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ANNUAL TECHNICAL REPORT

October 1, 1992 - September 30, 1993

Moroccan Cooperative Agricultural Development Project

Grant Number HNE-0158-G-00-2075-00

Submitted to the
Bureau for the Near East
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Submitted by the

San Diego State University Foundation
San Diego, California 92182

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This Annual Technical Report for the Moroccan Cooperative Agricultural Development Project was prepared by the San Diego State University Foundation utilizing input from participants in the Kingdom of Morocco, the State of Israel and the United States of America.

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OVERVIEW

Project Description

The Moroccan Cooperative Agricultural Development Project is funded by the Agency for International Development Bureau for the Near East. Initiated July 1, 1992, the Moroccan Project is being accomplished by participants from the Kingdom of Morocco, the State of Israel and the United States of America and is designed to meet a number of national development priorities set by the governments of Morocco and Israel.

The goal of the project is to increase the ability of Morocco's agricultural sector to meet internal demands for agribusiness products, and to strengthen the capabilities of both Morocco and Israel to export agribusiness products. The project constitutes a new stage in the Middle East Regional Cooperation program, introducing a new partner with Israel and the United States.

Accomplishments

Progress in comparison with the work plan and in comparison to the goals and objectives outlined in our original proposal, has been satisfactory for the period of October 1, 1992 - September 30, 1993. Accomplishments include:

General

- The Technical Committee met in Morocco on November 2-7, 1992, and in Israel on May 2-8, 1993;
- The U.S. Technical Committee members visited the farm site in Azemour, Morocco prior to the Technical Committee meeting in Israel;
- The Steering Committee met in Israel on January 17-19, 1993;
- The work plans for 1993-1994 and implementation schedules were prepared;
- The first draft of the Economic and Marketing study was completed;
- The first and second Morocco Report newsletters were issued;
- Contract required reports were submitted to USAID;
- SDSUF financial management reviewed the business, accounting and banking practices of Maghreb Agriculture in Morocco September 13-17, 1993;
- A business plan for use of revenue generated through project activities was developed.

Morocco

- **Goal - Speedling Nursery:** construction was completed, production began in June 1993;
- **Goal - Pot-Plant Nursery:** construction was completed;
- **Goal - Hardening Nursery:** construction was completed;
- **Goal - Open-field and Green-house Production:** green beans, melons, onions and tomatoes were planted and tested; melons were exported to Europe as well as sold in local wholesale and retail markets;

- **Goal - Training and Extension:** a demonstration for local farmers was given at the project site in Azemour in March. A larger demonstration took place at the farm on April 15, 1993. Approximately 200 farmers attended the event. Topics covered included a demonstration of irrigation techniques, plant protection, varietal experiments of melons and onions. Two Moroccan technicians will be trained in micro propagation techniques in Israel within the year. One participant received prepatory training at the Hassan II Institute in Agadir.

Israel

- **Goal - Tomato research:** tomatoes were planted and tested in April;
- **Goal - Onion research:** experimental plots were planted in Israel and Morocco;
- **Goal - Ornamental Eucalyptus research:** tissue culture propagation was initiated; propagation of ornamentals commenced;
- **Goal - Truffles research:** Moroccan truffles were sent to Israel in April for testing;
- **Goal - Economic and Marketing Study:** first draft of the study was completed. Reviewers are critiquing the document. Updates to the report will be provided as project activities expand.

PROGRESS REPORT, WORK PLANS & IMPLEMENTATION SCHEDULE
for
MOROCCO

The following is a summary of the **Goal** for each activity that is to be carried out at the project site in Azemour, as detailed in the grant.

Following the description of each goal is a **Progress Report to Date.** The progress report covers the period from November 1992 - June 30, 1993. The assessment is based on the work plans that were proposed by the Technical Committee during their first meeting in November 1992. The plans were partially carried out during the first eight months of operation. Due to the late start relative to the optimal planting, harvesting and marketing times in Morocco, results were impressive, but less than the potential.

For each goal and progress report there is a **Work Plan.** The plans cover the period of July 1, 1993 - September 30, 1994. The plans are based on the Technical Committee recommendations made in May 1993 during their second meeting.

SPEEDLING NURSERY

Goal: A speedling nursery will be erected in phases, with an initial capacity of one to two million seedlings per year supplied to farms in the target region. The size will increase five-fold during the project period. This activity is intended to influence the construction of similar nurseries in the country.

The nursery will specialize in the production of tomatoes, peppers, cucumbers, melons, and other crops to be identified. Experimentation will be directed towards the evaluation of locally produced growing media, utilization of fertilizers from various sources, and refinement of irrigation and management.

Speedling Nursery Continued

Progress to Date:

- construction materials were ordered from Israel;
- the nursery was erected; (1000 square meters of the Arava type greenhouse with accessories and equipment)
- construction was completed in August 1993;
- seeds purchased in Israel and Morocco;
- the first speedling production commenced in August (seeding and sowing) and was completed mid-September 1993;
  more of the following tomato cultivars were planted in September: Daniela FA-144, Diana 509, Korolla 508, Madona, R-503, R-505, FA-180, FA-175/3, FA-188, FA-189, FA-190, FA-191, AF-192 and BR-160.

Work Plan:

- variety testing of cultivators is being done;
- agro-management practices are being evaluated;
- commercial production of cultivators is planned;
- the sowing and mixing machines were shipped from Israel and arrived in September 1993.
- construction and preparation of the area to be used for the sowing machine and mixing plant began in September 1993 and is expected to be completed by November;
- projected production by the end of the planning period is 800,000 plants of tomato, melon, pepper, cucumber, onion and smaller amounts of other crops to be identified.

POT-PLANT NURSERY

Goal: The pot-plant nursery will generate two types of products: rooted seedlings and finished pot-plants. It will include both a mother plantation and a production unit. The mother plantation, based on the highest quality species available, will provide propagation material for the production unit. The production nursery will be divided into a rooting section and a pot-plant production section.

Linkages will be developed with leading European nurseries, and ornamental lines, mostly rooted seedlings, will be produced according to orders from these nurseries. Production for the local market will concentrate on a line of easy to produce plants, with high quality seedlings being made available to local pot-plant producers and finished pot-plants also being produced.

Pot-plant Nursery Continued

Experiments will include the effects of dwarfing agents, utilization of local materials for plant growth medium, nutrition, and optimization of light and temperature. The nursery will be used for on-the-job training of a large number of farmers in the art of pot-plant production. It will also assist Moroccan farmers who wish to start their own nurseries.

Progress to Date:

- construction materials were ordered from Israel;
- the 1000 square meter nursery was erected;
- construction was completed in August 1993;
- propagation materials were identified and procured.

Work Plan:

- propagation of ornamentals is to begin in October 1993;
- the following ornamentals will be propagated: Fiches Benjamin; Singonium, Schoflera, Difenbachia, Latania.

MICRO-PROPAGATION (Tissue Culture) LABORATORY AND HARDENING NURSERY

Goal: The intention of this activity is to develop commercial micro-propagation capability in Morocco that will produce micropropagules from a variety of foliage and other pot-plants. Because micro-propagation provides a means of quickly propagating disease-free material, banana and carnation growers in Morocco are importing expensive micropropagules since such material is not produced in Morocco. The importance of this technology to Morocco and its availability in Israel make this activity an excellent opportunity for cooperation.

Progress to Date:

- construction materials were ordered from Israel;
- the hardening nursery was erected;
- construction of the nursery was completed in August 1993;
- plans for building the laboratory have commenced, including preliminary architectural designs and a preliminary list of equipment needed for the laboratory.

Work Plan:

- construct laboratory by Summer 1994;
- finalize the list of equipment needed for the laboratory;
- collect bids for the equipment;
- order the equipment from USA by the end of 1993;
- order propagules;
- send two Moroccans to Israel for training in micro-propagation;
- begin tissue culture production of bananas and strawberries in late spring of 1994, after Moroccan trainees have returned from Israel.

OPEN-FIELD PRODUCTION OF ORNAMENTALS

Goal: This activity will focus on the production of hardy woody ornamentals since out-of-doors production of ornamental is attractive to small farmers due to low investment requirements. Also, this segment of the ornamental industry is little known in Morocco. Species to be tried will include melaleuca spp., eucalyptus spp., leptospermum spp., leucodendron spp., and wax flower.

Seedlings will be purchased in California and Israel. Trials on the 20-hectare site will be devised to produce optimal irrigation and fertilization regimes and post-harvest treatment.

Progress to Date:

- survey of local ornamentals available in Morocco;
- proposed plan for open-field ornamentals to be tested at the project site.

Work Plans:

- one-half hectare of Strelizia is to be planted in October;
- order 10,000 seedlings of melaleuca from Israel;
- ship melalecu to Morocco in January 1994;
- put up 500 square meters of shading in November 1993.

OPEN-FIELD and GREEN HOUSE PRODUCTION OF VEGETABLES

Goal: This component will include experimentation, demonstration, and application of modern methodologies and technologies of open-field-crop production, addressing parameter of crop rotation, soil preparation, manuring and basic fertilization, seed-bed preparation, irrigation, herbicide application, planting, fertigation, insect and disease prevention and controls, pollination, harvest timing, and post-harvest treatment.

The activity will seek to introduce a range of species and cultivars of vegetables for the processing industry. The main crops to be tested, improved and disseminated are fresh salad tomatoes and also onions, cucumbers, and artichokes for the processing industry. Varietal trends for each group will be thoroughly assessed.

Progress to Date:

Open-field

- **melons** were planted on January 25, 1993, in open-fields to observe four cultivars' resistance to Fusarium diseases (Arava, Revigal, Galia and Inbar varieties were planted under low tunnels);
- **onions** were planted on February 27, in open-fields, to observe the efficiency of local agronomic practices;
- **green beans** were planted on March 5, in open-fields, to test the Bell variety.

Green House

- **melons** were planted on January 7, in 1.4 hectares of Canary green houses; (Arava, Revigal, Galia and Inbar varieties were used).

* See Attachment A for a summary of the results of varietal testing completed to date for open-field and green house production activities.

Marketing

- **harvesting and marketing** of melons in local and export markets began in April. Smaller quantities of onions and green beans were sold in local markets.

Open-Field and Green House Production of Vegetables continued

Work Plan:

- **Open-field:** tomatoes, peppers and eggplants were planted on .5 hectare on August 25; artichokes were planted on 2 hectares on August 22;
- **Green house:** tomatoes were planted on 1.6 hectares in September; melons will be planted on 1.6 hectares in December;
- Results of the above activities will be evaluated in terms of varietiels and agro management practices;
- Israeli scientists, Dr. Irit Rylski and Dr. Moshe Bar will visit the project site in December 1993 to provide technical advise on vegetable production and tomato trials.

TRAINING AND EXTENSION

Goal: Training at the Azemour Project Site

All training at the project site will be carried out by a cadre of 10-15 Moroccan extension workers, drawing also on professionals from the Hassan II Institute of Agriculture and Veterinary Medicine and from the National Institute for Agricultural Research. Groups of farmers and farm technicians will be selected for extended on-the-job training at the project site in Azemour. Training will be provided on agronomic topics of general importance, and a training plan will be developed for each component. The Technical Committee will design the training, evaluate its effectiveness, and advise on equipment needs.

Short-term Project Site Courses of up to one week will be given on topics related to site activities. Examples are methods of plant propagation, maintenance of irrigation systems, fertilization, pest and disease control, farm management and marketing.

Extension Program

In addition to providing training as discussed above, the extension specialists will conduct an advisory service to farmers who cooperate with the project. They will be employed by the project and will work in various activities; their extension work will be in addition to their every-day job obligations.

Extension will be carried out in at least three areas; plant protection, vegetables and ornamental production. The extension program will be devised by the Technicl Committee.

Progress to Date:

- local farmers were invited to the project site in March 1993 to learn about production practices used for melons, green beans and onions;
- two hundred farmers attended a demonstration at the project site on April 15; irrigation techniques, plant protection methods, and varietal tests of melons and onions were explained;
- two local Moroccan technicians began training in May for their duties as nursery personnel;
- weekly meetings are held at the farm with technicians and the farm manager to review plans and provide in-depth discussion and direction;
- five Moroccan technicians were identified for training at the project site in Azemour

Work Plan:

- open demonstration days for the local farmers will be held at the project site monthly, beginning in November 1993;
- continue weekly training sessions with technicians;
- five Moroccan technicians will receive training in Azemour beginning November 1993.

Goal: Training Abroad

The extension workers will initially be trained for three to four months in Israel, participating in classes, tours, and on-the-job training that focuses on extension methods. The project will also train the leading staff of the tissue culture laboratory in Israel and train project research in the United States and Israel as needed.

Progress to Date:

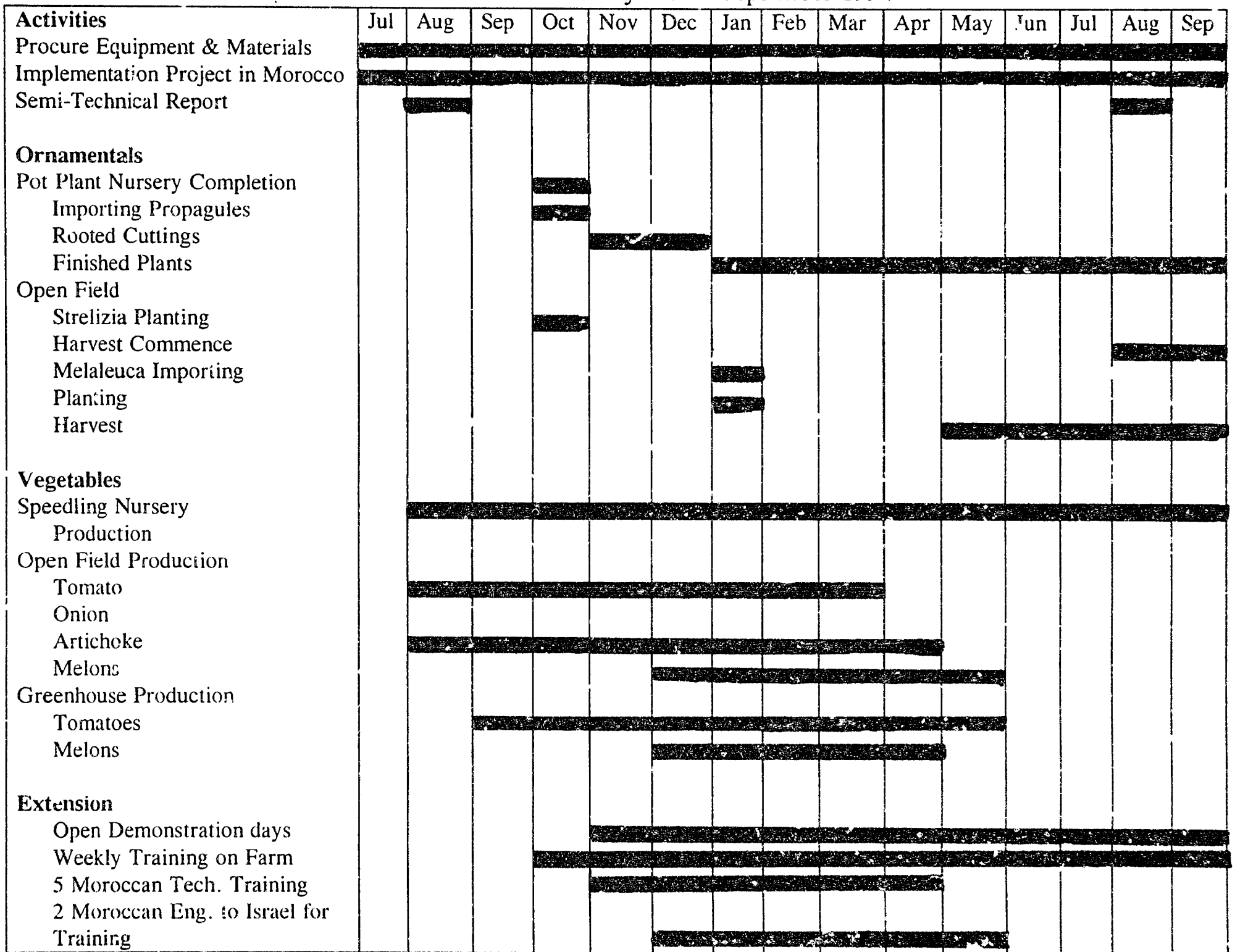
- two Moroccan engineers, Mr. Moulay Sadiq and Ms. Fatima Agdid, were identified for training in micro-propagation in Israel;
- Ms. Agdid received prepatory training at the Hassan II Institute in Agadir beginning September for two months.

Work Plan:

- Mr. Sadiq and Ms. Agdid will be sent to Israel by the end of 1993 for six months training in micro propagation techniques;
- on-the-job training will continue after returning to the project site after their training in Israel.

A Time Table for Implementation

Year Two - Morocco July 1993 - September 1994



PROGRESS REPORT, WORK PLANS & IMPLEMENTATION SCHEDULE
for
ISRAEL

Breeding of High Quality Tomatoes

Goal: The average yield of processing tomatoes in Morocco is 30 tons per hectare, while in Israel it is 80 tons per hectare. The studies on tomatoes to be carried out at the Moroccan site will be supplemented by the breeding of high quality tomato hybrids in Israel that are adapted to the environment of the Middle East.

Progress to Date:

- open-field and green house tomatoes were planted and tested in April 1993;
- selection of eight varieties of tomatoes was made in Israel from a total of 140 varieties;
- these eight varieties of tomatoes are being tested in Azemour.

Work Plan:

- Israeli scientists will travel to Morocco in December 1993 to evaluate on-going production activities and to discuss the spring planting schedule;
- evaluations on varietal tests in Morocco will continue, including disease resistant qualities and the agro-management practices.

Physiological and Nutritional Studies of Onions

Goal: Onions are a major crop in the countries of the semi-arid Middle East. Recently developed onion hybrids have increased the potential yield of onions and their dry matter production. This activity will contribute to realizing this potential in full by developing management procedures on the basis of a better understanding of plant physiology and nutritional requirements.

Progress to Date:

- experimental plots were planted in Morocco and Israel in January 1993;
- evaluation of the storage quality of onions began in Morocco;
- preliminary selection of best varieties made.

Physiological and Nutritional Studies of Onions continued

Work Plan:

- send a selection of best onion varieties to Israel for further testing;
- Israeli researchers will visit Morocco in January 1994 to evaluate varietal tests;
- new tests to be done in Morocco and Israel following the visit of the Israeli scientists.

Development of Verticordiaas an Ornamental Plant

Goal: This genus has many species which produce attractive flowering branches and has good potential for becoming a novel product in the floral markets of Europe and North America. Studies will be conducted on the effects of environmental and seed treatment on germination; edaphic and other environmental effects on plum growth and yield; formulation of appropriate agro-management procedures; post-harvest studies; and markets.

Progress to Date:

- research and testing of species of ornamentals with flowering branches commenced - species: Verti cordia and melaleuca;
- germination tests were made for eleven varieties of verti-cordia in five medians and in three seasons (Winter 1992; Spring and Summer 1993);

Work Plan:

- research and evaluations will continue based on outcome of first year's work;
- Melaleuca seedlings (10,000) will be shipped to Morocco for testing in January 1994;
- collection of additional plant material will be done.

Micro propagation of Ornamental Eucalyptus

Goal: This work will be conducted at a tissue culture laboratory of the Ben Gurion University which will also be responsible for training Moroccan technicians in methods of micro propagation, and advising on the construction and operation of the laboratory in Morocco. Results of this research will be applicable to the open-field ornamental production activity in Morocco.

Micro propagation of Ornamental Eucalyptus continued

Progress to Date:

- studies on the micro propagation of ornamental species of Eucalyptus and bananas commenced in Israel;
- tissue culture propagation was initiated in Israel
- delays occurred in the testing of nine selected varieties due to poor sprouting in the Spring of 1993.

Work Plan:

- testing in Israel will continue;
- selection of superior varieties of Eucalyptus will be made;
- Israeli scientist will visit Morocco in January 1994 to survey local varieties and refine research plans;
- Moroccan trainees will be sent to Israel in December 1993 to receive training in tissue culture technology for six months.

Commercial Production of Truffles

Goal: Truffles are well-known and highly appreciated commodity in Morocco, and in Israel there is an on-going research aimed at the "domestication " of desert truffles. Intensive production of truffles will potentially introduce a new field on intensive agriculture production for both Morocco and Israel. This activity will seek to identify Moroccan scientists who would be interested in cooperating with Israeli research in this area, and to expand direct ties between involved research institutions in both countries.

Progress to date:

- Moroccan truffles were sent to Israel in April for testing.

Work Plan:

- Israeli scientist will visit Morocco in February to collect additional materials and to establish contacts with Moroccan researchers;
- tests will continue in Israel on the commercial production possibilities of the Moroccan truffle;
- additional tests will be made with other varieties of truffles.

Economic and Marketing Studies

Goal: This component will seek to demonstrate that satisfactory markets exist for the products being studied under the project. The Economic study will include and evaluation of the costs of the different products developed in the project, especially at the Project site in Azemour; yields and prices in the local and export markets; and returns to farmers for increasing the efficiency of the production will be developed.

The primary elements that will be considered in the marketing analysis are as follows: population projections of potential beneficiaries of the project; the numbers of beneficiaries that will be reached by the Project site activities; the income per farm unit among these beneficiaries; the long-term increase in income that can be projected as a result of project outreach; the internal rate of return on investment; the income generated from the three nurseries operated by the project (speedling, pot-plant and micro propagation); data on European Community import and consumption of project crops; and potential profitability of the project.

Progress to date:

- first draft of the study was completed in January 1993;
- reviewers critiqued the document.

Work Plan:

- second draft is to be completed by October 1993;
- review of second draft will begin in November 1993;
- distribution of second draft will be done after reviews are completed and the document has been re-typed;
- updates to the report will be prepared as project activities expand.

A Time Table for Implementation
Year Two - Israel July 1993 - September 1994

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Breeding of High Quality Tomatoes															
Two Israeli Scientists to Israel						■	■								
Research and Testing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Physiological and Nutritional Studies of Onions															
Final selection of best onion						■	■								
Israeli researchers visit Morocco							■								
New tests done in Morocco								■	■	■	■	■	■	■	■
Development of Verticordiaas an Ornamental Plant															
Continuation of research	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Melaleuca propagules ship							■								
Collect plant materials								■	■	■	■	■	■	■	■
Micro propagation of Ornamental Eucalyptus															
Continuation of testing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Selection of superior varieties	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Israeli scientist visit Morocco							■								
Two Moroccan trainees to Israel						■	■	■	■	■	■				
Commercial Production of Truffles															
Collect additional materials								■							
Continue tests on varieties of Truffles	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Israeli scientist to Morocco								■							
Economic and Marketing Studies															
Draft number two	■	■	■	■											
Review of second Draft					■	■									
Distribution of second draft							■								
Report Updates								■	■	■	■	■	■	■	■

CHANGES IN PERSONNEL

Dr. Leon Garoyan was appointed as the U.S. Technical Committee specialist in agricultural marketing. Dr. Garoyan is the former Director, Center for Cooperative Administration, University of California, Davis. His current address is [redacted]

Dr. Ben Ami Bravdo will participate on the Technical Committee as a specialist in irrigation, fertigation and banana production. Dr. Bravdo is from the Faculty of Agriculture, Hebrew University in Israel. His current address is [redacted]

Ms. Teresa Stancato was hired as the new project secretary for the San Diego office. The salary level is 23.5K/year based on 50% time. She began her assignment on April 19, 1993.

MEETINGS AND COLLABORATIVE ACTIVITIES

Technical Committee and Related Meetings and Field Trips November 2-8, 1992

A trip to Morocco was made by members of the Technical Committee and other participating individuals from the U.S., Israel and Morocco. The purpose of the trip was to attend the Technical Committee Meeting as well as visit the project site in Azemour, visit farms in Agadir, Azemour and Marrakech, and to visit with scientists and staff of participating organizations such as Hassan II Institute of Agriculture and Veterinary Science.

In addition to the site visits, meetings were held at the US Embassy and US AID Mission in Rabat to discuss project activities, introduce project personnel to Mission Staff and to the U.S. Ambassador and to meet with other project staff to discuss possible collaborative activities.

MEETINGS

Technical Committee Meeting - November 6, 1992
The Technical Committee Meeting commenced on November 6, 1992. Opening remarks were given by Ms. Frea Sladek, Mr. Driss Lahlou and Professor Samuel Pohoryles. Dr. Dov Pasternak then reviewed the Scope of Work for the project. Mr. Itzhak Ayalon reviewed the out come of the technical visit made in September by himself, Mr. Uri Drori and Mr. Itzhak Peretz. Then the technical members of the delegation broke up into three groups in order to prepare an implementation schedule for the next eighteen months.

