ECHO® Development Notes

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Bicycle Pump Vacuum Sealer for Seed Storage

by Dr. Abram Bicksler, ECHO Asia Impact Center

Special thanks to all the past and present staff, interns, and volunteers who worked on this research: Rattakarn Arttawuttikun (Wah), James Manson, Niemeet Chompoothong (Lue), Seth Morgan, Brock Mashburn, Paw Danmalidoi, and Patrick Fitzsimons – it was truly a team effort!

Introduction

From related ECHO research (Croft et al., 2012)

Storing seeds in the tropics can often be difficult; with high temperatures and humid conditions, seeds lose their ability to germinate quickly. Many techniques for seed storage exist, from the high-tech standards of gene banks to simple methods used by villagers for saving their own seeds. All have their strengths and weaknesses, but when balancing costs and resources, which methods are really the most effective? This article highlights research conducted by ECHO Asia regarding the use of vacuum sealing, using a simple bicycle tire pump, for tropical seed storage under resource-constrained settings.

The three key factors that determine the rate of seed deterioration in storage are: oxygen pressure (amount of oxygen with the seeds in storage), seed moisture content, and temperature (Roberts, 1973). An increase in any of these factors will lower the storage life of the seeds, and as a general rule any increase of 1% moisture content or 10° F (5.6° C) in storage will halve the storage life of the seeds (Bewley and Black, 1985). Each factor contributes to seed decay in specific ways, and minimizing these conditions is critical to effective seed storage. Vacuum sealing is a relatively low-cost method that requires few inputs after an initial investment. Sealing helps conserve seed quality by minimizing oxygen presence and exposure to ambient humidity, thereby keeping seed moisture content low.

Figure 1: Bicycle tire pump modified for vacuum sealing. *Photo by ECHO Asia staff.*

Historical perspective (Dr. Tim Motis and Dr. Abram Bicksler)

ECHO's intial exposure to the use of bicycle pumps for vacuum seed storage came from a writeup sent to our Florida seed bank by development worker, Patrick Lahr. Based on that writeup, Dr. Tim Motis modified a bicycle pump to demonstrate the concept of vacuum sealing at the ECHO Florida Seedbank. A similar pump was also constructed at the ECHO Asia Seedbank by Niemeet Chompoothong, with further improvements made by Brock Mashburn to create a more usable machine that is able to create a better vacuum in a jar containing the seeds.

Research summary (Dr. Abram Bicksler)

The key(s) to this revised pump are: 1) reversing the bicycle pump piston and valves, 2) utilizing a tire stem with a reversed valve to ensure that evacuated air does not seep back into the jar while pumping, and 3) using a PVC cap with gasket to ensure that a tight, leak-free seal is created on the lid of the jar while evacuating the jar.

For an associated powerpoint with details on the creation of the vacuum sealer, visit http://tinyurl.com/owem6oc on ECHOcommunity.org.

Preliminary results of a 1-year experiment utilizing the bicycle pump vacuum sealer on 500g samples (batches) of Lablab beans (Lablab purpureus) at the ECHO Asia Seedbank's Earthbag House (Fig. 2) demonstration structure suggest that the bicycle pump vacuum sealer was able to evacuate a sufficient amount of ambient air from glass jars to maintain lablab seed viability at similar levels as with an expensive, commercial vacuum sealer.

Featured in this EDN

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Figure 2: Batches (500g lots) of lablab seeds in earthbag house. *Photos by ECHO Asia staff.*

When the experiment began in May 2013, all lablab seeds used in the experiment had an average seed moisture content of 9.5% (ideal seed moisture should be between 4-8%, but that is difficult to achieve in the moist tropics) and a seed germination rate of 94.5%.

To preserve seed viability, so that germination rates remain high over time, orthodox seeds should be stored under dry, cool conditions (see EDN 86 for more information). Orthodox seeds include those of most grain, pulse (dry bean), and vegetable crops; they can survive storage with most of the water removed from the seeds. One rule of thumb used by ECHO to assess seed storage conditions is that the sum of air temperature in degrees Fahrenheit and percent relative humidity should be close to 100 (Harrington, 1972). Keep in mind, however, that as humidity approaches 70%, seed moisture content increases to approximately 13%, at which point higher seed respiration rates and storage fungi become significant problems (McCormack 2004; Justice and Bass, 1978; Nakamura 1958).

