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APPROPRIATE TECHNOLOGY JUICE PASTEURIZER. The "tubular juice pasteurizer," as it is formally called, strikes me as an "appropriate technology" with unusual promise.

It is designed for situations where a large quantity of fruit is available for a limited period of time and for which there is no ready market or where marketing is not feasible because of difficulties in transporting the fruit to market. It also assumes a segment of the population would benefit either financially or nutritionally if it could produce an inexpensive pasteurized fruit drink.

It was developed in the late 1980's by Dr. Phil Crandall and colleagues while he was with the University of Florida's Lake Alfred Experiment Station. Dr. Crandall's team developed the pasteurizer specifically for difficult Third World situations. His criteria included: low cost, no moving parts, easy to build, easy to move, rugged, and provide agitation (for even heating). Heating is hard on quality, so an emphasis was placed on what he called HTST (high temperature short time). The result is a pasteurizer which can be carried by one person to the most remote site.

ECHO "sat" on this innovation for several years in hopes that the pasteurizer would become available commercially. It now appears that this will not happen. We had a volunteer, Dale Fritz, make four units for ECHO and are convinced that this simple device can be made in any country with no special tools or mechanical skills for a little over $100 counting accessories. So here are the details.

Pasteurization of fresh citrus juice requires a temperature of 90°C (194°F) for a few seconds. Calculations showed that an acid fruit juice could be pasteurized by passing it through a stainless steel coil of precise dimensions that was immersed in a container of boiling water. Dr. Crandall bent a 6 m (20 ft) length of stainless steel tubing into nine coils 19 cm (7.5 in) in diameter by wrapping by hand around a cylinder of the appropriate size (he said the cylinder could be something as simple as a log). The tubing used was grade 316 seamless, 9.5 mm outside diameter and 7.7 mm inside diameter. Inlet and

outlet tubes protruded 30 cm over the sides of the can and were connected to plastic tubes. The coil rested on a block of wood to prevent it from touching the bottom of the can.

The length of time the juice is in the coil is controlled by hydrostatic pressure. The inlet tube is attached via a tube (he used tygon) to a plastic funnel into which the juice is poured. The higher the funnel is placed the greater the pressure and so the faster the juice flows. In practice it is usually fastened about 1 meter above the coil. The temperature of the juice as it leaves the coil is periodically checked. If it is too low, the funnel is lowered to reduce the flow rate; if too high, it is raised.

Juice is collected in recycled bottles. Dr. Crandall used brown beer bottles, but soft drink bottles would

also work well. After attaching a cap, bottles are laid on their side for 3 minutes to sterilize the cap, then are cooled in running water (if available).

Dr. Crandall says that juice can be stored without refrigeration for some months. Pasteurization did not significantly decrease vitamin C content, but 3 months' storage at 21°C did, by about the amount that would be expected for pasteurized juice stored at that temperature. However, each bottle (375 ml) still contained over three times the US recommended daily allowance of 60 mg. Effects on color were similar. An instrument that measured the vacuum in the bottle showed that no fermentation had occurred after 3 months. Though there is no microbial degradation, chemical oxidation of canned or pasteurized foods still occurs. So the lower the storage temperature the better.

To keep the water boiling efficiently, construct a simple oven with loose bricks (see illustration). Dr. Crandall built it from used housing bricks to make a 40 cm diameter circle with an air draft in the front and out the top. An iron grate at 55 cm supported the fire and another at 75 cm supported the can.

A tasting panel of 21 experienced assessors graded juices from 1 (dislike extremely) to 9 (like extremely). The fresh orange juice was rated 7.2 (liked moderately); pasteurized 4.2 (disliked slightly). Dr. Crandall suggests this may be due to the panel's familiarity with commercial juice, which has flavoring oils added after heating.

I tasted the orange juice while visiting the Small Farm Resource Development Center in Belize (Christian Reformed World Relief Committee). Tom Post took me to a small store operated out of a home. If I recall correctly, the owner spent about 10¢ on juice and labor and sold the juice for 30¢, about half the price of a bottle of cola. I found the taste similar to other pasteurized orange juice, which is always a much different taste than fresh juice. The next season Tom took the pasteurizer to different communities which kept the bottles for their own use during the Christmas season. This was perhaps 3 years ago.

