

Semi Annual Report

Covering the period from December 2008 to June 2009

**Submitted to the U.S Agency for International Development: Bureau for Economic
Growth Agriculture and Trade (Middle Eastern Regional Cooperation)**

**Project title: The Introduction of New Crops to Arid and Saline Zones
In Israel and Jordan**

MERC project M24-004

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Grantee Institution: The Arava Institute for Environmental Studies (AIES) Israel

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Institution: Jordan University of Science and Technology (JUST), Irbid, Jordan

Submitted to:

USAID/EGAT, Washington, DC

U.S. Embassy, Tel Aviv (ECON/AID Office)

USAID Office (Field Mission), Amman, Jordan

JUST, Jordan

Second Report for MERC Project M24-004

I Technical Progress

1a. Research Objectives.

There is a desperate shortage of fresh water in the Middle East. More water resources must be reserved for drinking each year while growing populations also boost the demand for agricultural products. In an effort to supply the needs of the populations for water, food and produce; graywater, run-off water and saline water resources are being used for farming.

This has spurred the search for new crops that tolerate saline, brackish and poor quality water. Attempts are being made to introduce salt tolerant, water saving crops in more sustainable agricultural systems, but not much is known about the long-term sustainability and the benefits of reclamative, drought-resistant cultivars. While the need for such sustainable agricultural systems is obvious, much must be done to develop an alternative set of crop choices that will allow Jordanian and Israeli farmers to make a living while preserving local soil and water resources.

The Objectives of Project M24-004 are:

1. to investigate the benefits and the problems of new water saving sustainable crops in the arid south of Israel and Jordan, specifically the Rift Valley, the southern Negev, the arid areas around the Dead Sea and the Jordan Valley;
2. to exchange germplasm and knowledge about traditional crops, lost crops and water thrifty crop candidates;
3. to set up an Israeli-Jordanian format for cooperation in the arid zones of both countries for the promotion of ecological agriculture and;
4. to establish the foundations for more sustainable agricultural systems suitable for arid lands permaculture and long cycle arboreal crop rotation.

Obstacles, Delays and Boondoggles

The need for water thrifty agriculture

Jordan and Israel are water poor nations, sharing one small river between them and relying increasingly on heavily mineralized fossil aquifers, brackish runoff and reclaimed water. This poor quality water, mixed with chemical fertilizers, is currently being applied to the sparse and fragile topsoils of the arid south. The effect in some areas has been disastrous, with an increase in soil salinity, yields which fall off sharply after a few seasons and worrying levels of wind erosion.

Urbanization of the more hospitable north of both countries has exacerbated this problem, pushing patently unsustainable endeavors into the cheaper land of the sparsely populated south. In both Israel and Jordan, as agriculture moves south, the water becomes progressively saline, the climate more extreme and the soil much poorer. The crops of the Mediterranean zone yield unreliably under such conditions and intensive vegetable farming, done under plastic, salinizes and impoverishes the soil. Conventional agriculture is failing economically as well in some areas with a yearly loss of hectares and cultivars in the Arava and Jordan Valleys (*Mashov, 2002, Ben Chaim*).

As the water shortage becomes more critical, the need for sustainable agricultural development in these arid areas becomes more apparent.

While some high input and high water use agriculture must be done to satisfy the local need for fresh produce, the practice of cultivating winter vegetables, flowers and exotic fruit for export should be minimized and less ecologically damaging crops must be found.

Perennial plants are more suitable for arid zones

Both institutions have come to the conclusion that perennial crops must play a big part in arid zone agriculture.

The AIES has extensive experience with trees for arid areas through the AIES experimental orchard. JUST has a large agroforestry unit, within its Department of Natural Resources and Environment. Perennial plants and their longer cycles of living and yielding are more much suitable to the desert than annual crops: they need little tillage allowing for natural regeneration of soil structure and are more water-thrifty.

Perennial plants allow for a more ecological agriculture; the long slow breakdown of organic matter and release of minerals in the arid zones is suitable for the soil of long-lived plantations. Perennial plantations are friendly to the environment, shading and protecting the soil from the sun, lowering soil temperatures, encouraging colonization of beneficial soil organisms. Trees and perennial plants are sanctuaries and nesting places for birds, hunting grounds for insectivores, feeding areas for pollinating insects, highways into the earth for ants, beneficial nematodes, beneficial fungi and mycorrhizae, as well as conduits for sparse and precious rainfall. When the perennial plantations are established, their mitigating presence allows for the integration of some annual plants to utilize the run-off from the irregular rains.

