ECHO® Development Notes

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Bamboo

by Craig Bielema

Editors: ECHO will be offering a Tropical Agriculture Development (TAD) course on bamboo basics in February, 2017. This article covers a sampling of the content that will be taught.

Bamboo's reputation is largely based upon intrinsic peculiarities of certain varieties. The plant can grow a meter a day and is the staple diet for giant pandas; though a grass, it can grow to 30 meters tall with hollow wooden stems which are stronger than steel; and bamboo has a reproductive cycle in which all plants of the same species flower and then die simultaneously…worldwide. These sound like qualities conjured up for a fantasy novel.

Though the aforementioned qualities are true for some varieties, bamboo exists with a wide array of sizes, shapes, and palatability, and with varied growth and reproductive patterns. With diverse characteristics comes diverse functionality; bamboo is commonly used as food, fodder, fiber, fencing, furniture, and construction timber, all without sacrificing the life of the plant! Bamboo has many impressive and amazing characteristics, but its most important quality is the impact that its use can have on the life of a smallholder family.

Figure 1. A shoot of Giant Bamboo *(Dendrocalamus asper*), with culm leaves removed in preparation for cooking. *Source: Craig Bielema*

Like many plants, bamboo produces edible shoots (Figure 1); but unlike many plants, each bamboo shoot that is harvested can weigh 1-4 kg (Cusack 1999)! One shoot can provide a meal, but a bamboo shoot is mostly water and is low in carbohydrates (4-6%), protein (2-4%), and fat (0.3-0.5%) (Cusack 1999). However, bamboo shoots are rich in vitamins and minerals, including thiamin, niacin, calcium, iron, and vitamins A, E, and B6 (Cusack 1999). The leaves and hollow portions of the culm are useful for preparing food, as they can be used as wrappers and containers to cook rice, seafood, etc. Bamboo leaves can also be used as fodder, and contain roughly 15% crude protein.

Bamboo varieties are of two main types: leptomorph (running) and pachymorph (clumping). Although running bamboo will disobey a fence and pop up in the neighbor's yard, clumping bamboo can act as your fence and create a strong barrier between two areas. Clumps planted close together in a row can provide a beautiful living fence to provide privacy, windbreaks, and noise barriers. Bamboo can be harvested and used to build a small garden fence, partition, or privacy screen, although in outdoor applications bamboo can deteriorate rather quickly. It will last longer when located indoors, protected from insects and moisture—one of the reasons it is often used to make furniture. Other reasons to select bamboo for furniture making are its lightness, strength, and aesthetic appeal.

Figure 2. A bicycle from bamboo! *Source: Craig Bielema, who built the bicycle from the clump of bamboo growing in the background of the photo.*

Initially, bamboo can be challenging to use as construction material. It is not uniform in any dimension; it splits very easily; it seems difficult to join; and it is susceptible to insect damage and rot. But each of these challenges can be dealt with. Non-uniform construction materials can be difficult to use if you are accustomed to everything being square and true, but can give rise to beautiful, organic shapes and curves (Figure 2). In a way, non-uniform

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materials can be simpler to construct with; as you learn to transpose measurements and test-fit pieces, you will need fewer layout tools and math skills. Bamboo's ability to split easily is either a blessing or a curse, depending on whether you are trying to split it or not, but adequate planning can reduce unwanted splitting. Basic bamboo joinery is rather simple and can actually be accomplished quite easily with only a few basic hand tools. And as far as susceptibility to insect damage and rot, postharvest curing or chemical injection can be used to preserve and protect bamboo, so that it will stay strong for many years.

Bamboo's tensile strength and strength/weight ratio make it attractive to the engineer, its simple joinery makes it attractive to the builder, its beauty and unique shape make it attractive to the designer, its perpetual productivity make it attractive to the grower, and its shoots make it attractive to the cook. All of these attributes make it appropriate for the smallholder farmer! Consider joining us at our Fort Myers campus in February for "TAD: Bamboo Basics," a more in-depth and hands-on introduction to bamboo.

Reference

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A "2:4:2" Maize/Legume Intercropping Pattern:
Two Rows of Maize Alternating with Four Rows of Legume

by Tim Motis

INTRODUCTION

While doing legume intercropping research in South Africa (2010-2015), ECHO staff members learned about a system of cereal/cowpea production developed in Nigeria through research by IITA (International Institute of Tropical Agriculture) and national partners (Ajeigbe *et al.* 2010a, Ajeigbe *et al.* 2010b). This strip cropping approach involves a repeating sequence of two rows of a cereal crop, such as sorghum or maize, and 4 rows of cowpea (Figure 3).

