EDN ISSUE # 6 OCTOBER 1983

6-1. **PACHYRHIZUS EROSUS TUBERS MIGHT BE AN EXCELLENT CASH CROP FOR YOU TO CONSIDER** Of the many new food crops that we have tried at ECHO, I consider this the one above all that should be added to most Florida gardens. For many of you, it is already an important food crop, but others have never heard of it. This is a common trait of the "underexploited" food plants that are in our seed bank. Most of them are familiar to and liked by at least some of our readers. Very few are wild "weeds" that are being promoted for the first time as food. I will list some of the common names to help you decide whether you already know this plant: jicama (Mexico and the States), yam bean (not the African yam bean), ahipa (S. America), dolique tubereux or pais patate (French), fan-ko (Chinese), sankalu (India), or sinkamas (Philippines).

jicama is a leguminous vine grown for its edible tuber. The most unique feature of this tuber is that it remains crunchy after cooking. For that reason it can be used in any recipe that calls for water chestnuts. In a local supermarket we can buy water chestnuts for about $8 per pound. A 5 x 12 ft. raised bed could probably grow 25 pounds of jicama easily. It retails locally at 75 cents per pound. To the North American tastes of my wife and I, recipes lose nothing by making the substitution. We felt like rich folks during the jicama season (short days), adding jicama extravagantly to water chestnut recipes. It was even the hit of a fondue dinner that Bonnie served. Slices of the tuber are eaten raw in salads or with chili pepper and lemon juice.

The following paragraph is excerpted from the National Academy of Sciences book Tropical Legumes: Resources for the Future. Yam beans are among the most vigorous-growing legumes. They are coarse, hairy, climbing vines that can reach 5 m in length. Although they grow well in locations ranging from subtropical to tropical and dry to wet, for good yields they require a hot climate with moderate rainfall. They tolerate some drought but are sensitive to frost. When plants are propagated from seed, 5-9 warm months are needed to produce larger tubers, but propagating from small tubers greatly reduces the growing time (to as little as 3 months in Mexico). Flowers are sometimes plucked by hand, doubling the yield. [I found no difference in yield in a simple trial in which I picked flowers from half of a small plot. Tubers appear to form only as days become shorter.] Yields average 40-50 t per ha in Mexico's Bajio region. Experimental plots have yielded 80 or 90 t/ha. The tubers contain 3-5 times the protein of such root crops as cassava, potato, sweet potato and taro. However, the proportion of solids in fresh yam beans in only about half that of other tubers because of the high moisture content.

All of the above-ground parts of the plant contain the insecticide rotenone. I would not recommend eating the pods, although immature pods are reportedly eaten at a certain stage in the Philippines. A Wheaton college student is doing a literature search to determine to what extent the plant can be used as an insecticide. Perhaps we will have more to report to you on this. In the meantime, I would very much like to hear from you if you have experience with jicama in any of three areas. (1) Can the foliage be fed to rabbits, cattle, goats or other animals? (2) Do people use it for an insecticide and, if so, how do they prepare and apply it? (3) If there are special varieties that you think might be of interest to us and others and you would be willing to send us some seed to get started, let me know and I will send your plant import permit.

If you would like to try growing jicama and seed is not available in your country, write us for a small packet of free seed. Because of the potential for inadvertently introducing a disease, we do not wish to send seeds of any species if that species is already important in your area. Please consider this when making requests.

6-1. **TREATING AND STORING SEED** Here are some hints from ECHO's own experience with treating and storing seeds. Fruit tree seeds are often a special case which I will try to cover in a later issue. Many of our seeds can simply be thrashed or shelled and cleaned from debris by winnowing with the wind or a fan. In the case of hard-to-clean pulpy fruits, it is useful to break up the fruit then add water and ferment for perhaps 2 to 7 days before they are ever allowed to dry out. (Placing seeds in water for a few days after they are already dried would probably cause germination.) Examples of seeds that are fermented include tomato, egg plant, pumpkins and squashes. (Remember that the normal sequence in nature is for the fruit of such plants to rot before the seeds germinate.) My intern, Karen Ebey, just found an easy way to separate the tiny black seeds of lettuce from the fluffy material to which they are attached. She places the freshly harvested material in the bottom of a cup and stirs rather vigorously with fork. The seeds quickly settle to the bottom.

