for leaves from different varieties of cassava, which naturally tend to have differing levels of cyanogenic glycosides. Alternatively, the paper could be used to test how well cyanide is removed with other methods of food preparation, such as drying or frying. I have not tried it yet, but the paper should also work for assessing HCN released from mashed or cooked cassava roots. The test paper could also be used to determine the presence of cyanide in animal feed, by comparing HCN levels in different plant materials and resulting from different feed preparation methods.

Further Reading:

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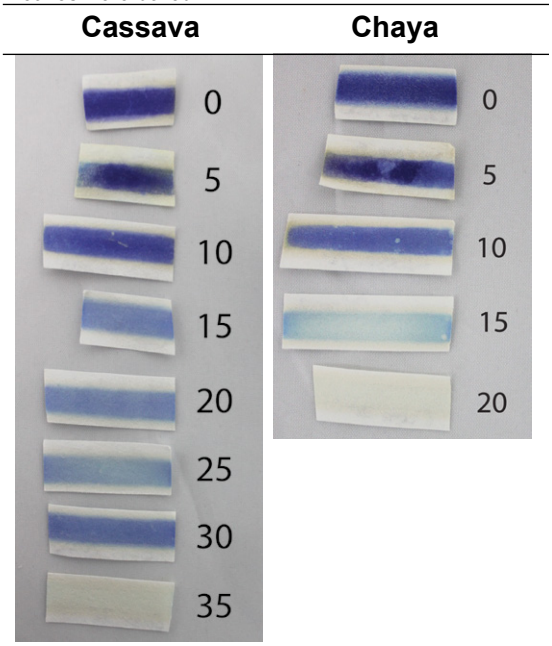
Articles in *ECHO Development Notes*:

Issue 81: Information on a cyanide testing kit developed by Dr. Howard Bradbury, using picrate paper and a color code to indicate cyanide levels in parts per million. Though we are unsure whether or not the kits are still available, an internet search with the terms "Bradbury cyanide method" will yield a number of related publications.

Issue 80: Information on cyanide levels in leaf protein concentrate made with chaya leaves

Issue 89: Perspective on cyanogen content in cassava tubers/flour.

Figure 3: *Color of Cyantesmo test paper after exposure to chopped leaves of cassava boiled from 0 (raw) to 35 minutes and chopped leaves of chaya boiled from 0 (raw) to 20 minutes. The numbers in the photo below indicate the number of minutes that chopped, green leaves were boiled.*



Effective Use of Workshops in Agriculture Extension

Prepared by Brian Flanagan as a USAID-funded Modernizing Extension and Advisory Services (MEAS) project

In EDN 127, we mentioned that a number of MEAS (Modernizing Extension and Advisory Services) documents were being summarized and distilled for ECHO's audience. An article on Farmer Engagement in Agriculture Extension was shared in EDN 128, and we want to continue to highlight these articles as good resources for extension work. Other ECHO summaries of MEAS docs can be found on ECHOcommunity.org.

Introduction

Workshops are an often-used and effective tool that extension workers can use to teach new skills to groups of farmers (Fig. 4). This document, drawn from the USAID/MEAS Technical Note on Presenting Workshops to Adults, explains how a workshop setting differs from that of a classroom/teaching setting, and how best to plan and conduct workshops to effectively transfer knowledge and skills to farmers.

Adults attend workshops for varying reasons, depending on their needs and motivations. Some are asked by supervisors to attend while others are looking to interact with peers. Other participants may have a specific problem they want solved, or they may simply want to learn more about a specific topic. Farmers in any given workshop will have a mix of these expectations and goals. The challenge for the workshop designer, therefore, is to identify those expectations and craft the workshop to best engage and meet the needs of the participants.

Workshop Characteristics

Workshops, like other teaching settings, require facilitators who can successfully apply adult education principles to share new knowledge. However, workshops also have unique characteristics that differ from other teaching settings. Four key characteristics define a workshop:

- Short-term intensive learning
- Small group interaction
- Active involvement
- Application of new learning

Guidelines for conducting workshops:

To conduct effective workshops, the following elements are recommended:

- Plan workshops around very specific learning objectives. Too often, workshop designers try to include excessive information, with little being learned because of the amount shared.
- State the intended outcomes and their importance early in the workshop.
- Develop workshop instruction around solving a problem or completing a task that is relevant to the participants.
- Provide an opportunity for participants to share their own experiences about the topics being discussed. Then use these real-life examples to highlight the key objectives of the workshop.
- Allot time for participants to practice new skills learned at the workshop. Participants who practice newly learned material in the workshop are more likely to remember and implement these new practices when they return home.

