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Essays

Using Science to Help the Poor: Low-Budget Research Ideas. Part 3: Research Opportunities

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This article suggests three topics for research that could produce valuable benefits for people living in underdeveloped areas of the world. If you are interested in pursuing any of these, we at ECHO would be glad to offer limited guidance and to network you with any other scientists who might be working on the problem you have chosen. See our occasionally updated document "Using Science to Help the Poor: Low-Budget Research Opportunities" at www.echonet.org.

Uses of Plant Tissue Culture

I can think of three important ways in which tissue culture can be used to help the poor. All involve crops that are normally asexually propagated by cuttings, tubers, etc. Disease buildup can be considerable after generations of propagation, reducing yields and spreading the diseases to other locations when propagules are distributed. The three research opportunities I see are:

- Providing disease-free planting material for farmers
- Extending the normal climatic range of asexually propagated crops, and
- Enabling transfer between countries of new asexually-propagated crops or superior varieties of existing crops without the risk of introducing disease.

I read a report of potatoes being grown in Vietnam, in a region normally thought to be too hot for potatoes (Tissue Culture: potatoes find new role in rice bowl [February 1989] *Biotechnology*. 7: 116). The Vietnamese are using techniques introduced by the International Potato Institute in Peru, CIP. Simple tissue culture techniques have been developed that are appropriate for Third World settings in remote locations and can be done by selected farmers themselves. Apparently the broader range of climates in which potatoes can be grown is due to the production of virus-free plants that tissue culture makes possible.

More recently, a fascinating project was undertaken by scientists at CIAT (International Center for Tropical Agriculture) in Colombia to train people and establish small businesses that sell disease-free tissue cultured cassava plants to neighboring farmers. These micro-enterprises are owned and operated by small-scale, resource-poor farmers with minimal education. Extremely small capital investments were required. It is fascinating to read how the CIAT scientists found inexpensive substitutes for tissue culture equipment and media, e.g. using volume measurements to eliminate the need for expensive mass balances and substituting the herbicide 2,4-D and commercial root growth promoters for expensive laboratory quality growth regulators. (Escobar RH, Hernandez CM, Larrahondo N, Ospina G, Restrepo J, Munoz L, Tohme J, Roca WM [2006] Tissue Culture for Farmers: Participatory Adaptation of Low-input Cassava Propagation in Colombia. *Experimental Agriculture* 42:103-120. DOI:10.1017/S001447970500311X.)

Dr. Noel Vietmeyer at the National Academy of Sciences told us that some of the "underexploited" Andean tuber crops have been found to produce much more abundantly in their native range when grown from virus-free plants produced by tissue culture. Also, when freed of the disease load that plants normally carry, some have done surprisingly well at lower elevations, where they are not normally grown (as in the case just mentioned of potatoes in Vietnam). Plants produced by tissue culture would be better able to survive in new areas. Also, if *only* disease-free plants were introduced, there would be no opportunity for re-infection.

Improved varieties of asexually propagated crops such as yam or cassava cannot be readily and safely sent between countries. Yet in many cases they could make a substantial contribution to local agriculture.

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Several possible projects are suggested:

1. Obtain technical details from the CIP/Vietnam project and develop a training package so that any private or voluntary agency wishing to introduce such a project could do so. (This information may or may not already be written up in a user-friendly style.)
2. For crops of special interest, develop techniques for making virus-free plants. Candidates could be selected from the wide variety of promising tuber crops grown in the Andean Mountains of South America. Tubers of some might be found in specialized food stores in temperate climates. (See the discussion of chaya below for another important need for virus-free material.)
3. Develop techniques (or, more likely, find plans already existing in the literature) whereby tissue cultured plantlets could be sent to *remote* locations to be grown into plants that can be set into the field. Techniques already exist for scientists to send plantlets to other scientists. We are interested in getting superior plants safely to and successfully grown by "the little guy."

We would like to be able to refer people to a commercial source or research center where they could obtain a disease-free start at growing new species or varieties. Detailed instructions would be needed to enable development workers who are not experts to be able to take the new plantlets from test tube to field. ECHO has recently learned that one of our most important "underutilized" food plants, chaya, may be a host for a cassava virus. The only way to distribute this plant is by cuttings, because it almost never produces seed. We do have one seed-grown plant, the only chaya in ECHO's collection that does not have this virus. ECHO has a cultivar that is horticulturally superior but it has the virus. We believe that this cultivar could be cleaned up by growing new plants in tissue culture from meristematic tissue. For an overview of ECHO's experience with chaya, see ECHO Development Notes issue #78 pp. 1-5, available at www.echotech.org.

Make an Antibiotic Ointment from Seeds of the Moringa Tree (to be used like Neosporin)

Antibiotic ointments are even more important in the tropics than in temperate climates. For example, we heard a few years ago from a missionary in Haiti who worked in a region where there was a rash of skin diseases and a shortage of antibiotic ointments.

Experiments at the University of San Carlos in Guatemala have shown that seeds from the pantropical tree *Moringa oleifera* can be used to make an antibiotic ointment that is effective against *Staphylococcus aureaus* and *Psuedomonas aeruginosa* in vitro.

They used fairly exacting laboratory techniques, and prepared the solution with a rotavaporator. Dr. Grace Ju and a student at Gordon College developed simpler techniques that could be used in an ordinary kitchen for preparing the antibiotic. They demonstrated its effectiveness on bacterial culture under lab conditions. This was a great example and direct result of ideas in *Using Science to Help the Poor*. Please e-mail us for a report on their work.

Other important questions remain. How long can the ointment be stored without losing effectiveness? How do various preparation methods compare in effectiveness to each other and to commercial ointments? Could this be the basis for a micro-enterprise business, or is it exacting enough that it would need to be done at an institution like a hospital? Ideally its effectiveness on human skin infections would be studied in selected remote locations.

Egusi Melon as an Emergency Milk Substitute

In *Amaranth to Zai Holes*, we reported on a unique use for egusi (Meitzner LS, Price ML [June 1996] Egusi Melon as an Emergency Milk Substitute in West Africa. Amaranth to Zai Holes, p. 262-263. http://www.echotech.org/mambo/index.php?option=com_wrapper&Itemid=70). Jim and Yoko Rankin with Adventist Relief and Development International in Ghana used two methods to make a milk substitute. The first way was by blending 100 g of dehulled egusi seeds with 2 cups (400 ml) of water. After blending, another cup of water, 2 teaspoons of honey, and ¼ teaspoon of salt were added. Milk substitute was made using a second method by simply mixing 100 g of dehulled (and presumably crushed) seed with 6/7 cup of water, honey and salt.

One question is: Is honey necessary? We've read somewhere that infants should not be fed honey for the first 12 months due to the possible presence of certain bacteria spores, so caution should be used here.

It would be very interesting to do a paper study comparing the nutritional content of milk with this milk substitute. In what ways are they comparable? In what ways would the egusi milk substitute be deficient? How does egusi milk substitute compare with soymilk? We have in our library a paper titled "Chemical, Functional, and Nutritional Properties of Egusi (*Colocynthis citrullus L.*) Seed Protein Products" (Akobundu ENT, et al., Journal of Food Science 47(3): 829-835). The paper details the mineral, fatty acid, and amino acid contents of egusi seeds. These data would allow you to determine the amounts of these compounds found in the milk substitute after diluting it with water. We have made some preliminary comparisons, but there is a need for more data. Naturally, any such milk substitute would only be used in emergency situations.

More ideas

More research ideas are described in my occasionally updated document "Using Science to Help the Poor: Low Budget Research Ideas" on the ECHO website. To see it, go to www.echotech.org and search for "using science."