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and Dawn Berkelaar

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

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## EDN Now Available in French!

We are pleased to report that *EDN* is now available in French. Currently one issue (*EDN* 91) has been translated, but more will be coming. As new issues are completed, they will be translated into French (Spanish issues have been available for over 10 years). We are also working on translation of the most important articles from past issues of *EDN*. If you would like to receive *EDN* in English, Spanish or French, write to us with your full name and address and specify which language(s) you would like to receive and whether you prefer airmail or a text-only email version. If you have not done so already, please also fill out the registration form (available from our website; click on "ECHO Documents" and then "Forms").

Subscriptions are free to workers helping small farmers or urban gardeners in Developing Countries. You may receive both English and Spanish/French if you work in both languages. Other individuals may subscribe for US \$10 per year.

French, Spanish and English versions of *EDN* and other articles are also available on the web from a link on ECHO's agricultural homepage ([www.echotech.org](http://www.echotech.org)).

Please note that the numbers for issues in all three languages correspond, but the dates for the French and Spanish issues tend to be slightly different. It takes some time for us to get the issues translated, and we want the date to reflect the time that the issue is sent.

## Assistance from Heifer International

By Dawn Berkelaar

Heifer International is a well-known organization that provides animals to resource-poor families, on the condition that the offspring of those animals will be shared with others who are in need. As people share their animals' offspring—along with their knowledge, resources, and skills—an expanding network of hope, dignity, and self-reliance is created that reaches around the globe. Many who read this article will already be familiar with Heifer International. But we wondered, "**How can organizations and farmer groups receive assistance from Heifer? What kind of commitment and obligations does that involve?**" To find out I interviewed Jennifer Keyes, Program Information Associate for Heifer International.

### ***DRB: What criteria are used to determine who receives help from Heifer International?***

JK: Heifer has developed a set of essential principles called Cornerstones for Just and Sustainable Development. All organizations and farmer groups that apply for assistance from Heifer are screened, monitored, and evaluated according to these principles. Here is a link to the Cornerstones: [www.heifer.org/Our\\_Work/Our\\_Approach/Cornerstones.shtml](http://www.heifer.org/Our_Work/Our_Approach/Cornerstones.shtml).

Heifer works with groups and communities and does not accept applications from individuals. The group's initial application needs to be made with the applicant group's local Heifer Office. Table 1 shows the countries where Heifer has offices. Interested groups should submit a letter of inquiry to [info@heifer.org](mailto:info@heifer.org); it will then be forwarded to the appropriate Heifer Office.

Heifer receives many requests for assistance with animal-related development programs. Each proposal is carefully considered with regard to Heifer's Cornerstones and to policies established by the Heifer Board of Directors. A limited number of new projects can be supported each year, based on available funding. Below are the procedures used:

- a. An applicant group sends a letter of inquiry to Heifer International.
- b. A Heifer staff member sends an initial application (Information Request) form back to the group.
- c. The applicant group completes the Information Request and sends it back to Heifer.
- d. Heifer staff members review the completed Information Request.
- e. Heifer staff members visit the project site for goal setting.
- f. Applicant group submits project plan.
- g. Heifer staff members do preliminary selection of projects for funding.
- h. Heifer approves, suggests modification, or rejects project proposal.
- i. If approved, the project is included in the budget for future funding.

**DRB: How does Heifer International decide which animals are distributed in an area?**

JK: It depends on the objectives outlined in each project proposal, what animals the community group selects for their project, and what the family or community wants to achieve. Also, animals placed are native to the area and therefore appropriate for [local] climatic conditions.

**DRB: In what countries does Heifer International work?**

JK: Currently, Heifer has projects in over 50 countries. Visit Heifer International's website to see an interactive map of current countries where we work:  
[www.heifer.org/Our\\_Work/Our\\_Projects/Index.shtml](http://www.heifer.org/Our_Work/Our_Projects/Index.shtml)

We do not have offices in every country where we work; some country offices manage programs in other countries. If a project group does not have a Heifer office in their country, they can send their information request to the nearest country office, but that does not guarantee that a project will be started in their country. Table 1 shows the 35 countries where we have offices.

