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ECHO is a Christian non-profit organization whose vision is to bring glory to God and a blessing to mankind by using science and technology to help the poor.

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Saving Your Own Vegetable Seeds

In my travels to impoverished countries, one of the problems most frequently mentioned by development workers is that farmers and gardeners face great uncertainty about vegetable seed supply. There may be plenty of seed for a particular vegetable, but not for the varieties the people like and know will thrive. Seed saving would be surprisingly easy with some vegetables, possible but somewhat difficult for others, and almost impossible for still other vegetable crops. It would help to know what the issues are; some basic techniques for seed saving; and which vegetables are easy and which are more difficult.

The July 2006 issue of the Avant Gardener Newsletter had an excellent summary of these very points. The following copyrighted article is adapted for ECHO's network with the generous permission of Avant Gardener. The purpose of their article was to encourage gardeners in the USA to save seed in order to have the varieties they like that are not commercially available. To subscribe to Avant Gardener (US\$24, US\$30 outside the USA) write them at Box 489, New York, NY 100028.

In EDN 86 (January 2005), we wrote about extending the life of seeds by storing them underground in a sealed PVC pipe. In a future issue of EDN we hope to share more low-cost ideas for storing seeds in areas where there is no electricity or refrigeration. We would like to hear of successful seed-saving techniques you may have seen. Martin Price

Heirloom Plants. To lose or throw away something valuable from the past is foolish, and what is lost may be irreplaceable.

The word "new" has great allure, for it seems to promise something better. In the case of plants, a new introduction is usually superior in one or perhaps a few respects to what has been grown. However, achieving bigger flowers, higher yields or improved disease resistance has too often meant sacrificing other qualities such as flavor, fragrance, or regional adaptability.

In extreme instances, "lost" genes can bring disaster. Dependence on one or a few hybrids can leave a crop vulnerable to catastrophe. In 1970 almost 50% of the maize crop in the southern part of the USA was destroyed by a blight for which the plants had no natural resistance. In 1984, a bacterial disease resulted in destruction of 18 million citrus trees.

Loss of genetic diversity, i.e. the diminishing of the gene pool as older non-hybrid varieties disappear, is an on-going world crisis. Much of the problem is due to consolidation in the seed industry as larger companies buy out smaller companies. A leading research group estimated in 2005 that just ten companies now control 49% of the global seed market. These companies concentrate on selling only their newest hybrids. A study by the FAO has found that 81% of tomato cultivars and 91% of field corn cultivars have been lost in the last century in the USA, and 9,000 wheat cultivars have disappeared in China in the last 50 years.

The Home Seedbank. With so many incentives for growing and multiplying old-time plants, more and more gardeners are learning to save seed. Actually, they are returning to a practice that was once considered as basic to gardening as planting or harvesting.

The principles of seed saving are simple, but carrying them out with a variety of plants can be challenging. The first rule is an important one. Open-pollinated plants are of two types, self- and cross-pollinating. Self-pollinators can be planted anywhere, but a plant that will cross with another variety of its species must be grown either one variety alone or with varieties isolated from each other. [Editor: Many gardening books and web articles tell how far apart cross-pollinating species must be separated. I entered "isolation distance" and "carrot" into Google (a web search engine) and immediately had several articles with carrot isolation distances. If you cannot find information for a particular plant (and if you work in community development) write to ECHO and we will see if we can find the information you need.]

Next to seed purity, you will have to maintain something called genetic vigor. Genetic traits may be concentrated in one plant in "inbreeders" such as tomatoes, or spread over many plants in genetically diverse "outbreeders" like corn. In the former (self-pollinating) plants, 6 to 10 plants are generally considered enough to maintain a broad genetic representation.

With more genetically diverse outbreeders (cross-pollinators), seed for much larger numbers—a minimum of 200 corn plants, for example—is advised to ensure a complete genetic picture.

This is not important if you are saving seed only for your own use—provided you collect seed only from plants that exhibit the vigor, flowering or resistance characteristics you want to preserve. But where the seed is to be exchanged or sold, the minimums should be observed to lessen the chances of undesirable genes "weakening" the plants. [Editor: Though the seeds you select are from plants that do well on YOUR land, at another location with different soils, pests and climates the crop might require some genes that were unimportant in your location and so may not have been included in the seed you selected for propagation.]

