

CHAPTER 2:

VEGETABLES AND SMALL FRUITS IN THE TROPICS

Vegetables and small fruits supply essential vitamins and minerals while adding variety and interest to the diet. Produce can also bring a high price in the market and provide additional household income. Vegetable use varies by region, culture, and social group. One of the first changes people make when they have more income is increasing the diversity in their diets, so you may observe more interest in vegetables and small fruits as families earn more.

Since vegetables and fruits are known to have a significant impact on health and nutrition, many people are interested in promoting their greater production and use. Many vegetables native to the tropics continue producing for months or years, and these treasures should not be overlooked in favor of temperate vegetables which must be continually replanted.

This chapter features resources, perspectives, and information on growing the many vegetables and fruits which have proven themselves under difficult conditions in the tropics.

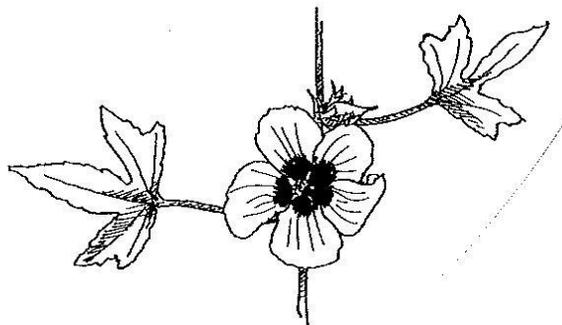
CHAPTER 2: VEGETABLES AND SMALL FRUITS

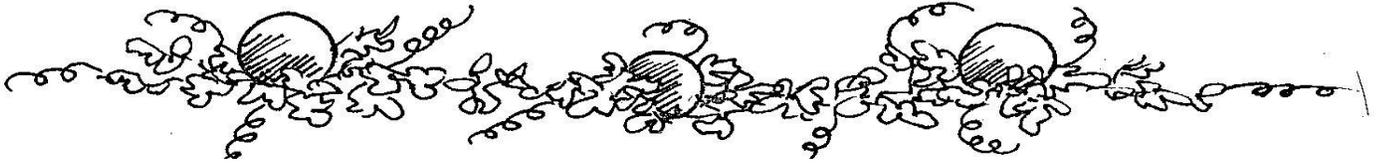
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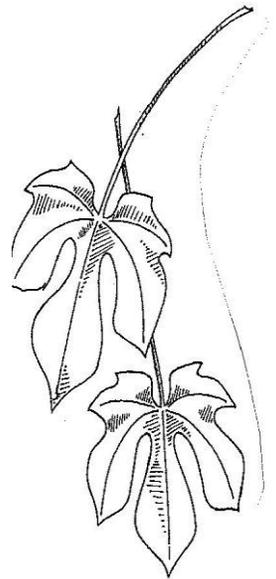
RESOURCES AND PERSPECTIVES

ECHO'S INVENTORY OF TROPICAL VEGETABLES. How many kinds of vegetables did God create? You can count the hundreds in this 157-page publication by Dr. Frank Martin, Victor Doku and Ruth Ruberté. Plants are considered in alphabetical order by family, with good indices for genus and common names. Within each family the "major" vegetables, if any, are described by a paragraph with standardized format, while the hundreds of minor vegetables receive only a single line (scientific and common names, type of growth, country of origin, plant part eaten, and whether cultivated or wild). The uses, and any poisonous properties, are noted when known. Thumbing through the book is the best way to find vegetables of a particular country. A very complete bibliography lists the most important sources of further information. Remember that this is an inventory, not a detailed description of everything you might want to know about the plants.

This may be the most complete listing of tropical vegetables ever developed. Because we did not consider the "market" large enough to pay printing costs, we have "published" it as a xeroxed copy in a binder. While most valuable in libraries, many will want a copy on their own desks. At US\$20 (\$15 for private voluntary organizations) plus postage it is a bargain considering the years of work that went into the book, and the difficulty of getting the information elsewhere. Available from ECHO.

EDIBLE LEAVES OF THE TROPICS (about 240 pp.) by Franklin W. Martin and Ruth M. Ruberté discusses the value of leaves in the diet and describes hundreds of edible leaves. Green leafy vegetables, common weeds, tropical trees, spices and teas, and temperate vegetables in the tropics are included. There is some information on toxic leaves and the culture of green-leaved vegetables. This book has been out of print since the early 1980s, but is in the process of being reprinted by ECHO. It will probably be available in late 1996. Write for details.

GROWING VEGETABLES IN FIJI AVAILABLE FROM ECHO. ECHO receives letters every month from individuals who did not grow up in the tropics, but who now find themselves called upon to do vegetable gardening under tropical conditions. Some have not had previous gardening experience in any climate. Now they may even be expected to teach the subject. Kirk Dahlgren authored this helpful, concise book while working as a Peace Corps director in Fiji. He discusses both tropical vegetables and techniques for growing temperate vegetables for which there may be considerable demand (and potential profit) in the tropics. We found it so useful both in teaching basic gardening techniques and in bridging the gap between temperate experience and tropical realities that we reprinted it. *Growing Vegetables in Fiji* costs US\$5 plus postage (\$2.25 N. Am.; \$3.50 S. Am.; \$5 elsewhere).



We find that people moving to the tropics make two opposite mistakes. One is to assume that in the tropics they will easily be able to grow the kind of vegetables they knew from temperate climates. The other is to assume too quickly that it cannot be done. While many temperate vegetables will not grow in most tropical locations, every so often we find someone succeeding with a vegetable we might have urged them not even to try. Experiments in your garden will cost little and may yield big rewards!

ECONOMIC PLANTS OF IMPORTANCE IN HAITI (44 pp.) is a very helpful book by Dr. Terry Berke. "When I was teaching at the American University in Les Cayes I often had only the Creole name of a plant. Once I had the scientific name I could usually find information about it in my reference books."

4 - Tropical Vegetables and Small Fruits

The book is not exactly a bilingual dictionary, but it can be used that way. A large table lists the names of a great many plants and the family to which they belong. Trees, vegetables, wild plants, and fruits are all listed. English, Creole and scientific names are alphabetized together. You then turn to the body of the book where each family is discussed. In that discussion the scientific, English and Creole names of the family members are listed along with a very brief discussion of each plant and its uses. This book was extremely helpful on a trip to Haiti. Often we were given the Creole name and had no idea what the plant was--until we checked it out in this book.

For easy reference to more common plants, the book includes one page of scientific names of common vegetables, followed by the English and Creole names. Another page does the same for fruit and multi-purpose trees. ECHO is publishing the book in-house as needed. The price is \$3.50 plus postage.

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 prices appear below. Write for ordering information to the bookstore at Zamorano, P.O. Box 93, Tegucigalpa, HONDURAS, Central America. (This well-known school is oriented towards hands-on, practical agriculture. After a guided tour by one of their students, 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 studying animal science, then they may rotate through raising animals, butchering, making cheese, processing milk, etc. If studying horticulture, then caring for vegetables, harvesting fruit, selling in the fresh produce store, etc.)

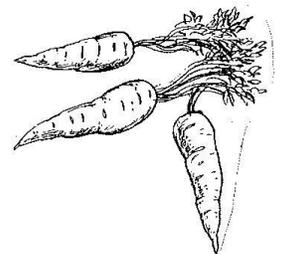
The books include: Cebolla, ajo y puerro (47 pp., \$8); Cultivo de la soya (61, \$8); Guía práctica para el manejo de malezas (222, \$18), Horticultura manual de prácticas de campo (180, \$10); Manejo integrado de plagas insectiles en la agricultura (623, \$30); Ordenes y familias de insectos de Centroamerica (179, \$10); Principios y prácticas de mejoramiento de plantas (119, \$8); Producción de cabras y ovejas en el trópico (174, \$15).

Other books, which I have not seen, which might be of interest: Caña de azúcar (104 pp., \$5); Guía práctica de cultivo de hortalizas (81, \$12); Manual de laboratorio nutrición animal (110, \$8); Manual de Laboratorio de introducción a suelos (81, \$5); Microbiología (\$15); Práctica de campo muestreo de nematodos (11, \$3); Principios prácticos para la producción de cultivos (119, \$10).

THE ASIAN VEGETABLE RESEARCH AND DEVELOPMENT CENTER conducts research, crop improvement, and offers seed for research and many publications on tropical vegetables. Write to Office of Publications and Communications, AVRDC, Box 42, Shanhua Tainan 741, Taiwan ROC; phone 8866 583 7801; fax 8866 583 0009; e-mail opc@netra.avrdc.org.tw; <http://www.avrdc.org.tw>.

"I WANT TO TEACH HOME VEGETABLE GARDENING" is one of the most frequent requests ECHO receives from people in the field. Small, bio-intensive household vegetable gardens can supply the vitamins and minerals often lacking in the diet of rural families. For this reason, most rural development groups have promoted home gardens at one time or another, and some have met with acceptance and enthusiasm.

Many more of these educational efforts, however, have been discontinued once the development staff have left the community. It is worthwhile to encourage people to grow and eat fresh fruits and vegetables, so promoting home gardens seems a simple and effective step in that direction. But the fact that gardening projects all around the world often fail to achieve permanence should make us especially cautious to launch such a program. Some guidelines are given below to help you evaluate the need for gardening education in your area and to identify some limitations to gardening.



If you are new to an area, your first step should be to observe the current growing practices *and diet* in the region. It could be that you see people growing vegetables for the market, but they do not eat them at home; in that case, simply growing more vegetables will not improve the diversity in their diets. Or it could be that you do not recognize gardening activities, but people eat many vegetables--for example, wild greens which they gather or perennial plants that are not obviously cultivated. If people are already gardening, you do not need to teach them, but it might be appropriate to examine more productive techniques or evaluate some new plants which could be added to their system. If they are not gardening, there is probably a whole complex of reasons why they are not, and it would be wise to consider the limiting factors before beginning a

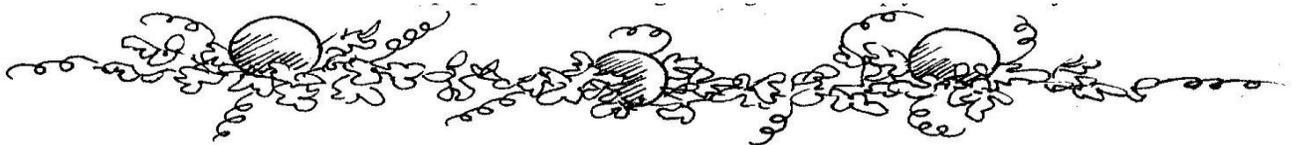
promotional program. As always, the goal should be discovering the most appropriate way to meet the needs in the community, rather than introducing any particular system. Keep in mind that a truly appropriate technique may spread by itself. My [LSM] observations from one area highlight a few reasons people may not garden.

In the Andean region of Ecuador, much effort has been poured into "teaching" various methods of vegetable gardening with little long-term adoption of the practice. Most people do not grow their own produce. The most common reasons farmers give include the following: seed supply is erratic and of varying quality (especially seeds distributed free often had poor germination), necessary vegetables could be easily and economically purchased in the market, lack of a regular water source for irrigation, lack of motivation to grow vegetables, difficulty of protecting the garden from free-ranging animals ("neighbors' chickens" are a serious problem), no market for their products, and dislike of vegetables. Pest problems are not reported as a serious limiting factor, and the Andean climate favors the production of a wide variety of vegetable crops.

The primary limitations to home gardening are related to food habits/values and farming systems. Vegetables have low priority in the Andean diet. For example, traditional Andean foods contain little if any vegetable portion: drinks are grain-based, and meat (cuy [guinea pig], beef, chicken, etc.) and starches (potato and many other native root/tuber crops) are often served without the complement of vegetables. A few green peas or carrots are tossed into the soup, onion is used to flavor meats and soups, some beets or radishes may top the rice, and hot peppers and tomatoes are used in hot sauce, but vegetables make few other appearances on the Andean table. As in much of Latin America--unlike tropical regions of Africa and Asia--leafy greens are viewed as animal food rather than important in human nutrition. People gather some wild greens to add to soups in times of food scarcity, but these foods have a poor reputation and they are not cultivated or preferred.