Figure 4. *Participants practicing grafting cuts at a workshop on grafting in Haiti (source: Brian Flanagan).*

Key Workshop Interactions

Three important types of interactions should occur in workshops:

- Facilitator ↔ Participant
- Content ↔ Participant
- Participant ↔ Participant

These interactions facilitate active involvement in the learning process, enabling participants to engage with the facilitator, the material and other participants. Such positive interaction is an important aspect of effective workshops.

If lecturing is used in a workshop, it should be brief. As learning is a social experience for most adults, plan times for participants to share and learn from each other in small groups. The workshop should also include an opportunity for participants to actively apply the new knowledge and skills learned during the training.

Summary

Workshops can be an effective extension method if properly designed and facilitated. Workshop designers should facilitate an active learning process in which participants engage with the material, but also with the presenter and fellow participants. These interactions help farmers to readily acquire new knowledge and put into practice what they have learned.

References

Myers, Brian E. 2011. Technical Note on Presenting Workshops to Adults. Modernizing Extension and Advisory Services.

Further Reading

Barrick, Kirby. 2012. Methods and Techniques for Effective Teaching in Extension and Advisory Services. Modernizing Extension and Advisory Services.

Note from the editors: *In selecting and using any extension approach, it is important to learn about existing ways in which farmers adopt new ideas and practices. Joel Matthews shared the following, based on his experience in West Africa:*

"Here is what I discovered in my research: Many farmers already have a system in place for evaluating and disseminating new techniques and plants. However, development facilitators, perhaps because they focus on introducing change, are unaware that a system of innovation already exists right under their noses. Why is this a problem? When we operate without awareness of a pre-existing system, we may be working at cross-purposes with that system.

"It is also important to recognize that indigenous systems of innovation may contradict the standard social science theory, known as Diffusion of Innovations, that explains the adoption and spread of new ideas. This is important because Diffusion of Innovations directs development facilitators to approach opinion leaders in hopes of convincing them to adopt a particular technique. This is done because it is believed that once opinion leaders adopt a technique, others will follow.

"Among societies such as the Hausa, however, the actual innovators live on the margins of society and have the least social capital. People eventually follow their lead, but only gradually as the innovation spreads among less and less marginalized folks. Eventually the innovation reaches the opinion leaders. This is the opposite of what Diffusion of Innovation predicts.

"The point being, that if we do not realize that competing systems of innovation exist, and then we do not take time to understand and work with those systems, we may wind up working against them. This may explain why after successfully demonstrating new techniques and training farmers how to utilize them, they often fail to continue with the programs. Very likely we have bypassed, confused, or reversed their system of innovation. When facilitators understand these systems, they can choose to work within rather than outside of them. This may be one of the most important ways to promote the 'bottom-up development' that is universally recognized as the path to sustainability."

ECHOES FROM OUR NETWORK

Potential Constraints to Sharing Permaculture Ideas

Gene Fifer at Cornell University wrote in response to Brad Ward's article on permaculture in *EDN* 129.

"I enjoyed your newsletter article on permaculture. I was the permaculture/tree crops intern at New Alchemy Institute back in 1983 under the direction of John Quinney, a permaculturalist from New Zealand. I have tried to bring this perspective to agricultural development also, most recently in Chad with Mennonite Central Committee. There are some difficulties in trying to bring this philosophy to developing countries and I thought I'd share my thoughts.

"The Australians and Kiwis [New Zealanders] who started permaculture were very individualistic and [came] from cultures that had strong institutions for land tenure and property rights. These guys were very much in the "back-to-the-land because civilization is going to crash" alternative/hippy culture. They also had an abundance of bushland to settle on. This is one reason why so many early designers had big sites under just one person's control. They never had to go through a village or community design process that would have required very strong consensus-building skills or asking chiefs or landlords for permission to change the landscape.

"They also didn't have to work in conflict zones or where theft and corruption were big. For example, in Cambodia, there was a big snail problem in the rice paddies that ducks would have solved—but ducks, as good sources of protein, would have been stolen, eaten, and been a net loss for the farmer. Often times crops are somewhat removed from where people live because they have had to cluster dwellings together for nighttime safety. This leaves any "investments" on the land very vulnerable.

"Most agricultural innovations that will be adopted by poor smallholders must show a monetary return pretty quickly. Appealing to people's sense of environmentalism, generational equity, or creation care just doesn't motivate. Many Western development staff feel that appealing to some kind of agrarian stewardship will resonate with people who are "close to the land" and "in touch with nature," but I have not found this to be true.