For most cross-pollinating plants, mixing seed from 20 to 30 plants can be considered a good average minimum. If space is lacking for this many plants, cooperative growing of small numbers of the same variety by friends or neighbors can supply enough seeds.

Seed must be properly dry before storing it. Its moisture content must be no more than 5-8%. Lacking equipment to measure this, here are two simple methods: either strike a seed with a hammer (if it shatters rather than squashes, it is dry enough) or fold it (it should break cleanly rather than bend).

Collecting and Storing Seeds. Lettuce, carrots, parsley and a few others carry their seeds in the open, so it is easy to collect them as they dry by placing a paper bag over the seed head and shaking and rubbing. Chaff is blown away by pouring the seeds from one bowl to another in a light breeze or with a fan. Seeds that are encased in pods (beans, peas, okra, broccoli) are collected when the pods are dry and brittle. Crushing the pods in a bucket or bowl allows the chaff to be blown away easily.

Seeds that form in fruits (tomatoes, cucumbers, eggplants, peppers, melons, squashes) are coated with a gel that must be washed or fermented away before the seed is stored. It is common practice to place seeds squeezed or scraped from fully ripe tomatoes in a container with water, stirring daily, until a moldy fermented gel mass forms on the surface. This is poured off and the seeds which have sunk to the bottom are rinsed several times and dried on a plate or mesh screen, being stirred occasionally. [Editor: This is not surprising when you consider that the normal experience of a tomato seed is to sit in rotting fruit for several days.]

Heat and moisture will quickly ruin seeds in storage. Properly dried seeds in paper or plastic envelopes or bags will store well in airtight jars with silica gel desiccant (something that will pull moisture from the air). If the jar is kept in the refrigerator, most seeds will remain viable for three to five years (an exception is onions, which keep for only one or two years). Put the container in the freezer, and seed life for many plants will be extended to ten years or more.

When seed is removed from the refrigerator or freezer, it is wise to let the container stand unopened overnight so moisture won't condense on the cold seed.

Details for Saving Seed from Specific Kinds of Vegetables.

The "integrity" of a batch of seeds rests on care in every operation from selection and harvesting to cleaning and storing. So says a veteran seed saver, and he and others provide tips for success with specific crops:

BEANS – Common beans are mainly self-pollinating, but lima beans and runner beans are cross-pollinated by insects. Varieties of these should be separated by at least a mile or the plants should be caged. For all beans, should wet or humid conditions at harvest time threaten to make the beans sprout or rot in the pods, it is best to remove them from pods for drying as soon as the pods start toughening and changing color.

BRASSICAS – With the exception of radishes and some leafy annual brassicas, many of the cole crops (cabbage, cauliflower, kohlrabi, brussels sprouts, etc.) are biennials. Not many gardeners choose them for seed-saving projects because the plants must be overwintered in the ground or indoors so they can be grown the second year when they go to seed. Harvesting their seed is easy but can take time, since the pods often dry in succession from the bottom to the top of the stalk. [Note that in climates that never have freezing temperatures, some of these species may never set seed.]

CORN – This is a less-than-ideal crop for the seed-saving gardener, because it is wind-pollinated and varieties therefore need to be separated by a mile or more. [Editor: If this is not possible, at least select seed from plants from the center of the field.] Alternatively, the ears can be hand-pollinated and bagged, but the large number of plants needed to ensure genetic vigor makes this a demanding job. Seed is easily removed from the cobs by rubbing two ears together when both cob and seed are thoroughly dry.

CUCUMBERS – Insects cross-pollinate cucumbers, so varieties need separating by at least a half mile or must be hand pollinated. The fruits must be well past eating, soft and discolored, before harvesting the seed. One expert recommends picking these overripe fruits and letting them stand another three weeks before cutting them open and scraping out the seeds. Like tomatoes, cucumber seeds require fermenting to remove the gelatinous coating on them.

EGGPLANTS – Like cucumbers, eggplant seed is harvested from overripe fruits. Grating or mashing the pulp into a container of water and then squeezing it are necessary to release the seeds, which will drop to the bottom and then can be rinsed and dried.

LETTUCE – Although lettuce is largely self-pollinating, some crossing by insects can occur, so separation of varieties by 20 feet (6 meters) is advised. Seed can ripen over several weeks, and bagging the seed head and shaking it daily is the best collection method. A mesh screen that allows the seed to pass through but holds back the chaff is most efficient for cleaning the seed.

