

EDN ISSUE # 12, AUGUST 1985

12-1. INTRODUCTION TO ISSUE 12. You will notice one difference in this issue. I normally feature many relatively short notes, making longer articles available as Technical Notes that you can request. This time there are fewer articles in order to share with you a timely but longer article on green manure crops written for us by Roland Bunch. Roland is author of the book Two Ears of Corn that we reviewed in issue #6. Let me know what you think of this different approach.

Roland's enthusiasm is contagious. "Our (World Neighbors) extensionists in Honduras who have worked in some of the most successful programs in Central America told me several times during my last trip that they have never before seen a technology develop so much enthusiasm and take off with so little program effort. They have done virtually no promotional work on it, yet it is taking off like wildfire. The program is harvesting seed by the 100 pound bag and cannot meet even a fraction of the demand." He mentioned that one farmer told him he is saving \$100 per year in coffee purchases by using the roasted beans of one ground cover, velvet bean, as a coffee substitute. (Doug and Ruth Welch had mentioned to me that it is used in this way in Zaire also). I think you will find his discussion helpful.

12-1. SEED FOR HIGH CAROTENE CARROTS AVAILABLE. Dr. C. E. Peterson is making this special seed available to our readers. He writes, "It is generally agreed that vitamin A is the 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 new USDA hybrid, A Plus, has over 150 ppm and variety 951-1 has over 320 ppm." To give a feel 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." I mentioned that it would be of no value to you if these did great but seed was not available in quantity in later years. He said two seed companies are planting now with harvest due in 1986. He will have a few thousand packets himself next year. If you would like to try them, just drop us a note. Because Dr. Peterson is very eager to learn how they do and are liked, be sure to report back to us.

12-1. SCHOOL GARDEN MANUAL COMBINES GARDENING WITH TEACHING. Marney Smith with Save the Children writes, "Although we are not ready for widespread distribution, we are interested in building a list of those who would like to receive a copy in the future. Can you mention it in your next newsletter? The manual is now being field tested for a year before translation into several languages and publication. It is designed specifically for Third World elementary and secondary schools. It demonstrates how a garden can be used as a classroom to teach ecology, plant and soil sciences, art, research, record-keeping, nutrition and entomology. Sections include how to start a school garden, techniques for cultivation, fertilization and organic insect control and several sections of curriculum." It sounds interesting. Let her know what language would be most helpful. Write Ms. Marney Smith, Gardening Consultant, Save the Children, P. O. Box 950, Westport, CT 06881, USA.

12-1. ANSWERS TO SOME QUESTIONS ON CITRUS Two of our readers asked some interesting questions about citrus. We called Larry Reed at Holm Citrus nursery who has so often been helpful. The questions and answers are of general interest, so I repeat them here.

Q. (From William Boykin in Zambia). "The navels, valencias and hamlins do not have the sweet flavors we had hoped. Is there anything we can do, or might it be the rootstock? We budded onto cape lemon."

A. The cape lemon rootstock is your major problem. Lemon rootstocks produce big quantities of fruit, but the quality is always poor. Lemon rootstock is for commercial juice production where they want to emphasize quantity. They then mix with smaller amounts of other juices to get the right taste. An advantage of the lemon stock is rapid growth, it being more vigorous than other stock. However, this also results in poor taste. Climate can also cause inferior taste. It would help if the climate were cooler. I would suggest budding onto either Carizzo or sour orange. They may not allow sour orange into the country because it is so susceptible to Tristeza. For example, Brazil's citrus industry was wiped out some years ago by tristeza. But it depends a lot on how virulent is the strain in your country. It is so good that I would take the risk and not worry too much about tristeza. My third choice would be Cleopatra mandarin. The disadvantage with it is foot rot. This world-wide problem is caused when workers injure the root while cultivating. It is most susceptible during the first 5 years. The safest thing would be to use a combination of rootstocks. Then it will be unlikely that you will be wiped out.

