EDN ECHO Development Notes

July 2010
Issue 108

Edited by Dawn Berkelaar and Tim Motis

ECHO is a global Christian organization that equips people with agricultural resources and skills to reduce hunger and improve the lives of the poor.

Issue Highlights

NOTE: Link to extra material from the web version of *EDN* 108.

ECHO
17391 Durrance Rd
North Ft. Myers, FL 33917
USA
Phone: (239) 543-3246
Fax: (239) 543-5317
echo@echonet.org
www.echonet.org

Human Urine as a Fertilizer

By Dawn Berkelaar

Few would argue against the importance of fertilizer (be it natural or synthetic) for successful farming. Those farmers who cannot afford synthetic fertilizers, and who have no animals to provide fertilizer in the form of manure, are at a disadvantage.

One high quality and universally available source of all the major macronutrients (nitrogen, phosphorus and potassium) is human urine. Using human urine as fertilizer is not unprecedented, but for various reasons in most countries it is not commonly considered as an option, especially for growing vegetables.

However, urine is especially high in nitrogen, which is often a limiting nutrient for crops. The amount of nitrogen in urine will vary depending on the amount of protein in the diet. One estimate indicates that urine contains between 5.2 and 9.6 g N per person per day, 75 to 90% of it excreted as urea. Urine also contains 2.5 to 3.6 g of potassium (in plant-available ionic form); and 0.6 to 1.1 g of phosphate (95 to 100% as plant-available phosphate ions). (EcoSanRes)

Data from Ecosan indicate that the pH of fresh urine is approximately 6, with the pH increasing as urea hydrolyzes to ammonia. The pH of stored urine is often slightly alkaline.

Many helpful publications exist on the topic of ecological sanitation (i.e. using human waste in a way that positively impacts the environment). For example, EcoSanRes, an international network of ecological sanitation experts funded by Sida (the Swedish International Development Cooperation Agency), has published "Guidelines on the Use of Urine and Feces in Crop Production." In various places in this article we include excerpts from the summary of those Guidelines.

Is Urine Safe to Use on Crops? And What about the Smell?

Health and olfactory concerns are usually the first issues people raise regarding the use of urine as a fertilizer. Careful treatment of urine can minimize both of these.

Except in rare instances, urine is sterile when it exits a person's body. The key is to collect urine separately from feces. This can be done in a number of ways. If chamber pots are used at night (e.g. ECHO staff member Danny Blank says it is not uncommon for Haitians to use a chamber pot at night so that they do not to have to leave the house in the dark), the contents can be used to fertilize plants in a kitchen garden near the house. An alternative is to urinate directly into a bucket, but the bucket should be kept sealed when not in use, to minimize smell and loss of nitrogen due to volatilization of ammonia, which is a breakdown product of urea. A third option is to use a composting toilet, which can be designed to automatically separate the solid and liquid portions of human waste.

According to WHO *Guidelines for the Safe Use of Wastewater and Human Excreta* (p. 36), "It can be concluded that pathogens that may be transmitted through urine are rarely sufficiently common to constitute a significant public health problem and are not considered to constitute a health risk in the reuse of human urine in temperate climates. *Schistosoma haematobium* [the parasite that causes schistosomiasis, a disease also known as bilharzia] is an exception in tropical areas, however, with a low risk of transmission due to its life cycle." This parasite must spend part of its life cycle inside a freshwater snail, so in areas where schistosomiasis is endemic,

avoid using urine near bodies of freshwater.

It may not be feasible to completely exclude the possibility that urine will contain disease-causing organisms, though precautions can be taken. If urine is applied to the soil (not on the plant, to prevent leaves and fruit from contacting the urine), the use of urine as a fertilizer would be more sanitary than existing methods used in many places (e.g. open pit latrines, or lack of a system for containment of feces and urine, sometimes resulting in contamination of freshwater).

The strong smell associated with urine comes in part from ammonia that is volatilizing. In order to limit volatilization of ammonia and to reduce smell, urine should be stored in a non-corrosive container that will seal (e.g. plastic or clay). Do not dilute urine while in storage—only when ready to apply the urine to crops. This is because there are substances in urine that inhibit growth of bacteria. They are less effective when their concentration is reduced by adding water to the urine.