**DRB: Is there someone interested parties can contact if they fit the criteria?**

For addresses or contact information for these offices, applicants can:

Call (in U.S. or Canada): 1-800-422-0474

E-mail: [info@heifer.org](mailto:info@heifer.org)

Write: 1 World Avenue; Little Rock, AR 72202

**DRB: What kind of commitment (on the part of the recipients) does having a project involve, other than passing on the gift?**

JK: The group is held accountable by completing progress and financial reports and they appoint a person in the group to complete these reports with the help of Heifer staff. Financial reports are due twice a year until all funds are accounted for. Progress reports continue for an additional two-year period after project funding is completed.

*Table 1: List of countries in which HPI has offices.*

Africa	Asia/South Pacific	Central & Eastern Europe	Americas
Cameroon	Cambodia	Albania	Bolivia
Ghana	China	Armenia	Canada
Kenya	Indonesia	Kosovo	Ecuador
Mozambique	Nepal	Lithuania	Guatemala
Rwanda	Philippines	Poland	Haiti
South Africa	Thailand	Romania	Honduras
Tanzania	Vietnam	Russia	Mexico
Uganda		Ukraine	Nicaragua
Zambia			Peru
Zimbabwe			United States

## Used Motor Oil

*By Esther Dunn, former ECHO Intern, and Dawn Berkelaar*

Several times over the years, we have received requests for information about what can be done to recycle used motor oil. Though this is not an agricultural question, it is a common issue faced even in remote rural areas. The two-fold question is how to make use of a potential resource and how to avoid contaminating your environment.

After motor oil is used, there are three basic options 1) throw it away, 2) burn it for energy recovery and 3) re-refine it. Traditionally, used oil has often been dumped on the ground, put in the garbage for the landfill, or spread on roads to suppress dust. These are definitely not good options! One gallon of used oil can contaminate one million gallons of water and make it undrinkable—this is a year's supply of water for fifty people! One pint of oil spilled in water can create an oil slick that can cover an acre.

Oil is regularly replaced in a vehicle because over time it obtains chemical or physical properties that hinder its use as a lubricant, and that can damage engine parts. If these impurities are removed, it can be used over and over again. The most common impurity in oil is water, which can come from leaky engine seals or condensation. Dirt also contaminates oil as it enters through bad seals and engine abrasion. Simple heating can drive off the water, and filtration can remove the dirt. However, the situation is not as simple as that. Chemical additives are included in motor oil to help prevent oil breakdown at high temperatures. Over time, these additives themselves will break down and can produce toxic substances such as xylenes, toluene and benzene. Heavy metals are also often found in used oil. For example, if leaded gasoline was used in the vehicle, there will be significant amounts of lead in the oil because of piston blow-by. Other heavy metals

sometimes found in used oil include cadmium, chromium, arsenic and zinc.

Burning used oil is a very feasible option. Both processed and unprocessed oil can be burned. The simplest processing method is to allow the oil to set. Settling and then decanting removes large particles and water so that the oil can more easily be burned (however, settling does not remove heavy metals and chemical additives). In the Middle East, used motor oil is collected and then sold to bakeries and industries (such as glass-making or pottery-making) to heat the ovens. The energy generated by burning used oil averages 144,000 BTUs per gallon. However, the presence of impurities in used oil means that burning it has the potential to produce hazardous air pollutants (metals and oxides). According to the Environmental Protection Agency regulations in the United States, "Used oil may be burned for energy recovery in used oil-fired space heaters provided that: 1) The heater burns only used oil that the owner or operator generates or used oil received from do-it-yourself oil changers who generate used oil as household waste; 2) The heater is designed to have a maximum capacity of not more than 500,000 BTU per hour; and 3) The combustion gases from the heater are vented to the ambient [outside] air."

VITA (Volunteers in Technical Assistance) have two "how-to" Technical Publications called "Waste Oil-Fired Kiln" (by Ali Sheriff and Bashir Lalji) and "Waste Oil-Fired Oven." Both documents can be downloaded from the following website address: [www24.brinkster.com/alexweir/CD3WD/CDList.htm](http://www24.brinkster.com/alexweir/CD3WD/CDList.htm). "Waste Oil-Fired Kiln" is listed as APPRTECH-VITA-Oil Kilns II. "Waste Oil-Fired Oven" is listed as APPRTECH-VITA-Oven Oil-Fired. If you are unable to access these files, ask us to send you a copy.

