
New Uses of Moringa Studied in Nicaragua

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.

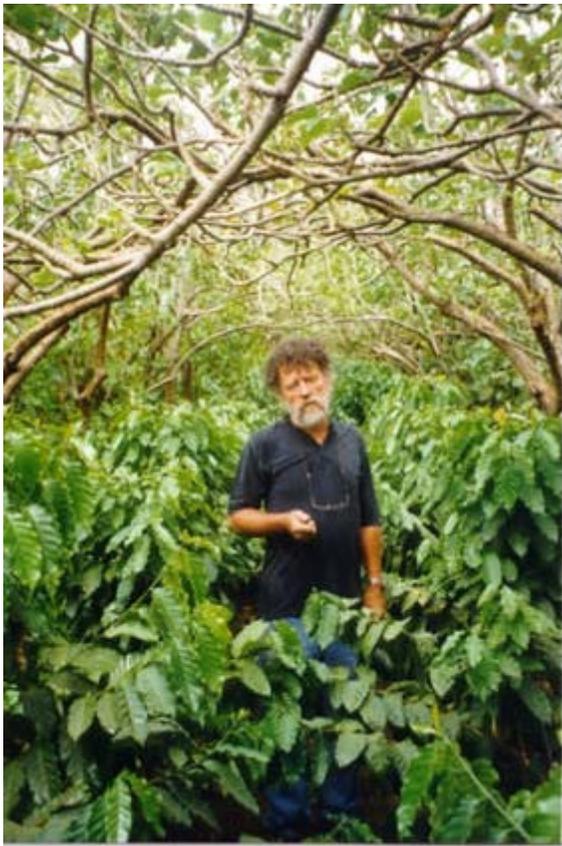
Here is how they make the spray:

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 dehulled. 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	

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.]



Intensive leaf production in Senegal

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 Ronozymetm P (also sold as Roxazymetm 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 (<http://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 dehulling 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 dehulled 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 antioxidants, 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 spiroolina 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.