In a review paper on the use of human excreta as fertilizer, Heinonen-Tanski and van Wijk-Sijbesma (2005) explained, "Nitrogen occurs in fresh urine as urea, which is useful for plants and [is often an ingredient] in commercial fertilizers. Urea degrades easily by microorganisms to ammonium, which is also useful for plants. As urea degrades in stored urine, the urine becomes alkaline (pH 9.0). Though ammonium is useful to plants, in a slightly alkaline solution, part of the ammonium can volatilize easily as ammonia. This evaporation can be noted in the form of an unpleasant smell. If the urine solution were acidic, ammonia would not be formed as readily. Because the adjustment of pH is both difficult and costly [and may not be favorable for plant growth], this is not recommended for private households. Instead, the urine should be poured into a 1 to 4 cm deep. . . furrow with a watering can and covered with soil soon thereafter… .It is recommended further that urine is applied as a fertilizer just before irrigation or during the rains so that it spreads more perfectly. It can also be applied in the evening when the evaporation will be lower" (Heinonen-Tanski and van Wijk-Sijbesma, 2005). See Supplement for other ways to apply urine.

Heinonen-Tanski and van Wijk-Sijbesma also concluded, "Human urine is not totally sterile, but. . .the amounts of different enteric [intestinal] microorganisms can be so low that adding urine to the soil can readily be accepted. The urine may have a slight smell but this is not repulsive. There can also be some precipitation…of insoluble phosphate salts [from the urine]. The Swedish practice has sometimes been to store urine for some months before use in order to wait for the die-off of possible enteric microorganisms. Because the survival time of microorganisms is always shorter at higher temperatures, the storage time of urine up [to] the time when it is needed as fertilizer can be minimized in tropical climates." Heinonen-Tanski and van Wijk-Sijbesma suggest that you try to avoid stirring the urine when it is being applied. Stirring will increase the volatilization of ammonia, and thus the smell. Also, any microorganisms that settle to the bottom would get mixed in again if the urine were stirred. Others recommend stirring.

Fertilization with human feces/manure, though possible, requires particular precautions and is not the focus of this article.

Does it Work?

According to the review paper on the use of human excreta as fertilizer, "If urine fertilization is done carefully at the correct time, the amount used is moderate, and the urine is incorporated into the soil, urine nitrogen has the same agricultural values as nitrogen of commercial mineral fertilizers" (Heinonen-Tanski and van Wijk-Sijbesma, 2005).

A paper in the *Journal of Agricultural and Food Chemistry* showed evidence that, compared to cabbages treated with industrial fertilizers, cabbages fertilized with human urine had less insect damage, similar microbiological quality [i.e. similar bacteria counts], and similar taste. (Industrial fertilized cabbages had faster initial growth, which may have attracted insects earlier.) The authors concluded that cabbage fertilized with human urine posed no significant health risks and did not affect the flavor of the cabbage (Pradhan *et al*, 2007).

How much Urine should I Use?

The EcoSanRes Guidelines include information that can help estimate the amount of urine to use on various crops. The amount will vary depending on the amount of nutrients in the urine, which will depend to some extent on the food the person ate—someone who eats less protein will have less nitrogen in their urine. The authors wrote, "Urine is used by the body as a balancing medium for liquids and salts and the amount of urine therefore varies with time, person and circumstances. For example, excessive sweating results in concentrated urine, while consumption of large amounts of liquid dilutes the urine. Thus, to determine the application rate of urine as a fertilizer, the calculation should preferably be based upon the number of persons and days that it has been collected from, as this gives a better indication of the nutrient content than the volume."

The amount of urine needed will also depend on the availability (to the plant) of the nutrients and the treatment of the urine before it is applied to crops. Different crops will also require different amounts of fertilizer. If an application rate for commercial nitrogen fertilizers is available, that can be used as a starting point.