A survey of cropping systems, conducted from 1992-1993, showed that farmers in the northern Guinea Savanna zone of Nigeria were already intercropping cowpea with cereals (mostly sorghum and millet but some maize) (Henriet *et al.* 1997). Cowpea was relied upon as a source of food for both human and animal consumption, and as a means to maintain soil fertility. In these traditional systems, however, cowpea was only producing 0 to 132 kg/ha of grain (Van Elk *et al.* 1997). Noted yield constraints included wide cowpea spacing, lack of fertility inputs, and shading of cowpea by the cereal crops.

The effort by IITA to improve upon traditional intercropping systems in Nigeria involved trials on experiment stations as well as on-farm trials. The 2:4 (referred to in this doc as 2:4:2) system shown in Figure 3 was validated in on-farm trials with participation by over 1600 farmers. As explained in an online IITA publication titled Improved Cowpea-Cereal Cropping Systems: Cereal-Double Cowpea System for the Northern Guinea Savanna Zone, total grain (cowpea + cereal grain) production in large-scale farmer field trials increased from less than 1.5 t/ha with traditional practices to over 3 t/ha with the 2:4:2 approach (Ajeigbe *et al.* 2010b).

In the planting pattern shown in Figure 3, maize and cowpea rows are spaced 75 cm apart. In-row spacing is 20-25 cm for maize and 20 cm for cowpea. Livestock are integrated into the system; residues are fed to farm animals and the resulting manure is returned to the field. Judicious use of inorganic fertilizers and insecticide are also used. The IITA publication mentioned in the preceding paragraph has more detailed technical information.

Advantages of 2:4:2 include:

- Dense planting of a cereal crop and cowpea, with minimal competition for light between crops.
- The planting of crops in rows makes the system easy to scale up. Ox-drawn implements, for example, can easily be used to establish planting bands/furrows for seeding.
- Simultaneous seeding of the cereal and cowpea, which simplifies planting strategy. Also, in comparison to relay cropping, planting both crops at the same time reduces the amount of time that the cowpea is shaded and that rainfall is needed.

Potential disadvantages are:

- The significant amount of land devoted to cowpea as opposed to maize could be unattractive for some farmers. This is largely an issue of economics. In northern Nigeria, where IITA saw widespread acceptance of this system by farmers, the price of cowpea grain in markets was high enough to justify the amount of land devoted to the legume. Ajeigbe *et al.* (2010a) pointed out that, with less land devoted to maize, fertilizer requirements are lower (because maize requires more nutrients than cowpea).

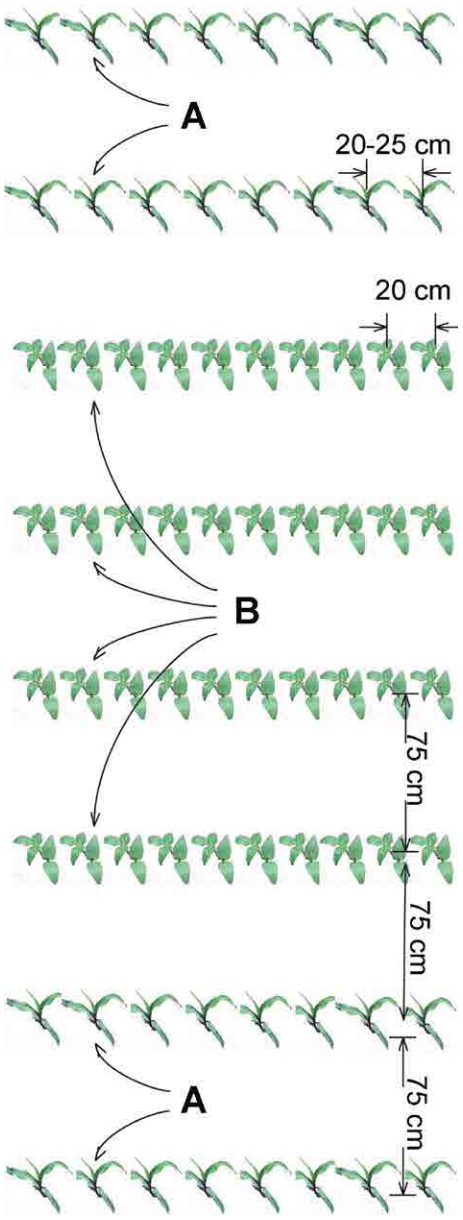

Figure 3. Illustration of the IITA 2:4:2 maize/cowpea strip cropping pattern. Two rows of maize (A) are alternated with 4 rows of cowpea (B). *Source: Tim Motis.*

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• With the cereal and legume crop planted at the same time, there is greater risk of both crops failing if the rains stop before the plants are established. Seeding when the soil is moist is important.