In the ECHO Asia Seedbank Earthbag House, air temperature in the jars---kept under vacuum---ranged from 16°C to 27°C (61°F to 81°F). Ambient air temperature, outside of the earthbag house, averaged close to 30°C (86°F), indicating that the earthbag house had a moderating influence on temperature. Relative humidity in the bicycle-vacuum jars ranged from 50% to 60%, not as low as can be achieved with dessicants but significantly lower than the 78% ambient humidity outside the earthbag house.

After one year in the various storage treatments, the lablab seeds stored in traditional vacuum-sealed bags using a commercial vacuum sealer had a seed moisture content of 13.0% and a seed germination rate of 97.5%. By comparison, the lablab seeds stored in glass jars using the bicycle pump vacuum sealer had a seed moisture content of 10.3% and a seed germination rate of 97.5%, and lablab seeds stored in paper bags on the floor of the earthbag house deteriorated due to fungal and pathogen presence in the humid earthbag house.

From this work, it is clear that seeds stored in some form of vacuum sealing have a much greater seed viability over the course of time than those seeds stored using traditional (in our case, paper bags in a cool, moist structure) storage methods. In particular, we found that seeds stored with the modified bicycle pump vacuum sealer possessed a more desirable seed moisture content (the lower, the better) and an identical seed viability to those seeds stored with an expensive commercial vacuum sealer. We hereby heartily encourage the use of this bicycle pump vacuum sealer in conjunction with a cool storage environment as part of a suite of appropriate seed storage techniques. We also look forward to publishing this research in greater detail in a future ECHO Asia Note.

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Selenium and Human Health

by Dr. Edward Berkelaar, Redeemer University College

Selenium (Se), along with iron, zinc, and iodine, is one of a number of essential micronutrients that must be consumed in sufficient amounts in order to maintain human health. Selenium is part of a number of proteins within the human body that play an important role in protecting our bodies from infections. There is evidence for links between the Se status of individuals and the progression of HIV/AIDS in their bodies. Populations consuming insufficient amounts of selenium may be more at risk of dying from HIV infections; early studies suggest that increased consumption of Se slows the progression of HIV to AIDS and results in fewer secondary infections. On the other hand, if over-consumed, Se can be toxic to humans and other animals, although this happens infrequently and is usually a result of contamination by industrial processes. This article will summarize how we are exposed to Se, where people are at risk of consuming too little Se. It will suggest strategies for increasing Se consumption.

How do we get selenium?

Selenium is naturally present in very low concentrations in soil, and the concentration varies from region to region. Sometimes levels of Se in soil can vary over relatively short distances. Plants accumulate Se from the soil in which they are grown. Selenium is then consumed by the people (or farm animals) eating the plants. Eating animals (or animal products, such as milk or eggs) that have eaten plants also results in consumption of Se. Many factors influence the amount of Se in foodstuffs, including the concentration of Se in soil; soil conditions such as pH, soil texture (clay vs sand), percent organic matter; and the type of plant grown. Different kinds of plants growing in the same soil can vary widely in the amount of Se they take up and store in their tissues. Selenium can also be taken as a supplement; it is sometimes present in multivitamin supplements containing minerals. Overall, the total amount of Se consumed is determined by the concentration of Se in each food consumed and the amount of each food that is consumed.

How much selenium should we consume? Under what conditions might consumption of selenium be too low?

Recommendations vary somewhat for what is considered a healthy range of Se consumption. According to the Food and Nutrition Board of the Institute of Medicine of the National Academies, the recommended daily allowance for Se for adults is 55 µg/day. Women who are pregnant or lactating are recommended to take in 60 and 70 µg/day, respectively (NIH, 2013). The World Health Organization has set approximately 26-34 µg of Se per day for adults as the minimum recommended level of consumption (FAO/WHO Expert Consultancy, 2002). Consuming less than this increases the risk of adverse health effects. The safe upper limit of Se consumption is around 450 µg/day. Actual consumption of Se varies from country to country (and between regions within countries), with lowest consumption in areas where:

