EDN ECHO Development Notes

June 2000
Issue 68

Edited by Martin Price, Ph.D.

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

New Uses of Moringa Studied in Nicaragua

By Lowell Fuglie

We featured the work of Dr. Lowell Fuglie (Church World Service, Dakar, Senegal) with the moringa tree as a base for a nutrition program in EDN 64. *When he spoke at ECHO's conference last November he told us that he had heard of innovative research into uses of moringa in Nicaragua. In April of this year he made a trip to Nicaragua to see this work first-hand. The following is his report on that trip. While parts of this project make use of machinery that few in our network would have available, the results can still be helpful. You might find a way to adapt to your situation, even if yields might be less. Editor.*

I was able to pay a 4-day visit to Nicaragua last week to see the work done by Nikolaus and Gabriele Foidl of BIOMASA in research on the moringa tree (*Moringa oleifera*). They have accumulated a wealth of new information about the use of moringa in agroforestry systems, as cattle feed, as a growth hormone for plants, as well as insights into oil extraction and water treatment.

BIOMASA is an agricultural research program located in Nicaragua that has studied various aspects of moringa for over six years.

Moringa Leaf Extract As A Plant Growth Hormone

Juice from fresh moringa leaves can be used to produce an effective plant growth hormone, increasing yields by 25-30% for nearly any crop: onions, bell pepper, soya, maize, sorghum, coffee, tea, chili, melon . . . One of the active substances is Zeatin: a plant hormone from the Cytokinines group. This foliar spray should be used in addition to (and not in lieu of) other fertilizers, watering and sound agricultural practices.

In one trial, use of this spray increased maize yields from 60 to 130 sacks per hectare. Using this hormone, BIOMASA was able to grow coffee at 30 meters altitude. Coffee, shaded with *Jatropha curcas*, produced beans in just 17 months.

Here is how they make the spray:
a) Make an extract by grinding young moringa shoots (not more than 40 days old) together with a bit of water (about one liter per 10 kg fresh material).

b) Filter the solid out of the solution. This can be done by placing the solution in a cloth and wringing out the liquid. The solid matter, which will contain 12-14% protein, can be used as livestock feed.

c) Dilute the extract with water at a 1:32 ratio and spray directly onto plants (if the extract is not going to be used within five hours, it is best stored in a freezer until needed). Apply about 25 ml per plant.

The foliar spray should be applied 10 days after the first shoots emerge from

the soil, again about 30 days before plants begin to flower, again when seed appears and finally once more during the maturation phase.

Nikolaus Foidl with coffee under Jatropha

Moringa Shoots As Green Manure

Using moringa as a green manure can significantly enrich agricultural land. In this process, the land is first tilled. Moringa seed is then planted 1-2 cm deep at a spacing of 10x10 cm (a density of one million seed per hectare). The density can be greater. The only limits to plant density are availability of seed, water and fertilizer. After 25 days, the seedlings are plowed into the soil to a depth of 15 cm. The land is prepared again for the crop desired.

Seeding can be done mechanically if the seed is first de-hulled. Planting kernels will reduce germination time by up to three days.

A simple method of seeding is to first rototill the soil to a depth of 10 cm, then scatter seed over the soil and rototill again to a depth of 2-3 cm.

Intensive Moringa Leaf Production

Whether produced for use as a green manure, for livestock or for human consumption, moringa can be grown intensively with yields of up to 650 metric tons of green matter per hectare. This compares very well to other green manure crops such as lablab beans, which yield up to 110 tons/hectare of green matter in pure stands.

These high yields were obtained through subsoiling to a depth of 60 cm (to encourage drainage and good root development), rotavating, then planting moringa at a 10x10 cm density (one million plants per hectare) with sufficient fertilizer (cow dung is preferred). BIOMASA did sub-soiling with a deep plugging unit produced by a German company called HOWARD (unit costs US$8,000 and requires a 150 HP tractor).