MELONS – The large seeds of all kinds of melons are easy to remove and clean as soon as the fruit is ready for eating. Except for watermelons, melons will cross with each other, so hand-pollinating is necessary if varieties cannot be separated by half a mile.

OKRA – The big and bright hibiscus-like flowers of okra attract many insects that can cross-pollinate these usually self-pollinating plants, so caging the plants or bagging the flowers is advisable if more than one variety is grown. Seed is easily removed by splitting the pods when they are completely dry.

PEAS – Peas are handled just like beans. Pods that are maturing in wet weather can be picked and spread in an airy place to complete drying.

PEPPERS – The plants are fairly small so it is simple to cover them with a mesh screen cage to prevent crossing if different varieties are growing within 500 feet (152 meters) of each other. The fruits must be fully ripe (brightly colored) to contain viable seeds, which are easily scraped out and dried in a bowl.

SQUASH AND PUMPKINS – These are a confusing group. They include several species, and there are often very different forms within the same species. So it is important to study them carefully to be sure that if you are growing two varieties of the same species they are isolated from each other or hand-pollinated. Seed of all types is harvested when the skin of the fruit has turned very hard.

TOMATOES – The tomato is both one of the world's favorite garden crops and a favorite among beginning seed savers, being easy and nearly foolproof. The majority of tomatoes are self-pollinating. A major exception is the double flowered beefsteak types and even then their crossing rates are 5% or less; varieties of these should be isolated by at least 15 feet (4.5 meters). Seed of all kinds of tomatoes should be "bulked" (collected and mixed) from three or more plants of a variety to get the fullest range of genes.

[Editor: When processing seeds that are wet (e.g. from fruits) you may notice that some seeds float while most settle to the bottom. The seeds that float are likely to be immature and should be discarded.]

ECHOES FROM OUR NETWORK

More on Maize in Africa

Stephen Carr wrote to us about the comments on maize included in EDN 91 ("Echoes from our Network"). Stephen is a graduate in agriculture from London University who served as a missionary for 20 years in villages in the Southern Sudan and Uganda, initiating a range of agricultural projects. Subsequently he served as head of the Crops Division in the government of the Southern Sudan, and later as agricultural advisor to the Prime Minister's Office in Tanzania. He then spent 11 years as a Principal Agriculturalist in the World Bank covering Sub-Saharan Africa. Currently he is retired and lives in a village in Malawi where he deals with policy and technical issues related to involvement with small scale farmers by government and major donors.

"I have worked with small-scale farmers in a number of African countries over the past 54 years, some 35 of which were spent as a member of village communities in the Sudan, Uganda and Malawi. My first reaction to some of the comments made by your contributors is that one should only be critical of the decisions which have been made voluntarily by millions of smallholder farmers when one has the fullest understanding of all the reasons which led to their making a change in their cropping, and particularly their staple food. Howard Gibson makes the point that there was the "introduction of maize to the exclusion of other crops." I am not sure what he means by this. Maize reached Southern Africa a couple of hundred years ago when there was certainly no government department to push people into using it. Millions of farm families over the years

made an entirely voluntary choice to move out of sorghum into maize so that, by the time that David Livingston reached Malawi, he found maize as the main choice of local people. Nearer to Mr. Gibson's home in Uganda, the dominant crop was finger millet, which in the 1950's was the number one crop of the country next to bananas. Over the past 50 years farmers have steadily abandoned the crop of their own accord. Why? Firstly because of its huge demand for labour. Having weeded my own finger millet fields on my hands and knees, I know just how much work is involved. It is slow work to harvest with its tiny heads. It is hard to thrash and cannot be pounded in a pestle and mortar. In addition, it does not produce well when soil fertility starts dropping with increased pressure on the land. It was an excellent crop when the Ugandan population was 6

million, employment opportunities were low, land could be fallowed for long periods and many girls did not go to school and could provide a good deal of the necessary labour. Because of the dramatic changes that have taken place over the past half century, farmers have found that finger millet just does not meet their needs. So, they have made the change to a crop with three times the yield potential which is easy to weed, harvest and shuck. I was somewhat concerned to see the claim made that finger millet and sorghum have "tap roots". [Actually] none of the graminaceous crops have tap roots and all have a network of fibrous roots.