Technical Committee Members present at the above meetings were Mr. Allal Chibane, Dr. M. Nadir and Mr. Hammoutou El-Mekki of Morocco; Dr. Dov Pasternak, Dr. Josef Elkanna, Dr. Irit Rylski and Mr. Elizer Spigel of Israel; Dr. Michael Reid of the United States. Others in attendance were Mr. Driss Lahlou, Mr. Hassan Alami and Mr. Mimoum Mokhtari of Morocco; Dr. Samuel Pohoryles, Mr. Itzhak Peretz, Mr. Itzhak Ayalon and Mr. Uri Drori of Israel; Ms. Frea Sladek, Dr. Bonnie Stewart, Mr. W. Timothy Hushen and Ms. Mary Gellner of the United States.

Meetings continued

US A.I.D. - Rabat Meeting
The following members of the project delegation met with US AID officials in Rabat: Mr. Hassan Alami, Ms. Frea Sladek, Dr. Bonnie Stewart, Mr. W. Timothy Hushen, Dr. Dov Pasternak, Mr. Itzhak Pereta and Mr. Itzhak Ayalon. US AID officials included Mr. Charles Uphaus, Agriculture Officer; and Dr. James Lowenthal, Deputy Mission Director. Project activities to date were reviewed.

Dr. Stewart had a follow-up meeting with Mr. Uphaus and Mr. Martin V. Degata, the new US AID Mission Director, after the Technical Committee meeting ended in order to discuss the outcome of the meetings and the problems related to procuring agricultural equipment for the project on a duty free basis.

US Embassy - Rabat
Following the meetings at US AID in Rabat, the delegation met with Ambassador Vreeland. The purpose of the meeting was to introduce project members to the Ambassador and to discuss project accomplishments to date.

Moroccan Agri-business Promotion Project (MAP) Meeting - November 1992
Mr. Donald S. Humpal, Project Director for MAP, met with the Technical Committee members and delegation to discuss areas of possible collaboration between the two projects. Mr. Humpal was very cooperative and helpful. Another meeting was held with Mr. Bryan Cordray, procurement Specialist for the MAP project. Issues related to importing equipment were discussed.

Budget and Expenditure Guidelines Meetings
Meetings were held on November 8 and 9 with our Moroccan partners, Mr. Hassan Alami, Mr. Driss Lahlou, Mrs. Wafa Benefares, Mr. Mohamed Bafrij and SDSUF staff, Dr. Bonnie Stewart and Mr. W. Timothy Hushen, to review US AID financial reporting guidelines and requirements. Specific forms were provided to them for their use and reference.

Economic and Marketing Study Meeting
Meetings were held with Dr. Samuel Pohoryles to review the Scope of Work of the economic and marketing study for the Moroccan Cooperative Agricultural Development Project. This component will seek to demonstrate that satisfactory markets exist for the products being studied under the project. The study will include an evaluation of the costs of the different products developed in the project at the Azemour site; yield and prices in the local and export markets; and returns to farmers and to investment capital.

Field Trips

Morocco

Agadir

The Technical Committee delegation met with the Director and staff of the Agricultural Regional Development Office in the Souss Massa area in Agadir and the Hassan II Institute of Agronomy and Veterinary Medicine. They presented an overview of the agricultural activities in the region. The delegation visited the laboratories of the Hassan II Institute of Agronomy and Veterinary Science at Ait Mellou.

Regional Development and Hassan II Institute staff present included Mr. Mohammed Tazi, Director of the Agriculture Regional Development Office (ORMVA); Dr. Abderrahmane Hilai, Director of the Horticulture Section of the Hassan II Institute in Agadir; Mr. Mohamed Faqir, Agronomy Engineer (ORMVA); and Mr. Hassan Bellouch, Chief of the Bureau of Horticulture (ORMVA).

The afternoon was spent visiting local private farms of Mr. Kabbage Mohammed and Mr. Meziani Omarin the region of Souss Massa. Information was gathered on bananas and carnations grown in plastic houses. Also, irrigation systems and infrastructure were viewed.

Azemour

A visit to the project site at Oujda de Chtoukas Azemour was made. Project start up activities were discussed and the design for the plant propagation center reviewed. Visits to protected agriculture operations in the region were made.

Marrakech

A rose nursery near Marrakech was visited. Covered structures and irrigation systems were viewed as well as the packaging and storage facilities.

Steering Committee and Related Meetings and Field Trips January 1993

Members of the Steering Committee and other participating individuals from the US, Morocco and Israel met in Israel on January 14-18, 1993. The purpose of this trip was to attend the Steering Committee Meeting as well as to visit agricultural sites throughout Israel. The US participants visited the project site in Morocco enroute to Israel.

Steering Committee Members present at the meetings were Mr. Driss Lahlou and Mr. Hassan Alami from Morocco; Dr. Samuel Pohoryles, Dr. Dov Pasternak and Mr. Itzhak Peretz from Israel; Mr. Harry Albers, Ms Frea Sladek and Dr. Albert Johnson (representing Dr. Ronald Hopkins) from the United States. Others in attendance were Mr. Itzhak Ayalon from Israel.; Dr. Bonnie Stewart, Mr. W. Timothy Hushen, Dr. Mohamed El-Assal and Ms. Davene Gibson from the United State.

MEETINGS

Steering Committee Meeting January 17, 1993
The Project Steering Committee Members met in Jerusalem, Israel on January 17, 1993. Opening remarks were given by Professor Samuel Pohoryles, Mr. Driss Lahlou and Mr. Harry Albers. Mr. Driss Lahlou and Mr. Itzhak Ayalon then reviewed activities and accomplishments to date at the project site in Morocco. Dr. Dov Pasternak provided an overview of research plans for Israel.

Mr. W. Timothy Hushen presented a financial report for the first fiscal year. Dr. Bonnie Stewart discussed the technical reports that have been submitted to US AID. It was agreed that the next meeting of the Steering Committee would be held in Morocco during the second week in October 1993. The Steering Committee Members agreed that the Technical Meeting would meet again in Israel during the first week of May 1993, to coincide with the AGRITECH meeting. Funding for this meeting would be supplemented by contributions from the Hansen Institute, San Diego State University Foundation.

Foreign Minister
While in Israel, Steering Committee members met with the **Honorable Shimon Peres,** Minister of Foreign Affairs, in his office in Jerusalem on January 17, 1993, to discuss the regional cooperation programs. Mr. Peres expressed appreciation for San Diego State University Foundation's role in promoting peace through international cooperative programs like the Morocco project. Mr. Peres said that he viewed these activities as a first step towards long-term cooperation and peace in the region.

Meetings continued

Minister of Agriculture
Support for the activities of the Moroccan Cooperative Agricultural Development Project was given by **Mr. Yaakov Tsur,** Israel Minister of Agriculture, during a luncheon meeting with the Moroccan Cooperative Agricultural Development Project Steering Committee members in Jerusalem on January 17, 1993. Mr. Tsur strongly encouraged regional cooperation programs.

FIELD TRIPS

Israel
In Israel, site visits were made to several nurseries and experiment stations in Israel. Members viewed rooting of tissue culture bananas and foliage ornamentals at the Shorashim and Rosh Hanikra Nurseries. Similar technology will be developed in Morocco at the Azemour farm.

Open-field banana production was seen in the Carmel Coastal Area. Members enjoyed visits to the Ramat Negev Experimental Station and the Institute for Applied Research at Ben Gurion University of the Negev.

Morocco
Prior to the Steering Committee Meeting January 11-13, 1993, the following persons traveled to Morocco to visit the project site in Azemour and to visit USAID officials: Mr. Harry Albers, General Manager-SDSUF; Dr. Albert Johnson, Emeritus Vice President-SDSU; Ms. Frea Sladek, Associate General Manager-SDSUF; Dr. Bonnie Stewart, U.S. Project Director-SDSUF; Ms. Davene Gibson, Assistant General Manager, SDSUF and Mr. W. Timothy Hushen, Director, Program Management-SDSUF. The purposes of the visit were to view the project site and to meet with USAID officials to discuss planned activities.

Technical Committee and Related Meetings and Field Trips
May 1993

In May 1993 Technical Panel Members from Morocco and the United States traveled to Israel for site visits and a planning meeting. Israeli members of the Technical Committee joined the group in Tel Aviv at the Agritech Exposition. Agricultural technology from Israel and around the world was displayed at the exposition.

The US Technical Committee members visited the project site in Morocco en route to Israel.

MEETINGS

Technical Committee Meeting May 6-8, 1993
Technical Committee Members present were Mr. Allal Chibane, Dr. Mohamed Nadir and Mr. Hammoutou El-Mekki of Morocco; Dr. Dov Pasternak, Dr. Josef Elkanna, Dr. Irit Rylski, Mr. Elizer Spigel and Dr. Ben Ami Bravdo of Israel; Dr. Richard Jones of the United States. Dr. Michael Reid visited the project site in Morocco in April. His recommendations were incorporated into the work plans prepared by the Committee. Others in attendance were Mr. Driss Lahlou, Mr. Itzhak Ayalon and Mr. Uri Drori from Israel. Ms. Fazia Lahlou from Morocco; Dr. Bonnie Stewart from he United States.

The Technical Committee held a planning meeting at the Lagoona Hotel in Eilat Israel on May 6, 1993. Dr. Dov Pasternak welcomed members to the second Technical Committee meeting of the Moroccan Cooperative Agricultural Development Project. His opening remarks were following by comments from Mr. Driss Lahlou of Morocco and Dr. Bonnie Stewart of the United States. After the opening remarks, the participants separated into three groups. Work Plans and Implementation Schedules for the next eighteen months were prepared.

Ben Gurion University of the Negev
Team members visited Ben Gurion University of the Negev and the Institutes for Applied Research in Beer-Sheva. **Professor Lehaim Naggan**, Vice-President and Dean of Research and Development, hosted a dinner for the group.

Israeli research scientists presented their technical plans to the group in Beer-Sheva. The meeting provided an excellent opportunity to discuss plans with the Technical Committee and to get important feedback on their plans.

Meetings continued

Meeting with the Minister of Agriculture - May 2-7, 1993
His Excellency, **Mr. Yakov Tsur**, Israeli Minister of Agriculture, hosted 150 foreign delegates at his Kibbutz Netiv Halamed Hay. Special recognition was given to the Moroccan, Israeli and American representatives from the Moroccan Regional Cooperation Project. Television, radio and newspapers covered the event.

FIELD TRIPS

Morocco
Project Site in Azemour
The US Participants, Dr. Richard Jones, Dr. Michael Reid, and Dr. Bonnie Stewart visited the project site in Azemour prior to the visit to Israel to observe activities and accomplishments to date. They were joined in Morocco by Mr. Driss Lahlou, Mr. Itzhak Ayalon and Ms. Fazia Lahlou. They also met with Mr. Hassan Alami and Mr. Charles Uphaus, USAID - Rabat.

Visitors observed the new irrigation system, greenhouse and open-field production of fruits and vegetables, and the local and export sales of farm products, melons in particular. The shipment of materials for construction of the three nurseries had just arrived from Israel. Construction activities were to begin mid-May. A demonstration for two hundred farmers had been given at the farm earlier in the month. The team was favorably impressed with the accomplishments to date.

Marketing and Distribution Centers - Casablanca
The team visited several marketing and distribution centers for fresh fruits and vegetables. Included were collection centers for local wholesale markets (Marche de Gros), collection centers for exporting fruits and vegetables (Domaines Royaux Station), cold storage and packing facilities (Domaines Royaux Station), citrus packing facilities (Delassus) and retail markets. Products from the Project Site were viewed at these market places.

Casablanca, Azemour and Al-Jadida Regions - April 27-30, 1993
Local potted-plant nurseries were visited in an effort to assess the local availability of these products. Open field ornamentals were identified by the team as possible options for growing at the Project Site.

Israel
Agritech Exposition, Tel Aviv
Agricultural technology from Israel and from around the world was displayed at the exposition. Participants viewed the exhibits and attended lectures given by Dr. Dov Pasternak and Dr. Irit Rylski.

Field Trips continued

Site Visits

Tours were made of protected agricultural operations in the Carmel Coastal area. Tomato and pepper production was seen at Moshav Geva and Moshav Habonim. Banana production at Kibbutz Maagan Michael was viewed by the visitors. Protected agriculture operations in the Negev were visited including the Ramat Negev Experimental Station and Ha Besor Station. A tour was made of a large potted-plant nursery owned and operated by the Soloman Brothers in Moshav Shakha.

Review of the Morocco Cooperative Agreement Implementation Practices September 13-17, 1993

Mr. Robert Benshoff, Associate General Manager for Financial Management for San Diego State University Foundation, Mr. Frank DiSanto, Director of Grants and Contracts Administration, SDSUF, and Dr. Bonnie Stewart, U.S. Project Director, visited Morocco in September 1993.

The purpose of the visit was to review the business, accounting and banking practices of Maghreb Agriculture; review compliance with the Cooperative Agreement requirements; assist in arranging an independent audit; and to finalize the business plan for use of revenue generated through project activities. (See Attachment C for a copy of the business plan.) A visit to the project site was made to observe progress to date.

The travel costs for Mr. Benshoff and Mr. DiSanto were paid for by San Diego State University Foundation.

TRAVEL COSTS

The attached summaries details the costs, dates, names, origins and destinations for the project related travel described above.

TRAVEL COSTS
Morocco Technical Committee Meeting
November 1992 - Casablanca, Morocco

PURPOSE: Morocco, Israel and U.S. Participants attend the November 5-7, 1992 Morocco Technical Committee Meeting. Technical Committee Members visit Morocco Project Institutions and Nurseries: Azemour, Project site; Rabat, USAID Mission; Agadir, Research Institute and farm sites; Marrakesh, nursery.

DATE	PARTICIPANT NAME	ORIGIN/DESTINATION	DESCRIPTION	EXPENS
	US PARTICIPANTS			
Nov 2-13	Dr. Bonnie Stewart	San Diego/Casablanca/San Diego	Air Ticket	1,110.10
			Hotel/Lodging	1,010.00
			Per Diem	299.00
			Air Travel: Agadir	101.06
				2,520.16
Nov 4-8	Dr. Michael Reid	Davis, CA/Casablanca/Davis, CA	Air Ticket	1,196.00
			Hotel/Lodging	283.31
			Per Diem	208.00
				1,687.31
	ISRAELI PARTICIPANTS			
Nov 2-8	Dr. Dov Pasternak	Tel Aviv/Casablanca/Tel Aviv	Air Ticket	1,236.00
			Hotel/Lodging	556.23
		(business calls)	Misc. Hotel Exp.	94.24
			Per Diem	280.00
			Air Travel: Agadir	101.06
				2,267.53
Nov 4-8	Dr. Samuel Pohoryles	Tel Aviv/Casablanca/Tel Aviv	Air Ticket	1,236.00
			Hotel/Lodging	430.70
			Per Diem	231.00
			Air Travel: Agadir	101.06
				1,998.76
Nov 2-8	Dr. Irit Rylski	Tel Aviv/Casablanca/Tel Aviv	Air Ticket	1,236.00
			Hotel/Lodging	556.23
			Per Diem	280.00
			Air Travel: Agadir	101.06
				2,173.29

DATE	PARTICIPANT NAME	ORIGIN/DESTINATION	DESCRIPTION	EXPENS
Nov 2-8	Dr. Josef Elkanna	Tel Aviv/Casablanca/Tel Aviv	Air Ticket	1,236.00
			Hotel/Lodging	556.23
			Per Diem	280.00
			Air Travel: Agadir	101.06
				2,173.29
Nov 2-8	Dr. Elizer Spigel	Tel Aviv/Casablanca/Tel Aviv	Air Ticket	1,236.00
			Hotel/Lodging	556.23
			Per Diem	280.00
			Air Travel: Agadir	101.06
				2,173.29
Nov 2-8	Dr. Itzhak Peretz	Tel Aviv/Casablanca/Tel Aviv	Air Ticket	1,236.00
			Hotel/Lodging	556.23
			Per Diem	280.00
			Air Travel: Agadir	101.06
				2,173.29
Nov 2-8	Mr. Itzhak Ayalon	Tel Aviv/Casablanca/Tel Aviv	Air Ticket	1,236.00
			Hotel/Lodging	556.23
			Per Diem	280.00
			Air Travel: Agadir	101.06
				2,173.29
Nov 2-8	Mr. Uri Drori	Tel Aviv/Casablanca/Tel Aviv	Air Ticket	1,236.00
			Hotel/Lodging	556.23
			Per Diem	280.00
			Air Travel: Agadir	101.06
				2,173.29
MISCELLANEOUS BUSINESS EXPENSE				
Nov 3-8	TC Members	Casablanca	Misc. Meeting Expense Business calls, faxes, film, books, photocopies, Telefax.	1,258.86
GROUND TRANSPORTATION				
Nov 3-12	Dr. Bonnie Stewart	Casablanca	Misc. Taxi service	115.36
Nov 3	TC Members	Azemour	Van rental - Project site	
Nov 5	TC Members	Rabat	" - USAID Mission	951.82
Nov 7	TC Members	Marrakesh	Field trip to Nursery	352.53
			Ground Trans. Exp:	1,419.71

TOTAL EXPENSE: $ 24,192.07

TRAVEL COSTS
Morocco Steering Committee Meeting
January 17, 1993

Purpose: Morocco, Israel and U.S. Participants attend the January 17, 1993 Steering Committee Meeting held in Jerusalem, Israel. Steering Committee Members visited Project Institutions and nurseries: USAID Mission in Rabat; Ben Gurion University and Experiment Station in Tel Aviv; Speedling Nurseries; Tissue culture laboratories; Banana houses; Potted plant nurseries.

DATE	PARTICIPANT NAME	ORIGIN/DESTINATION	DESCRIPTION	EXPENS
Jan 10-23	Dr. Bonnie Stewart	San Diego/Casabanca/Tel Aviv/ Jerusalem/Cairo/Wash. D.C./S.D.	Air Ticket	$ 2,813.10
			Prepaid Hotel/Lodging	223.00
			Per Diem	1,241.80
				4,277.90
Jan 10-18	Mr. Harry Albers	San Diego/Casablanca Tel Aviv/Jerusalem/Cairo	Air Ticket	$ 1,047.00
			Prepaid Hotel/Lodging	268.00
			Per Diem	930.00
				2,245.00
Jan 10-13	Ms. Frea Sladek	San Diego/Casablanca San Diego/Casablanca	Air Ticket	$ 2,050.00
			Per Diem	498.80
				2,548.80
Jan 10-17	Dr. Al Johnson	San Diego/Casablanca/Tel Aviv Jerusalem/Cairo/San Diego	Air Ticket	$ 1,082.50
			Prepaid Hotel/Lodging	223.00
			Per Diem	930.00
				2,235.50
	MOROCCO PARTICIPANTS			
Jan 13-17	Mr. Driss Lahlou	Casablanca/Tel Aviv/ Jerusalem/Casablanca	Prepaid Hotel/Lodging	$ 268.00
			Per Diem	619.00
				887.00
Jan 13-17	Mr. Hassan Alami	Casablanca/Tel Aviv/	Prepaid Hotel/Lodging	$ 268.00
				619.00
				887.00

TRAVEL COSTS Continued .....

DATE	PARTICIPANT NAME	ORIGIN/DESTINATION	DESCRIPTION	EXPENS
	ISRAELI PARTICIPANTS			
Jan 14-17	Dr. Dov Pasternak	Tel Aviv/Jerusalem/Tel Aviv	Prepaid Hotel/Lodging Per Diem	$ 255.00 173.00 428.00
Jan 14-17	Mr. Itzhak Peretz	Tel Aviv/Jerusalem/Tel Aviv	Prepaid Hotel/Lodging Per Diem	$ 84.00 249.00 333.00
Jan 14-17	Mr. Itzhak Ayalon	Tel Aviv/Jerusalem/Tel Aviv	Per Diem	$ 356.85
MISCELLANEOUS BUESINESS EXPENSE				
Jan 10-17	SC Members	Casablanca/Tel Aviv/Jerusalem/ Cairo	Misc. Meeting Expense Phone/Fax; Materials & supplies; Film developing	173.24
Jan 13-17	SC Members	Casablanca/Tel Aviv/Jerusalem	Prepaid by Yarkon Tours Planned meals at hotels subtracted from Participants Per Diem.	$ 1,050.00
Jan 13-17	SC Members	Casablanca	Ground Transportation to Project Sites	$ 587.0
			TOTAL EXPENSE:	**$ 16,009.29**

TRAVEL COSTS
Morocco Technical Committee
May 1993 - Casablanca Morocco

PURPOSE: Moroccan, Israeli and U.S. Participants attended the May 1-8, 1993 Technical Meeting in Israel. Visits in Israel were made to several protected Agricutural operations as well as the Agri-Tech Exposition in Tel-Aviv. U.S. Technical Committee Members visited the Morocco Project Project site in Azemour prior to the meeting in Israel.

DATE	PARTICIPANT NAME	ORIGIN/DESTINATION	DESCRIPTION	EXPENSES
	U.S. PARTICIPANTS			
Apr 26-May 11	Dr. Bonnie Stewart	San Diego/Casablanca/ Tel-Aviv/Wash DC/San Diego	Transportation (Air/Ground)	$2,822
			Hotel/Lodging (Prepaid 4/30-5/7)	$842
			Per Diem	$1,031
			Total Dr. Stewart	**$4,695**
Apr 26-Apr 30	Dr. Michael Reid	Sacramento/Madrid/ Casablanca/Madrid/Sacramento	Transportation (Air/Ground)	$1,703
			Hotel/Lodging	$133
			Per Diem	$384
			Total Dr. Reid	**$2,220**
Apr 27-May 9	Dr. Richard Jones	Cairo/Casablanca/Paris/ Tel-Aviv/Beer-Sheeva/Eliat/ Beer-Sheeva/Tel-Aviv/Cairo	Transportation (Air/Ground)	$2,104
			Hotel/Lodging (Prepaid 4/30-5/8)	$1,110
			Per Diem	$558
			Total Dr. Jones	**$3,772**
	MOROCCAN PARTICIPANTS			
Apr 30-May 8	Mr. Driss Lahlou		Transportation (Air/Ground)	$1,903
			Hotel/Lodging (Prepaid)	$127
			Per Diem	$38
			Total Mr. Lahlou	**$2,068**
Apr 30-May 8	Ms. Fazia Lahlou		Hotel/Lodging (Prepaid)	$588
			Per Diem	$141
			Total Ms. Lahlou	**$729**
Apr 30-May 8	Mr. H. El-Mekki	Casablanca/Paris/Tel-Aviv/ Casablanca	Transportation (Air/Ground)	$923
			Hotel/Lodging	$856
			Per Diem	$141
			Total Mr. El-Mekki	**$1,920**

DATE	PARTICIPANT NAME	ORIGIN/DESTINATION	DESCRIPTION	EXPENSES
	MOROCCAN PARTICIPANTS cont'd.			
Apr 30-May 8	Mr. Allal Chibane	Casablanca/Paris/Tel-Aviv/ Casablanca	Transportation (Air/Ground)	$923
			Hotel/Lodging	$856
			Per Diem	$141
			Total Mr. Chibane	**$1,920**
Apr 30-May 8	Mr. M.Nadir	Casablanca/Paris/Tel-Aviv/ Casablanca	**Transportation (Air/Ground)**	$923
			Hotel/Lodging	$857
			Per Diem	$141
			Total Mr. Nadir	**$1,921**
	ISRAELI PARTICIPANTS			
May 5-May 7	Dr. Dov Pasternak		Transportation (Air/Ground)	
			Hotel/Lodging	$428
			Per Diem	$38
			Total Dr. Pasternak	**$466**
May 5-May 7	Dr. Irit Rylski		Transportation (Air/Ground)	
			Hotel/Lodging	$509
			Per Diem	$38
			Total Dr. Rylski	**$547**
May 5-May 7	Dr. Josef Elkana		Transportation (Air/Ground)	
			Hotel/Lodging	$281
			Per Diem	$38
			Total Dr. Elkana	**$319**
May 5-May 7	Mr. Elizer Speigl		Transportation (Air/Ground)	
			Hotel/Lodging	$281
			Per Diem	$38
			Total Mr. Speigl	**$319**
May 5-May 7	Mr. Uri Drori		Transportation (Air/Ground)	$80
			Hotel/Lodging	$127
			Per Diem	$38
			Total Mr. Drori	**$245**
Apr 30-May 8	Mr. Itzhak Ayalon	Casablanca/Paris/Tel-Aviv/ Paris/Casablanca	Transportation (Air/Ground)	$1,814
			Hotel/Lodging	$586
			Per Diem	$178
			Total Mr. Ayalon	**$2,578**

DATE	PARTICIPANT NAME	ORIGIN/DESTINATION	DESCRIPTION	EXPENSES
MISCELLANEOUS BUSINESS EXPENSE				
30-Apr	TC Members	Agritech Exhibition	Tickets	$54
Apr 26-May 11	Dr. Bonnie Stewart		Misc. Meeting/Trip Expenses (Film, film developing, phone, and safety depoist box)	$128
	TC Members	Yarkon Tours	Minibus, Guide, Porterage Fees, Extras for Meals, Hotels & Misc. Exp.	$5,642
			Total Miscellaneous Expenses	**$5,824**

TOTAL EXPENSES FOR MAY 1993 TECHNICAL COMMITTEE MEETING **$29,542**

The Hansen Institute for World Peace, San Diego State University Foundation, paid for $7,306.00 of the above expenses.