Seeds are treated in an antibiotic solution (10% bleach is good) for 2 minutes. This eliminates much of the bacteria or fungi from the seed surface. (Vinegar has some antibiotic action. If that is all you have available you might wish to experiment on a small scale to determine how much you could use without reducing viability. I do not know how effective this would be.) Seeds are then washed in clean water. Quite likely you will find that a small percent of the seeds float and the rest settle to the bottom. The floating seeds are less well developed and will be less likely to germinate. You will increase the overall percent of viable seeds by removing the floating ones. If all of the seeds float you will have to decide whether they were not yet ripe or whether that species of seed just happens to be less dense than most.

We treat the seeds with a combination fungicide/insecticide once they have dried to the point of just being moist (or even totally dry if you miss that point. Dry the seeds in the sun or with another system, making sure that the temperature does not exceed 130 F (54 C) for most seeds. The limit for trees and volatile oil seeds like onion, soybean and carob is 105 F (41 C). Then store the seeds in airtight containers with proper labels identifying the seed and date of harvest. Store in a cool, dry place if that is available. The humidity is the most critical factor.

The bean seed bank at CIAT in Colombia places dry seeds in a chamber containing a desiccant to reduce moisture below 10%. This has probably been achieved if the color indicator on the desiccant has not changed over a period of about 5 days with the seeds present. We have adapted this procedure, placing dried seeds in a small open container on top of some Drierite in the bottom of a large-mouth peanut butter jar with the lid tightly closed. We mix a small amount of the more expensive indicator with the inexpensive white Drierite. If the blue turns to pink in only a couple days, we replace the Drierite. Once it has remained blue for nearly a week we assume that moisture content of the seeds is below 10%. Sometimes we keep the bulk of the seeds in these filling requests. The extra moisture that these seeds will pick up in the refrigerator will probably do more to reduce viability than sitting in the very dry jars at room temperature. If you cannot purchase Drierite or other desiccant, Organic Gardening magazine says that you can use an equal volume of powdered milk (perhaps with a few crystals of indicator desiccant thrown in?). I have no idea how the relative water-holding capacities of powdered milk and Drierite compare. Desiccant (or milk) can be rejuvenated by heating for a time in an oven at a low temperature. You may be able to locate some kind of desiccant at a nearby medical clinic.

6-2. **A METHOD FOR MEASURING THE VIABILITY OF YOUR SEEDS** If you save your own seed, it is a good idea to check the viability of those seeds before planting time comes. If the percent that germinate is low, you will then know to plant a larger number of seeds. It is also very important to check the percent of germination of seeds that may have been given to your project by groups in the USA or other countries. These often are last year's seeds. Local farmers can be seriously hurt if they rely on those seeds when the critical planting time comes, only to find that they germinate poorly or not at all.

Here is the method that we use at ECHO. A representative sample of seeds are removed from the container. The sample size depends on how many seeds are available. The larger the sample, the more reliable will be the results. We soak the sample in 10% bleach for two minutes, then drain and rinse with water. The seeds are next distributed on a clean damp paper or cloth towel. This is then carefully rolled into a long cylinder and stored in a warm damp place. We have found that it works nicely to place the rolls in a tray which also contains a bowl of water. The tray and its contents are then enclosed in a plastic bag. Of course, direct sunlight must not strike the bag or it would overheat its contents. Another idea would be to place one end of the roll in a glass containing a small amount of water. Be sure to label each roll.

Record the number of seeds that have germinated each day (or two days or whatever period you choose). Remove those that have germinated and replace the roll until the next inspection. Remember that seeds vary widely in the amount of time it takes to germinate. Some may germinate in 3 days. other kinds may take 3 weeks. (Last week we had a plant ivory tree come up from a seed that we had planted 16 months earlier!) Finally, calculate the percent that have germinated.

6-3. **START A SMALL CANNING BUSINESS, SEALING IN METAL CANS, FOR UNDER $500?** Don Mansfield in Mali wrote that he knew of household businesses among Eskimos in Alaska in which fish were canned in tin cans. It is of course simpler to preserve food in glass jars. This is fine for home use where the jars can be recycled, but may make competition in the marketplace impossible. Don mentioned the Wisconsin Aluminum Foundry as the source of the equipment so we contacted them. You may well have a local source for such equipment, but we provide this information for those who do not. If you wish to follow up on this discussion, the address of the company is P.O. Box 246, Manitowoc,l Wisconsin 54220 USA (Attn: Philip Jacobs).