I called Tom for an update. He was assigned outside the country for some time and is now back. The pasteurizer is not being used. He cited three reasons. Belize is relatively well off for a Third World coun-
try; the cost of a drink is not prohibitive for most. So they are not that motivated to use the pasteurizer. "If I had been around promoting it, they would have been happy enough to use it. But their interest is not great enough to take the initiative in seeking it out." Also there are fewer oranges around than appears at first sight, especially when large quantities are picked for processing. Finally, the season of excess ripe fruit is extremely short there, only a couple weeks or so. The pasteurizer would have been much more successful if there was some juice available for processing at many other times of the year.

This brings up the subject of what other juice can be processed. About the only limit is that it must be an acidic juice (pH < 4.5; safer to say <4.0). This includes apple, some tomatoes, lemon, lime, passion fruit, cashew etc. Dr. Crandall only experimented with orange and apple juice and a drink similar to one liked in Nepal called "orange squash" (25% orange concentrate, 42.5% sugar and 32.5% water).

The apple juice only required a temperature of 80°C, so the height of the funnel was raised accordingly. The taste panel rating was essentially unchanged (7.0 and 6.7 for fresh and pasteurized juice respectively). The "orange squash" was not evaluated.

If someone was willing to do some "recipe developing," it should be possible to come up with some very tasty juices. Different fruits, mixtures of fruits, and adding sugar or flavorings could all be tried. Concentrates to be mixed with water or lemon juice and sugar by the consumer might be popular. If the juice is not quite acidic enough, it could be adjusted with a bit of lemon, lime or passion fruit. How about: Andes raspberry, guava/passion fruit, tamarind, grapefruit, soursop, red mombin, etc. etc.

Dale Fritz said it cost him $25 to make a coil (made from seamless stainless steel 3/8 inch od x 20 ft long, type 316 tubing). He checked out the current retail price of other accessories that would be needed. Input and outflow tubing $1.60; thermometer $11.90 - $19.95; bottle capper $29.95; bottle caps, 10 gross for $19.00; a potato ricer/fruit press, $8.99; funnels about $1.50. You would also need a 5 gallon metal bucket with lid, bottles, container for the extracted juice, a pitcher for pouring, a stick to support the funnel and material for the fire box. He points out that the USA and Canada use different sized beer bottles, so one must be sure the size of caps and bottle capper is right for the country. [Dr. Crandall has never found this to be a problem.] He said that both are readily available in stores that sell supplies to people who make their own beer (a source that will be unfamiliar to many of our readers).

I phoned Dr. Crandall to clarify some points. The interview follows.

Q. Your article states that orange juice was heated to 90°C and apple to 80°C. How do we know what temperature a juice will require?
A. I would just recommend that every juice be heated to 90°. The microbes in orange juice are probably killed at a lower temperature, but it must reach that temperature to inactivate an enzyme called pectin esterase. Have you noticed that a couple days after you extract fresh orange juice there is a clear layer on top and "crud" on the bottom? When this enzyme breaks down esters in the juice, some complex acids are formed. These combine with calcium to make something that at the molecular level might be described as a 'fish net,' which settles to the bottom. Apple juice does not have this enzyme, so it does not need the extra temperature. Solids still settle out in apple juice for a different reason. This is going to happen even with the most sophisticated equipment.

Q. What is the margin for error in temperature?
A. This depends on how great a content of microbial life is in the juice and on the pH. A target temperature of 90°C allows some margin for error. The pH (a measure of acidity) is really important. Below 4.5 clostridia spores will not germinate even if they are present. Over pH 4.5 one bottle could kill a person! You should have some pH test paper which turns different colors based on pH. With simple equipment, it might be well to shoot for a pH of 4.0 for an extra margin of safety.

Q. How is the pH lowered?
A. Just add lemon or lime or any other very sour juice. Be sure not to have acidic juices in contact with lead, aluminum or copper containers as the acid can react to produce toxic heavy metals compounds.

Q. At what pH is food too sour to enjoy? Give us a perspective.
A. Apple and pineapple juices are less than 4.5.

Tomato juice is borderline (caution!). Most citrus juice is about 3.5; lemons and limes are about 2.0.

Q. Are all citrus equally suited for pasteurizing?
A. The citrus that are easy to peel, like mandarins, make terrible juice. A chemical is formed (a lactone) that tastes like kerosene. That is why you almost never see pasteurized tangerine juice on the market. Use oranges that are difficult to peel.