Undiluted urine can be analyzed for nitrogen concentration, but the EcoSanRes summary of the *Guidelines* also suggests it can be estimated at 3 to 7 g N per liter. Another way to approximate is to "apply the urine produced by one person during one day (24 hours) to one square meter of land per growing season. If all urine is collected, it will suffice to fertilize 300 to 400 m^2 of crop per person per year with N at a reasonable rate. For most crops, the maximum application rate, before risking toxic effects, is at least four times this dosage. [So there is little chance of adding too much by

following these guidelines.] Urine also contains sufficient phosphorus to fertilize up to 600 m^2 of crop per person and growing season, if the application rate is chosen to replace the phosphorus removed."

How and When to Apply Urine

Advice from the EcoSanRes summary of *Guidelines*: "Urine can be applied neat [undiluted] or diluted. However, its application rate should always be based on the desired nutrient application rate [for a specified area]."

"Any potential need for supplementary water should be met with plain water, not diluted urine. To avoid smells, loss of ammonia and foliar burns, urine should be applied close to the soil and incorporated as soon as possible.

"Urine is a quick-acting fertilizer….[The] nutrients are best utilized if the urine is applied from prior to sowing up until two-thirds of the period between sowing and the harvest." After this time, the nitrogen will no longer help the crop, and much of it will likely be lost due to leaching or volatilization before the next crop is planted.

Urine Fertilizer Trial at ECHO

Frequency of application is also important to consider. The EcoSanRes summary says that under most circumstances, the total yield is the same whether the urine is applied in one large dose or in several smaller doses. Scott Britton and Andrew Kroeze tested this in a trial on ECHO's farm in the summer of 2009, evaluating the use of human urine at different application frequencies on the growth of crops. They compared various application frequencies, while maintaining the same overall application rate of N for every treatment (each plant received 4 grams of nitrogen in total). The treatments included (for comparison) 1) no fertilizer (the control) and 2) soluble fertilizer (the standard for comparison).

The trial at ECHO included field and pot studies, comparing and measuring the effects of urine at three different application frequencies on growth of corn, okra and pak choi (Chinese cabbage, *Brassica rapa chinensis*). It consisted of five different treatments:

(1) **Once a week** at a 9:1 ratio of water and urine mix (~10% urine), for 0.5 L of liquid and 4 g N in total;
(2) **Once every two weeks** at a 3:1 ratio of water and urine (25% urine), for 0.5 L of liquid and 4 g N in total;
(3) **Once every month** at a 1:1 ratio of water and urine (50% urine), for 0.5 L of liquid and 4 g N in total;
(4) 0.5 L of **only water** (0% urine); and
(5) **Once a week**, 16-3-16 soluble synthetic fertilizer with micronutrients, at a rate that would total 4 g N.

In the pot study, plants were grown in 5 gallon pots with five replications of each treatment. Seeds were sown directly into pots filled with sand from the farm. Pots were watered as needed during the rainy season. Fertilizer mixes were applied to the soil (not the foliage) at the predetermined frequencies and dilutions for eight weeks (six weeks for pak choi, since it grows faster). The field study included the same treatments and amounts of urine. The age of the urine was not a factor.

Plant observations (health, coloring) were made weekly, and plant measurements (height, diameter of leaf spread, and diameter of main stem) were collected after eight weeks. Figure 1 shows some of the results.

Figure 1: Plants used in a trial at ECHO. The top photo shows corn plants; middle photo shows okra plants; and bottom photo shows pak choi (pak choi grown in pots did not fare well with urine fertilizer, but pak choi grown in the field did as well as plants given soluble fertilizer). In each photo, the plant on the far left was unfertilized. The plant second from the left was given urine fertilizer (50% urine, 50% water) once a month. The plant in the middle was given urine fertilizer (25% urine, 75% water) twice a month. The plant second from the right was given urine fertilizer (10% urine, 90% water) once a week. Each of the middle three pots/rows received 1 liter of urine in total. (The ratios in parentheses are for corn and okra, not pak choi). The plant on the far right was given 16-3-16 soluble fertilizer once a week. Photos by Andrew Kroeze or Scott Britton.