"The ecology and resource dynamics in permaculture are very scientific and appeal to folks with a Western, albeit alternative, scientific background. Folks in villages tend to not understand or believe very basic science including nutrition, public health, medicine, or economics, not just agricultural sciences. So making appeals that explain about principles and philosophy tends to lose people. That's why showing is better than explaining.

"I appreciated your alternative ethical pillars of: 1) actively love God's image bearers; 2) diligently steward God's creation; and 3) live contentedly and joyfully share God's provision. Blessings on your work and I hope to read more about your experiences."

Brad Ward responded as follows: "I very much appreciate your feedback, perspectives and kindness. You have drawn out some really excellent points, especially regarding the filters through which the permaculture concept was originally organized and the continued weaknesses of 'development' (in this case permaculture development) that is imported through the dominant western paradigm that believes it knows what's best.

"In my view you are spot on with the observation that innovations must show economic returns in the near term for smallholders to be interested. It is all too easy for someone who has no experience of chronic food insecurity (and all the other manifestations of material poverty) to focus all of their concern on the 'Care for the Earth' ethical pillar. As I think about your comment regarding the 'close to the land/in touch with nature' native, I actually feel myself cringe remembering the times I have used that overlay in my way of thinking about smallholders. Taped to the bottom of my computer monitor, right next to a little slip of paper with my version of the ethical pillars of permaculture, is the well-known quote "Go to the people, live among them, learn from them, love them. Start with what they know, build on what they have." I like this quote as a reminder of priorities. I don't like it because it uses the words *them* and *they*. I realize the naiveté in wishing the us/them thing wasn't part of human reality. As for local village folks' lack of understanding of the mechanisms of science that we take for granted, that was not my experience in Central America. Folks I knew embraced cause and effect and liked to learn how things worked. Thanks for widening my view in this regard.

"In thinking about how permaculture has thus far worked itself out in an almost entirely western/individual context, I wonder how practitioners who believe in the usefulness of the design tools, and their applicability in any and every situation, can learn skills to present the 'design system' in a way that allows it to be absorbed, re-imagined and ultimately valued by folks whose cultures and societal norms have evolved in a very different way. Maybe this is the next frontier for the development of the permaculture tool box."

Caution about Inca Nut

Abram Bicksler, Director of ECHO's Impact Center in Thailand, wrote in response to the article about Inca nut in *EDN* 129. "The Inca nut article does a nice job of highlighting this crop and some of its potentials. I might add a few cautions about its widespread adoption here in Asia. We have quickly seen it go from a crop plant of promise to an over-promised crop plant of monocultures! People (agriculture extension workers, development practitioners, farmers, etc.) are going crazy over it here; it has the smell of another jatropha, palm oil, rubber, or date palm monoculture "get-rich-quick" scheme

to it. It may in fact be a nice alternative to oil palm (have you seen the news about this "crime against humanity," as Indonesia clears and sets alight unthinkable square kilometers of rainforest to plant monocultures of oil palm?), but not if it is going in as another monoculture that leads to deforestation, over-reliance on pesticides, commodification, and market volatility, which are never good for smallholders.

"Also, besides a lot of land clearing in order to plant Inca nut in Laos and Cambodia, we are seeing a lot of hardwood poles being used to support the plants because they are vines and require trellising. This adds to deforestation, as Cambodia is also experiencing for increased black pepper production in the once-forested northeast. Gliricidia might make a nice living pole, but my guess is that smallholders will choose hardwoods over gliricidia due to management concerns of the living trees.

"So rabid is the excitement about Inca nut that we have begun dissuading people from thinking about it, due to the seemingly endemic "next big crop" mentality. If we do suggest the use of this plant, we have been promoting it not as a monoculture, but for home consumption (to help a family offset their cooking oil needs) in a polyculture environment, where it can use existing vegetation and can be a nice peripheral crop. Inca nut seems to have a great niche in a clearing or around the edges of a field."

FROM ECHO'S SEED BANK

ECHO's Seed Bank has several new vegetable varieties, profiled below.

Tropical pumpkin, variety 'Trinidad' (*Cucurbita moschata*). The vigorous vines require ample space for optimal growth. Fruits have dark green skin and deep orange, sweet flesh inside. The mark where the pumpkin touches the ground will change color from light green to cream to deep orange, indicating when the fruit is ready for harvest. This variety is originally from Trinidad, and came to us via Hope Seeds.

Okra, variety 'Burmese' (*Abelmoschus esculentus*). This plant was one of the top 5 best varieties in an observation trial of 25 varieties at the ECHO farm in Florida. The leaves are large—typically 40 cm (16 in) across. Pods are borne continuously, beginning when plants are 45 cm (18 in) tall (approximately 60 days after planting). The spineless pods are best when harvested at 25 cm (10 in) inches long. Pods are tender and sweet, less mucilaginous than other okra, and can be eaten raw or cooked.