- **Soil concentrations of Se are low and diets are made up of locally-grown foods**. In parts of China known to have low-Se soils, Se consumption was in the range of 2.6 – 11 µg/day, but was higher in other regions. Those living in a low-selenium area of New Zealand consumed 11 µg Se/day. In Finland, Se consumption increased from 26 to 56 µg/day after 1985, when trace amounts of Se were added to chemical fertilizers. In the United States and Canada (where wheat is grown in regions with naturally high levels of Se in soil) daily consumption of Se was found to be 80 to 224 µg/day (EUFIC, 2008).
- **Predominately vegan diets are consumed**. A study from India suggested that daily consumption of Se was 48 µg/day for those consuming conventional diets, but 27 µg/day for a lower income population consuming a vegan diet. Similarly, in Sweden, those consuming a vegan diet consumed 10 µg Se/day, while others consuming a conventional diet consumed 40 µg Se per day (FAO/WHO Expert Consultancy, 2002). A study of Se uptake in Malawi, where commonly consumed vegetables are low in Se, concluded that intake of 20 to 30 µg/day was widespread (Chilimba *et al*., 2011).

Some have estimated that 0.5 to 1 billion people globally are severely Se-deficient, while even more may consume Se at less-than-optimal amounts. These people may be at increased risk of certain cancers and infectious diseases (Coombs, 2001).

What are some human health issues arising from insufficient consumption of selenium?

More research needs to be done in this area, and definitive conclusions have not been reached. However, there is intriguing evidence of a number of links between low Se and human health.

Keshan and Kaschin-beck Disease: The earliest link between Se deficiency and human health was the discovery that lack of Se can cause Keshan disease. Keshan disease occurred in people living in a region in China known to have extremely low concentrations of Se in soil. Symptoms included fatigue after mild exercise and cardiac problems such as arrhythmia and palpitations and even congestive heart failure (FAO/WHO Expert Consultancy, 2002). Another disease called Kaschin-beck disease was also observed in children in this region of China, and is characterized by stunted growth (shortened fingers, leg and arm bones). The incidence of these diseases in China has dropped since the 1970s due to improvements in nutrition.

Cancer: Adequate Se appears to offer protection from certain types of cancer, including prostate, lung, and colon cancers (Brown and Arthur, 2001).

Immune Function: Ongoing research suggests links between Se and infectious diseases; lack of Se appears to increase the likelihood of submitting to certain viral infections. Researchers are still studying the link between HIV and Se, but HIV clearly causes a decrease in levels of Se in the blood, which is in turn related to the rate at which HIV progresses to AIDS and mortality (FAO/WHO Expert Consultancy, 2002).

How can selenium consumption be increased?

There are several ways to increase consumption of Se within a population. But be careful - whatever the method, remember that Se can be toxic when exposures are too high. There is only about a ten-fold window between not enough Se (less than 60 to 70 µg/day) and too much Se (more than 450 µg/day).

Selenium Supplements: One option is to supply supplements to those suspected of having a low Se diet. This is not a great long-term solution, and does not help people in the early stages of certain diseases, but if you are working with people who are HIV positive, it would not hurt to supply Se supplements.

Food Processing: In many parts of the world, certain minerals are added to foods during processing to ensure an adequate supply of these elements in the human diet. For example, sometimes iodine is added to salt, and iron to wheat flour. If you live and work in a region where Se is in low supply, and if there is a food staple that is centrally processed (e.g. flour?), consider whether or not adding trace amounts of Se is possible. In parts of North America and Europe, animal feeds are supplemented with trace amounts of Se both for animals' health and to increase the amount of Se in animal products such as eggs or milk (Melse-Boonstra *et al.,* 2007). Like humans, livestock can also suffer negative effects from insufficient Se.

Agricultural Practices: Techniques can be employed to increase the amount of Se in soil, and to increase its bioavailability to plants. In some regions (e.g. Finland), Se is added to chemical fertilizers in order to increase the amount of Se in foods. Selenium is present in compost and animal manures, so maintaining high levels of soil organic matter can help increase Se supply. Soil pH is also important; somewhat similar to phosphate, if soils are acidic, the Se that is present in soil is less easily taken up by plants. Organic matter can buffer against changes in pH, and adding lime can increase soil pH.

