

## **EDN ISSUE 28. DECEMBER, 1989**

**28-1 SOME THOUGHTS FROM THE EDITOR.** When one or more from our network visit at the same time, they find the visit is all the more helpful because of what they learn from each other. When ECHO chooses a date and suggests that people planning a visit try to come then, we call it an "unconference" (a very, very informal conference).

You have read in EDN of Roy Danforth's work with tropical fruit trees and reforestation in Zaire. (He now has 277 species). I asked some time ago if we could plan an unconference around his next visit. He just confirmed that we can plan this for Monday June 4, 1990. Dr. Frank Martin has also agreed to be here that day, unless a consulting trip interferes. If you would like to attend and perhaps spend a few days afterward using our reference materials, get in touch as soon as you can. Bring slides to help explain the agricultural side of your work.

This fall I went to Haiti to see the rooftop gardening work of Pat and Connie Lahr. We have kept in close touch and have exchanged ideas with them for the last couple years. In the next EDN I hope to include details and pictures of their gardens as well as results from experiments we are doing here at ECHO with both our own and their techniques.

ECHO would like to collaborate closely with one or two groups that are already involved in urban ministry and that have a strong interest in pursuing rooftop gardening. This needs to be a project you are already committed to, as ECHO has no money to offer. We would send an occasional intern for up to a few months as well as visits by myself. We prefer a location in the Caribbean basin area where we can make visits at a modest cost. We now have several techniques that work well. The next phase is to gain experience in actual urban settings.

Acres of "land" are represented by flat rooftops in tropical cities. Gardens can be on the rooftops of institutions, such as schools or orphanages, or homes. Something with so much potential is worth considerable effort to find a way around any technical, social and economic problems.

If you might be interested, write me a note describing your urban ministry and we can correspond from there.

**28-1 INTERCROPPING WITH SUGAR CANE.** I believe this has the potential to be one of those innovations that development workers are always seeking: something that can have a large and immediate impact and limited risk. (This assumes, of course, that it is not already a local practice). So we are dedicating considerable space in this issue to the subject of intercropping with sugar cane.

Many of you work where there is not enough good land to go around. Intercropping on land previously used solely for cane is almost the same as finding new land. It is a way to produce food for local consumption on land that was previously used primarily to earn foreign exchange. It reduces risk of total loss due to crop failure because even if something like a hurricane destroys the long season (several months) cane crop, some financial return will have been realized. Cash flow is improved. It might even slightly reduce the pressure to clear new marginal land.

The Canadian aid agency, IDRC, featured the work of Dr. Govinden on this topic in their magazine IDRC REPORTS and were able to put me in touch with him for more information. He graciously sent detailed reports of this work in Mauritius. All of the following are based on his articles.

Dr. Govinden writes, "We have several teams working on intercropping of sugarcane with various food crops at the Mauritius Sugar Industry Research Institute. Intercropping with sugar cane is practiced on a large scale and is responsible for 77% of the potatoes, 60% of the groundnuts and 50% of the maize (corn) produced in the country. Additionally, small planters grow a wide range of vegetables in their sugarcane fields. These include beans, peas, tomato, cabbage, pepper, and okra, to name a few."

Farmers in Mauritius have been intercropping with sugar cane on a small scale for over a century. The practice picked up during the shortages of World War II, but only "took off" during the past 10-20 years. "Intercropping with sugar cane is widespread in India, Philippines, Mauritius, Reunion, and Taiwan.... It is practiced on a limited scale in Brazil, China, Colombia, Egypt and Indonesia."

**28-2 MAIZE (CORN).** Unlike potato, maize reduces the sugar cane yield, due primarily to competition for light by the tall maize plants. The extent of reduction depends on the height, time to maturity, and leafiness of the maize. No evidence has been found of any effect of intercropping on insect or disease damage, either positive or negative. Mechanical harvesting is a problem.

Sugarcane can and is often grown on lands too steep for maize. Intercropping of sugarcane on such lands allows the production of some maize without leading to soil erosion. In fact the maize confers additional protection to the soil from the erosive action of rain during the establishment period of the cane. In Mauritius there are two cane planting seasons. "In the first season, maize is harvested before and, in the second season, after the cane. The peak labor demands therefore do not overlap."

"The success of intercropping depends on maximizing the complementarity and minimizing the competition between the component crops. ...It has been suggested that maize and sugarcane are too similar for there to be benefits from the intercrop." However, there is still an important difference that can be exploited -- the difference in the time at which each crop makes use of the growth resources.