The green matter is harvested when plants reach a height of 50 cm or more (every 35-40 days), cut at a distance of 15-20 cm above the ground. Although losses of seedlings may be 20-30% in the first year, the vigorous regrowth of the remaining seedlings will produce 3 or 5 new shoots after each cutting. Up to nine harvests can be obtained annually. In time (some of BIOMASA's moringa stands are three years old) the 15-20 cm stem will become thick and woody but will continue to send up green shoots.

The 650 metric ton yield was obtained in sandy, well-drained soil at 30 meters altitude. Rainfall was 1300 mm annually with irrigation practiced during the dry season. At this level of production, the nutrient requirement per hectare each year is:

1,800 kg Calcium	0.5 kg Copper
1,400 kg Magnesium	380 kg Phosphorus
0.6 kg Boron	280 kg Nitrogen
0.3 kg Zinc	

Intensive leaf production in Senegal

For bulk orders, local fertilizer producers can mix this to order. Barring that, adding urea to existing fertilizers can provide many of the needed nutrients. [Ed.: Note that the

soils in other locations may be able to provide a portion of these requirements and fertilizer needs may be different.]

Moringa As Livestock Feed

BIOMASA conducted extensive trials using moringa leaves as cattle feed (beef and milk cows), swine feed, and poultry feed. With moringa leaves constituting 40-50% of feed, milk yields for dairy cows and daily weight gains for beef cattle increased 30%. Birth weight, averaging 22 kg for local Jersey cattle, increased by 3-5 kg.

The high protein content of moringa leaves must be balanced with other energy food. Cattle feed consisting of 40-50% moringa leaves should be mixed with molasses, sugar cane, young elephant grass, sweet (young) sorghum plants, or whatever else is locally available. The maximum protein and fiber content of livestock feed should be:

	Protein	Fiber
Lactating cow:	18%	26-30%
Beef cow:	12-14%	36%
Lactating sow:	16-18%	5-7%
Meat pig:	12-14%	5-7%

Care must be taken to avoid excessive protein intake. Too much protein in pig feed will increase muscle development at the expense of fat production. In cattle feed, too much protein can be fatal (from alteration of the nitrogen cycle).

Nutrient value of moringa leaves can be increased for poultry and swine through the addition of an enzyme (phytase) to break down the phytates, leading to increased absorption of the phosphorus found in moringa. The enzyme should be simply mixed in with the leaves without heating. It is NOT for use with ruminants. [Companies that sell phytase include Roche (Hoffman-LaRoche), which has distributors worldwide. ECHO was quoted a price of US$6.40/kg of Ronozyme™ P (also sold as Roxazyme™ in some regions). One kilo of enzyme at that concentration can treat 3333 kg of broiler chicken feed, the same amount of swine feed, or 5555 kg layer chicken feed. If you don't know of a local Roche dealer you can find one on the internet at www.roche.com/vitamins/areas.html or write to their mail order address at Roche Vitamins Inc., PO Box 910, Nutley, NJ 07110-1199, USA.]

Cattle were fed 15-17 kg of moringa daily. Milking should be done at least three hours after feeding to avoid the grassy taste of moringa in the milk.

With moringa feed, milk production was 10 liters/day. Without moringa feed, milk production was 7 liters/day.

With moringa feed, daily weight gain of beef cattle was 1,200 grams/day. Without moringa feed, daily weight gain of beef cattle was 900 grams/day.

The higher birth weight (3-5 kg) can be problematic for small cattle. It may be advisable to induce birth 10 days prematurely to avoid problems. Incidence of twin births also increased dramatically with moringa feed: 3 per 20 births as opposed to the usual average of 1:1000.