Chickens, and to a lesser extent other animals, are a primary reason that people are unable to grow vegetables. Chickens are rarely confined, and their scavenging of insects and scraps around the house makes important contributions at little cost. However, their scratching quickly destroys garden beds and seedlings, and the necessary fences may be too expensive or difficult for people to construct before they begin a garden. Some people said that for this reason, communal gardens met with greater success than individual gardens--only one tall fence had to be constructed to protect everyone's crops together. People who did have gardens were often ingenious in the construction of their fences--using a variety of materials such as scrap wood, old plastic, shrubs, etc. Another important factor to understand is the key role played by the animals raised around the home, especially cuyes and pigs. Some people fed their garden vegetables to their animals, so it was clear that animal production was more important to the families than eating the vegetables.

I occasionally noticed one house which had extensive vegetable plantings in an otherwise gardenless community. When asked how they had such a nice garden, the families' most common responses related to health or economic benefits. People who maintained gardens on their own knew about the nutritional value of the vegetables, often explaining some specific improvement in the health of their children, such as their teeth or energy level. Others noted the extra income from selling their vegetables. People who found a market and made money from their gardens tended to have large, well-tended gardens which produced continuously with irrigation. These benefits made gardening worthwhile, even for people who did not grow vegetables simply because they liked them.



VEGETABLES AND SMALL FRUITS IN THE TROPICS

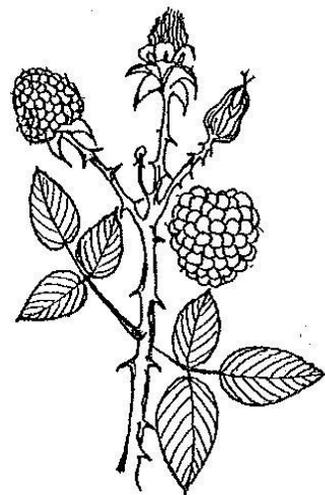
AMARANTH IS A DROUGHT-RESISTANT, FLAVORFUL GREEN. (Refer to page 75 for more information on amaranth seed.) Amaranths are cultivated worldwide as fast-growing, short-lived annuals. The leaves are high in calcium and iron. With their relatively high oxalic acid content, leaves should be boiled before eating. Some species can be weedy due to their high seed production, and leaf-eating caterpillars are a major pest. ECHO has many varieties of vegetable amaranths (mostly *Amaranthus tricolor*) which are favored for their leaves, although leaves of grain amaranths may also be eaten. We usually send two or three varieties when we receive a request, but if amaranth already grows in your area and you want to conduct a larger variety trial, specify that in your letter and we will send

more.

ANDEAN BLACKBERRY. One of my fondest memories from Victor Wynne's farm in Haiti (at 6,000 feet) is the juice made from this Andean berry (*Rubus glaucus*, mora de castilla). It thrives on his farm, bearing over a very long season. Victor says that it bears most of the year, although berries do not command a high price.

According to the book *Lost Crops of the Incas*, this blackberry is native from the southern highlands of Mexico to the northern Andes. It is widely cultivated in gardens in Ecuador and Colombia. "It is said to be superior in flavor and quality to most cultivated blackberries and raspberries. ...They are especially juicy and make excellent jam, which tastes like jam made from black raspberries."

This plant may be suitable for those working with peasant farmers at higher altitudes in the tropics. The plants are normally propagated by tip layers or stem pieces because they yield sooner, but they can also be started from seed. You must have the patience to baby the seed until it germinates. Victor says, "We kept our original seed continuously moist for at least two months before any seed germinated. Trays should be covered with some air-breathing transparent film to prevent drying out." They grow well on many kinds of soil. In well-tended plantings, annual yields are said to reach 20 tons per hectare.



ECHO does not have seed at present; we would like to receive some from our network in the Andean region.

BRAZILIAN SPINACH IS A GOOD SOURCE OF GREENS. Cory Thede in the Brazilian Amazon reports:

"Brazilian Spinach (*Alternanthera sissoo*, also Samba lettuce, sissoo spinach) forms a thick ground cover. It creeps and roots from nodes over a large area. It responds well to fertilizer. A pest (centipede?) eats holes in the leaves at certain times of the year, but this only damages the appearance a bit. Once planted, it can be maintained permanently, as a perennial. Propagate it by cuttings placed in the ground, with some shade (palm fronds for a week or two); it is very hardy, but keep it moist while rooting. It grows fast but is not invasive. Brazilians usually eat it raw in salads with oil/vinegar, tomato, and onion, although the literature recommends cooking it. This, together with lettuce and collards, are the most common greens in the area. In fact, it is better-liked than lettuce. Branches

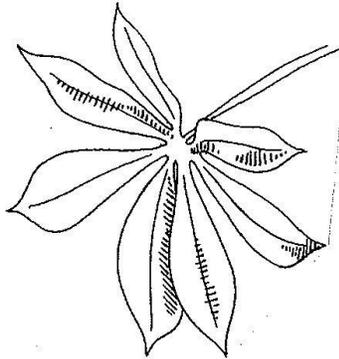


are sold in the market--pull leaves off the stems and eat the young vine tips." If you work in the humid tropics, ECHO can provide cuttings if you visit us in Florida or ship them to you just before you leave the States. The cuttings would not survive overseas mail.

BUSH OKRA FROM ECHO GREW WELL. HOW DO WE EAT IT? Klaus Prinz wrote from Thailand, "We could not figure out how to eat the small pods. They ripened quite fast, though, so that a lot of seed was collected." Bush okra is a misleading name. It is actually grown for its leaves, which are cooked and eaten. It is called bush okra because its seed pods look a lot like very small okra pods. The scientific name is *Corchorus olitorius*, also called jute mallow and Egyptian spinach. It is a major source of food from the Middle East to Tropical Africa. The fibers are used in twine, cloth and burlap bags. The better vegetable varieties are smaller and more branched than those selected especially for fiber, but all have edible leaves. A related species, *C. capsularis*, is the better known source of jute. The plants tolerate wide extremes of soil, are easy to grow and are resistant to drought and heat. Leaves may be dried for later use as a tea or cooked vegetable. They require little cooking. The leaves are mucilaginous (slimy), like okra, so may be offensive to some people. Plants reach over 3 feet (1 m) high and are about 20 inches (50 cm) in diameter. [The above information is from Frank Martin's *Edible Leaves of the Tropics*.] Want to give it a try? We have plenty of seed.

CASSAVA LEAVES. Cory Thede also mentions: "Brazilians also dry and powder cassava leaves and add them to foods--this is a very handy form of storage, especially for moms who don't want to leave the house to collect leaves during the cooking. Eating leaves is not too common a practice here, so maybe the powder disguises them well enough to be accepted, especially when used to enrich soups."

We asked David Kennedy with Leaf for Life for his perspective on using dried cassava leaves as a food, since cassava contains substances that produce hydrocyanic acid (HCN) when fresh leaves are eaten or pulverized. "HCN is a fairly common toxin in food. Cassava, lima beans, and sprouted sorghum have caused HCN poisonings. Acute HCN poisoning is quite rare. The minimum lethal dose is estimated at 0.5-3.5 mg per kg of body weight. So a child weighing 20 kg would need to consume between 10 and 70 mg of HCN. Ten grams of a low-HCN variety of dried cassava leaf would contain something like 0.08 mg. Chronic toxicity (also quite rare) has been reported mainly where there is a great dependence on cassava and a very low protein intake. Damage to the nervous system and especially the optic nerve can be caused by chronic exposure to HCN. Low consumption of proteins, especially sulfur-bearing amino acids, cigarette smoking, and air pollution all intensify the body's negative reaction to HCN.



"One would be tempted to steer clear of cassava leaves altogether to avoid any toxicity problems, except that the plant has several important attributes as a leaf crop, yielding large quantities of leaf that is high in dry matter, protein, and micronutrients...throughout the year in most locations. ...People are currently eating cassava leaves as a vegetable in much of Africa, and parts of Asia, and Latin America. I think the question is not *whether* to eat cassava leaves, but rather *how* to. Encouraging the use of low-HCN varieties is critical to this effort. A grinding technique that ruptures cell walls will dramatically increase the rate and total amount of HCN that disperses into the air. It is important that the leaves be ground when fresh, and quite well pulped, not just shredded. The loss of HCN is very

dramatic then during drying." He sent us a Ministry of Agriculture publication from Brazil which showed the following HCN content for one variety (Cigana) of cassava: fresh--737 ppm; flour from a leaf dried whole--123.89 ppm; flour from a shredded leaf--75.58 ppm; and 33.60 ppm when dried after thorough pulping. The potential nutritional benefits of using leaves of this common and productive crop is considerable. (For more on this topic, refer to page 265 in the Food Science chapter.)

CARROT EMERGENCE IN CLAY SOIL. (The following is taken from the July 1993 issue of *HortIdeas*.)

Researchers in Brazil "tested various techniques to boost the emergence rate of carrot seedlings in heavy clay soil. Shading the seed bed worked better than mulching with organic materials such as sawdust and straw; adding a layer of sand resulted in poorer emergence than with bare soil." The *HortIdeas* editors add that they have "had no complaints about our stands of carrots since we began, several years back, covering the rows with boards until a high percentage of the seedlings break through the soil surface."

HIGH-CAROTENE CARROT SEED AVAILABLE. Dr. C.E. Peterson wrote, "It is generally agreed that vitamin A is the third most serious nutritional deficiency in the world, following total calories and protein. It is estimated that in four Asian countries 250,000 children become totally blind and many more partially blind each year due to vitamin A deficiency. ... Standard varieties of carrots have 80-100 ppm. The USDA hybrid A Plus has over 150 ppm." The Beta III carrot (not a hybrid) is a "market carrot" with a carotene content of 180-320 ppm. To give an idea for how much is needed, he said that one pound of an experimental variety that has 560 ppm would provide enough vitamin A for an adult for a month. "By comparison, the levels in some vegetables are: tomato 0.5 ppm, Chinese cabbage 23 ppm, kale or mustard greens 18 ppm." ECHO has trial packets of the A Plus and Beta III; if they grow well for you, you may order seed in quantity from commercial sources. Seed for the A Plus carrot may be available in bulk from Asgrow Seed Company, 4420A Bankers Circle, Doraville, GA 30360, USA; phone 800/234-1056, and Park Seed Co., Cokesbury Rd., Greenwood, SC 29647, USA; phone 800/845-3366. Order the Beta III from Asgrow as well. (If you have difficulty locating Beta III seed, contact Mr. E. Hansen in Kalamazoo, MI, USA, at phone 616/384-5545; fax 616/384-5647.)

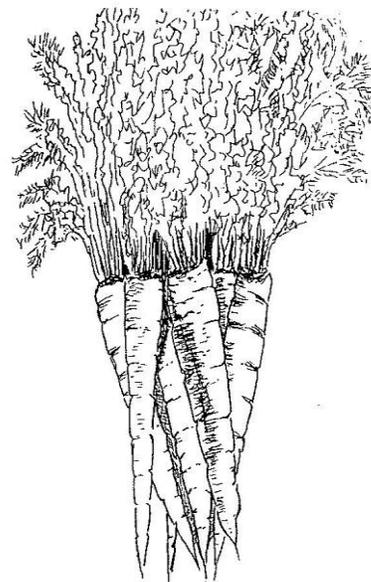
Dr. P.W. Simon with the USDA at the University of Wisconsin wrote, "Vitamin A is necessary for normal vision and eye health, mucous membrane and skin health and disease resistance. A U.S. nutrition survey indicated that 40% of Spanish Americans, 20% of blacks and 10% of whites suffer from vitamin A deficiency. [It can cause] night blindness, permanent blindness and even death."