"[I should also] comment on the inefficiency (in biological terms) of traditional sorghums and bulrush millet in comparison with maize. Both these crops are still grown on millions of hectares in those areas where there is hardly ever enough rain for another grain crop. They produce little grain in relation to their total vegetative growth, so farmers have to plant large areas in order to feed themselves. The fact that most of the plant is stalk and leaves is seen as an advantage to people heavily dependent on cattle for their survival. This is a totally different situation to that faced by increasing numbers of farmers in East and Southern Africa with small plots of land and few or no livestock, who cannot afford to grow a plant of which only 20% is actually human food. Hence, their move to maize, which is the most efficient of all grain crops.

"I often see references to the fact that "in our grandfather's time they always had enough food" with no subsequent comment on the fact that since then there has been a six or more fold [increase] in population density. The same applies to the statement by Stacia Nordin that people used to eat a wide range of wild fruits [and] vegetables. I lived in the Southern Sudan for many

years with a population density of 2 persons to the square kilometer, and we did indeed do just what Stacia claims. How different is the situation in the Malawian village in which I now live, in an area with over 250 people to the square kilometer, and no "bush" anywhere from which one could collect wild plants. One cannot make meaningful comparisons between situations that have been dramatically changed by phenomenal population growth. In the case of Malawi the population grew 14-fold in 100 years.

"Mention is made of the problems of bird damage on sorghum and bulrush millet. It is true that there are sorghums that have such high content of tannins and cyanide that birds will not eat them, but they require a lot of processing to make them both safe and palatable as a human food. Most people in Eastern Africa know well that good quality "sweet" sorghums have to be protected from dawn to dusk for the last six weeks before harvest if the family is going to be able to feed itself. Pictures of Sudanese or Ethiopian children sitting on their high platforms above the crop for hours on end were common enough fifty years ago. The coming of schools was one of the factors that led people to switch to maize.

"I am all too well aware of the inherent dangers of being heavily dependent on one major staple food as the climate is set to become increasingly unpredictable. On the other hand, your contributor's call for a crop suited to semi-arid areas with poor soils which will "thrive under such conditions, yields well and requires minimal inputs" does appear to describe no existing plant which would feed an African family from a small area of land. Possibly genetic engineering could produce such a miracle plant in the future but then it will face a whole lot of different "political" problems.

"I finish where I began, not as a protagonist of maize (I have spent most of my years with sorghums and millets) but as a respector of the judgement of small scale African farmers who have chosen introduced maize, sweet potatoes, cassava, groundnuts and a myriad of other "new" crops over sorghum, millets and Bambara earth nuts, which were their traditional crops, in the same way as English farmers adopted wheat, barley and potatoes when they were introduced to them."

A Market for Used Motor Oil

Walther de Nijs, Executive Director of LISO (Local Initiatives Support Organisation) wrote from Tanzania.

"With interest I read your article on Used Motor Oil in *EDN* 93. I would like to share with you that used engine oil is a commodity here, but for a different purpose than you described. Here we use it to "paint" poles for a fence or poles for houses (mud hut construction) (with the oil definitely slowly leaking into the environment, sorry) or to "paint" the roofing timbers. The idea is that the oil is so dirty that termites and other insects hate it like nothing else. When put on the poles that are used for a fence, it wears off and after some time (depending on soil humidity I assume) it wears off to the extent that the poles become attractive again for termites and fungi. But it helps. On the roofing timbers I don't think there are environment hazards; it certainly prevents your timber from being eaten and, consequently, your roof being blown away by storm. I used it in my house, my cow stable and in our office. Works perfectly, no insects chewing away on the timber!

"After changing oil in a car, the mechanic always requests to keep the oil. He sells it (or we ourselves do, now that we found out that it has a price) for some US\$ 4.50 for a 5 liter container."

FROM ECHO'S SEEDBANK

Atemoya: Hand Pollination to Increase Fruit Set

By Tim Motis, *ECHO Seedbank Director*



If asked to compare the eating quality of various tropical fruits, many of us at ECHO would rank atemoya at or near the top. Our

nursery manager, Tim Watkins, described its flavor by saying it “dances on your tongue.” In issue 54 of *EDN*, the head of our technical department, Dr. Martin Price, described atemoya as one of few “fully adequate” dessert fruits and suggested chilling the fruit in the refrigerator before spooning the creamy, white flesh out of the thin rind.