Moringa Leaf Concentrate

Chickens will not voluntarily consume moringa leaves or moringa leaf powder. However, about half the protein content can be extracted from the leaves in the form of a concentrate which can then be added to chicken feed (or used in many other ways). The protein content desired in chicken feed is 22%. To obtain the concentrate, mix leaves with water and run the mix through a hammer mill. Heat this mash to 70 degrees Celsius for 10 minutes. The protein will clump and settle to the bottom. After pouring off the liquid, this can then be freeze-dried.

A somewhat simpler alternative to freeze-drying is to take a pressure cooker and fit in the top a copper tube or steel tube. Take a compressor from an old refrigerator. Link the tube to the compressor inlet and run the compressor. At a temperature of 300 C and about 50 mm of vacuum you can take out most of the water by evaporation in vacuum (in case you need it dry).

But if you wish to use it as a fresh fodder just take the sludge after sedimentation and mix it with dry fodder until you can handle it as a semidry mass. Then press it through a meat grinder to make homemade pellets. For pig fodder just mix the pellets with the normal fodder (be careful not to overdo it - fattening pigs need 12-14% and lactating pigs 16-18% protein).

Moringa Seed Oil Extraction

Nikolaus Foidl designed a motorized moringa seed de-huller with a built-in blower to separate out the chaff. The de-hulling part of the machine consists of two revolving rubber plates slightly oval in shape. Seed is run through 3 times, with the space between the plates diminished slightly each time (smaller seed not de-hulled the first time will be de-hulled the 2nd or 3rd time).

Nikolaus suggests that a screw press made of simple iron may be better suited to moringa oil extraction than one made of steel. Chromium and nickel in the steel may react with the oil and lower oil quality. One possibility is the FAKT press, a German-designed oil press now produced in India, which BIOMASA has successfully used to extract Jatropha oil. The FAKT press costs about US$1400 and will process 80-90 kg/hour. [Contact FAKT - Associated Consultants, Stephan Blattman Str. 11, 78120 Furtwangen, Germany; phone: +49 7723 91 20 63; fax: +49 7723 53 73; e-mail: ReiMetzler@aol.com.]

Following extraction, moringa oil should be filtered (through cheese cloth or coffee filter). This will remove the protein content upon which bacteria feed. Viscosity of oil can be improved by heating it to 40-50° C before filtering.

At Church World Service in Senegal, one oil extraction trial used kernels that had been de-hulled three months earlier. The oil promptly separated into a milky wax and liquid. According to Nikolaus, this was probably due to the rapid deterioration in the stored kernels of the anti-oxidant vitamin E. A few (1-5) drops per liter of the essential oil of sage, rosemary or mint (or a twig of the latter), both excellent anti-oxidants, can be added to moringa oil to stabilize it. (Trials can be done to determine at what point the taste of the sage or rosemary oil becomes noticeable.)

Water Treatment

Among other achievements, BIOMASA installed a water treatment system using moringa seed powder in one village in Nicaragua. BIOMASA also isolated the active ingredient, a polyelectrolyte, in the laboratory. One hundred kg of moringa kernels will produce about 1 kg of (almost pure) polyelectrolyte.

BIOMASA found that the level of polyelectrolyte present in the kernels is substantially less during the wet season. (This may explain why, in our work in Senegal, a water treatment experiment done last September failed to work!) Seed harvested for water treatment should be harvested during the dry season only.

Seed powder can also be used to harvest algae from waste water, currently an expensive process using centrifuges. Spirolina algae is farmed in Mexico and Israel with minor production in other countries. The spirolina are used in health food and cosmetic products, and it is a common fish food ingredient. Seed powder will cause the algae to sink to the bottom. Once harvested, further drying can be done with a simple steam-heated drum dryer heated to 110°C to kill eggs, etc. In feeding fish, 100% of protein can come from algae sources. For cattle feed, however, at most 10% of protein content can be replaced with algae protein. It should also be cautioned that algae food or feed products can contain toxins from the water in which it was grown.

General Notes

According to Foidl, moringa wood makes excellent pulp - as good as poplar (*Populus* sp.).

