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U.S.-Israel Cooperative Development Research Program

A Partnership for International Development

U.S. Agency
for International
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Washington, D.C.
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April 1987

Research Program (CDR)

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The U.S.-Israel Cooperative Development Research Program

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Who will feed Africa? Under the U.S.-Israel CDR Program, African scientists are benefitting from Israeli technical expertise and development experience as they struggle to solve their continent's most persistent problems. Their goal is a better tomorrow for this Jalou girl and her friends.

Inner Front Cover:

Israel's varied terrain includes reclaimed deserts and swamps, valleys and hills, making it an ideal outdoor laboratory for agricultural research. Here contoured fields grace the Galilean hills.

All photographs are from the files of I.M. Asher, the Embassy of Israel, AID/SCI, AID/XA or CDR grantee institutions, unless otherwise noted.

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Introduction

For several decades, Israel, a small country with few natural resources, has sought rapid progress through technological innovation. The remarkable success of this effort suggests that Israeli experience and expertise can be used effectively to help solve similar problems confronting less-developed countries (LDCs). Developing country scientists have long expressed interest in Israeli technology and in collaboration with Israeli scientists. The United States of America — in view of its technical leadership and its valued friendship with both LDCs and Israel — is in a unique position to facilitate such international partnerships and technology transfer for the benefit of all.

The U.S. Agency for International Development (AID) has undertaken a variety of substantive initiatives in this area. These include a joint U.S.-Israel agricultural initiative in the Caribbean Basin, a program in regional cooperation linking selected Israeli and Egyptian research institutions, and consideration of Israeli training centers as providers of training for developing country participants in AID programs. One of AID's most recent and successful efforts has been the U.S.-Israel Cooperative Development Research Program (CDR), under which teams of Israeli and developing country scientists jointly tackle significant development problems while building LDC research capacity and expertise.

In just two years, CDR has become a valued part of the international interchange between the scientific communities of Israel and developing countries. Over 700 proposals for joint research have been received, and 80 projects are underway in 20 countries. We look forward to the continued success of this exciting new program. It stands as an important example of how we hope to engage the considerable technical capability of Israel in our development programs around the world.

M. PETER MCPHERSON,
Administrator
U.S. Agency for
International Development

What is the U.S.-Israel Cooperative Development Research Program (CDR)?

The U.S.-Israel Cooperative Development Research Program (CDR) is a new initiative of the U.S. Agency for International Development (AID) which seeks to increase the access of less-developed countries (LDCs) to Israeli scientific, technical and development expertise. It provides funding for Israeli and developing country scientists to cooperate in joint research on significant development problems, while strengthening the future ability of LDC scientists to do such research themselves. CDR emphasizes close working-level partnerships between Israeli scientists and their developing country counterparts in Africa, Asia and Latin America. The program is implemented — and its quality assured — through an objective, peer-reviewed international grants competition.

Both developing country and Israeli scientists and institutions are welcome to submit CDR grant proposals. Applicants may be from universities, government laboratories or the private sector. Priority is given to Israeli research collaboration with those developing countries having a USAID Mission or USAID Representative (page 29). African countries remain of particular interest. CDR also supports cooperative research involving international research centers, such as IRRI, CIP, ICIPE, ILRAD and IITA. Although cooperative research involving middle-income countries, such as Brazil, Chile, Mexico and Nigeria is sometimes funded, it must be unusually promising and of exceptional benefit to developing countries.

In FY 1985, the U.S. Congress set aside $2 million to begin this new AID initiative. The Program was enthusiastically received from the start. Developing country and Israeli investigators submitted over 340 proposals during the first three months of CDR's existence (first review cycle)! About 200 additional proposals were received during the remainder of the first year (second review cycle).

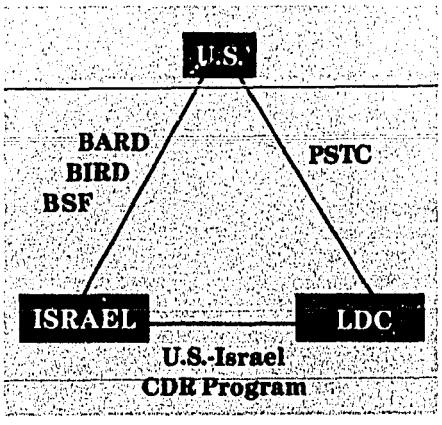
The original $2 million budget permitted funding 14 projects, after extremely rigorous review. The maximum grant size was $150,000, which is rather modest for projects of this kind. Although the actual amount and division of funds varies in practice, such a sum might provide about $25,000 a year to two collaborating institutions (one LDC, one Israeli) for the three year duration of a typical grant.

CDR's $4.785 million budget for FY 1986 permitted funding an additional 33 projects. CDR's budget for FY 1987 is $5 million. This will permit funding 20 more projects from the almost 200 grant requests received by CDR in the fall of 1986 (early FY 1987). For FY 1988, LDC and Israeli scientists and institutions are being invited to submit joint research proposals for up to $250,000 (total funding), spread over three to five years. This will facilitate more productive, longer-term, Israel-LDC relationships. Already, 210 new grant applicants are competing for the 20 grants that CDR can offer at current funding levels.

CDR completes a triad of U.S. Government programs encouraging innovative research in the U.S., Israel and LDC scientific communities (Figure 1). AID's Program in Science and Technology Cooperation (PSTC) links developing country institutions and their U.S. counterparts in joint development-oriented research.* U.S.-Israel bilateral programs, such as the U.S.-Israel Binational Science Foundation (BSF), Binational Agricultural Research and Development Fund (BARD), and Binational Industrial Research and Development Foundation (BIRD) link U.S. and Israeli scientists in a broad variety of research and development endeavors. CDR completes this triad by linking developing country and Israeli scientists.

*For further information please contact: AID Office of the Science Advisor (AID/SCI), SA-18, Room 720, Washington, DC. 20523.

U.S.-Israel-LDC Cooperation



Under the U.S.-Israel Cooperative Development Research Program (CDR), Israel's success in using technology to solve its own development problems is being transferred to less developed countries.

As mentioned, CDR seeks innovative research ideas in the natural sciences and engineering that aim to solve serious development problems. By research, we mean the testing of a scientific hypothesis or the development of new technology through organized observation in an experimental setting (laboratory or field). Even if somewhat basic in nature, the research must be directed towards a significant development need. CDR also encourages Israeli technology transfer and training opportunities for developing country scientists; but only in the context of a joint research project.

CDR does *not* fund: planning or policy studies, core support for organizations, operations or social science research, conferences, surveys, evaluations, baseline data collection, routine

Areas of Emphasis

mapping, or literature reviews. Travel and training may be included to achieve the purposes of a well-defined research project, but are not funded as independent projects. Unlike the binational grant programs mentioned above, CDR does *not* consider the benefits of the proposed research to Israel. PREDOMINANT BENEFIT TO DEVELOPING COUNTRIES AND FIRM, EFFECTIVE RESEARCH COLLABORATION BETWEEN DEVELOPING COUNTRY AND ISRAELI SCIENTISTS IS ESSENTIAL.

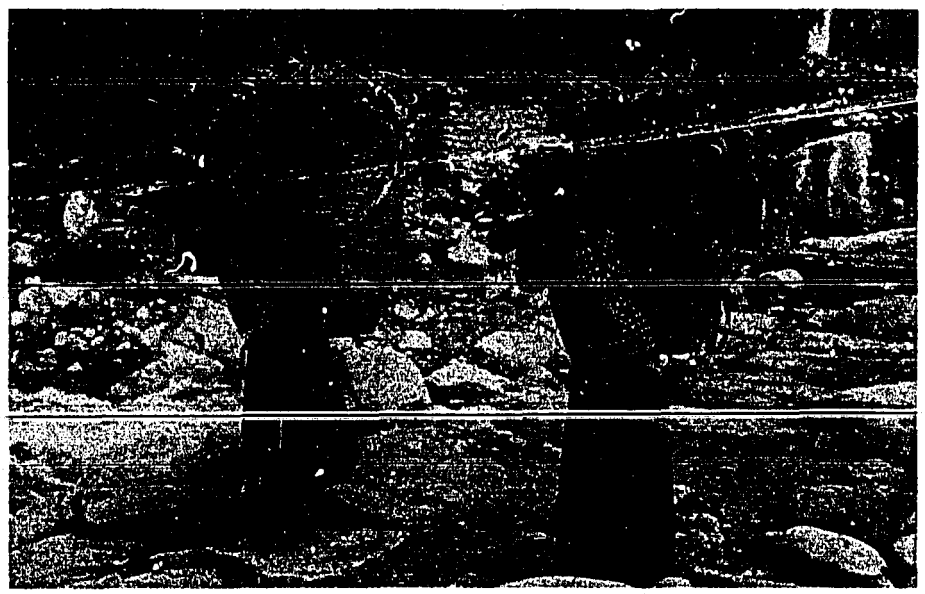
Although CDR does not serve as a clearinghouse for potential collaborators, it does encourage the establishment of such mechanisms by others. For example, it recently helped establish a joint effort between the Royal Nepalese Academy of Science and Technology, USAID/Kathmandu and the Embassy of Israel (Kathmandu) to facilitate matching Nepalese and Israeli scientists with similar interests. Proposals from under-represented countries, expecially those in Africa, are particularly encouraged.

The U.S.-Israel CDR Program emphasizes areas in which Israeli expertise would be particularly valuable to LDCs. These include, but are not limited to: arid lands agriculture and agroforestry, biotechnology for human and animal health, plant biotechnology, biological pest control, hydrology and aquaculture, engineering and energy research. Table 1 shows how many proposals were received and funded in each of these areas during FY 1985-87.

Table 1. CDR Areas of Emphasis

Funded		*1985*	*1986*	*1987*	*Total*
11	Arid Lands Agriculture	52	22	17	91
15	Biological Pest Control	29	25	17	71
14	Human Health	34	31	40	105
12	Engineering/Food Science	69	36	54	159
11	Plant Sciences/Biotechnology	61	26	34	121
7	Veterinary & Animal Science	19	16	15	50
11	Water (Aquaculture/Hydrology)	49	24	26	99
—	Other	36	8	7	51
81	TOTAL	349	188	210	747

Note: Dates refer to fiscal year (FY) preproposals received. Projects funded approximately one year later after rigorous review.



Severe deforestation in the hills, forces these Nepalese women to travel long distances for firewood. USAID, the Royal Nepalese Academy of Science and Technology (RONAST) and the Government of Israel are taking an active role in helping link Nepalese and Israeli scientists in research to develop innovative solutions to these and other pressing problems.

1. Arid Lands Agriculture

Using *the* Negev desert as a large outdoor laboratory, Israeli scientists have developed a wide variety of innovative technologies for coping with the unique agricultural challenges of arid environments (page 8). The U.S.-Israel CDR Program helps transfer and extend these results through joint research with developing country collaborators.

One approach is to maximize the efficient use of the limited soil and water resources that *are* available. For example, M. Schwartz of the Jerusalem College of Technology is working with Peruvian collaborators at the Universidad Nacional Agraria to develop methods for growing plants in sand dunes with salty water. The high porosity of the sand is an advantage here — the water percolates so fast that potentially harmful salt accumulations are carried below the plants' root zone.

Other investigators seek to harness runoff by developing optimal rainwater harvesting systems for self-sustaining livestock production in Kenya.