A few basic atemoya facts from *EDN* issue 54 include:

- Atemoya is a cross between cherimoya (*Annona cherimola*) and sugar apple (*A. squamosa*).
- The flesh of an atemoya fruit is firmer with fewer seeds than sugar apple.
- Because mature fruits ripen quickly, a good harvesting method for home gardeners is to, twice a day, pick up fruits that have fallen to the ground.

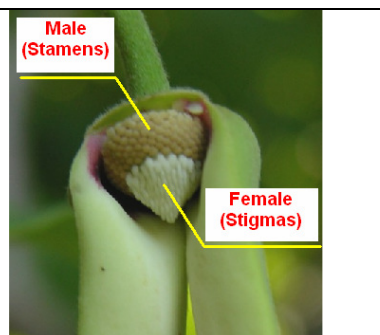


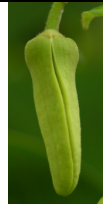


Figure 1. An atemoya flower with a petal removed to expose male and female flower parts. Stamens are initially a whitish (female stage) color and then turn brown (male stage).

- Atemoya is typically propagated by grafting. However, seeds are a good way to introduce atemoya into a new area; the characteristics of resulting trees will vary but the fruit will probably be good. Seedling trees will start to bear about three years after planting.
- Atemoya thrives under a fairly broad range of conditions in tropical and subtropical climates. Optimal conditions seem to include a dry period of several months during the winter before flowering occurs in the spring. Atemoya will withstand light freezes, but it is intolerant of waterlogged or salty soil.

Have you grown atemoya and experienced limited fruit set? Poor pollination may well be the cause. Atemoya flowers are unattractive to many insects and do not self-pollinate. Furthermore, the female flower parts are quickly desiccated (dried out) by dry weather. Consider hand-pollinating to boost fruit production and quality. Hand pollination increases fruit set by up to 50% in most cases.

Hand pollination of atemoya flowers is a simple procedure based on the interesting fact that the female and male parts (Figure 1) of each flower mature at different times. A flower is functionally female (Figure 2) just before and shortly after the flower petals separate. During this stage, the male flower parts (stamens; Figure 1) are whitish in color. Not more than a day later, the same flower becomes functionally male (Figure 2) as evidenced by wide open petals that easily fall when touched. At the male stage, pollen can be seen on the stamens (Figure 1) which will have turned brown.

To hand pollinate, simply collect pollen from male-stage flowers and brush/dust

		
Petals splitting	Receptive female stage. Petals pulled apart to show (right) the inner structure onto which pollen from another male-stage flower is transferred.	Male stage when: 1.) petals wide open and easily fall when touched 2.) pollen falls readily from the stamens.
Figure 2. Stages of atemoya flower development.		

the pollen onto the stigma (Figure 1) of a flower in the female stage. Male-stage flowers, with their pollen, may be collected and kept in a jar. The pollen grains will readily fall off of the stamens (Figure 1). Transfer the collected pollen to the base (Figure 2) of female-stage flowers using a thin, fine-haired brush; coarse hairs will damage flower parts.

What time of year is hand pollination done? This depends on when flowering occurs. In Florida, flowering begins in March or April. [NOTE: ECHO farm manager, Danny Blank, has observed that a second set of blooms can be induced by a June pruning.] In Australia, atemoya flowers during October and November.

When during the day should pollen be collected and transferred? This depends on when the male and female stages of flower development occur. Here at ECHO, Tim Watkins has successfully hand pollinated atemoya by collecting the pollen late in the afternoon and transferring it to female-stage flowers during the evening or morning. Collected pollen may become non-viable if one waits more than a day to use it. Observe atemoya flower development in your area to decide when to collect and transfer pollen. Also, try using pollen from atemoya (the same tree or other trees and

becomes dark due to red and yellow plant pigments. These are harmless, but the water should be discarded because of the dissolved oxalates and nitrates. The leaves themselves will not discolor during the cooking process. In fact, they become an attractive green color looking much like cooked spinach. Lengthy cooking will reduce the vitamin content.

We do not recommend that these greens be cooked in a steamer. When staff at ECHO prepared the greens this way, the leaves became black and had an unpleasant taste. It actually irritated the tongue. Apparently the pigments and oxalates normally removed by discarding the cooking water were left in the steamed leaves.