Leaves are excellent for biogas production.

The effective altitude limit for growing moringa is 500 meters. [Ed: This might be higher nearer the equator.] Excessively windy conditions will cause the tree to dry out.

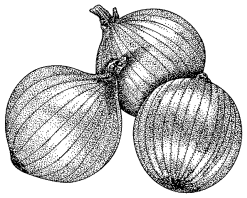
Vitamin A (Beta-carotene) content: there are around 25 kinds of B-carotene. Efficiency of retinol production varies among types. Research is still required to know more about the B-carotene types in moringa leaves and their efficiency in transforming carotene to retinol, as well as the losses or inactivation due to various moringa processing methods.

We've had to be brief about most of these processes. For more information contact: Nikolaus Foidl, Proyecto Biomasa, Uni Rupap, Costado Sur, Villa Progreso, Managua, Nicaragua; e-mail: biomasa@ibw.com.ni. ECHO also has added a new website on moringa to the internet at www.moringaseed.com.

Producing Onion Powder for Sale and to Extend the Season

By ECHO interns Phil Watson, Dawn Bakker, & Jason Dahlman with Daniel Sonke

ECHO recently received a letter from Sister Luisa Campos in the Dominican Republic asking us for information on how to process onions into powder. This processing would be for long-term storage and for the economic advantage of selling the processed onions at a greater price when fresh onions are no longer available.



For example, Tom Post with the Christian Reformed World Relief Committee told us of an innovative farmer in Belize who found a way to grow one particular cultivar of onion in an area where onions were not a commercial crop. He made more on his small plot of onions than the rest of his farm. But the next year he could not sell his crop because the local stores found that the bulbs soon rotted. The project ended. Perhaps in a situation like that, if there had been a market for onion powder, the farmer could still have succeeded.

We researched this topic and found a very helpful article published by GTZ in the March 1983 issue of their publication, *GATE*. The article, entitled "Appropriate technology for dehydration of vegetables and fruits" by T.H. Jackson, outlines the principles behind dehydrating all sorts of fruits and vegetables but goes in depth into the processing of onions. The article is written from a village industry perspective and employs a great deal of appropriate technology principles. (The article was found on a very helpful CD-ROM, *The Humanity Development Library*, containing over 1200 books, reports, and magazines, including ECHO's book *Amaranth to Zai Holes: ideas for growing food under difficult conditions.* The CD-ROM is available from ECHO to overseas development workers for $12.00, including airmail postage overseas.)

We also received some helpful advice about onion processing from the United Kingdom-based Intermediate Technology Development Group (ITDG), an independent charity providing resources on technologies suitable for rural communities in developing countries.

We gleaned information from each of these sources to summarize a method of processing onions into powder. Then we asked ECHO appropriate technology intern Jason Dahlman to try out some of these methods on onion and garlic. His experience is incorporated into the rest of this article.

1) Preparation. Production of onions should be timed, if possible, so that the harvest coincides with a season of warm, dry weather. Ideally, preparation should start early in the morning, so that drying can begin the same day. Use clean onions of good quality and free of blemishes. Wash the onions in drinking-quality water (i.e. boiled or chlorinated), then remove the outer skin, growing tip, and roots. Peel the onions and slice thinly to an approximate thickness of 4 to 5 mm (0.16-0.20 in).

Jason used both white and yellow onions throughout the process and found no noticeable difference between the two. He found that slices must be separated into rings to dry properly.

The articles we read recommend blanching the sliced onions. Blanching is not actually necessary when drying onions, but it is suggested because the heat should destroy enzymes in the onions that would otherwise cause them to turn brown in color. One way to blanch onions is to wrap the slices in a muslin cloth, place them in a wire basket with a tight fitting lid, and suspend the basket over a pot of boiling water for 3-5 minutes. Steam will also kill some microorganisms that could cause spoilage.