Always run the raw juice through a strainer or colan-
der to remove larger particles, which might plug up the coil. We chose a small diameter coil because it makes the "ride" through the coil more turbulent for the juice. This assures that every bit of it is in con tact with the hot sides of the tube and reaches 90°C.

Q. Do you have any thoughts on mixtures of juices and flavorings?
A. Almost any culture will prefer a colored, sweet and acidic juice. Add some passion fruit for color, acid and flavor and sugar to make sweeter. For a first test, heat some juice in a pan on the stove, let it cool, then taste. If you like it, you will love it when pasteurized in the coil (which is a lot gentler treatment than heating in a pan).

Q. Where do you buy bottle caps in the Third World?
A. I recommend recycling bottle caps. You can simply flare out the sides on an appropriately sized rock, then cap it down tightly on the bottle with the bottle capper.

Q. Is there danger of using bottles in which chemical poisons have been stored?
A. Every bottle must be cleaned in hot, soapy water. After that if the human nose cannot detect a smell it is very unlikely that enough of something will be present to cause a serious health problem.

ECHO recommends that you purchase all the parts that you can in the country where you work. Dale is

putting together 4 complete kits for ECHO. One we will set up at ECHO (and demonstrate during our agricultural missions conference!) and one we are sending to Haiti where we are helping with a Small Farm Resource Center (at Bohoc near Pignon). We are willing to sell any extras to visitors.

MORE ABOUT THE UBERLANDIA CARROT THAT SETS SEED IN THE TROPICS. We first offered this carrot in the last issue. Dr. Warwick Kerr has provided more information.

"Carrots do not usually flower in the tropics. Eighty years ago a group of Portuguese growers planted carrots from Portugal and the Madeira Island in the southernmost state of Brazil. Some of these plants flowered and produced seed. Plant breeders from Sao Paulo and Brasilia independently collected seeds and developed varieties called 'tropics' and 'Brasilia.'

"I used these two in my work at the Federal Universities of Maranhao and, currently, of Uberlandia. For five generations I selected the best carrots using the following criteria: (1) size between 12-18 cm, (2) parallel sides, (3) red xylem, (4) resistance to local diseases, (5) late flowering, (6) no green on the top of the root. I call the resulting cultivar 'Uberlandia.' The vitamin A content (carotene) is between 9,000 and 11,000 I. U.

"It is advisable that people who grow the carrot in other areas carry out their own selection. Here is how to do it. After 90 days dig up all the carrots. Select the best 30 according to the above standards or standards of your own. Re-plant these carrots right away and allow to go to seed. The red xylem can be observed by cutting 3 cm of the inferior tip (narrow end) of the carrot. Discard if the xylem is yellow."

Dr. Kerr has made a great contribution to Third World gardeners. In the USA, much of the work done at universities is for a hybrid so that people will need to purchase seeds each year and money will be available to fund research programs. We need more breeders working on seeds for the poor.

There is clearly variability in the seeds, as the three carrots I tasted (second generation from original Uberlandia seed) had green tops and yellow xylem. We will begin our own selection program to adapt to our conditions, and encourage you to do the same.

FRUIT FLY TRAP MADE FROM BASIL. [The following is taken from a note in *Ileia Newsletter*, vol 9, # 3, p. 31. See EDN 42-6 for a review of this newsletter.] "In Keralea (southern India) fruit fly (*Dacus dorsalis* and *D. cucurbitae*) incidence is severe in mango trees. P. Reghunath and M. Indira describe a low-cost technology to combat this insect pest."

A fruit fly trap is prepared as follows. "20 g of *Ocimum sanctum* (holy basil) leaves are crushed and the extract together with the crushed leaves are placed inside a coconut shell, which is then filled with 100 ml water. To increase the keeping quality of the extract, 0.5 g citric acid is added and the extract is then poisoned by mixing 0.5 g carbofuran 3G. The traps are suspended from mango tree branches at a rate of 4 traps per tree. The fruit flies feed on the ocimum extract and are killed in a few minutes. In our trial, over a hundred flies per week were caught in this way.