The Jordanian side of the project has another vital contribution to the search for new perennial crops, a living gene bank for crop candidates and IFT (Indigenous Fruit Trees, also known as IWT, Indigenous Wild Trees). The southern areas of Jordan are a natural preserve for IFT. Many of the plants needed for the germplasm exchange have been mapped and collected by the agroforestry unit of JUST.

Shared benefits

Joint research efforts between Jordan and Israel, the AIES and JUST, are attempting to bring these elements together, allowing both countries and both institutes to benefit synergistically from freely shared resources and freely shared knowledge.

Ib. Research Accomplishments

Progress at JUST

On the campus at JUST, construction is complete of the greenhouse site, which is accommodating the plants transferred from Israel to Jordan. It is a large well planned well built modern greenhouse and quarantine site. A separate progress report from Drs. Tadros and Talazi is attached complete with photos.

Plants from Israel to Jordan.

Currently over a score of plants have been transferred to Jordan.

Balanites aegypticus (Lalob, balm tree or desert date): A lush, small leafed spiny tree with a distinctive white and green trunk that produces a cornucopia of useful material. In Israel and Jordan, it is an undomesticated tree of wadis with deep sand and has not undergone even rudimentary investigation or selection. The Jordanian section of the Rift valley is especially rich in wild trees.

Key references: Vietmeyer and Dafforn *Lost Crops of Africa vol. II, Fruits and vegetables, 2004*

Caperis sinaica, Caperis spinosa, Caperis bendov: spreading drought tolerant, fleshy leafed plants, with edible buds and flowers.

Key references Nissim Crisphil *Medicinal Plants, 1995*

Houmski, *Fruits of Israel*, reprinted 2001

Zisiphus sp. (Domim): Upright thorny evergreen trees of several species. The Jordanian Rift is rich with variations of Zisiphus that can be found in Israel's Rift Valley and the Edom mountains. The trees need little care and produce generous amounts of sweet, red and reddish brown fruits.

Key references Houmski, *Fruits of Israel*, 2001

Popenoe, W., *Manual of Tropical and Subtropical Fruits*, 1920

Acacia sp. (Gopherwood tree): Acacias are esteemed as sources of fodder for wild and domesticated animals that eat some of the small feathery leaves and green thorns and most of the fallen and fresh acacia pods. Four kinds of acacia, one quite rare, live in drift sands of the Rift Valley. Collection of seeds, observation and elementary selection may result in new crops that do not need any supplementary water.

Key references **Saline Agriculture** NAS 1990

Smida and Darom, **Trees In Israel**, Keter 1992

Commiphora sp. (Myrrh): Small deciduous desert trees which are the source of Biblical myrrh.

Key references, Peter Conway **Tree Medicine** 2001.

Boswellia sp. (Frankincense): Swollen trunked xerophytic desert trees with aromatic sap living in gullies, cliffs and wadis. When the tree is “tapped”, the resins run down the bark in long, string like “tears”, which are harvested at the end of the eight month long tapping season. Trees are not tapped until the tree is between five and seven years old. The resins are valued as incense and for treatment of asthma, arthritis and inflammatory disorders of the bowel.

Key references Peter Conway **Tree Medicine** 2001

FAO Non-wood news, March 2002

Cassia sp (Coffee senna, Desert coffee): Cassia is a vigorous small tree with blue green leaves, whorled pods and showers of yellow flowers. The seeds are roasted as a coffee substitute for a particularly potent local brew that protects the liver from parasites and has antibacterial action. Leaves contain anti cancer compounds. The bush or small tree is especially at home in dunes and on terraces where it binds and protects the soil.

The cassia is one of the most useful medicinal plants in arid and semi arid tropics. The flowers are used to treat problems in the throat. The leaves are used to treat abdominal pain, parasite infestation, gout, insect bites and hepatitis. The roots are used to treat malaria and fever and the seeds are prepared by decoction to treat asthma.

One species of cassia is indigenous to Ein Gedi, Israel. Two other species can be found in the Jordanian section of the Rift Valley.