• The unequal number of cowpea and maize rows does not allow for full crop rotation from one season to the next. Partial crop rotation can be done each season by planting maize into two of the rows previously occupied by cowpea.

SUMMARY OF AN ECHO 2:4:2 TRIAL

To gain first-hand experience with this system, we decided to set up a trial at our demonstration farm in southwest Florida. We also wanted to see how well other commonly-grown legumes perform in a 2:4:2 pattern with maize. Below is a brief summary of our first year (April 2015-Jan 2016) of experience with 2:4:2.

Methods

Treatments were three different legume crops: cowpea (*Vigna unguiculata* 'Thai Long'), jack bean (*Canavalia ensiformis*), and velvet bean (*Mucuna pruriens*) (Figure 4). The 'Thai Long' cowpea variety used in this trial is early-yielding and is capable of significant vine growth. Lablab (*Lablab purpureus*) would have been a good choice, but it does not always grow well during our hot, humid rainy seasons. Jack bean, however, tolerates Florida's summer rain and heat and produces a canopy that is about the same height as lablab. Thus, jack bean was selected, even though the beans are not typically eaten (see an ILEIA document, Edible cover crops, for an exception to the general rule–some interesting content on food uses of jack bean in parts of Ghana).

Figure 4. Cowpea (top) and jack bean (bottom) in a 2:4:2 ECHO trial conducted in 2015. *Source: Tim Motis*

Our third treatment was initially rice bean (*Vigna umbellata*), but the seedlings were eaten by rabbits. Velvet bean seedlings, from seeds left on the ground after a 2014 planting, were allowed to grow and replace the rice bean. CAUTION: we do not advise eating velvet bean seeds, as the L-dopa they contain can be harmful to humans and non-ruminant animals. As a cover crop, velvet bean is an excellent option for weed suppression and restoration of soil fertility. A Feedipedia datasheet by Heuzé *et al.* (2015) describes its use as animal feed and forage.

Treatments were replicated three times, with each replication consisting of a block of space divided into three plots (each plot was 10.9 m long by 7.0 m wide). Each legume was randomly assigned to one of the three plots within each block/replication, resulting in a randomized complete block design.

Soil amendments were as follows:

• 23 kg/ha of nitrogen from 8:2:8 (8% nitrogen: 2% phosphorus: 8% potassium) inorganic fertilizer applied to the maize; this amount was split into three applications.

• 2 t/ha of compost applied to the maize

• 1 t/ha of compost applied to the legume plots

Maize and the legumes were planted between the 8th and 10th of April. Maturation time, from seed to harvest, is quite short (8 weeks for 'Thai Long') for cowpea. Therefore, in keeping with what was done in Nigeria by IITA, a second cowpea crop was sown (during the first week of November). Measurements included above-ground plant biomass and grain yield.

Lessons learned

Based on the results shown in Table 1, and recognizing that this only reflects one growing season, some key points are:

Table 1. Above-ground biomass and grain yields, as influenced by the legume grown in each plot. Each value is the average of three weight measurements (one in each three plots).

	Above-ground dry matter (kg/ha)	
Legume treatment	Legume plants	Maize plants
Cowpea	2996 b	2950
Jack bean	4311 a	2984
Velvet bean	2800 b	3033
P value*	0.0050	0.9762

	Grain yield (kg/ha)	
Legume treatmnent	Maize alone	Maize + legume
Cowpea	1267	2287 a
Jack bean	1433	1539 b
Velvet bean	1385	1678 b
P value*	0.5874	0.0231

*Within columns, at least two values differ statistically if the corresponding P value is ≤ to 0.05. Where P ≤ 0.05, means were separated via Duncan's multiple range test; any two values are statistically different unless followed by the same letter.

1) The three legumes grew well in sandy soil, with jack bean contributing the most above-ground biomass.