"To successfully control pests we advise an integrated strategy. Set the traps in the trees at the above rate, as soon as fruit set begins and continue till harvest. Change the traps every week and set fresh traps. When the population of flies is heavy, give a spray with malathion 0.1% and sugar 2%. Collect and destroy attacked fruits that rot and drop down."

SUGGESTIONS TO HELP AGROFORESTERS REDUCE SEEDLING LOSSES FROM TERMITES. [Taken from *Agroforestry Today*, July-Sept. 1990 pp 4-6]. 1. Select trees that are resistant to termites. These include species of *Cassia, Acacia, Grevillea, Markhamia, and Terminalia*. 2. Use plant extracts and minerals as protectants. These include finely

chopped leaves of *Euphorbia tirucalli* or wood ash applied to planting holes; leaf or berry extracts of *Aloe graminicola, Melia azedarach [ED: China berry, a freeze tolerant relative of neem] , Lippia javanica* or *Ocimum* sp (basil).; and leaf mulches of *Cassia siamea* or *Azadirachta indica* (neem). 3. Plant extra seedlings, to allow for termite losses, both in the nursery and after planting out. 4. Use containers of polyethylene tubing. Pots made of banana fibre should not be used for seedlings where termites are a threat. It is of paramount importance at transplanting to remove the plastic sleeve carefully and retain an intact soil-root ball. 5. Use healthy and vigorous planting stock. Any root pruning should be scheduled to allow sufficient recovery and repair of damaged tissues before transplanting. 6. Give nursery stock enough water just before planting out. 7. Plant seedlings on time, soon after the first annual crops are sown or when the soil is wet to a depth of 20-30 cm. 8. Provide substitute sources of food for termites. This could involve leaving as much cleared plant debris as possible on the soil surface when preparing tree planting sites; using organic manure in planting holes whenever possible; ring weeding rather than clear-weeding stands of young seedlings; retaining grass residues as mulch in and around planting holes; and placing a row of cut banana pseudostems along nursery perimeters. 9. Apply spot treatments of a controlled-release granular formulation of carbosulfan (0.3 to 1.0 grams active ingredient per plant). Other non-persistent insecticides such as chlorpyrifos and carbofuran are not recommended due to severe phytotoxic effects.

Research is currently in progress on another, novel, approach to control of subterranean termites [which rely on fungi to make suitable food from decaying vegetation carried into the colony]. This approach is to apply fungicides to deprive them of their major food source by controlling these symbiotic fungi.

THE ROWER PUMP, WEST AFRICAN VERSION. Timothy Volk (Mennonite Central Committee in Nigeria) was prompted by the note on the Rus pump (EDN 41) to write about the rower pump that the MCC is successfully introducing in Nigeria. "The rower pump is rapidly gaining acceptance here, especially for dry season gardening. The current price for the pump is 500 Naira (US$12.50), compared to 10,000 Naira for a gas powered pump."

The name, "rower," comes from its mode of operation. A person sits on a log and "rows" back and forth to pump the water. "It is feasible to pump 60 liters per minute over long periods of time." Water can be lifted up to 6 meters.

The rower pump concept was developed in Bangladesh, where they are today mass produced and used primarily in irrigation. The West African version made design changes to lower its cost and simplify its construction. For example, in the Bengali version the piston and foot valve are made from machined aluminum and injection-molded polyethylene, while the corresponding parts in the West African pump are handmade from PVC plastic.

A detailed and well written 36 page book, *MCC West African Rower Pump*, is published by the Africa desk of the MCC. They donated a few copies for ECHO to distribute to interested members of our network. If you want it sent via airmail enclose postage ($2 in the Americas, $4 elsewhere). The rower pump appears to be more difficult to make than the Rus pump (EDN 41-1), but not too much of a challenge for a mechanically oriented person. In return for the extra work, the advantage is a higher volume of water and less effort.

CORRECTIONS

Dr. Folkard sends the following two corrections for our note "New Data on Moringa Seed to Purify Water" (EDN 43-2). The concentrations in the second paragraph should have been 50 mg/l and 75 mg/l. Also, the proteins responsible for the coagulating ability have a net *positive* charge, not negative.