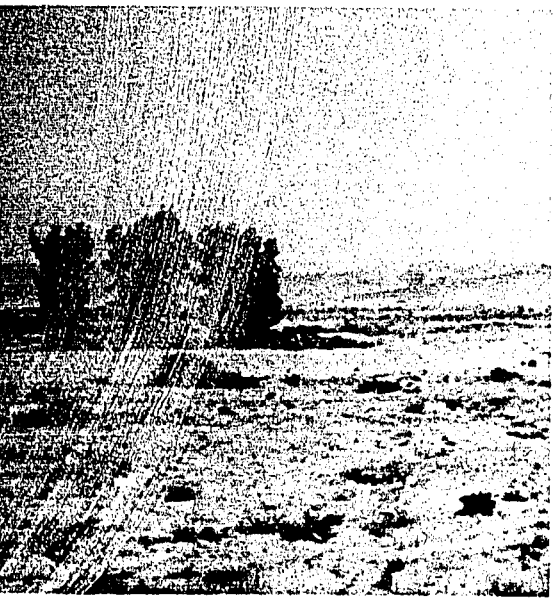
A complementary approach to dryland farming seeks new crops especially adapted to harsh desert conditions. Y. Mizrahi and colleagues at the Ben-Gurion University of the Negev are seeking and testing a wide variety of new fruit and nut crops with their collaborators at Thusano Lefatsheng Botswana. Botswana's arid Kalihari Desert is itself a treasure house of under-exploited species requiring further investigation. For example, the *mongongo* fruit is abundantly produced by large trees under highly adverse conditions. The enclosed *mongongo* nut is highly prized by the !Kung bushman of the Kalihari desert. On the West African coast, natives of the Namibian Desert often consume 100-300 *mongongo* nuts a day. Yet little has been done to develop the plant's full agronomic and commercial potential. *Marula* fruit is another abundant indigenous delicacy with great potential, as are certain dryland species of wild orange and plum. A similar, but separate, CDR project seeks new perennial shrubs for pasturage in semi-arid regions.

Other investigators in Israel, Thailand, the Philippines and Portugal are trying to increase the tolerance of more familiar crops — tomato, potato and wheat — to drought and salt stress. Still others are doing important basic research on the mechanisms of salt tolerance and its relationship to nutrient uptake. In all, CDR already funds 11 projects out of the 91 proposals it has received in this area.

The Kalihari desert of Bostwana is the home of many exotic wild fruits that flourish under highly adverse conditions. This *san* bushman is cutting open a "water-root"; he will then squeeze the water out. (Photograph courtesy of Irven De Vore, Anthro-photo File, Cambridge, Mass.)

Saline deserts can be turned into productive "pastures" of fodder crops. (a) This *awassi* lamb is grazing on *Atriplex* saltbushes which flourish on salty soils in the intense desert heat. (b) *Atriplexes* excrete the salt their roots absorb into microscopic hairs protruding from their leaves. These swell, burst and scatter their salt outside the plant. (Photomicrograph courtesy of J. R. Goodin, Texas Tech University.)

Making the Desert Bloom



Israeli experience in making even the most forbidding arid environments bloom has direct application to many developing countries. Here in the northern Negev Desert, microcatchment basins around each tree produce an isolated man-made oasis without irrigation or regular care.

"This is just sand — we have a lot of it," says our suntanned guide, pointing to the parched Negev desertscape behind him. His eyes sparkling, his halo of white hair blowing in the wind, Joel De-Malech, winner of this year's prestigious Israel Prize, reminds one a bit of David Ben-Gurion, Israel's first Prime Minister, who also saw Israel's future in these bleak, inhospitable drylands. "And this is what we have made of it," he smiles, pointing to the lush green fields, vineyards and orchards of the Ramat Hanegev Agricultural Experimental Station, incongruously springing from the lifeless brown vastness around us. "And this," he continues, "is the difference." He indicates the two large valves at his feet — the blue one controlling fresh water piped from the Sea of Galilee far to the North, the red one controlling local saline water from the large prehistoric aquifer under the Negev and Sinai deserts.

Evaporation losses make conventional irrigation too wasteful here. Instead thin plastic tubes deposit water drop by drop in or near the root zone of each plant. Special sensors continuously relay information on environmental conditions and plant stress to microprocessors, which adjust water and nutrient flow accordingly. Relatively salt-tolerant crops like wheat, asparagus, and melons grow well under saline "trickle-drip" irrigation. Cotton yields are actually *higher* than with fresh water. Tomatoes of exceptional quality also flourish on carefully optimized fresh/saline water regimes. Even salt-sensitive plants like maize (American corn) are beginning to yield to Israeli ingenuity. The trick is to provide fresh water at the critical phases of growth, with a gradual increase of salinity later. The search is also on for more salt resistant cultivars and species. Some forage salt-bushes at the Eilat Experimental Station can be grown with seawater!

Harnessing the heavy, if infrequent, desert rains is another challenge. Over 2000 years ago, field crops and fruit trees flourished in the Northern Negev, due to the remarkable water management practices of the ancient Nabateans. Rediscovering and refining these age-old arid land techniques, modern Israelis "harvest" the runoff water from entire hillsides to supply their experimental farms near the ancient city of Avdat. Once again olives, almonds, apricots, barley and wheat grow in the desert — even without supplementary irrigation. Even the barren steppes on the road to Sde Boqer are dotted with self-sustaining, man-made oases, each tree surrounded by its own mini-catchment basin.

To the large areas of the developing world stalked by drought and famine the Israeli experience offers a vision of hope — a vision that Israel is willing, even anxious, to share. Approached with intelligence and determination, the desert is not a problem, but a solution. Isaiah expressed similar hopes: Let the wilderness and steppe rejoice, and the desert exult and bloom.

The bleak scenery of the Judean desert provides a striking backdrop for this experiment in growing tomatoes under plastic.

Joel de Malech, winner of this year's Israel Prize for his contributions to desert agriculture, stands between experimental plots of maize growing on fresh and saline water delivered directly to each plant by the dual trickle-drip irrigation system behind him.

(a) In Malawi, G. Myirenda of the Makoka Experiment Station examines a cassava plot to be used in joint research with D. Gerling of Tel Aviv University on the biological control of (b) *Bemisia tabaci,* the whitefly vector of cassava mosaic virus.

Natural Enemies Help Control Pests

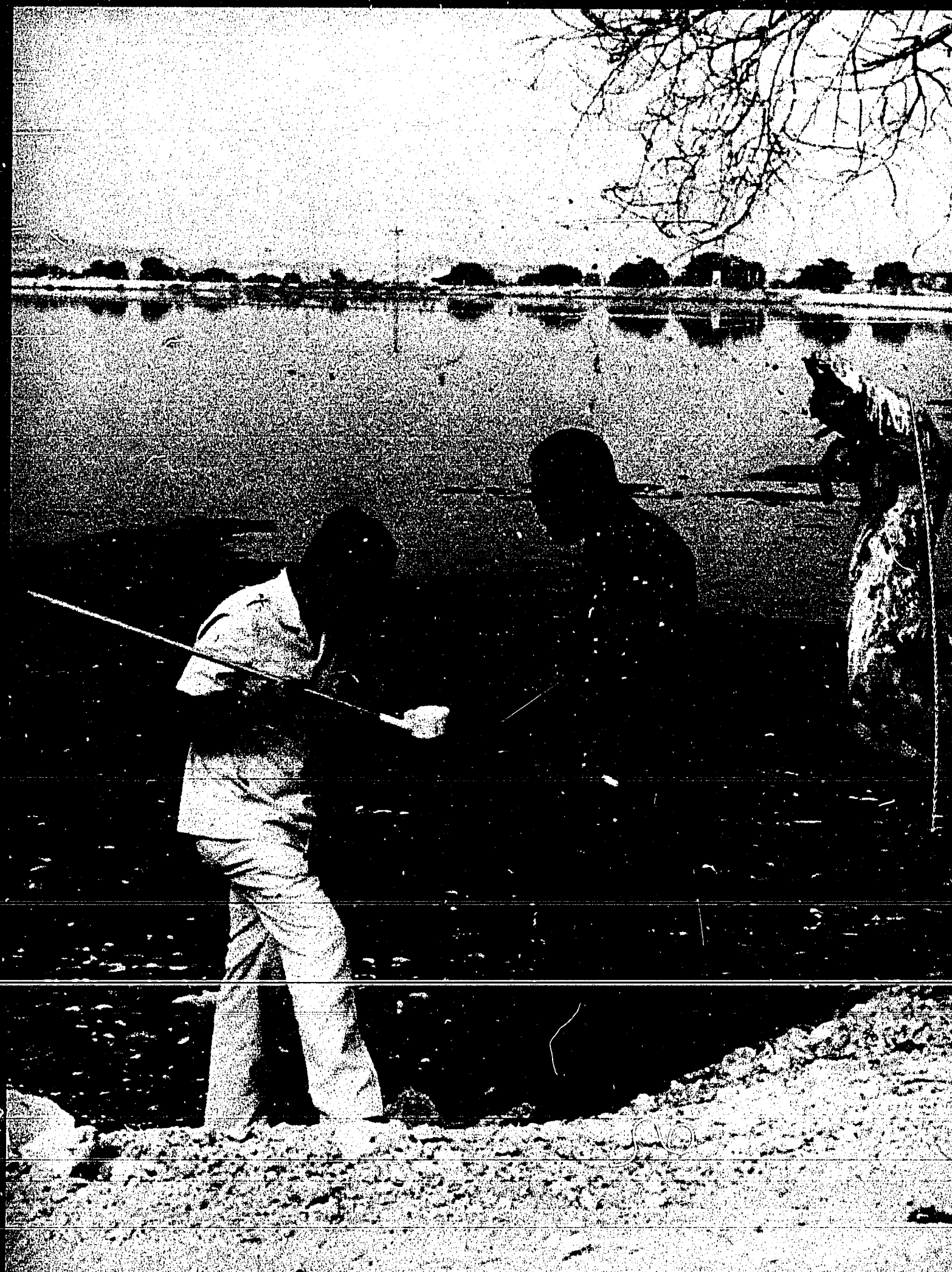
In the ongoing battle against insect pests, the insects are all too often the winners. For example, despite over 40 years of synthetic pesticide attacks, mosquitos still transmit an estimated 300 million cases of malaria — which result in 2 million malaria deaths — annually. Increased pesticide resistance and environmental concerns have led to renewed interest in biological pest control.

Fortunately, most pests themselves have "pests," natural enemies that can become Mankind's welcome allies. Israeli scientists have long distinguished themselves in this area. For example, in 1977, Joel Margalit noticed a large number of dead mosquito larvae in a stagnant desert pool. After investigating and eliminating a variety of alternative explanations, Margalit and his colleagues at Ben-Gurion University discovered a new bacterial strain, which produced spores containing a highly potent and selective insect endotoxin. Now known as *Bacillus thuringiensis var. israelensis* (BTI), after its place of discovery, this preparation is highly effective against the larvae of the mosquitos that carry malaria and the blackflies that carry African "river blindness." It can kill 50% of the larvae of some *Culex* mosquito species within 15 minutes. Already endorsed by the WHO and EPA, the main drawback of BTI is its short useful half-life in the field.

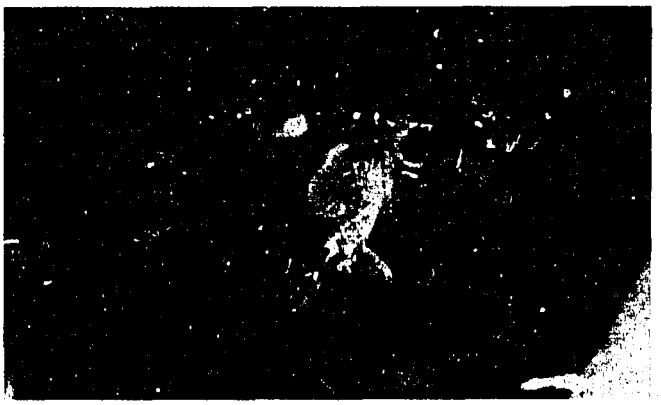
A wide variety of research approaches for BTI improvement have been submitted to CDR for consideration. For example, CDR grantees A. Keynan of the Hebrew University of Jerusalem and A. Traore of the Guinea Ministry of Agriculture are using recombinant DNA techniques to transfer the DNA fragment coding for BTI toxin to *Bacillus sphaericus*, a more persistent mosquito control agent already in wide use. All such experiments are carried out in full compliance with existing NIH recombinant DNA guidelines.