In developing countries, 90% of the vitamin A is typically from plants. The body converts carotene from the plants into vitamin A. Excess consumption of vitamin A itself is toxic, but the body regulates the carotene-to-vitamin A

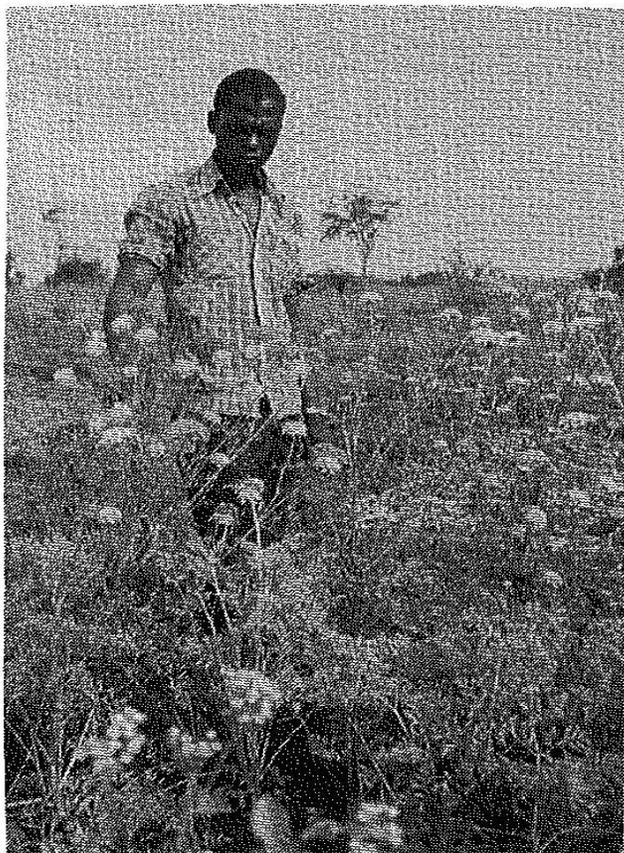
conversion so that toxic amounts of vitamin A are not produced, even when high amounts of carotene are consumed.

Here are some other interesting comments on carrots from Dr. Simon. Carrots tend to be less sweet if the nighttime temperatures are high, if light intensity is low and if there is a lot of organic matter in the soil. Store under refrigeration or delay the harvest. Do not store in a sealed plastic bag, since they need to "breathe" and will spoil. Do not store carrots near apples or pears, as the ethylene gas that these fruits emit will cause the carrots to become bitter. Carotene is relatively stable during processing--between 5-20% of it is lost when canned.

The Beta III carrot contains three times as much carotene as typical carrots. "To completely fulfill adult vitamin A needs with Beta III, 140 average sized roots (11 kg) would be required per person per year. This would require approximately one square meter of land." Dr. Simon says, "The major problem with the Beta III is its long thin 'imperator' shape, in contrast to the short broad roots grown everywhere else in the world but in the U.S.A." His present research is looking for the short, broad root shape and even higher carotene content. He is also looking into solving the difficult problem of carrot production in the lowland tropics. This brings us to another important topic: can you grow your own carrot seed?



UBERLANDIA CARROTS WILL SET SEED IN THE TROPICS. In the spring of 1992, William Tabeka wrote from Uganda. He wanted to grow carrots, but seed was not available. We sent information on the difficulties of producing carrot seed in the tropics. Carrots are biennials; they normally spend a winter dormant in the ground, then produce seed the second year. We also enclosed just a few seeds from a packet we had just received from Dr. Warwick Kerr in Brazil. He said that this carrot, called 'Uberlandia,' would set seed even in the tropics, and would do so in a single season.



Our interest in this carrot increased greatly when Mr. Tabeka sent us this picture of himself standing by what appeared to be carrots in full bloom. I wrote right away inquiring if that is indeed what I saw, and what he thought of the taste. He replied, "I assure you that the carrots really did put on seeds. The taste of the root is good and there is a difference, because that one which put on seeds has a root that is a bit longer than the others (some high carotene carrot seeds we had sent). There is no difference at all in the appearance of the seeds." A recent letter says he is now growing carrots from seeds that he harvested during the last rainy season.

We planted a few plots in the spring to produce seed for our seedbank. By early summer, they blossomed heavily and eventually produced seed. We need to work on timing to see if we can get seed during the dry season, as the heat and humidity of our rainy summers make it difficult to obtain high quality seed. Nonetheless, we can now offer our network seed with about 70% germination.

We allowed most plants to go to seed, so we have little information on size or taste of the roots (by the time seed was mature, the roots had shriveled up). I sampled two 3-inch carrots, trying them both raw and boiled. I prefer the varieties I am used to, but if they were the only carrots available, I would be glad to have them. In other trials, we found great variation in the plots, from commercial-sized, bright orange

carrots to small yellow roots. Someone familiar with plant breeding could do a great service to the small farmer.

Presumably a variety with superior qualities could be developed which would also still produce its own seed. ECHO has plenty of seed, and we continue to select better-quality carrots each year. If you try this seed, we will be VERY interested in your experience with and impressions of this carrot.

Dr. Kerr provided more information about these carrots. "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."

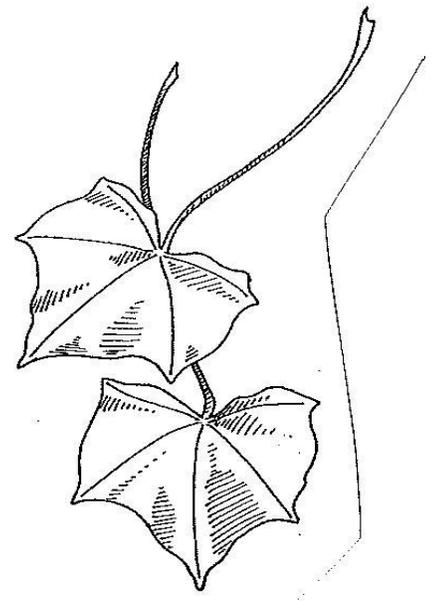
Dr. Kerr has made a great contribution to third world gardeners. In the USA, nearly all work by private industry and much of the work done at universities is for a hybrid so that people will need to purchase seeds each year and money will be available to fund research programs. We need more breeders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

CHAYA IS ONE OF THE MOST PRODUCTIVE LEAFY VEGETABLES AND AN INCREDIBLY RESISTANT PLANT. Chaya, *Cnidoscolus chayamansa*, is native to the drier parts of Central America and Mexico, where it is grown in dooryards, often as a hedge. Consequently it has been no surprise to find that it is very resistant to drought. Ross Clemenger planted some cuttings in northern Colombia after visiting us. The weather turned so dry that he had to sell a lot of cattle for lack of forage. The chaya, however, flourished. What has been surprising is that chaya is equally resistant to our terribly hot, humid, rainy summers. In fifteen years neither disease nor insects have been a problem. The only things that have harmed our chaya are freezes and standing water. It will come back from the ground after a freeze, but is killed by a few days of standing water. Plants can reach 10 feet (3 m) in height and about 5 feet (1.7 m) in diameter.

The young leaves are used to wrap tamales or are eaten with the thick terminal stems cooked as greens. They have a firmer texture than most greens I have eaten. If people in your area eat greens, I think they would likely develop a taste for chaya. For example, an American friend who married a Mexican woman has become quite fond of chaya, and says they like to serve it at least twice weekly. Another friend of Chinese descent is enthusiastic when we take her a bag of chaya leaves, even though it is not a plant she had in China.

Chaya is one of the most valuable green leafy vegetables. It was among the "underexploited" food plants popularized by the National Academy of Sciences. Leaves are reportedly high in protein, calcium, iron, carotene and A, C, and B vitamins. One consideration with chaya is that it should not be eaten raw. It contains cyanogenic glycosides, which can lead to cyanide poisoning. These are inactivated and released as a gas by frying or boiling for 5 minutes. (We discard the cooking water, but that is not essential.) Brief stir-frying is not adequate cooking.

If you work in Central America, you may have heard of *Chaya brava* in your area. The leaf petioles and stems of this variety contain tiny stinging hairs which make it necessary to wear gloves when harvesting the leaves. Some have brushed against the plant with their bare skin and were left with a red rash. Please note that **ECHO now has a non-stinging variety (*mansa*) available for distribution.** If stinging chaya grows in your region, it may be difficult to convince people to harvest and eat it. People who ordered chaya from ECHO



before 1990 received a variety with a few stinging hairs; if it was successful, you might want to order this one which is from Belize.

Chaya is easily propagated by cuttings. Though it is frequently in bloom, it almost never sets seed--a quality which nearly eliminates its weed potential. Fortunately, because it is so resistant to dry weather, we can get live cuttings to you. We did a simulated tropical mailing. Several packages of chaya cuttings, prepared in different ways, were left in our hot workshop during the summer to simulate delayed overseas delivery. They were then removed at 1-4 week intervals and planted. We had good results at up to three weeks, and some survived after four weeks. We sent a package to Asia which was received 10 days later. They trimmed the bottoms and placed the cuttings in fresh coconut milk. In half an hour the surviving small leaflets had regained turgidity. Several cuttings survived. (Some of the edible hibiscus cuttings also survived the trip, so perhaps we can begin sending those as well.) We sent some cuttings in a regular envelope to Dr. Warwick Kerr in Brazil. He now distributes cuttings in the local church and reports that his family eats them at least twice a week.

Arkhit Pradhan in India wrote, "Chaya is all over now from your original cuttings. It's in maybe thirty villages in the hills. People have found it will grow when other greens are not coming through with the rains--strange plant."

If you want to try chaya in your area and think a small airmail package can reach you in three weeks, we will send you a few cuttings. This will cost us a few dollars in postage, so please only order if you will promptly care for the cuttings. Water the soil moderately but do not keep overly wet while cuttings are starting.

Cory Thede in Santarem, Brazil, writes: "Chaya is iguana-proof! Leaves are within their reach, but they don't touch them. Though it is exceptionally productive in some parts of the world, it grew erratically here--I think a dry-season mite stunted its growth. I did not see much use being made of it in this area.

"Propagate chaya by OLD (grey, not green) thin stalks if they are to be transported, as these have less pith and weight. (For immediate planting, any part will do.) When it arrives, cut off any rotting parts but you probably do not need to make new cuts if it is healing well. Be sure to plant it right side up, so leaf scars look like smiles not frowns. The bud is above the leaf scar. Leaves are flavorful when cooked with ham, onion, salt, and pepper." [Ed: I prefer them with salt and vinegar.]

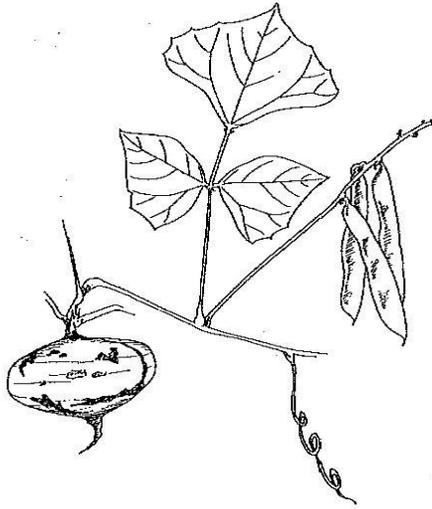
EGGPLANT PRUNING. Warwick Kerr, head of the biology department at the Universidad Federal do Maranhao in Brazil, prunes his eggplants and African eggplants. The second crop (the farmers call it the "second life") is 30% greater than the first in spite of the death of 10-15% of the plants after pruning. Here is how he does it. When each eggplant has produced 20-30 fruits and the plantation looks old, he cuts the plants at a height of 30 cm, then removes the cut branches from the garden as far as possible or burns them. Finally he applies chicken manure, his cheapest fertilizer, irrigates and sprays the stalks with insecticide and fungicide. All plants that happened to acquire a virus usually die upon pruning, so he collects his seed from the second crop.

GRAPES IN WARMER CLIMATES. The following excerpt on grapes is taken from an article by Rick Parkhurst in the *California Rare Fruit Growers* newsletter (1981 #2). "For a long time it has been known that the 'wound effect' can replace the cold requirement in grapes. This means that the plant is pruned very severely every year. In the tropics more than 90% of the previous season's growth is removed by pruning. This severe cutting back helps the plant to break the rest period. When the fruit is harvested the plant is pruned. In three or four weeks, new growth appears and in three or four months new fruits ripen. The grapes in the tropics give two regular crops each year. Once this principle was realized, grape-growing spread throughout India, Thailand and other tropical countries."