"Sugarcane is planted in wide rows (1.4 - 1.6 m). It takes 2-3 weeks to germinate, grows slowly for the first few months and does not cover the soil until about 4-5 months after planting. In the case of ratoons, canopy closure occurs earlier, in about 3-3.5 months. [A ratoon crop is a crop that comes up from the roots after a previous crop was harvested]. During the first 3-4 months, the cane makes little demand on the available ... space, light, water and nutrients. These can therefore be used to produce compatible intercrops.

"Maize ... grows fast and achieves canopy closure in 1-1.5 months. Early maturing cultivars can be harvested within 3-3.5 months after planting, before the cane canopy closes."

Because maize is taller than the young cane, it is important to use short and early maturing varieties. "Moreover, a balance must be found between planting enough maize to give worthwhile yields and using higher densities that can lead to competition with the cane. Much of the cane yield reductions from intercropping with maize can be attributed to the use of tall and late-maturing maize cultivars planted at excessive densities."

Dr. Govinden calls the potential row between the rows of cane the "interrow." When maize is planted in each interrow it "does not compete with cane for underground resources. When the cane row width is 1.6 m, the maize plants are 0.8 m away from the cane. Maize roots do not extend that far and therefore do not have access to fertilizers placed in the cane row. The maize must therefore be fertilized separately."

Maize growth occurs during the first two phases of sugarcane growth: germination and tillering. [Tillering refers to the plant sending up additional stalks]. Germination is not affected by intercropping, but tiller formation is often seriously reduced. "As soon as the [maize] is removed, however, tillering resumes normally and, in time, much of the adverse effects disappear." There is even a name for the ability of sugar cane to overcome initial setbacks: "rattrapage." If rattrapage is to be complete, it is important that there be adequate water, nutrients and no weeds after the intercrop is removed.

If cane farmers use herbicides, maize is an especially good intercrop because of similarity of reaction of the two crops to herbicides.

"Once sugarcane is planted, it is usually not replanted for several years; 8 years on the average in Mauritius." Ratoon crops grow more quickly than newly planted cane and hence are more competitive with maize. However, maize has less adverse effects on the cane when it is a ratoon cane crop. Consequently, Dr. Govinden suggests leaving the interrow between newly planted cane for other crops such as potato, beans, and groundnuts that are less competitive than maize and which themselves do better with newly planted cane than in ratoon cane. The maize would then be intercropped with the ratoon cane. "With time the ratoons encroach upon the interrow space, making [further] intercropping more difficult. Maize is indeed one of the few crops that can be successfully intercropped with 2nd or 3rd generation ratoons."

"In order to create more space for intercropping of 3rd or older ratoons, it has been proposed to plant the cane in paired rows." In Mauritius, two rows of cane were planted at only 0.95 m apart separated from the next pair of rows by 2.25 m. Success was variable. Sometimes cane yield was reduced.

Here are his suggested guidelines to developing cultural practices for maize/cane intercropping in your area.

**28-3 TIME OF PLANTING.** "In order to minimize the adverse effects of maize on cane, the maize should be planted as soon as possible after the cane. This ensures that the cane will have enough time after the maize harvest to offset initial setbacks. In practice, the maize may be planted up to 3 weeks after the cane."

**LAND PREPARATION.** "The land preparation for plant cane [i. e. not ratoon cane] is adequate for the maize as well. The cane furrows should not be too deep since it is difficult to plant maize mechanically on high ridges. In ratoon cane which is not burned at harvest, the trash must be lined up, usually in alternate interrows. The maize is then planted in the free interrows...".

**VARIETIES.** "Only short-statured and early-maturing varieties should be used in order to minimize competitive effects on the cane. The plant height should be less than 2 m and the crop cycle from sowing to physiological maturity should be between 85 and 95 days. Since maize yield is a direct function of the length of the crop cycle, the balance between a longer cycle for higher maize yields and a shorter cycle to minimize adverse effects on cane can only be found after experimentation under local conditions."

**PLANTING PATTERNS AND PLANT DENSITY.** "Various planting patterns are possible. In Mauritius, whether in plant or ratoon cane, one row of maize is planted in alternate interrows of cane. [i. e. as you walk across the field you encounter cane, cane, maize, cane, cane, ...]. It is possible to grow one row of maize in every interrow of cane, but shading of cane is more pronounced when the cane rows are bordered by maize on both sides."