Diet: Plants growing in the same plot of ground can differ in the amount of Se they accumulate and store in their tissue. Many fruits and vegetables contain low concentrations of Se. However, plants of the *Brassica* (e.g. cabbage) and *Allium* (garlic and onion) genera, certain legumes, and nuts (especially Brazil nuts) tend to accumulate greater amounts of Se. Mushrooms can contain higher amounts of Se as well. Fish and meat (especially organ meat) also tend to be richer in Se. In a survey of staple foods of Malawi and Mauritius, most vegetables contained less than 1 µg Se/ 100 g of the vegetable. The highest concentrations of Se were measured in black chickpea (*Cicer arietinum*; 138 µg Se/100 g), Kabuli gram (*Canjanus cajan*; 93 µg Se/100 g), soybean (*Glycine max*; 78 µg Se/100 g), and Lima bean (*Phaseolus lunatus*; 53 µg Se/100 g). The Se concentration of animal products ranged from ~ 10 to 70 µg Se/100 g. (Melse-Boonstra *et al*.,2007). In the same study, the Se content of cereals were studied. Corn flour and rice contained 2.5 and 2.4 µg Se/100 g, respectively, while flours made from millet or sorghum contained 8.0 and 9.3 µg Se/100 g, respectively. As with other crops, while different species can accumulate Se with different efficiencies, the amount of bioavailable Se in soil will have a significant impact on the amount of Se grain crops. A recent decline in Se consumption by Europeans is believed to be caused by a switch to consumption of grains grown in Europe and away from consumption of grains grown in North America, where they are grown in Se-rich soils (Haug *et al*., 2007).

Conclusion

Consuming sufficient amounts of Se is very important for maintaining health. Selenium concentrations in soil, and the bioavailability of Se, vary. Plants also vary in their ability to accumulate Se within their tissues. These factors make generalized recommendations difficult to make. If your location and the typical diet in your area suggest less-than-optimal Se consumption, strategies mentioned in this article may work to increase Se in the diet. Readers who suspect they may be in a low-Se region and would like further input can consult the references below, and may also contact ECHO to be put in touch with the author, Edward Berkelaar.

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FROM ECHO'S SEED BANK

Sorghum Pollination

by Holly Sobetski, ECHO Florida Seed Bank Manager

Sorghum is primarily self-pollinated, meaning that a sorghum plant will accept pollen from its own flowers. Sorghum can also accept pollen from other sorghum plants (cross-pollination) by means of wind or insect transfer (note the bee on the sorghum head in Fig. 3). Cultivated sorghum is generally cross-pollinated between 2 and 10%, with wild varieties crossing even more.

Floral initiation happens deep within the plant 30 to 40 days after germination. The flag leaf is the last leaf to emerge on the plant, and is usually smaller than the other leaves. It begins to bulge with

Figure 3: Sorghum cross-pollination can take place through insect transfer. *Photo by Holly Sobetski*

the developing flower head 6 to 10 days before flowering takes place, and flowering happens between 55 and 70 days after germination. Flowers start to open two days after the sorghum head emerges from the flag leaf. Maximum flowering occurs on the third or fourth day, and it takes six days for the whole inflorescence to completely flower (although it could take from 4 to 13 days, depending on the type). Flowering (the emergence of the anthers and stigma) starts at midnight and goes until 10 am, with the best flowering occurring between 6 and 8 am.

The stigma (female part) receives pollen from the anther (male part) before the flower even opens. But the stigma also remains receptive for 10 days, which means pollen can be accepted from other flowers during that time. Pollen remains viable for 3 to 6 hours in the anther and 10 to 20 minutes outside of it. Fertilization takes 2 hours, and the grain matures 30 to 35 days after fertilization.

Cross-pollination, or outbreeding, introduces new genes and traits to plants. This can be helpful for improving sorghum production and growth. But, if you have an open-pollinated variety that produces well and you want to save the seeds from it, you can ensure the purity of the cultivar by planting it at least 200m (656ft) away from other varieties. Remove plants that are too short, too tall, diseased, etc., before flowering takes place.