Some additional information comes from a one-page response to a question on grapes that I found in VITA's files called "Grape Vine Management in the Tropics." "Grape vine management in the tropics is a problem: vines tend to be short-lived, produce small crops, and require special care. Grapes like a period with temperatures below 0°C. Attempts in the tropics have not been very successful; plants continuously grow, produce clusters, rebud, remain evergreen, and eventually burn out. However, there are tricks that have been developed for use under **dry** tropical conditions to simulate a dormancy period. If the vine is forced into two growth cycles, one in the wet season and the other in the dry season, it will produce. By pruning at the beginning of the wet season, a growth cycle is initiated in which a small crop may result. Following this, the vine is pruned again to induce another cycle of growth. It is during the dry season that the main crop results in quality grapes. Irrigation is used in conjunction with pruning to assist the

plant during this cycle. (It is a very common practice to leave too much wood on the plants when pruning and this causes poor quality and premature burn-out of plants). In the dry warm climates of Peru, India and places in Brazil, [the dry season has] simulated a dormancy period." James Smith reports that he ate excellent grapes in the mountains of Cameroon. Grapes are now a commercial crop at a winery just a few miles from ECHO, where most years we have no freezing temperatures.

Muscadine grapes are native to Florida and do not require much cold. They grow as single berries rather than in bunches, and they are very resistant to pests and diseases. Most muscadines are eaten fresh. ECHO has fact sheets on muscadine grapes from the University of Florida for those who are interested.



JICAMA (*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: jícama (Mexico and the United States), yam bean (not the African yam bean), ahípa (S. America), dolique tubereux or pais patate (French), fan-ko (Chinese), sankalu (India), or sinkamas (Philippines).

Jícama 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 jícama easily. It retails locally at 75 cents per pound. To the North American tastes of my wife Bonnie and me, recipes lose nothing by making the substitution. We felt like rich folks during the jícama season, adding jícama extravagantly to water chestnut recipes. It was even the hit of a fondue dinner that we served. Slices of the tuber are eaten raw in salads or with chili pepper and lemon juice, or another dip.

Tuberous root development is initiated by short days. We have planted seed at several times of the year here at ECHO in SW Florida. Regardless of planting date, tubers were not formed until days became very short, around December. For this reason, it is unlikely that jícama can be grown commercially in the USA except in southern Florida and perhaps southern Texas. For maximum size the tubers were usually harvested in January and February. Vines planted in early spring were so vigorous by the time short days gave the signal to produce tubers that very large, distorted tubers burst from the ground. Tubers from seeds planted in May and June had the best combination of large size and good appearance. Seeds planted in August gave apple size tubers, though the taste and crispness were superior.

The following paragraph is excerpted from the National Academy of Sciences book *Tropical Legumes: Resources for the Future*. Jícama is among the most vigorous-growing legumes. It has coarse, hairy, climbing vines that can reach 5 m long. 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/ha in Mexico's Bajío 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 jícama is 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. Much of the above-ground portion of the plant can be used as an insecticide, although there are plants better suited to this preparation (such as *Tephrosia*).

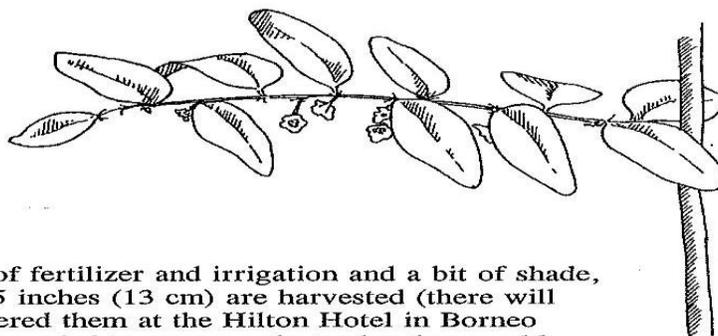
12 - Tropical Vegetables and Small Fruits

One report from scientists in Senegal suggests crushing 2 kg of mature seed into a fine powder and mixing with 400 liters of water. After one day, finely strain the mixture to remove all the seed matter, then apply to plants to protect from a variety of insect pests.

We would like to hear from you if you have experience with jícama in any of three areas. (1) Can the foliage be fed to rabbits, cattle, goats or other animals? (2) Do people use it as 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 can send us some seed to get started, let us know and we will send you a plant import permit. If you would like to try growing jícama and seed is not available in your country, write us for a small packet of free seed.

ETHIOPIAN KALE GIVES SEED IN THE TROPICS. Kale is the favorite green in my family, both for its taste, texture and nutrition. A drawback is that it does not set seed in the tropics. Dr. Warwick Kerr in Brazil sent us seed of the "Ethiopian kale" (*Brassica carinata*) which does produce seed. According to *Cornucopia*, "tender leaves and young stems, up to 12 inches high, can be eaten raw in salads. Older leaves and stems are cooked and served like collards or mustard. The inflorescence may be used as a broccoli-like vegetable. Seeds are the source of an edible oil." This kale has grown exceptionally at ECHO for years, and we have received many other positive reports on this hardy, productive plant from around the world. It grew so well in missionary Mark Vogan's gardens in Ecuador that he incorporated it into his rabbit feeding system and allows it to grow as a "weed" wherever it sprouts for this purpose.

KATUK (*Sauropus androgynus*) is one of the staple vegetables in Borneo, where it is sometimes grown as an edible hedge. It is one of our favorite summertime greens at ECHO. All greens, whether cooked or raw, are important nutritionally and can be tasty in various dishes. However, few are known especially for their unique taste. Katuk is delicious; after chewing a raw leaf or stem tip a few times you can notice a pea-like or nutty flavor. The leaves can be quickly stripped from the stem by pulling it between your fingers. Tender tips, leaves, flowers, and small fruits are eaten.



y of fertilizer and irrigation and a bit of shade, the top 5 inches (13 cm) are harvested (there will be discarded them at the Hilton Hotel in Borneo to ensure only tender tips would

There is another use for katuk in Borneo. By using plenty of fertilizer and irrigation and a bit of shade, they are able to make the tips grow very quickly. The top 5 inches (13 cm) are harvested (there will be only few leaves) and sold to the finest restaurants. I ordered them at the Hilton Hotel in Borneo then watched as they were cooked. The bottom inch was discarded to ensure only tender tips would be prepared and the remaining 4 inches were cut in two. These were then stir fried for perhaps 60 seconds. They can be eaten raw as well. Malaysian Borneo hopes to export these to Japan as "tropical asparagus." (Of course, it is not really asparagus). A delegate at our Agricultural Missions Conference reported that katuk tips are now being grown and marketed in Hawaii.

Katuk is native to the lowland rain forest understory and prefers a hot, humid climate. It will grow in shade or full sun, and it tolerates occasional flooding and acidic soils. Under ideal conditions, it can grow up to 1.5 m per month. However, stem diameter does not grow apace with length and it soon gets so tall that it falls over, earning its description in *Edible Leaves of the Tropics* as "an awkward plant." In cultivation, it must be regularly trimmed for optimal production of new shoots. Be sure to keep it pruned to between 3-6 feet (1-2 m) high.

Plant about 2-3 feet apart in full sun or partial shade. Because they use shade cloth in Borneo for producing tender tips, I grow it under the eaves on the north end of my house. An additional benefit here is that plenty of water will fall on the plants from the roof even after a light rain and it will get only filtered light. Some people recommend katuk for alley cropping systems with nitrogen-fixing trees. We have had no disease or insect problems at ECHO, although slugs are reportedly a problem among new cuttings or seedlings in some areas. Katuk will produce abundantly throughout the warm months. During the coldest 2-3 months of winter at ECHO, plants may appear a bit sickly, stop growing, and be less tasty until new growth resumes with warm weather.

Katuk is easily propagated by moderately woody cuttings (20-30 cm long, with at least two nodes), though they can be

slow to establish. If you visit ECHO on your way to the field, you can pick up some cuttings. During short days, there will be a lot of small blossoms underneath the stem, which can be stripped right along with the leaves and cooked. Our katuk, vegetatively propagated for some time, flowered but did not produce seed until we acquired plants from a different source (when they produced seed immediately); it is *possible* that separate plants are required for seed production or some varieties are selected for or against seed production. ECHO seedbank intern Jim Richard collected seed in December and allowed it to air dry until it was planted in January. It germinated in about 3 months. Since 1996 was the first year we successfully grew katuk from seed, we cannot guarantee that we will be able to distribute it from our seedbank, but if you are willing to wait you can request seed from ECHO and we will put your name on a waiting list until seeds are ready in January.

According to Cory Thede in Brazil, "Katuk and false roselle (*Hibiscus acetosella*) are easy to start from cuttings of any part of the plant, old or new growth (even in the dry season). Strip off most leaves and put the cutting directly into the ground under partial shade. They are survivors and palatable to most people. The false roselle was especially popular because of the red-purple color and sour, tangy flavor. Katuk is a light producer of greens compared to others I grew." [ECHO also has seed of false roselle.]

KIWIFRUIT (*ACTINIDIA DELICIOSA*) IN THE TROPICS. I have always discouraged people who wrote from the tropics asking where they could obtain plants of this New Zealand vining fruit. It is definitely not a tropical fruit. For example, the newsletter of the Rare Fruit Council International in Florida in 1987 says that kiwi has been tried all over Florida and has never been successful. (The plants grow well, but do not fruit.) So I assumed that it would be even more difficult in the tropics.

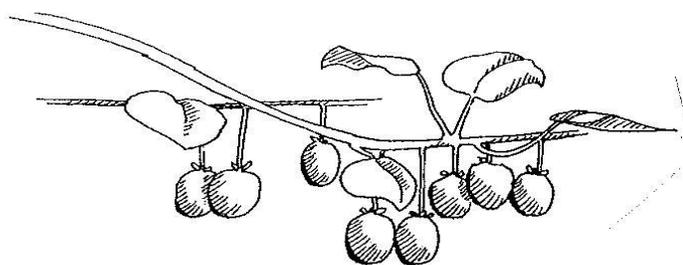
A few years ago I toured the farm of my friend Victor Wynne, at just over 2000 meters in Haiti. To my surprise there were vigorous kiwifruit vines and, hanging under them, were several kiwifruit. That does not mean you should all rush off your orders for kiwi plants. First of all, he planted them in 1983 (variety 'Abbott') and later almost tore them out when they never bore. In 1988, he got a few fruit. Though there were several more fruit after the sixth year, it was not at all clear if there was any commercial potential. That will all depend upon how heavily and reliably they bear.

There is a fantastic annual networking newsletter to promote cooperation and communication among kiwifruit enthusiasts, called the *Kiwifruit Enthusiasts Journal*. Each issue is like a large magazine, the 1993 issue (#6) having 193 pages. It is a grassroots newsletter, with over 100 people from 12 countries contributing to one issue we saw. Advertisements provide sources for the plants. They do not take subscriptions because its publication frequency depends on who volunteers to help. For the next issue or a back issue send US\$14.95 plus shipping (\$2.25 in USA; \$3.75 overseas surface; \$11.25 airmail) to Friends of the Trees, P.O. Box 4469, Bellingham, WA 98227, USA; tel/fax 360/738-4972; e-mail trees@pacifirim.net; <http://www.pacifirim.net/~trees>.

Much of the work seems to be toward extending the range in which kiwifruit can be grown, especially looking for cold-hardiness. To help you evaluate the chances in your area, here are the countries where commercial plantings exist, according to the *Enthusiasts* newsletter: New Zealand (half of all production), California in the USA, France, Italy, Japan, Israel, Chile, Greece, Yugoslavia, Hungary, Korea, Australia, Spain, and British Columbia in Canada. The newsletter says the coming rage will be smooth-skinned kiwifruit and colored kiwifruit (red, yellow and purple skinned).