In Jason's experiment the steam blanching process resulted in sticky onions and garlic which were more difficult to utilize. Perhaps more practice with various blanching methods (such as a quick immersion in boiling water instead of steam) and times would minimize the stickiness. ECHO appropriate technology specialist Charlie Forst suggests that instead of blanching, a citric acid or ascorbic acid treatment may be used to prevent browning. Citric acid is widely available as a flavoring powder or food preservative and is sometimes sold as "lemon powder." Ascorbic acid powder is widely available in the US as a powder used in canning or jam making. Mix 1 teaspoon (5 ml) of powdered citric acid or ascorbic acid per each 2 cups (1.1 liters) water. Dip the onion slices in the solution for just a minute or two. Remove and proceed with the drying process.

2) Drying. The simplest and cheapest method of drying onions, according to T.H. Jackson, is to sun dry them by spreading the slices on trays made of a wooden frame, for example 50 cm by 80 cm, with a base of nylon mesh (approximately 1.5 mm mesh size). Use poles to elevate the frame to table height, both to allow for air circulation and to avoid contamination. For the first day, turn the onions every hour. After that, turn them a few times throughout the day. Allow the onions to dry to a moisture content of about 10%. When the onions are dried to the correct level, they become brittle and will easily snap when bent. In a semiarid climate with warm, dry weather (ideal for drying onions), this should take between 3 to 5 days. In the moist tropics, drying onions to the right moisture content is more difficult.

One improvement over open air drying is to raise the ambient air temperature by enclosing the trays in a solar dehydrator and/or using a wind driven extractor fan. One very simple type of solar collector which can help decrease drying time is a sheet of corrugated iron painted black on the side exposed to the sun. The corrugations help to give ventilation. The iron can be placed either under or over the tray; the latter may help protect against flies and damage from sunlight. A similar effect could be produced by mounting a tray underneath the roofing metal on a metal roof in a warm climate. An additional advantage to drying in a dark location is that the color of the finished product will likely be lighter, which would be considered higher quality by consumers.

Using a solar dehydrator method may reduce drying time to as little as three to nine hours.

At 10% moisture, onions have a reasonably long storage life, but to make onion flakes or powder it is recommended that they be dried further, to no more than 6% moisture content. This 6% moisture content is also recommended for safe hygiene. Export specifications for some dried onion products require this moisture level. To achieve 6% moisture, blow or draw heated air through a bed of the dehydrated onion slices. With air between 50-55°C (122-131°F), it will probably take about eight hours to reach the desired moisture level. Only a small airflow is needed for this process, so a solar-energy-powered fan is quite feasible. [Ed.: While we don't have a simple test for a 6% moisture level, using these drying methods will presumably achieve a moisture level that is close to 6%. If one is marketing locally at test is presumably not needed as long as the product is satisfactory.]

Several simple designs for solar dryers are described in a booklet by Intermediate Technology. The booklet, *Drying*, is number six in a series of Food Cycle Technology Source Books (see *Amaranth to Zai Holes*, p. 279). This booklet is available from ECHO's bookstore for $15.50 plus $4.00 surface shipping and handling. It is also available from Intermediate Technology at Myson House, Railway Terrace, Rugby, CV21 3HT, UK.

Jason found that the humid climate at ECHO during the week he did his experiments made open air drying ineffective, especially for the onions. Even though he did the work during our dry season, neither onions nor garlic dried enough to make powder. In contrast, garlic dried well in a solar dryer with no fan. It dried even better in a solar oven designed to roast or bake foods. He had problems with

onions drying too slowly in the solar dryer he used and drying too quickly (searing on the outside preventing drying inside) in the solar oven. We suspect, however, that further experimentation with solar dryer models and drying times could result in onions drying effectively here at ECHO.