If varieties are growing closer than 200m apart and you want to save seeds of a specific variety, you can use pollinating bags to prevent cross-pollination (Fig. 4). A pollinating bag or mesh bag can be used right before or right after the plant starts to flower, allowing the plant to completely self-pollinate and ensuring the purity of the seed.

First, snip off any open florets (the exposed anther and stigmas will be obvious; the head flowers from the top to the bottom). This prevents the development of seeds from flowers that could have already cross-pollinated. Then, cut the flag leaf at the base. Put the dated bag over the entire panicle, allowing at least 5 inches between the bottom of the head and the bottom of the bag. Fold the sides of the bag over and paper clip. Leave the bag in place for 10 to 15 days, so flowers have sufficient time to open and to finish fertilization. When the bag is removed, it can be wrapped around the stalk and stapled to show that seed head was bagged.

During the rainy or humid season, sorghum heads tend to get moldy in the bag, so bagging has the best results when practiced in the dry season.

Figure 4: Example of a pollinating bag used to prevent cross-pollination in sorghum. *Photo by Holly Sobetski.*

Sorghum provides an important summer fodder where temperatures are high and rainfall is insufficient for corn. Most sorghum is grown for grain, forage, fuel, fiber, syrup and/or sugar. Cleaned grain can be cooked like rice or ground into flour.

The ECHO Florida Seed Bank offers sample size packets of the following sorghum varieties (log into your account on www.echocommunity.org to view the seed catalog):

Bird Resistant – a dwarf, white seeded variety that contains tannins, giving the unripened grain a bitter taste. The tannin content decreases as the grain matures and is lowest when the grain reaches 16-18% moisture content. Can be used as a feed, however it is a less desirable feed crop. Developed at Purdue University.

Broomcorn – used as a source of fiber for brooms and brushes. Stalks can also be used to make paper, while the pulp is used to manufacture craft paper, newsprint and fiberboard. The best brush is produced where the summers are warm and the soils are moist and fertile.

Forage – a tall-growing sorghum used for animal feed and silage. Provides an important summer fodder where temperatures are high and rainfall is insufficient for corn.

Giza 114 – solid-stalked sorghum burns at a high temperature and is used for fuel. Grain heads are also desirable for feed. Produces a variety of colored grain.

Red's Red Sweet – a variety of sweet sorghum that grows well at ECHO Florida. The cane is processed into sorghum molasses.

Striga Resistant – this sorghum produces desirable grain for feed and is resistant to striga, a particularly noxious parasitic weed. It has been the most detrimental in sub-Saharan Africa where drought and low soil fertility already make it difficult to grow a good crop. Developed at Purdue University.

Source: *Training Manual: Development of Cultivars and Seed Production Techniques in Sorghum and Pearl Millet*, ICRISAT 1997.

ECHO SOUTH AFRICA RESEARCH UPDATE

How much nitrogen is there in moringa stem versus leaf tissue?

Posted By Tim Motis, Wednesday, December 10, 2014

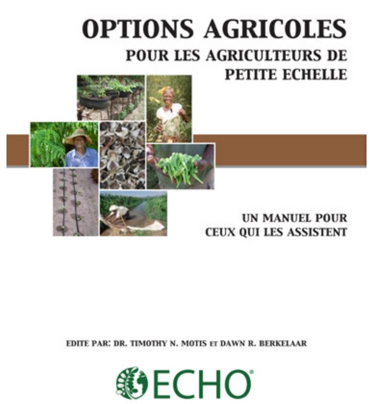
In one of our field experiments in South Africa, we are looking at the production of moringa leaf powder in an alley cropping system with legumes grown at the base of the moringa trees. So far, we've been able to get two cuttings of leaves each year. Each time we harvest the leaves, we also prune the moringa trees back to a height of 1 meter. Pruning results in branches being cut, which we chop into short pieces and leave on the ground as mulch.

We were curious to find out how much nitrogen that woody stem biomass contains in comparison to moringa leaves. So, we dried and ground some moringa stem tissue and sent the resulting powder off to a lab for tissue analysis. We found that moringa stem/branch tissue contained 1.7% nitrogen. As expected, this was quite a bit lower than the 4.8% found in the leaf tissue. However, it compared quite well to the 1.2% nitrogen in our chicken manure. Interestingly, potassium was more concentrated in moringa stem (3.1%) than leaf (1.9%) tissue, reading comparable levels to equal amounts of banana stalk.