The technical bulletin "Waste Oil-Fired Oven" says that the oven is capable of maintaining a baking temperature of 160-190°C (320-374°F) on 0.946 to 1.4 liters of waste oil per hour, depending on the chimney draft. The estimated cost for building the oven (in 1980) was US\$25.00 to US\$60.00. The design uses a drip-feed system. The oven should be in a semi-enclosed area with adequate ventilation for combustion.

Both Technical Bulletins contain warnings that we would do well to repeat. Waste engine oil might contain lead from leaded gasoline. The lead could be a hazard to people around the oven, because it would be released into the air as the oil burns. The warning continues: "Users of waste engine oil should have the oil tested to find out if it contains lead. [This is probably not going to happen in remote rural areas.] The baking chamber of the oven should be sealed tightly to keep combustion products away from the food being baked. The oven should be used outdoors or in a well-ventilated place. The chimney should be high enough to carry combustion products well away from the work area.

"Do not use engine oil to fire space heaters [i.e. small heaters not ventilated to the outside] or food dryers. Waste oil from electric transformers should not—repeat, not—be used as fuel

in any circumstances. Transformer oil contains polychlorinated [biphenyls] (PCB) compounds. PCB is highly toxic and should not be burned [or even handled] at all. If you think your waste oil supply might come from electric transformers, do not take chances. Do not burn the oil."

Special space heaters can also be purchased specifically for burning used motor oil. This is usually done on a relatively large scale. Most such heating units are purchased by mechanics that collect oil from the engines they service. The uncle of one of our former technical staff has a unit which heats his home and water through the long cold winters of the northern US, so smaller-scale units are available, but expensive. Heaters for used motor oil cost US\$2,000-15,000 and burn thousands of liters of oil a year. However they can be a good investment in certain cold climates. Savings on fuel can pay for the stoves within a year or two. If there are cool highland regions in your area and this idea is of interest to you, we suggest you contact:

North West Industrial Equipment, LLC  
22023 70th Ave. South  
Kent, WA 98032  
<http://www.oilburners.com/>

A third option for used oil is to re-refine it. In this process, the components of used oil are cleaned and separated into light hydrocarbons (used for fuel), a base lubricating oil, a heavy product sometimes used as an asphalt extender, and some waste. Re-refining oil requires one-third of the energy (compared to refining paraffinic crude oil) for an equivalent volume of oil. However, re-refining oil is definitely not a low technology means of cleaning motor oil. It is estimated that you need some 25 million gallons a year to justify the expense here in the United States.

The following are websites with some information about reusing motor oil:

National Oil Recyclers Association  
<http://www.noraoil.com/>

<http://www.msue.msu.edu/imp/modwq/53279301.html>  
(A comprehensive 1993 study by Michigan State, addressing the options for managing used motor oil)