Scott summarized the results as follows: “Urine is a…useful fertilizer. It is certainly better than nothing! The way that urine is applied matters. Peter Morgan [who has done many trials using urine as a fertilizer; see end of article for details] found that the more urine he applied, the higher the yields for corn (maize). However, he found that high application rates and concentrations also resulted in more leaching and therefore waste. So interestingly, for his growing conditions in southern Africa, a 5:1 mix of water and urine was more efficient, though lower yielding than a 3:1 mix.”

Scott continued, “Our trial’s emphasis on application frequency is important because it determines how much time farmers will invest in fertilizer application. Though application three times a week worked great, that is a large demand on a farmer’s time. A good place to begin experimenting with urine would be to apply it once a week, at either a 3:1 or 5:1 ratio of water to urine. For our trial, corn seemed to grow better with an every-other-week application of diluted urine than with 16-3-16 soluble fertilizer.

“Okra did well with an application of diluted urine every week, and might benefit even further from a more dilute mixture applied three times per week. The okra did almost the same with urine once a week as with soluble fertilizer once a week. Also, in the field, the okra plants given urine once a week were amazing. They were a bit slow to put out pods, but that is because they started putting out side branches that ended up putting out pods. All of the other treatments (except maybe the every-other-week urine application) just put out pods on the main leader, but the plants given urine every week put energy into side shoots that then put out good-looking pods on both the main leader and the side shoots, resulting in more than 30 pods for some of the plants. We collected those data later than the others because we didn’t see what was going on until later.

“The pak choi in the pots did not respond well to the urine. In the field, however, the pak choi given urine fertilizer every week did about the same as the plants given soluble fertilizer.”

Experience with Urine Fertilizer in Haiti

Mark Hare working with MPP (Mouvement Paysan Papaye; Farmer’s Movement of Papaye) and the Road to Life Yard project in Haiti has experimented with the use of urine as a fertilizer. He heard about the idea from folks from the organization SOIL in Cape Haitian, who used urine to fertilize vegetables. Mark began applying urine to amaranth plants in tire gardens, keeping two as a control and using urine on three. All tires contained the “potting mix” they usually use, which contains approximately three parts soil; two parts dried, pulverized and sifted manure (cow, horse and burro); and one part sand. Some compost was also mixed in with the manure. Urine was the only additional fertilizer used, and the difference was so remarkable that he began talking with Road to Life Yard crew members about it.

Mark shared, “Another crew member, Wilner Exil, had already had an experience using urine. He had mulched two banana plants with bean chaff and poured urine on the mulch every morning. He was impressed by how fast the chaff turned into compost, and started using chaff mulch and urine on the [other seven]. He [had] noticed that the bananas with urine were much greener, while the other ones were yellowish.

“Since then, he has discovered that with application of urine, compost piles can also decompose more rapidly, taking a month and a half rather than three months (whether with or without urine, the compost was turned consistently).”

Mark has not done formal trials comparing urine to other fertilizer and/or to no fertilizer. But he repeated his amaranth demonstration a second time, including four tires fertilized with urine and three without (see Figure 2). He said, “After about two weeks, a friend who works with me told me to start using urine on all of them because it would be stupid to lose the production.”

Mark does not measure the exact dilution of urine that he uses. He puts an amount of urine anywhere from a pint to a quart (or sometimes more) into a watering can that holds two gallons of liquid, and then fills the remainder with water. His colleague Wilner says he can use a concentration as much as 1:1, filling the watering can half full with urine and half with water (for vegetables). Wilner notes that if you water with urine in the morning, it is good to water again, without urine, in the afternoon.

Urine fertilizer does not necessarily result in better plant growth. Mark added, “I also tried a comparison with green peppers and with tomatoes—one tire of peppers and one tire of tomatoes with urine, and one of each without. The result in that comparison tended to be negative. The peppers and tomatoes with urine produced less. I would need to repeat that, though. There may have been other factors involved. In contrast, we also have farmers who had very sad looking tomato plants and reportedly started using urine on them and ended up producing tomatoes ‘in abundance.’”