Biological methods can also be highly effective against plant pests. *Bemisia tabaci* is a widespread whitefly pest. In the process of feeding on plant sap, it transmits a variety of important plant viruses. In Africa, it carries cassava mosaic disease, a Gemini virus which can decimate plantings of this important food crop, reducing yields up to 75%. CDR grantees G. Nyirenda of the Makoka Agricultural Experiment Station in Malawi and J. Gerling of Tel Aviv University are seeking effective ways to control this pest in Africa. They are considering a variety of promising *Bemisia* parasites and are also field testing the use of simple yellow traps. Swang Wangboonkong of the Thai Department of Agriculture and D. Vierov of the Volcani Center, are studying the effects of pesticides on the population dynamics of *Bemisia* and its natural enemies in Thailand, where it transmits tomato yellow leaf curl virus. Taking advantage of Nature's marvelous balance holds much promise for improved developing country agriculture and health.

Dr. Joel Margalit discovered the potent biocontrol agent *Bacillus thurengiensis var. israelensis* in a Negev pool similar to this one. Here he collects local mosquito larvae with recent CDR grantee W.A. Otieno of Kenya's International Center for Insect Physiology and Ecology (ICIPE).



2. Biological Pest Control



A friend of man, the female of the small wasp *Encarsia lutea* lays her eggs on the pupae of the whitefly *Bemisia tabaci*. The emerging larvae parasitize and destroy this important crop pest.

Man lives surrounded — and dramatically outnumbered — by insects. Some are helpful, while others carry deadly human, plant and animal diseases or directly damage important crops. Although synthetic chemical pesticides have been a boon to many developing countries, their expense, potential for abuse, effect on human health, impact on the environment and limited lifetime (in the face of increasing insect resistance) have all come under recent scrutiny. New biological control methods provide an attractive alternative in many applications. Israel has long been a leader in this field (page 10), and 15 of the 71 proposals submitted to CDR have already been funded.

The African armyworm, *Spodoptera exempta*, causes heavy damage to cereal crops and pastures over wide areas. The adult moth can travel over 1200 miles. M. Edelman of the Weizmann Institute of Science and W. A. Otieno of the International Center of Insect Physiology and Ecology (ICIPE) in Kenya are assessing the effectiveness of both naturally occurring and genetically engineered insect viruses in controlling this voracious pest. Tel Aviv University scientist M. Broza is also working with Dr. Otieno to develop and field test other bacterial biocontrol agents. M. Rumakom of the Thai Department of Agriculture and M. Kehat of the Israel Agricultural Research Organization's Volcani Center are developing pheromone traps for monitoring and possibly controlling another moth pest, *Heliothesis armigera*, in Thailand.

Many fungal diseases also can be controlled by biological methods. C. Rolz of the Central American Research Institute for Industry (ICAITI) is working with Israeli collaborators to develop microbiological control methods for coffee rust, a major problem throughout Latin America. A. Ofusu-Asiedu of the Ghana Forest Products Research Institute and I. Chet of the Hebrew University of Jerusalem are screening soil microorganisms, such as *Trichoderma* spp., to find new biocontrol agents against a wide variety of fungal pathogens. They hope to grow these economically on local agricultural and forestry wastes.

CDR grantees in Israel and Ghana are seeking biocontrol agents like *Trichoderma* spp. to protect plants from fungus diseases without imported pesticides. Here tomato seedlings infected with *Fusarium* wilt are shown without (left) and with (right) *Trichoderma* protection.

3. Human Health

Over the last 40 years, Israel has created a level of advanced medical expertise and public health care equal to that of developed countries; but it can still remember its bitter struggle against the tropical diseases typical of the developing world. This dual experience makes it a valuable partner for Third World research in tropical medicine.

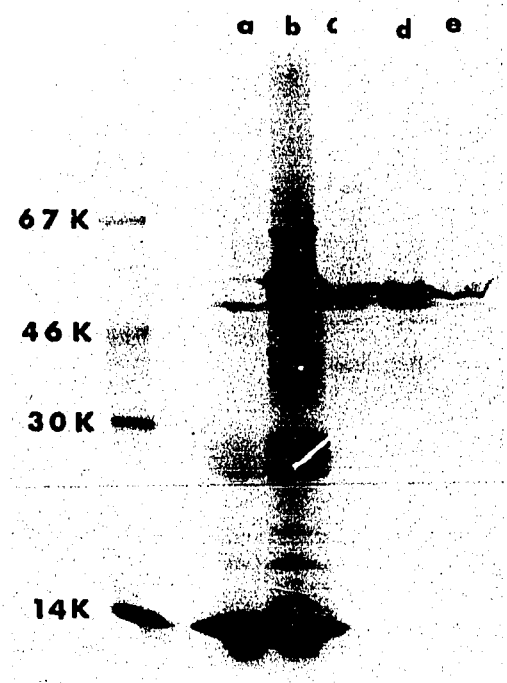
Several projects involve tropical diseases like trypanosomiasis ("sleeping sickness"), malaria and leishmaniasis, which are caused by microscopic parasites. For example. A. R. Njogu of the Kenya Trypanosomiasis Research Center is working with colleagues at the Weizmann Institute of Science to investigate the usefulness of microtuble proteins as new targets for drugs against the trypanosome parasite.

Other CDR grantees are developing new diagnostic or analytic methods. T. T. Farajardo of the Eversley Child Sanitarium in Cebu, Philippines, is collaborating with Israeli colleagues on tests to determine the presence, viability and drug resistance of *Mycobacterium leprae*, the cause of leprosy. G. Schroeder of Delron Development, Inc., is collaborating with N. Librojo at the University of the Philippines at Los Banos on non-invasive, non-radioactive methods for conducting human nutrition studies. The naturally occuring isotope ratios of carbon, nitrogen and hydrogen in normal foods are compared with those in newly-formed hair, nails and saliva. Prof. Myembe at the University of Kinshasa in Zaire and I. Polachek at the Hebrew University of Jerusalem are developing a simple method for identifying African fungi which can cause human disease. In contrast, C. Pholpramool of Mahidol University in Thailand and his colleagues at Tel Aviv University are evaluating the use of sulfonamide drugs and their analogs as potential male contraceptives. In all, 14 health-related CDR projects are underway, out of the 105 received for review.

4. Plant Biotechnology

Eleven CDR projects are already underway in the area of plant biotechnology, and — as the large number of submissions (121) indicates — this area should grow rapidly. Plant tissue culture techniques are a particular focus of much developing country interest.

Ghanian investigators and their Israeli counterparts are already studying how special substances produced by double-stranded RNA viruses influ-



Ghanian and Israeli scientists are studying the double-stranded RNA viruses which inhabit plant-damaging fungi, such as *Rhizoctonia solani*. These viruses produce special proteins, being analyzed here, which can affect the virulence of the fungus (vertical scale is molecular weight in kilodaltons).

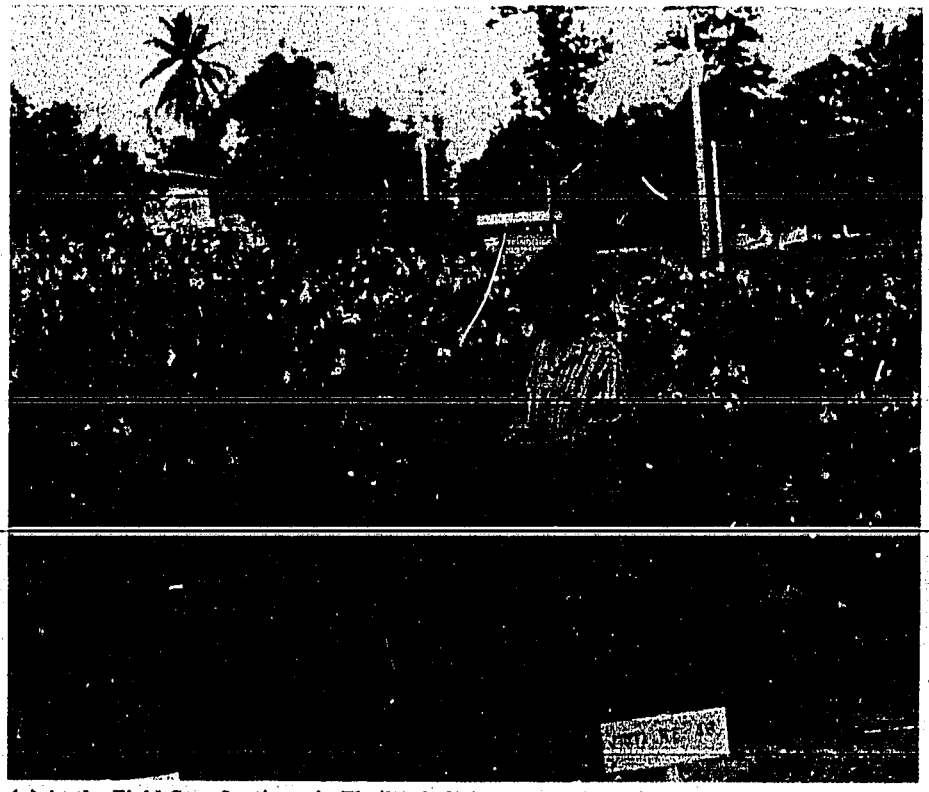
In the remote Loo Valley in the Philippines, CDR grantee N. Librojo (far right) pursues her nutrition studies on the local inhabitants. New techniques being developed with Israel's Delron Development Inc. will help eliminate the need for the current invasive methods which require radioactive tracers.

ence the way the pathogenic fungi they inhabit cause diseases in plants. A Portuguese-Israeli team is trying to transfer the genes conferring "take-all" disease resistance from wild wheats to cultivated wheats, while scientists at the University of the Philippines at Los Baños and Ben-Gurion University of the Negev are studying how fixed nitrogen nutrients are released by cyanobacteria to the surrounding environment.

Thai scientists are collaborating in the development of genetically improved, non-shattering sesame cultivars, with synchronized ripening and higher overall yields. Sesame is an important, but little-studied developing country crop which can withstand high temperatures, and grow without rainfall or irrigation (using stored soil moisture). The potential for yield improvement is great.

5. Veterinary Sciences

Israeli animal scientists combine professional competence with an unusual level of creativity and innovation. For example, R. Galun of the Hebrew University of Jerusalem is working with Kenyan collaborators at ICIPE on an unusual "vaccine" to discourage animal ticks. Ticks surpass all other arthopods in the number and variety of diseases they transmit to domestic animals. The resulting economic loss to developing countries runs to billions of dollars. Ticks are unusually slow feeders. Blood meals last from 20 minutes to several days and are maintained by signals the tick receives from special receptors in its mouth parts which bind corresponding chemicals in the victim's blood. The CDR-supported "vaccine" would stimulate the animal host to produce antibodies which



(a) At the Field Crop Institute in Thailand, CDR grantee V. Banjasil inspects his collection of sesame varieties. (b) Sesame seeds are packed into the upright capsules that cover the plant's tall stem. In current varieties, these ripen and open at different times, which prevents efficient harvesting.

Cattle play an important, multi-faceted role in developing countries. They are a source of milk, meat, traction, transport, savings, exchange and prestige in many traditional societies.