Broccoli, variety 'Waltham 29' (*Brassica oleracea* var. *italica*). This open-pollinated broccoli variety was developed at the University of Massachusetts in the 1950s. It produces uniform large heads with consistent color. The plant has good cold resistance, and grows well during cooler seasons in warmer climates.

Active development workers can request free sample packets of these seeds through their profile on www.ECHOcommunity.org.

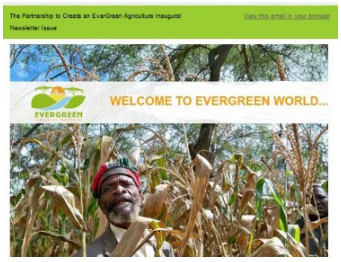
BOOKS, WEB SITES AND OTHER RESOURCES

EverGreen World, new newsletter published by the EverGreen Agriculture Partnership.

Most of us know the term "Agroforestry," broadly defined as the integration of trees into the agricultural landscape. Using the term "EverGreen Agriculture" puts the focus on the long-term sustainability of systems that integrate trees with food crops and livestock.

On the EverGreen Agriculture site, the newsletter is introduced as follows:

"Evidence has been rapidly accumulating on many continents that the integration of trees into crop fields (i.e. EverGreen Agriculture) may produce all sorts of benefits to farmers, and there is increasing recognition that it could contribute enormously to addressing the big global challenges of rural poverty alleviation, restoring infertile



and degraded farmlands to greater productivity, and making farming more resilient to climate change. These systems also have much greater potential for pulling carbon out of the atmosphere than conventional farming practices, and could thus contribute enormously to reducing atmospheric carbon and to significantly enhancing the biodiversity of agricultural systems.

"….The goal of this new newsletter is to keep you informed about…developments in the realms of policy, technology and development. It seeks to highlight the connections, and to keep you up-to-date on this transformation, engaged in the debate, and appraised of its relevance to your work in government, the private sector, non-governmental development organizations, [and] in the education and research communities."

The first issue contains articles on the subjects of Climate Change, Scaling-Up EverGreen Agriculture, Temperate EverGreen Agriculture, Evergreen Energy, EverGreen Restoration, and Gender and Youth. This first issue includes a link to a story on Farmer Managed Natural Regeneration, described by ECHO in *EDN* 58 (November 1997) and now widely recognized as a significant practice in sustainable dryland agriculture.

The EverGreen World Newsletter is to be published quarterly; subscribe online.

UPCOMING EVENTS

ECHO Florida Events:

Location: ECHO Global Farm, USA
Presented by: ECHO

Tropical Agriculture Development 1: The Basics

July 25-29, 2016

Tropical Agriculture Development Workshops

- **Agroforestry/Perennial Cropping**
  April 6-8, 2016
- **A Day with Eric Toensmeier: Perennial Cropping and Carbon Farming**
  April 9, 2016
- **Appropriate Technology**
  May 24-27, 2016
- **Introduction to small-scale livestock production in the Tropics**
  September 20-22, 2016

ECHO International Agricultural Conference

November 15-17, 2016

International Events:

ECHO West Africa Anglophone Forum

February 9-12, 2016
Location: Accra, Ghana

ECHO East Africa Pastoralist Symposium

March 1-3, 2016
Location: Sportsmans Arms Hotel, Kenya
Presented by: *ECHO East Africa*

ECHO West Africa Forum

April 12-14, 2016
Location: Scripture Union Guest House-Training and Conference Center, Nigeria
Presented by: *ECHO West Africa* and *CAPRO*

Other ECHO West Africa Events:

- A series of training of 20 agricultural associations in Burkina Faso (starting from February 2016)
- Pastors training in Bobo Dioulasso, Burkina Faso (April 20-23, 2016)
- Pastors training in Koutiala, Mali (May 11-13, 2016)

Central America/Caribbean Regional Conference

September 27-30, 2016
Location: Best Western, Las Mercedes, Managua, Nicaragua

Highlands Symposium

November 1-4, 2016
Location: Addis, Ethiopia

Each of ECHO's Regional Impact Centers regularly offers smaller-scale country or topic-specific training workshops throughout their respective regions. Please watch ECHOcommunity for further information. Subscribing to "calendar notifications" will help ensure that you don't miss out.

More information and registration details can be found on www.ECHOcommunity.org.

PLEASE NOTE: At ECHO we are always striving to be more effective. Do you have ideas that could help others, or have you experimented with an idea you read about in *EDN*? What did or did not work for you? Please let us know the results!