Michael Pilarski, editor of the kiwifruit journal, sent us this summary on varieties: "Kiwifruit can be grown in the tropics and subtropics in high elevation areas which receive winter cold periods. The 'Hayward' variety most often seen in the marketplace is one of the poorest choices. The best varieties for low chill areas identified to date by the KEJ network are 'Elmwood' (large-fruited, early bearing); 'Vincent'; 'Dexter' (from Australia); and 'Koryoku' (from Japan). Even more likely of success are the species: *Actinidia chinensis* (large-fruited, smooth-skinned and sweeter than *A. deliciosa*) and *A. melanandra* (small-fruited, red, sweet fruit)." He is probably the best contact on the subject (see above for Friends of the Trees address).

Kiwifruit is no longer the "get rich quick" crop it once was; it is "over-planted" and prices are dropping on the international market. Some recent plantings made with the help of high-interest loans are going bankrupt. If your country does not produce kiwifruit and your region has just the right microclimate so that you have any chance of producing, kiwifruit might be a long shot for a high-value home market. It is not for most of our network and I would



not even think of participating in the export market from a country marginally suited to the crop. If you do try kiwifruit, be sure to let us and Michael Pilarski know the results.

Dr. Campbell gave the following comments in our video tape series on tropical fruits. Kiwifruit is a fruit of warm temperate climates, not of the cooler subtropics. It needs substantial cooling hours (around 45°F/7°C or cooler). Temperatures in the 50s (°F) may have the same effect, but in many more hours. To make matters worse, periods of hot weather during the "cool season" can counteract some of the effect of cool days. When the bearing season arrives, it is important that nighttime temperatures not be too high. (That is presumably why kiwifruit are not a commercial crop in the southeastern part of the United States.) In subtropical mountains suitable conditions might be found, but he speculated that the frequent cloud cover might reduce performance.

Here are some other interesting tidbits from the *Enthusiast*. Kiwifruit is especially nutritious because the seeds are eaten. (It is technically a "berry.") A five-ounce kiwifruit has more potassium (450 mg) than a six-inch banana (370 mg). It has almost twice the vitamin C of a medium orange. Avocado is one of the few fruits with a lot of vitamin E; kiwifruit has twice that amount. The skin does not need to be removed (and contains many of the fruit's nutrients). Just scrub off the fuzz with a vegetable brush. In cooked foods, the fuzz virtually disappears and the skin adds a tang and chewable substance not unlike citrus peel. "When pureeing kiwifruit it is important not to over-blend. If the tiny black seeds are crushed, they will turn the drink or soup bitter."

TROPICAL LETTUCE. Dr. Frank Martin gave us our initial start on a tropical lettuce, *Lactuca indica*, also called Indian lettuce. This has grown well in both the hot, wet summer and the colder winter of southern Florida. During the summer it grows to about 8 feet (2.5 m) high. Winter size is about half that. The rather large leaves can be eaten raw or cooked. According to Dr. Martin's book *Edible Leaves of the Tropics*, it is commonly grown in the Orient, mainly cooked as greens, but it can be eaten raw. We have found it to be quite disease and insect resistant. It is more bitter than the popular lettuces of temperate regions, though after the first bite the bitterness is little noticed. After cooking or when served with vinegar the bitterness is not present. Some local friends have become quite excited about it. Bonnie and I use it as a lettuce only when the weather is too hot for regular lettuce, but it fills a real void during those hot periods. It is good cooked by itself or mixed with other edible leaves at any time. If you are in a region where lettuce does not grow well, write for a free packet of seed. We will be interested to see how it does in different areas. It might even be a good lettuce for a rain forest.

LETTUCE (*LACTUCA SATIVA*) VARIETIES SUITED FOR HOT AREAS. Montello. Our readers in the warm lowlands probably have a problem growing lettuce. I attended the combined annual meeting of the Caribbean Food Crops Society and the tropical region of the American Society of Horticultural Sciences in Trinidad. One of the field trips was to visit a commercial lettuce operation. They were growing very nice lettuce for the hotel and other markets, even though the location appeared to be near sea level. The variety was 'Montello.' The plants were under shade cloth in long narrow bags filled with artificial potting mix and carefully watered. They looked beautiful, though I did not get to open up a head. They may not be as tightly packed as iceberg lettuce grown in a temperate region, but the quality is apparently quite acceptable. It has large, dark green heads and reportedly ships well. Timing is crucial because the plants do go on to bolt. We saw one bolted planting that had apparently matured when the market could not take them all. Rhine Fecho, who has started an Episcopalian agricultural school in Haiti, told me that he was growing this same variety in full sun, in soil, in August near sea level.

ECHO has purchased 'Montello' lettuce seed and will send a small trial packet to our overseas readers who wish to try it. You should be able to increase your own seed (or purchase in bulk from Twilley Seeds, P.O. Box 65, Trevoze, PA 19053-0065, USA). Bend seed heads into bags and shake off the mature seed. We have found that the fluff can be removed from the seed by placing it in a jar and stirring vigorously with a fork. Alternatively, harvest plants when 30-50% of the seeds show white fluff and dry for a few days. Seed can be stored in airtight containers in the tropics for 6 months if dried to 8-10% moisture. (One way to get seeds this dry is to leave them in a closed container with excess desiccant and keep replacing the desiccant with fresh until it remains dry. This is seen easily if you have a small amount of desiccant that turns color when wet. Lacking the indicator, you will have to use your judgment.) In a

cool dry place (refrigerator) it can be stored 6 years.

Roy Danforth wrote from Zaire that the Montello lettuce "is superb. It heads very nicely and is not bitter. It is similar to the iceberg variety. It heads after it has produced a good salad bowl's worth of leaves and produces a lot of good viable seed, which I've started spreading around everywhere." Roy works 3 degrees north of the equator. In our own summer gardens we find it difficult to grow. We have free trial seed packets for third world workers (U.S. readers should request our seed sales list).

Queensland. Pat and Connie Lahr gave us a packet of seed for this lettuce after a visit to Australia. Pat believes it is grown primarily by an association of organic market gardeners. As far as he knows seed is not sold commercially. It is a big leaf lettuce that appears to be exceptionally resistant to bolting. Leaves are large, somewhat resembling a cos-type lettuce, with an attractive yellowish hue. In Australia they say it produces 8 weeks in summer, up to 14 weeks in winter and that it is best to use lower leaves.

My main interest is their apparent resistance to heat. We have not done carefully controlled experiments, but 'Queensland' appears to outlast most of our lettuce varieties when the warm season arrives. Each time we grow it I wonder, "Is this ever going to bolt so we can save seed?" (A key to preventing bolting is to make sure the plants are never water stressed. It might well be that they would bolt quickly if we did not have irrigation.) ECHO produces a small quantity of seed for our network. Be sure to save your own seed if it does well.

Several people wrote concerning their results with 'Queensland' lettuce. 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 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] but on top of the ground. This method is working well in that it greatly reduces water loss in the soil below."

Maioba is Brazilian in origin, noted as high in vitamin A and resistant to acidic soils. Available from ECHO.

Anuenu is bred for resistance to tip-burning and heading under warm growing conditions. You may purchase it in bulk from the University of Hawaii (Seed Program, Department of Horticulture, 3190 Maile Way, Room 112, Honolulu, HI 96822, USA; they only ship to US addresses; phone 808/956-7890).

LUFFA GOURD (*Luffa acutangula*--angled and *L. cylindrica*--smooth; preferred for sponges) is well known in temperate countries for producing "sponges." The plant prefers hot growing seasons and is a productive vegetable in the tropics. Young fruits can be eaten raw or cooked. In Asia, the young leaves, flowers, flower buds, and roasted seeds are all eaten. Immature fruits may be harvested about 2 months after planting, while the mature fruits used for "sponges" require 4-5 months. Submerge mature fruits in water for a week so the fruit disintegrates, then wash and dry the fibers, bleaching with hydrogen peroxide before drying if desired.

MALABAR SPINACH (*Basella alba*, *B. rubra*) is a very succulent vine grown throughout the tropics for the young leaves and stems, often used as a potherb. The flavor is mild, and the leaves are somewhat mucilaginous when cooked. They can also be eaten raw. It is tolerant of many soil types. Plant seeds or vine cuttings to establish the plants, and harvest regularly. This is a productive, low-maintenance perennial with few pest problems, although nematode damage is so severe at ECHO that it only thrives in soils high in organic matter.

MORINGA REPORT. Cory Thede in Santarem, Brazil, wrote: "We have a marked dry season of 5 months or so. Moringa (*M. oleifera*) did well in the city but didn't grow well in infertile rural soils. Maybe calcium from the cement, and possibly other nutrients that accumulate in the city, made the difference. Iguanas are a serious garden pest in the area, and they like it...they try to climb even a young plant to eat the leaves, but it is fragile and they knock it over. The young leaves are easy to prepare for cooking; avoid the tough stems of the older leaves. A moringa hedgerow is a convenient way to assure a steady supply of young leaves." This is a very important, drought-resistant vegetable tree. Be sure to see the chapter on Multipurpose Trees for much more information on moringa.

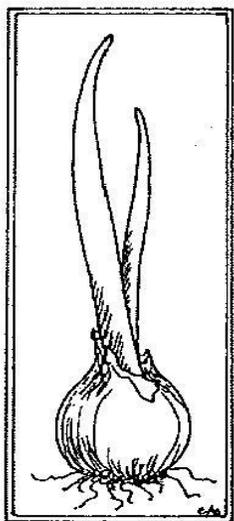
NEW ZEALAND SPINACH GROWING HINTS from James Gordley in Panama. "I am having great results with New Zealand spinach, *Tetragonia tetragonioides*. [Ed: This is a popular spinach substitute in hot parts of the USA.

Because most seed catalogs carry the seed, ECHO does not. One seed source is Burpee, Warminster, PA 18974, USA.] By tying it up on chicken wire it takes very little space and the leaves are kept off of the ground. Before using the wire I had trouble with mold growing on the underside of the leaves. Not anymore. I also find it helpful to use a straw mulch around the plants, especially during hard tropical rain storms, to keep the leaves from being splashed with mud. The muddy leaves also become diseased. With the mulch and wire, neither are problems. I harvest the leaves and allow the stalk to remain on the wire. Within days new leaves have grown out and one cannot see where the leaves were removed. We clean the leaves then soak for three minutes in a solution of 1 tablespoon of 3% hydrogen peroxide in 1 quart of water. There is no aftertaste from the peroxide."

"OKINAWA 'PURPLE' SPINACH (*Gynura crepioides*) looks similar to a local Brazilian weed--both are purple under the leaves, but the weed has an upright growth habit and is an annual. The cultivated type, which may be a selected weed, is perennial, branching, and tends to fall over, making a bush. It grows very well and is pest-free. It has a tasty, pine-like flavor and did well in poor soils. Mix it with other vegetables; the unique flavor may be too strong on its own." Cory Thede reports this success from Santarem, Brazil. Cuttings available at ECHO.



AFRICAN OKRA VARIETY IN ECHO'S SEEDBANK continues to produce when days are short, unlike many okras. The pods are edible to a fairly large size. This variety was much sought after by Haitians when they saw it in full leaf and producing in the Central Plateau in August, when their other okras had died. If okra is already grown in your area, this one may be well worth a trial for comparison.



ONIONS IN THE TROPICS AND SUBTROPICS. A case could be made that onions are one of two universal vegetables that are cherished in almost every culture, tomatoes being the other. Both are difficult to grow in many tropical and subtropical climates. Where a vegetable is both popular and difficult to grow, it brings a good price. If a way can be found to grow that crop, both local farmers and consumers will benefit. While attending a horticulture conference in Honduras, Scott Sherman and I had an opportunity to visit with Dr. Lesley Currah. She travels the third world working with onion researchers. The interview follows. Be sure to note the offer of seed for a variety trial of these onions in the chapter on Germplasm.

Q. Tell us more about the Natural Resources Institute where you work.

A. The NRI is an agency of the British government, the Overseas Development Administration. Their purpose is to use science and technology to help people in third world countries develop using their own natural resources. Help is offered to any country eligible to receive British aid.