<http://www.recycleoil.org/>  
American Petroleum Institute

## A Non-chemical Method of Rat Control for Rice Fields

*By Dawn Berkelaar*

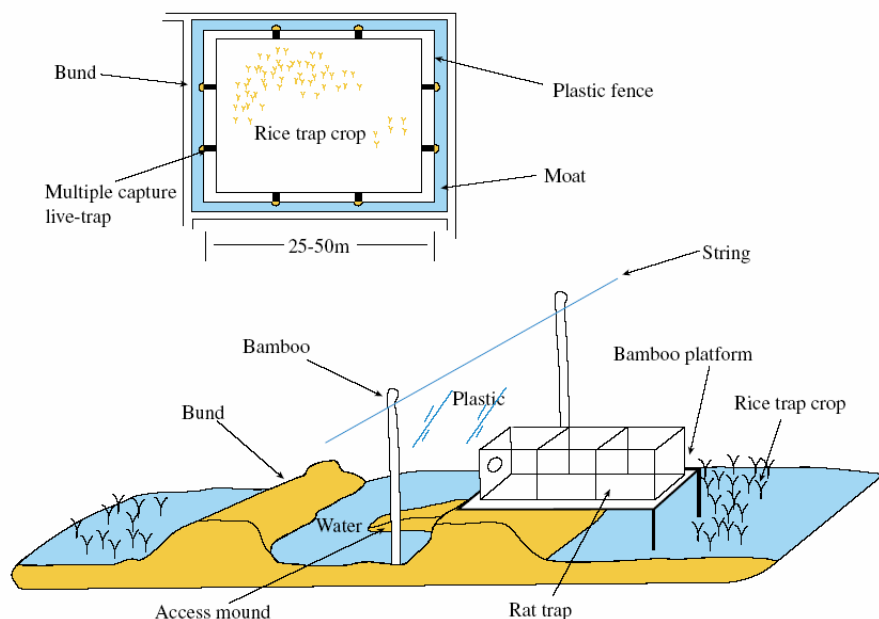
A publication from ACIAR (Australian Centre for International Agricultural Research) described a method of controlling rodents in lowland irrigated rice crops without the use of chemicals. The publication is a Research Note describing Community Trap Barrier Systems (CTBS). These systems are large cages (20 to 50 meters square) made of plastic, bamboo or wooden stakes, string or wires, staples, and rat traps (see Figure 1). The cages are strategically constructed

within a crop field and a trap crop (often an early-maturing rice variety) is planted within the cage. The cage is encircled by a moat, and specific mounded entrances lead to live-traps. The lure crop attracts rats from surrounding fields as far as 200 m away. A single CTBS can protect an area of 10 to 15 hectares.

One of the most interesting aspects of the ACIAR Research Note is a discussion of rodent breeding biology and its relationship to the growth of a rice crop. Here is an excerpt from the publication: “Breeding in ricefield rats [*Rattus argentiventer* and *Rattus losea*] appears to be triggered by the maturation of the rice plant itself, with females first entering oestrous 1-2 weeks prior to maximum tillering. After a short pregnancy of 3 weeks, litters of up to 18 pups (average of 11-12 pups) are produced. The pups grow rapidly and are ready to breed at 6 weeks of age. Adult females are able to fall pregnant again within a few days of giving birth, and therefore can produce three litters during the generative phase of the rice crop—a total of 30-40 young rats for each original female by harvest time.

“The number of breeding seasons per year is also linked to the number of cropping cycles. A single rice crop per year results in one rat breeding season, two crops results in two rat breeding seasons etc. (Figure 2).

“...Where harvest is staggered by more than one or two weeks within a single cropping area, the rat population will move from field to field, causing increasingly severe damage in the later-harvested crops. Even more critically, rats born during the early part of the cropping season will themselves be old enough to start breeding before harvest is completed. This can produce a sudden explosion in rat numbers. Instead of one female producing 30-40 young, she and her offspring will produce 100-120 young.”



If you are interested in obtaining instructions to build a CTBS, please write to us for a copy of the ACIAR Research Note. The document is also available on the web at: <http://www.cse.csiro.au/research/tropical/rodents/> Click on “Latest ACIAR Research Note” under Rodent Management Quick Links.

Figure 1: View of large rat trap cage (bottom) and diagram showing placement of traps around rice trap crop (top). Figures from ACIAR Research Note.

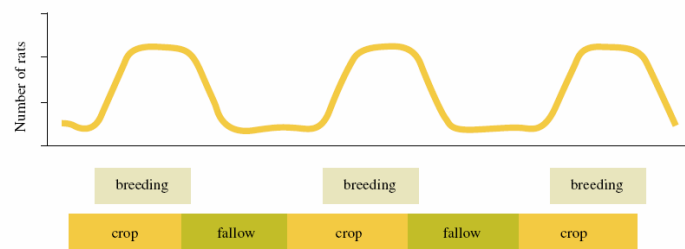


Figure 2: Graph showing co-incidence of rat breeding seasons and number of cropping cycles.

In practical terms, this means that killing a female rat before or during the breeding season before her first litter is weaned (at the milky stage of rice) is equivalent to killing 30-40 rats just before harvest. Also, fields in a particular area should be harvested within two weeks of each other to avoid a situation in which rats simply move from one field to another for food. An extended fallow period often results in a rapid decline in the local rat population.