"Maize plant population density may be varied between 15,000 and 30,000 plants per hectare (20,000 plants per hectare is recommended in Mauritius). A lower density ensures that the maize has no effect on the cane but the yield of maize is also lower. In areas where the cane growing season is long and where the cane is more competitive, the maize plant density may be increased."

FERTILIZATION. ... "A good rule is to base the recommendation on the response of sole-cropped maize and to apply as much fertilizer per plant as in pure stands." [And to likewise fertilize the cane as a sole-cropped plant].

IRRIGATION. ... "In areas where surface irrigation is used, the cane furrows should not be too deep, otherwise the ridge in the interrow on which the maize is grown may not be properly watered." In drip irrigation systems, a separate drip line is needed for the maize.

WEED CONTROL. [I usually assume that few readers work with farmers who have access to agrichemicals. Because this technique might be done by peasant farmers but on large commercial farms, such may not be the case. In fact, it is quite likely that the cane field has already been treated. This may present a problem with some potential intercrops that are unrelated to cane.] Grasses and broad-leaved weeds are controlled with a pre-emergence application of "Primagram" (a mixture of atrazine and metolachlor). [Imagine what that would do to a subsequently planted intercrop of beans!]. If grass is not a problem, use atrazine alone. Nutsedge can be controlled with "Basagran DF" or 2,4-D amine which should be applied underneath the maize canopy after it has grown to knee height.

HARVEST. "In pure stands, maize may be left to dry in the field, but in sugarcane interrows, it should be harvested soon after physiological maturity in order to minimize shading of the cane. The grain must then be dried."

MAIN PROBLEMS. "Sugarcane is sometimes called the lazy man's crop. The management of sugarcane intercropped with maize is more difficult; careful attention must be paid to details. Timeliness of operations is important. Main problems relate to mechanization and to pests and diseases." Mechanization of planting is easy, with one row maize planters. Harvesting is more difficult and is still done by hand in Mauritius.

"Perhaps the major objection to intercropping sugarcane with maize is the fear of increasing pests and diseases common to the two crops." Especially downey mildew, sugarcane mosaic virus and maize streak virus. "In South East Asia where downy mildews are a problem, intercropping ... is possible so long as resistant maize cultivars are used." [There appears to be little information on the subject, but no reported serious problems.]

"Sugarcane and maize have several pests in common, mainly borers. ... One report from India indicates that when sugarcane is intercropped with maize, the difference in borer infestation was negligible." "The fact that insecticides are not used in cane certainly helps to maintain the activity of biological control agents."

POTATOES. Potatoes are the most successful intercrop. Potatoes do not reduce the yield of the cane and conversely sugar cane does not affect potato yields. Each crop is fertilized separately according to its recommended needs.

GROUNDNUT (PEANUT). Groundnuts resemble potatoes in that they do not adversely affect cane yields. They differ from potatoes in that fertilizer requirements on cane lands are very low; so low that most growers do not use any fertilizers. Work is underway to determine to what extent groundnuts may provide fixed nitrogen to the cane.

BEANS. Dry beans do not reduce yields of cane. Recent results indicate they may be able to grow beans in the interrows left free when maize is intercropped with sugar cane. (Remember that cane does better if maize is not grown on both sides of the cane row). An advantage over many crops is that beans have a relatively short life and require less water than most crops.

GENERAL COMMENTS. In contrast to what is commonly observed in other countries, intercropping of sugar cane with food crops in Mauritius is much more popular with the corporate sector (sugar estates) than with the small holders. In some cases the estates produce the maize, potato and groundnut themselves. Others rent the cane interrows to planters for a few months. The reason may be that small landholders have two jobs and lack the extra time to do intercropping. The timing of some food crops cultivation may be complementary to sugar cane in terms of labor use.

In many countries the large plantations "have the best lands and infrastructure and have access to inputs such as fertilizers and irrigation. They should therefore also share the burden of producing food. This they can do by intercropping their sugarcane with food crops.... They need not do it themselves, but could rent out the interrows or make them available freely to landless peasants for the purpose of intercropping as is commonly done in Mauritius."

Thanks to Dr. Govinden for sharing this information. I will be very interested to hear about your own experience if you try intercropping with sugar cane, or details of local practice if it is already done.