A standard kitchen oven on low heat works well for drying vegetables. Simple electric dryers are available in the US and other Western nations as well. Jason found that it was very easy to dry onion in ECHO's electric dryer. Perhaps the cost of such a dryer is economical enough to warrant investigation by projects with a little investment money. Costs typically range from US$50 TO $350 for home models. Lehman's Hardware and Appliances sells nice kitchen models for US$165.00 (with 8 square feet of drying rack space on stacked racks) or US$197.00 (for a model with 14 square feet of rack). Contact Lehman's at One Lehman Circle, PO Box 41, Kidron Ohio 44636, USA; phone: 330-857-5757; fax: 330-857-5785; e-mail: info@lehmans.com; www.lehmans.com.

3) Powdering. After drying, the product may be broken up into small, uniform sized pieces using a "kibbling" machine. This may be a special slicing machine or a mill set to produce large bits rather than fine powder. The larger onion flakes can then be separated from the finer material with a sieve and packaged for sale as flakes. The advantage of a kibbling machine is that the onion flakes produced with it generally command a higher price than does onion powder. However, the machine would also require a capital investment of anywhere from US$50 to $175 for a hand mill or much more for a custom-made, powered machine. If the finished product is to be marketed locally, the kibbling operation can be omitted. You can instead choose to powder the onions directly after drying.

To powder the onion slices, use a mortar and pestle, rolling pin, or a stone mill for small-scale operations. Powered mills (plate mills ["burr mills"] or hammer mills) are recommended for larger operations. Further reduce the finer material down to a less than 6% moisture content in the air dryers and then mill the product. Ideally, the ratio of raw onion to processed dried onion is 10:1 (The article did not specify if this is a weight or volume ratio, but presumably it is by weight).

4) Packaging. Sealed packaging is important to prevent powdered onion from clumping or spoiling due to regained moisture. Use sealed glass jars or good quality sealed plastic bags for best storage of dried, powdered onion, since the tendency of onion powder to cake is increased by moisture. Very strict attention to cleanliness is essential to prevent contamination of the onion powder.

If you are interested in the production of onion powder for sale, make sure you run small-scale onion processing trials before you attempt commercial production. You also might want to inquire about opportunities for training in packaging and marketing.

A final item to keep in mind if you intend to process onions as a business: Dr. Leslie Currah of Currah Consultancy, United Kingdom, mentioned that onion powder can be quite flammable. This could pose a danger when large amounts are stored or when clouds of dust are flying around in the powdering area.

Germinating Oil Palm Seed

Abstracted by Kristin Davis

One problem with growing oil palms (*Elaeis guineensis*) is that the seed germinates with difficulty, sometimes taking two years! The Methodist Relief and Development Fund's magazine *MRDF: Africa Link* highlights some ways of improving germination in the June 1999 issue.

"A one-foot deep pit is dug and the bottom is lined with male inflorescence [flower] from the oil palm. Next a layer of ripe oil palm fruits (taken from the inside layers of the fruit bunch) is laid down and covered with a thick layer of grass, then a layer of soil, and finally a layer of banana stems (to prevent chickens from scratching out the contents)."

This 'compost' germination pit is watered lightly each day to encourage the contents to heat up as in a normal compost pit. After five or six months the pit contents are opened up, by which time there should be the start of good germination. The seedlings are taken from below the surface as soon as the growing shoot appears through the shell (up to 1 in [2.5 cm] in length), and then transplanted into prepared polyethylene bags around 12 in (30 cm) height and 7 in (17.5 cm) diameter."

The seed can also be placed in a cloth or burlap bag with soil, watered and buried in the ground beside the cooking fire for a month before hanging in the rafters for three weeks, at which point germination should begin.

A new variety of oil palm has been developed that will grow in higher altitudes. (The 'Dura' type will grow in the highlands but has lower yields of oil.) The Food and Agriculture Organization (FAO) and a Costa Rican company called ASD bred the new hybrid from 'Dura' and the high-yielding 'Tenera.' The result is a high-yielding variety of oil palm for the highlands. It has been tested in Ethiopia to 900 meters.