If you wish to plant some true-to-type seeds I would recommend two varieties: ridge pineapple or what is called "old sweet seedling." By the way, any true-to-type seedling [plant grown from seed that will give fruit like the parent tree] is susceptible to foot rot.

Q. (From Peter van Lonkhuyzen in Haiti). I have used budwood from some three year old trees that are not bearing fruit yet. Someone told me that by using such young trees my grafted trees will start bearing late and never will give good yields. Is this true?

A. A grafted tree will normally start bearing some fruit within a year. The fact that the parent trees you used were not bearing at three years suggests that they were seedlings. If so, you will have to wait about as long as if you had planted the seed.

There is one way you can get some quick budwood. Take budwood from a mature bearing tree and graft onto a rootstock in your area. As soon as this has grown to produce some branches, you can use this to bud other trees. They call this "first generation budwood." However, the second generation of trees should not be used for budding until they have started bearing.

Q. What rootstock should I use that is resistant to both drought and tristeza?

A. Sour orange is drought resistant, but if you want tristeza resistance also I would recommend Carizzo. Of course, even that is only drought resistant to a point. True-to-type seedlings will never tolerate drought as well as the normal rootstocks. I might also mention that a rooted cutting from any variety of citrus will have about half the normal life expectancy of a grafted citrus, due to susceptibility to a range of root diseases.

Q. How is it possible that in some places they have Washington naval trees without thorns while somewhere else the same variety has thorns?

A. There can be some differences in thorniness within a variety. In the one location they must have budded from trees that did not have thorns. You will still have some thorns of course. Alternatively, the thorny ones could be seedlings, as they tend to have more thorns.

[Editor:] Larry has been most helpful to readers who have ordered from his wide variety of citrus seeds. He can supply anything mentioned above and more at a very fair price. Until the citrus canker problem is cleared up he cannot ship budwood. Write Larry Reed, Holm Citrus Seeds, 505 S. Lakeshore Way, Lake Alfred, FL 33850, USA. There is no need to go through ECHO.

12-1. UNUSUAL JAPANESE COMPANY MAKES EQUIPMENT FOR "COTTAGE" INDUSTRIES. There is great potential for small scale industries in the Third World, both to generate employment and to reduce the need for imports. The Cecoco company in Japan has a fascinating array of machinery for rural "cottage" and small and medium scale industries. When you write for information you are sent a few sheets of prices etc. To really understand what is available and, especially, to make decisions about purchase you have to send \$20 to get their 159 page catalog. I have not personally seen any of their equipment, but it sounds great. To give you an idea, let me share some items as I leaf through the catalog. Their address is Cecoco, Agricultural and Small Industrial Center, P. O. Box 8, Ibaraki City, Osaka-Pref., 567 Japan.

With Cecoco equipment you could make any of these products: tooth picks, wooden ice cream spoons, paper clips, hair pins, safety pins, snap buttons, wire, barbed wire, window screen, nails, screws, nuts, bolts, springs, chains, zippers, chalk, paper boxes, tapioca and potato starch, rope and straw mats.

The section on rice begins with hand and foot operated equipment (thresher, winnower, two-man hand huller, paddy separator, and polisher) followed by quite a variety of power machinery. Other food processing sections include flour milling, noodle machine, oil expeller, bakery equipment, equipment, coffee pulping, roasting and milling equipment, power and hand sugar cane squeezers, all kinds of equipment to handle fish for food or fish meal. Then there is cotton processing machinery, a wide variety of pumps, all kinds of mills for feeds, egg incubators, peanut roaster, peanut butter machine, rice straw softener, small and medium scale saw mills, equipment for tilling fields, printing presses, basic manpower units to drive other machines, many coconut husk processing machines, pulverizers and grinders, and cane processing machines. Happy shopping!

12-1. GREEN MANURE CROPS OFFER TREMENDOUS ADVANTAGES TO THE SMALL FARM IN THE THIRD WORLD. By Roland Bunch, *World Neighbors, Honduras*. (Apdo. 278-C, Tegucigalpa, Honduras, Central America).