The same legumes also grew well in a dry sandy soil, with no fertility inputs, in ECHO research plots in South Africa, a project undertaken from 2010 to 2015. Legumes are often able to thrive in poor soils because of their ability, in association with rhizobial bacteria, to utilize nitrogen from the atmosphere. This is what makes them a good option for building soil organic matter. In this trial, they added 3 to 4 t/ha of dry matter to the soil, in addition to the 3 t/ha from maize. For these residues to favorably impact the soil, it is important to leave as much of it as possible on the ground. If biomass is removed from the field for animal feed, return some of the resulting manure to the field. Collecting manure to put back on a field is easier with controlled grazing than with free-roaming livestock.

2) Within the 2:4:2 system, other legumes besides cowpea grew well with maize–without reducing maize growth and yield below that with maize + cowpea.

In this strip cropping pattern, a maize row is only bordered by a legume on one side, the other side being the adjacent maize row (as

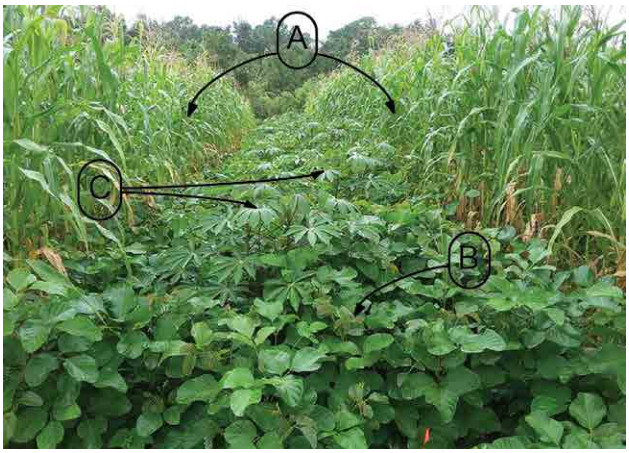

Figure 5. A strip cropping approach being tried at ECHO (Florida), with 2 rows of maize (A) alternated with 4 rows of legume (B; in this case, jack bean), and cassava (C) grown in the middle of the legume strips.

shown in Figure 3). By comparison, in an alternate-row system, with every other row being planted to a legume, every maize row is bordered by a legume row on both sides. Strip cropping, therefore, gives farmers a way to integrate vining legumes with large leaf canopies that contribute high amounts of organic matter. Delaying the planting of the legume is also a good strategy but, as mentioned earlier, a longer rainy season is required.

3) The maize/cowpea combination produced the most grain.

This underscores the trade-offs to consider in selecting legumes to try with this system. Cowpea may not produce as much plant biomass as jack bean or velvet bean, but it provides an early-season bean crop (ready before the maize harvest) and can usually be planted twice in a single growing season.

Next steps

A follow-up trial is underway in which we are incorporating a no-legume control and growing cassava within the legume interspaces (Figure 5). Cassava could improve the resilience of maize-legume intercropping systems under marginal growing conditions. Future trials could also be done to evaluate other legume options such as lablab or pigeon pea (*Cajanus cajan*).

CLOSING THOUGHTS

Consult the first two references listed in the next section to learn more about IITA's experience with the 2:4:2 system. Their approach has been rigorously tested and replicated in many farmers' fields. Our evaluation of 2:4:2 with other legumes besides cowpea is very preliminary, but hopefully it inspires ideas for creative adaptation beneficial to farmers.

If you are interested in exploring the potential of 2:4:2 intercropping for your project area, find out if farmers are already growing legumes with their cereal crops. If they are, ask what row arrangement they are using and why. If what they are already doing makes good use of the land, in terms of crop yields and economic returns, there may not be any reason to switch to a different row pattern. Look for ways to improve on existing intercropping systems, such as planting a higher- or earlier-yielding cowpea variety, that do not require farmers to make major changes. If the 2:4:2 pattern looks promising, try it out on small test plots. Let us know of your experience and insights.

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Paper Mulberry: A Complicated Agroforestry Resource

by Rick Burnette

Figure 6. Paper mulberry tree, with a close-up view of the foliage and bark. *Source: Rick Burnette*

In the courtyard of the Bo Sang Handicraft Centre on the outskirts of Chiang Mai in northern Thailand, freshly painted umbrellas and parasols in bright colors are lined up to dry in the sun. These products are made from sa paper; fibrous sheets produced from the inner bark of the indigenous paper mulberry tree (*Broussonetia papyrifera* (L.) Vent; Figure 6).