**28-4 OPPORTUNITY AS AN APPRENTICE ON A SMALL ORGANIC VEGETABLE FARM.** Sam Smith called today requesting some materials before he takes off on one of his frequent volunteer trips as an agricultural consultant to church-related and other non-profit groups in the Third World. He mentioned that he and his wife each summer hire 3 or 4 apprentices to help on their small organic vegetable farm in Massachusetts. (They pay \$75 a week plus room and board). Because of their special interest in Third World agriculture, they would be especially interested in finding apprentices who share that interest. They would try to make some special arrangements to make it as relevant as possible to Third World agriculture, though fully realizing the differences in techniques and climate. I know nothing about Sam or the farm except what I learned in this call, so if you are interested ask whatever questions are important. His address is Caretaker Farm; Hancock Road; Williamstown, MA 01267.

**28-5 INTERNSHIPS IN REGENERATIVE AGRICULTURE.** The Rodale Research Center hires interns to assist RRC scientists in research plot establishment and maintenance, data collection and report writing. This year they will have 12 openings in the farming systems, new crops, horticulture, and entomology programs. Starting and ending times are flexible, but generally run April through October. Wages are \$5 per hour. Unpaid internships can be negotiated throughout the year. Write Kent Martin, Rodale Research Center, R. D. 1, Box 323, Kutztown, PA 19530.

**28-5 THE NEW FARM: MAGAZINE OF REGENERATIVE AGRICULTURE.** If I were farming in the United States, this is one magazine I would not be without. Most of you are familiar with the Rodale publication Organic Gardening. You might say that The New Farm is the farmer's equivalent of that popular gardening magazine. In fact it was started by Robert Rodale, and later turned over to the non-profit Regenerative Agriculture Association.

There is a difference between the philosophies of the two magazines. The New Farm is not adamantly opposed to all chemical input. Many articles focus on the experience of farmers at reducing chemical inputs, rather than completely eliminating them. This is more useful to most farmers, who are not likely to switch to totally "organic" techniques. Other articles do feature the experience of farmers who are trying pure organic farming.

The issue I randomly pulled from the library has a "pull out" Cover Crop Guide to 53 legumes, grasses and mixes for temperate farms; an article describing the experience of one farmer with direct marketing; an update on Iowa's new regulations to ensure honest soil test recommendations; the experience of a Colorado farmer claiming 222 bushel corn without chemicals; an article on a dairyman who grows 160 bushel corn without purchased fertilizer. The first issue I read, back in 1981, was a great example of investigative reporting. Identical soil samples were sent to 200 testing laboratories requesting recommendations of fertilizer to produce corn. The differences between laboratories was astounding.

Because New Farm is directed toward temperate farming and use of typical U. S. farm equipment, it will be of lesser value to the typical person in ECHO's network than to U. S. farmers. It may be helpful to many of you, however. If you are interested, let me suggest that you order a sample copy. Managing editor Mike Brusko said they would cover the postage for sending a sample, but you need to enclose the single issue price of \$2.75. Subscriptions are \$15 per year (\$24 for two) plus \$8 in Canada and \$12 elsewhere per year. The address is 222 Main St.; Emmaus, PA 18098.

**28-5 CAN KIWIFRUIT (*ACTINIDIA DELICIOSA*) BE GROWN IN THE TROPICS.** I have always discouraged people who wrote from the tropics asking where they could obtain plants of this New Zealand vining fruit. It is definitely not a tropical fruit. For example, the newsletter of the Rare Fruit Council International in Florida in 1987 says that kiwi has been tried all over Florida and has never been successful. (The plants grow well, but do not fruit). So I assumed that it would be even more difficult in the tropics.

This fall I was touring the farm of my friend and sometimes EDN contributor Victor Wynne. The farm is located at just over 6,000 feet in Haiti. To my surprise there were vigorous kiwifruit vines and, hanging under them, were several kiwifruit.

That does not mean you should all rush off your orders for kiwi plants. First of all, he planted them in 1983 (variety Abbott) and later almost tore them out when they never bore. Then last year he got a few fruit. Though there were several more fruit this (the 6th) year, it is not at all clear if there is any commercial potential. That will all depend upon how heavily and reliably they bear.

There is a fantastic annual networking newsletter to promote cooperation and communication among kiwifruit enthusiasts, called the "Actinidia Enthusiasts Newsletter." Each issue is actually more like a large magazine, the 1988 issue having 116 pages. It is a grassroots newsletter, with over 100 people from 12 countries contributing to the latest issue. Advertisements provide several sources for the plants. They do not take subscriptions because its publication frequency depends on who volunteers to help. For the next issue or a back issue send U. S. \$10 to Friends of the Trees, P. O. Box 1466, Chelan, WA 98816.