TRAVEL COSTS
Preparation for Annual Audit
September 1993 - Casablanca Morocco

PURPOSE: Mr. Robert Benshoff, Associate General Manager for Financial Management, Mr. Frank DiSanto, Director of Grants and Contracts Administration and Dr. Bonnie Stewart, US Project Director to meet with Mr. Driss Lahou and others in order to prepare for the annual audit of the files of the Morocco Project.

DATE	PARTICIPANT NAME	ORIGIN/DESTINATION	DESCRIPTION	EXPENSES
	U.S. PARTICIPANTS			
Sep 11-Sep 19	Dr. Bonnie Stewart	San Diego/Casablanca/ San Diego	Transportation (Air/Ground)	$1,658
			Hotel/Lodging	$450
			Per Diem	$401
			Total Dr. Stewart	**$2,509**
MISCELLANEOUS BUSINESS EXPENSE				
Sep 11-Sep 19	Dr. Bonnie Stewart		Misc. Meeting/Trip Expenses (Film, film developing, phone)	$112
			Total Miscellaneous Expenses	**$112**
TOTAL EXPENSES				**$2,621**

San Diego State University Foundation paid for the travel costs of Mr. Benshoff and Mr. DiSanto.

TRAVEL COSTS
Other Project Related Travel
September 1993 - Casablanca Morocco

PURPOSE: Technical evaluation, procurement of equipment and consultations.

DATE	PARTICIPANT NAME	ORIGIN/DESTINATION	DESCRIPTION	EXPENSES
Nov-92 Jan-93 Mar-93		Travel for 1992/93		$3,000
			Total Travel Nov., Jan. & Mar.	**$3,000**
Sep 19-Sep 26	Mr. Itzhak Ayalon	Casablanca/Tel-Aviv/ Casablanca	Transportation (Air/Ground)	$2,402
			Total Sep. Travel	**$2,402**
			Total Travel Expenses	**$5,402**

PROCUREMENT

An irrigation system was purchased and installed at the project site in December 1992; and materials used in the construction of the three nurseries were ordered in December 1992, with delivering March 1993. Construction commenced in May 1993 and was completed by June 1993. For details see the following list attached, "**Equipment: Source, Origin & Cost.**"

EQUIPMENT FOR AZEMOUR

	EQUIPMENT: SOURCE, ORIGIN & COST - SEPTEMBER 1993			
		SOURCE	**ORIGIN**	**CCST U.S. $**
1	1000 m2 "Speedling Nursery"			
	a. Galvanized steel structure			
	Plastic Cover IR AF	Israel	Israel	$20,470
	b. Rooting tables	Israel	Israel	$3,089
	c. Pots	Israel	Israel	$3,760
	d. Media for rooting .ables	Israel	Israel	$2,025
	e. Heating system	Israel	Israel	$13,750
	f. Tensiometer	Israel	Israel	$360
2	1000 m2 "Hardening Nursery"			
	a. Galvanized steel structure			
	Plastic Cover IR AF	Israel	Israel	$18,920
	b. Planting trays	Israel	Israel	$220
	c. Planting bags 3 liter	Israel	Israel	$1,500
	d. Tables for hardening	Israel	Israel	$3,089
	e. Heating system for tables	Israel	Israel	$2,100
	f. Irrigation system	Israel	Israel	$7,000
3	1000 m2 "Pot Plant Nursery"			
	a. Galvanized steel structure			
	Plastic Cover IR AF	Israel	Israel	$18,920
	b. Tables for seedlings + 2 trolly	Israel	Israel	$18,472
	c. Trays	Israel	Israel	$3,950
	d. Irrigation system	Israel	Israel	$10,000
	e. Heating system for tables	Israel	Israel	$2,300
4	Low Tunnels Plastics			
	a. IR-AF	Israel	Israel	$9,260
	b. Polydak	Israel	Israel	$729
	c. Al-Or brown	Israel	Israel	$120
	d. Thermofilm	Israel	Israel	$3,200
	e. Plastic cover 30 micron	Morocco	Morocco	$2,000
5	Main Irrigation System			
	a. P.V.C. Pipes & Accessories	Morocco	Morocco	$1,362
	b. Laterals & Control head	Morocco	Israel	$24,323
	c. Drip Irrigation sys. for green beans	Morocco	Israel	$836
	d. Irrigation parts	Morocco	Morocco	$74
6	Other Equipment & Supplies			
	a. Massey Ferguson tractor	Morocco	United States	$35,904
	b. Seeds	Israel	Israel	$1,927
	c. Seeds	Morocco	Israel	$1,474
	d. Parts & Service Auto	Morocco	Morocco	$1,247
	e. Plastic for low tunnels	Morocco	Morocco	$410
	f. Mulch	Morocco	Morocco	$793
	g. Mulch	Morocco	Morocco	$192
	h. Plastic cover for low tunnels	Morocco	Morocco	$895
	i. Mixing & Filling System	Morocco	Morocco	$31,630
	j. Sowing Machine 2 drums	Morocco	Morocco	$26,870
	k. Trays(1000)	Morocco	Morocco	$3,950
	L. Freight Forwarding	Morocco		$5,0[illegible]0
	Subtotal			$110,293
7	Computer & Fax Equipment			
	a. Notebook computer	United States	United States	$3,749
	b. Lazer printer and software	United States	United States	$818
	c. Fax machine	United States	United States	$1,003
	TOTAL			$115,863

PUBLICATIONS SUBMITTED TO USAID

The following Technical Reports have been submitted to USAID., as requested by the Moroccan Cooperative Agricultural Development Project grant.

Technical Reports Required by Grant	*Date Submitted*
• **Quarterly Technical Progress Report**	
October 1, 1992 - December 31, 1992	January 10, 1993
April 1, 1993 - June 30, 1993	July 10, 1993
• **Semi-Annual Technical Progress Report**	
July 1, 1992 - September 30, 1992	Oct. 10, 1992
October 1, 1992 - March 31, 1993	April 10, 1993
• **Annual Technical Report**	
July 1, 1992 - September 30, 1992	Oct. 10, 1992
October 1, 1992 - September 30, 1993	In Progress
• **Semi-Annual and Annual Technical Report**	
November 1992 Update	November 30, 1992

Financial Reports Required by Grant	*Date Submitted*
• **Quarterly Financial Report**	
July 1, 1992 - September 30, 1992	October 10, 1992
October 1, 1992 - December 31, 1992	January 10, 1993
January 1, 1993 - March 31, 1993	April 10, 1993
April 1, 1993 - June 30, 1993	July 10, 1993
• **Projection of Funding Requirements Report**	
Fiscal Year July 1, 1993 - September 30, 1994	April 8, 1993

The "Morocco Report" Newsletters	
Spring 1993	(copy attached)
Fall 1993	(copy attached)

MOROCCO REPORT

NEWSLETTER *SPRING 1993*

MOROCCO A NEW MERC PARTNER

The Moroccan Cooperative Agricultural Development Project is a new Middle East Regional Cooperation (MERC) program, initiated July 1, 1992. The program is funded by the United States Agency for International Development and is administered by San Diego State University Foundation.

Participants are from the Kingdom of Morocco, the State of Israel and the United States of America. The project constitutes a new stage in regional cooperation by introducing the Kingdom of Morocco as a new cooperating participant. It is hoped that world peace will be promoted through such regional cooperation in agricultural development activities.

In Morocco, the project goal is to increase the ability of the agricultural sector to meet local demand. It is expected that export capabilities for both Morocco and Israel will be strengthened through project activities.

Specific project activities in Morocco include building three nurseries. A speedling nursery will specialize in the production of tomatoes, peppers, cucumbers and melons. A pot-plant nursery will generate rooted seedlings and finished pot-plants. A hardening nursery will include a tissue-culture laboratory in addition to the nursery.

Representatives from Israel, the United States and Morocco sign the agreement to cooperate in agricultural research and development projects. Professor Samuel Pohoryles (left) signs the agreement as Frea Sladek and Driss Lahlou (right), look on. This agreement represents a historic first step in cooperative activities among scientists and private sector representatives from Morocco and Israel and their colleagues in the United States.

Open-field production activities will test additional varieties of vegetables for their adaptability to local growing conditions.

Training and extension of farmers and farm technicians will be done on the project site in order to disseminate information on the new technologies being developed and introduced. Selected extension workers will receive training for three to four months in Israel.

In Israel research activities are under the direction of Dr. Dov Pasternak. Participating institutions include the Ben Gurion University of the Negev, the Volcani Institute and Hebrew University.

Israeli scientists at these institutions are working on developing new and improved varieties of tomatoes, onions and ornamental eucalyptus. Research on the commercial production of truffles, an edible mushroom popular in the Middle East and Europe, is in progress.

New varieties developed will be field tested at the Moroccan project site in Azemour.

The Moroccan Cooperative Agricultural Development Project
Funded by the Agency for International Development/Bureau for the Near East
Administered by San Diego State University Foundation, SD, California 92182

PROJECT UPDATE

Azemour, Morocco
A Moroccan private businessman and agriculturist, Mr. Driss Lahlou, provided the project with farm land in Morocco where project activities will take place. This farm is located in Azemour, approximately 45 miles south of Casablanca. An Israeli Technical Advisor, Mr. Itzhak Ayalon, is the resident manager in Azemour.

Viewing the Project site in Azemour, Morocco, Mr. Driss Lahlou, Moroccan Project Coordinator (left), and Mr. Itzhak Ayalon, Israeli Technical Advisor

What is Happening in Azemour?
In December 1992, an irrigation system was installed at the farm for the greenhouses and open field production. It will be fully automated in the near future. Also, materials to be used in the construction of the three nurseries were ordered in December. The shipment of goods from Israel arrived in mid-March. A weather station also will be purchased for the farm.

In January 1993, four varieties of **melons** were planted in two greenhouses (Galia, Arava, Galia C-8 and Inbar). Plants had reached the height of 70 cm by February 18. Additional melons were planted under low tunnels during the first week of February.

Onions were planted during February in open fields as experimental plots for varietal testing.

In March, land was prepared for planting **green beans.** Production is expected for late spring.

Demonstrations on melon, onion and green bean production techniques were presented to local farmers in March 1993. As the project grows, additional demonstrations will be scheduled.

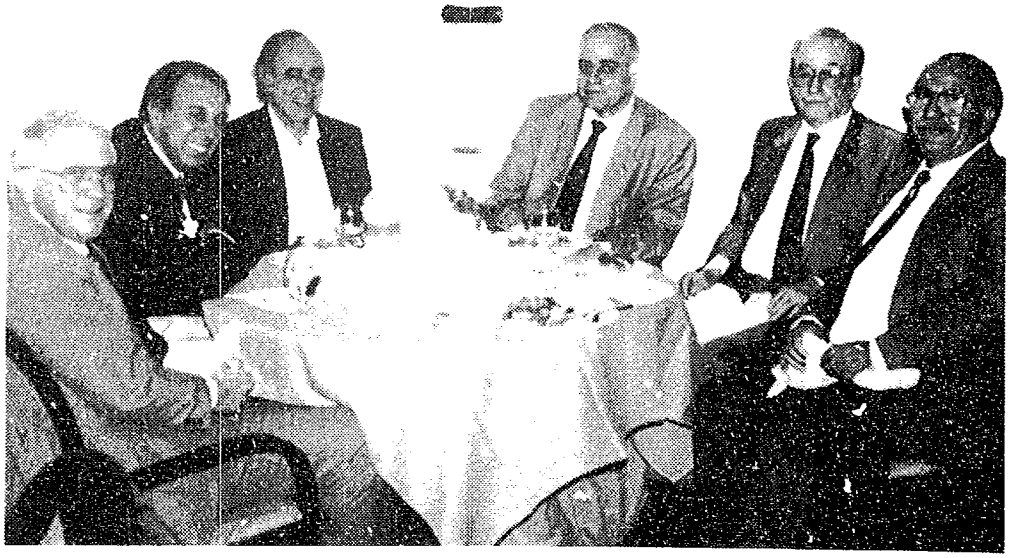
MARKETING STUDY

An economic and marketing study of the Moroccan agri-business sector is being conducted under the direction of Dr. Samuel Pohoryles.

Dr. Pohoryles has completed the preliminary draft of the study. Local market dynamics as well as regional market dynamics have been evaluated. The impact of project activities in the region is examined.

AGRICULTURE MINISTER MEETS PROJECT TEAM

Support for the activities of the Moroccan Cooperative Agricultural Development Project was given by Mr. Yaakov Tsur, Israeli Minister of Agriculture, during a luncheon meeting with the Moroccan Cooperative Agricultural Development Project Steering Committee members in Jerusalem on January 17, 1993. Mr. Tsur strongly encouraged regional cooperation programs.



Meeting with the Israeli Minister of Agriculture. Left to Right: Mr. Harry Albers, U.S. Steering Committee member and Executive Director, San Diego State University Foundation; Mr. Hassan Alami, Moroccan Steering Committee member; Mr. Driss Lahlou, Moroccan Project Coordinator; Mr. Yaakov Tsur, Israeli Minister of Agriculture; Professor Samuel Pohoryles, Israeli Project Coordinator; and Mr. Itzhak Peretz, Israeli Assistant Project Coordinator.

NEW TECHNICAL PANEL EXPERT ON-BOARD

Dr. Leon Garoyan is the newest panel member of the Technical Committee for the Moroccan Cooperative Agricultural Development Project. He has extensive experience in private sector fruit and vegetable marketing, and has additional experience in the international market place and in agri-business promotion.

Dr. Garoyan is the former Director of the Center for Cooperatives, University of California, Davis and the President of Management Research Associates. He has consulted internationally for over thirty years in the fields of marketing, industrial organization and cooperatives.

We look forward to Dr. Garoyan's participation in the project.

AMBASSADOR VREELAND SUPPORTS PROJECT GOALS

Rabat, Morocco

The U.S. Ambassador to Morocco, Mr. Charles Vreeland, met with Technical Committee members in November 1992 to discuss project accomplishments to date. Ambassador Vreeland was enthusiastic about the project and supported all efforts in this regional cooperation program.

TECHNICAL PANEL MEETS WITH USAID OFFICIALS IN RABAT

Members of the Technical Committee met with USAID officials in Rabat last November to discuss project start-up activities. Mr. Charles Uphaus, Agriculture Officer and Dr. James Lowenthal, Deputy Mission Director, provided support and encouragement to Project members.

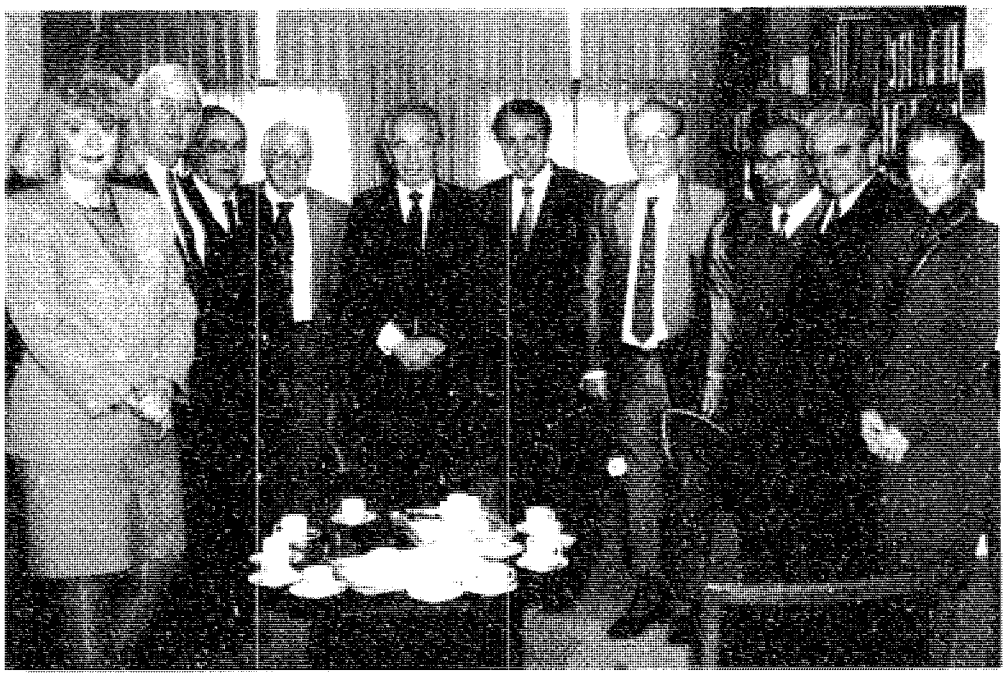
STEERING COMMITTEE MEETS IN ISRAEL

The Project Steering Committee members met in Jerusalem, Israel on January 17, 1993, to review the progress of the project and to discuss plans for the next year.

Prior to the meeting, site visits were made to several nurseries and experiment stations in Israel. Members viewed rootings of tissue culture bananas and foliage ornamentals at the Shorashim and Rosh Hanikra Nurseries. Similar technology will be developed in Morocco at the Azemour farm.

Open-field banana production was seen in the Carmel Coastal Area. Members enjoyed visits to the Ramat Negev Experimental Station and the Institute for Applied Research at Ben Gurion University.

While in Israel Steering Committee members met with the **Honorable Shimon Peres,** Minister of Foreign Affairs, in his office in Jerusalem on January 17, 1993, to discuss regional cooperation programs. Mr. Peres expressed appreciation for San Diego State University Foundation's role in promoting peace through international cooperative programs like the Morocco project. Mr. Peres said that he viewed these activities as a first step towards long-term cooperation and peace in the region.



Steering Committee members meet with the Honorable Shimon Peres, Minister of Foreign Affairs, January 17, 1993, Jerusalem, Israel. Left to Right: Ms. Frea Sladek, Associate General Manager for Sponsored Research & Educational Programs, San Diego State University Foundation; Dr. Albert Johnson, Emeritus Vice President, San Diego State University Foundation; Mr. Driss Lahlou, Moroccan Project Coordinator; Mr. Harry Albers, Executive Director, San Diego State University Foundation; The Honorable Shimon Peres; Mr. Hassan Alami, Moroccan Steering Committee member; Professor Samuel Pohoryles, Israeli Project Coordinator; Mr. Itzhak Peretz, Israeli Assistant Project Coordinator; Dr. Dov Pasternak, Israeli Steering Committee member and Chairman, Technical Committee; Dr. Bonnie Stewart, U.S. Project Director.

TECHNICAL PANEL MEETS IN MOROCCO

November 1992

The first meeting of the Technical Committee was held in Casablanca last November 7. Work plans for the next eighteen month period, and an implementation schedule, were prepared.

Before the meeting, panel members traveled to Agadir to meet with the Director and staff of the Agricultural Regional Development Office of the Souss Massa area in Agadir and the Hassan II Institute of Agronomy and Veterinary Medicine.

Technical committee members also visited the project site at Azemour. Visits to covered farming operations in the Azemour region were made.

The next Technical Committee meeting is scheduled for May 2-7, 1993. The meeting will be held in Israel.

Technical Committee members traveling to Azemour in November 1992. Left to Right: Mr. Eliezer Spigel, Israeli Extension Specialist; Dr. Irit Rylski, Israeli Research Scientist for Vegetables; Mr. Uri Drori, (kneeling) Israeli Project Engineer, Dr. Bonnie Stewart, U.S. Project Director; Mr. Allal Chibane, Moroccan Plant Production Specialist; Dr. Dov Pasternak, Chairman of the Technical Committee and Head, Institute for Agricultural Applied Biology, Ben Gurion University; Dr. Hammoutou El-Mekki, Moroccan Plant Production Specialist; Dr. Josef ElKanna, Israeli Extension Services Specialist; Mr. W. Timothy Hushen, Director of Program Management, San Diego State University Foundation; and Ms. Frea Sladek, Associate General Manager for Sponsored Research & Educational Programs, San Diego State University Foundation

This is a U.S. Agency for International Development Project. Comments or questions may be forwarded to:

Dr. Bonnie Stewart
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Phone (619) 594-5644
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MOROCCO REPORT

NEWSLETTER *FALL 1993*

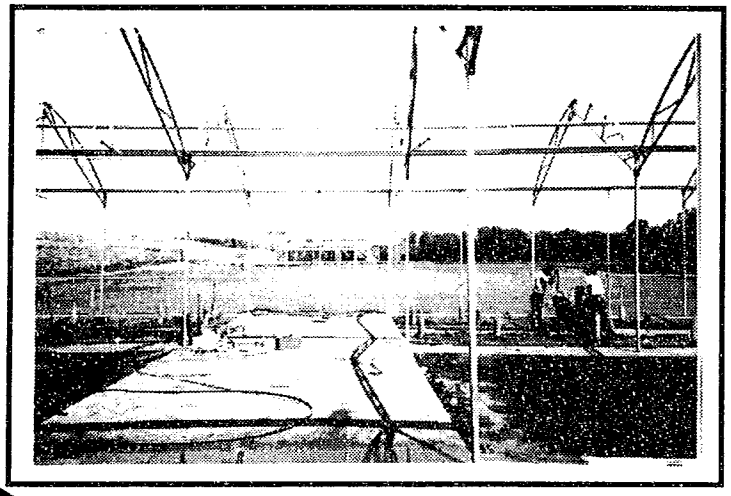
IMPRESSIVE START FOR THE MOROCCO PROJECT

Nurseries are Constructed

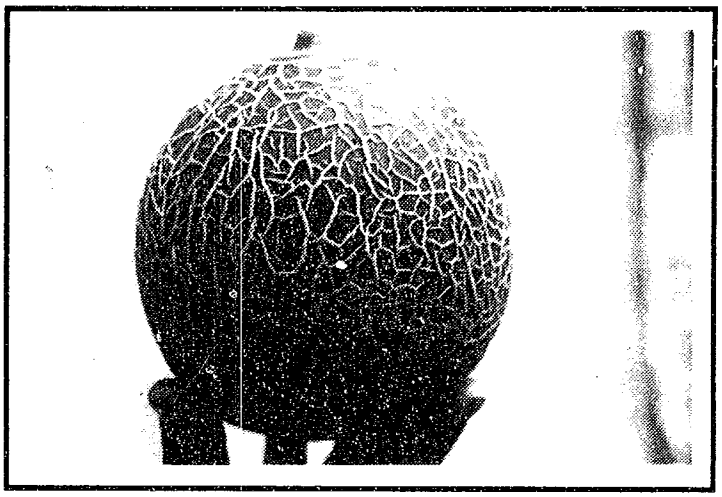
Accomplishments of the Moroccan Cooperative Agricultural Development Project have been impressive.

Three nurseries were constructed in the first year of the project. At the project site in Azemour, Morocco, a large shipment of building materials arrived from Israel in mid-March 1993. Construction of the nurseries began shortly after. By August the nurseries were completed.

The three nurseries include a "speedling" nursery that will specialize in the production of tomato, pepper, cucumber and melon seedlings; a potted-plant nursery that will generate rooted seedlings and finished pot-plants; and a hardening nursery for the production of tissue culture seedlings. The hardening nursery will be expanded to include a tissue culture laboratory.



Construction of the nurseries at the project site in Azemour, June 1993.



Export Quality melons were observed by local farmers.

The "speedling" nursery started to operate in August. It is expected that the other two nurseries will be operational by the end of 1993.

DEMONSTRATIONS FOR LOCAL FARMERS

Local farmers were invited to the project site in Azemour, Morocco last March. They learned about production techniques for melons, onions and green beans.

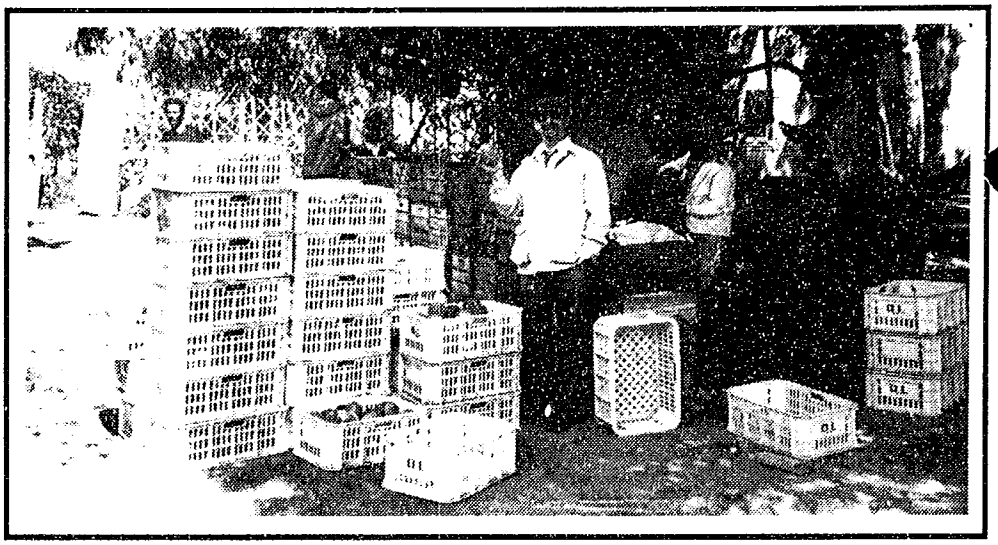
The Moroccan Cooperative Development Project is funded by the Agency for International Development Bureau for Near East Regional Cooperation Programs. The project is being accomplished by participants from the Kingdom of Morocco, the State of Israel and the United States of America.