Key references Peter Conway, **Tree Medicine** 2001

Cereus peruvianus (Cactus apple, apple cactus, kubo fruit): An erect columnar cactus with dark green ramifying branches. It is an excellent apiary plant since the long scaly flowers are full of nectar. Cereus has had some commercial success as a minor exotic fruit crop. The plant is very hardy, propagates easily, is water thrifty and is healthiest in mixed plantings.

Key references Mizrachi, Nerd and Nobel, **Cacti As Crops** 1997

Nerd, Raveh and Mizrachi **Adaptation of Five Columnar Cactus Species to Various Conditions in the Negev Desert of Israel** 1993

Argania spinosa: Introduced to Israel in a previous AID program in 1985 and included in Project M20-018, this tree is a botanical treasure and too good and potentially useful to leave out of a germplasm exchange with Jordan. The tree produces nuts, oil, animal fodder, poles and timber. It is easily propagated by seeds and the AIES has a selection of superior trees that are being cloned as a result of work and research done in the prior MERC project. Argania spinosa could be the “olive” of the arid south.

Key references: Morton and Voss **The Argan Tree, Source of Edible Oil**, 1987

Nerd, Eteshola, Boroway and Mizrachi **Growth and Oil Production of Argan in the Negev Desert of Israel**

Dispyros digyma (Black sapote): A relative of the persimmon from the highlands of Mexico, the black sapote is both drought tolerant and salt tolerant. The small tree with the large shiny dark green leaves and dark slender trunk was included in the germplasm exchange with Morocco. It may prove valuable in the permaculture section of JUST because of its long fruiting season and the versatility of the black sapote pulp which can be turned into a variety of VAP, including fruit leather, flavoring, syrup, baked goods and sweets.

Key references, Morton, JF, **Fruits for Warm Climates**, 1987

Selenicereus megalanthus (Topaz fruit): The most delicious of all cactus fruit, also known as the yellow pitaya. This is an extremely drought tolerant, salt tolerant, epiphytic cactus that is grown on a trellis, usually under shade net. A niche market exists for topaz fruit, though little is known about its potential or cultivation needs and hybridization and breeding experiments are current.

E. Solowey **Small Steps Towards Abundance** 2003

Hylocereus sp. (Pitaya. Red pitaya): Large beautiful fruit from climbing epiphyte of the “night queen” family of cacti. The pitaya is also grown under shade net on a trellis and wires. It is already a minor water-thrifty crop in Israel with a small export market to the EU and a niche market for use in making ice cream and frozen yogurt. The flowers are esteemed as materia medica. The AIES has a very large collection of

pitaya cultivars and genotypes and much experience in all aspects of propagation, cultivation and marketing of pitayas.

Key references Mizrahi, Nerd, Nobel, **Cacti As Crops** 1997

Morton, J F, **Fruits For Warm Climates**, 1987

Sclerocarya caffra (Marula) A tree from the SADC region of Africa, the marula is another water thrifty tree whose domestication began in 1985 with an AID project between Ben Gurion University and the Thusano Lefatsheng organization of Botswana. Efforts at selection and domestication gained momentum when the marula was included in the prior MERC project M20-018. A small orchard of selected germplasm from superior trees was planted and germplasm made ready for an exchange with ENAM in Morocco. In Project M24-004, it is proposed that the marula be tried in a permacultural format at JUST where the multiple products of the trees, its attributes and copious fall of fruit will be fully utilized. The fruit can be eaten fresh, turned into brandy, wine, beer and fruit leather. The kernel can be pressed for superior edible and cosmetic oil. The leaves, fruit and fruit skins can be fed to goats, sheep and camels. The male tree is a valuable apiary plant. Marula bark is an anti-malarial, and marula timber is light and hard, with a reddish grain. Marula trees provide dense shade and stabilize sand and eroding soil with highly developed root systems.

Key references Solowey E., **Integrated Sustainable Agroforestry Industrial Crops for the Negev and Arava, Small Steps Towards Abundance**, 2003

Manilkara zapota (Sapodilla): A slow growing evergreen tree with a brown skinned, sweet pear-like fruit. The tree is tolerant of extreme temperatures and poor soils. Sapodillas were planted in the course of project M20-018 to determine their salt tolerance and crop potential at the AIES. In the course of the project, selection and hybridization has produced superior trees. These proven trees should be introduced in the course of project M24-004 to JUST as “headstart” germplasm, needing no reciprocal AIES element.