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

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

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

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

**28-6 SWEET POTATO COOKBOOK PUBLISHED BY ECHO.** We have appreciated contributions from Dr. Frank Martin to EDN on many topics over the years. His main professional interest, however, is the breeding of sweet potatoes. When his technical expertise and personal interest in cooking was teamed with the skills of writer and agriculturalist Ruth Ruberte and amateur gourmet cook (and professional engineer) Jose Herrera, this unique and valuable cookbook resulted.

Frank's personal acquaintance with scientists and sweet potato enthusiasts from many countries has made him aware of many delightful recipes that alone would make this book an outstanding addition to the kitchen library. But it is his familiarity with the different kinds of sweet potatoes that makes the book especially unique. The type of sweet potato influences its cooking. Each type is better for some purposes than for others. The cookbook includes recipes designed to take advantage of these different types: dessert, tropical, white staple or orange staple types.

Dessert type sweet potatoes are very sweet, usually moist in the mouth, and almost always orange. On cooking in any manner, sweetness increases markedly. The flavor may seem carrot-like or even oily to some people. Tropical type sweet potatoes are less sweet, often dryish or dry in the mouth, and white, cream or yellow. Flavor is highly variable. These are the kinds of sweet potatoes most often found in the tropics, but a few are grown in the USA (Yellow Jersey, Rojoblanca and the Cuban boniatos of Florida). Cooking in any form increases sweetness.

White staple type or "non-sweet" sweet potatoes were developed by Frank just before he retired. They are not sweet or are only very slightly sweet. Sweetness does not increase, or increases only slightly, upon cooking. They are often, but not necessarily, dry and need to be mashed to make them attractive to most palates. The flavor is usually neutral. They are white, whitish, cream, or pale yellow in color. Yellow staple type sweet potatoes is the orange colored equivalent of the white staple type. They have a large amount of provitamin A and may taste like a carrot to some people.

Sweet potatoes are one of the world's most important food crops, surpassed only by wheat, rice, corn, Irish potato, and barley. Frank says they have the potential to be an even more important crop for peasant farmers (and the rest of us for that matter). The key to increasing their usefulness may surprise you -- get rid of the sweetness! "Irish" potatoes (which really came from South America) are a temperate crop and poorly adapted to the hot, humid tropics. Yet their taste and cooking versatility are appreciated around the world. Dr. Martin believes that "bland" sweet potatoes, which could be used like Irish potatoes, could become a major part of tropical diets in a way more traditional varieties never could. These non-sweet or staple type sweet potatoes are almost a new crop.

I fit the "profile." I have never cared much for sweet potatoes. But I very much enjoy the non-sweet varieties (served with butter and chopped onion) with both taste and texture more similar to the potato, though still different.

The danger of introducing a new disease or insect is much greater with cuttings or tubers than with seeds. ECHO will only mail them overseas if you send us a plant import permit from your government. We should have cuttings again by April. It is illegal to ship to several States, so call before ordering if you are in the USA.

Sweet Potatoes are easy to grow, relatively free of pests, highly productive, and always good food. They produce in poor tropical soils without the benefit of fertilizers, tolerate drought once established, and thrive in tropical heat. Americans are often surprised to learn that sweet potato leaves are a popular vegetable in many countries. When both leaves and tubers are used for food, sweet potatoes will probably produce more nutrition per acre than any other crop. This all adds up to one fantastic crop for small land-holders in the tropics and sub-tropics.

The cost of the book is \$6.00 plus \$3.00 airmail postage (1.50 in the USA); 36 cents tax in FL).

**28-7 STOPPING BEES.** Suppose a situation arises where you must quickly eliminate an exposed group of bees. For example, a swarm is hanging in a school yard or a truck carrying hives has upset. How can you kill or immobilize the bees?

Dr. Eric Mussen, a California extension bee keeper, writes in his newsletter From the U.C. Apiaries, "The answer in many cases, especially in areas of Africanized bees, is "soap water." Mix one cup of dish washing detergent in a gallon of water and apply to the swarm using any sprayer. He says it is just as effective as using a flame thrower.