Mr. Philip Jacobs responded with helpful literature, but no details of small-scale operations in the third world. When asked, he said he knew that they were used that way, but would not disclose any specifics. Although they do not actively court such business, he will be happy to quote prices to any of our readers. They are willing to sell in units as small as one, but be sure to specify how many you are interested in purchasing. He will then send a pro-forma invoice. For some reason he will not supply price information to me, so you will have to request it individually. He did send a price sheet from one U. S. distributor which can give you an idea. But upon questioning, he said he thought these prices were quite high and he would not ask that much. I apologize for all the mystery.

Hand operated can sealers indeed cost less than I would have expected (and these are the "high" prices that he sent us). Their "Automatic Master Sealer" is listed at $193. It is equipped to seal can sizes 1,2,2 1/2, and 3 (half pint, pint, 30 ounce and quart). (The price includes equipment only for #2. It is not clear what that equipment is, but hopefully it is a rather inexpensive adaptor). Their "Senior automatic sealer" will seal sizes 10and 12 (4 and 5 quarts) as well as the smaller ones if you have the right equipment (adaptor?). It is listed at $664. They also have other models, some with motors. The company also has a line of aluminum pressure cookers with large capacity that appear to be heavy-duty equipment. They use a metal-to-metal seal. so you would not have problems replacing gaskets. You might wish to ask about those too, when you write.

Mr. Jacobs mentioned two free mimeographed bulletins that are exceptionally practical and thorough. "Home Preservation of Fishery Products" (22 pp.) and "Home Canning of Fishery Products" (44 pp.) are both available from the U. S. Dept. of the Interior, U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries, Washington, D. C. 20240. The former discusses preservation methods other than canning: corning, brine salting, dry salting, drying, smoking, pickling. The latter discusses canning with detailed discussions for specific fish and shellfish. For example, the author points out that if tin cans are to be used with fish or shellfish, the cans should be lined with "C" enamel, unless vinegar is added. The reason is that fish and shellfish liberate sulfide compounds when heated to high temperatures. This causes a discoloration of the inside of plain tin cans than can be transferred to the food. Because of thinner walls and greater ability to conduct heat, tin cans require a shorter cooking time than glass, and cool more rapidly. He lists two additional sources of hand-operated can sealers (Ives-Way Products, 820 Saratoga Lane, Buffalo Grove, IL 60090; Dixie Canner Equipment Company, Athens, Ga 30601). You might also wish to obtain "Home Canning of Meat and Poultry", Home and Garden Bulletin #106, free from the Office of Govt. and Public Affairs, U. S. Dept. of Agriculture, Washington, DC 20250. By the way, the latter says that plain tin cans should be used for canning meats, rather than C-enamel, R-enamel and sanitary-enamel. Fat in meat or poultry causes the enamel to peel off inside the can, making it appear unappetizing (though not harmful).

If you have had experience with small-scale commercial canneries I would appreciate hearing as many details as you have time to write. It is a subject of interest to many. I am interested in both technical details and a perspective on the potential of canning for small businesses based on your own experience.

6-3. **ROOF TOP GARDENS FOR URBAN AREAS** While standing on the roof of Grace Mountain Mission's orphanage (Beth Mayhood) in Haiti, I was struck by the enormous amount of prime "arable" land that is represented by flat roofs in a typical tropical city. The roof is 50 feet on each side and constructed of steel-reinforced concrete. Hundreds of such roofs are going unused throughout the city. The orphanage could grow most of its vegetables there. Farmers transplanted to the city might rent rooftops of apartment buildings and go into truck farming. The gardens might even keep the buildings cooler. The trick would be to find a way to garden without causing the roof to cave in. We have now been experimenting with such a system for a year. Although we do not have a finely-tuned system with all the bugs worked out of it, I believe it is time to share our success to date. Hopefully some of you will do some experimenting and we can combine our results.