I asked Mark if he had any ideas about why his peppers and tomatoes did not fare well with urine fertilizer. He responded, “The other farmer's tomatoes were in tires, as were mine. I don't have an exact answer. All of my green peppers and tomatoes had vermicompost this year, so maybe there was already plenty of nitrogen and the urine pushed everything over the edge. We also forgot to mix in sand with the vermicompost, so the top layers of the tires were fairly waterlogged.”

I asked Mark whether or not others in his area have begun to use urine as a fertilizer, and if it has been a difficult thing to promote. Mark answered, “A number of the people who receive technical assistance from the Road to Life Yard crew members have started using the urine that they collect from chamber pots at night. Wilner and I think maybe around half. In some localities, it could be more.

“Those who have started using it have seen results, and so continue to use it. People who don't are turned off by the smell, don't try it and so don't see the positive results.”

Figure 2: Amaranth growing in tire gardens (second row) in Haiti, June 2009. In the middle row of tires, the plants on the far left and right were fertilized for five of the previous seven days with a mix of water and urine in a 5:1 or 6:1 ratio. In the photograph, plants in all four tires are the same age. [Photo by Danny Blank during his visit to MMP (Mouvement Paysan Papaye) Road to Life Yard Project led by Mark Hare and his Haitian colleagues.]

Conclusion

Human urine seems to have significant potential as a source of essential plant nutrients. If you have experimented with the use of human urine as a fertilizer, or if you are inspired to do so by this article, we would love to know of your results.

For More Information

Guideline on the Use of Urine and Faeces in Crop Production. Hakan Jonsson et al.
www.ecosanres.org/
A helpful publication, as mentioned in the article

An Ecological Approach to Sanitation in Africa: A Compilation of Experiences
Dr. Peter Morgan, Aquamor, Harare, Zimbabwe
and
Experiments Using Urine and Humus Derived from Ecological Toilets as a Source of Nutrients for Growing Crops
By Peter Morgan
http://aquamor.tripod.com/KYOTO.htm
Peter Morgan has done much research on the topic of recycling human waste. He aims to make ecological sanitation, or "eco-san," "simple and cost-effective for use by low income communities in Africa. The ultimate aim is to form much stronger links between sanitation, agriculture and food production that actually work in practice, and can [provide benefits to having a toilet that go beyond sanitation.] It also aims to demonstrate that effective toilets for use in Africa can be built by a family with very little support from outside." Included here are shallow pit composting eco-toilets, since "the pit latrine is the most commonly used toilet in Africa, and is likely to remain so for some time." Simple urine diversion systems are also described.

Heinonen-Tanski, Helvi and Christine van Wijk-Sijbesma. 2005. Review paper: Human excreta for plant production. *Bioresource Technology* 96: 403-411.
This helpful paper summarizes a lot of information about using human urine and feces as fertilizer.

Pradhan, Surendra K. *et al*. 2007. Use of human urine fertilizer in cultivation of cabbage (*Brassica oleracea*)—Impacts on chemical, microbial and flavor quality. *Journal of Agricultural and Food Chemistry* 55: 8657-8663.

Correction

We included the wrong address for IDE in the printed version of *EDN* 107. The url should be <www.ideorg.org/>.

ECHOES FROM OUR NETWORK

Feedback about Making Potting Mix

Dan Hemenway wrote to us after reading *EDN* 106. "By the way, one reason why charred rice hulls may work well in potting mixes is that any form of charcoal improves the capacity of soil to hold nutrients and release them to plants. No doubt you have been reading about the biochar 'discoveries' in Amazonia, though I read about the same properties of charcoal as a teenager in the 1950s in a book that was rather aged then. Since charcoal is something that can be produced in many 'undeveloped' regions, often from wood that is too large for cook fires, it might be worth adding to mixes in further experiments.

"[Here is another useful idea.] You will find that rotted and pulverized sabal palm logs, shredded, make contributions to potting mixes that are way beyond what you would expect. It is a far superior amendment to peat. I would expect that other palm species have different rates of decomposition and different end results, but it is worth looking into, particularly with weedy species like sabal. The core of the logs eventually (and fairly quickly) breaks down into a black, humus-like material that is fantastic! I use the logs in our trials adapting chinampas techniques to local conditions, particularly for bed walls, where they last just long enough to stabilize the soil."