While plant mulch would not provide the cation exchange capacity (for purposes of retaining nutrients and preventing leaching losses) that manure does, it is helpful to know that even the moringa stem residues can contirbute to soil fertility when left on the soil.

BOOKS, WEBSITES AND OTHER RESOURCES

French Translation–Agricultural Options for Small-Scale Farmers: A Handbook for Those Who Serve Them



ECHO is pleased to announce the French translation of *Agricultural Options for Small-Scale Farmers: A Handbook for Those Who Serve Them*. The title in French is *Options Agricoles pour les Agriculteurs de Petite Echelle: Un manuel pour ceux qui les assistent*. *Options* is filled with practical options for those working to assist smallholder farmers and urban gardeners in the tropics and subtropics. The book features material from *EDN* and from technical notes, written by experienced practitioners, on agricultural systems that they have implemented in the field and that have been adopted by thousands of farmers.

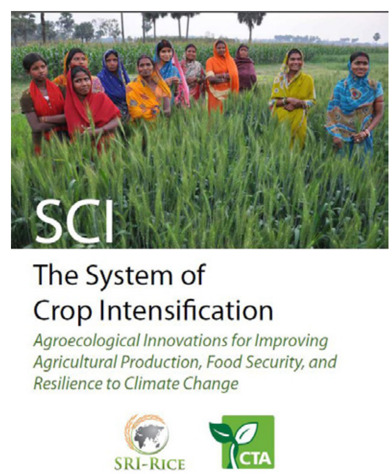
The new book is available for purchase from ECHO's bookstore (www.echobooks.net). It is priced at $19.95 per copy. *Amaranth to Zai Holes* continues to be freely available online (www.ECHOcommunity.org). We hope that this book will provide helpful perspective and practical project options that, ultimately, will lead to improved livelihoods of smallholder farmers in French-speaking areas. Please let us know if any particular practice or technique from the book is helpful, or if you have related items to share for possible mention in *EDN*.

The System of Crop Intensification: Agroecological Innovations for Improving Agricultural Production, Food Security, and Resilience to Climate Change

By B Abraham, O O AdeOluwa, H Araya, et al.

In *EDN* 120, we summarized a document about SCI, the System of Crop Intensification, a methodology that applies SRI principles to crops other than rice. CTA (the Technical Centre for Agricultural and Rural Cooperation) and SRI-Rice (the SRI International Network and Resources Center at Cornell) have produced a publication that reports on work currently in progress.

According to the foreword, "This booklet is not presenting a new 'technology'—to be transferred and adopted—but a set of ideas and experiences that we hope will encourage many people to 'think outside the boxes' of their current practices and to capitalize upon certain biological processes and potentials that exist both within their present crops and within the soil systems in which these crops grow."



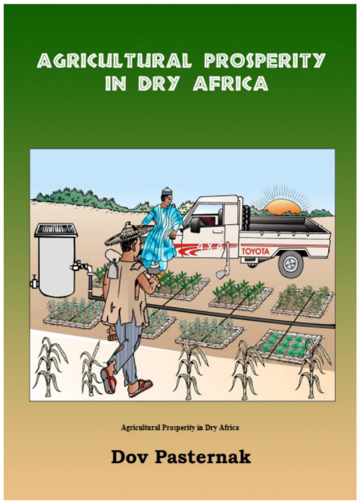
The document can be accessed and downloaded at http://publications.cta.int/media/publications/downloads/1795_pdf.pdf

Agricultural Prosperity for Dry Africa

Review by Bob Hargrave

In this book, available as a PDF download on ECHOcommunity (http://www.echocommunity.org/default.asp?page=APIDABook), Professor Pasternak shares insights from his lifelong work in international agriculture and specifically the dry areas of West Africa and Israel.

From 2001 to 2011 he was head of Crops and Systems Diversification at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Sahelian Center in Niger focusing on the genetic improvement of sorghum, millet, groundnuts, chick peas and pigeon peas.



This book contains a wealth of practical suggestions for dealing with the problems facing dryland farmers in Africa. He discusses crops, strategies, and technologies that lead to increased production and income for farmers with limited resources. A number of these solutions will be familiar to long time ECHO followers.