<u>Initial experiments</u> We considered soil to be too heavy for most roof tops. Because we have an abundance of wood chips, courtesy of the electric company, most of our experiments have used fresh wood chips for the growing medium. Other possibilities might include sugar cane bagasse, rice hulls, peat moss, vermiculite, grass clippings, corn cobs etc. Well-rotted organic material would be ideal but, like most people, we do not have an abundance of such material available. Consequently, all nutrients must be provided by fertilizer or manure teas until a subsequent season when the medium has become sufficiently decomposed. Basically, we are using a highly simplified hydroponic system, the most sophisticated equipment being a watering can. Enough excess water is added each time to flush out a small amount of the fertilizer to prevent salt build-up (unless frequent rains do it for us).

Because I had always assumed that the major requirement for success in container gardening was a sufficiently deep pot, we chose a 3 ft deep bed on a cement slab for our first model. Some plants, especially watermelon and kale, grew vigorously. Others gave mixed results, with some showing marked nutrient deficiencies. We watered daily with a soluble fertilizer with micronutrients (Dr. Chatalier's, our cost about 90 cents for 130 gallons).

Greater success with shallow beds We then went to the opposite extreme and planted vegetables in beds that were only 2 1/2 to 3 inches deep. We constructed several that were 2 ft wide and 4 ft long with a solid bottom for experimental purposes (normal beds would be much larger). Some contained wood chips some wood chips covered with a layer of ground corn cobs, others a mix of peat, pearlite and vermiculite. To our surprise, these shallow beds performed much better than those that were 3 ft deep. Each one was watered with 2 gallons of water one day and 2 gallons of the soluble fertilizer the next. During the cool winter months we grew excellent onions, radishes, lettuce, peas, strawberries, potatoes and kale (in the finer peat mix, but not wood chips, we could grow good carrots. Carrots were distorted in wood chips).

Why do such shallow beds do better than deeper beds? The roots of any plant very quickly reach the bottom of the container (or roof top), at which point they encounter a layer of water. Plants growing in the 3 ft beds would not encounter this film of water until their roots grew 3 ft. We expected to find a carpet of dense roots at the bottom, as happens in nutrient film hydroponic growing. Instead, roots were distributed throughout the medium. This suggests that more than just the extra water is involved. We kept both the shallow and 3 ft beds moist and did not notice wilting of the leaves. My best guess is that the water that quickly drops to the bottom contains fertilizer at the original concentration that we added. Water that is held on the surfaces of the organic chips is quickly depleted by the growing microorganisms. Those plants whose roots reach the layer of water below obtain all needed nutrients. Their roots still grow throughout the medium, however, in response to the available water.

Our first garden on a roof We decided to build a structure with a flat roof for more realistic testing. Because we needed a shelter for our rabbits, we constructed a flat roof (12 x7 ft) and suspended rabbit cages below. Next we put sides 3 inches high around it and filled the area with wood chips and a thin layer of ground corn cobs. This is shown in the picture. (We used the corn cobs because we had found that seeds germinate better with such a layer than they do in wood chips alone, perhaps because it helps to keep the surface moist.) Before the initial planting, a garden fertilizer with micronutrients was mixed with the chips at the usual Florida rate of 6 pounds per 100 square feet (Florida "soil" is almost pure sand with very few nutrients, just like the wood chips). The 3 inches of wood chips are watered daily with soluble fertilizer included every other day. For summer crops we planted sweet potatoes, cow peas and peppers, all of which are doing well and showing no signs of nutrient deficiency. Essentially no heat buildup takes place under the roof. We have just completed the second such unit and are training the sweet potato vines across chicken wire stretched between them above head height for additional growing space and to further reduce temperature in the rabbitry.

Other applications These gardens are not limited to roof tops. They can be set up at the base of a tree to take advantage of the shade, for example. It would normally be difficult to garden so near a tree because of all the roots and competition for nutrients by the tree. We placed a 30 x 4 ft strip of thick plastic on the ground, starting at the base of a pine tree, put 3 inches of wood chips on top of the plastic and covered the wood chips with some peat mix to help retain surface moisture. (That was before we found that ground corn cobs do the same thing and cost nothing.) The kale and strawberries planted there grew exceptionally vigorously. Kale is a cold weather crop and would not be expected to even survive a Florida summer. Even though we have pretty much ignored this bed this summer the kale, which is in full shade right at the base of the pine tree, is healthy. Though it did not grow during the summer, it is now producing again as cooler weather arrives. Kale in the garden has long since died. Another use of this kind of bed would be in any situation where the ground could not easily be worked up, perhaps because of rocks or pavement or chemical contamination. By the way, with larger beds, there is no need to put sides on the roof top garden.