Sprouting grains

Wafula Ferdinand, coordinating officer for Biogardening Innovations, wrote to us regarding the article in *EDN* 106 on sprouting cereals for food. "Many thanks for the rich information that your organization has been sharing world wide. I am an ECHO network member and receive your hard copy of [ECHO Development Notes].

"In…issue 106, I was particularly keen [about the article] on sprouting cereals for food. In the community where I am

working (Bunyore) here in Western Kenya, farmers usually sprout maize before planting. This ensures [that every planted seed is viable] and lessens the period that crops usually stay in the soil.

"Another interesting thing, millet is usually sprouted before milling for either porridge or as baking yeast for traditional brew. The porridge from flour that has been sprouted and fermented is usually sour and [more] tasty than plain flour. Also sprouting and fermenting the flour increases the volume of the food stuff.

"Thanks again for sharing with us these good practices. [This] increases our confidence in extension work, particularly on preserving our traditional ways of food preparation."

Planting sprouted maize reminds me [DRB] of seed priming, which is written about in *EDN* 83. Seed priming basically means soaking seeds in water before sowing them, to minimize the time that seeds spend absorbing water from the soil. That way they are able to germinate and emerge quickly.

ECHO staff member Larry Yarger commented, "Several years back, there was a move towards planting pre-germinated seed. When I was in Thailand, rice seed was soaked until the radical had just poked its nose out, and then the seed was spread onto the wet mud to fully germinate. Some were using the technique to eliminate transplanting, but most liked it because it did improve and prove germination."

Faidherbia albida

Tony Rinaudo (working with World Vision Australia) responded to the article about *Faidherbia albida* in *EDN* 107 with helpful comments. "In West Africa, crops growing under a canopy of the nitrogen fixing *F. albida* trees produce an extra 2.5 to 3 tons of stalks per hectare and two and a half times the grain (equating to an extra 1,200 to 1,500 tons of grain) with three times the protein content, compared to crops growing in the open. Twenty-five trees per hectare provide a full fodder ration for one to one-and-a-half sheep per year. This is three times the optimal stocking rate for the Sahel. The high protein seed pods are called sheep biscuits in Ghana. The trees also host cattle egret and many other predators of insects, helping to protect crops against pests. An adult egret for example eats 30 to 50 locusts per day.

"I think the role of trees like this will increase as the impact of climate change increases. Many crops in tropical / sub tropical areas are already growing at their threshold temperature range. Any increase in temperatures will translate to reduced yield (e.g. for each 1ºC increase in temperature, rice yields will decline 10%). For many countries, average temperatures are predicted to increase 4 to 5ºC, and this is only the mean—spikes in temperatures will also occur. The future for agriculture as we know it looks bleak. What will the impact of a 40% decline in food production mean for a country already unable to feed its population?

"However, an email conversation I had with Roland Bunch leads me to think there are practical strategies which we can implement to reduce the impacts."

[Roland's e-mail indicated that after a decade or so of research in Honduras, the FAO concluded that light shade will actually increase crop yields in the lowland tropics by about 50 to 70%. All the crops they studied tended to stop growing in the lowland tropics' mid-day heat. FAO calculated that 15% shade would lower the temperature approximately 10ºC.

The ideal would be to maintain about 15% shade, which is tricky but not impossible. Roland wrote, "[FAO] experiments showed that, with shade, farmers got about 50% higher yields in the good years than did their neighbors. But even more important for smallholder farmers, in the bad years, when their neighbors harvested virtually nothing, those with the shade got about the same yields as their neighbors did in good years. Their risk [of crop failure] was tremendously reduced. This happened both when there was not enough rain (when we had El Nino) and when there was too much (Hurricane Mitch)."]

Tony Rinaudo continued, "Trees like *F. albida* could be critical for agricultural production in the future. Even so, I have not promoted it outside of Africa as I am concerned about its potential for weediness. In Africa, a weevil destroys much of the seed and so there are some limits to its rapid spread. It is always good to find what the local best match is for a particular purpose.