Approximately 80 kilometers north of Bo Sang, an elderly ethnic Karen lady is picking tender paper mulberry leaves in a small grove on the edge of her village (Figure 7). The leaves will be cooked in a large tin over an open fire and fed to her pigs.

In the United States, via an internet forum, foragers are discussing the merits of the edible fruit produced by naturalized paper mulberry trees in their neighborhoods. Meanwhile, residents of Islamabad are recovering from spring allergies resulting largely from pollen produced by hundreds of thousands of wild paper mulberry trees. The pollen count in Pakistan's capitol surpasses 50,000 particles per cubic meter, compared to the 9,000 level that is considered serious in the US.

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Paper mulberry is native to China, Japan, Korea, Laos, Cambodia, Thailand, Burma and Assam (India), but cultivated extensively elsewhere in Asia and the Pacific. It has also naturalized in parts of southern Europe and the USA (Kew 2016). According to the World Agroforestry Centre, paper mulberry prefers a sub-humid, warm, sub-tropical monsoon climate such as that found in parts of Southeast Asia and Northeast India. In temperate regions such as North America, growth is not as vigorous.

Figure 7. Harvesting paper mulberry leaves.
Source: Rick Burnette

Uses of Paper Mulberry

Throughout much of the Asia and Pacific region, paper mulberry is considered an asset offering a wide range of products and services that include:

Fiber

Bark fiber of the plant is often used for cordage. In Polynesia, the bark is processed into tapa cloth; strips of inner bark – known as bast – are removed from the outer bark, washed and pounded into multi-layer sheets. The finished tapas are traditionally painted and printed with decorative designs (Whistler and Elevitch 2006).

In parts of Thailand, Laos and surrounding regions, sa paper is also made from bark harvested from wild and planted trees. Fahrney *et al.* (2007) describe how strips of bark are removed from trees with the outer bark separated and discarded. After drying, the inner bark is boiled with wood ashes until soft. The resulting fiber slurry is poured into wooden frames supporting mesh screens that capture the inner bark fiber and allow excess liquid to drain away. The frames and contents are dried in the sun after which the resulting paper sheets are removed and bundled for use.

Fodder

Paper mulberry leaves have a significant level of protein - up to 20 percent on a dry matter basis - making it a good source of fodder (Amnat *et al.* 2001). In Southeast Asia, cattle and water buffalo graze the foliage, while boiled leaves are fed to pigs. Some farmers reportedly feed fresh leaves to carp and tilapia in their fish ponds (Fahrney *et al.* 2007).

Wood

Paper mulberry wood is light, soft and brittle, greyish-white in color with an even, straight grain. According to the World Agroforestry Centre (Orwa *et al.* 2009), the wood is used mainly in the manufacture of cheap furniture, match sticks, packing cases, boxes, plywood, building boards, sports equipment and pencils. Until his death in early 2016, Boyd Pridmore of Lakeland, Florida, promoted the strong, lightweight wood of naturalized paper mulberry, referring to it as Florida balsawood.

Food

The globose, bright orange fruit of paper mulberry is edible and sweet. Tender leaf shoots are steamed and eaten in Indonesia (Whistler and Elevitch 2006).

Medicine

Paper mulberry is used as traditional medicine in the Pacific and China; the plant's medical properties are described as "astringent, diuretic, tonic, vulnerary." The leaf juice has diaphoretic (inducing perspiration) and laxative qualities (Orwa *et al.* 2009).

Other

According to Anderson (1993), the Lahu people of upper Southeast Asia and Southwest China use the rough leaves of paper mulberry as sandpaper. The leaves are also reported to have pesticidal and antifungal properties (Orwa *et al.* 2009).

Environmental and agricultural benefits

Paper mulberry offers protection from soil erosion on disturbed sites by providing tree cover. It also yields soil-building and weed-controlling leaf litter (Orwa *et al.* 2009).

Establishment

Paper mulberry grows best in sites with significant sun exposure and with moist, well-drained sandy loams and light soils.

Whistler and Elevitch (2006) state that root shoots (suckers), portions of matted roots or stem cuttings are used for propagation. Root shoots are generally considered the best multiplication option. Using a sharp knife to harvest the shoots when they are 30–45 cm (12–18 in) in height, the taproots are kept intact. The harvested shoots can be left to "harden" in place for a month before transplanting them into pots or planting directly into the field. The prepared shoots can be planted as close as 80 cm (2.7 ft) apart in rows that are 1.2–1.8 m (4–6 ft) apart.