UPCOMING EVENTS

ECHO's Agricultural Missions Conference Update November 8-10. (1) It looks like we will be able to keep costs below $200, including motel, board and registration. We are trying to reduce it further. (2) Delegates are encouraged to come early or stay late so you can get the Saturday night supersaver plane fare and make use of ECHO's library. We will have some housing for that. (3) "What if agriculture is not my primary responsibility?" That is true of the majority of people in our network. If you are interested, you will find the conference relevant. (4) "Do you have travel grants for Third World nationals?" That would be wonderful, but unfortunately we do not. Perhaps someone will provide such funds in other years. (5) The first keynote speaker will be early the first morning, so plan to arrive by the previous evening.

Sustainable Development for the World/Desarrollo Sostenible para el Mundo, July 9-22, 1994. This is a 14-day intensive course in the Mexican tropical highlands sponsored by Zopilote Association in collaboration with six Mexican rural development organizations. Cost: $950 plus travel to the site. Contact Ianto Evans, Zopilote Association; Box 123; Cottage Grove, OR 97424 USA. Phone 503/942-3021.

Axel Bosselman is planning to conduct a **workshop in dryland reclamation** during the last five days of July 1994. Write him for exact time. The cost will be $64 including food and, perhaps, housing through local churches.

The Society for Economic Botany will hold its annual meeting in Mexico City this summer (June 20-26), the first time outside the USA. In addition to contributed papers, there will be a symposium on "Collection and management of wild useful plants in Mexico." Two "sattelite" symposia will be on "Economic botany research in Mesoamerica" and "Advancement in the study and use of medicinal plants in Mexico." Registration before May 15 is US$100 for members and $120 nonmembers, $40 for students, special rates for Latin Americans. For more information write Lucille Kaplan; Dept. of Anthropology; Univ. of Massachusetts at Boston; Boston, MA 02125-3393. Phone 617/287-6846; FAX 617/287-6650. In Mexico contact Dr. Robert Bye; Jardin Botanico, Instituto de Biologia; Universidad Nacional Autonoma de Mexico; Apdo. Post. 70-614; 04510 Mexico, DF, Mexico. Phone (national area 915; international 525) 616-1297; FAX 622-9046. I will probably attend. Let me know if you are going, so we can be sure to meet.

Course on "Introduction to sustainable agricultural systems" at U. C. Davis campus. The University of California is offering this course (6 units, pass/fail grading, $504.) June 27-August 18, 1994. Lectures, laboratories and discussions are combined with three mornings of practical field experience each week and numerous field trips. Emphasis is on the biology and management of agroecosystems. The social, economic and political aspects of agriculture are also examined. I presume its orientation is on California agriculture. Contact Mark Van Horn, Student Experimental Farm, Dept. of Agronomy, Univ. of California, Davis, CA 95616. Phone 916/752-7645.

ECHOs FROM OUR NETWORK.

Two people wrote concerning **'Queensland' lettuce** (EDN 41-5) **Ken Turner in the Philippines** says "it was the best of 10 leaf lettuces tested, for ease of growing, durability and taste. I'm impressed. If leaf lettuce could just become an alternative here to head lettuce, this could be a winner. Head lettuce sells for $3 per kg in some months." **Victor Sanders in Haiti** wrote, "'Queensland' lettuce does very well here in Haiti (in the mountains of La Gonave). We are getting all the lettuce we need during the dry season. I am growing it [with your rooftop garden methods; EDN 30] but on top of the ground. This method is working well in that it greatly reduces water loss in the soil below."

Isabel Carter, editor of *Footsteps*, provided additional **details about using "power flour"** to convert

thick porridge into a sweeter, more runny food for infants (see EDN 42-2). The following is abstracted from the September 1992 issue *Footsteps*. "Grains can be germinated by leaving them in water for a day. [ED: they will not have spouted but the biochemical transformations involved in germination have begun]. During the sprouting process they develop high concentrations of amylase [the enzyme that converts starch to sugar]. "Soak cereal grains (maize, rice, millet) for up to one day in a covered pot or bucket. Legumes such as mung beans, haricot beans and cowpeas can also be germinated. They need longer soaking -- up to two days. Dry the grains well in the sun. If sorghum is the main cereal, this can also be used to make power flour, **but it must be allowed to act for a few minutes then the porridge must be cooked for a few additional minutes.** Mill as usual for ordinary grains." They recommend using either cereal grain flour alone or a mix of 1 part legume to 2-3 parts cereal. Power Flour is available commercially in Tanzania as "kimea" and in India as "ARF" (amylase-rich flour).