"I would also like to add that it is important to not focus on single species no matter how outstanding they are. *Faidherbia* does not produce good firewood and its timber is not durable, being very susceptible to borers. Therefore it is important to promote other species as well, especially appropriate indigenous species.

"I once visited an 18-year-old *F. albida* project in Niger. The trees were planted on farmland at 10 x 10 meter spacing and they had a very good impact on crop yields. However, for a number of years the trees had failed to produce seed pods. I do not know the cause, but suspect that insects that destroyed the flowers had increased in numbers, or perhaps an insect eating bird normally present in a more balanced environment may have been missing due to lack of suitable habitat."

BOOKS, WEBSITES AND OTHER RESOURCES

Plant Information Online

ECHO intern Scott Britton found a very helpful FAO website that provides plant information for many of the plants we promote:

http://ecocrop.fao.org/ecocrop/srv/en/home

Scott shared, "The website features a "Find plant" link, taking you to a database of 2568 plants. The individual plant files offer brief descriptions and a "Datasheet' link provides tables of growing information. Try typing in "vigna acon" for mothbean—it took me about 30 minutes to compile all of those data from other sources.

"It also has a "Search" link at the homepage offering the user the chance to enter selected growing info and search for plants matching those selections."

Other good sources of plant information regularly used by ECHO staff include Purdue University's Hort New Crop search (www.hort.purdue.edu/newcrop/), www.worldagroforestry.org/resources/databases/agroforestree, tropicalforages.info and Winrock's fact sheets on Nitrogen Fixing Tree Species (www.winrock.org/fnrm/factnet/factpub/factsh.htm). AVRDC's website also has great information sheets (www.avrdc.org/LC/indigenous/).

FROM ECHO'S SEED BANK

Chickpea Seeds from ICARDA

By Tim Motis

Figure 3: Chickpea plant at ECHO. Photo by Tim Motis.

Looking for a nutritious legume that thrives in dry, cool conditions? You might want to try *Cicer arietinum*, referred to as chickpea and also by many other common names such as garbanzo, gram and bengal gram. Chickpea is noted for drought tolerance. It will produce a crop with an annual rainfall of 26-39 in (650-1000 mm), typical of semi-arid regions. Consequently, it has received attention as an alternative crop for areas where rainfall patterns have shifted to the extent that farmers cannot rely on the higher amounts of rainfall they would normally expect. Though often grown in more temperate areas, ECHO has chickpea seed from the International Center for Agricultural Research in Dry Areas (ICARDA), for evaluation in "southerly latitudes."

Round-shaped pods are produced on short (usually 1-2 ft; 30-61 cm), bushy plants. Average yield of dried seeds, from pods typically harvested 90-150 days after planting, is about 700 kg/ha.

The green pods and young shoots can be consumed as a vegetable. Sprouted seeds can be eaten as a vegetable or added to salads. More commonly, the dry seeds are used to make flour or dahl. Dahl (split chickpeas without the seed coats) can be cooked to make a thick soup or dried and then ground into flour. The well-known paste called hummus is derived from a combination of cooked, ground up chickpea and sesame seed oil. ICARDA has an interesting web page filled with chickpea recipes: www.icarda.org/Publications/Cook/Cook%20Book.htm

The seeds are high in protein (20%) and are a good source of potassium. In addition to use for human consumption, chickpea seeds can be milled for use as animal feed; animals can also eat the green or dried leaves and stems. As an animal feed, chickpeas have been shown to have similar nutrition as soya cake.

Chickpea's origins are probably in southeast Turkey. The plant is grown in parts of Asia (e.g. India, Burma and Pakistan), areas of the Mediterranean, Ethiopia, parts of Latin America (e.g. Mexico, Argentina and Chile) and Australia. Chickpea prefers temperatures from 64-79°F (18-26°C), although more established plants can tolerate higher temperatures. Soil temperature should be above 59°F (15°C) for proper seed germination. Though drought resistant, chickpea is intolerant of heavy rainfall. Seed setting is optimal at a relative humidity of 20-40%.

Varieties of chickpea differ in pod size and seed color. Most varieties are classified as "Desi" or "Kabuli" types. Desi chickpea seeds are smaller, darker-colored and not as smooth as the cream-colored, mild-flavored seeds of the Kabuli varieties (*see Figure 4*).