The goal of the Morocco Project is to increase the ability of Morocco's agricultural sector to meet internal demands for agribusiness products. Export capabilities for both Morocco and Israel will be strengthened through project activities. The project constitutes a new stage in the Middle East Regional Cooperation Programs, introducing a new partner with Israel and the United States.

The Moroccan Cooperative Agricultural Development Project
Funded by the Agency for International Development/Bureau for the Near East
Administered by San Diego State University Foundation, SD, California 92182

A larger demonstration took place at the farm on April 15, 1993. **Two hundred farmers attended** this event. A demonstration of irrigation techniques took place. Explanations of the plant protection methods used at the farm interested farmers greatly. Discussions of the varietal experiments of melons and onions was lively.

Farmers have been eager to learn about the project activities. They expressed interest in attending future demonstrations at the farm. At this time, more demonstrations are being scheduled.



At the project site in Azemour, Morocco, Mr. Charles Uphaus, Agriculture Officer, United States Agency for International Development in Rabat, looks at melons being sorted for local and for export sales.

EXPORT QUALITY VEGETABLES ARE HARVESTED

Open-field and green house production activities at the project site resulted in local and export sales of fresh vegetables.

Notably, green house and open-field produced melons were sold in the local wholesale and retail markets. Quantities of melons also were exported to markets in Europe. The harvesting and marketing of the melons began in April. Other successful green house crops grown included green peppers and okra.

Green beans, onions and tomatoes were planted and tested in open-fields. Smaller quantities of these products were sold in local markets.

Open-field and green house production activities involve the testing of newly developed varieties of vegetables for their adaptability to local growing conditions. Potential local and export market demand for the new varieties is being assessed.

Israeli scien[illegible] who are working on selected research projects for the Morocco program. Left to Right - Front Row: Dr. David Mills, Ben Gurion University; Dr. Dov Pasternak, Head, Institute for Applied Research, Ben Gurion University. Left to Right - Back Row: Mrs. Ada Harazi, Hebrew University; Dr. Chaim Rabinovic, Volcani Institute; Dr. Eitan Pressman, Volcani Institute; Mr. Yossi Ben-Dov, Ben Gurion University; Dr. Nurit Bejarano, Ben Gurion University; Dr. Irit Rylski, retired, Volcani Institute; Dr. [illegible]e Barr, Volcani Institute.

WORK PLANS PREPARED

The Technical Committee held a planning meeting at the Lagoona Hotel on May 6, in Eilat, Israel. Work plans and implementation schedules for the next eighteen months were prepared.

STEERING COMMITTEE WILL MEET IN OCTOBER

The next meeting of the Steering Committee will take place in Casablanca, Morocco next October 26 and 27, 1993. Members will visit the project site in Azemour before the scheduled meeting.

TECHNICAL PANEL MEETS IN ISRAEL

In May 1993 technical panel members from Morocco and the United States traveled to Israel for site visits and a planning meeting. Israeli members of the Technical Committee joined the group in Tel Aviv at the **Agritech Exposition.** Agricultural technology from Israel and around the world was displayed at the exposition.

Participants attended lectures at Agritech give by Dr. Dov Pasternak, Chairman of the Technical Committee, and Dr. Irit Rylski, Israeli Technical Committee member.

Site visits were made to protected agricultural operations in the Carmel Coastal area. Tomato and pepper production was seen at Moshav Geva Carmel and Moshav Habonim. Banana production at Kibbutz Maagan Michael was viewed by the visitors. Protected agriculture operations in the Negev were visited including the Ramat Negev Experimental Station and Ha Besor Station.

Panel members visited **Ben Gurion University of the Negev** and the Institutes for Applied Research in Beer-Sheva. Professor Lehaim Naggan, Vice-President and Dean of Research and Development, hosted a dinner for the group.

While at Ben Gurion University, Israeli scientists who are working on research projects for the Morocco program, gave presentations to the Technical Panel. Research activities included the development of new and improved varieties of salad tomatoes, onions and ornamental eucalyptus. Research on the commercial production of truffles also is in progress. Field testing is being done in Morocco.

Technical Committee members meet in Eilat, Israel in May 1993. Left to Right, front row: Dr. Ben Ami Bravdo, Israeli Technical Committee member; Mrs. Ruth Bravdo; Dr. Irit Rylski, Israeli Technical Committee member; Mr. Driss Lahlou, Morocco Project Coordinator; Mr. Elizer Spigel, Israeli Technical Committee member; Mr. Uri Drori, Israeli Project Engineer; Mrs. Josef El Kanna; Dr. Bonnie Stewart, U.S. Project Director. Left to Right, back row: Dr. Dov Pasternak, Chairman of the Technical Committee and Head, Institute for Agriculture and Applied Biology, Ben Gurion University; Mr. Allal Chibane, Moroccan Technical Committee member; Mr. Hammoutou El-Mekki, Moroccan Technical Committee member; Dr. Richard Jones, U.S. Technical Committee member; Mr. Itzhak Ayalon, Israeli Technical Advisor; Mr. Josef Ishy; Mr. Jawad Berrada; Dr. Josef El Kanna, Israeli Technical Committee member; and Dr. Mohamed Nadir, Moroccan Technical Committee member.

NEW TECHNICAL EXPERT JOINS TEAM

Professor Ben Ami Bravdo from the Faculty of Agriculture of Hebrew University will participate on the project's Technical Committee. He is a highly regarded specialist in fruit trees, irrigation and fertigation. He will offer his expert advise on banana production as well as provide guidance in the introduction of advanced technology in the tissue culture propagation of bananas. Professor Bravdo participated in the recent Technical committee meeting held in Eilat, Israel.

MINISTER OF AGRICULTURE HONORS MOROCCO PROJECT DELEGATION

May 5, 1993

His Excellency, Mr. Yakov Tsur, Israeli Minister of Agriculture, hosted 150 foreign delegates at his Kibbutz, Netiv Halamed Hay. Included were three delegations from Egypt and one from Morocco.

Special recognition was given to the Moroccan, Israeli and American representatives from the Moroccan Regional Cooperation Project. His Excellency was enthusiastic in his support of Morocco as a new regional cooperation partner. He expressed a desire for greater cooperation with Morocco as well as with new countries in the region.

Photo from an Israeli newspaper of His Excellency, Mr. Yakov Tsur, Israeli Minister of Agriculture, welcoming Moroccan, U.S. and Israeli delegates to his Kibbutz Netiv Halamed Hay, May 5, 1993. Left to Right: Dr. Mohamed Nadir, Moroccan Technical Committee member; Dr. Bonnie Stewart, U.S. Project Director; Minister Tsur; Mr. Itzhak Ayalon, Israeli Techncial Advisor.

During the visit, television, radio and newspaper reporters interviewed Mr. Itzhak Ayalon, Israeli Technical Advisor, currently residing in Morocco; Dr. Mohamed Nadir, Moroccan Technical Committee member; and Dr. Bonnie Stewart, U.S. Project Director. The interviews were broadcast on Israeli national television the same day. Newspapers also gave full coverage of the event.

This is a U.S. Agency for International Development Project.
Comments or questions may be forwarded to:

Dr. Bonnie Stewart
U.S. Project Director c/o SDSU Foundation San Diego, California
Phone (619) 594-5644
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PROBLEMS

PROBLEMS AND ACTIONS TAKEN TO ADDRESS THEM

Communication

Regional Cooperation Programs involve individuals from three distinct cultures. Sensitivities, social organizations, and even national priorities may differ among them. Within this setting, management and coordination often require finesse and imagination to attain program goals. Participants have been sensitive to this multicultural diversity.

Efforts taken to facilitate mutual cooperation and understanding have been, continual phone and fax communications among partners. Continued contact enables all participants to maintain on-going understanding and to clarify any unresolved questions.

Visas

Another problem encountered has been securing visas for the Israelis needing to travel to Morocco. Because there are no formal diplomatic relations between the Kingdom of Morocco and the State of Israel, obtaining visas has been a time consuming and expensive activity. We discussed this issu· with our Moroccan partners and they are working on a method to alleviate this problem.

Currently, Moroccan consultant's embassies in Paris and Spain have lists of Israeli project participants and have assisted in expediting their travel authorization.

Equipment Purchases

The problem of ordering equipment to be shipped to Morocco from Israel and the potential Moroccan tax liability on equipment purchased. The resolution was San Diego State University Foundation requested approval from USAID for a budget modification to transfer funds from the Moroccan Sub Grant to the Morocco San Diego account so that SDSUF could purchase items directly and thus reduce the potential tax liability in Morocco and to expedite the process of ordering equipment. Subsequently, SDSUF requested of USAID an amendment to the grant to enable the Foundation to pay for equipment or services from the Sub Grant monies upon written request of the Sub Grantees. The limit for equipment is $100,000 and up, $50,000 for services. This request was approved.

ACCOMPLISHMENTS IN REGIONAL COOPERATION

There has been impressive cooperation among the participating countries as reported. The Technical Committee met in Morocco in November 1992, and then again in Israel in May 1993. The Steering Committee met in Israel in January 1993, with additional plans to meet in Morocco in October 1993. Additional visits were made by Dr. Pasternak to the project site in Morocco to review project activities. Mr. Uri Drori visited Morocco to supervise construction of the nurseries.

Every effort has been made to interface with USAID staff in Washington, D.C., Morocco and Israel by project members.

RESULTS OF VARIETAL TESTS
OPEN FIELD PRODUCTION

Melons

The open field production started this year by planting Melons. The idea was to observe a potential cultivar and resist to Fusarium diseases. The planting was on January 25, 1993 under low tunnels. No treatment to the was made. The preparation process was as follows:

- 500 kg. Super phosphate 48%;
- Ammonium Sulfate 21% and Potassium Sulfate was applied per hectare;
- 0.5 hectare were planted with 2.5 plant per m2.

Results

The cultivar appears to be resistant; no Fusarium wilt was monitored and the fruit productivity was normal. The only problem observed was low netting on the melon. Thus the melon was not of export quality.

Onion

Onion grows in Morocco mainly in the winter/spring season. Sowing/planting date begins in mid January through the end of February. There is a wide range of varieties being planted in Morocco: white, yellow, violet, mild, sweet and hot pungent.

The agrotechnque being used are traditional methods because most of the growers are fairly small and they can not afford to buy expensive machinery. Harvesting season starts at the end of June through mid August.

Pest control is being done by the most common methods. Fertigation method is the traditional and conventional approach, such as flood irrigation and sprinklers.

Method and materials
The experiment was carried out on a sandy soil in the Azemour region. No soil treatment was done. The preparation process was the common process and the fertilizers that were applied before planting were as follows:

- 500 kg. Super phosphate;
- 500 kg. Potassium sulfate;
- 500 kg. Ammonium sulfate per hectare.

Planting
The planting date was February 27, 1993 and was a direct sowing.

Wilting and Collapse
Wilt and collapse started gradually on June 16, 1993.

Harvest
July 25, 1993

Eleven Cultivars were planted in four replications, each at random arrangement. Each replication was 20m x 1m, sowing by hand about 2cm between the plants and 20cm between raw in the planting bed.

Cultivar	Avg kg. m2	Color	Shape	Taste	Size
Rouge	9	Violet	Grenex	Very Pungent	Big
H-822	7	Lt. Violet	Globe	Slight Pungent	Big
R-990	12	Lt. Yellow	Globe	Pungent Sweet	Big
H-216	18	Violet	Grenex	Slight Pungent	Med/Sm
THR	4	White	Grenex	Very Pungent	Med/Big
H-404	8	Brown	Globe	Pungent	Med
H-826	8	Lt. Brown	Flat Globe	Slight Pungent	Big
H-688	11	Yellow	Flat Globe	Sweet	Med
H-974	7	Lt. Brown	Globe	Pungent	Med
Balbosa	10	Lt. Brown	Rounded	Slight Pungent	Med/Big
La-Reine	6	Lt. Brown	Top	Very Pungent	Med

Conclusion
In this trail, one cultivar was above average, H-216. The production per m2 was 18 kg. which is very high. Another three cultivar were good in production: R-990, Babosa and H-688. The rest of the cultivars showed good potential. It is very important to check the effects of salinity on the fruit size, taste and production. The average salinity was 3.5 E.C. More experiments and tests will be conducted in the coming year.

Green Beans

Green Beans were planted on March 5, 1993 The cultivar was very thin and fine named Bell. The preparation included only fertilizer application. No soil treatment or organic manure was applied. An area of 4000 m2 was sowed in direct double rows. The irrigation was drip irrigation, one lateral per double row line. The results were as follows:

- Production: 5,900 kg.
- Harvest Period: May 9, 1993 - June 13, 1993. Total of 34 days.
- Average Market Price: 2.74DH/kg.

A saline water 4.2 E.C. was the main cause for the short harvest season.

RESULTS ON VARIETAL TESTS
GREEN HOUSE PRODUCTION

Melons

On January 7, 1993, four cultivars of melons sere sowed: Arava, Revigal, Galia and Inbar. The planting was in the Canary greenhouse type, 1.4 hectares, density was 20,000 plants per hectare. Each cultivar was planted in double row beds, covered with plastic mulch covered under low tunnels inside the greenhouse for the first four weeks after planting. This was done to protect the plant from the low night temperatures.

- Preparation with fertilizers was as follows:
- 500 kg. Supter triple 48%;
- Ammonium sulfate 21%
- Potassium sulfate in the soil before planting.

Irrigation was planned for each stage according to the plants needs. The stages were planted through the first male blossom, the second stage was the female blossom, the third stage was the fruit set and the last stage was the fruit growth and harvest.

Labor was used according to the crop development. Following is the weekly labor tables accumulating the number of workers for all the melons which was 1.4 hectare.

Month	Week 1	Week 2	Week 3	Week 4	Week 5	Total
January	135	18	21	24.5		198.5
February	4	42	23	91		160
March	103.5	150.25	86	124	35	498.75
April	48	79.5	118.75	113	84.5	423.75
May	26	89	114	35		264
TOTAL						1545

Following is the harvest table showing quantities of melons that were exported and those which sold in the local market. From this table it is clear that the most productive cultivar was GALIA, about 7.67 kg./m2 and the lowest was INBAR, 3.88 kg./m2. Also, it is clear that Arava with 56% export quality and Revigal with 55% export quality are to be considered as candidates for export growers. Galia with 46.7% export quality is not too far from the first two cultivars and there is a relative advantage, based on these results to galia because the productivity means that Galia is a strong competitor with the first two. Revigal C-8 has the highest % exportable quality per m2 production which is 3.78 kg./m2, Arava with 3.58 kg./m2 and Galia with 3.58 kg./m2 suitable for export.

Prices for the local market started at 6.00DH/kg. and then went down to .80DH/kg in May. The export prices are about 5.5DH/kg.

Cultivar	Local	Export	Total	% Export	% Local	Avg. kg./m2
Arava	6,797	8,656	15,454	56%	44%	6.29
Galia	10,017	8,806	18,824	46.7%	53.3%	7.67
Revigal	7,596	9,346	16,942	55%	45%	6.90
Inbar	7,137	2 386	9,524	25%	75%	3.88

ATTACHMENT B

MOROCCAN COOPERATIVE AGRICULTURAL DEVELOPMENT PROJECT

PROPOSAL

High quality tomato for cultivation in the open field in Morocco

by

Moshe Bar, Etan Pressman and Nehama Gilboa
Department of Plant Genetics
Agricultural Research Organization, The Volcani Center,
Bet Dagan 50 250, Israel

1. Title: High quality tomato for cultivation in the open field in Morocco.

2. Research Objectives

This project is aimed to develop determinate type F_1 hybrids and agrotechniques to improved production and quality of fresh market tomatoes in Morocco.

The project is expected to result in higher yield, improved flavour of the fruit and pest resistance.

3. Background

The cultivated tomato is one of several important food crops to have benefited from remarkable improvements during the past 5 decades. Average fresh market tomato yields in Israel are 80 tons/ha and in Morocco 30 tons/ha. (2). Developments in crop culture and management coupled with improved varieties have undoubtedly been the major factors contributing to the dramatic and sustained improvements which have occurred during the past half century.

The principal aims for determinate type cultivars for open field production are yield concentration, proper fruit set and growth, good cover to overcome radiation damage, fruit quality according to market requirements, disease resistance, long shelf life and taste (1).

Thanks to our past breeding efforts, cultivated and wild Lycopersicon breeding material is available in our department to custom breed open field F_1 hybrid cultivars suitable for cultivation under a variety of environmental conditions.

The suitable period for transplanting tomato seedlings, in particularly into the open field, depends very much on the weather. Cold, rainy spring will cause a delay in transplanting date and thereby a delay in picking and marketing. In order to obtain early yield inspite of the delay in transplanting, it is suggested to use older transplants bearing one or two trusses.

Maintaining a high density population of seedlings in the nursery for a long duration will lead to shading one ethiolation which may reduce the value of the seedlings. Therefore the elongation of the seedlings

should be very carefully controlled.

The control of elongation of the seedlings can be achieved either by the use of growth retardants or by mechanical treatments.

4. Specific goals

The goals in this projects are: (a) tomato varieties (F_1 determinate hybrids varieties) adapted to open field cultivation with high concentrated yield, higher soluble solids content, higher sugar/acid ratio and pest resistance. (b) Developing techniques for controlling the development of transplants bearing one or two trusses in the nursery and examining their growth and yields after transplanting into the field.

5. PLAN OF WORK (first year)

a. Various genetic material including commercial cultivars from different sources and experimental F_1 hybrids from our breeding work will be tested in the main production areas of Morocco.

b. Plants of the F_1 hybrids will be treated with growth retardants or mechanical treatment in the nursery. Their development prior to or following transplanting will be studied.

6. REFERENCES

1. Atherton, S.G., and Rudich, J. (1986) The tomato crop . Chapman and Hall, New York.

2. Chouker-Allah, R. (1989) Economic and agronomic situation of processing tomatoes in the Maghreb countries (Morocco, Algeria, Tunisia). 3rd ISHS international Symposium on the processing tomato, Avignon, France.

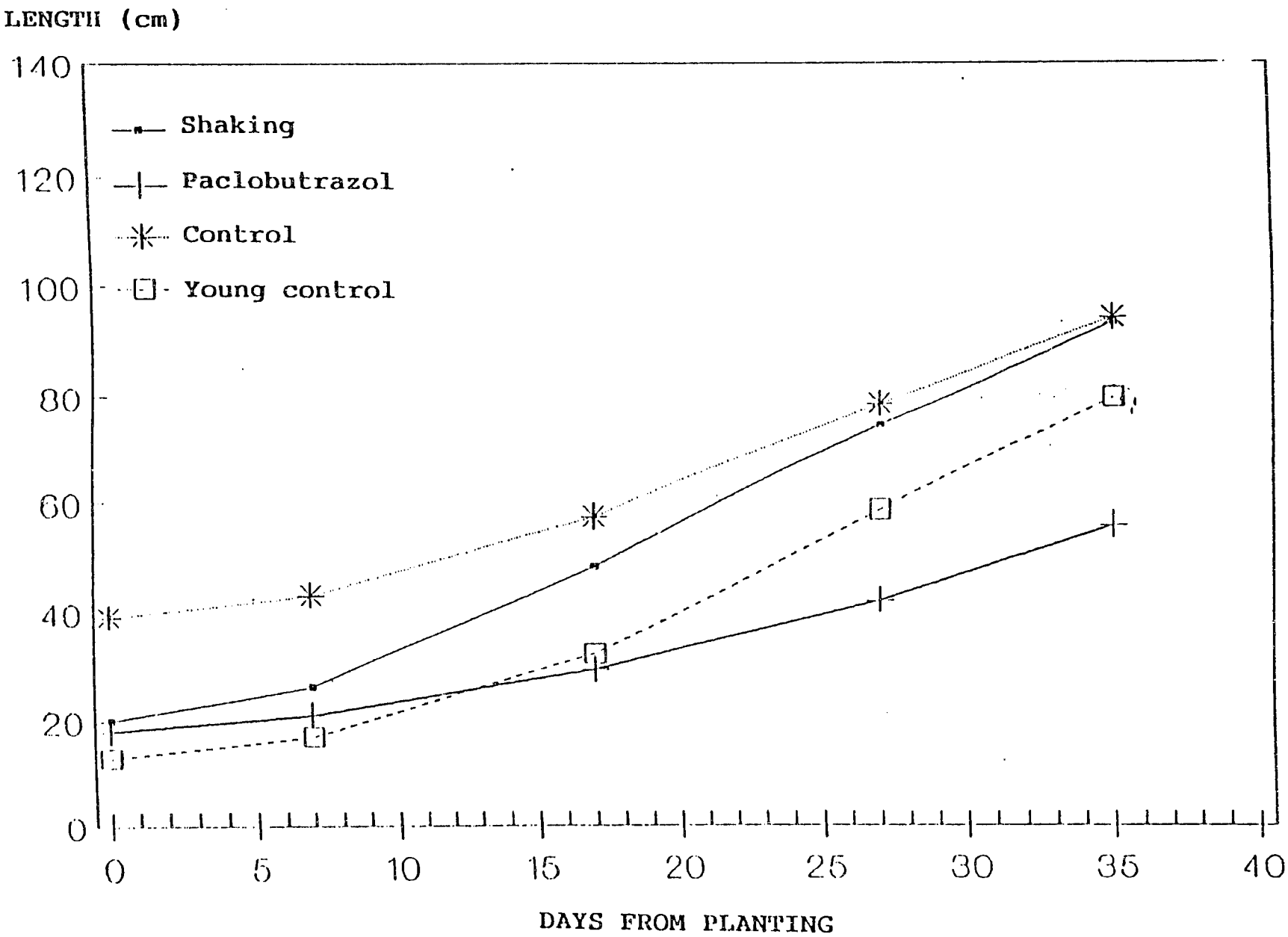

Fig. 1: The effect of different treatments, to transplants grown in 10 cm pots, on the rate of stem elongation.

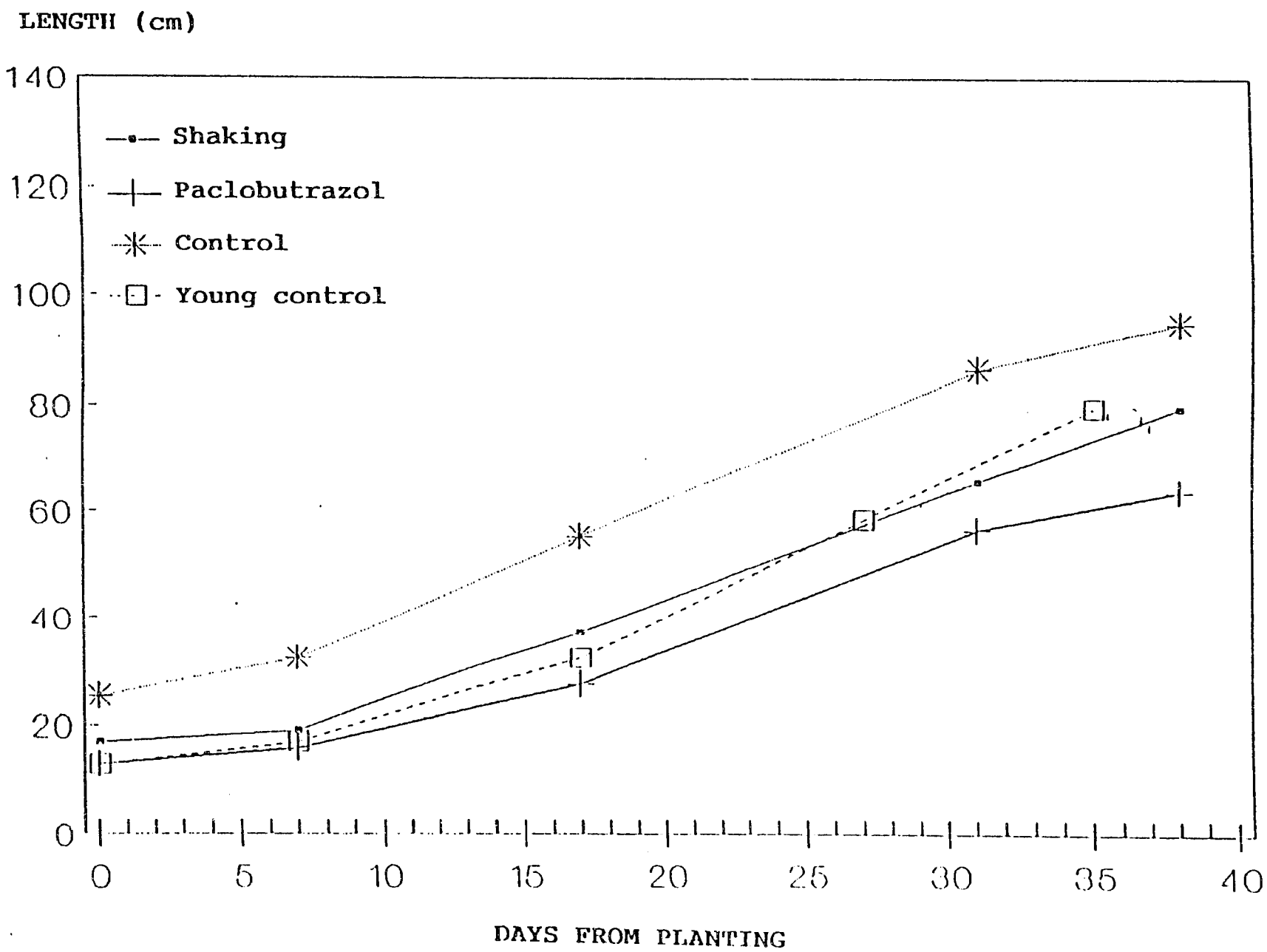

Fig. 2: The effect of different treatments, to transplants grown in 5 cm trays, on the rate of stem elongation.