Fahrney *et al.* (2007) describe how both paper mulberry and teak (*Tectona grandis*) are planted in the rotational upland rice fields of northern Laos in preparation for long-term improved fallows. The spacing of paper mulberry and teak is at least 3 m by 3 m (10 ft by 10 ft), so that interplanted upland rice production remains possible for a few years until the fields are fallowed (Fahrney *et al.* 2007).

Tree Management and Life Span

Whistler and Elevitch (2006) report that while bark production can begin within six months of establishment, it usually takes 12-18 months for trees to reach the ideal harvest height of 3–4 m (10–13 ft). According to Fahrney *et al.* (2007), Lao farmers consider that the minimum stem diameter for harvest is "between the thickness of a thumb and a knife handle" or about 2 to 4 cm (0.79 to 1.58 in). Whereas suitable-sized primary trunks are used in the first harvest, secondary stems will be used in following collections.

Side branches are usually removed from the cut stems to assure a clean, straight stalk free of side branches. This helps to

ensure that the tapa cloth will be free of major holes (Whistler and Elevitch 2006).

In warm, sub-humid climates, paper mulberry trees maintain leaves most of the year (they are leafless only one to three months). As a result, leaves can be harvested for forage or green manure almost year-round (Orwa *et al.* 2009).

Fahrney *et al.* (2007) were unable to determine how long paper mulberry trees in the upland rice fallows of Laos remain productive. However, Whistler and Elevitch (2006) state that trees in the Pacific can grow for many decades.

Invasiveness

Paper mulberry is dioecious, with male and female flowers produced on separate plants. Outside of its native range, should both male and female plants be present, paper mulberry can be invasive, as birds consume the fruit from "female" plants and spread the seeds. In the Australian state of Queensland, the Department of Agriculture, Fisheries and Forestry notes that paper mulberry has become sparsely naturalized. Concerned that the plant will develop into a significant problem in subtropical coastal and subcoastal areas, officials consider it a "high risk" species and recommend the removal of trees.

According to Kew Royal Botanic Gardens (2016), paper mulberry has also become naturalized in the United States and southern Europe. In the US, the plant was first introduced as a fast-growing shade tree (MacDonald *et al.* 2008). Paper mulberry establishes itself in open habitats, such as forest and field edges, and is found from Illinois to Massachusetts, south to Florida and west to Texas. Agricultural officials in Florida are concerned with its establishment across the state. Although it does not yet seem to have altered Florida's plant communities, paper mulberry has increased in abundance. As a result, state officials recommend that the tree not be planted in Florida, and that existing plants be physically removed or chemically controlled in landscapes (MacDonald *et al.* 2008).

Internationally, paper mulberry is identified as an invasive weed in over a dozen countries (Swearingen *et al.* 2010) including Pakistan, Argentina and Uganda. In West Africa, Kyereh *et al.* (2014) report that since paper mulberry was introduced to Ghana in 1969, it has since become second only to *Chromolaena odorata* (Siam weed) as an invasive species; it is found mainly in disturbed forests and other open sites. Partly due to the invasive potential of paper mulberry, the Florida-based ECHO Seed Bank does not offer seeds of this species.

Curiously, in the Pacific islands, the plant is apparently not invasive, as all trees are male clones (no explanation was given as to how this came to be). In that region, paper mulberry is vegetatively propagated with cuttings. The tree also spreads slowly by easy-to-control root suckers (Whistler and Elevitch 2006).

Conclusion

Throughout much of Asia and the Pacific, paper mulberry serves as a significant fiber, fodder, food and wood resource. It also stabilizes and improves the soil on disturbed sites. However, its invasiveness combined with cases of aggravating pollen production make it unsuitable for introduction. As a result, there may only be a few options related to the introduction and use of paper mulberry:

- Limit the use of paper mulberry to within its native range.
- Outside of its native range, reduce or exterminate the tree (particularly fruit-bearing female plants) wherever it is perceived to be invasive.
- If paper mulberry must be planted outside of its native range, use the Pacific island model, with vegetative propagation (cloning) and establishment done only with plant material (i.e., root shoots) from male plants.