Figure 4: Kabuli-type chickpea seeds from ICARDA. Photo by Tim Motis. See www.pulsecanada.com/what-are-pulses/chickpeas for a comparison photo of kabuli and desi seeds.

When planting chickpea, plant in rows 25-30 cm apart or broadcast the seeds at a rate of 25-35 kg seed/ha.

In 2008, ECHO's seed bank received seeds of multiple lines of chickpea from ICARDA. The various lines likely have resistance to *Ascochyta* blight, something that ICARDA has addressed in their chickpea improvement efforts. Ascochyta blight is a fungal disease favored by wet conditions and mild temperatures. Although kabuli chickpeas are typically grown in more temperate climates, in comparison to desi types grown in semi-arid tropics, it would be interesting to know how the lines ECHO received from ICARDA (for evaluation in southerly latitudes) perform in warmer areas. While our supply lasts, we would be glad to send a complementary trial packet of several of these lines to ECHO network members. If you are not yet a network member, see ECHO's website for information on joining our network: www.echonet.org/content/agriculturalResources/840.

UPCOMING EVENTS

17th Annual ECHO Agricultural Conference

Fort Myers, Florida
December 7-9, 2010

Online registration is now available. Go to www.echonet.org and click on "Conferences and Symposia" under the "Agriculture" tab, or find the registration page at www.regonline.com/builder/site/Default.aspx?eventid=806085.

This is a networking conference, which means that our delegates are important resources. If you will be attending the conference, keep in mind that we have speaking slots for 45-minute morning (plenary) sessions, 60-minute afternoon workshops on the ECHO farm, and 25-minute evening PowerPoint talks.

As you register, carefully read the first page of the online registration form, which contains detailed information including a link to a speaker presenter form (https://creator.zoho.com/echonetwork/conference-possible-presenters/form-perma/Presenter_Information/). Submitted forms are forwarded automatically to our speaker selection committee.

A few subject categories and topics that would be of interest (based on input from last year's delegates) are the following:

- Gardening and farming: ideas for growing plants under various conditions (wet, dry, shade, desert)
- Soils: composting, vermiculture for urban gardens
- Fruit trees: new methods of propagation, rare fruit species, pruning practices
- Insect/pest control: organic solutions for small plots
- Drying, storing, preserving food

Let us know if you are able to address any of these topics. We look forward to meeting many of you at conference!

In Memory of Lowell Fuglie

Lowell Fuglie died of lung cancer in Quebec (Canada) on Wednesday, April 21. Lowell is considered something of a hero in community development by the ECHO staff. A pioneer in the moringa community, he had worked with moringa since 1995. Several of us remember the video he showed at our 1999 ECHO Agriculture Conference, sharing the amazing results using moringa leaf powder in cases of severe malnutrition. Many of the children that were given leaf powder showed marked improvement in health in less than 40 days. Information from that video is also in his book *The Miracle Tree/Moringa oleifera: Natural nutrition for the tropics*.

Lowell worked for 17 years in Dakar, Senegal, with the organization Church World Service. About 15 years ago, Lowell read about the exceptional nutritional qualities of moringa in *EDN*. Rather than cooking the leaves, he hit on the idea of drying the leaves and pounding them into a powder. When a malnourished mother would come to a remote nutrition clinic, perhaps because she could not give enough milk, or was having difficulty with a pregnancy or had to wean her toddler too early, the clinic would give her a bag of this green 'medicine.' Lowell developed guidelines for various situations involving malnutrition, telling how many tablespoons (or bottle caps) to add to porridge or soups or other staple foods.

The moringa tree has been valued as a vegetable tree for centuries in places like India and the Philippines. Trees were scattered throughout other places in the tropics but usually were not considered an important food. A great tribute to Lowell's pioneering work is that today countless thousands of additional moringa trees are now growing and being used as food and for the treatment and prevention of malnutrition.

Just before his death, Lowell was still working on the second edition of his book *The Miracle Tree*. We will let our readers know if we learn that this update of his book has been published.

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!