This issue also had some interesting comments about fermented foods. Fermented cereals "are widely used in Africa. Fermented legumes are often used in Indonesia and other Asian countries. The advantage ... is that naturally occurring bacteria [make the food acidic]. This improves the taste and also has the advantage that diarrhoea causing germs cannot grow so easily. ...Because of lack of time and fuel, mothers are usually not able to prepare fresh food throughout the day, especially for feeding young children who need several meals a day. In a recent study in Ghana, it was found that the number of diarrhoea causing organisms in food prepared using fermenta
tion was **less than half** that in food which had been prepared freshly then left lying around. The fermen tation process also breaks down some of the fiber in the food and increases iron absorption. [The traditional process lasts 48 hours, not enough to produce alcohol.] Why have people stopped using fermented food? A study in Kenya suggests that health workers feel that traditional fermented foods are not modern, and should be discouraged."

Footsteps is free to individuals working to promote health and development. Specify English, French or Spanish. Tear Fund, Footsteps, 100 Church Road, Teddington, Middx TW11 8QE, United Kingdom.

Tony Rinaudo in Niger wrote of his experience **using "zai holes," to harness termites to increase corn yields.** "Oxfam, working in Burkina Faso, promotes this method of tillage. This is a traditional practice of digging a 20x20 cm hole 10 cm deep during the dry season and filling it with mulch such as crop residue. This leads to increased termite activity which, in turn, increases the rate of water infiltration when the rains come. Millet is planted in the individual holes, which also help protect the seedlings from wind damage (100 km/hr winds at planting time are not uncommon).

"Where farmers are using it, it is making a big impact on crop yields. Soils here are infertile and if farmers have manure at all they just broadcast it on top of their fields. Much of this is baked, blown and washed away. If the manure and organic matter are placed in a zai hole, losses are minimized and nutrients are concentrated where the plant can use them. Crop plants have a competitive advantage over weeds that are not in the zai hole.

"Zai holes also allow greater water infiltration. The technique was originally used for hard pan soils which are uncultivatable using traditional farming methods. In our project we convinced one farmer to try zais on a small plot of barren land. He did and harvested 100 kgs of corn and 15 kgs of sorghum. The next year farmers in 20 villages dug over 50,000 zai holes! We urged farmers to also try zai holes in their sandy soils. The results were convincing enough that many are now digging holes without us telling them to.

"For some time we have been trying to re-establish cassava as a major crop in the district. There have been more failures than successes because of the harsh climate and poor soils. ...In 1993 we only received 1/3 - 1/4 of the average rainfall (130-240 mm of rain). In spite of this, because we insisted that farmers dig zai holes, 80% of the 44 ha planted survived. Even in good years we have never had such a

high success rate using traditional planting practices."

Tony adds, "Keep an eye on developments in the food use of Australian acacias. I believe these trees will be very important in semi-arid to arid subsistence agriculture in the future. Last year farmers here planted over 4,000 trees with a view to food production. They did this with no promise of food or money payments from us."

[Please note that different species of termites behave differently. So a technique you read about in EDN may not work where you live. Victor Sanders showed me termite nests high up in trees in Haiti. He tried painting the trunk with neem leaf tea, which was reported to stop termite damage in Mali (EDN 26-1). It had no effect in keeping this kind of termite from nesting in the tree.]

Joel Matthews, Niger. "In experimenting with direct seeding and transplanting seedlings, I have found that a trench with 'watering cups' greatly increased survivability of new seedlings in hot, dry sun scorched areas." In an area where Joel wanted to make a living fence, he dug a narrow trench about 8 inches (20 cm) deep. At spots where a tree was to be planted, he loosened the soil perhaps another 8 inches deep and made a slight depression for hand watering if needed. He calls these "watering cups."

"When preparing my living fence, I only did a portion as a trench; the others were in a slight depression. I direct seeded *Ziziphus mauritiaca* and *Z. spina christi* in mid May. After a 3 week moist period we had almost a full month without rain. The result -- 80% of the seedlings in the trench survived with periodic watering, whereas only 40% of the seedlings with watering cup only but no trench survived. My trial with no watering cups and no trench saw only about a 20% survival rate."