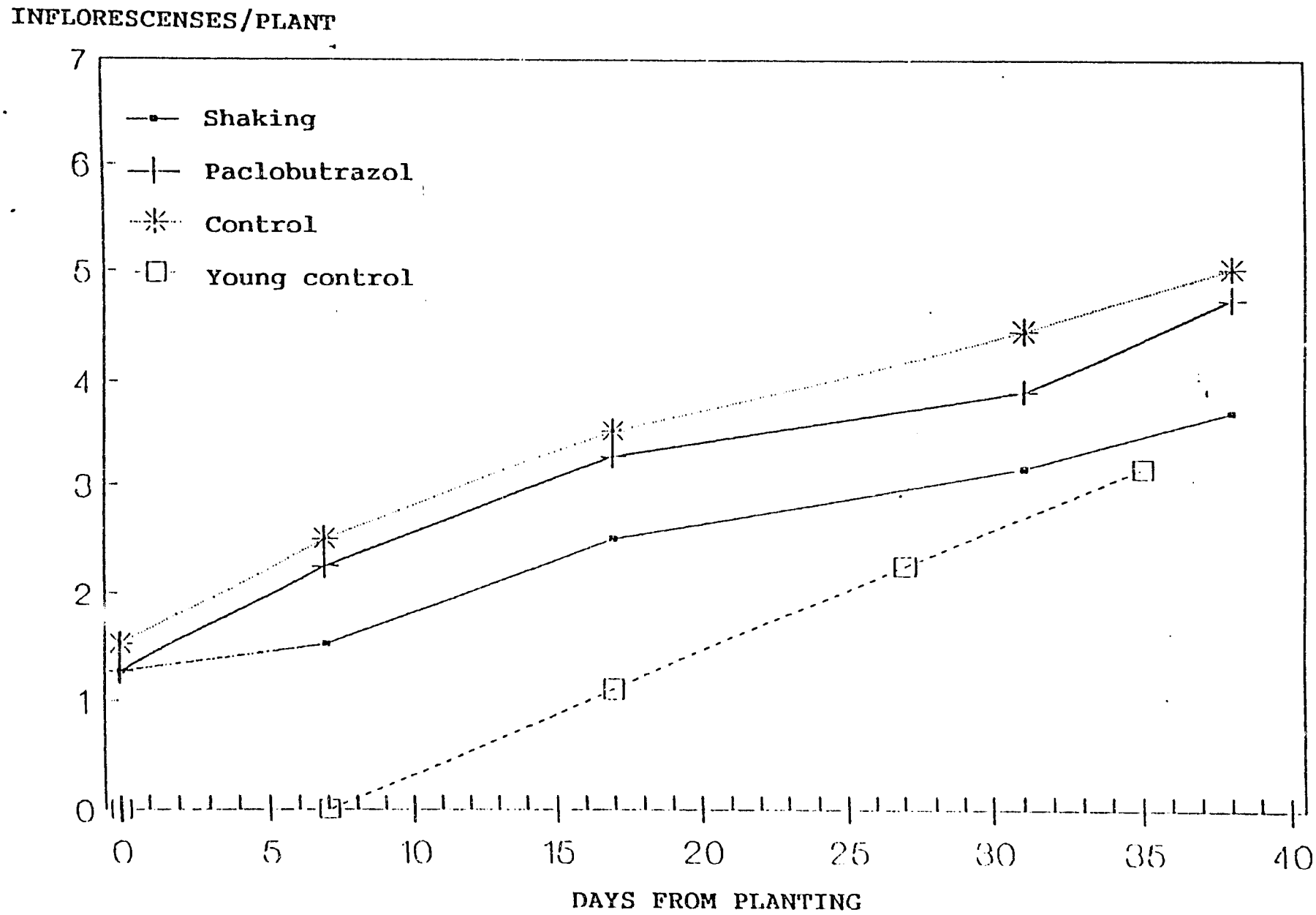

Fig. 3: The effect of different treatments to transplants on the rate of inflorescenses development.

PROPOSAL

High quality tomato for cultivation in the open field in Israel and Morocco

by

Moshe Bar and Nehama Gilboa
Department of Plant Genetics
Agricultural Research Organization, The Volcani Center,
Bet Dagan 50 250, Israel

1. Title: High quality tomato for cultivation in the open field in Israel and Morocco.

2. Research Objectives

This project is aimed to develop determinate type F_1 hybrids to improved production and quality of fresh market tomatoes in Israel and Morocco.

The project is expected to result in higher yield, improved firmness and quality of the fruit (color, flavour) and improved pest resistance.

3. Background

The cultivated tomato is one of several important food crops to have benefited from remarkable improvements during the past 5 decades. Average fresh market tomato yields in Israel are 80 tons/ha and in Morocco 30 tons/ha. (2). Developments in crop culture and management coupled with improved varieties have undoubtedly been the major factors contributing to the dramatic and sustained improvements which have occurred during the past half century.

The principal aims for determinate type cultivars for open field production are yield concentration, proper fruit set and growth, good cover to overcome radiation damage, fruit quality according to market requirements, disease resistance, long shelf and taste life (1).

Thanks to our past breeding efforts, cultivated and wild *Lycopersicon* breeding material is available in our department to custom breed open field F_1 hybrid cultivars suitable for cultivation under a variety of environmental conditions.

4. Specific breeding goals

The goals in this projects are tomato varieties (F_1 determinate hybrids varieties) adapted to open field cultivation with high concentrated yield and suitable fruit quality, based on the following characteristics:

a. F_1 hybrids

The production of F_1 hybrids is benefited by the gain of heterotic advantages and greater ease of combining desired characteristics and use of male sterility to reduce hybrid seed costs (4).

b. Plant architecture

Plant architecture has a significant role in the development of early, highly determinate cultivars with concentrated fruit set and growth and good cover to overcome radiation damage. A proper plant habit for open field growth will be achieved by introgression of genes for plant architecture including recessive genes like brachytic (br) and dwarf (d) to our present parent lines.

c. Pest resistance

Introgression of genetic resistance in our present parental lines to important pathogens such as race 2 of Fusarium wilt, bacterial speck, Fusarium crown and root rot and root knot nematodes which are found in Morocco and Israel (7).

d. Fruit firmness and shelf life

The non ripening mutants rin and nor are available in our department. These genes inhibits tomato fruits ripening, climateric rise respiratory and ethylene production (6).

The F_1 hybrids formed by crossing a normal line with a non ripening line produce fruit that ripen slowly, lose firmness at lower rate, have an extented shelf-life and therefore improve tomato quality.

e. Fruit quality

Tomato fruit quality hinges on a number of important components: soluble solids, acidity and flavor compounds. The role of the sugar/acid ratio and soluble solids content is a major determinant of fruit quality for both processing and fresh market tomatoes (5). However, standard tomato cultivars generally yield in the range of 5-7% solids. We found that there is a promise in utilizing high yielding small fruited line of the cherry-cocktail size to increase high solids yield per unit area in F_1 hybrids (3), and we

introgressed this trait to our parental lines to increase fruit quality.

5. PLAN OF WORK (first year)

a. Various genetic material including commercial cultivars from different sources and experimental F_1 hybrids from our breeding work will be tested in the main production areas of Morocco and Israel.

b. Introgression of desirable traits improved TSS, male sterility, plant habit and pest resistance, into parental lines to obtain seeds of the Bc_1F_1 generation.

c. Selection for desirable traits will be performed in the Bc_1F_2 generation.

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Cultivar	Total yield tonnes/donam	Marketalbe yield tonnes/donam	Marketalbe yield (%)	Green fruit (%)	Overmature (%)	Average fruit wieght (gr.)
UC-82	10.1	9.1	90	2.3	7.3	50
59	12.0	10.8	90	4.1	5.7	57
62	13.7	12.3	90	3.1	6.6	54
64	11.5	10.0	87	1.9	11.1	77
67	11.1	10.4	94	2.2	4.0	63
71	12.2	10.4	85	8.9	5.9	60
72	11.6	10.1	87	4.2	8.5	61
73	14.6	13.3	91	4.3	4.0	49
99	12.4	10.5	85	2.3	12.7	60
111	13.1	11.2	85	1.5	12.5	72
115	14.7	13.3	90	3.5	5.6	63
120	13.8	12.4	90	4.1	5.9	60
134	13.8	12.2	88	4.6	7.1	66
135	13.5	11.4	84	3.0	12.6	55
137	12.4	10.1	81	1.7	16.5	63
138	14.5	11.9	82	3.5	14.3	63
140	15.4	13.6	88	5.0	6.5	77
145	16.3	13.2	81	7.9	11.5	76
146	13.8	11.9	86	2.6	10.6	72

Cultivar	Soluble solids (%)	Jointless (%)	Color	Firmness	pH
UC-82	4.4	81	3.0	4.0	4.34
59	4.5	94	4.0	3.5	4.35
62	4.8	93	4.5	4.0	4.39
64	5.1	57	4.2	3.5	4.44
67	4.7	51	5.0	3.0	4.36
71	4.3	97	3.5	2.5	4.46
72	4.7	90	4.0	2.5	4.37
73	4.7	99	4.0	4.5	4.30
99	4.5	97	4.0	2.5	4.48
111	4.7	58	4.0	4.5	4.40
116	4.8	100	4.2	3.0	4.35
120	4.7	100	4.0	4.0	4.38
134	4.6	99	3.8	2.5	4.35
135	4.6	99	3.8	2.5	4.38
137	4.5	63	4.2	2.0	4.44
138	4.8	95	4.2	3.0	4.37
140	4.6	50	3.8	3.5	4.36
145	4.8	99	4.2	3.5	4.48
146	4.3	78	4.2	2.0	4.27

Onion storage trial: Varietal Effect

Cultivar	Quality bulbs, %
RAM 710	93.7 a
Barak	88.0 ab
El Ad	82.7 b
H-508	78.7 b
Granex 2000 (Hazera)	60.7 c
Granex (Asgrow)	51.7 d

*Mature bulbs were hand picked, sorted and stored under ambient conditions for 5-6 months in an open shade

Onion storage trial: Effect of storage conditions (A) on storage performance of 7 commercial cultivars (B)*.

a) Analysis of variance

Source	SS	DF	MS	F	P
Storage trt	27.5	1	27.5	0.21	0.65
Cvs	7769.8	6	1295.0	9.98	0.00
A * B	364.5	6	60.7	0.47	0.83
Error	3633.3	28	129.8		

Short-day (SD) onion genotypes vary greatly in their storageability, but ranking order is not affected much by storage conditions. Hence, unlike other physiological characteristics, selection for good storage should be applicable in many climatological locations.

*Mature bulbs were hand picked, sorted and stored for 5-6 months in perforated boxes either in an open shade (ambient-conditions) or at 25°C. All IL cvs matures 2 - 4 weeks earlier than cv Granex.

Characterization of some onion hybrids and their performance after 5-6 months in storage.

Cultivar	Skin Adhesion	Skin color	Diameter (cm)	Doubl -ing,%	Storageability sprt,%	Storageability rot,%
Granex 2000	3.9	4.0	9.5	1	39	0
Granex	3.2	3.5	9.0	1	44	10
RAM 710	3.9	3.7	9.5	0	4	0
RAM 735	3.3	3.7	10.0	3	31	0
RAM 802	3.7	3.7	10.0	1	23	0
RAM 803	3.7	3.7	10.0	1	3	7

DEVELOPMENT OF VERTICORDIA Spp. FOR THE ORNAMENTAL INDUSTRY

WORK PLAN - 1993

Y. Ben-Dov

Verticordia is a genus belonging to the Myrtaceae family. There are about 35 species of Verticordia, most of them native to Western Australia and most of them woody shrubs typified by colorful flowers. They can be used for flowering branches and as flowering potted plants. The range of flower colors is quite impressive—yellow, red, pink, purple, etc.

This genus is presently unknown to the ornamental market.

We are seeking the following species for introduction purposes: *V. grandis, V. codlomia, V. drummondii, V. mitchellia, V. monodelphia* and *V. plumosa*. Presently we have in our possession propagation material of the species *V. huegelli*. This is a dwarf shrub about 60 cm high with dark red flowers. Most of the work in the first research year will be carried out with this species.

Propagation. It appears at this stage that a major problem in the production of Verticordia is plant propagation, whether from seeds or from cuttings.

a. Effect of seedbed media on germination. Five different media will be tested: Pure quartz sand; 2/3 sand and 1/3 peat moss; pure vermiculite; 1/2 peat moss, 1/2 vermiculite; 30% peat moss, 30% vermiculite, 30% perlite and 10% sand.

b. Vegetative propagation. Top cuttings from young seedlings will be treated with two different media: 1/2 peat moss and 1/2 vermiculite; 1/2 vermiculite and 1/2 perlite. The hormone "stem root" (active ingredient - IBA) will be applied, and three concentrations of IBA tested (3,000, 6,000 and 8,000 ppm). Bed temperature will be controlled between 23 and 25°C, and rooting will be carried out in a fog system.

Growth media. Ten-liters, containers containing the following media: 2/3 sand and 1/3 peatmoss; 30% vermiculite, 30% peat moss, 30% perlite and 10% sand; pure sand from desert sand dune; loess soil; and "Hamra" (a sandy loam red soil). Each of the medium treatment will be grown under 25% shade in a screen-house and in full sunlight. There will be ten pots per treatment. At this stage fertilizer will be applied as a slow release compound called Osmocot (decay over 6 months) at 10 g per liter of each of the media.

The following parameters will be determined: overall appearance, growth rate (elongation), flowering date.

FIRST RESULTS WITH *VERTICORDIA*

Yossi Ben-Dov

Germination tests were made for 11 varieties of *Verticordia*, in 5 different media. The seeding was done at three different times: Spring, Winter, Summer (1992-93).

a) Of the 165 possibilities for germination (11 varieties x 5 media x 3 dates). The only one that germinated was *V. plumosa* (in 20 of the 50 pots) during the spring of 1993. It is known that it is difficult to germinate Verticordia, and efforts to date confirm this. It is also possible that there was a problem of seed freshness - after one year Verticordia seeds loose their germination power. Because of these difficulties, in Australia *Verticordia* is reproduced by vegetative propagation.

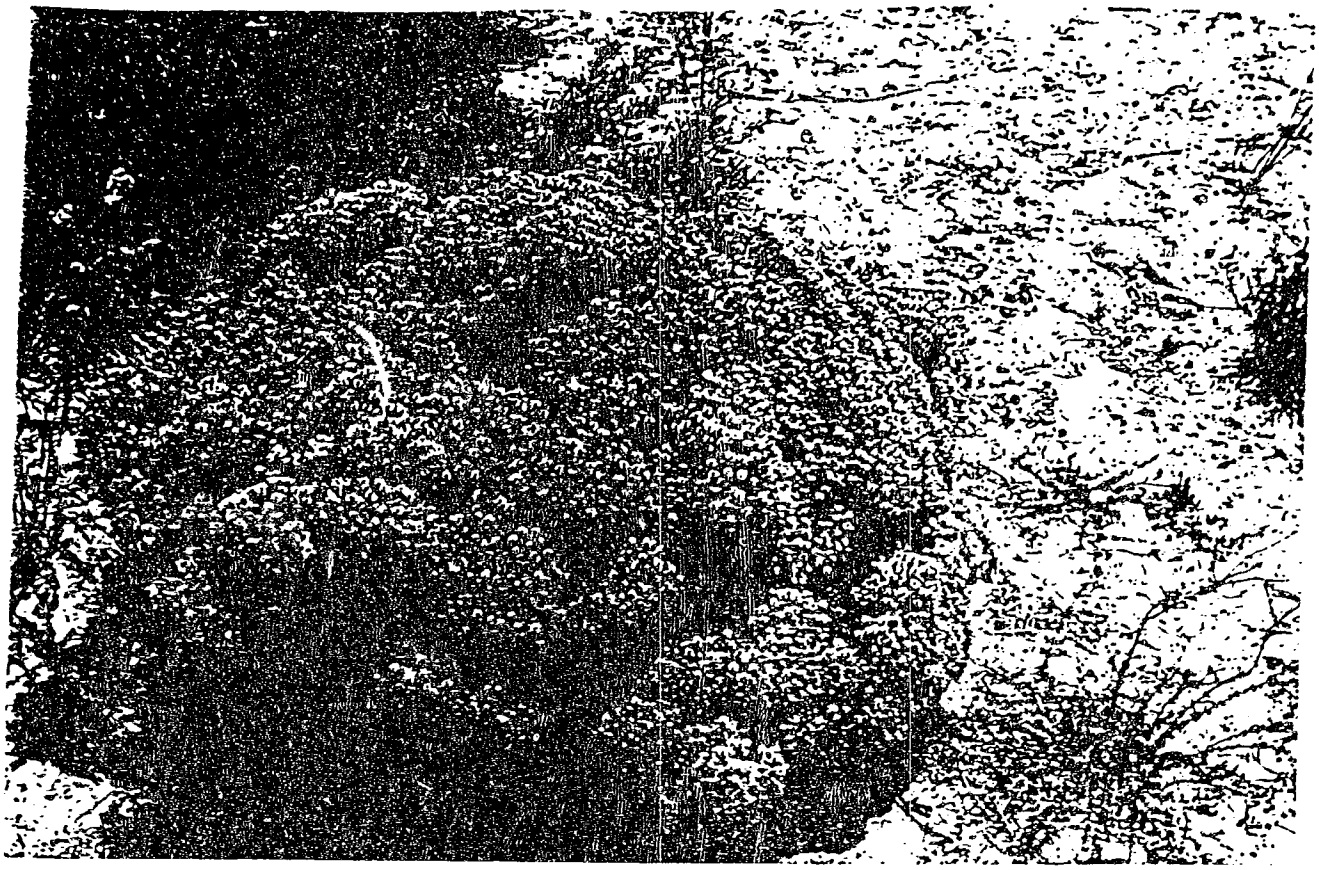
b) We have begun using the 20 plants that developed for vegetative propagation, and we currently have 100 seedlings cloned from the starting material. We are continuing with the propagation in order to have sufficient material to continue of research and development.

c) In light of our experience, we decided to make an effort to import plant material from Australia, and have succeeded to date in acquiring 5 seedlings each of 3 varieties: *V. plumosa, V. densiflora* and *V. monodelphia*. These were in fragile condition due to the need to expose the roots to conform with quarantine procedures. (Some were up to 2 years old, and being removed from a growth medium effected them the most.) All told, the *V. densiflora* did not survive; three each of the other 2 varieties survived. The *V. plumosa*

is developing well, and shall soon be a source for vegetative propagation. The *V. monodelphia* is developing very slowly. When it passes a suitable stage of development we want to change its growth media.

In order to proceed, it will be necessary to bring plant material from Australia from nurseries that specialize in *Verticordia*. Methods for accomplishing this task are being investigated (including the possibility of a trip to Australia by a member of the project team).

(Greater detail on the experiments conducted to date are available if required - planting dates, temperatures at that time, composition of the different media, etc.,)



VERTICORDIA MOUSSELPAS

THE INSTITUTES FOR APPLIED RESEARCH
BEN-GURION UNIVERSITY OF THE NEGEV

BGUN-ARI-62-93
Limited

MICROPROPAGATION OF ORNAMENTAL EUCALYPTUS SPECIES

Annual report
June 1992-July 1993

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The Institute for Agriculture & Applied Biology

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SUMMARY

The number of ornamental eucalyptus branches reaching the flower markets in Europe and the prices they command are on the rise. The objective of the present program is to develop the methodology for *in vitro* propagation of species that have potential as cut branches in the ornamental flower industry.

Plots planted with several ornamental species of eucalyptus have been established in Israel from seeds. Eucalyptus is characterized by a high degree of genetic variability among individual trees and there is, therefore, an advantage in vegetatively propagating the species of interest and in establishing superior clones. However, vegetative methods such as rooting cuttings or grafting are quite difficult to apply. Propagation *in vitro* appears to offer an effective alternative.

In the initial phase of this study we focussed on shoot culture establishment from seedlings germinated *in vitro* and from mature trees. Shoot cultures of *E. kruseana* and *E. ficifolia* from seedlings were established with minor problems. We have now obtained several clones that proliferate satisfactorily. In the case of *E. kruseana*, several plant hormone combinations were studied and a particular combination of relatively low levels of cytokinin and auxin was found to be preferable. Culture establishment from mature trees proved very difficult to obtain due to: 1) external (mostly fungal) and internal contamination (mostly bacterial), and 2) production of phenols and tissue browning and death. In the case of *E. macrocarpa* we were not able to obtain vigorously growing shoot cultures from mature trees. This was not the case with *E. kruseana* , and we obtained several proliferating cultures from a particular tree of this species in April; proliferation was optimal in the medium previously identified as most suitable for the seedling material.

Key words: Micropropagation, shoot culture establishment, *E. kruseana* , *E. ficifolia*, *E. macrocarpa*

INTRODUCTION

The eucalyptus is an important forest tree cultivated commercially in its native habitat in Australia and in many other locations in the world. It is used in the paper and wood industry, as a source of domestic fuel, for construction, shade, windbreaks, and in ornamental horticulture (Ouyang and Peng, 1990). Other important uses are in honey and oil production. Morocco imports large quantities of eucalyptus wood for the paper industry.

In Israel eucalyptus trees are used mainly for shade, windbreaks and landscaping. In the Negev, eucalyptus species adapted to the semiarid climate have been planted in cities, rural settlements and limans (water-harvesting reservoirs established in wadi beds) as well along roads.

Three important representatives of the genus *Eucalyptus* are *E. torquata* and *E. woodwardii* and their hybrid *E. torwood*. *E. torquata* has a red flower, *E. woodwardii* has a lemon yellow flower, and *E. torwood* flowers exhibit a wide range of colors, from lemon yellow through yellow, orange and pink to red.

Eucalyptus branches have long been used as decorative green fillings in flower bouquet or arrangements. *E. cenerea* is cultivated in southern Europe, along the Mediterranean Sea and its branches are sold in the flower markets; it used to be grown in Israel, and its branches were exported from Israel until the 1990/91 growing season. It is being replaced by other attractive eucalyptus species, such as *E. kruseana*. According to the 1991/92 annual export report of the Production and Marketing Board of Ornamental Plants, about 220,000 branches commanding a price of 12 Dutch cents apiece were exported in 1990/91 and 240,000 branches at 24 Dutch cents apiece in 1991/92. The number of branches exported increased during the 1992/93 season (Y. Ben-Dov, personal communication) for a price increase of 40 Dutch cents. The number of branches produced will increase significantly as most of the newly planted plots begin to yield in the coming season.

At the Institutes for Applied Research we have been involved for many years in developing eucalyptus as an ornamental tree for landscaping. Recently we have focussed on developing eucalyptus for the flower industry, and we feel

we have contributed much to the progress made so far (Ben-Dov and Margalit, 1982; Ben-Dov, et al., 1989; Pasternak and Ben-Dov, 1984).

Trees with a specific flower color or other trait such as vigorousness have to be raised through clonal propagation. This is due to the high degree of heterozygosity of the species (Ouyang and Peng, 1990). Eucalyptus plants are very slow to root when layered or when cuttings from mature trees are used (Ouyang and Peng, 1990). Coppice shoots of several species root well; however, not all eucalyptus species sprout readily from stumps (McComb and Bennett, 1986). Vegetative propagation through cutting and grafting has not yet showed much promise in studies conducted in our institute (Ben-Dov et al., 1989; Pasternak and Ben-Dov, 1984). Seen against the background of these difficulties, propagation *in vitro* may would seem to be attractive due to the possibility it offers of producing many plants in a relatively short time.