A CTBS is most successful when it is implemented within a whole community rather than just by an individual. This is because rats can travel great distances in search of food and thus will reinfest a crop from an unprotected area.

CTBS will be most cost-effective if crop damage from rodents is expected to be 10% or higher, if the cages are well-made and maintained, and if it is adopted by an entire community. Experiments done in Indonesia and Vietnam have shown increases in rice production of 0.3 to 1 tonne per hectare within the area 200 m from the cage in all directions. In these two countries, materials for each CTBS unit cost around US\$25-50. Materials can usually be reused for 2 to 4 seasons.

A few other ideas (in addition to the CTBS) were given for controlling rodents in rice fields. For example, bunds should be kept low and less than 30 cm wide to make it difficult for rats to burrow. Rat burrows should be located and destroyed when rice is in the tillering stage [producing multiple stems]. Rodents should be trapped within two weeks of when the crop is planted.

## Seed Yields Decline at Higher Average Temperatures

Abstracted by ECHO staff from the article "Rising Temperatures and Plant Productivity," published in the August 2006 issue of *Agricultural Research* magazine. <http://www.ars.usda.gov/is/AR/archive/aug06/plant0806.htm>

What happens to seed yield if a crop is planted in a warmer climate or if global warming causes temperatures to rise? Increased carbon dioxide levels may encourage some plants to grow larger and increase crop yields, but elevated temperatures could leave some seed crops sterile according to L. Hartwell Allen, Jr., a soil scientist in the Agricultural Research Service's Chemistry Research Unit in Gainesville, Florida.

"Increased temperatures affect reproductive processes more than they affect photosynthesis and vegetative growth. A plant may still grow to its typical size even if its seed development fails."

Researchers in Florida and at the International Rice Research Institute measured heat's effect on yields of rice, grain sorghum, kidney beans, soybeans, and peanuts grown at four maximum/minimum daily temperature cycles.

"Each crop was found to have its own optimal mean daily temperature (OMDT) for seed yield. As temperatures rose, yields decreased, dropping to zero at about 18°F (10°C) above each crop's specific OMDT." Seed productivity generally decreased by about 6 percent for every 1°F (0.55°C) above a given plant's OMDT. Current summer temperatures in the southern United States are 2-4°F (1.1-2.2 °C) higher than optimum for most grain crops.

"Compared to rice and grain sorghum, which yield best at an OMDT of 77°F (25 °C), kidney beans were more sensitive to heat, while soybeans and peanuts were less so. Pollination failure was the chief cause of yield declines at higher temperatures. The number of pollen grains per flower and the percent of viable pollen declined as temperature increased, as did the number and size of seeds per pod.

"Allen found that fewer soybeans were produced at above-optimal temperatures, and individual beans grew less. Peanut yields fell because the number of viable pollen spores and percentage of flowers setting seeds declined, eventually reaching zero.

"For all the crops studied, even when pollination was successful, shortened seed-filling time and higher respiration rates at moderate temperature increases also contributed to yield declines.

Allen says that using traditional breeding to develop crops with built-in heat tolerance may offer the best hope for helping plants—and growers—cope with rising temperatures [Ed: or for places where temperatures are already above optimum].

"We're trying to identify cultivars that yield well in very hot environments," he says. "If heat tolerance could be incorporated into all productive crop varieties, it would lessen the agricultural impact of climate change.

"Also, adjusting the time of day when pollen is shed by a plant could improve its viability. Varieties that shed pollen earlier in the day, when temperatures are cooler, would be more likely to flourish."

## Banana Wilt Disease in East Africa

Abstracted from the IRIN (Integrated Regional Information Network) news feed of the United Nations Office for the Coordination of Humanitarian Affairs, Central and Eastern Africa Weekly Round-up 337 for 24-30 June 2006.

Food security in Burundi is under threat due to fears that an incurable banana disease, which has already been reported in several neighboring countries, could sweep across the nation, an official of an agricultural research institute said.