Don't we have to wait for the organic matter to decompose? We have all been taught not to mix uncomposted plant material with soil. The reason is that microorganisms that go to work breaking it down may use up all of the available nutrients in the soil solution. So it may sound foolish to try growing directly in uncomposted organic matter. The reason it works is that we add an excess of nutrients every couple days. If gravel were light enough to use, it would take less fertilizer and would work just as well. However, it is not as wasteful as it seems because the nutrients used by the microorganisms will become available again when their bodies in turn decompose. After one or two seasons the organic matter has become an excellent growing medium. In effect it has become compost. Presumably less fertilizer would be needed at this point. If you have compost that does not contain a lot of soil and is light enough it would, of course, be better to start with that.

But can the poor afford fertilizers? In some situations fertilizers with micronutrients are available locally. The cost of the inputs would need to be compared to the local price of vegetables to know whether that system would work. If enough compost (or at least some) were available to use for the roof top garden, little or no fertilizer might be needed. We have begun small-scale experiments with rabbit manure tea. We chose gravel for the first experiment because it would not use up the nutrients. Cowpeas planted in gravel covered with corn cobs and watered with manure tea performed about as well as those watered with fertilizer. The second experiment in which we grew green beans in wood chips during the hot part of the summer showed severe nutrient deficiency with the rabbit manure and nearly as severe with the fertilizer. Preliminary data suggest that more fertilizer is needed in the summer while the organic matter is decaying more rapidly. (Green beans are a good indicator crop for nutrient deficiency. Their rapid growth enables the experiment to be terminated within a couple months also.)

What is yet to be done? We have yet to try a roof top garden on the roof of a house or apartment or commercial building. We have not tried it in the third world. We do not know what unexpected technical problems may be encountered or how interested local villagers would be. We have not tried materials like sugar cane bagasse or rice hulls that may be more available to most of our readers (we do not have access to these). We do not know the minimum amount of fertilizer that is adequate for different media and plants. A lot more work needs to be done to determine how best to make and use manure teas.

Do you think that this has potential in urban areas in your country? Have you heard of similar gardens? If so, can you provide us technical information about them? Do you plan on trying a roof top garden, either on a roof or on the ground? If the answer to any of these questions is yes, please write us right away. We can then keep you informed of progress by ourselves or as reported by others.

6-6. **WORLD NEIGHBORS BOOK IS OUTSTANDING** I have had several occasions to recommend Two Ears of Corn: A Guide to People-Centered Agricultural Improvement since it came out in 1982. Those of you with minimal experience and reading in the area of community development could find it revolutionary. The rest will find it helpful, as well as a good introduction for those coming to work with you. If you have not read a book such as this I would put it in the must read category. The needs around you are too great to ignore them just because you are not an "expert". But there is great wisdom in learning what you can before moving ahead. We arranged for a copy to be sent to John Douglas in Zambia after he asked our comments on some interesting agricultural projects that he was beginning. He wrote back, "I don't think I have ever read anything that had such a practical grasp of both village problems and solutions. I can already see that the book will make a difference in the way we carry out our program."

The book is divided into 5 sections: (1) General orientation (2) Getting started (3) Choosing and using technology (4) Administration and (5) Expansion and Consolidation. Here are some selected chapter headings: The program goals; the program area; planning;start slowly,start small; limit the technology; choosing an appropriate technology; small-scale experimentation; teaching the technology; employees; supporting services; evaluation and phase-out; multiplying our efforts; building institutions;integrated programs. I especially appreciated the chapter on small-scale experimentation because this is at the heart of much that ECHO does. The author shows that is possible to find new and better methods or resources not only by your own experiments but by involving the farmers themselves in small-scale experimentation.

You can order the book for $7.50 each plus $5 airmail postage from World Neighbors, 5116 North Portland, Oklahoma City, OK 73112 USA. The price including surface postage is $7.95. Orders for 25 or more are $5.95 each plus postage. [UPDATE: The book is now also available in Spanish. It has become widely used on the field and in classrooms. The new price is $7.95 plus postage, which you will have to estimate.]