Q. What is your assignment?

A. I work in the fruit, vegetable and root section. My current assignment is an evaluation of onion production and storage in low latitudes. A particular interest is to expand onion production in very wet climates and on islands at sea level. Our approach is fourfold. (1) We are promoting a network of contacts on onions in the tropics through a newsletter called "Onion Newsletter for the Tropics." (2) We evaluate onion varieties through trials done by collaborators around the world. (3) We provide training in how to do a trial and interpret the results. (4) We maintain a gene bank of interesting onion accessions.

Q. Often a development worker from a temperate climate will plant onion seed from home only to find that it only makes "little green onions," no bulbs. Explain what is happening.

A. Onions are very sensitive to day length. The kind of onion that is grown in the higher latitudes requires long day length to form bulbs. When onions are grown during short days it is important to plant what are called "short day onions."

Q. Is there a sharp border between long and short day varieties or are there degrees of short-day-ness?

A. There are several intermediate degrees, which would be common in places like north Texas or Spain. A well organized seed catalog will not just say whether onions are "short" or "long" day varieties. They will organize them under day lengths, e.g. 11-13 hour, 12-14 hour etc. Some varieties like Beth Alpha in Israel go to less than 12 hours. These mature around Christmas. However, because the quality of onions harvested at mid-winter is often inferior, e.g. with more double bulbs, farmers usually want onions to mature as days begin to lengthen but before the rains have started.

Q. What does happen if you plant a long day onion near the equator?

A. As you said, they grow into little green onions. They may thicken a little at the base. They may actually be preferable for producing little green onions because the short day types might begin forming bulbs too soon.

Q. Do onion sets exist for short day onions?

A. Many in the tropics use the set system to get onions going near the end of the rainy season in order to extend the onion harvest forward in time. Probably 30% of the onions in Bangladesh are grown that way. Sets are commercially available in Zimbabwe. However, the quality of onions grown from sets can be inferior, for example with more double bulbs.

Q. How would a farmer make his/her own sets?

A. Just as the hot season is starting, sow seeds at a very close spacing. Do not thin the onions. Harvest at ½ inch (1.25 cm) diameter or else they will bolt. If they are sufficiently crowded and if it is well past the day length where the variety would normally bulb, they will die down naturally. It may take a few seasons of trial and error to get it right. Keep the sets in an airy, warm place, such as just under the rafters.

Q. Under what conditions might a farmer be able to save his/her own onion seed?

A. This is difficult. You need a variety that will easily bolt (send up a flower stalk) the second year. You do not want any variety that bolts the first year because that trait would create havoc in your harvest. Select bulbs from the best onions and store until the next season. Timing then becomes important. If you plant too soon while daily temperatures are increasing they may go into bulbing mode and split rather than flower. Wait to plant the bulbs until the average daily temperatures have started decreasing. The stalk gets a lot of diseases so, unless it is very dry, you may need to spray a lot.

Q. What do you look for in a variety trial?

A. You would want most varieties in your trial to be acceptable to local people. If onions are eaten raw, you want varieties which are mild; if cooked, pungent onions that store well. The pungency, by the way, depends not only on the variety of onion but also on how much sulfur is in the soil. You would want to look for onions where a high percentage of the harvested bulbs are marketable and where the bulbs store well. Even the shape and color may affect marketability and price.

Q. How should onions be stored?

A. We are writing a bulletin on storing onions in the tropics. The humidity should be about 75% and the temperature 25-30°C. If the temperatures drop much below 18°C the onions may begin to sprout. For example, in Zimbabwe we found that stored onions began sprouting when evening temperatures dropped to 15°C. This is somewhat dependent upon variety, but only to a limited degree. Light is not a very important factor. Light may cause some fading of red onions on the surface only. Light can also cause some green color to develop in white onions.

Q. Do short day onions store reasonably well?

A. Yes, but there is room for improvement. The Israelis have been working to select grano and granex types that will store for a long time. The factors they select for are ability of the bulb to go into a good dormant period and qualities in the skin that will protect the bulb. Their varieties are being tested all over the tropics.

Q. I notice a lot of short day onions named "grano" or "granex," followed by a number. What are these?

A. Texas grano onions came from onions in Spain which over-winter well in the field, but have poor storage characteristics in general. The granex series is hybrid, the grano open-pollinated (non-hybrid).

Q. This brings up an important question. If you are working where it is possible to produce your own onion seed, would it be a big mistake to save seed from a hybrid onion?

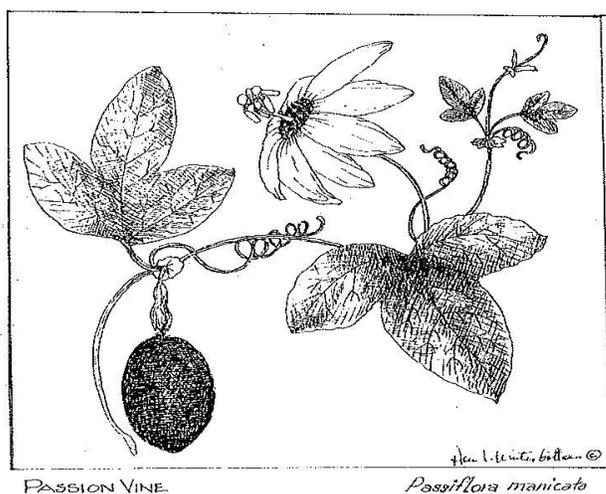
A. No, if you are prepared to do a little selection, and if the hybrid is much better than the locally available varieties, you might end up ahead. For example, in India the Pusa Ratnar variety came from the red granex hybrid. You might have some problems with male sterility in early generations.

Q. How are onions pollinated?

A. Onion pollen is sticky, so there is not much wind pollination. They are pollinated by insects, such as honeybees. Some seed producers throw dead chickens in the field to attract blow flies. Some crawling insects are also pollinators.

Q. Some of the special seeds that ECHO distributes have come from members of our overseas network. Is there any way in which they might help you?

A. I am interested in any traditionally maintained, locally grown onion. However, the needs of our seed bank require that we obtain about 50 g of any new accession. England is so far north that we are unable to increase the seed ourselves. If someone has an onion that might be of interest, they should first write and tell me as much about it as they can, and why they value the onion. My address is Lesley Currah, Horticulture Research International, Wellesbourne, Warwick, CV35 9EF, UK.



PASSION FRUITS FOR HIGHER ALTITUDES. Two of the passion fruits covered in *Lost Crops of the Incas* are the sweet grenadilla, *Passiflora ligularis*, also called sweet passion fruit and the purple passion fruit, *Passiflora edulis*. Victor Wynne in Haiti says, "I particularly recommend the sweet passion fruit to anyone with growing conditions approximating ours, perhaps over 5,000 feet, and a good depth of soil or subsoil to hold moisture during dry spells. The fruit never fails to sell locally to the supermarkets at a good price. It takes about six months for the young vines to get established, and they should be protected from strong sun. We have strung a horizontal wire on 8 foot posts set 1.5 feet into the ground. The fruit is borne on side branches which reach almost to the ground." He would like to get away from posts and wire and is experimenting with trees. The vine "is in no way a killer of trees (i.e. it does not smother them as do some other *Passifloras*). It is more moderate in its

growth." Unlike the yellow passion fruit grown in the lowlands, this one "does not fall when ripe, so must be picked. Thus, a support tree should have a structure allowing one to climb up to reach the fruit."

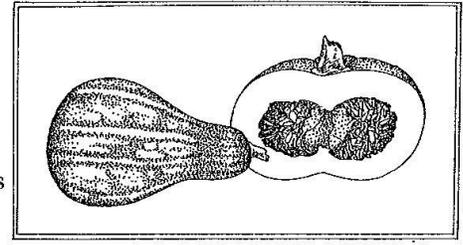
According to the *Lost Crops* book, this fruit has been grown as low as 800 meters and as high as 3,000 meters in Bolivia and Colombia. Because of its strong rind, "it transports well without injury. Consequently Colombia is now exporting this fruit to Europe." It flourishes in Hawaii and is grown somewhat in New Zealand. "This plant sets fruit less abundantly than the common passion fruit, but can produce two crops a year. Because of its resistance to root and collar rot, it is a useful rootstock for other passion fruit species. ...Some people find [the taste] too sweet and flat, which is why lime juice is often added."

ECHO sometimes has small quantities of seeds of these varieties. Please let us know if you have seed to spare. This fruit is already grown in most tropical countries, so you may be able to find seed locally.

SEMINOLE PUMPKIN IS A MULTIPURPOSE, PRODUCTIVE VEGETABLE. I had wanted to get seed for the Seminole pumpkin ever since Dr. Julia Morton sent me a copy of her article: "The Sturdy Seminole Pumpkin Provides Much Food with Little Effort." We finally obtained seed and planted a single hill in an out-of-the-way spot and gave it almost no attention. It vined through weeds in a large area and produced 20-30 pumpkins, which we ate using winter squash recipes. We love the flavor, finding it a great tropical substitute for the popular acorn squash. Each is a convenient size, somewhat bigger than a large grapefruit. ECHO has seed of several varieties.

If it produces in your climate, you will be able to save your own seed.

Julia Morton writes, "It will spread over the ground, drape a fence or climb a tree; needs to be fertilized only at planting time; requires no protection from insects. The fruit, variable in form and size, is hard-shelled when mature and keeps at room temperature for months, is excellent baked, steamed, or made into pies. The Indians sliced, sun-dried and stored surplus pumpkins. Very young tender fruits are delicious boiled and mashed; the male flowers are excellent dipped in batter and fried. Thus the vine produces three totally different vegetables. This is an ideal crop for the home gardener. The portion of the vine which has borne will die back, but vigorous runners, which root at the nodes, will keep on growing, flowering and fruiting, yielding a continuous supply."



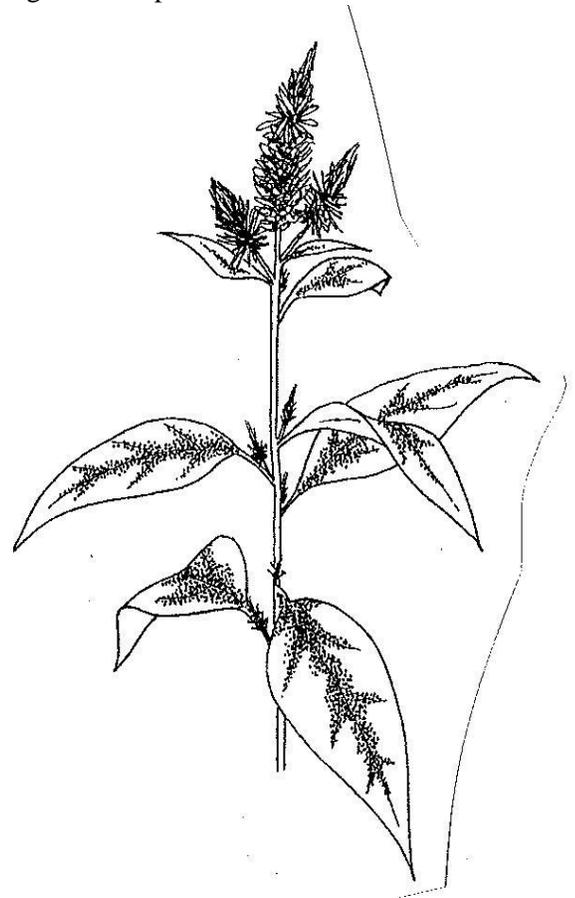
The fruits were seen hanging from oak trees by early settlers as they canoed through the Florida's Everglades. The native tribes girdled the bark of oak trees to kill them, then planted the pumpkin at the base (a technique we are not recommending!). ECHO also has several other varieties of pumpkins which you may request if they produce well in your area.