Micropropagation consists of several steps or stages: stage 0 (zero) - preparation of mother plant; stage 1 - establishment of aseptic culture; stage 2 - multiplication; stage; 3 -rooting; and stage 4 - hardening. It is a well known fact that it is quite difficult to kill the surface contamination in eucalyptus and to keep the apical bud or the naked and dormant axillary bud alive (McComb and Bennett, 1986). Eucalyptus tissue is often killed by sterilizing solution, and explant tends to produce a brown exudate which can prevent growth of the axillary shoots that survive.

In the present study we report on shoot culture initiation both from seedlings germinated aseptically in tissue culture (*E. kruseana* and *E. ficifolia*) and from mature trees (*E. kruseana* and *E. macrocarpa*).

MATERIALS AND METHODS

Selection of individual trees

In the spring of 1993 several mother trees of *E. kruseana* and *E. macrocarpa* were selected at the plantation of Sede Teiman (10 km west of Beer-Sheva) by Mr. Y. Ben-Dov. Selection was according to characteristics such as vigor and branch biomass, general shape, leaf color, size and shape, leaf density on the branch (or node length), and lack of leaf spots (a phenomenon that is caused by fungi and spoils the branch).

Culture initiation

A. Mature trees

Newly produced shoots 6-15 cm in length were cut in the field and brought to the lab in an insulated cold box. Intact shoots were washed under running water and with soapy water, then treated for 15 min with 0.5% Benlate (a fungicide) and left for 90 min before removing leaves (in *E. kruseana*, 0.5-0.6 parts of the leaf). Next, shoots were treated with 1% hypochlorite solution containing 1 drop of Tween 20 in 100 ml for 10 or 12 min, after which they were washed in sterile water and cut into nodal segments. In several cases shoots were left in a sterile jar for 24 h at room temperature before culture.

The explants were cultured in 5 ml 1% agar-agar containing 1% sucrose and in some cases 0.2% charcoal or 0.2% polyvinylpyrolidone (PVP). The 25x100 mm tubes were covered with various cap types permitting various degrees of gas exchange or diffusion, then placed on an unlighted shelf. Death and fungal contamination rates were recorded during the first 2 weeks, after which explants were transferred to Bactoagar (Difco) with half-strength MS medium (Murashige and Skoog 1962).

Four to five weeks later, surviving explants, which sometimes produced new shoot from the axillary buds, were transferred to MS medium supplemented with benzyladenine (BAP) and naphthaleneacetic acid (NAA) or woody plant medium (WPM) (Lloyd and McCown, 1981).

B. Seedlings *in vitro*

Seeds were cleaned of debris and surface sterilized in 1% hypochlorite for 10 min. In the case of *E. ficifolia*, seed coat was removed by hand and seeds were surface sterilized once more in 1% hypochlorite for 1 min. Seeds were washed 3 times in sterile water and cultured on 0.8% agar supplemented with 1% sucrose.

Shoot proliferation was carried out by cutting shoot segments from the seedlings. Segments were cultured on MS medium supplemented with various combinations of cytokinins and auxins.

RESULTS AND DISCUSSION

A. Shoot culture initiation from seeds

E. ficifolia

In the first experiment (#1) we used seeds of *E. ficifolia*. Of 135 seeds that were sterilized and cultured on MS medium, only 23 germinated; of these, twelve were contaminated with bacteria. Seedlings developed normally and several produced side shoots (up to 12 per seedling). After six weeks shoot segments of these seedlings were subcultured on WPM. After a further six weeks we were able to get 3-15 tubes per clone (with an average of eight per clone). The performance of nine clones six months after initiating cultures from seeds is presented in Table 1. Multiplication rate after this period was low, although rooting percent was quite high. Rooted plantlets grew vigorously in culture, and in the near future we will conduct further experiments on rooting substrates such as vermiculite and cellulose plugs to study the degree and quality of rooting before we proceed to harden the plantlets.

E. kruseana

Of 490 seeds of *E. kruseana* (exp. #2) that were sterilized and cultured on MS medium, 265 germinated after four days. After an additional four days 240 seedlings with cotyledons developed without fungal contamination. Roots of seedlings were cut and explants were subcultured on MS medium supplemented with 0, 1, and 5 mg/l of GA_3 (gibberellic acid). The purpose of using GA was to cause shoot elongation and easier manipulation of the growing seedling; however, it was observed that in all GA treatments shoots

were much shorter than in the control. This is in contrast to the known effect of GA, i.e. elongation of shoots. GA also caused root death. It seems that GA is useless for seedlings of *E. kruseana* .

Table 1. Shoot and root production in *E. ficifolia* subcultured on WPM for 2 months.

Clone	No. explants	Replication rate	Rooted (%)
2	36	3.6	100
4	41	2.7	87
5	44	2.9	93
6	81	4.1	75
8	156	5	94
9	13	2.6	80
10	2	2	100
12	53	2.8	53
13	4	1.3	100

This experiment was followed by a shoot proliferation study using nine different combinations of 0.01 - 0.1 mg/l NAA and 0.1 - 1.0 BA. Three types of explants excised from the seedlings were used: I- hypocotyl plus cotyledons; II - epicotyl with the first set of leaves (no apical meristem); III - apical meristem plus basal shoot (epicotyl). More shoots were produced in the presence of 0.5-1.0 mg/l BA than at the lower concentration (Table 2). We found treatment #5 (0.5 mg/l BA and 0.05 mg/l NAA) to be the best in regard to shoot production and elongation.

Interestingly, shoot elongation in explant III was significantly smaller than in the other two explants (Table 3). In regard to the number of shoots produced from each explant type, no difference was found between the three types.

Table 2. Effect of NAA and BA on shoot production and elongation of three types of shoot segments in *E. kruseana* seedlings. Values are mean± SE of 15 explants.

Treatment			No. shoots	Total length
#	BA (mg/l)	NAA (mg/l)		
1	0.1	0.01	2.8±0.2	14.4±1.9
2	0.1	0.05	2.9±0.3	18.6±3.9
3	0.1	0.1	2.8±0.2	12.7±1.6
4	0.5	0.01	3.5±0.3	10.9±3.5
5	0.5	0.05	3.9±0.3	17.1±2.8
6	0.5	0.1	3.5±0.3	12.9±1.1
7	1.0	0.01	3.1±0.3	8.9±1.4
8	1.0	0.05	3.2±0.2	11.9±1.4
9	1.0	0.1	3.9±0.3	15.2±2.0
P (0.05)			0.048	0.010
LSD (0.05)			5.9	0.7

Table 3. Effect of explant type on shoot elongation of *E. kruseana* seedlings. Values are mean± SE of 45 explants.

Explant type*	Total length	No. shoots
	(mm)	
II	15.2±1.2	3.3±0.1
III	10.4±0.7	3.2±0.1
IV	15.2±1.6	3.4±0.1
P (0.05)	0.007	0.653
LSD (0.05)	3.42	0.445

*I- hypocotyl plus cotyledons; II - epicotyl with the first set of leaves (no apical meristem); III - apical meristem plus basal shoot (epicotyl).

Explants of *E. kruseana* were then subcultured on MS medium supplemented with 0.5 mg/l BA and 0.05 mg/l NAA (treatment #5; see Table 4).

Table 4. Multiplication of *E. kruseana* explants on MS medium supplemented with 0.5 mg/l BA and 0.05 mg/l NAA after 6 weeks.

Clone	No of explants	Multiplication rate
1	0	-
4	2	1
5	6	3
6	9	1
7	3	1
8	68	4.3
9	14	2
10	33	1.4
11	36	1.4
12	11	1.2
17	69	2.9
21	48	1.7
24	54	2.3
25	11	1.4
31	19	1.4
34	44	2
35	136	3.4
37	28	2.2
50	33	3.7
53	39	3
67	132	6.9
68	92	4.6
15	10	1.4

B. Cultures from mature trees

E. kruseana

In a preliminary experiment (# 6), we initiated cultures from a tree on the grounds of the Institutes for Applied Research. All nodal segments, 16 in number, were found to be clean of fungus and green (no blackening effect) on the first medium used - agar-agar plus 1% sucrose - after about 10 days. The explants were transferred to 1/2 strength MS medium. After a month half of the explants were lost, mainly due to release of bacteria. After two more months all explants but one showed no development of the axillary bud, though in some callus developed; the single explant with axillary develoment was transferred to WPM to facilitate further development of the new shoot, but to date this treatment does not look very promising.

In another experiment (# 7), we initiated cultures from tree #1 of row #1 in Sede Teiman in April. A total number of 192 segments from four different parts along the tip of the twig were cultured in tubes covered with one of three different caps: paper, Kimble (plastic) and Magenta (plastic). After 10 days it was observed that there was a higher incidence of death of shoot segments under Magenta caps due to the greater tightness of the caps and lower gas diffusion. We have recently reported on this phenomenon (Mills et al., 1990). Rate of mortality was higher in segments close to the tip and the best survival was recorded in the part furthest from the tip. A fungal contamination rate of 12-25% was observed. Two weeks after culture, explants were transferred to half-strength MS. Some growth of the axillary bud was observed in these explants, but only after a month. About six weeks from initial culture, surviving explants were transferred to three different media: MS supplemented with 0.05 mg/l NAA and 0.5 mg/l BA, MS supplemented with 0.1 mg/l NAA and 1.0 mg/l BA, and WPM. After five weeks, no growth could be observed on WPM; on the low hormone medium growth of axillary buds was observed in 13 out of 18 explants and in the high hormone medium in 9 out of 19 explants. Four weeks later, 10 of the previous 13 and 6 of the previous 9 explants, respectively, continued to grow and proliferate. So far, the low hormone medium seems to be somewhat better. It should be noted that in the last step antibiotics were added to the medium to counter the release of endogenous bacteria into the medium. Shoot cultures of *E.*

kruseana have therefore been established, and proliferation will be continued to increase the population available for rooting trials.

In an additional experiment conducted in June, we initiated cultures from tree #6 of row #3 in Sede Teiman. A total number of 281 segments from three different parts along the tip of the main branch were cultured in tubes. Death of explants was very low (7% after two weeks); however, most cultures were found to be contaminated with fungus (94%). It therefore seems that the period of the year when explants can be cultured *in vitro* relatively effectively is limited to the spring months of April and May.

E. macrocarpa

In this experiment (# 9) we initiated cultures from tree #6 of row #1 in Sede Teiman. A total number of 66 segments from the tip of the twig were cultured in variously capped tubes as described above. After 11 days, it was observed that mortality of shoot segments was higher under paper caps and lowest under Kimble caps. No fungal contamination was observed. Attempts to subculture small axillary shoots or the entire explants resulted in eventual death due to browning of the tissue.

In an additional and more extensive experiment (# 11), we initiated cultures from tree #10 of row #4 in Sede Teiman. Harvested branches had side twigs of up to 15 cm in length. A total number of 240 explants cut along the twigs and the main branch were cultured in tubes with 1% sucrose in three basic treatments: control, addition of 0.2% polyvinylpyrolidone (PVP), or 0.2% charcoal. In each treatment tubes were covered either with Kimble or with Magenta caps. Activated charcoal has been reported to enhance shoot elongation of *E. citriodora* (Ahuja, 1985). In general, it was observed that explants that were left in a humid jar for an additional 24 h before culture showed less browning and death after a week (Table 5), supporting the idea that ethylene accumulating in the closed tube after injury stimulates browning (Housti et al., 1992).

Table 5. Effect of explant type, storage of explants for 24 h before culturing and culture conditions on the condition of explants of *E. macrocarpa*, expressed as percent of explants having a brown (dead) base but still showing green bud seven days after culture initiation.

Shelf period	Explant type *	Agar		Charcoal		PVP		
		K cap	M cap	K cap	M cap	K cap	M cap	Mean
None	a	67	83	67	83	100	50	75±17
	b	33	33	17	50	50	67	42±18
	c	0	50	50	33	17	17	28±20
	Mean	33	55	45	55	55	45	
24 h	a	50	50	50	67	50	33	50±11
	b	22	40	33	40	11	30	29±11
	c	75	25	25	50	25	25	38±21
	Mean	49	38	36	64	29	29	
	Grand mean		44		50		40	

* a - nodal segments of side twigs; b - nodal segments from the tip (young part) of the main branch; c - nodal segments from the bottom (old part of the main branch) lacking side twigs.

After two weeks in culture the phenomenon of reduced browning and death was not noticeable, and mortality of explants ranged from 33 to 75% of the initial number of explants. Explants taken from the tip and the base of the excised main branch survived much better than explants taken from the side twigs. The latter were younger and therefore more sensitive to the treatment with hypochlorite. This treatment was quite effective, since fungal contamination was limited to 3-7%. After two weeks from culture initiation, 70 surviving explants were transferred to half-strength MS medium. After a further five weeks 47 explants were found to have survived (Table 6); there were more survivors from the treatment with PVP.

Table 6. Effect of explant type, storage of explants for 24 h before culturing and culture conditions on explant survival in *E. macrocarpa* seven weeks after culture initiation.

Shelf period	Explant type *	Agar		Charcoal		PVP		
		K cap	M cap	K cap	M cap	K cap	M cap	% of total
None	a	1	1	0	1	0	1	11
	b	1	1	2	0	2	0	17
	c	4	1	4	1	5	4	53
	Mean							27
24 h	a	0	0	0	0	0	1	3
	b	2	0	2	1	3	2	18
	c	0	2	0	2	1	2	29
	Mean							17
	% survival	22	14	22	14	31	28	
	Mean %		18		18		30	

* a - nodal segments from side twigs; b - nodal segments from the tip (young part) of the main branch; c - nodal segments from the bottom (old part) of the main branch lacking side twigs.

In 15 explants from the PVP treatment the axillary bud grew to a size of 1-3 mm; they were transferred to two different media: MS supplemented with 0.05 mg/l NAA and 0.5 mg/l BA, or MS supplemented with 0.01 mg/l 2,4-D and 0.1 mg/l BA (MS_{10}). Growth of *E. macrocarpa* in these media is very slow and is much affected by the production and release of phenols to the medium.

Establishment of shoot culture from mature tissues of eucalyptus is quite difficult. Two types of microorganisms, fungi and bacteria, create a major problem of infection of the cultures. Fungi grow rapidly during the initial culture and cause death of explants; endogenous bacteria are released from the shoots into the medium during shoot proliferation, altering the pH of the medium and excreting toxins, both factors that cause death of explants (mainly when explants do not grow vigorously). Fungus can be effectively controlled by surface disinfection. Intensive use of hypochlorite, however, causes damage to the tissue, presumably through the release of ethylene, which stimulates browning and leads to tissue death. It seems that different species of eucalyptus respond differently to surface sterilization, with browning of the tissue developing differently. The degree of browning in *E. macrocarpa* is more intensive than in *E. kruseana* and is similar to *E. torwood* (Mills, et al., 1990). Endogenous bacteria cannot be eliminated during the first disinfection treatment. Bacteria can be controlled to some extent by adding antibiotics to the medium. Antibiotics, however, interfere with organ growth, and bacteria re-proliferate when the antibiotics are removed.

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Micropropagation of Musa spp. and ornamental woody and ornamental species

Work plan for Israel

November 1993- October 1994

Submitted by David Mills

General

As indicated before work in Israel will be emphasized on Eucalyptus and establishment of banana cultures. Work in Morocco will be emphasized on micropropagation of banana and herbaceous ornamental species. Work on ornamental species and banana including extended work on meristem culture of banana will be carried out in Israel upon availability of trainees from Morocco. It should be emphasized that such a trainee has not arrived here, a fact that impair this program significantly.

Eucalyptus species

The following species have been identified as having potential for production of foliage and cut flower for ornamental industry: *E. cinerea, E. spatulata, E. krusseana, E. torquata, E. woodwardii, E. torwood, E. gillii, E. formannii, E. alba, E. albida, E. clelandii, E. ficifolia, E. macranda, E. Preissiana, E. Rhodantha, E. Eremophila E. calophyla, E. macrocarpa and E. crucis.*

In the first year work was initiated on shoot culture initiation both from seedlings germinated aseptically in tissue culture in species *E. kruseana* and *E. ficifolia* and from mature trees in speciesb *E. kruseana* and *E. macrocarpa*. Work

will be continued on cultures of these species and initiated with several species of the list above using methodologies described below.

CULTURE INITIATION

A. *In vitro* culture

Seeds of selected species of the above list will be sterilized in 1% hypochlorite for 20 min. Seeds, 3 per tube (about 50 tubes), will be germinated in 0.1 strength-MS medium supplemented with 1% sucrose. Rate of germination, contamination, and seedling death will be recorded. After seedlings have 3 nodes, a period that usually takes several months, nodal segments will be transferred to 3 different media: 1) Murashige and Skoog (MS) supplemented with vitamins, benzyladenine (BA) and naphthaleneacetic acid (NAA). After 2 months the following growth parameters will be determined: height of the propagule, number of side shoots, total length of shoots, and total number of nodes. The best medium for each species will be determined. Shoots grown on the best medium and those grown on the other media will be further propagated on the former.

B. Establishment of culture from coppice of mature trees

Trees of Eucalyptus will be selected in Sde-Tieman. Cutting branches will take place during winter in order to induce coppice production. In Spring, newly produced shoots, 20-40 cm in length, will be cut in the field and brought to the lab in an insulated cold box. Leaves will be cut at the petiole about 1 cm from the branch, and then the branch will be cut into nodal segments. The explants will be treated for 10-20 min with 0.5-1.0% benlate (a fungicide) and then for 10 min with 1.1% hypochlorite solution containing 1 drop of Tween 20 in 100 ml. In some experiments other concentrations of hypochlorite and soaking periods

will be applied. The explants will be washed 3 times with sterile deionized water and then cultured in 5 ml 1% Agar Agar containing 1% sucrose and 0.2% charcoal. The 25x100 mm tubes will be covered with paper stoppers that permit relatively high gas exchange or diffusion and then put on an unlighten shelf. During the first 2 weeks death and fungal contamination rates will be recorded and then the paper stopper will be replaced by a plastic stopper to reduce drying of the medium. Totally green explants or those with slight browning at the injured edges will be transferred to MS medium supplemented with NAA and BAP in various combination and put in the light. Newly produced shoots will be further propagated.

SHOOT MULTIPLICATION

Shoot multiplication will be carried out with *E. kruseana* and *E. ficifolia* mainly with the material obtained from the selected mature trees. In previous year we found that MS medium supplemented with 0.5 mg/l BA and 0.05 mg/l NAA to be the best in regard to shoot production and elongation. Shoot proliferation will be carried out using this medium. Shoot population will be increased to a level permitting initiation of rooting trials. If necessary shoots will be kept on media containing antibiotics to keep spread of bacteria.

ROOTING IN VITRO

Experiments designated to find optimal conditions for rooting in vitro will be carried out with *E. kruseana* and *E. ficifolia* . Shoot segments will be transferred to either MS medium supplemented with indolebutyric acid (IBA) or Woody Plant Medium. Several parameters will be examined in the case of low rooting percentage such as: application of charcoal, antigebberellin compounds, dipping in IBA.

In addition it should noted that 1- plans for work on Musa as indicated in work plan for 1993 are in effect for the coming year, depending upon the arrival of a trainee from Morocco; 2 - plans to work on specific selected trees of E. torwood as indicated in work plan for 1993 were not executed since sprouting in spring was weak not permitting excising shoots. In a matter of fact three years in a row of excising shoots from these trees weaken them to a stage that further use will endanger them.

Work Plan for the Morocco project

TRUFFLE CULTIVATION

V. Kagan-Zur and N. Roth-Bejerano

Among the desert truffles of North Africa and the Arabian peninsula, there are truffle species belonging to the genus *Terfezia* that grow symbiotically on the roots of annual species of the genus *Helianthemum* (Cistaceae) (Awameh & Alsheikh 1978; Awameh 1981; Alsheikh, 1984). One of the most highly appreciated and most abundant of these species is *Terfezia boudieri*, which lives symbiotically with two annual *Helianthemum* species, *H. salicifolium* and *H. ledifolium* (Awameh et al. 1979; Awameh 1981). Some work has been done towards cultivation of this truffle (e.g. all the aforementioned authors), but no successful effort has been reported so far (Singer & Harris 1987).

We propose to study the potential for cultivating the Moroccan black desert truffle *Terfezia boudieri* on the above-mentioned annual *Helianthemum* species (both of which also grow in the Israeli Negev), in Morocco and in Israel, in the framework of a cooperative research effort.

Our ultimate aim will be to formulate recommendations for the farmer who wishes to grow truffles commercially.

Cultivating truffles on an annual basis has several obvious advantages over cultivation of perennial couples:

a. In the case of perennials there is a comparatively long wait before the plot starts producing (at least two years for *Helianthemum-Terfezia*).

b. To ensure continued production in a perennial plot, the fruiting bodies have to be collected individually between and underneath the plants, while with annuals the whole plot can be harvested mechanically at one go.

c. With annuals questions can be formulated and answered within one season. Where perennials are concerned experiments take much longer.

d. Survival of the symbiosis over the dry season is not a concern where annuals are cultivated.

Proposed Long-Term Stages of the Research,

1. Fruiting bodies of *T. boudieri* will be collected in Morocco. Mycelium will be isolated using methods already in use in our laboratory (Roth-Bejerano et al. 1990).

2. The annual *Helianthemum* species will be germinated from seeds (this is being done routinely in our laboratory), then inoculated either with the isolated mycelium on artificial media under sterile conditions (Roth-Bejerano et al. 1990), or with truffle spores using a semisterile procedure in sterile soil (Kagan-Zur et al. 1992). Optimal soil composition will be determined.

3. The ability of a single well-established symbiosis (as opposed to a community of several plants) to support fruiting bodies (truffle) formation will be investigated:

a. by enabling a single symbiotic plant to complete its life cycle on its own, in pots of various sizes (to avoid limiting the roots and especially to avoid preventing the mycelium from achieving a potential critical mass);

b. as above, but with several plants in one pot, the size of which will be varied over two ranges, one as in (a) above and the other designed to allow for the increased number of plants;

In the latter experiments (a and b) symbiosis will be obtained using either mycelium (genetically homogeneous) or spores (genetically variable), in order to enable us to assess whether genetically different mycelia are required for fruiting body production.

4. Although the experiments will be conducted all year round, particular attention will be paid to the productive period of the plant's growth season. This is in the light of our work with *H. sessiliflorum* and *T. leonis*, in the course of which we observed that under a year-round irrigation regime the appearance of fruiting bodies was confined to a particular season; by contrast, in the same experiments the symbiosis persisted intact and the symbiotic plants flowered continuously (Kagan-Zur et al. 1987). The reasons for this phenomenon are not known at the moment; temperature, daylength, light

intensity, minute changes in the atmosphere, combinations of the above, or other factors may be implicated.

5. Plots of inoculated seedlings will be established during the productive season in both countries:

a. Plant seeds submerged in spore solution containing adhesive agents (Kagan-Zur et al. 1992) will be germinated on location.

b. Preinoculated seedlings will be transferred to plots (much like tomato seedlings); the inoculum will consist of either spores or mycelium, whichever will have been found to be more efficient.

c. Different irrigation regimes will be tried to determine optimal combinations. The goal will be to assure fruiting body formation while preventing the roots from penetrating too deeply into the soil (Kagan-Zur et al. 1986). The parameters concerned are: total amount of water, volume of water per irrigation, and frequency of irrigation.

Research Plan for the First Year

1. A trip to Morocco is planned to take place some time in February-March 1993. Its purpose will be to establish collaboration with local researchers and collect starting material in the form of *Terfezia boudieri* fruiting bodies. All further work described below will be carried out in Israel as the Israeli part of the project.

2. The samples of *T. boudieri* material will be used as follows:

a. For isolation of mycelium on the following artificial media: medium developed by Bonfante & Fontana (1972-1973) (principal medium); and MMN medium (Marx, 1969). The two differ in their carbon and nitrogen source, as well as in their vitamin supplements and Ca^{2+} concentration, and different truffles prefer one or the other (our own unpublished results).

b. As a spore source. Samples of the material will be sun-dried. To preserve the germination potential of the spores, the samples will be kept in a desiccated state. When needed, pieces of fruiting body will be imbibed in

water for 24 h, then surface sterilized using NaOCl followed by ethanol. The pieces will then be macerated (using a sterile mortar) in the appropriate solution for the experiment.

3. Seeds of the two annual *Helianthemum* species (*H. salicifolium* and *H. ledifolium*) from our own collection will be used during the first months of the research, and new batches will be collected from the wild as soon as they become available in the early spring.

4. In the first instance, until mycelium becomes available, seeds will either be imbibed in spore solution containing an adherent (sucrose or gelatin, Kagan-Zur et al. 1992), then sown for germination; or they will be germinated directly and inoculated later with spore solution. White polystyrene cups will be used containing sterile soil mixtures composed either of sand, vermiculite and peat (1/3 : 1/3 : 1/3), or of sand and peat alone (80% : 20%); these mixtures have already been used successfully for germinating and growing the above annuals. White polystyrene cups have been shown to support a higher survival rate of the seedlings, possibly due to reduction of soil temperature (our unpublished results).