C. argentea is best eaten as a vegetable before it begins flowering. Most sources recommend harvesting five to seven weeks after sowing for optimal nutritional value. The highest total marketable and edible yields and total crude protein yield, however, occurs at 15 weeks after sowing. After flowering, the new leaves are too small and unappealing to be worth eating.

NUTRITION

The nutrient content in *C. argentea* varies between cultivated varieties, and apparently with time of harvest. Green-leaved varieties generally are more palatable and have higher protein and ascorbic acid (vitamin C) content than red varieties.

A 2004 study in Karnataka, India compared the nutrient qualities of 38 underutilized green leafy vegetables. Partial results of this study are in Table 1. *C. argentea* is an outstanding source of iron and a very good source for protein and vitamin C. (The USDA recommends 60 mg vitamin C, 1000 mg calcium and 18 mg iron per adult per day.) The data in Table 1 are from samples weighing 100 g fresh weight. The evaluation of all the compounds was found to vary with the position of the leaves and their age.

An AVRDC (Asian Vegetable Research & Development Center) study showed *C. argentea* to be high in

antioxidant content. Antioxidants bind free radicals (cellular by-products known to cause cancer, heart disease and a weak immune system, among others) in the bloodstream and render them harmless. Principle antioxidants include vitamins C, E and carotenoids (beta-carotene). Out of 20 indigenous leafy vegetable species tested for antioxidant content, *C. argentea* placed second only to [leaves of] *Cleome gynandra* (spider flower), *Moringa oleifera* (horseradish tree) and *Toona sinensis* (Chinese mahogany).

Peace Corps volunteer Jessica Jacklet tested *C. argentea* at her site in Panama, where few vegetables grew well. The foliage of *C. argentea* was rich and dark with lovely purple flowers. Those who started growing *C. argentea* were very proud of its exceptional growth. She introduced the plant as "purple spinach" to the villagers, who were learning ways to incorporate the leaves into their recipes. This very productive plant is hardy and attractive, and it merits trial in more areas.

CULTIVATION

SEEDING. *C. argentea* may be seeded directly into the soil at a depth of 0.75 cm (0.25 in) or started in a seedbed. Germination can be expected at five to seven days. Thin seedlings to 15-30 cm (6-12 in) apart, or transplant them into the field when 10-15 cm (4-6 in) tall, at two to three weeks, using the same spacing. For a once-over harvest (uprooting the whole plant), seed may be mixed with sand or loose soil at a ratio of 1:20 (to obtain a more even distribution) and broadcast onto the prepared soil. The seeding rate is 6-9 g per 10 m², whether broadcast or seeded directly into rows. *C. argentea* germinates very readily.

FERTILIZATION. *C. argentea* responds well to fertilizer application. Organic manures, supplied at a rate of 24-40 T/ha, may substitute for or augment inorganic fertilizers.

ENVIRONMENTAL & CULTURAL CONDITIONS. Minimizing weed competition shortly after seeding is important because the *C. argentea*

seeds and resulting seedlings are so small. A rich organic soil is the best for growing *C. argentea*. It tolerates full sun, but will produce best under partial shade. *C. argentea* is killed by standing water or freezing temperatures. Although temperatures below 20° C (68° F) will severely restrict growth, it withstands high temperatures well. Optimal daytime temperatures range between 30 and 35° C (86-95° F) with optimal nighttime temperatures between 23 and 28° C (73-82° F). *C. argentea* has produced well at altitudes as high as 1700 m (5400 ft).

C. argentea and other members of the amaranth family tend to reseed themselves abundantly. In places where few plants will grow without special care, that might be an advantage. However, caution should be taken that it does not become a new weed.

HARVESTING AND SEED PRODUCTION

ONCE-OVER HARVEST. This method of harvesting refers to uprooting the whole plant. At four to five weeks after sowing, thin out the tallest plants (20-30 cm or 8-12 in). The whole of each uprooted plant can be eaten, or the roots may be cut off, bundles made and prepared for market. Harvest continues in this manner until any remaining plants are 40-50 cm (16-20 in) tall. At this point, you may see the onset of flowers and/or lateral branches. Either way, at this stage newly emerging leaves will be small and unfit for harvest.