QUAIL GRASS (*CELOSIA ARGENTEA*) IS AN EXCELLENT SPINACH SUBSTITUTE FOR HOT WEATHER. Often folks from the States form the opinion that vegetables will not grow under the difficult tropical conditions where they work. It would be more accurate to say that vegetables which they knew in the temperate zone may not thrive there. You will find gardening to be much easier if you grow food plants that God made for climates like yours. Quail grass is a good example. Even in temperate regions spinach only does well in the cooler part of the season and certainly will not grow in the hot tropics. Quail grass, on the other hand, will grow to about 8 feet when spaced about a foot apart and has leaves which taste very much like spinach. (It might be more productive to plant much more closely than that, however.) Roy Danforth tried it in Zaire. He wrote that he was very pleased that it tasted so much like spinach. More important, the local folks are quite interested in it also.

I understand that it is already an important vegetable in parts of Africa and elsewhere. It is not a grass at all, but is in the same genus as the ornamental celosia and cocks comb. Young growing tips or older leaves are cooked for only a few minutes to soften. The water becomes an unappetizing black, but the leaves are an attractive green. The taste is spinach-like with no trace of bitterness. The cooking water should be discarded because it contains oxalic acid.

We sometimes like to cook greens in a steamer. When we cooked quail grass that way the leaves were black and had an unpleasant taste that we had not noticed before. Apparently the black pigment and the oxalic acid that are normally removed in the cooking water were all left in the steamed leaves.

I have found no specific nutritional information, but it is in the same family as amaranth and is claimed to be similar except lower in protein. The leaves should be high in vitamins A and C, iron and calcium. The calcium would not be available because it is tied up by oxalic acid. The oxalic acid should pose no danger unless leaves were eaten in unusually large quantities.



Like its ornamental relatives, quail grass is attractive in its own right. When the days become shorter in late August it is covered with purple blooms. The inflorescence becomes longer and longer, remaining purple at the tip. The basal end turns brown and contains ripe seeds while the tip continues to bloom (and attract bees and other insects). A row in

the garden is attractive with or without blossoms.

I have often wished for a vegetable that grew like a weed without all the tender loving care that is so often needed. Quail grass is such a vegetable. Every place I have grown it, it reseeds itself abundantly. We need do no work to grow it. It definitely could become a weed problem (although an edible problem). We have had no disease problems and very little insect damage. It is susceptible to nematodes, so a mulch is helpful. It is killed by standing water or freezing temperatures, but does quite well in our cool winter as well as the hot summer. ECHO has plenty of seed. Please share your results with us.



Peace Corps volunteer Jessica Jacklet tested a packet of quail grass at her site in Panama. Few vegetables were grown in that area, as most vegetables performed very poorly. This picture shows Jessica (5'10" tall) standing by the quail grass, which was reportedly untouched by insects. The foliage was rich and dark with lovely purple flowers. Those who started growing quail grass are very proud about its exceptional growth. She introduced the plant as "purple spinach" to the villagers, who are learning ways to incorporate the leaves into their recipes. So far, people have added the leaves to a rice and lentil dish, and one containing eggs and tomatoes. This very productive plant is hardy and attractive, and it merits trial in more areas.

RHUBARB GROWN AS AN ANNUAL. Rhubarb is a common perennial plant in temperate regions, and it thrives vegetatively in cool highland regions in the tropics. In the Andes of Ecuador, it is widely appreciated among farmers, and many seek root divisions so they may continuously harvest their own rhubarb at home. People make sauces, pies, and juices of the tart stems. However, rhubarb is not adapted to the tropics, and the plant will not survive the extended heat and humidity of tropical lowlands. If you are now in the tropics and miss cooking with rhubarb, you will be happy to know it can be grown as an annual from seed. We grew the red-stalked variety 'Victoria' ("the deepest red of all seed-grown types") from the Park Seed Co., Cokesbury Rd., Greenwood, SC 29647, USA. In Florida, we plant the seeds in August, transplant in October, and harvest rhubarb through the cool winter season. The plant gradually dies off through the summer.

Ralph Kusserow in Tanzania wrote, "You mentioned in EDN about growing rhubarb as an annual. I have been doing that now for several years and it works. We just start taking from it as soon as it is ready. The plants always die eventually from some sort of root rot. I have to watch that I don't overwater it." Most stems of seed-grown rhubarb will be green rather than the intense red selected through vegetative propagation, but tasting a rhubarb pie in the subtropics made us overlook that quickly!

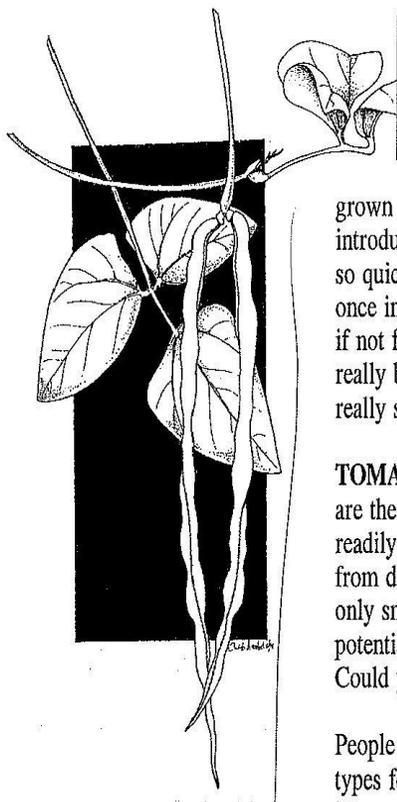
STRAWBERRIES. Strawberries would seem to be an "underexploited" cash crop in some countries. For example, Jose Postigo began a project at about 3,000 feet in the Dominican Republic, using U.S. varieties. Within a year he was selling dozens of boxes of beautiful berries in the capital. Several women also created jobs making jam from excess or older berries in their homes.

Strawberries bred for temperate zones only flower in long days, so varieties used in most of the U.S. would not yield fruit at low latitudes. You must grow day-neutral varieties in the shorter days of the tropics. The following are listed in a publication from California: 'Douglas,' 'Pajaro,' 'Vista,' 'Brighton,' 'Hecker,' and 'Aptos.'

Here at ECHO I have been pleased at the size and quality of berries and plants grown from seed. (Strawberries are normally propagated by runners.) I have not compared them to commercial varieties, but it is a good way to introduce plants to remote locations. Angelino Chipana and Abdon Paredes in Bolivia gave me a picture of a successful plot they began from seed. Though a few others say the plants are living, we have received no other reports of successful plantings. Some reported the plants were eaten by ants. Many had no germination. This could be related to heat, though ours always germinate even in the hot greenhouse in the summer. If you know of strawberries being grown in the tropics at other than higher altitudes, send us details. We are always interested in "tricks" to grow crops outside of their normal environment.

ECHO does not carry strawberry seed. The "Sweetheart" variety can be ordered from Park Seed Co., Cokesbury Rd., Greenwood, SC 29647, USA (25 seeds for about \$2 plus postage; they bear the same year they are planted). If you can get fruit of the 'Douglas' variety, blend at a low speed in a blender, then separate and dry the tiny seeds. Plant by scattering on top of moist potting mix and patting with your hand to barely embed the seed into the soil. To make sure the top of the soil never dries out, place a glass or plastic sheet over the pot until they begin to emerge. Be sure NO sunlight hits the pot or it will overheat with the plastic covering. An alternative might be to set the pot in a basin containing an inch or so of water. We have pulled together considerable information on strawberries in the tropics; contact ECHO if you have more questions. If you are in the tropics but not at least 3000 feet (1000 m) elevation or on a very dry but irrigated farm, forget strawberries.

SWISS CHARD. Dale Gunnar in southern Texas writes, "We harvest swiss chard year-round. When we pull up the old stalks in late winter or early spring, we bury sections of the stalk. These quickly root and send up new growth. This is much faster than reseeding." Over the years, ECHO has received many reports from our network that Swiss chard produces well and long. It does well for us only during our mild winter season.



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THAILAND LONG BEAN (*VIGNA UNGUICULATA*) PRODUCES ABUNDANTLY IN THE RAINY SEASON. Gary Rohwer writes from Nigeria: "The nature of the wet, humid growing season makes beans the best crop to fight against hunger and improve nutrition in this area. In particular, the Thailand Long Bean [a cowpea with an edible 10-inch pod] is a very impressive variety. It resembles a bean which is grown in Nigeria and eaten by the people here, so there is no problem in introducing this variety. The most impressive factor is that this variety grows so quickly. The beans which the people here have been planting only produce once in a growing season, but Thailand Long Bean could be planted three times if not four during the rainy season. I have introduced the bean and people have really been excited about it. If it was planted on a large scale here, they could really see the results." ECHO grows seed for our seedbank during the summer.

TOMATOES IN THE TROPICS AND SUBTROPICS. Tomatoes and onions are the most universally known vegetables. They are so versatile that they are readily accepted in most cultures. One of the most common statements we hear from development workers in the field is, "They grow good tomatoes here, but only small cherry or plum types. I think there would be a lot of market potential for some of the large types that we have in our gardens back home. Could you send me some seed of big tomatoes so I can introduce them here?"

People in the lowland tropics only grow the smaller (cherry and plum or roma) types for good reason: fruit set of large market tomatoes is very poor in many hot, tropical areas. If you have a variety of large tomato that is healthy and flowering, then the reason it is not setting most likely has to do with temperature.

Both daytime highs and nighttime lows have a variety of effects on the ability of a tomato to set fruit. Small tomatoes seem to be less adversely affected by these extremes, which is why those types are the ones in local markets. We had hoped to find clear-cut guidelines but could not, so we will venture our own: If daytime temperatures are not less than 33°C (92°F) and nighttime temperatures less than 22°C (72°F) you may experience difficulties. If daytime temperatures are over 40°C (104°F) or nighttime temperatures over 26°C (79°F) you will almost surely have poor fruit set and possibly damaged fruit.

These may not be bad rules-of-thumb, but as so often happens in real life, the reasons are too complex to be precise. Here are some of the factors so you can understand what is happening, and possibly find a solution.

Effect of nighttime temperatures. These can be either too low or too high. Temperatures at night that do not drop to at least 79°F are clearly damaging to fruit set. Cultivars that were developed for early production in temperate regions had to be able to also set fruit earlier--when temperatures were low. These cultivars can set fruit as low as 4.4°C (40°F). On the other hand, cultivars developed for warm climates typically will not set fruit if night temperatures fall below 10°C (50°F).

Pollen grains must germinate before the ovule can be fertilized. At 25°C (77°F) germination takes about an hour; at 10°C (50°F), 5 hours; at 5°C, (41°F) 21 hours. Once it germinates, the pollen tube must grow until it reaches the ovule. This growth rate increases with temperature from 10-35°C (50-95°F), but is reduced outside that range. The ovule may deteriorate before it is fertilized.

Effect of high daytime temperatures. The anther must dehisce (burst open) before its pollen grains can be released. This process is inhibited by temperatures that are too high. At temperatures over 35°C (95°F) the surfaces of both the pollen grain and the stigma may dry out, which causes poor fruit set. The pollen germination rate increases with temperatures up to a point, but over 37°C (99°F) germination is greatly inhibited.

A high of 40°C (104°F) seems to be a critical point. Exposure to temperatures greater than this can damage both ovules and pollen production. E.g., if the ovule has been exposed to very high temperatures nine days before flowering, it can deteriorate. Once fertilized, the endosperm of the developing seed can deteriorate at over 40°C (104°F) for between 1-8 days after fertilization.

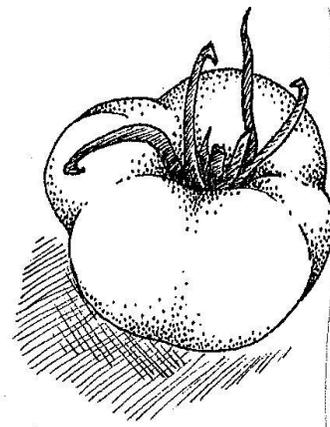
The difference between daytime highs and nighttime lows (diurnal variation) is also important. In regions and seasons where days are *long*, tomatoes are not productive unless the difference between day and night temperatures is at least 10°F. We have been told that a very high diurnal variation, as might occur in a desert or high in the mountains, can apparently overcome some of the effects of high temperatures listed above.