Green manure crops are crops which are grown to be turned under to increase soil fertility. Leguminous green manure crops, i. e. those which can make nitrogen fertilizers from atmospheric nitrogen, can offer small-scale Third World farmers a tremendous number of advantages:

- 1) They provide large quantities of nitrogen for the soil.
- 2) They add many tons of organic matter to the soil, thereby improving topsoil depth, water-holding capacity, nutrient content, friability, and texture of the soil.
- 3) Inasmuch as the green manure crop grows in place, it presents no transportation problems, in contrast to either compost or chemical fertilizers.

- 4) Green manure crops require absolutely no capital outlay after the initial purchase of a handful of seed. Because they require no chemical inputs, dependency on outside sources of fertilizer, nutrients, and pesticides is reduced.
- 5) Green manure crops can shade the soil up to eleven months out of the year, a factor extremely important in tropical climates for preservation of soil moisture and organic matter.
- 6) The cover they provide for the soil protects the soil from wind or water erosion.
- 7) Green manure crops provide generous amounts of high protein fodder for animals, which can be especially valuable if it is available during the last months of the dry season (inasmuch as fodder at this time of year is the limiting factor in traditional animal-raising in much of the Third World).
- 8) Some green manure crops provide human food, including various kinds of edible beans, peas, and pods.
- 9) Green manure crops can provide a cash income, by selling firewood, food or feed (and maybe seed).
- 10) They often provide an incentive for people to abandon harmful traditional practices, such as burning crop residues or letting animals loose in the dry season to devour everything in sight.
- 11) Some green manures, when intercropped with basic grains, can control most weeds, thereby eliminating costly weeding operations.

Something like 30% of all the increases in harvests achieved by small farmers in the Third World during the last three decades has been achieved through the use of chemical fertilizers. Should petroleum prices shoot up once again, as could easily happen sometime in the next decade, prices of chemical fertilizers could easily become too expensive to be economically feasible for use with traditional basic grains. Almost overnight, Third World basic grain production could plummet, causing famines the extent of which would make the present situation in Africa seem mild by comparison. Widespread use of green manure crops could avert much of this impact.

Comparison with Compost. Inasmuch as composting is a technology that is often recommended for Third World development programs, it might be useful to compare composting with the use of green manure crops.

- 1) Compost merely decomposes the organic matter one already has, whereas a green manure crop can often add over 40 tons of additional organic matter per hectare. Inasmuch as organic matter is often in short supply on villagers' farms (or is already being recycled), this is an important consideration.
- 2) At best, compost will return to one's field about 98% of the nitrogen one started out with. A green manure crop, however, will add considerable quantities of new nitrogen to the system.
- 3) A compost heap takes a tremendous amount of work, as anyone who has personally made one can attest. Though compost will often pay in a vegetable garden, it is not economical when used on basic grain crops such as corn or millet. On the other hand, although a green manure crop takes a bit of labor to plant (using a dibble stick) and a fair amount of labor to incorporate, it takes nowhere near the labor

a compost heap does. And in some cases where the green manure crop is intercropped among traditional crops (such as corn, sorghum, or millet), it covers the ground so well that one or even two weeding operations can be eliminated, thereby actually bringing a net savings in labor.

4) A compost heap requires water. This often means it is made near a water supply but at a fair distance from where it is to be applied. Green manure crops are planted to take advantage of available rain water, and are planted right where they will be used.

5) Compost cannot be used as a food source, either for animals or humans.

A Few Ideas About What to Look For. The major problem with green manure use around the Third World is that village farmers cannot afford to give up land in order to just grow a soil amendment. Or when they have the land, they cannot spare the labor. However, there are three ways in which these objections can be overcome. In many situations only one of these will be appropriate, in others two. Experience so far seems to indicate that only rarely is none of them appropriate.

1) Green manure crops can often be planted among traditional row crops, especially corn, sorghum, and millet, without decreasing the production of the main crop at all the first year, and usually with major increases in the major crop in succeeding years. The major instance in which this is not possible is when people are already intercropping two or three other crops with their major grain.