Excerpt

On one of these open days, I went into the field to follow up on the demonstration to VIPs by Saidou, our chief technician, of new dual purpose (grain and fodder) cowpea varieties. Saidou was talking to an impressive group of well-groomed NGO leaders. He was explaining the merits of each of the cowpea varieties. From the expressions on their faces, I could tell that this was the first time that these people had ever heard about and seen cowpeas (a major staple crop in the Sudano Sahel), and that they had no understanding of, nor interest in varietal differences.

...

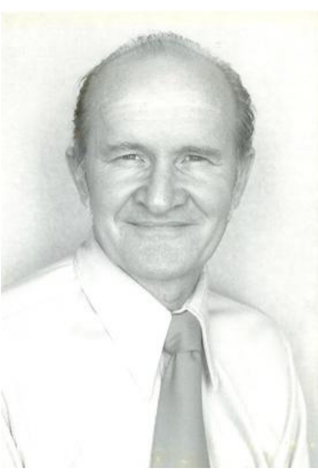
In stark contrast, when we brought farmers to the same field of cowpeas the following day, we were not even given a chance to explain the potential of the varieties. Immediately, the farmers saw the potential by themselves and began running all over the field collecting seeds in their pockets and frocks to try in their own fields. In less than 15 minutes, not a single seed was left on the plants.

Professor Pasternak would like to get feedback regarding this book.

Contact him via email (dov.pasternak@gmail.com) to share your comments and any details of your work in dry Africa. We at ECHO would also appreciate your thoughts (email: echo@echonet.org).

IN MEMORIAM

Dr. Franklin W. Martin died this year at the age of 85.



If you have made significant use of ECHO's materials, written with tropical/subtropical smallholder farmers in mind, you will likely recognize the name of Dr. Frank Martin. Examples of his writing include ECHO's book *Edible Leaves of the Tropics*, the booklets *Techniques and Plants for the Tropical Subsistence Farm* and *Survival and Subsistence in the Tropics*, and many articles for *ECHO Development Notes*.

I first met Dr. Martin by chance in 1978 during a short visit to the Mayaguez Institute for Tropical Agriculture in Puerto Rico, in conjunction with my post-doctoral research on grain sorghum at Purdue University. Dr. Martin had served as director of the Institute for 20 years and had recently stepped aside to continue his research and writing.

I was impressed with his ability to take what he knew as a scientist and apply that to small-holder farmers. He later became a role model for me as I moved to subtropical Florida to lead ECHO to be an organization blending good science and an understanding of the practical realities and limitations faced by those farm families and of the needs of people like you who work with them. My first trip overseas for ECHO was a "pilgrimage" to Puerto Rico to visit Dr. Martin and to share ECHO's vision with him. I came home with small seed packets that became ECHO's first 28 accessions of underutilized tropical plants.

A few years later I ran into Dr. Martin again at a conference in Trinidad and learned that he was soon to retire. I quickly invited him to visit southwest Florida and to consider retiring here and being an ECHO volunteer to give us occasional direction, to share ideas of seeds to acquire, to teach our staff special techniques, and especially to write articles to share with our overseas network. He also gave ECHO permission to update and publish his book *Edible Leaves of the Tropics*.

Dr. Martin's health began to decline several years ago, so he had to end his writing and volunteer work. But what he had already done continues to be read and applied, as ECHO's overseas network of community development workers continues to expand. Now his writings can be read on the web in almost any country

Written by Dr. Martin Price

UPCOMING EVENTS

ECHO East Africa Symposium

February 3 - 5, 2015

Arusha, Tanzania

The ECHO East Africa Symposium will provide a network and training opportunity for those involved in alleviating hunger and poverty in East Africa. Three mornings of plenary sessions featuring knowledgeable and experienced speakers will be followed by afternoon workshops and discussion groups led by regional agricultural development workers and experts.

Looking ahead:

TAD I

Our introductory Tropical Agricultural Development course will be held on the following dates:

June 1 - 5
July 27 – 31

TAD II

Tropical Agricultural Development II, Basic Gardening for the Tropics, will be held June 22 – 26.

Further information on these events, including links for registration, are available at 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!