"Worst of all, the bacterial disease attacks all varieties of banana crops," said Melchior Nahimana, the director-general of the Livestock and Agricultural Research Institute of the Great Lakes in the central province of Gitega. Banana is one of Burundi's main subsistence crops; cassava is the staple.

"It's an alert that we are making, and the most endangered areas to be affected first are provinces located on the border with the DRC, Rwanda and Tanzania," Nahimana said. [Full story at [www.irinnews.org/report.asp?ReportID=54307](http://www.irinnews.org/report.asp?ReportID=54307)]

Note from ECHO: The causative agent is *Xanthomonas campestris* pv. *Musacearum*. This disease has been known in Ethiopia as a wilt of Ensete (*Ensete ventricosum*) and was first identified in Uganda in late 2001.

Other links:

[www.asareca.org/agriforum/articles21/agf21articles/banadis.htm](http://www.asareca.org/agriforum/articles21/agf21articles/banadis.htm)

[www.inibap.org/pdf/uganda.pdf](http://www.inibap.org/pdf/uganda.pdf)

[www.bspp.org.uk/ndr/july2004/2004-44.asp](http://www.bspp.org.uk/ndr/july2004/2004-44.asp)

## The World's Wheat Crop Under Threat from New Disease

Abstracted by Martin Price October 2005 from a report on the CIMMYT web site, <http://www.cimmyt.org/english/wps/news/2005/sept/griMeeting.htm>

Representatives of major donor countries and organizations, together with wheat specialists from around the world, 75 in all, gathered in Nairobi last fall to hear a report from an expert panel about the status of a new rust strain, first reported in Uganda in 1999. Only now is the significance and potential danger of the new strain becoming clear. The disease, Ug99, also called black rust, has spread to Kenya, Ethiopia, and possibly other countries. They agreed that the new strain of wheat stem rust is a major, strategic threat to global wheat production.

"Nobody's seen an epidemic for 50 years, nobody in this room except myself," said Norman E. Borlaug, Nobel Peace Laureate and former CIMMYT wheat breeder. "Maybe we got too complacent."

The new strain or strains are especially dangerous, because many wheat cultivars in major wheat producing countries show little or no resistance. The spores of the fungus are well-adapted for long distance travel on high-altitude wind currents.

To identify new sources of resistance, the Kenya Agricultural Research Institute (KARI) is screening thousands of wheat lines from all over the world at its station in Njoro, in the Great Rift Valley, a known hotspot for wheat rusts. "Despite the overall impression that most wheats are susceptible, we've found a few lines at Njoro that show resistance," says CIMMYT rust specialist Ravi Singh.

But resistance in an experimental wheat line is a long way from a resistant, high-yielding cultivar that farmers will actually grow. The delegates endorsed the creation of the Global Rust Initiative to monitor the spread of the disease and to work on long-term solutions—including new, locally-adapted, resistant wheat varieties and a global testing and distribution system.

For further information, contact Ravi Singh (r.singh@cgiar.org).

## Common Mistakes in Agricultural Development and a Key to Success

*Roland Bunch spoke at ECHO's Agricultural Conference in 2003. Below we summarize his talk.*

Development is a) a process of people learning to solve their own problems, b) sustainably. It means progressing from one

problem to another. Agricultural development is possible in more ways and climates than people often think.

### Some Common Mistakes

Often if you look at a graph of yield of a particular crop during a specific program, the yield rises but then drops again when programs leave.

One very common mistake is trying to do too many things at once. Successes tend to happen with very simple, limited technologies. Walk beside people, don't run ahead. Farmers can't take risks and will only pick one or two changes. If each picks a different one, there will be no consensus, and consensus is extremely important in rural communities. It is better to teach one idea to hundreds of people than to teach a hundred ideas to one person. Stick with simple, limited technologies in order to reach a critical mass. You need 35-40% of people in support of something to change the whole community.

Another common mistake is providing give-aways, donations, and subsidies. In this situation, people feel that development happens to them. People become accustomed to receiving. The donations become crutches, and can reduce the multiplier effect. Giving things away changes the development workers' approach, too. They are more likely to begin dictating.

A third common mistake is failing to check the economic feasibility of a particular technology (e.g. compost is uneconomical to use for basic grains).