If you consider the establishment and use of paper mulberry, be sure to investigate any official recommendations and laws concerning the species. Also, as done in this article, review the literature to find out what others have experienced and learned. As always, when considering the introduction of a new crop, carefully weigh the known benefits against possible liabilities.

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ECHOES FROM OUR NETWORK

Stinging chaya; fruits for high rainfall areas

Cory Thede, working on the north coast of Haiti, sent a note about a local chaya plant with a branch (Figure 8) that mutated to a wild stinging type. He commented, "When I accidently backed up against it, I felt stings and it gave me an itchy rash on my arm and back that lasted about a week. The rest of the plant is regular and almost completely spineless." He added, "I was going to dispose of it but then decided it may be useful in some living fences."

Figure 8. Chaya branch with stinging hairs (as indicated by arrows). *Source: Cory Thede*

Cory also included an update on fruits that he is growing, obtained from ECHO and other sources. "Starfruit is very popular here. [In 2007 I planted] two Kary, one Sri and one Bell variety, from ECHO. Neighbors that have seedlings from these trees have had fruit for several years. The seedling trees on the main part of our open campus get harvested by kids while the fruit is still small and dark green. This year they even raided one of the original trees in the back of my nursery by my house a few times, day and night. We have shared bushels of fruit at the summer church conferences on our campus for several years and offer trees for sale.

"Canistel and Malay apple also do well and are popular. [We have] 8690/Trompo from ECHO. The Bruce canistel and Malay Apple are from Pine Island Nursery. I also have [a variety of] Malay apple from Dominican Republic that seems [to have] a little better flavor, but it is not very productive yet.

"Some other new fruits that I think have good potential for our (high rainfall) area include jack fruit, ever bearing mulberry from ECHO (through HAFF), peach palm, and rambutan (though I only have rambutan seedlings and they are under 3 years old so I don't know if they will fruit well here). [Grafted] thornless jujube from ECHO is a good fruit that can be used like apples, but almost all the pits are empty. [Two seeds germinated and one of the plants is still alive.] I hope with its pollen I can get more of the very large fruit and viable seed. Thornless jujube is one of the few fruits that does well in both rainforest and desert climates.

"Date palm doesn't grow as well here as on LaGonave or the dry Gonaives area, and [it has not bloomed.] I thought the cooler winters here on the North coast (lowest winter temperature of about 57 instead of 67ºF) might induce yearly bloom.

"USAID is really promoting cacao in our area; there seem to be more cacao nurseries around than ornamentals or anything else. If cacao will grow well here under peach palm, that should be a great combination."

Exotic leaf miner problem in Nigerian tomatoes

Kathy Barrera sent an article about tomatoes from Deutsche Welle news and asked for help in dealing with a tomato problem in Nigeria. She wrote, "The situation with tomatoes is critical and why I am looking to try new types of tomatoes, they are the basis of every soup almost to eat with starch. Though there are tomatoes…, commonly grown as a type of plum tomato, we have not seen [them] in the Abuja market for a couple months. The rich of course buy imported [tomatoes] from South Africa as they do many vegetables and fruits…."

Bob Hargrave responded to Kathy. "We discussed this problem in our weekly meeting. It seems from the article you sent and from other information that the main problem is the Tomato leaf miner (*Tuta absoluta*) that was introduced to Africa from South America a few years ago. And although we do not see any immediate solutions we do have these suggestions:

"First, check with the government ministry of agriculture (or whatever the government extension service is called) and see if they have recommendations. They should be aware of the situation and able to suggest pest management strategies.

"Second, there is a website devoted to this pest that has information about pest management:http://www.tutaabsoluta.com/tuta-absoluta. As you noted, the chemical pesticides are not effective or economical. Cultural practices as outlined in the website are the best first step." Biological control agents and neem seed extract are also presented. Examples of bio-agents include the egg parasitoid *Trichogramma achaeae* and an entomopathogenic (insect-killing) fungus, *Metarhizium anisopliae*. Neem seed extract, applied as a foliar spray, causes larval mortality.

"The website also gives the biology and life history of the pest to better understand when it is most damaging and also when it might be most vulnerable. As one staff member phrased it, 'Know your enemy'!

"We do not know if any tomato varieties are more resistant than others. So like many situations in farming, there is not a quick, simple solution but rather a set of pest management practices that should reduce the damage if practiced consistently from this point on."