SUSTAINED HARVEST. This method involves periodic cutting and regrowth. The first harvest is made after about four to five weeks. Tops are cut, leaving a stem 15-20 cm (6-8 in) from the ground, allowing side shoots to grow. A second harvest is taken 15-20 cm from the stem, again leaving a sufficient number of buds for regrowth. Cuttings may be made in this manner at two to three week intervals. This method allows for four to five harvests to be made before the onset of flowering at which time leaf size and quality begin to decline.

Most farmers prefer the once-over harvest method to the sustained method, though the former yields slightly less overall. Some farmers will combine the two techniques, first harvesting the entire plant as a thinning operation, then ratooning the remaining crop.

SEED PRODUCTION. For seed production, select several healthy, vigorous plants and mark them. After the first harvest, cut these plants 15-20 cm from the ground, and allow for regrowth. Pruning will stimulate multiple lateral branch production and, therefore, multiple flower heads. If planting specifically for seed production, transplant seedlings into rows 70 cm apart with 40-45 cm between each plant in the row.

Seed harvests in tropical environments may be expected to begin 10 weeks after sowing and to continue up to another 10 weeks. Seed is ready to be harvested when flowers begin to turn silvery in color and the leaves turn yellow. To harvest the seed, cut the whole flower spike and place in a bag that allows air to circulate. Store in the shade until dry, and then thresh. Alternatively, you can collect seed weekly because seed is formed starting at the base while the flower keeps growing longer. Hold a container under the seed head and rub or tap it gently.

Seed yield is 200-700 kg/ha. One thousand (1000) seeds weigh 1.0-1.5 g.

PESTS & DISEASES

Although relatively pest-free in temperate regions and at ECHO's subtropical location in Florida, *C. argentea* sustains damage from a number of diseases and pests in the tropics. Spider mites and nematodes tend to be the biggest pest problems. Also reported in Nigeria are the variegated locust and a beetle, *Baris planetes*, which attack and feed on immature seed capsules causing seed loss. Sometimes caterpillars feed on the foliage, and grasshoppers and aphids can cause minor damage. Nut grass (*Cyperus spp.*) is a serious weed problem.

C. argentea is reported to be quite susceptible to root-knot nematode (*Meloidogyne spp.*) infection causing the formation of galls on the roots, stunted growth, small brown-colored leaves and reductions in yield of up to 40% (however, at ECHO, where root knot nematode problems are severe in general, we have no difficulty whatsoever growing *C. argentea*).

White rust (*Albugo blitii*) and crown blight (*Choanephora cucurbitarum*) are considered the most serious fungal diseases affecting *C. argentea*, and are most problematic during the rainy

season and when there is high humidity. Appropriately spaced plant stands, clean fields (free of diseased and dead plants) and resistant varieties can help to significantly reduce fungal disease damage to your crop.

Other diseases include damping-off, collar rot and leaf spots.

Use appropriate measures to control diseases and pests without endangering your household or the environment. If you must utilize commercial chemicals, remember to read the label and understand how to safely apply the chemical, how to clean yourself and your equipment afterwards and how to safely dispose of the empty container.

ECHO has seeds of Lagos Spinach. We have 'Green' and 'Mixed' (mixture of red and green) types. Those serving small-scale farmers overseas may request a free trial packet. For others, please send \$4.00/packet to cover seed and mailing costs. Each packet contains half a teaspoon of seeds. We have just obtained seed for several new varieties and will announce their availability in future EDN issues after we have increased the seed supply.

A list of references and useful resources is found in the Technical Note. Request a copy, or check our website.

UPCOMING EVENTS

South East Asia ECHO Agricultural Conference
Chiang Mai, Thailand
June 10 to 14, 2007

The South East Asia EAC will be structured much like the annual EAC that takes place in Florida, including morning plenary (whole group) talks; afternoon workshops; and concurrent evening presentations. ECHO conferences are designed for community development workers in a broad region to share knowledge,

experiences and needs with each other. We like to call it a "networking conference." Most of the presentations at the South East Asia EAC will be particularly relevant to agricultural issues and options encountered in that region. Other topics will be of general interest with regards to agricultural development. The last day of the conference will consist of a choice of local conference tours. Visit the ECHO website for more information (www.echonet.org).

Registration information is available on the ECHO Events website at www.echonet.org. Click on "Southeast Asia ECHO agricultural conference" on the bottom right hand side. The registration deadline is May 1. If you are unable to access the registration form online, write to us at ECHO (address on page 1). Be sure to include a phone number and other contact information.

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