5. The cups will be held under various conditions: a. in a controlled growth room (25°C, 16 h light), b. in a glass greenhouse, c. at two different shade levels (30% and 60%), and d. outdoors. The aim of this step is to assess the best conditions for obtaining initial symbiosis, to enable mycorrhization indoors independently of the season of the year. This information is also important in view of possible differences in conditions between Morocco and Israel.

6. As soon as mycelium becomes available, seeds will be surface sterilized (NaOCl) and germinated in sterile test tubes containing agar-solidified half-srength Hoagland solution (Hoagland & Arnon 1950), with or without activated charcoal, along with a mycelial inoculum (Roth-Bejerano et al. 1990). The test tubes will be kept in a controlled growth room (25°C, 16 h light).

7. Once a month, samples of each treatment will be collected and studied. Overall appearance of the plant (shoot weight, root weight, degree of branching of both, time of flowering, no. of flowers) will be correlated with level of mycorrhization. The latter will be assessed by staining the roots with Trypan-blue (Roth-Bejerano et al. 1990) and recording the number of mycorrhized roots and the form of the association (close contact between root and hyphae, hyphal penetration between cortical cells, Hartig-net formation etc.).

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THE INSTITUTES FOR APPLIED RESEARCH
BEN-GURION UNIVERSITY OF THE NEGEV

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Limited

CULTIVATION OF TRUFFLES

Annual Report
July 1992 - June 1993

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Institute for Agriculture & Applied Biology

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Summary

As we did not receive the annual *Terfezia boudieri* fruiting bodies despite an express undertaking by an agent involved in the project, we concentrated on survival studies both of mycorrhizae and of plants of the Israeli symbiont *Helianthemum sessiliflorum* (a perennial plant) mycorrhized by *Terfezia leonis* , the Israeli Negev truffle. Control plants were kept outdoors in black plastic bags. Other batches were either covered with a 50% shade net, or buried underground with only shoots sticking out, or covered with straw, again with shoots sticking out. Results indicate that shaded growth conditions are detrimental to the plants. Straw covered pots maintained the highest level of mycorrhization throughout the year. Seedlings germinated in the wild and subsequently transferred to the above array of conditions maintained a higher level of mycorrhization than greenhouse-germinated seedlings. The two categories of plants differed in shoot and root development, the former developing faster in the summer-autumn period, the latter in the winter-spring period. Chlorophyll content per gram fresh weight had two peaks, one in the autumn and the other in the spring. Flowering took place throughout the year in control plants and showed two peaks in plants in buried or straw covered pots. Plants kept under shade did not flower at all in autumn and winter. All had a flowering surge in the spring, their natural flowering season. No connection was found between mycorrhization and plant growth parameters.

Key words: Mycorrhiza survival, plant growth parameters, *Terfezia leonis* , *Helianthemum sessiliflorum* .

Introduction

Our aim in this study was to cultivate the truffle *Terfezia boudieri* , which enters into symbiosis with annual *Helianthemum* species. Due to unfortunate circumstances beyond our control, the fresh truffle specimens we were promised proved to consist of a single dry truffle unfit for mycelium isolation from the gleba. We therefore concentrated our studies this year on improving our knowledge concerning the Israeli desert truffle *Terfezia leonis*, which enters into symbiosis with perennial *Helianthemum* species, *H. sessiliflorum* in particular.

In an earlier study we succeeded in isolating *Terfezia leonis* mycelium from gleba and obtaining symbiosis between the truffle and *H. sessiliflorum* using both the isolated mycelium (Roth-Bejerano et al. 1990) and spores (Kagan-Zur et al. 1992). Some information is available concerning desert truffle mycorrhizae. Successful mycelium isolation has been reported from spore germination (Awameh & Alsheikh 1978, 1980a,b, Fortas & Chevalier 1992a). Mycorrhization has been reported by a group from Kuwait, who also defined the type of association formed as endomycorrhizal (Awameh et al. 1979, Awameh 1981, Alsheikh 1984). The existence of *Terfezia* spp. capable of forming ectomycorrhizae and of others forming endomycorrhizae was reported by Dexhimer et al. (1985). The ability of some species of desert truffles to form either ecto- or ectendomycorrhizae depending on the nutritional conditions was demonstrated (Fortas & Chevalier 1990, 1992b) under protected coditions.

Very little is known about the physiology of the plant symbiont involved, apart from a remark that *H. gutatum* prefers a short day for development (Fortas & Chevalier 1992b). No attempt has been made to study *Helianthemum*, its needs and responses to changing conditions. In order to be able to cultivate truffles, one needs to gain an understanding of the plant symbiont as well. We therefore studied both plant parameters and survival, as well as survival of the mycorrhizae under different regimes. In our preliminary experiments the mycorrhizae failed to survive when the mycorrhized plants, originally planted in black plastic bags or buckets, were transfered outdoors. We assumed that this incident was partly attributable to overheating of the root system, which may have been detrimental to the fungal symbiont. The response of mycorrhized *Helianthemum* plants kept in black plastic bags to different treatments aimed

at lowering their root temperature is reported here; both plant and mycorrhizal attributes were studied.

Materials and Methods

Seeds, soil and pots. *Helianthemum sessiliflorum* seeds were lightly abrased using no. 0 sand paper. Ten seeds each were placed in 200-cm^3 black plastic pots containing a sterile soil mixture consisting of dune sand, vermiculite and C1 finnish peat in equal parts.

Three months after germination seedlings were transferred to one-litre black plastic bags with nonsterile local truffle soil (over 90% sand).

Germination and initial growth conditions. Three different conditions were employed (as indicated below in Experimental conditions). Seeded pots were put to germinate in a greenhouse with uncontrolled light conditions; heating was applied in winter and cooling in summer, but there was no control over temperature.

Inoculation. Initial inoculation was done by dipping abrased seeds in a 25% sucrose spore suspension (for adhesion). The spores were obtained from air dried fruit-bodies which were rehydrated and ground in a mortar and pestle prior to use. In later inoculations the sucrose was omitted.

Experimental conditions. Inoculated seeds were germinated as described above. Around May seedlings were transferred to the one-litre black plastic bags and received an additional batch of spore suspension close to their root system. The bags were divided into four groups:

1. Control plants (inoculated), which were kept outdoors, no measures for reducing root temperature being taken.

2. Buried plants (inoculated): bags were buried in a bed with plant shoots sticking out.

3. Shaded plants (inoculated): a shade net giving 50% shade was placed over plants.

4. Straw-covered plants (inoculated): shoots were allowed to stick out. These bags were used as controls.

In addition, field-grown young seedlings were collected from the wild, infected with the spore suspension, and distributed among the different treatments. Plants were irrigated so as to avoid both drying out of the bags and overflooding (shaded and straw-covered plants needed less water).

Sampling and monitoring. One month was allowed for adjustment to the different conditions, after which five bags in each treatment were sampled monthly at the beginning of every month starting July 1992. Sampling of field-germinated seedlings started in December 1992. Results concerning these field-grown seedlings were recorded separately.

Shoot weight, root weight, leaf weight, chlorophyll content (acetone extract according to Arnon (1949)) and number of flower trusses were recorded (flower trusses flowering at the time of sampling and older fruit-bearing trusses were recorded separately).

Mycorrhizal level was estimated by staining one, randomly chosen, major root branch in each bag (including all its thin branches) with Trypan blue 0.1% (Roth-Bejerano et al. 1990) and observing it under the light mycroscope. Mycorrhization was evaluated according to two scales:

a. level of mycorrhization, ranging from attachment of hyphae to the roots (value of 1) to a well-developed Hartig net (value of 4).

b. abundance of mycorrhizae, top rating of 10 (100% of the root covered). Multiplying both values resulted in a calculated mycorrhization value for each plant. The highest value was therefore 40, the lowest 0.

Results

Seedlings germinated in the greenhouse were temporarily transferred outdoors in early spring due to problems in the greenhouse. Many of them perished, and the number of survivors was quite low. We therefore resorted to transferring field-germinated seedlings, which were still green and thriving in

late May, into the same type of plastic bags as the surviving greenhouse-germinated seedlings, under the same soil and inoculation conditions. They were distributed among the treatments.

The plants were very uneven. On the average, greenhouse-germinated "Buried" plants were the heaviest and "Shade" plants the lightest (Table 1). That "Shade" plants were highly stressed could be sensed from the fact that there were no live active flower trusses on these plants between the third and tenth sampling (Sept. 92 and April 93) (Figure 1C). Control plants were flowering slowly throughout, and a new flush of flowering started in May 93 (recorded in early June) (Figure 1A). Both "Buried" and "Straw" plants had two waves of flowering—autumn-early-winter, and spring (Figure 1B,D). Flowering of field-germinated seedlings was erratic and is not presented.

Leaf-to-shoot weight ratios were essentially the same for all treatments, except for "Shade", where almost all leaves were shed between January and March 93. New leaves appeared in April (recorded in May) (Figure 2).

In plants of all treatments, chlorophyll content of leaves exhibited two waves (Figure 3). The lowest content was recorded in January for greenhouse-germinated plants (Figure 3A) and in February for field seedlings (Figure 3B). Again, "Shade" plants behaved exceptionally due to lack of leaves between the 8th and 10th samplings.

The shoot-per-root weight ratio reflected the same pattern of behavior in all treatments: a higher shoot development as compared to the root system during autumn (peaking in November-December), and probably during May (Figure 4). The monthly averages calculated over all treatments are presented in Figure 5 to stress this fact.

As expected, control plants were essentially nonmycorrhized. When all control plants containing Hartig net are considered regardless of distribution level (Figure 6), the total yearly percentage is around 5%. Buried and straw-covered plants had a higher percentage of mycorrhized plants, the ones transferred from the wild faring best. The lowest incidence of mycorrhized plants was among those germinated in the greenhouse and kept under shade; however, there was a much higher percentage of mycorrhized plants among plants

germinated in the wild and shaded than among wild-origin plants kept under control conditions.

When calculated mycorrhization ratings (see Materials & Methods) were plotted monthly for each treatment (Figure 7A), it became obvious that the only greenhouse-germinated plants mycorrhized all year long were those covered by straw. In the spring, shaded and buried plants also became mycorrhized, but control plants were again essentially nonmycorrhized. The situation among field-germinated plants is not too clear, but apart from control plants is essentially similar (Figure 7B).

Discussion

Surprisingly, the shade-net covered plants suffered almost from the outset of the experiment. We have always been able to grow young seedlings in a growth room where light intensity is about 10% of summer outdoor intensity. In the present experiment we applied 50% shading, which even in winter assures a stronger lighting than the above-mentioned 10%. Temperatures under shade nets are 1-3°C lower than outside, yet control plants kept outside fared better. In addition, in our work with *Cistus* plants we observed a compensatory mechanism in which lower light intensity was set off by increased leaf size and chlorophyll content per gram fresh weight. It seems that *Helianthemum* was unable to adjust in this manner to the changed environment, and eventually all leaves were shed. Towards spring new leaves appeared in which the chlorophyll content was higher (Figure 3A,B). This parameter will be monitored to see whether the rise in chlorophyll concentration represents a compensation for lower light intensity or is just associated with the production of fresh new leaves.

Production of flower trusses was continuous and uniformly moderate in control plants, except for a flush in the spring. This agrees with previous observations in plants kept in buckets outdoors. Like the buried plants and to some extent like the straw-covered plants in this experiment, field plants irrigated all year round flowered weakly most of the year, slowly ceased flowering in winter, then took off again in the spring (Roth-Bejerano & Kagan-Zur, unpublished results). The natural flowering season for *Helianthemum*

plants in the spring. The mechanism governing continuous blooming is not physiologically understood at the moment and may have no bearing on truffle production, as the field-grown irrigated plants that behaved in this manner produced truffles only at the right season.

Chlorophyll content of all treated and control plants (except "Shade") exhibited two yearly peaks of chlorophyll per gram fresh weight, one in the autumn and another in spring (Figure 3A,B). Whether this reflects waves of appearance of new leaves or of a certain measure of succulency during winter should be clarified. The fluctuations in chlorophyll level more or less coincided with waves of flowering.

The shoot-per-root weight ratio was essentially similar for all treatments (Figure 4A,B; Figure 5) and showed one main peak, reflecting two different growth periods: one, towards winter, where shoot development took priority over root development, and one, from December to March (recorded in April) reflecting a more intensive root development as compared with shoots. This seems to have little to do with the degree of mycorrhization, as contrary to shoot/root patterns, mycorrhization level was different for each treatment (Figure 7). Also, the most vigorous plants were those in bags buried in a soil bed (Table 1), while the most thoroughly mycorrhized plants were those covered with straw. It is still not understood why soil cover induced better mycorrhization. This point will be further studied.

Under field (nonsterile) conditions, calculated mycorrhization ratings up to 10 could reflect contamination, since other soil fungi could have become attached to the roots. Plants given such low ratings were considered nonmycorrhized. Examination of results presented in Figure 7A,B reveals that "Buried" and possibly even "Shade" plants became mycorrhized in the spring. It also seems that field-germinated plants maintained a significant, though low, level of mycorrhization throughout the summer and autumn, then lost mycorrhization in winter (Figure 7B); this could reflect an infection acquired in the natural field. By contrast, greenhouse-germinated seedlings may have lost infection owing to shock incurred when they were transferred outdoors due to greenhouse problems in spring 1992 ; or, alternatively, they may not have been mycorrhized to begin with.

When plants definitely showing a Hartig net were counted for the whole year regardless of intensity of infection (Figure 6), field-germinated plants were consistently more mycorrhized, and the poorest performance was that of the controls. This finding supports the notion that exposure of the root system to overheating may induce deterioration of existing mycorrhizae. Greenhouse-germinated plants kept under shade were the least mycorrhized, which may support the assumption that these plants were already poorly mycorrhized at the onset of sampling.

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Table 1. Yearly average of *Helianthemum sessiliflorum* growth parameters under different growth regimes. Parameters of greenhouse-germinated plants and plants collected from wild are presented separately.

Treatment	Shoot (g)		Root (g)		Leaves (g)	
	Greenhouse	Field	Greenhouse	Field	Greenhouse	Field
Straw	2.19	1.59	0.67	0.48	0.67	0.54
Buried	4.42	0.61	0.96	0.15	1.06	0.16
Shade	0.71	1.04	0.30	0.33	0.22	0.29
Control	1.76	1.10	0.57	0.23	0.49	0.34
*LSD	1.55	0.6	0.4	0.2	0.3	0.18

*LSD = Least Significant Difference

Figure 1. Flowering of *Helianthemum sessiliflorum* plants germinated in the greenhouse and kept under different growth regimes. A: Control plants. B: Buried pots C: Shaded plants. D: Straw-covered pots. Sample 1 was taken in early July 1992 and Sample 12 in early June 1993.

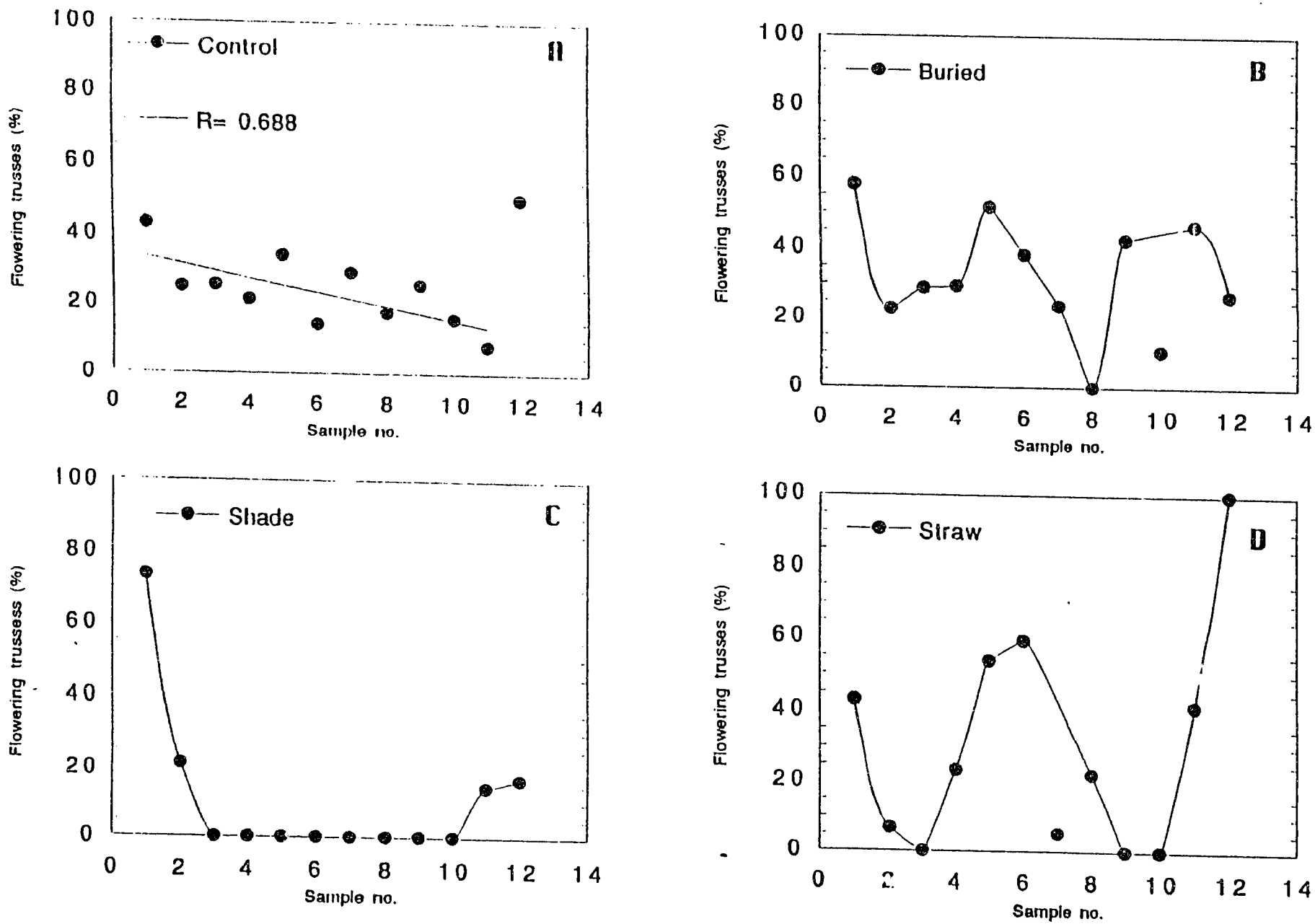


Figure 2. Leaf-to-shoot weight ratios of *Helianthemum sessiliflorum* plants germinated in the greenhouse and kept under different growth regimes. Sample 1 was taken in early July 1992 and Sample 12 in in early June 1993.

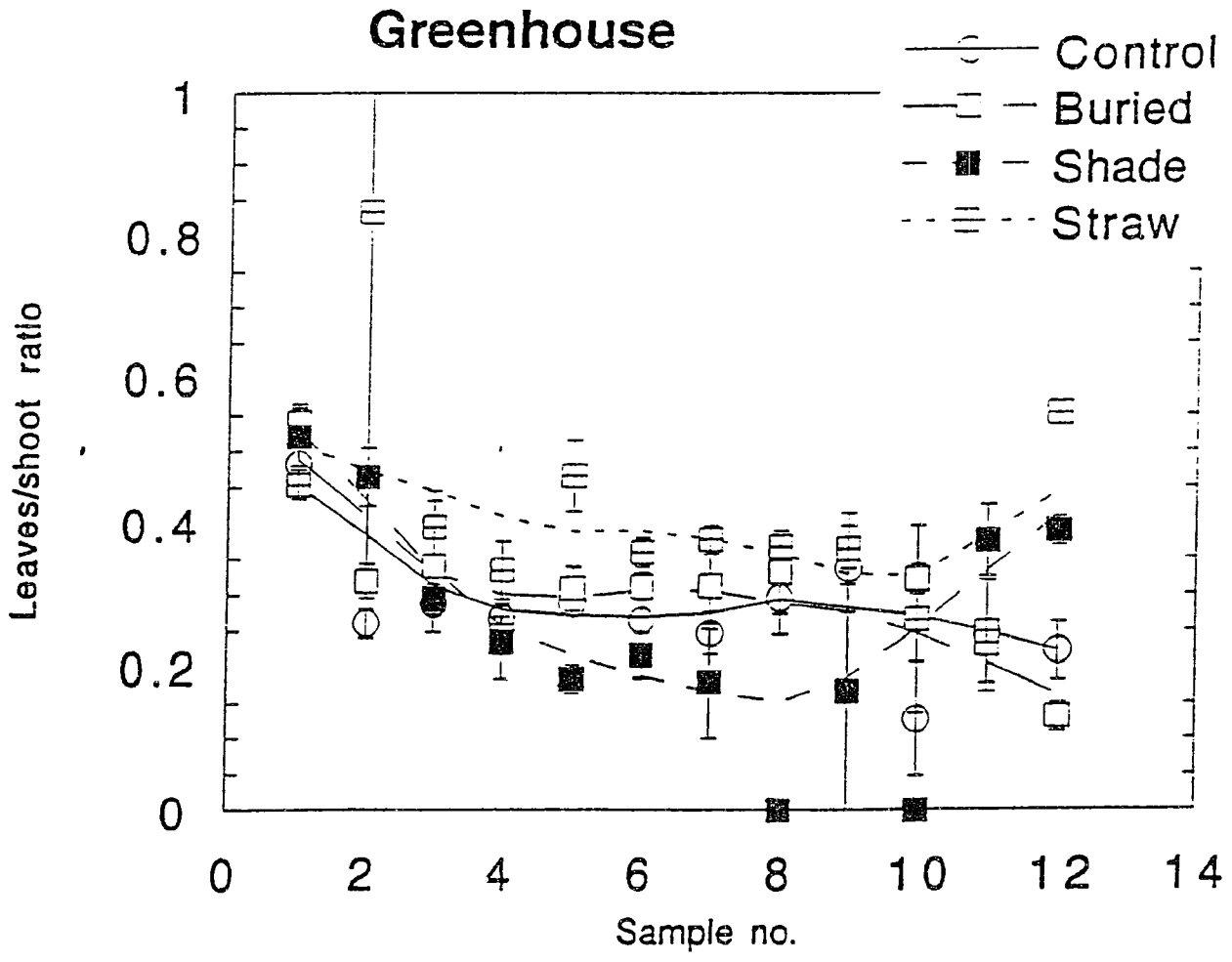
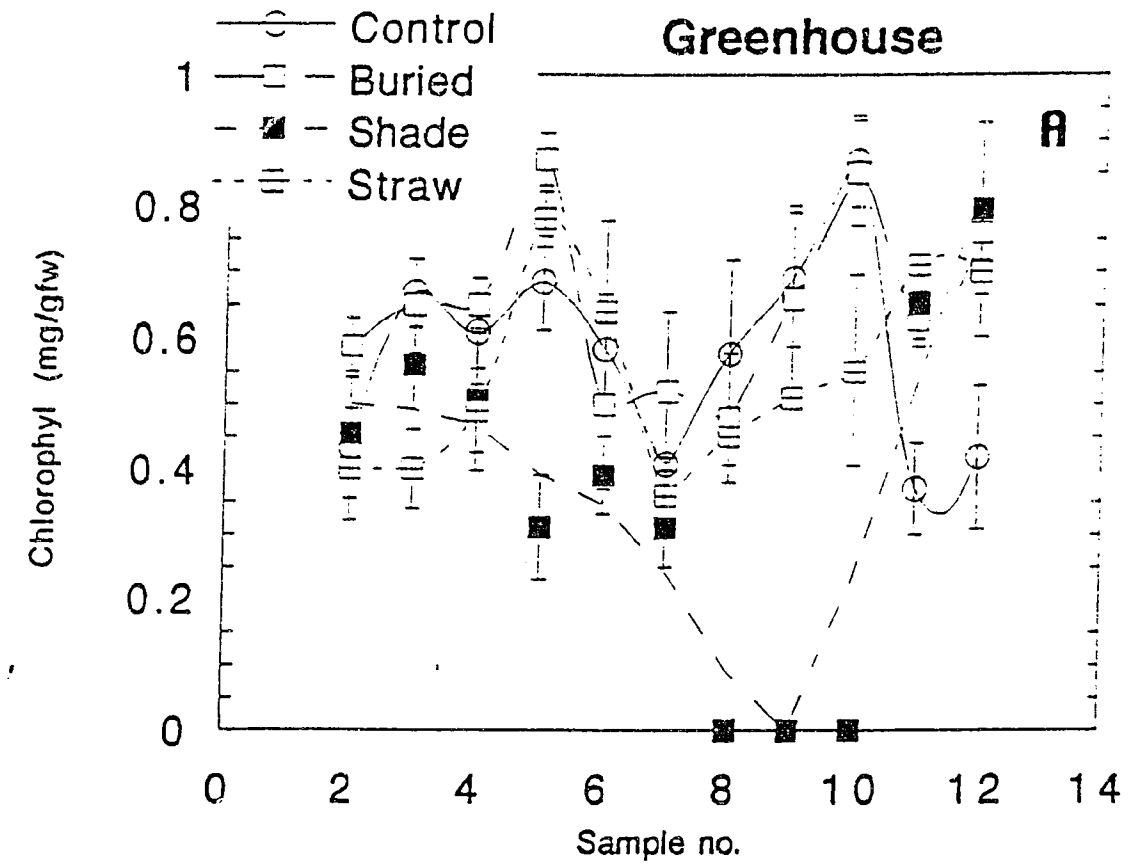


Figure 3. Chlorophyll content (mg/gfw) of *Helianthemum sessiliflorum* plants germinated in the greenhouse (A) or collected from the wild (B) and kept under different growth regimes. Sample 1 was taken in early July 1992 and Sample 12 in in early June 1993.