Benefits cited include: lower soil temperature, greater moisture retention, wind protection, protection from animals, overhead shading possible (e. g. by placing corn stalks over the trench), water catchment, and improved microclimate. [Might birds be less likely to dig up seeds or pull up young seedlings?]

Norman Siegel in Mexico asked about a **Neem Tree that does not bear seed.** They ended up with only one tree from the seed packet we sent. This can easily happen because neem seeds are only viable for perhaps a month. "We have been reproducing it by cuttings but it has not yet seeded." The problem may be that neem must be cross pollinated with an unrelated neem tree. We planted two neem trees at ECHO, about 200 meters apart. We waited in vain for fruit to set the first two years after they reached blooming age. The next year we had a small tree in a pot that was blooming, so positioned it on a small platform near one side of the larger tree. That year we had fruits in a circumference of a few feet around where that pot had sat. I have never read of this requirement, but in most real-life situations other trees would be nearby.

We planted a second tree beside our one tree. Last year it bloomed, and both trees produced fruit. We grafted this tree onto the more distant tree. The tiny grafts gave a few blossoms and I believe we got some fruit. Our Edible Landscape Nursery is preparing to sell neem trees with an unrelated graft so that home owners who only have room for one tree can get seed. A veneer graft takes well.

Neem seed remains viable for only a few weeks, so others in our network may have had only one tree survive. If so, and if no one else in your area has neem, write for another packet of seed. We will put your order on hold to be shipped either when our trees bear next fall or when someone brings us a fresh supply from another country.

Julio Prudencio Bohrt in Bolivia is seeking to establish a network of Latin American institutions who are interested in urban agriculture (gardens, hydroponics, small animal husbandry, etc). His interests are exchange of experiences, research, recommending policies for more effective governmental assistance, and better coordination of efforts. He has asked ECHO's help in making contact with interested parties.

His address is Casilla 6254, La Paz, Bolivia, tele-FAX 591-2-329-636.

BOOKS AND OTHER RESOURCES

SEVERAL AGRICULTURAL BOOKS IN SPANISH. Dr. Keith Andrews, director of the Panamerican School of Agriculture in Zamorano, Honduras, sent several of their agricultural books for ECHO's library. The books and their price appear below. (If you visit ECHO to make use of our library, and work in a Spanish-speaking country, ask us to make you a printout of the Spanish language books. Though we have fewer French books, we can also make a printout of those.)

This well-known school is oriented towards hands-
on, practical agriculture. After a guided tour by one of their students a couple years ago, I was envious of the practical experience their graduates receive. As I recall, students work half a day in the area they are currently studying. If animal science, then they may rotate through raising animals, butchering, making cheese, processing milk, etc. If horticulture, then caring for vegetables, harvesting fruit, selling in the fresh produce store, etc.

Here are the books: Cebolla, ajo y puerro (47 pp, $8.00); Cultivo de la soya (61 pp, $8.00); Guía práctica

para el manejo de malezas (222 pp, $18.00), Horticultura manual de practicas de campo ($10.00); Manejo integrado de plagas insectiles en la agricultura (623 pp, $30.00); Ordenes y familias de insectos de Centroamerica (179 pp, $10.00); Principios y practicas de mejoramiento de plantas (119 pp, $8.00); Produccion de cabras y ovejas en el trópico (174 pp, $15).

Other books, which I have not seen, which might be of interest: Caña de azúcar (104, $5.00); Guía práctica de cultivo de hortilizas (81, $12.00); Manual de laboratorio nutrición animal (110, $8.00); Manual de Lab. de introducción a suelos (81, $5.00); Microbiología ($15); Práctica de campo muestreo de nematodos (11, $3.00); Principios prácticos para la producción de cultivos (119, $10.00).

To order, write to the bookstore at Zamorano, P. O. Box 93, Tegucigalpa, Honduras, Central America.

Do you have a favorite book in French, Spanish, Creole or other language that might be of interest to our network? If so, we would welcome a one or two paragraph review and complete address (and price and ordering information if you happen to have it).

ECHO HAS ANOTHER EMAIL NUMBER (NOT AGAIN!). For some reason the internet email number we listed in the last issue no longer works. In the interest of having a more reliable system we have subscribed to Compuserve. Our new number is 74172.370@compuserve.com (note the use of a dot, not a comma, between the two parts of the number!). We will discontinue the much more expensive Sovam system number at the end of May.

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