Contacted ASD at P.O. Box 30-1000, San Jose, Costa Rica; phone: (506) 257 2666, fax: (506) 257 2667; e-mail: g.alpizar@asd-cr.com. Also, The Malaysian Oil Palm Promotion Council has a web site on the oil palm with information on history, nutrition and recipes at www.mpopc.org.my.

Easy recipe for mole repellent

By Daniel Sonke

[I have not found evidence that moles, a burrowing mammal, are considered a pest outside North America. However, many other burrowing mammals are considered pests in the tropics. ds.]

Organic Gardening magazine of April 1998 had this easy recipe for creating a mole repellent (p 60): "Combine 1/8 cup (1 oz. or 29.5 ml) of castor oil per gallon (3.8 liters) of warm water, and a few drops of dish detergent to help mix the oil with the water. You can apply the repellent with a tank sprayer or a sprinkling can, covering about 300 square feet (27.9 m^2) with each gallon." In a subsequent issue there were letters praising the effectiveness of this simple recipe. One reader offered this alternative recipe: "Mix 1 tablespoon (14.8 ml) castor oil and 2 tablespoons (29.5 ml) liquid soap in a blender until it gets stiff like shaving cream. Then mix in 6 tablespoons (88.7 ml) of water; combine 2 ounces (59 ml) of this mixture with 2 gallons (7.6 liters) of water in a watering can and pour the solution along the property line." Perhaps these recipes would be effective on other animal pests? If you try them, please let ECHO know whether or not they are effective, with some details of your situation.

Prevention of Malaria with Insecticide-Treated Nets

Abstracted by Kristin Davis

From *Footsteps* No. 33, "Insecticide-Treated Nets" & IAMAT (International Association for Medical Assistance to Travellers), "How to Protect Yourself Against Malaria" 2000 edition.

Over 2.5 million people, mostly in Africa, die from malaria every year. Malaria is caused by a parasite called *Plasmodium* carried by the female *Anopheles* mosquito. She bites people and animals in order to obtain blood which she needs to develop of her eggs.

The *Anopheles* mosquito can be recognized by its posture. It looks as if it is standing on its head with the rear legs up in the air. Other mosquitoes sit flatter on a surface. *Anopheles* are also silent; they do not buzz around your head but instead fly straight towards you.

Mosquito nets are effective in protecting people sleeping under them as long as the nets have no holes and people are not sleeping up against them. However, a mosquito will continue searching until it finds a way in or finds part of the body that is against the net where it can bite through.

Using insecticide-treated nets has shown to bring a 20-60% reduction in malaria. When a mosquito encounters a treated net they will either die or fly away.

Nets are first placed into a dilute liquid insecticide mixture. The nets should be clean and dry. You can use insecticides such as permethrin, deltamethrin or lambdacyhalothrin.

Calculate the area of the net you want to treat. Remember that some nets are shaped such that you must measure height as well as length and width. For rectangular nets, add up the total surface area (two times the area of the sides plus two times the area of the ends plus the area of the top). With a circular net, lay it out flat and then multiply the base circle area measurement by the height.

Next, measure how much liquid one net soaks up. Put a measured amount of water into a bowl, soak the net in it and then wring it out into an empty container. Measure the wrung out amount and subtract this from the original amount of water to find how much water the net soaks up.

To estimate the amount of insecticide needed (in ml), you multiply the recommended dosage (mg/m^2) by the area of the net (m^2) and divide that by the concentration of the insecticide (%) times ten.

$$\text{Amount of insecticide needed (ml)} = \frac{\text{Recommended dosage (mg/m}^2\text{)} \times \text{Area of net (m}^2\text{)}}{\text{Concentration of insecticide (\%)} \times 10}$$

For instance, deltamethrin is sold by the trade name K-Othrin. It comes in a concentration of 2.5% (sometimes written as 25 ml/liter or 25 ppt) and the dosage is 25 mg/m^2. If your net is 6.5 m^2, you multiply 25 x 6.5 and divide that by 2.5 x 10, coming up with 6.5 ml.