### A Key to Success

A simple technology is best. Farmers need to be able to adapt it before they will adopt it. If a technology is not changing, it is—or will be—low-productivity. There needs to be constant change and constant innovation. Simple technologies should be simple to teach and simple to adapt. Motivate and teach farmers to experiment.

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## ECHOES FROM OUR NETWORK

### Maize in Semi-arid Areas

**Bob Hargrave** (ECHO staff member) read the feedback about the Green Famine in *EDN* 91 and shared, "Dr. Sharland's comments remind me of work done by a group from the University of Trier (Germany) in the 80's. They collected rainfall data from

several of the semi-arid areas and came up with estimates of how many years out of 10 there would be sufficient rainfall AND appropriate rainfall distribution for a maize crop. I don't remember the exact figures...but the best semi-arid environments would only produce maize in 6 years out of 10. But, like Danny commented, maize

is such a favorite that people were willing to take the risk. Or maybe, as Roger pointed out, they remember the good years as "normal"!

"My favorite definition of semi-arid areas is "marginal for maize"."

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## BOOKS, WEBSITES & OTHER RESOURCES

### PROTA—a helpful online resource

Tom Post sent us information about a website called PROTA (Plant Resources of Tropical Africa). "One of

our CRWRC staff in Mali...was informed of this site by the AVDRG folks and shared it with me. I used it to quickly discover the nutritional value of *Amaranthus cruentus* leaves. But, it contains information [about] a great

variety of plants used in tropical Africa. I think this is a great tool—a lot like Frank Martin's book: *Handbook of Tropical Food Crops*—but online and free."



Jane Volker, ECHO's librarian, looked at the website and added the following. "I checked a little further and found the 16 volume set of PROTA plant resources books are on their free database, full text!! This great resource

is free on the web. Have a look—the depth of information on each plant is incredible! From the homepage, go to "search PROTAbase" in the top left corner, then type in either the scientific

or common name of the plant and search."

PROTA's website is [www.prota.org/uk/About+PROTA/Mission.htm](http://www.prota.org/uk/About+PROTA/Mission.htm)

## FROM ECHO'S SEEDBANK

### Green Gram or Mung Bean (*Vigna radiata*)

By Bob Hargrave, ECHO Staff

#### Introduction

*Editors: Bob Hargrave worked in agriculture in dryland parts of Kenya for 17 years. He is on loan from AIM to ECHO, where he heads the Technical Response Unit. The staff members that are part of this group are the ones who respond to your questions about problems you encounter as you help small farmers, and to your requests for trial packets of seeds.*

Areas of the world that are considered Arid and Semi-Arid Lands (ASAL) present a challenge for the farmer with limited resources. These areas are marginal at best for maize and beans, which are favored by many people. Where maize and beans are not an option, other grains and legumes must be produced to provide a balanced plant-based protein.

Grains usually produced in ASAL areas are sorghum and the millets. One of the best options for a legume is the green gram or mung bean (*Vigna radiata*; Figure 3). I had more success under varying conditions with this legume than any other in several different ASAL areas of Kenya. Green grams consistently suffered less damage from insects than cowpeas (*Vigna unguiculata*) and were more reliable than common beans (*Phaseolus* species) under unfavorable conditions.

Green grams were already being cultivated and eaten when we arrived in Kenya. They have been a staple for several of the people groups in Kenya for a long time. The Kenya Agricultural Research Institute (KARI) had come up with an improved variety by 1985.

Figure 3. Green gram plant and immature pods. Photo by Bob Hargrave.



The term "bean sprout" is most commonly applied to sprouts made from green grams or mung beans. Anyone who has eaten the Chinese dish called chow mein will undoubtedly have eaten green gram sprouts.

The genus *Vigna* is best known for cowpeas (*V. unguiculata*). Cowpea varieties familiar to North American readers are Black-eyed, Zipper Cream, White Acre and Crowder peas. Other vignas include *V. unguiculata* ssp. *sesquipedalis* (Asparagus or Yardlong Bean), *V. aconitifolia* (Moth Bean), *V. angularis* (Adzuki-Bean), *V. mungo* (Urd Bean or Black Gram Bean), *V. umbellata* (Rice Bean), and *V. vexillata* – (Wild Mung Bean). In this article the term "green gram" will be used to avoid confusion between it and "Black Gram Bean" or "Wild Mung Bean."