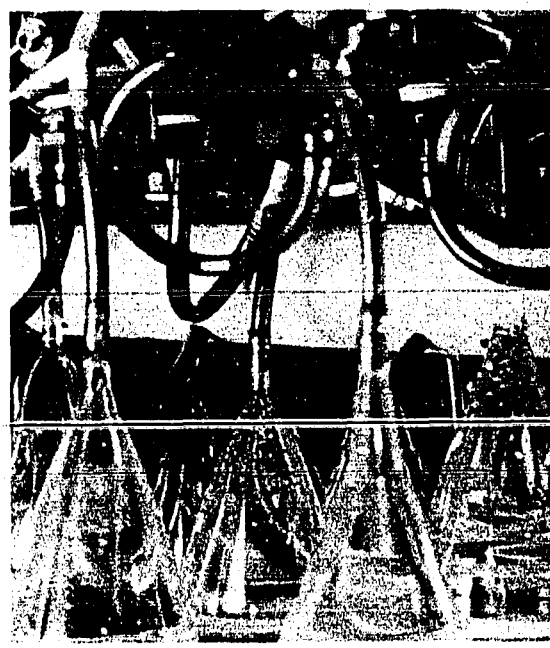
would block these receptors, thus short-circuiting the chemical feedback required to maintain the tick's feeding response.

CDR is also helping Peruvian and Israeli animal scientists develop a live vaccine against caprine arthritis-encephalitis virus (CAEV), an important goat disease. The scientists are splicing the DNA coding for the appropriate protective antigen into the vaccina virus — the well-known cowpox virus from which "vaccination" gets its name. Portuguese investigators at the Instituto de Higiene e Medicina Tropical are teaming up with Israeli counterparts to develop a vaccine against leishmaniasis in dogs to prevent the spread of this fly-borne disease to humans. Using immunological techniques for diagnosis rather than prophalaxis, the Kimron Veterinary Institute is working with the Kenya Medical Research Institute to develop an early pregnancy test for cattle in an attempt to reduce embryonic death. In all, seven of 50 veterinary projects have been funded.

6. Water Sciences: Aquaculture and Hydrology

With its long coastline and biotechnology expertise, Israel is a natural center for innovative aquaculture and mariculture. Three CDR projects center on the genetic and hormonal manipulation of tilapia, an important fish species in developing country aquaculture and a valuable, readily available source of protein. The early and prolific spawning of tilapia, if not controlled, leads to food shortages and stunting under typical pond cultivation conditions. One method to get the larger fish sizes preferred in many local markets is to control reproduction through the use of hormones which generate all-male populations.

The National Directorate of Aquaculture in Panama and Tel Aviv University seek to understand and optimize such hormone treatments and to improve the production of all-male red tilapia, which are particularly prized. R. Avtalion of Bar-Ilan University and

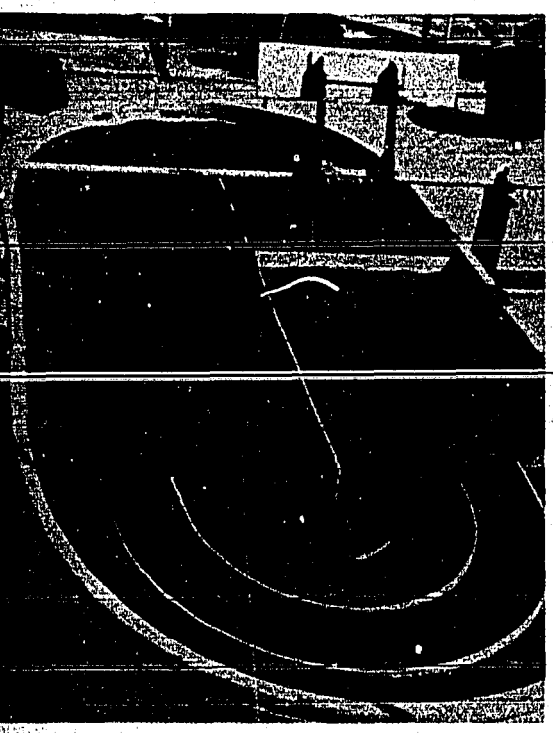


These fish eggs are being maintained and analyzed at Bar-Ilan University for sex-linked biochemical markers to improve *Tilapia* breeding there and in the Philippines.

O. Gelman of the Philippine Technology Research Foundation are looking for specific male sex-linked "marker" proteins to help analyze the genetics of given tilapia crosses. The technique, once successful, will give a major boost to rational breeding programs for larger male hybrids. The genetic purity of their fish lines is constantly monitored at the molecular level using analytical techniques like polyacrylamide gel electrophoresis (PAGE).

Projects on the aquaculture of superior strains of *Gracilaria*, an agar-producing seaweed, and *Spirulina*, a source of valuable fatty acids and feed, round out CDR's aquaculture research program.

In hydrology, scientists at the University of Botswana are collaborating on a study of ephemeral streams—dry much of the year, torrents during the brief, intense desert rains. A Portuguese-Israeli team is developing stochastic models to better predict the hydraulic properties of groundwater aquifers (underground water sources) from the limited, often uncertain, data that are usually available.



The bright sunlight and brackish water of many semi-arid regions are ideal for growing (a) *Spirulina* algae, microscopic plants high in protein and other valuable chemicals. (b) Ben Gurion researchers have developed efficient algae production systems, and are working with their Thai colleagues to develop superior *Spirulina* varieties.

7. Engineering

Although Israel is better known for its expertise in computer technology, most of the CDR engineering projects funded to date involve the more LDC-oriented disciplines of food processing and biomass conversion technology. Volcani Center scientists and their counterparts in Costa Rica are developing enzyme methods for macerating tropical fruits for juice production (thus eliminating the need for expensive fruit presses) and fermentation methods for producing shelf-stable preserved meat products (thus eliminating the need for expensive refrigeration). A Thai-Israel team is developing a small, rapid cashew nut sheller, suitable for local cottage industry. Scientists at the Central American Research Institute for Industry (ICAITI) and the Technion—Israel Institute of Technology are trying to improve ethanol yields from sugarcane fermentation by developing

Israeli engineering technology, represented by these electronics researchers at Bar Ilan University, opens new worlds of possibilities in dealing with persistent developing country problems.

Investigators at the Jerusalem College of Technology and the University of Oporto (Portugal) are developing an innovative method for converting local leather industry wastes into useful plastics. Here investigators examine the results using a scanning electron microscope.

ethanol-tolerant yeast strains.

Many industrial processes rely on special catalytic chemicals such as enzymes (protein catalysts), which temporarily bind one reactant to facilitate its chemical interaction with other reactants. Similar hand-in-glove complementarity characterizes the human immune system, which produces antibody proteins to recognize and bind specific foreign proteins, or antigens. B. Green at the Hebrew University of Jerusalem and V. Vithayasai at Chiang Mai University in Thailand are trying to develop a general approach to the rational design of new enzyme catalysts using antibodies as templates. This would greatly aid in the economical production of drugs, pheromones and other specialized chemicals of potential importance to developing countries. Twelve of the 159 submissions in this area have already been funded.

CDR Review Procedures and Guidelines

Because of the large number of annual submissions, CDR uses a two-stage review procedure. Investigators first submit a two to three page *pre*proposal, which describes in some detail their specific plans for scientific research and collaboration. Preproposals also explain the importance of the research to LDC development. A suggested preproposal format appears in the next section, although potential applicants should first contact CDR for any revisions, shifts in emphasis and the next deadline for submissions.

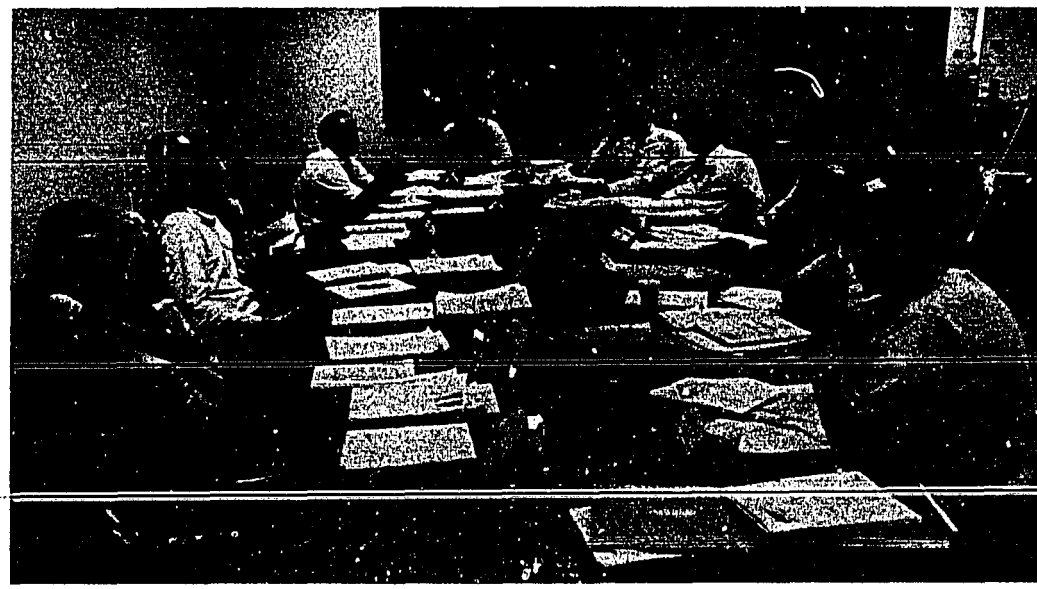
A preproposal is not a binding offer, and CDR does not require the formal, written agreement of institutions or collaborators at this initial stage. Preproposals are reviewed by AID staff for their likely impact on international development. Priority is given to those areas in which Israeli science and technology have a demonstrable, competitive advantage.

On the basis of this preliminary review, approximately 100 investigators are invited to submit a detailed full proposal. Full proposals undergo objective technical peer review by panels of expert scientists not affiliated with AID. USAID Missions abroad are subsequently consulted on approved projects in their host countries.

CDR uses four primary criteria in evaluating proposals and making funding decisions:

- scientific merit,
- importance to internatinal development,
- innovation, and
- enhancement of LDC research capacity.

All subsidiary aspects of an experiment — such as equipment, training and travel — are supported in direct relation to CDR's assessment of the research itself, as judged against these four criteria.



All CDR full proposals receive a rigorous technical peer by external panels of eight to ten recognized experts in the specific field of enquiry. Over a dozen such *ad hoc* panels are convened annually. All serve without pay.

How to Apply to CDR

Please prepare a brief, yet scientifically detailed, description of the proposed research and its importance to development using the format below. Clearly indicate that the preproposal is directed to the U.S.-Israel CDR Program. Three copies of the preproposal, *in English*, must be received by the annual deadline. White paper, 8.5 x 11 inches (21.5 x 28 centimeters) is preferred.

Preproposals should not exceed three pages; longer texts may be returned. Similarly, please do not append supporting documents, resumes, nor publications for this preliminary review. These will be requested later, if you are invited to submit a full proposal. Due to staff limitations, we are unable to acknowledge receipt of preproposals unless a self-addressed postcard is enclosed. Investigators are usually informed of the results of this initial review about 3 months after the deadline for submissions.

Developing country investigators should submit their preproposals through their local USAID Mission. Please allow sufficient time for Mission review and transmission to Washington, D.C. In contrast, Israeli investigators should submit their preproposals directly to CDR at the address below, with an information copy to the Science Attache, U.S. Embassy (Tel Aviv).

CDR preproposals should provide in succinct, highly specific terms:

1. The project title (descriptive, specific and short).
2. The project objective (a one or two sentence description).
3. The principal investigators and all scientific collaborators, their institutions, full mailing addresses, telex codes and telephone numbers.

Note: The active participation of both Israeli and LDC scientists/institutions is required. Do *not* submit a preproposal without identifying both institutions. However, do not send resumes at this time.