Key references Morton J.F. **Fruits of Warm Climates**

Popenoe, W. 1974 **Manual of Tropical and Subtropical Fruits**

Chandler W. **Evergreen Orchards**, 1959

Passiflora sp. (Passionfruit): A climbing vine with round sweet fruits full of small flat seeds and delicious watery pulp. A perennial, sometimes deciduous, requiring shade in arid zones but little water with great in-species diversity and much potential for adaptation to desert conditions.

Key references. Morton J. **Fruits for Warm Climates** 1987

Fruits of Southern Australia, Chapman, Sturtz et al, 1985

Vietmeyer et al **Lost Crops of the Incas**, NAS, 1989

Mesquite, (*Prosopis juliflora*): a desert tree with pods full of sugar and protein, extremely hard dense timber, grows in arid and semi arid warm areas, though trees are frost tolerant to -5 degrees and survives on as little as 150 mm rainfall. Used in dune stabilization, arboreal pastures, land reclamation projects. The pods can be turned into syrup, edible low gluten flour or ethanol.

Key references National Academy of Sciences, **Firewood Crops, Shrubs and Tree Species for Energy Production**, 1980

Black Mesquite (*Prosopis negra*): a tree very similar to the mesquite with pods useful for animal feeding to 20% of the ration for domestic animals, not particular to soil but needs more moisture than mesquite and obtains greater heights. It is also very salt tolerant and can be irrigated with brackish water and hypersaline solutions. Key references National Academy of Sciences, **Firewood Crops, Shrubs and Tree Species for Energy Production**, 1980

Tamarugo (*Prosopis tamarugo*) this is an extremely salt and drought tolerant tree from the Atacama Desert. Its pods and leaves are used for animal feeding and its hard timber can be processed into high quality charcoal. It is planted in very arid and saline areas in reclamation projects, to produce timber and fodder and to stop the movement of dunes. This tree survives for years without water in areas with under 50mm rainfall.

Key references National Academy of Sciences, **Firewood Crops, Shrubs and Tree Species for Energy Production**, 1980

Albizia lebbeck A handsome, spreading deciduous tree with white bark. It may reach thirty meters in height. It requires 500mm of rainfall and is not particularly tolerant of salt or drought. The trees are not particular as to soil type but its fodder and timber are excellent. The fodder may supply 27% of a domesticated animal's ration. The worked wood is hard and resembles rosewood. This tree has proved suitable for semi arid uplands with a distinct rainy season. Associated node bacteria are efficient nitrogen fixtures in Albizia lebbeck plantings.

Key references National Academy of sciences, **Firewood Crops, Shrubs and Tree Species for Energy Production**, 1980

Recently added were the seeds of the **Leucaemo** tree.

Plants from Jordan to Israel

The AIES has received the seeds of wild balanites, wild desert figs, wild capers, acacias, cassias and wild zisiphus. The Jordanian myrrh tree, never very numerous appears to be extinct though our partners from JUST have searched for it in the southern part of their country..It is unfortunate that our project apparently started too late to save this small rare tree

Germplasm Exchange

- a. **Preparation of Germplasm**-In order to move seeds, plants or plant parts from one country to another in a biosafe and responsible manner, certain precautions must be taken. All plant parts should be treated with insecticides, fungicides and bactericides and packed in a closed quarantine site, then transported to another closed facility before being unpacked. This is especially true of live plant tissue, such as scions, cuttings or whole live plants. The AIES already has access to a quarantine site. A similar site has been made available at JUST.
- b. **Construction in Jordan** - JUST has built a greenhouse, quarantine bldg. for further work with the germplasm. The AIES site includes an all purpose building/office of insulated panels but the JUST site has usable existing buildings.
- c. **Construction in Israel**-In Israel, a new water and fertilizer injection system has been constructed to extend the current MERC planting area to accommodate new trees. This was the main need of the AIES since most elements necessary for the germplasm exchange were built during the previous germplasm exchange with Morocco. Small groves and sections have been added to existing MERC plantings and a special area has been created for the xerophytes among the "Silk Road Trees" IFT.
- d. **Germplasm exchanges**-Since the distance between JUST and the AIES is not great, three exchanges have already taken place one in Aqaba and the others in Israel. After the plant material is properly packed, it can be transported easily.