Dr. Mussen believes this works because detergents are "wetting agents." This means that water sticks to every surface of the bee instead of running off. The bees are unable to fly with wet wings [and perhaps heavier body weight when wet?]. The spiracles, or breathing holes, which normally are able to repel water, are entered by the "wetter" water, suffocating the bee.



Do not use it near a hive where it might get on the comb, if you want the hive to return to normal activity. [The above is based on an article in Apis, the state of Florida beekeepers' newsletter].

**28-7 BOOK REVIEW: LA ABEJA AFRICANIZADA (The Africanized Bee), in Spanish only.** [Thanks to ECHO Board member Dr. David Unander for the following review]. Since being introduced into Brazil in 1957, African honeybees have been spreading through the tropical and subtropical parts of the Americas. They are expected to reach Texas and California in 1990 or 1991, and eventually spread through the southern U. S. They readily interbreed with the honeybees of European ancestry, so that today it is correct to speak of the honeybees through much of Latin America as being Africanized; that is, most of the wild bees and many of the bees in hives now have at least some African ancestry and behavior traits.

Can Africanized bees be successfully kept, or are they too dangerous? The newspaper where I live, normally not overly hysterical, recently devoted the cover story of its Sunday magazine to predictions of great personal danger to citizens and grave economic loss to farmers as the "killer bees" begin to arrive in California. Dr. Dario Espina-Perez, a Latin American entomologist and beekeeper, disagrees strongly with this B-movie scenario in this excellent book.

He begins with a very interesting chapter on tropical apiculture (beekeeping) per se. He discusses, for example, problems with heat, humidity, termites and dry seasons; various options for hive construction; how to move established wild colonies from undesired places, such as the eave of a house, to a hive; evaluating the apiculture potential of a region; and problems from agricultural insecticides. A chapter on African honeybees describes in what ways they differ from their European cousins. In particular, they are smaller, tend to swarm more often, are more aggressive and seem to produce 50-100% more honey. He carefully makes the point that all bees are aggressive some of the time. The aggression of Africanized bees has been found to vary with region and altitude. The higher the altitude, for example, the more pacific their behavior becomes. (I hope this is good news for some of you living in mountainous areas). Like all honeybees, they are most aggressive when they perceive their hive as being threatened, and least aggressive when collecting pollen (unless directly stepped on). There is a chapter on bee aggression; how it is regulated in the hive, how a stinger works, different human reactions to the venom, including allergic reactions and, of great value, a list of medications to have on hand for various numbers of stings and reactions to them.

After this foundation, there are four chapters with recommended management techniques for Africanized bees organized under: (a) controlling aggression; (b) controlling swarming, (c) controlling migration and (d) miscellaneous tips. He has a well-developed plan for maintaining breeding colonies of both European-ancestry and local Africanized bees, with hives for honey production using hybrid bees. There is a good discussion of where to place -- and where not to place -- Africanized hives. For example, Africanized bees do not like vibrations from highways nor strong smells of any origin near the hive. Also there is a review of necessary bee-keeping equipment. I learned that Africanized bees react most negatively to dark colors, better to white, and best of all to orange. There are various recommendations for hive dimensions and openings, honey harvesting schedules, keeping track of new queens, and other management techniques, in order to control the swarming and migratory tendencies of these bees.

Additional ideas are contained in five appendices. There are also some pages of references. One appendix contains the minutes from a question and answer session between Honduran beekeepers and a roundtable of entomologists and beekeepers experienced with Africanized bees, followed by detailed recommendations for Honduras beekeepers which were worked out at that meeting.

Excellent diagrams and photos illustrate successful apiculture operations with Africanized bees by various Latin American beekeepers. There are also photos of hive structures he advises against. Although the Africanized bees are not the "killer bees" of Hollywood, it seems clear that their aggression merits enough respect that some low-cost apiculture techniques which were previously unacceptable in the Americas are no longer safe; beekeeping will now need greater forethought and some additional equipment.

**28-8** La Abeja Africanizada, 158 pages, is published by Editorial Tecnológica de Costa Rica, Instituto Tecnológico de Costa Rica, Apdo. 159-7050, Cartago, Costa Rica. In a Costa Rican bookstore my copy cost 310 colones, which at the December 1989 exchange rate was about \$3.75. I do not know what shipping would cost from the publisher, but I think a check or international money order for \$6.00 to \$7.00 should cover everything. If you are a beekeeper in the Americas (and read Spanish), it would be a good investment.