4. The proposed starting date and project duration.
5. The work/research plan. This is the *most important* part. Appropriate scientists will judge your proposed research. Please do not generalize. What are your specific scientific hypotheses and underlying assumptions? What specific experiments will you perform to test them?
6. How does this research relate to, and advance, the state-of-the-art? Cite a (very) few key references, if appropriate. What is innovative about this research? Why is it important? How will the findings be used?
7. What specific LDC problem is being addressed? What is the likely impact of this work on international development? Do the results have important implications for developing countries *other* than the one collaborating in the research? What is the competitive advantage of Israeli expertise in this area?
8. What is the substantive role of both the LDC and Israeli collaborators? CDR projects should be a true intellectual partnership. Although such contributions are rarely equal, they should be significant and clearly complementary.
9. Please provide a brief estimated budget using the summary format below (totals only) for both institutions.

This budget is not binding and may be modified in the subsequent full proposal. Requests exceeding $250,000 will either be reduced to that level or rejected. If applicable, please indicate any other sources of support for this research.

	LDC Institution	*Israeli Institution*
Personnel		
Supplies & Equipment		
Travel & Training		
Overhead		
Other		
TOTAL		

How Can I Get More Information On CDR?

Please contact the:

U.S.-Israel Cooperative Development Research Program
Agency for International Development
Room 720, SA-18
Washington, D.C., USA 20523

Telephone:
(703) 235-3666
Telex:
Western Union 892703.

CDR Grantees for 1985-1987

Arid lands

Ben-Gurion University of the Negev with the University of the Philippines at Los Baños
S. H. Lips and E. P. Pacardo
C5-001 $150,000 1986

Relationship Between Nutrient Uptake and Saline Water Irrigation

To increase the yield of selected crops while utilizing waters of various salinities under different fertilization regimes.

Israel Agricultural Research Organization (Volcani Center) with the Estacão Agronomica Nacional, Portugal
A. Blum and T. Moreira
C5-038 $118,750 1985

The Development of Drought Resistant Wheat Breeding Germplasm

To develop new screening techniques for the identification of wheat cultivars that are resistant to drought. Wheat is native to the Near East.

Hebrew University of Jerusalem with the University of Nairobi, Kenya
Y. Mualem, C. Muchiri and R. K. Muni
C5-064 $143,830 1986

Rainwater Harvesting Systems for Livestock in Sandy Semi-arid Regions

To develop economically viable systems for harvesting rainfall as a reliable livestock water supply. To utilize a new numerical model for water-poor areas to investigate soil hydraulics, collector configurations, and investigate water-yield effects to design a rain harvesting system suitable for Kenya.

Ben-Gurion University of the Negev with Thusano Lefatsheng (Terre Aide) Botswana
M. Forti and F. Horenburg
C5-218 $145,434 1986

Pasture Improvements with Perennial Shrubs

To investigate and introduce into cultivation new productive, nutritious shrubs for animal feed in arid and semi-arid pasture lands in Botswana.

Ben-Gurion University of the Negev with the University of the Philippines at Los Baños
M. Tal and D. A. del Rosario
C5-221 $150,000 1986

Improvement of Salt Tolerance in Tomato and Potato Plants

To develop varieties of tomato and potato plants that will grow under the saline conditions found in certain soils in the Philippines and elsewhere.

Ben-Gurion University of the Negev with the Estacão Agronomica Nacional, Portugal
A. Golan and M. Mota
C5-224 $136,000* 1987

Improvement of Pistachio Nut Production in Arid Zones

To develop methods to irrigate pistachio using saline water and to eliminate blank nuts by supressing postulated inhibitory proteins.

Ben-Gurion University of the Negev with Thusano Lefatsheng (Terre Aide) Botswana
Y. Mizrahi and F. Horenburg
C5-228 $149,975 1985

New Subtropical Fruit and Nut Crops for Arid lands

To develop several native plants of Botswana and other semi-arid and arid regions which have significant underexploited potential as new fruit and nut crops, with special emphasis on superior cultivars that can be raised on brackish or saline water. The results and selections should be of use throughout arid subtropical Africa.

Jerusalem College of Technology with the Universidad Nacional Agraria, Peru
M. Schwarz and S. Helfgott-Lerner
C5-325 $149,000 1986

Commercial Crops Under High Saline Conditions Using Advanced Sand Culture Methods

It is now possible to successfully grow crops using high salinity water under hydroponic conditions. Similar results will be sought using advanced techniques to grow plants in sand typical of sand dunes.

Israel Agricultural Research Organization (Volcani Center) with the University of Evora, Portugal
I. Shainberg and A. G. Ferreira
C7-036 $150,000* 1987

Improving Rain Penetration and Reducing Soil Erosion in Dryland Farming

To study the effects of soil crusting on rain infiltration, runoff, erosion and seed germination and to develop new methods for stabilizing soil structure.

*Budget of projects scheduled for FY 1987 funding are only approximate.

***Mongongo* nuts, *marula* fruit and the *tsi* bean are among the many underexploited fruits of the Kalihari Desert region which deserve further attention as potential candidates for arid lands agriculture. Here a *san* bushman family crack and eat *mongongo* nuts, the subject of one Botswana-Israel study. (Photograph courtesy of Irven De Vore, Anthro-photo File, Cambridge, Mass.)**

Technion — Israel Institute of Technology and the Israel Ministry of Agriculture (Doar Ha Nasholim) with the Ministerio do Agricultura y Ganaderia, Costa Rica
G. Shelef and H. Nanne Echandi
C7-090 $150,000* 1987

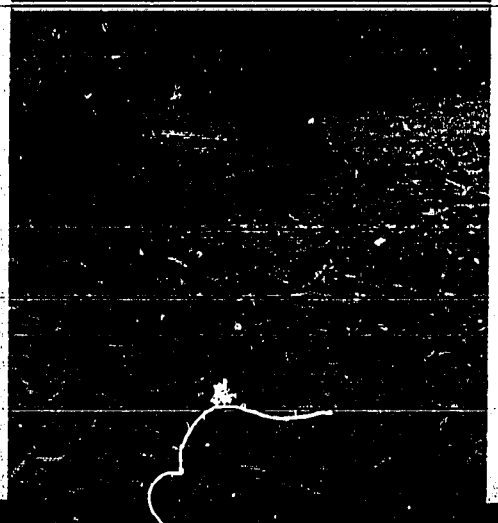
Integration of Aquaculture in Irrigation Schemes

To demonstrate that significant aquacultural production is possible with minor additional capital investment, in conjunction with agricultural irrigation schemes.

Ben-Gurion University of the Negev with the University of Cape Coast, Ghana
H. Tsoar and K. Anane-Fenin
C7-143 $146,567* 1987

Bimodal Eolian Desert Sand Sheets and their Potential Significance for Development

To elucidate the spatial, dynamic, physical and chemical aspects of desert sandsheets formed by wind deposition. These can provide a better substratum than dune sand for modern desert agriculture.



Yehib, a small bush native to the deserts of Somalia and Ethiopia, produces a tasty nut in regions with less than six inches of rainfall a year. Here Israeli scientists are exploring its potential as a new crop for other arid lands. The trickle-drip "emiter" which waters the plant is seen on the left.

Biological Pest Control

Tel Aviv University with Makoka Agricultural Experiment Station, Malawi
D. Gerling and G. Nyirenda
C5-004 $150,000 1985

Development of Integrated Management Methods for the Control of *Bemisia tabaci*

To minimize the incidence of cassava mosaic virus by providing efficient, cheap and simple ways to control its whitefly vector.

Israel Agricultural Research Organization (Volcani Center) with the Department of Agriculture, Thailand
M. Kehat and M. Rumakom
C5-020 $146,275 1986

Use of Sex Pheromones for Monitoring and Control of *Heliothis armigera*

To develop pheromone traps for monitoring moth populations in the fields of Thailand and Israel, and to explore the possible use of pheromones to suppress the pest population.

This *G/wi* bushman family is eating *tsi (marama)* beans, a Kalahari crop well suited to areas of scant or erratic rainfall. An important source of high-quality protein and linoleic acid, this dual-purpose crop also produces an edible underground tuber. The tuber, which can weigh over 20 pounds, permits the *tsi* bean to ride out years of drought. (Photograph courtesy of Irven De Vore, Anthrophoto File, Cambridge, Mass.)

Israel Agricultural Research Organization (Volcani Center) with the Department of Agriculture, Thailand
D. Veierov and S. Wangboonkong
C5-028 $149,890 1986

Optimization of Foliar-Applied Formulations for the Control of *Bemisia tabacci* under Field Conditions

To improve the control of this important whitefly pest through enhanced formulations of currently used pesticides. The population dynamics of the whitefly and its natural enemies will be followed in treated and untreated fields.

Hebrew University of Jerusalem with the Forest Products Research Institute, Ghana
I. Chet and A. Ofusu-Asiedu
C5-107 $150,000 1985

Biological Control of Plant Diseases Using Microorganisms Grown on Agricultural and Forestry Wastes

To study the feasibility of using naturally occurring microorganisms isolated from soils in Ghana as biocontrol agents against soil-borne fungal pathogens.

Hebrew University of Jerusalem with the University of the Philippines at Los Baños
D. Rosen and B. Morallo-Rejesus
C5-127 $149,952 1986

Genetic Improvement of Natural Enemies for Biological Pest Control: Selection for Resistance to Pesticides in Species of *Aphytis*

To identify populations of a parasitic wasp (*Aphytis*) that carry genes for resistance to pesticides commonly used in citrus groves. The wasp controls various scale insects, which are themselves already pesticide resistant.

Hebrew University of Jerusalem with the Ministry of Agriculture, Guinea
A. Keynan and A. Traore
C5-141 $150,000 1985

Biological Control of Mosquitoes with *Bacillus Sphaericus*

To improve, this bacterial biocontrol agent of disease-transmitting mosquitoes by recombinantly inserting and expressing the DNA coding for the BTI toxin, found in another such agent.

Ben-Gurion University of the Negev with the University of Sri-Jaywardenepura, Sri Lanka
A. Zaritsky and H.G. Nandadasa
C5-142 $150,000* 1987

Biological Control of Mosquitoes and Blackfly Larvae by Means of Genetically Engineered Water-Dwelling Bacteria Expressing the Cloned Delta-Endotoxin Gene of *Bacillus thuringiensis var. israelensis* (BTI)

To increase the persistance in nature of the safe, natural pesticide produced by BTI, by using recombinant techniques to produce the chemical in a more environmentally effective agent.

Weizmann Institute of Science with the International Center of Insect Physiology and Ecology (ICIPE), Kenya
M. Edelman and W. A. Otieno
C5-144 $150,000 1986

Pest Control by Viral Bio-insecticides

To assess the natural genetic variation in viruses attacking insect pests in Kenya and to then genetically select viruses that will control specific pests.

Tel Aviv University with the International Centre of Insect Physiology and Ecology (ICIPE), Kenya
M. Broza and W. A. Otieno
C5-175 $150,000 1986

Development of a Microbial Preparation for Biological Control of the African Armyworm, *Spodoptera exempta*

To develop a bacterial agent suitable for field use against the African armyworm, an important pest.

Central American Research Institute for Industry (ICAITI), Guatemala with the Hebrew University of Jerusalem
C. Rolz and I. Chet
C5-330 $149,100 1985

Biological Control of Coffee Rust

To develop microbiological control methods for *Hemileia vastatrix* by inoculation of the infected coffee plants with competing or parasitic microbes, and to better understand the host-microbe interaction.

Israel Agricultural Research Organization (Volcani Center) with the University of Mauritius
K. Ascher and I. Fagoonee
C7-006 $120,000* 1987

Enhancement of the Pesticidal Activity of Neem *(Azadirachta indica)* and Persian Lilac *(Melia azedarach)* Products

To prolong the residual effects of these natural pesticides by chemically protecting them from ultraviolet light and oxidation. Field tests will be conducted with native pests in Mauritius.