Fruits that do set at high temperatures are often so badly damaged or misshaped that they are not marketable. Also red varieties tend to become more orange at higher temperatures. This is because synthesis of the red pigment, lycopene, is slowed at high temperature but the orange pigment, β -carotene, continues to accumulate normally. Presumably tomatoes grown under shade cloth would be a little less damaged by heat.

[References used for the above discussion: *Vegetables: Characteristics, Production and Marketing* by Lincoln Peirce, Wiley & Sons, 1987; *The Tomato Crop*, Atherton and Rudich, Chapman & Hall publishers, 1988; personal conversation with Dr. Don Maynard, Florida Gulf Coast Research and Education Center.]

ECHO offers two types of tomato seed: open-pollinated *disease-resistant* varieties, and trial samples of a hybrid *heat-tolerant* variety. AVRDC (see p. 50) and other tomato breeders are continually looking for more varieties which combine these traits, and we will make this seed available to you as it comes to ECHO. We also have varieties high in vitamin A. Tomato varieties always include a series of letters that represent their disease resistances: V for *Verticillium* wilt, F1 and F2 for *Fusarium* wilt races 1 and 2, respectively, T for tobacco mosaic virus, N for nematodes. In the tropics you want to see as many letters as possible.

The disease-resistant tomatoes developed for Florida are mixed together in a variety trial packet. We selected only open-pollinated ones (standard or non-hybrid, so you can save your own seed). Note that these were developed for our mild winter, so they are not selected for hot, humid weather. Their resistances are listed. Tropic is a stake-type tomato resistant to V, F, T, gray leaf spot, leaf molds, tolerant to early blight. Walter is resistant to F1, F2, gray leaf spot. Hayslip is a fresh market variety with determinant vines (i. e. do not need staking) resistant to V, F1, F2, grey leafspot, resistant to blossom end rot, black shoulder, catface and cracking. Florida MH 1 is a high yielding variety that is very resistant to F1, F2, V, T, grey leaf spot, leaf molds, and graywall. Floradade is a determinant variety especially adapted to V infected alkaline soils. It is resistant to V, F1, F2, gray leafspot. If you only want to try one variety, we can package it separately for you; be specific in your request to us if that is the case. ECHO periodically updates the mixture of seeds in our variety trial as we hear of great successes with other varieties, so you may receive a different mix than what is listed here. For larger quantities of these varieties and many more (both standard and hybrids) suited to the tropics, we recommend Kilgore Seed Company, 1400 West First Street, Sanford, FL 32771, USA; phone 407/323-6630. They have good prices.



Ordinarily, there is little use doing a trial with hybrid seed if you could not import seed after the trial, so we will only send hybrids if you specifically ask for them. However, some people have reported good success with planting a few tomato plants from a packet of hybrid seeds, then multiplying plants by cuttings. In that case, you would not need quantities of hybrid seed but could still benefit from the advantages that hybrids offer. Be sure to impress upon farmers that seed saved from hybrid fruits will not produce the same quality of fruit as the parent. We do not normally recommend hybrids because growers cannot save their own seed, but it is best not to be too dogmatic. There may be many situations in which purchasing seed will make economic sense if farmers can get a significantly higher price for out-of-season tomatoes or if for the first time large tomatoes were available. Also, because many superior genes are in hybrid plants, you might use them in developing a plant just right for your location by selecting the few outstanding plants each year.

'Solar Set' is a fresh market hybrid tomato that sets fruit moderately well under high temperature (92°F [33°C] day, 72°F [22°C] night) and high humidity conditions. It was developed by Dr. Jay Scott at the University of Florida to extend the tomato season by a few weeks at either end of the normal season. It was not developed to produce throughout our terribly hot, humid summer, and in fact succumbs rather quickly to disease in the summer. The hope is that it will produce tomatoes a few weeks earlier than other varieties, bringing a superior price. Presumably it might also extend the season into somewhat warmer weather, although the premium price for end of season tomatoes will be less than that commanded by the first tomatoes of the year. This tomato is described as having large fruit with few defects even under adverse weather conditions. 'Solar Set' does not flower earlier than other cultivars, nor do fruit ripen more quickly. The improved earliness is entirely a result of a greater number of fruit which set early in the plants' development. It is resistant to *Fusarium* races 1 and 2, *Verticillium*, and gray leafspot. It is apparently not resistant to nematodes. ECHO's experience is that it is more prone to disease than several other tomatoes, as we might expect from the few types of resistance listed for it.

'Solar Set' is distributed by the Asgrow Seed Company (4420A Bankers Circle, Doraville, GA 30360, USA; phone 800/234-1056; fax 770/416-0108). We spoke with Tom McBride at Asgrow about the variety. So far results have been very good in areas where tomatoes flower at high temperatures. 'Solar Set' is a determinate variety, unlike many of our readers may be used to (called indeterminate). In other words, relatively short plants will flower and set fruit for a relatively short period of time (30-40 days), but they fruit heavily and will do a good job of holding what fruit does set. While the tomato is a warm season plant, there is a point where it may be too warm for good germination (probably around 100 degrees). Because this is a hybrid, the seed is relatively expensive. Asgrow's smallest unit in 1996 is 2000 seeds, which costs about US\$30.

ECHO can send you a trial packet to test them; if they are very successful, you may purchase a large quantity of seed from Asgrow or reproduce plants by cuttings. ECHO has obtained one of the larger cans and will send as many seeds as you want for \$1.50 per 100 seeds, including postage (count approximate). Before deciding to test them, remember that difficulties in obtaining smaller quantities of seed may make a trial of little interest to you.

The Tomato Growers Supply Company (P.O. Box 2237, Fort Myers, FL 33902, USA; phone 941/768-1119; fax 941/768-3476) has a huge selection of tomato varieties, including the productive 'Heatwave VFFA' hybrid (also determinate) which yields best when daytime temperatures are 90-96°F (32-35.5°C). They feature many heirloom varieties especially noted for disease resistance, if that is your main problem in growing tomatoes. Processing types are also mentioned. Their catalog lists several pages of sweet and hot peppers as well.

TOMATOES RESIST FLOODING IF GRAFTED TO EGGPLANT. The AVRDC (see p.50) in Taiwan is interested in improving tomato harvests during the hot, humid part of the year when supply is short and prices are high. A special problem can be flooding during tropical storms.

Scientists noticed that eggplants which grew next to tomatoes survived a flood that killed the tomatoes. Simple experiments showed that they could easily graft tomato onto the eggplant rootstock. (They were not able to graft pepper to eggplant.) This led to trials in 1993 in which a tomato variety selected for its ability to produce in hot weather was grafted to eggplants. (Their choice was Taichung ASVEG #4.)

"Flooding, which occurred after the first harvest of tomato, killed ungrafted plants whereas all tomato:eggplant grafts survived to produce more fruit. Early flooding (at 32 days and 40 days after transplanting) did not diminish growth



and yield of the control.... This agrees with our observation in other species that early flooding does not necessarily result in plant mortality. Young root systems probably recover following flooding due to their superficial distribution near the soil surface which dries out first when flooding ceases."

The eggplant should be sown first and the tomato seed planted as the growing point of the eggplant appears above the cotyledons (2-3 weeks later). If necessary, tomato scions (budwood) can be kept in the refrigerator for up to two weeks, but must be wrapped with newspaper and covered in a plastic bag. (The same is not true for eggplant scions.) Tomato scions were made when the plant reached the three true-leaf stage by

cutting at an angle of 30°.

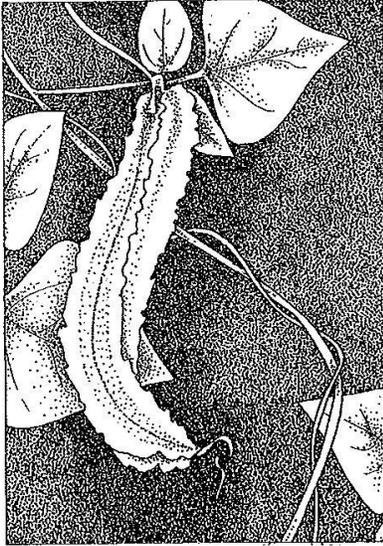
Simple rubber tubing, of the type used for bicycle valves, was used to hold the scion onto the stock. The tubing was cut at the same 30° angle. Then the rubber tubing plus scion were slipped onto the cut surface of the eggplant stem. Lining the angle of the cut of the scion with the angle of the cut on the tubing helps to correctly position the scion/rootstock surfaces. They can graft 150-200 seedlings per hour. To reduce grafting costs, they are experimenting with pinching the tops to form two stems so they can plant farther apart.

The plants were kept at 85% relative humidity. The tubing was cut 3-7 days after grafting so as not to restrict stem growth. At the same time plants were removed from the high humidity conditions and hardened off before transplanting. Thanks to Dr. David Midmore at AVRDC for supplying the picture and details from their 1993 annual report. For a copy of the article, write him at AVRDC, P.O. Box 42, Shanhua Tainan 741, Taiwan ROC.

WAX GOURD (*Benincasa hispida*) or Chinese wintermelon is the best cucurbit for seed oil in the hot, humid tropics. The large fruit (ECHO has grown some a meter long, and they are reported to twice that) has crispy white flesh, and its waxy coating helps give it a long storage life (up to a year without refrigeration). Young gourds are used like chayote, in stretching soups and stews. In China, mature gourds are used as soup pots: they are hollowed out and filled with soup ingredients, "capped" with the cut lid of the gourd, and steamed for up to six hours. Wax gourd prefers high temperatures and moderate rainfall; it does not do well in very high humidity. Hand pollination aids fruit production. Unlike other cucurbits, wax gourd does not contain vitamin A. It has few pests and diseases in most areas.

HAVE YOU TRIED WINGED BEANS, *PSOPHOCARPUS TETRAGONOLOBUS*? There has been so much promotion of the winged bean that I find myself thinking all of our readers know about it. However, it is too important a plant to fail to bring it to your attention. This legume will vine up a four-meter pole. Nearly all parts are edible and high in protein. The leaves can be cooked like spinach and are quite tasty. The long four-sided pods with serrate "wings" running the length of the corners can be eaten like green beans. The dried seeds are the nutritional equivalent of soybeans. Fried flowers taste like mushrooms. When production is over, the stems can be fed to cattle, and most varieties have edible tubers that contain up to eight times the protein of an Irish potato.

The winged bean is native to the Asian tropics. When I have tried growing green beans during the hot, humid Florida summers, they have always been killed by disease or insects before they could produce pods. Winged beans, on the other hand, seem to resist almost everything except nematodes if well fertilized and watered.



We can send you seeds of a few varieties and a short technical note on the cultivation, preparation, and nutritional value of winged beans. Most varieties only bloom during short days, so they do not bloom and produce pods in Florida until mid-October. On the other hand, there are a few day-neutral varieties that get excellent yields right through the long days of summer. If you are far enough from the equator that this can be a problem, request the day-neutral seed from us. For others, we will send a selection of perhaps four regular varieties.

Winged bean seeds need to be scarified before planting. Alan Lee had less than 50% germination a month after planting his winged bean seeds. "I dug up the ungerminated seeds and nicked them all a few times with the corner of a razor blade, then replanted them. Within a week several had germinated and I expect more." Seeds will not germinate until they have absorbed water. Scarification softens or opens the seed coat so water can be absorbed. Nick the seed with a knife or file or strike it across cement as in striking a match. Some seeds are soaked overnight. (*Leucaena* seeds are put in water that has just been boiled then left overnight. If you have any hard seeds that fail to germinate, it is possible the seed may still be viable. It may need to be scarified.)

After fourteen years of growing winged beans and distributing seed, we have come to believe that their potential has been overstated. Only very special recipes make the dried seeds appealing in taste. Pods are acceptable to the North American taste, but other beans are usually preferred. Leaves and raw flowers are quite good but probably limited to household use. No one at ECHO cares much for the tubers. (If the beans were propagated by tubers year after year, as is the practice with some other beans, it is possible that they might develop more in size and be more useful, although the texture might deteriorate.) Our impression from our network is that no one has had a major success introducing winged beans. In its countries of origin, winged bean products continue to be popular. It is worth trial for its many virtues, but do not expect as much of its market potential as early reports indicate.