Put that amount of insecticide into the amount of water you have estimated that your net can soak up. Use rubber gloves and work outside. Soak the net, wring it out and then dry it. They are then ready to be hung. Wash all your equipment, clothes and skin with soap and water and properly dispose of leftover insecticide and bottles. The nets only need to be treated twice a year.

For those who can't afford nets, curtains can be treated in the same way, or other materials can be used in the place of mosquito netting.
Other ways to prevent bites:

Wear long-sleeved shirts and trousers after dusk. Light colored clothing seems to help as mosquitoes are more attracted to dark clothing. Avoid wearing perfume or after-shave. Use mosquito repellent on your skin and clothes.

Spray bedrooms with pyrethrin insecticides at night before going to bed. Mosquitoes like to hide in dark corners, in closets, under beds, etc.

Tie up mosquito nets during the day. Check for mosquitoes when putting them down at night. Mend holes and tears in the nets. Make sure the net is tucked in around the sleeping person, and as much as possible, avoid touching the net while sleeping.

Avoid leaving breeding places for mosquitoes such as uncovered containers of water. Garlic sprays will also keep the larvae away from standing water.

Correction

We incorrectly listed the e-mail for Bejo Seeds in the last issue. The correct address is potato@bejoseeds.com. Their web site can be found at www.bejoseeds.com/potato.

UPCOMING EVENTS

ECHO's Seventh Annual Agricultural Missions Conference
November 14-16, 2000
ECHO, Ft. Myers, FL, USA

Registrations are now being accepted for ECHO's AMC 2000. This year promises to be a great one. Here are just some of the 2000 speakers. Mike Benge, a forestry expert with the US Forest Service will be speaking on practical experiences with agroforestry and multipurpose trees.

Calvin Yoke from WoodMizer, a sawmill company will speak on management. This was a very popular talk in a previous conference.

Phil Rowe, a banana breeder from Honduras with the Honduran Foundation for Agricultural Investigation, will speak on improved banana and plantain varieties and will bring tissue-cultured plantlets of his best varieties along to distribute.

Dr. Bryan Brunner, head of the horticulture department at the Univ. of Puerto Rico, will speak on general production practices for papaya, from seed to harvest and techniques for pruning passion fruit. He will also touch on the topics of production of tropical cut flowers for income in appropriate situations and collection and sale of seeds of ornamental and timber species.

Professional beekeeper Harry Volker will lead two workshops on beekeeping. One will be a hands-on introduction to beekeeping for the beginner. The other will be on beekeeping in the tropics. He has taught these subjects in Belarus and Zimbabwe.

Steve Baima will demonstrate an "appropriate technology" alternative to the wheel chair, to give mobility to the handicapped in Third World settings. He will also share first-hand experiences with its actual use.

You may not realize how much the ECHO staff learns from these conferences we host. I can assure you that we are looking forward to learning from the 2000 speakers AND the delegates, since learning from each other is a theme at ALL our conference. Contact ECHO for registration and more information.

IFOAM 2000 – The World Grows Organic
August 21- September 2, 2000
Convention Center, Basel, Switzerland

More than 1000 participants are expected at the IFOAM (International Federation of Organic Agriculture Movements). There will be a wide range of subjects and participants at the conference. Sessions will be in English with translation to Spanish, French and German available. A very brief sampling of sessions and workshops includes genetic engineering, organic cotton, tropical fruit production, indigenous knowledge, and pigs in rural development.

For more information contact IFOAM 2000/FiBL, Ackerstrasse, CH-5070 Frick, Switzerland; tel. (41) 0 62 865 72 97; fax (41) 0 62 865 72 73; e-mail ifoam2000@fibl.ch; web site www.ifoam2000.ch.

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