Israel Agricultural Research Organization (Volcani Center) with the Estacao Agronomica Nacional, Portugal
S. Marco and F. Albano-Ilharco
C7-056 $150,000* 1987

Control of Insect-Transmitted Viruses Utilizing Insect Response to Color and Contact Stimuli

To study how the spread of plant viral infections can be reduced by repelling their insect vectors with inexpensive, highly reflective local materials.

Tel Aviv University with the Centro Internacional de Agricultura Tropical, Colombia
D. Wool and A.C. Belotti
C7-077 $147,000* 1987

Identification and Characterization of Genetic Strains in *Bemisia tabaci*

To use electrophoretic techniques to identify genetically distinct subspecies of this important pest and to clarify their relative pesticide resistance and importance as plant virus vectors.

Hebrew University of Jerusalem with the University of the Philippines at Los Baños
E. Cohen and L.E. Padua
C7-100 $150,000* 1987

Improved Preparations for Microbial Insecticides: Inhibiting Bacterial Lysis and Prolonging Field Stability

To improve the persistence of BTI toxin by physically and chemically protecting the BTI spore wall and by adding appropriate biopolymers, including chromophores to protect the toxin from damage by sunlight.

International cooperation in science contributes to international understanding. Here Weizmann Institute scientists display new strains of high-yielding, drought-resistant wheat, suitable for semi-desert areas.

Kasetsart University, Thailand, with the Ben-Gurion University of the Negev
T. Attathom and J. Tal
C7-150 $149,450* 1987

Densonucleosis Viruses as Insectisides

To develop the densovirus *Galleria mellonella* as a vector to transport genes coding for natural pesticides into the insect genome.

Human Health

Hebrew University of Jerusalem with the Eversley Childs Sanitarium, Cebu, Philippines
I. Levy and T. T. Fajardo
C5-109 $150,000 1986

Rapid Detection of Drug-Resistant and Viable *Mycobacterium leprae* in Patients with Lepromatous Leprosy

To develop, for use in the field, simple and rapid methods for determining the viability of *M. leprae* and its resistance to drugs.

Hebrew University of Jerusalem with the International Center of Insect Physiology and Ecology (ICIPE), Kenya
Y. Schlein and M. Mutinga
C5-136 $149,054 1986

Field and Laboratory Studies of Novel Aspects in the Epidemiology of Leishmaniasis

To clarify the role of sandfly mycoses in the epidemiology of leishmaniasis and indicate whether these fungi may be used as a biological control measure for the disease.

Weizmann Institute of Science with the Kenya Trypanosomiasis Research Institute
C. L. Jaffe and A. R. Njogu
C5-139 $149,925 1986

Microtubule-Associate-Proteins: A Possible Chemotherapeutic Target Against Trypanosomes

To identify trypanosome microtubule-associated proteins (MAPS) which differ from those of mammals for use as possible targets for existing drugs and for the development of new drugs against trypanomiasis (African sleeping sickness).

Hebrew University of Jerusalem with the Univerrsity of Kinshasa, Zaire
I. Polacheck and L. Muyembe-Tamfum
C5-322 $134,000 1986

Development of a Simple and Rapid Biochemical Test for the Accurate Identification of Fungi and its Epidemiological Application

To establish and test a simple method, applicable to conditions in Africa, for the identification of pathogenic fungi.

CDR scientists are developing more effective biological control methods for the blackfly vector of Onchocerciasis, a major cause of blindness in developing countries. Here an Israeli doctor conducts an eye exam in Malawi.

Delron Development, Inc. with the University of the Philippines at Los Baños
G. Schroeder and N. Librojo
C5-348 $150,000 1985

Stable Isotopes as Naturally Occurring Indigenous Tracers for Non-Invasive Human Nutrition Studies

To investigate the use of different ratios of the naturally occurring stable isotopes of carbon, nitrogen and hydrogen to trace the flow and fate of nutrients in humans without the use of radioactive tracers.

Hebrew University of Jerusalem with the Ministry of Health, Belize
L. Weinrauch and F. Cawich
C7-019 $128,975* 1987

Chemotherapy for Cutaneous Leishmaniasis in Belize

To extend promising recent results with Old World Leishmaniasis to species common in the New World. Both animal and clinical trials will be conducted with parasites isolated from patients in Belize.

Shaarei Zedek General Hospital and Delron Development Ltd. with the Univesity of the Philippines at Los Baños
S. Frier and C. Barba
C7-079 $114,900* 1987

Evaluation of Medium-Chain Triglycerides as a Rapidly Assimilated Energy Source for Malnourished Lactating Women and Children

To investigate, using non-invasive stable isotope techniques, the rate and extent of metabolism of medium versus long chain triglycerides in nourished and malnourished humans.

Weizmann Institute of Science and the University of Science and Technology at Kumasi, Ghana
C7-102 $149,860* 1987
E. Hanski and P.A.K. Addy

Bordetella Pertussis Invasive Adenylate Cyclase: Its Role in Whooping Cough and an Evaluation of its Potential in an Acellular Vaccine

To prepare monoclonal and polyclonal antibodies to this enzyme, leading to a sensitive ELISA test for better diagnosis and further study. To help develop a better, safer vaccine.

Ben-Gurion University of the Negev with the University of Ilorin, Nigeria
A. Danon and T.S. Emudianughe
C7-128 $119,684* 1987

Protein Binding of Drugs in Malnutrition and Parasitic Disease

To investigate possible changes in the drug metabolism of patients with malnutrition and/or parasitic diseases, by studying the *in vitro* binding of tritiated drugs to their blood serum proteins.

Hebrew University of Jerusalem with King Mongkut's Institute of Technology, Thailand
D. Spira and N. Wongvisetsirikul
C7-160 $150,000* 1987

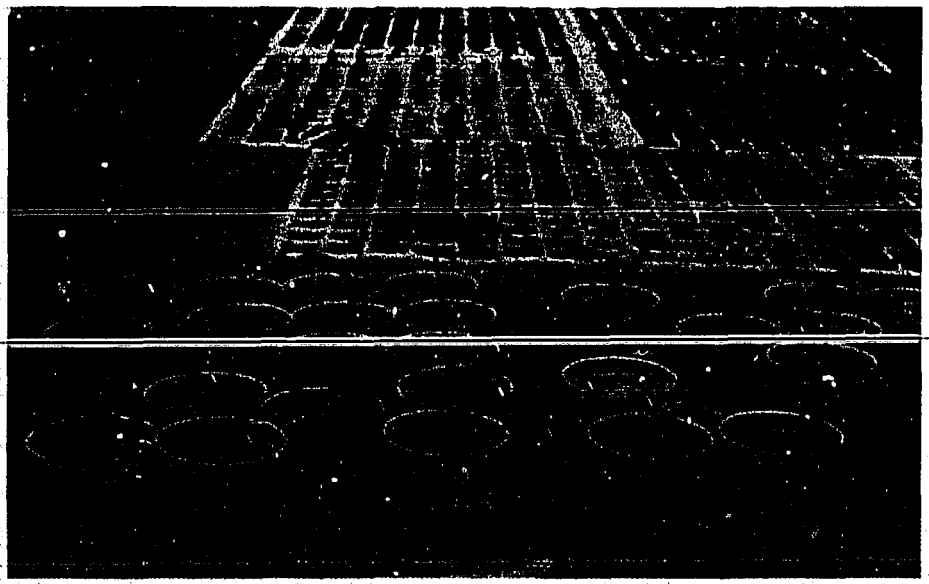
Development of a New Strategy for Anti-Malarial Drugs

To synthesize and test novel, non-toxic iron chelators as potential anti-malaria drugs. To study the basis for their therapeutic action, which may involve free radical intermediates.

Hebrew University of Jerusalem with the Kenya Medical Research Institute
J. Hamburger and D.K. Koech
C7-162 $150,000* 1987

Towards an Anti-Granuloma Vaccine for Schistosomiasis Using Recombinant DNA and Hybridoma Techniques

To isolate from *Schistosoma mansoni* the messenger RNA which encodes the antigen responsible for granuloma formation, to clone the complementary DNA in bacteria and to immunize test animals with the amplified antigen in hopes of inhibiting granuloma formation.



Single plant cells can be grown into full plants using tissue culture methods. This important technique can rapidly produce many identical copies (clones) of valuable or scarce plants. Israeli scientists are applying these methods to a wide variety of new plants.

Mahidol University, Thailand with Tel Aviv University
C. Pholpramool and L. Levin
C7-169 $150,000 1986

Sulfonamide Drugs as a Male Anti-fertility Agent

To develop compounds suitable for use as male contraceptives. Sulfonamide drugs and their analogs will be considered as part of this research.

Hebrew University of Jerusalem with Mahidol University, Thailand
Y. Yuthavong and Z. I. Cabantchick
C7-171 $150,000 1986

Modulation of Membrane Transport: A Bio-chemical Approach to the Chemotherapy of Malaria

To develop chemical and immunochemical tools with potential for the treatment of malaria.

Hebrew University of Jerusalem with the Institute of Nutrition of Central America and Panama, Guatemala
E. Razin and J.R. Cruz
C7-193 $149,989* 1987

A New Approach for Understanding the Underlying Mechanisms in Shigelosis

To study the biochemical role of shiga-toxin in bacillary dysentery as it relates to mast cell activation.

Plant Biotechnology

Tel Aviv University with the Forest Research Center, Ghana
Y. Koltin and A. Ofusu-Asiedu
C5-002 $149,950 1985

The Double-Stranded RNA Viruses of Fungi and the Regulation of Virulence of Plant Pathogens

To elucidate the role of this relatively new group of viruses, which infect fungi, in the regulation of the virulence of fungal diseases in plants. Such research could lead to modifying the ability of these fungi to cause disease.

Israel Agricultural Research Organization (Volcani Center) with the Ministry of Agriculture and Livestock Development, Kenya
A. Erez and S.P. Gachanja
C5-031 $145,000* 1987

Growing Deciduous Fruit Trees in Tropical Regions Lacking Winter Chilling

To develop a system to stimulate early breaking of bud dormancy to extend the range of temperate fruit production to tropical developing countries.

Israel Agricultural Research Organization (Volcani Center) with the Estacão Agronomica Nacional, Portugal
U. Kushnir and M. Mota
C5-039 $139,900 1985

Screening, Transfer, and Incorporation of Alien Genetic Material into Wheat Genomes for Resistance to "Take-all" Disease

To screen comprehensive collections of wild wheats in Portugal and Israel for resistance to the take-all disease. Resistance genes from wild relatives will then be transferred into cultivated wheats. Wheat originated in the Near East.

Hebrew University of Jerusalem with the Field Crop Research Institute, Thailand
A. Ashri and V. Benjasil
C5-147 $149,700 1985

Enhancing Genetic Variability and Breeding Improved Sesame (*S. indicum*) Cultivars

To develop widely based populations of sesame for selection and breeding of improved non-shattering cultivars, with uniform ripening and high yields, thus facilitating harvest with minimal seed losses and a shorter growing season.

Israel Agricultural Research Organization (Volcani Center) with Chulalongkorn University, Thailand
B. Kessler and J. Boonjawat
C5-200 $150,000* 1987

Epicuticular Plant Surface Agglutinins (EPSA)

To study how cuticle proteins can help protect plants from pathogens and superoxide free radicals and to produce EPSA with peroxidase and superoxide dismutase activity to be used as plant protectants.

Ben-Gurion University of the Negev with the University of the Philippines at Los Baños
S. Boussiba and M. Martinez
C5-233 $149,925 1986

Ammonium Translocation in Cyanobacteria and Their Use in Biofertilizers

Cyanobacteria are being considered as biofertilizers because of their nitrogen fixing capacity. The project seeks to determine the process and the limiting steps which govern the release of reduced nitrogen from the cyanobacteria to the surrounding environment.