BOOKS, WEB SITES AND OTHER RESOURCES

Seed Saving Videos: from the World Vegetable Center (AVRDC)

Reviewed by Tim Motis

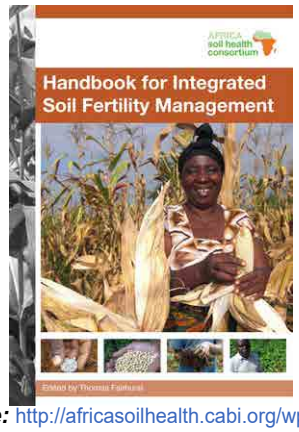
The World Vegetable Center, as the name implies, focuses on vegetables to reduce poverty and malnutrition. Their website has numerous, helpful resources and publications. Among them are videos on how to save vegetable seed. They cover amaranth, eggplant, nightshade (see EDN 103), pumpkin and tomato. Available in French, Tok Pisin, Indonesian and English languages, the videos present practical seed-saving and storage practices relevant to small-scale farmers and gardeners. The web address for these videos is http://avrdc.org/saving-seed/.

Africa Soil Health Consortium: Handbook for Integrated Soil Fertility Management

Reviewed by Bob Hargrave

A question that we get asked at ECHO is "Are you an organic farm?" And the answer is "No. Because of our unique soils, climate and objectives, we do use herbicides, insecticides and mineral fertilizer as needed. At the same time, we aim to minimize our use of and reliance on expensive inputs."

Our practice is similar to the "Integrated Soil Fertility Management (ISFM)" approach, described in a handbook published by the International Fertilizer Development Center (IFDC; handbook available for free download at http://africasoilhealth.cabi.org/wpcms/wp-content/uploads/2014/05/ISFM_handbookv2.pdf). To be clear, this handbook promotes the use of mineral fertilizer as a key component in increasing and sustaining food production by smallholder farmers.



Source: http://africasoilhealth.cabi.org/wpcms/wp-content/uploads/2014/05/ISFM_handbookv2.pdf

The IFDC defines ISFM as "a set of agricultural practices adapted to local conditions to maximize the efficiency of nutrient and water use and improve agricultural productivity". The approach includes all available resources in the integrated fertility management program: fertilizers; locally available soil amendments; organic matter such as crop residue, compost and green manure; and intercropping.

The ISFM handbook is intended for training extension workers and for anyone engaged in rural development. It includes practical information for analyzing local conditions and resources, and for planning a program of soil fertility management. The authors emphasize that a good agronomic program also includes use of adapted disease- and pest-resistant crops; planting on time; weed control; proper plant densities; integration of livestock; and sound economic principles.

UPCOMING EVENTS

ECHO Florida Events:

Location: ECHO Global Farm, USA
Presented by: ECHO

23rd International Agriculture Conference

November 14-17, 2016

Tropical Agriculture Development Workshops

- **Tropical Agriculture Development 1: The Basics**
  January 16-20, 2017
- **Bamboo Basics: production, preservation and construction**
  February 7-10, 2017
- **Seed Saving: a practical overview for small-scale seed banking**
  May 9-11, 2017
- **Tropical Agriculture Development 1: The Basics**
  July 24-28, 2017
- **An Introduction to Community Development**
  August 14-18, 2017

ECHO's remaining 2017 training schedule will be posted at ECHOcommunity.org/events.

ECHO East Africa Events:

Highlands Symposium

November 1-3, 2016
Location: Addis Ababa,Ethiopia

(REAP Kenya) ANAMED Training Seminar in Natural Medicine

November 6-12, 2016
This event is run by REAP Kenya, NOT ECHO

Biogas Summit and Co-design Workshop

November 21-25, 2016
Location: Arusha, Tanzania

East Africa Symposium

February 7-9, 2017
Location: Arusha, Tazania

ECHO West Africa Events:

North Ghana Training

October 26-28, 2016
Location: Tamale, Ghana

Niger Moringa Symposium

December 12, 2016
Location: Niamey, Niger

Nigeria Forum

March, 2017
Location: Jos, Niger

ECHO Asia Events:

ECHO Asia Coffee Processing Camp

November 29-December 1, 2016
Location: Chiang Mai, Thailand

ECHO Asia/MBC NW Myanmar Agriculture and Community Development Workshop

February 7-10, 2017
Location: Kalay Myo, Myanmar

ECHO Asia Agriculture and Community Development Conference

October 3-6, 2017
Location: Chiang Mai, Thailand

ECHO's Regional Impact Centers regularly offer 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!