2) Green manure crops can often be intercropped with basic grains toward the middle or end of the growing season, with the idea that their major growth would occur during the dry season, thereby using land that would not ordinarily be under cultivation.

3) Wherever multiple-year fallows and/or shifting agriculture is used, green manures can be planted on land the first year it is to go fallow. Thus the period of fallow can be cut to one year instead of three to fifteen years.

What characteristics should we look for, then, in a legume that will be useful under these circumstances?

1) It must be a non-woody annual with vigorous growth.

2) It should grow well in the poorest of soils in the area, without needing any kind of fertilizer.

3) One must be able to plant it in local fields with no special soil preparation, and either with a dibble stick or, preferably, by broadcasting the seed.

4) The plant must have few enough natural enemies that it will grow vigorously without the use of any pesticides or major labor requirements.

5) The legume should either be very shade-resistant (for intercropping) or drought-resistant (for growing into or through the dry season).

6) If possible, it should first cover the ground well, then climb any stalks that remain in the field.

7) If possible, the green manure crop should be edible by animals and/or humans.

Some Already Known Possibilities. Although a good deal of research still needs to be done in finding adequate plants (far too much of the extant research has been done on fertile experimental stations or with the use of chemical fertilizers, thereby making it virtually useless to small farmers), there are a few species that seem to fit most of these conditions admirably well in certain parts of the world:

1) *Canavalia ensiformis* (jackbean, etc.) is highly shade- and drought-resistant, covers the soil, climbs extremely well, and is edible by animals. It does well from sea-level to about 1,800 m. It has almost no natural disease or insect pests. It can be dibble-sticked (at 2 seeds/sq. m.) or broadcast (at 4 per sq. m.) in among other crops. I have seen it grow vigorously on soil so badly eroded and depleted that no weeds would grow there at all. A high-protein fodder, the pods and beans can also be eaten by humans if certain precautions are taken.

2) *Stizolobium* spp. (velvetbean) covers the soil and climbs much like the jackbean. It grows even more vigorously than the jackbean under less harsh conditions, but not as well as the jackbean under really harsh conditions (in Yucatan, where droughtiness is always a problem the jackbean does better in years of low rainfall, whereas the velvetbean does better when rainfall is higher than normal, but still scarce). Be sure to use a variety that does not have the irritating itchy powder on the pod (we have such a variety from Honduras). It grows from sea-level to 2,000 m. So far no natural diseases or pests have been observed in Central America, where it is native. It can be dibble-sticked (2 seeds/sq. m.). A high-protein fodder, the beans can also be toasted and ground to make a tasty high-protein "coffee," or used to "stretch" real coffee.

3) *Clitoria ternatea* is even more drought-resistant than the *Canavalia*, although being small-leafed, it does not cover the soil well. We really do not have much experience with this plant yet. It grows well at sea-level.

4) *Dolichos lablab*, etc. (lablab bean) also covers the soil and climbs, much like the velvetbean. On semi-fertile soils around 1,200 to 1,600 m., it grows very well with good shade-resistance, and so fast that it should not be planted in corn until at least 2 months after corn is planted. I do not have wider experience with this plant yet. It produces good forage. [Ed: Young pods of some varieties are quite tasty when cooked. Dr. Andrew Duncan recently told me that he saw a variety with an exceptionally wide pod growing on sides of village houses in Bangladesh.]

Miscellaneous Observations.

1) What can be done in areas where animals are let loose during the dry season while the green manure crop is still growing? One approach is to first show people the results of the green manure plant on an enclosed piece of land. Next get a good number of people to try it out, perhaps timing the planting to get a good start before the animals are let loose. Those who experiment first can often be motivated to spread the word to others with the idea that the destruction for each person will be less if more people plant it. Eventually, if enough people plant it, community pressure will make everyone keep his animals locked up (except in cases where the person with all the animals is a large landowner).

2) On very steep hillsides, something must be done to keep the organic matter from washing away. Piling crop residues along roughly contour lines can help, as can contour ditches. Another possibility is incorporating the green manure immediately after cutting it, but this is hard work before the rains come (if the soil is a heavy one), and once the rains have come, people generally do not have extra time.