Israel Agricultural Research Organization (Volcani Center) with the Research Laboratory for Agricultural Biotechnology and Biochemistry, Nepal
R. Jacobsohn and V.P. Agrawal
C7-031 $148,000* 1987

Studies on the Avoidance and Control of Broomrape *(Orobanche* spp) a Parasitic Weed of Developing Countries

To identify the host range of broomrape, to develop methods to identify and quantify seeds in soil, and to evaluate promising control measures.

Israel Agricultural Research Organization (Volcani Center) with the Department of Agriculture, Thailand
B.D. Kishinevsky and N. Boonkerd
C7-034 $149,400* 1987

Increasing the Biological Nitrogen Fixation of Peanuts in Developing Countries

To develop superior *Rhizobia* inoculants to increase nitrogen fixation and peanut production, in optimal conjunction with other measures, such as irrigation and phosphorus fertilization.

Tel Aviv University with the Universidad Nacional Agraria, Peru
I. Wahl and R. Mont Koc
C7-114 $149,350* 1987

Utilization of *Hordeum spontaneum* Resistance for Barley Leaf Rust Control

To identify and incorporate disease resistance from the rich genetic resources of wild Near East barley into two susceptible Peruvian cultivars, planted on 80% of the total barley acreage in Peru.

Weizmann Institute of Science with the International Potato Center (CIP), Peru
E. Galun and J. Dodds
C7-191 $121,015* 1987

Characterization of Organelle Genomes in Potato Germplasm

To study, at the molecular level, the chloroplast genome of potatoes to elucidate the genetic reltionship between cultivars and as an aid to breeding better potatoes for developing countries.

Weizmann Institute of Science with the International Potato Center (CIP), Peru
D. Aviv and J. Dodds
C7-198 $149,912* 1987

Gene and Organelle Transfer by Electroporation: A Prospective Tool for Potato Improvement

To electrically stimulate the transfer of chloroplasts and mitochondria between potato cultivars, with an emphasis on transfering organelle-related traits such as frost and heat tolerance.

Veterinary Sciences

Kimron Veterinary Institute with the Universidad Nacional de Costa Rica
V. Zaslavsky and M. Ramirez
C5-091 $149,400* 1987

Towards a Vaccine: Cloning and Expression of the Genes of Newcastle Disease Virus (NDV)

To identify and clone DNA fragments in the gene for NDV hemmaglutinin-neuraminidase which code for specific antigenic epitopes (antibody recognition sites). These could be used to develop new NDV diagnostics or a synthetic anti-NDV vaccine.

Kimron Veterinary Institute with the Kenya Medical Research Institute
S. Mordechai and J. Camacho
C5-101 $147,600 1986

Isolation of a Luteotropic Substance Produced by the Blastocyst and Early Pregnancy Diagnosis in Cattle

To isolate, purify and characterize the chorionic gonadotropin-like substance produced by cultures of trophoblast cells. To develop a radioimmunoassay for early pregnancy tests in cattle. The test should reduce embryonic death in cattle.

Hebrew University of Jerusalem with the International Centre of Insect Physiology and Ecology (ICIPE), Kenya
R. Galun and C. Mango
C5-114 $150,000 1986

Protection of Animals from Ticks by Interference in the Feeding Process of the Ticks

To protect livestock from tick infestation by developing an antibody to the feeding receptors located on tick mouthparts, thus inhibiting tick engorgement.

Hebrew University of Jerusalem with the Instituto de Higiene e Medicina Tropical, Portugal
L. Schnur and P. Abranches
C5-117 $150,000 1986

Development of a Vaccine against Canine Leishmaniasis

To develop a vaccine to immunize dogs against *L. donovani* thereby helping prevent the spread of this parasite to humans.

Tel Aviv University with San Marcos University, Peru
A. Yaniv and E. Ameghina
C5-336 $149,978 1986

Preparation of a Live Vaccine against the Caprine Arthritis-Encephalitis Virus (CAEV)

To develop, using recombinant techniques, a live vaccinia virus which can express CAEV-neutralizing antigens, in order to immunize goats against caprine arthritis encephalitis.

Hebrew University of Jerusalem and the Institute of Animal Research (Kibutz Lahav) with Tribhuvan University at Rampur, Nepal, and the Nepal Livestock Development Program
J. Hillel and M. Kharel
C7-110 $150,000* 1987

A Study of Goat Cross-Breeding for Increased Meat Production

To improve local Nepalese *khari* goats by hybridization with Israeli breeds, with an emphasis on increasing male meat production and female fertility.

Kimron Veterinary Institute with the University of Peradeniya, Sri Lanka
E. Bogin and C.P. Kodikara
C7-111 $150,000* 1987

Milk Bacterial and Leucocytic Contents and Enzyme Levels as a Test for Mastitis

To develop rapid, improved screening methods for milk quality and bovine mastitis using ELISA, bacterial enzyme analysis, and bound antibody techniques.

Cattle are central to the life of traditional herding societies such as the Masai. When water is scarce, young cattle may be watered by hand. Israeli scientists and their Kenyan counterparts are developing improved, economically-viable systems for harvesting rainwater for reliable livestock management in semi-arid regions.

Water: Aquaculture and Hydrology

Bar-Ilan University and the Israel Agricultural Research Organization (Dor) with the Philippine Technology Research Center Foundation
R. Avtalion and O. Galman
C5-065 $149,850 1985

Evaluation of Autosomal and Chromosomal Influence on Tilapias

To investigate the importance of a male-specific protein as a sex-linked marker for the analysis of the progeny produced by various genetic crosses. The ultimate goal is to produce larger male hybrid fish for aquaculture.

Tel Aviv University with the National Directorate of Aquaculture, Panama
Z. Yaron and R. Prettomalca
C5-174 $149,980 1986

Control of Growth and Reproduction in Tilapia by Hormone and Gene Manipulation

To study genetic manipulations in tilapia hybrids in order to produce monosex clones with enhanced growth characteristics, and to investigate the pathways by which anabolic steriods exert their influence.

Ben-Gurion University of the Negev with Kasetsart University, Thailand
A. Richmond and J. Boonsoon
C5-222 $148,500 1986

Strain Selection of Spirulina Algae Suitable for Mass Production — A Novel Agrotechnology for Arid Lands

To improve the potential of the microalga *Spirulina* as a source of commercially important chemicals. Wild strains will be collected in the field and evaluated in the laboratory and in outdoor ponds.

From the stark desertscape of the Wadi Zin in the South to these lush springs in the North, Israel is a land of hydrological contrasts. This variety and the central position of water in Israeli development, make Israeli hydrologists natural partners in research on water and water management.

Tel Aviv University with the National Laboratory for Civil Engineering, Portugal
G. Dagan and L. Ferreira
C5-269 $141,000 1986

Identification of Aquifer Hydraulic Properties Under Uncertainty

To develop a stochastic method for characterizing the spatially distributed hydraulic properties of groundwater aquifers. These results could materially improve the evaluation and management of both groundwater supply and quality.

National Directorate of Aquaculture, Panama, with Tel Aviv University
R. Malca and Z. Yaron
C5-337 $129,291 1986
Population Control, Growth Enhancement and Marketability of Red Tilapia

To improve the efficiency of producing all-male red tilapia, a valuable fish suitable for tropical aquaculture, using both hormonal treatments and hybridization.

Israel Oceanographic and Limnological Research, Ltd., with the University of the West Indies
M. Friedlander and D. Prasad
C5-344 $150,000 1986

Genetic Improvement of *Gracilaria* sp., an Agar-Producing Seaweed

To develop a system for selecting strains of *Gracilaria* seaweed with high yields of agar by selecting spores from wild strains of seaweed and in some cases treating them with mutagens.

Tahal Consulting Engineers, Ltd. with the National Meteorological Institute, Costa Rica
J. Lomas and H. Herrera
C7-021 $144,600* 1987

Yield Improvement of Upland Rice through More Efficient Utilization of Rainfall

To increase rice yields 10-15% by better utilization of the rain water lost as runoff during the "little dry season."

Israel Agricultural Research Organization (Volcani Center) with the University of the Philippines at Los Baños, Philippines
Z. Plaut and E. Pacardo
C7-040 $150,000* 1987

Productivity Enhancement in Rainfed Areas Using Water Catchments, Small Storage Pools and Drip Irrigation

To combine water-harvesting techniques, which collect and store runoff water, with trickle drip irrigation to create a new, stable arid lands agricultural system based on rainfall.

Ben-Gurion University of the Negev with King Mongkut's Institute of Technology, Thailand
Z. Cohen and M. Tanticharoen
C7-131 $149,650* 1987

The Alga *Spirulina* as a Source of Valuable Biochemicals

To optimize spirulina strains and culture conditions to produce larger amounts of gamma-linoleic acid (GLA) and pigments, and to improve purification methods for these valuable natural products.

Hebrew University of Jerusalem with the University of Botswana
A. Schick and P. Shaw
C7-151 $136,212 1986
Floods in Ephemeral Streams: Evaluations Based on Geomorphology

To determine relationships between river regime, degree of armoring, and the movement of bedload particles within the active alluvium of ephemeral streams.

Khon Kaen University, Thailand, with the Israel Agricultural Research Organization (Volcani Center)
S. Sethaputra and I. Shainberg
C7-187 $147,200* 1987

Hydrological Study of Rainfed Agricultural Watersheds

To develop a mathematical model for watersheds taking into account the unique hydrological characteristics of rice paddy land.

Engineering Sciences

Israel Agricultural Research Organizataion (Volcani Center) with the Universidad Nacional de Costa Rica
S. Angel and M. Zumbado
C5-058 $150,000 1986

Development of Shelf-Stable Fish, Rabbit and Red Meat Products Through Energy-Saving Fermentative Processes

To preserve meat through a low energy fermentation process and controlled drying without the use of expensive refrigeration.

Hebrew University of Jerusalem and the Weizmann Institute of Science with the University of Peradeniya, Sri Lanka
E. Tel-Or and S. Kulasourija
C5-179 $133,860 1985

Development of a New Field Tool to Optimize the Nitrogen Fertilization of Rice by the Water Fern *Azolla*

To develop a field probe for simple, fast and sensitive detection of the physiological condition and photosynthetic productivity of *Azolla*. To use the probe to select the most suitable *Azolla* strains for rice farming under various conditions and to monitor their productivity.

Hebrew University of Jerusalem with Chiang Mai University, Thailand
B. Green and V. Vithayasai
C5-187 $149,500 1986

Antibody Molecules as Templates and Catalysts for Organic Chemical Reactions

To find a general approach to enzyme design based on the use of antibodies. This would greatly aid in the manufacture of drugs, pheromones and other chemicals important to developing countries.

Israel Agricultural Research Organization (Volcani Center) with the Universidad Nacional de Costa Rica
N. Ben Shalom and R. Strubi
C5-208 $150,000 1986

Production of Subtropical and Tropical Fruit Juices Using Macerating Enzymes

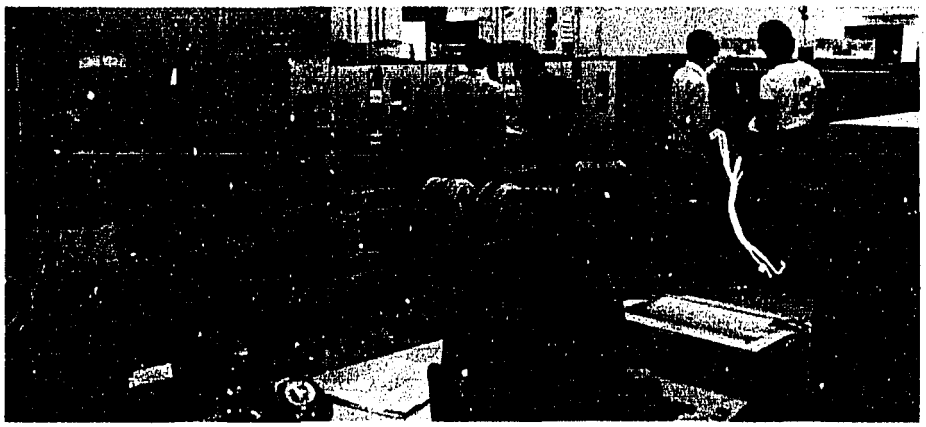
To apply the latest advances in proteolytic enzyme technology to the maceration of tropical fruits in order to develop an industrially applicable process to produce juices and related fruit products without the need for expensive equipment, such as fruit presses.