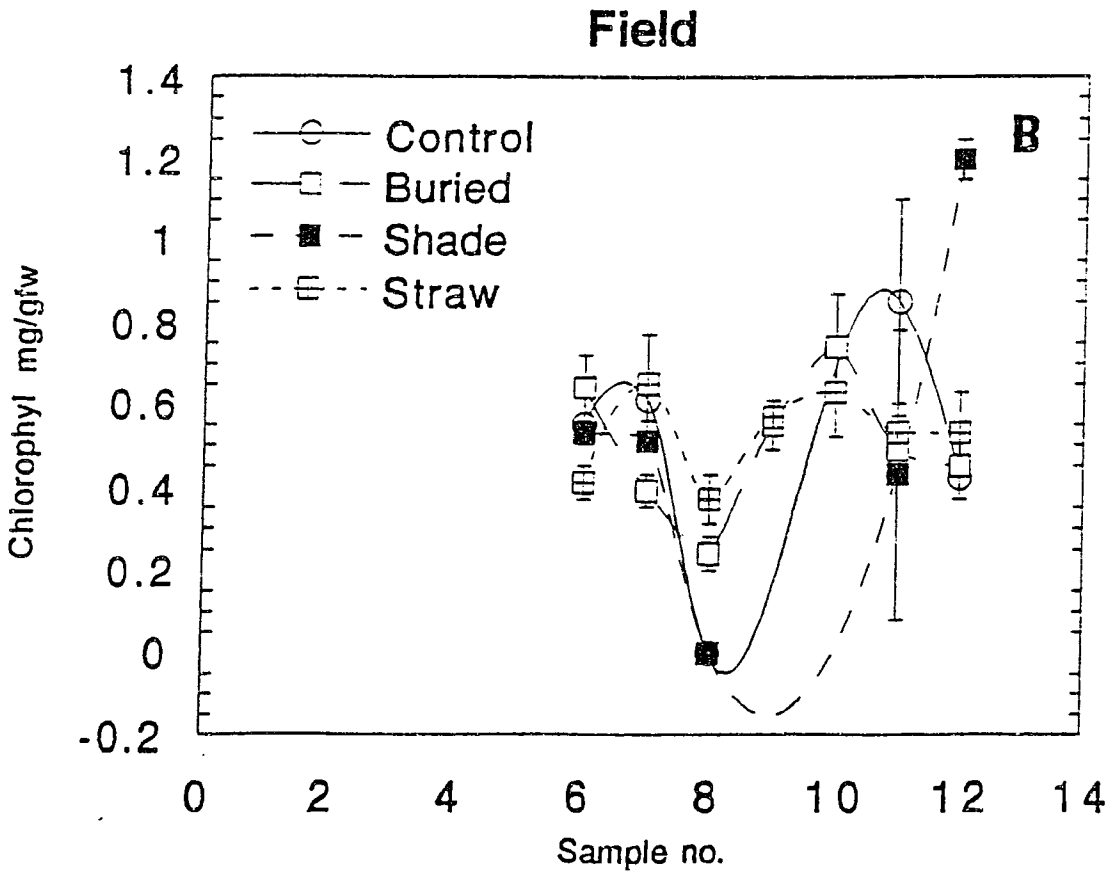


Figure 4. Shoot-per-root weight ratios of *Helianthemum sessiliflorum* plants germinated in the greenhouse (A) or collected from the wild (B) and kept under different growth regimes. Sample 1 was taken in early July 1992 and Sample 12 in in early June 1993.

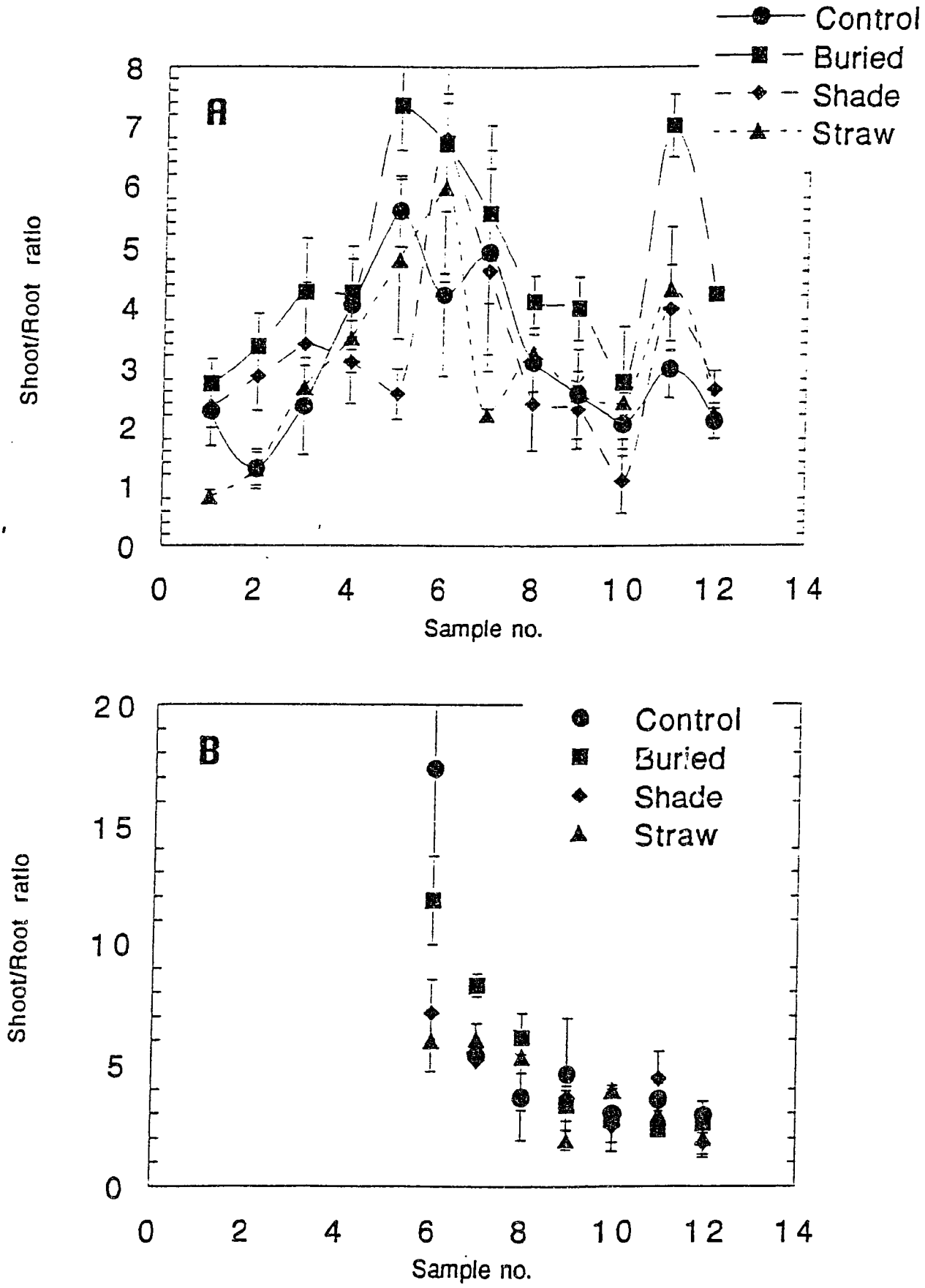


Figure 5. Monthly average values of shoot-per-root weight ratios over all *Helianthemum sessiliflorum* plants, calculated regardless of growth regimes. A: Plants germinated in the greenhouse B: Plants collected from the wild. Sample 1 was taken in early July 1992 and Sample 12 in in early June 1993.

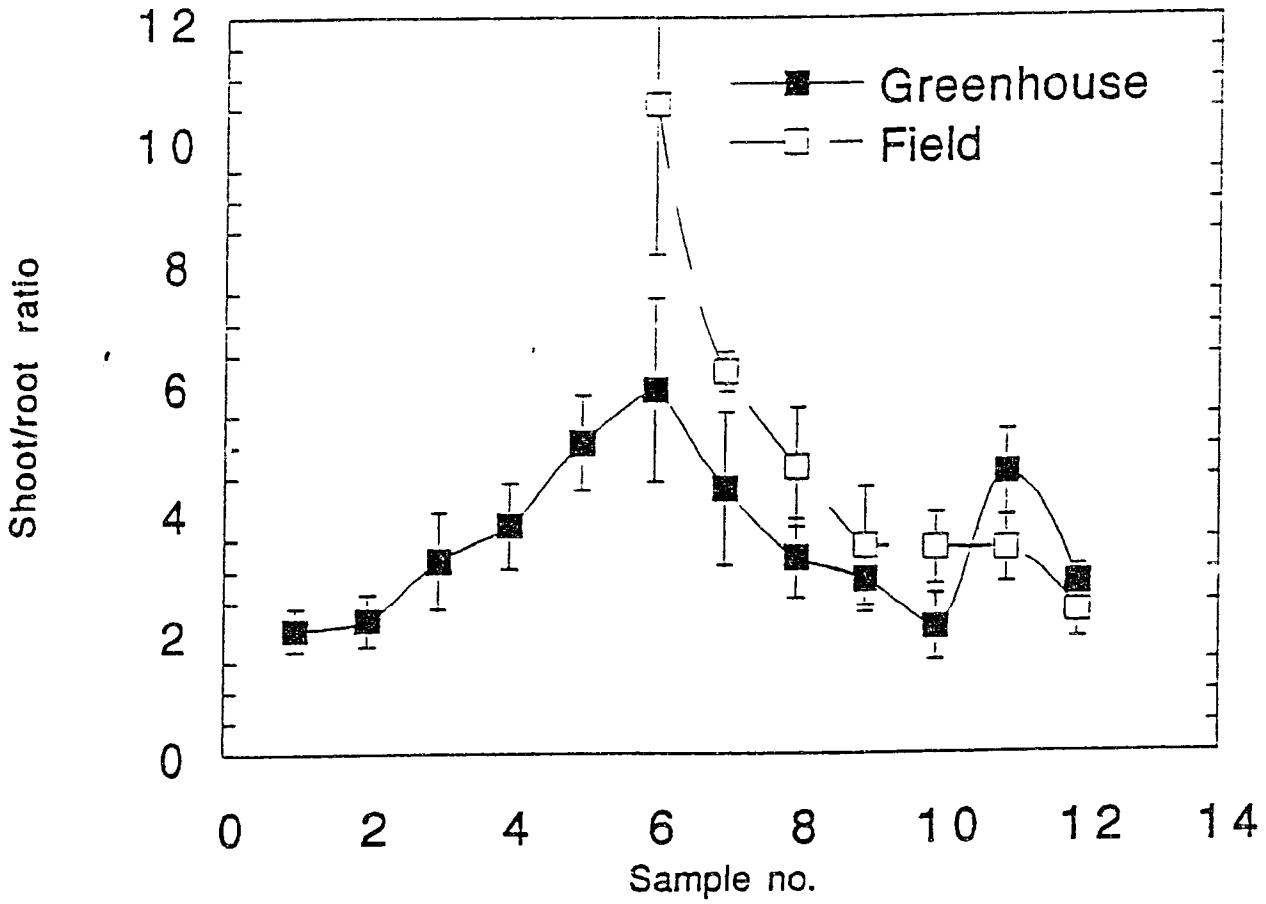


Figure 6. Percent of total number of *Helianthemum sessiliflorum* plants showing a Hartig net in each growth regime.

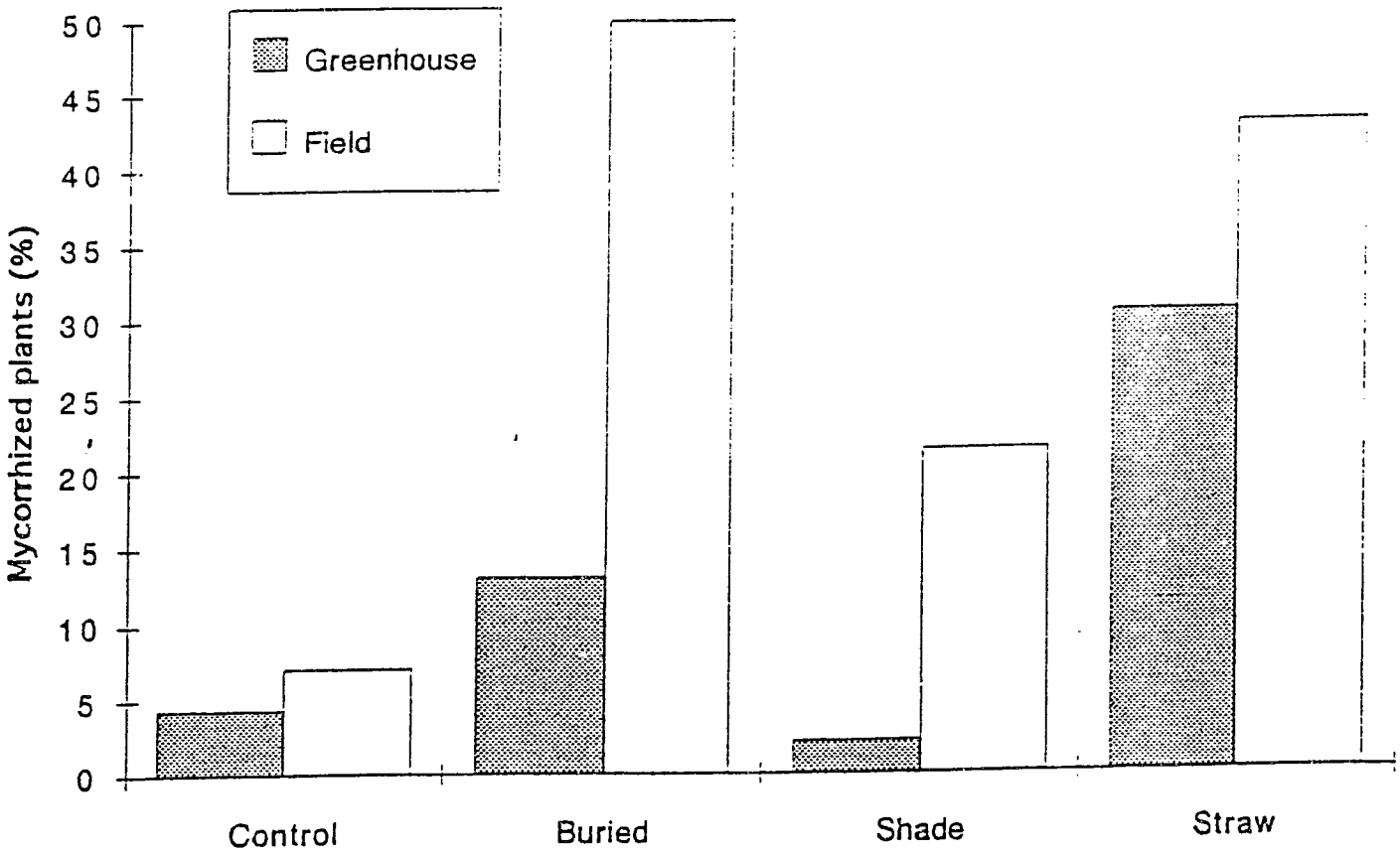
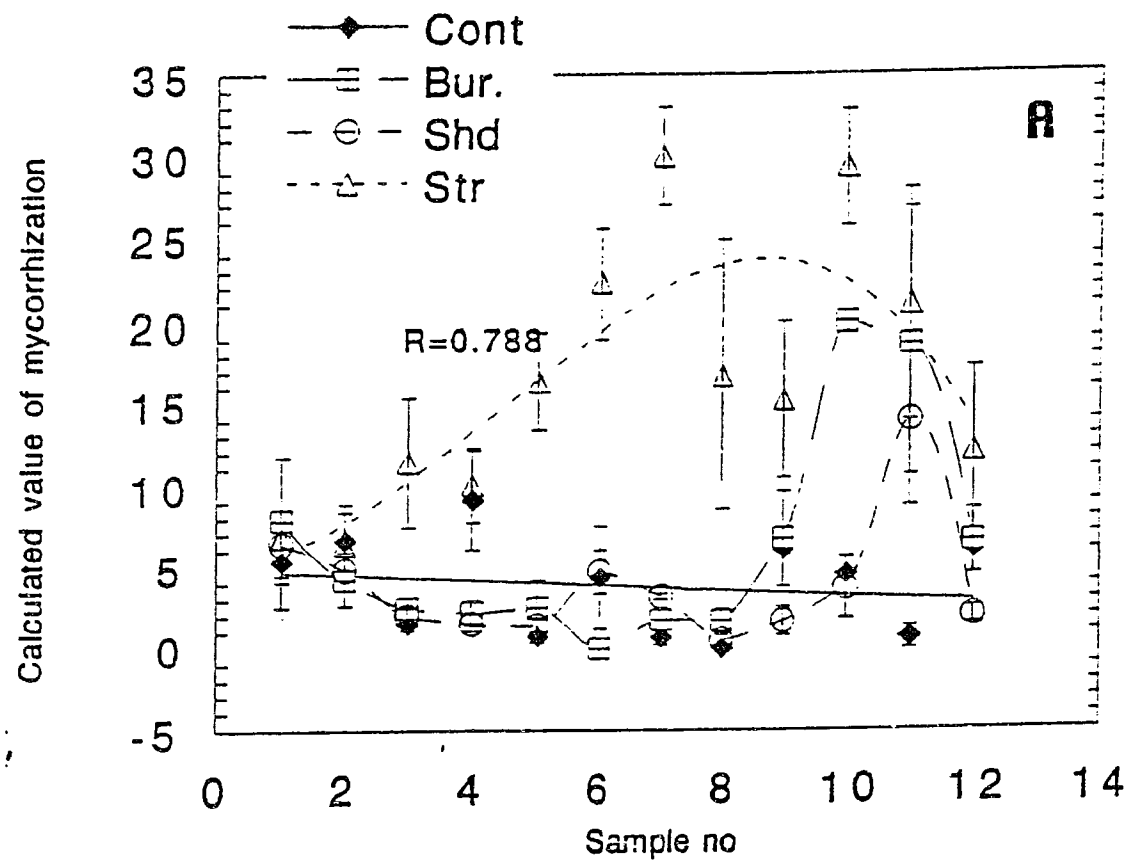
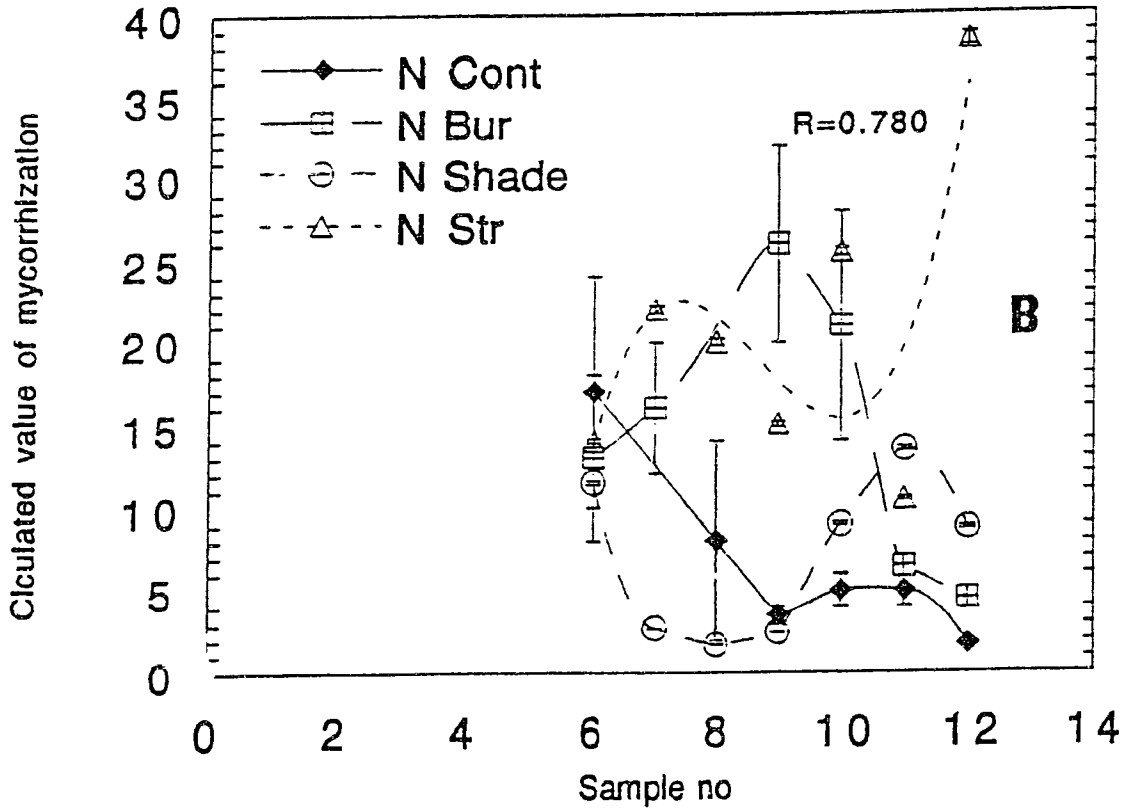


Figure 7. Calculated mycorrhization value (see Materials and Methods) for *Helianthemum sessiliflorum* plants germinated in the greenhouse (A) or collected from the wild (B) and kept under different growth regimes. Sample 1 was taken in early July 1992 and Sample 12 in in early June 1993.





ATTACHMENT C

BUSINESS PLAN
for the
MOROCCAN COOPERATIVE AGRICULTURAL DEVELOPMENT PROJECT
Azemour Site, Morocco

USAID Grant Number HNE-0158-G-00-2075-00

Purpose of the Plan
To present reinvestment options for the revenue generated through project activities, and to identify those options preferred by the Project's Steering Committee. The business plan adopted will provide the parameters for disbursement of estimated revenue of the farm. .

Discussion and Background
San Diego State University Foundation, in collaboration with Maghreb Agriculture, a private agri-business development company in Morocco, and Ben Gurion University of the Negev in Israel, are cooperating together to accomplish project goals identified in the grant.

Technical activities in Morocco are taking place at the project site in Azemour. This site was contributed to the Moroccan Project on a cost sharing basis by Mr. Driss Lahlou. Mr. Lahlou is the President of Maghreb Agriculture.

It is expected that the development of the farm and the adaptation of new technologies the farm will generate revenue from the sale of crops. It is also expected that the revenue will grow as production expands and new markets are identified. Therefore, a plan for distribution of this revenue needs to be addressed early-on in the project.

USAID Parameters
This business plan is based on current Office of Management and Budget Circular A-110 guidelines for program related income.

Revenue
The revenue from the sale of farm products should be retained by Maghreb Agriculture and used according to a plan designed and approved by the Steering Committee. Revenue will be used to further program objective in the following ways:

- provide additional training and demonstration at the project site in Azemour for Moroccan farmers, thus increasing the cost-sharing contributions of our Moroccan partner;
- provide funds to expand the varieties of fruits, vegetables and ornamentals under investigation in Azemour;
- invest in a hydrology study for the farm in Azemour to determine long-term impact of water use in the region;
- invest in other items that further program objectives.

Reporting

Maghreb Agriculture will be responsible for maintaining accurate, detailed records and documentation of all revenues received and expenditures made in conjunction with this plan. Maghreb Agriculture will provide a quarterly report to San Diego State University Foundation, showing revenue and expenditure information for the preceding quarter. This report will be submitted to the Foundation's U.S. Project Director by the 20th day of the month following the end of the report period. Exhibit A to this plan represents a suggested format for the report.

Budget

A projected estimate of revenues and an estimate of expenditures will be prepared yearly and approved by the Steering Committee.

Conclusion

It is expected that in the long-run, the project will continue. The revenue generated from the sale of products will be used to perpetuate activities at the farm beyond the support of USAID.

Messr. Driss Lahlou
President, Maghreb Agriculture

9/10/93
Date

Mr. Frank DiSanto
Director, Grants and Contracts Administration, SDSUF

9/14/93
Date