3) On flatter land, the green manure should usually be cut and allowed to dry for a couple of weeks before incorporating it (if during the dry season). The labor saved in incorporating it will be worth more to the farmer than the small amount of fertility lost. In one case farmers cut holes in the Canavalia cover to plant corn when the rains came, cut down the Canavalia entirely about two weeks later and replanted the Canavalia. Then, two weeks later, they incorporated the dead Canavalia vegetation. In this manner, they avoided both weeding operations in their cornfields!

4) Where weather is unreliable, a combination of similar plants, one of which is more drought-resistant (e.g. jackbean and velvetbean) reduces risk of total loss, yet assures a vigorous crop if rains are plentiful.

5) In West Africa, we are trying a system of planting a perennial every sixth row (pigeon pea), and then gathering the corn or millet residues under the pigeon pea plants at the end of the year, to be distributed six months or so later when well-mixed with better C:N pigeon pea leaves. The presence of the pigeon pea trees (already known as a cash crop) will also prevent burning of residues.

6) On South and Southeast Asian hillside areas, Leucaena leucocephala is planted as a contour barrier and constantly pruned, thereby providing erosion protection, some green manure, and firewood (see the booklet produced by World Neighbors called Leucaena-based Farming). This produces less green manure than other systems, but can be used where green manure cannot be intercropped among traditional crops.

7) We certainly would welcome any experience you have in this subject. Much more information and experimentation must be done. We readily admit we are just getting started at this, but the positive response from hundreds of villagers and dozens of other programs has made us decide to share what little we know as soon as possible so we can all work together to learn more about it. I would think that, right now, the most important subjects we need to learn more about are: a) What legumes will work above 1,800 m.? b) What additional plants will work at any elevation? c) Do adaptive research to see what of these technologies will work outside the Southern Mexico/Central American habitat that this information comes from. d) Which legumes can be broadcast rather than planted with a dibble stick? e) Which of these green manure crops provide the best yield increases with which basic grain crops? f) What green manure crops would be best under high rainfall conditions?

12-6. Where can I get seed? Thanks a million Rolland! (Martin speaking now). We have a modest amount of one vigorous variety of velvet bean that we can share. We will fill seed requests for Roland's variety of velvet bean, as well as Clitoria ternatea, sword bean and jack bean in January if it does not freeze this year. We have plenty of lablab beans, pigeon peas and leucaena, including a variety that is hopefully less toxic because it is low in mimosine. If we cannot supply seed, we will see if Roland can help, though note that he cannot meet the local demand. Please note that seeds for jackbean, swordbean, and velvetbean are quite large. We will send approximately 6 seeds of these, which will come in a very bulky envelope or a small package (if such packages do not get through to you, perhaps someone will be visiting that can bring them in). This will give you a few plants to begin increasing your own seed. Do not ask for pigeon pea if it is an important crop in your area, as you do not need it and we want to minimize risk of diseases of established crops. If you want more than 6 seeds of the larger seeded varieties, please send a couple dollars to help with postage. Some of you have ideas and experience with groundcovers. Let us hear from you.

12-6. A COMMENT ON GREEN MANURE FROM ZAIRE. Pete Ekstrand just visited us and had this account from the Paul Carlson Medical Program in Zaire. They have found that *Pueraria phaseoloides* (tropical kudzu or puero) grows vigorously and can even smother the vigorous native imperata grass if the grass is manually bent over. This is not the same kudzu that took over so much land in Alabama and elsewhere. They then cut circles perhaps 2 meters wide and plant fruit trees, coffee etc. in the middle. It had not rained for 60 days when he visited and the ground in the circles was hard and dry. But one arm length under the ground cover the soil was moist and could be moulded with the hand! We have not succeeded in harvesting our own seed, so let me refer you to the Yates Seed Co, P. O. Box 117, Rockhampton, 4700, Australia. Yates is an excellent source for a large number of tropical pastures.