Jerusalem College of Technology with the University of Oporto, Portugal
A. Wyler and B. de Castro
C5-268 $150,000* 1987

A Process for Converting Hides or Scrap Leather into a New Thermoplastic Material

To determine the properties of these new, potentially high-value materials made from common LDC wastes, and to study how they vary with pressure, temperature, time and other process parameters.

Israeli engineering and computer technology rank high among developing country priorities for technical assistance. Shown here, the computer laboratory at the Jerusalem College of Technology.



Weizmann Institute of Science with the Universidad Nacional de Costa Rica
J. Gressel and H. Trimino
C5-274 $150,000 1986

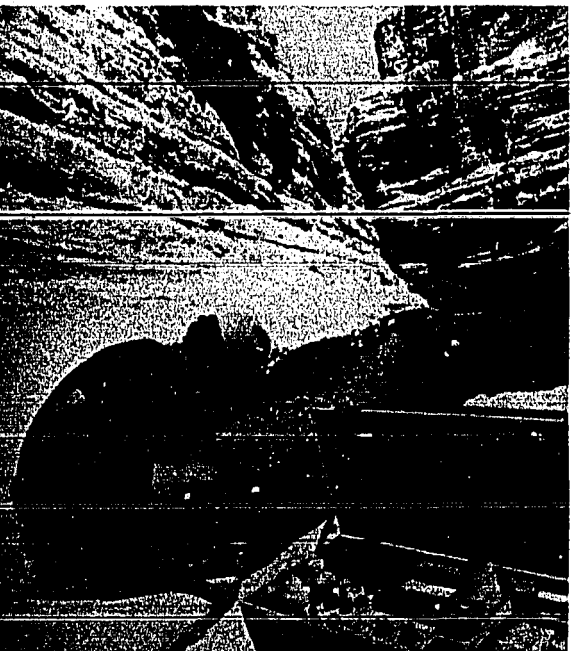
Upgrading of Straws for Ruminant Feed by Solar Pasteurization and Fungal Ligninolysis

To develop a simple, low-cost process to convert straw to protein-enhanced animal feed through solar pasteurization and fermentation.

Khon Kaen University, Thailand with the Israel Agricultural Research Organization (Volcani Center)
M. Thivavarnvongs and Y. Sarig
C5-301 $149,600 1985

Compact Sized Cashew Nut Sheller

To help farmers and small manufacturers shell cashew nuts more efficiently and with higher quality, to improve income in rural areas. The device will be designed, built and tested in Thailand with Israeli collaboration.



Successful irrigation using brackish desert aquifers is an Israeli specialty. Here an investigator measures the salinity of springs in the Southern Negev.

Central American Research Institute for Industry (ICAITI), Guatemala with Ben-Gurion University of the Negev
C. Rolz and A. Vonshak
C5-328 $148,600 1985

Study of a Non-conventional System of Industrial Wastewater Treatment: High Range Anaerobic Digestion and High Rate Oxidation Ponds

To develop an efficient biological system to reduce the polluting potental of discharges derived from the pulp industry, using algal species capable of growing on those effluents.

Central American Research Institute for Industry (ICAITI), Guatemala with the Technion-Israel Institute of Technology
C. Rolz and P. Margalith
C5-329 $120,000 1986

Substrate and Ethanol Inhibition of Yeast in Concentrated Substrates

To improve ethanol yields from sugar feedstock by selection and parametric analysis of special yeast strains.

Tel Aviv University with the Universidade Nova of Lisbon
Y. Shapira and L. Guimaraes
C7-018 $150,000 1986

Improvements in Metallization and Passivation of Solar Cells

To investigate a new metal semiconductor and MOS interface for potential use in a new solar cell with applications for developing country use.

Israel Agricultural Research Organization (Volcani Center) with the Alimentos y Productos Agropecuarios S. de R.L., Honduras
D. Ben-Ghedalia and A. Rubenstein
C7-043 $150,000* 1987

Nutritional Upgrading of Lignocelluloses by Ozonation

To assess the efficacy of ozone treatment in converting common agricultural waste residues into more nutritious animal feed.

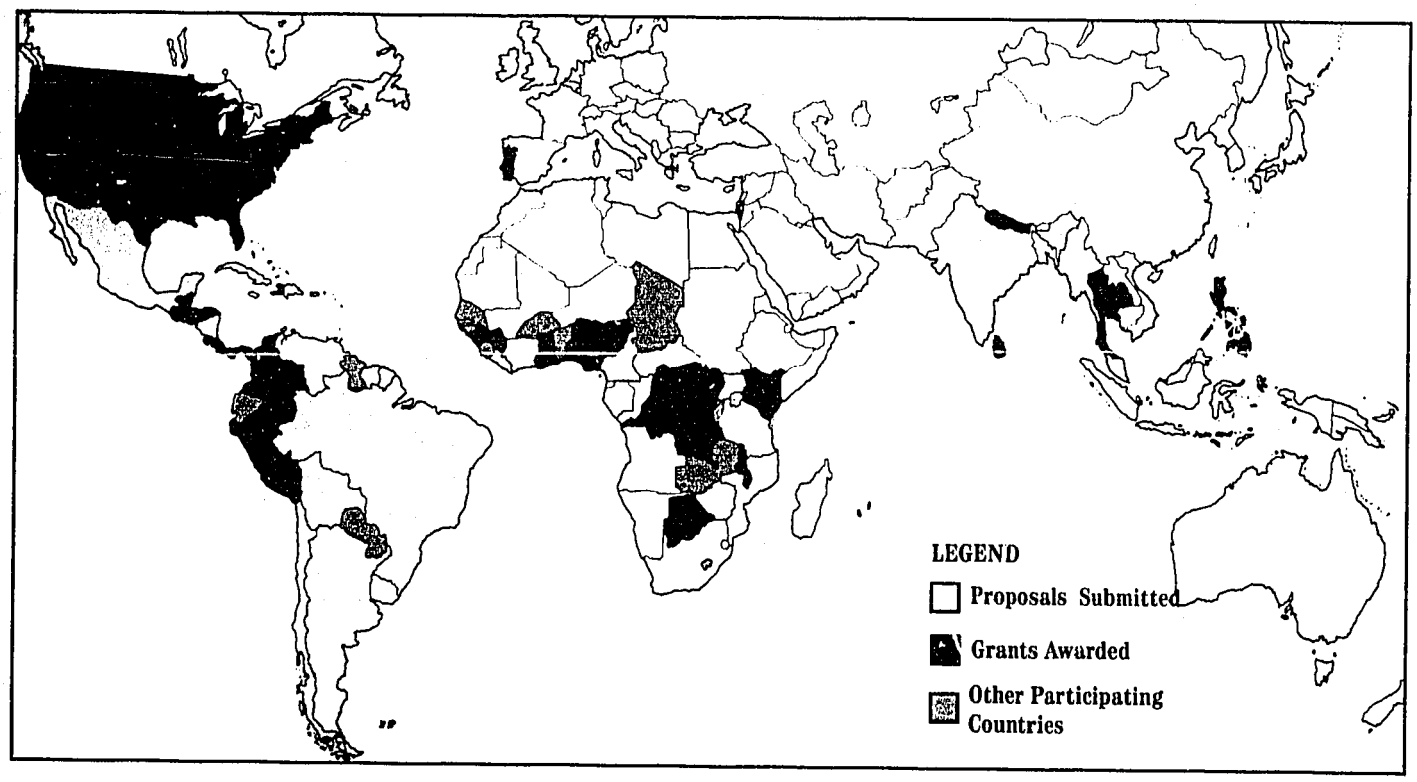
Israel Agricultural Research Organization (Volcani Center) with the Universidad Nacional de Costa Rica
M. Calderon and M. Mora
C7-052 $150,000* 1987

Bio-production of Modified Atmospheres in Small Grain Storage Areas for Insect Control

To develop a low-cost, LDC system that uses compost-generated carbon dioxide gas to control pests in adjacent airtight storage bins.

A Worldwide Initiative . . .

Countries participating in the U.S.-Israel Cooperative Development Research Program (CDR). Light shading denotes submissions; full color denotes projects already underway. Light grey denotes other eligible participants.



U.S.-Israel CDR Principal Cooperating Countries

Belize
Benin
Bolivia
Botswana
Burkina Faso
Burma
Burundi
Cameroon
Cape Verde Islands
Chad
Costa Rica
Dominican Republic
Eastern Caribbean*
Ecuador
Egypt
El Salvador
Fiji
Gambia
Ghana
Grenada
Guatemala
Guinea
Guinea-Bissau
Guyana
Haiti
Honduras
Ivory Coast
Jamaica
Kenya
Lesotho
Liberia
Malawi
Mauritius
Nepal
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Portugal
Rwanda
Senegal
Sierra Leone
South Pacific**
Sri Lanka
Swaziland
Thailand
Togo
Zaire
Zambia
Zimbabwe

*Antigua/Barbuda, Barbados, Dominica, Grenadines, St. Lucia, St. Kitts/Nevis, St. Vincent.

**Cook Island, Kiribati, Niue, Solomon Islands, Tonga, Tuvalu, Vanuatu, W. Samoa.

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Hebrew Summary

ארה"ב-ישראל

תכנית לשיתוף פעולה במחקר לפיתוח

תוך כמה עשרות שנים, ישראל,מדינה קטנה שאיננה משופעת במשאבי טבע, הצליחה להגיע לפיתוח מהיר בעיקר באמצעות טכנולוגיות חדשניות.

ההצלחה המשמעותית של מאמץ זה, מצביעה על כך מהנסיון והידע הישראלי, יכולים לסייע לפתרון בעיות דומות בסניהן ניצבות מדינות מתפתחות רבות.

ארה"ב – בהתחשב במנהיגותה בתחום הטכנולוגיה וקשרי ידידותה עם המדינות המתפתחות וישראל – מצויה בעמדה מיוחדת המקנה לה את היכולת לאפשר שותפות בינלאומית במחקר ובהעברת טכנולוגיה לטובת הכל.

התכנית לש"פ במחקר ופתוח היא יזמה של הסוכנות האמריקאית לפיתוח בינלאומי, השואפת להגביר ולהקל על הנגישות של המדינות המתפתחות אל הידע הישראלי בתחומי המדע, הטכנולוגיה והפיתוח.

התכנית מקצה מימון למדענים ממדינות מתפתחות ומישראל למחקרים משותפים של בעיות פיתוח מרכזיות, כאשר המטרה היא גם להכשיר מדענים בארצות אלה, לבצע בעצמם מחקרים דומים בעתיד.

במשך השנתיים בהן מיושמת התכנית, היא הסבה לערוץ חשוב של חילופי ידע בין קהיליות המדע בארצות המתפחות וישראל. הוגשו מעל ל – 700 הצעות מחקר וכ – 80 מתוכן העוסקות בקשת רחבה של נושאים ובשותפות עם עשרות ארצות מתפתחות – נמצאות כבר בשלבי ביצוע.

פרוט של תחומי המחקרים, הארצות השותפות והתנאים להשתתפות בתכנית, בגוף החוברת.

Trickle-drip methods can be used successfully with a wide variety of desert-adapted plants to promote growth with minimal inputs of water.