Green grams have been grown in China and used for bean sprouts for thousands of years. They are extensively cultivated in much of Asia and also in semi-arid areas of Africa. In India they are used to make *moong dhal*—dehulled and split green grams used for various dishes.

#### Description

Green grams grow on an annual bushy leguminous plant that grows to a height

of 30 cm to 1 meter. Flowers are pale yellow and crowded in clusters of 10 to 25. Pods are green while filling, turning to black or brown when mature. The pods are 3 to 5 inches long and contain 10-15 seeds. Seeds are small, round or oblong, and usually green (Figure 4).

#### Uses

Green grams are very nutritious for human consumption. They may be used as a fresh, shelled bean, a dry bean or sprouted. The dry beans are a good source of vitamins and minerals and contain around 20% protein. Around the world they are consumed directly and used in various dishes including curries, soups, breads, sweets, noodles, and solids.

Bean sprouts can be produced in 4 to 8 days. 50 ml of dry green grams will produce approximately 1 liter of sprouts. To make bean sprouts, first soak the green grams overnight. The next morning rinse the grams twice and place the wet seeds in a 1 liter glass jar with a cloth cover. Put this jar in a dark, warm place. Placing the sprouting seeds in darkness keeps the sprouts from turning green and stimulates the sprouts to elongate. [DRB: I have also read that sprouting them in the dark prevents a bitter taste.]

In the evening and twice a day until they are ready, rinse the seeds and return them to the dark, warm location. Once they start sprouting, the green seed coats will separate and may be removed while rinsing. The bean sprouts are ready to use when they have reached 4 to 8 cm in length and before the first leaves have fully developed. They are then ready for use in your favorite recipe or just about any combination of stir-fried vegetables.

The sprouts may be kept refrigerated for several days.

Figure 4. Green gram. Photo by Bob Hargrave.



## Cultivation

### Varieties

There are many varieties and land races of green grams around the world. The World Vegetable Center (also known as AVRDC) is the leading organization currently breeding new varieties and providing information about the production of green grams. If green grams are growing in your area, it is probably best to use the local variety. ECHO does have one unnamed variety

of green gram in our seed bank and can provide a small packet for evaluation according to our seed distribution policy.

Angela Boss grew some green gram in the Central African Republic and sent this report: "We have managed to get more than 9 kilograms off of a 20 x 7m plot of green gram beans, which people here are quite happy with....[Plants] are upright and non-vining, and [seeds] only take 30 minutes to soften in water." Angela commented that they started picking the beans after 2 months.

### Climate

Green grams grow best in warm climates at a temperature of 28 to 30°C (82-86°F). They usually mature in 60 to 90 days. The early maturing varieties can often produce before drought destroys many bean species. In areas with higher rainfall it is recommended to grow green grams on raised beds.

### Cultural practices

Green grams will respond to fertilizer or manure application but will normally give satisfactory results if grown on relatively good soil. They can be inoculated by the common "cowpea" bacteria.

Green grams are susceptible to the usual array of pests and diseases that attack other *Vigna* species. However, if grown during the correct season with good cultural practices, they should not need pesticides.

Green grams mature continuously for several weeks and should be hand picked every few days for maximum production. As with most legumes, the pods may be picked when they have changed color from green to brown, indicating that the grain filling period is complete. Dry the pods to the proper moisture content for storage (10% or less; generally when seeds are hard and dry).

### Resources

World Vegetable Center Learning Center  
PO Box 42, Shanhua, Tainan 74199;  
Taiwan ROC; Tel: +886-6-583-7801;  
Fax: +886-6-583-0009;  
email: [avrdocbox@avrdoc.org](mailto:avrdocbox@avrdoc.org)  
<http://www.avrdoc.org/LC/home.html>

University of Wisconsin Alternative Field Crops Manual  
(Green grams grow well where there is a short warm season, so they can be grown in temperate climates)  
<http://www.hort.purdue.edu/newcrop/afcm/mungbean.html>

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