Germplasm from Jordan to Israel					
Type of germplasm	Crop candidate	Form	Origin	Destination	Format
IFT or IWT	Lalob (Balanties)	Seeds	JUST	AIES	Xerophyte
IFT or IWT	Wild capers	Seeds	JUST	AIES	Xerophyte
IFT	Wild zisiphus	Seeds	JUST	AIES	Orchard
IFT	Acacia	Seeds	JUST	AIES	Xerophyte
IFT	Desert figs	Seeds	JUST	AIES	Xerophyte
IFT	Cassia sp	Seeds	JUST	AIES	Agroforestry

Germplasm from Israel to Jordan					
Type of germplasm	Crop candidate	Form	Origin	Destination	Format
Orchard	Cereus peruvianes	Cutting	AIES	JUST	Permaculture

Germplasm from Israel to Jordan					
Type of germplasm	Crop candidate	Form	Origin	Destination	Format
Orchard	Argania spinosa	Saplings	AIES	JUST	Permaculture
Orchard	Diospyros digyma	Seeds	AIES	JUST	Permaculture
Cash crop	Topaz fruit	Cutting	AIES	JUST	Net house
Orchard	Sapodilla	Saplings	AIES	JUST	Orchard
Orchard	Marula	Saplings	AIES	JUST	Orchard
Cash crop	Passionfruit	Seeds, plants	AIES	JUST	Net house
Cash crop	Pitaya	Seeds, plants	AIES	JUST	Net house

Grazing Plants					
Type of germplasm	Crop candidate	Form	Origin	Destination	Format
Arboreal pasture	Albitzia lebbeck	Seeds	AIES	JUST	Pasture
Arboreal pasture	Prosopis juliflora	Seeds	AIES	JUST	Pasture
Arboreal pasture	Prosopis tamarugo	Seeds	AIES	JUST	Pasture
Arboreal pasture	Prosopis negra	Seeds	AIES	JUST	Pasture

Potential usefulness of Germplasm		
Crop Candidate	Products	Other uses
Pitaya	Fruit, flowers	Apiary plant. Mulch
Topaz fruit	Fruit, flowers	Apiary plant, mulch
Marula	Fruit, oil, timber, VAP	Browse, shade, reclamative
Passionfruit	Fruit flowers	Apiary plant, pioneer
Balanites	Fruit, oil, flowers, sap, leaves	Browse, shade, poles, fence
Commiphora sp	Sap, smokewood, flowers	Xerophyte, apiary, reclamative
Boswellia sp.	Sap, incense, smokewood	Xerophyte, apiary, reclamative
Acacia	Sap, pods, wood	Xerophyte, apiary, browse,
Cereus cactus	Fruit, VAP	Pioneer plant, apiary plant
Argania	Nuts, oil, wood	Browse, reclamative
Capers	Bud, medicine, cosmetics	Ground cover, apiary plant
Sapodilla	Chicle, fruit, timber	Shade, windbreak, reclamative
Zisiphus	Fruit, poles, VAP, kamaradin	Browse, living fence, windbreak
Cassia	Flowers, leaves, pods	Ground cover, apiary, reclamative

Ic. Scientific Impact of Cooperation

JUST and AIES plan to collaborate on a peer-reviewed paper relating to the potential of the exchanged germplasm to improve land reclamation capabilities, enrich permacultural formats, and facilitate the widespread planting of arboreal pastures.

Id. Project Impact

The teams from AIES and JUST are just beginning to evaluate the possible impacts of this project on our crop libraries, our ability to find new uses for lost crops and the development of new crops from indigenous germplasm.

Ie. Strengthening of Middle Eastern Institutions.

This project has greatly expanded the species library for permaculture, land reclamation and agroforestry in Jordan and Israel. The new construction in Jordan has opened up many possibilities regarding the introduction of plant species and the establishment of wild germplasm planting in Israel is an important step in the conservation and investigation of several species of rare trees.

Project website and link to desertagriculture.org. The website is an important way to disseminate details about the project, convey information about involved plant species, and make contact with other researchers with similar interests and aims, but also serves as a conduit for comment, interaction and further cooperation. A website for Project M24-004 should be created. This site should be linked to the current MERC M20-018 site. In the prior project, the importance of the website was underestimated and not enough funding was budgeted for updating, and for compatible equipment and expansion. The website has facilitated contacts with many people and organizations that otherwise would not have gotten in touch with the AIES. It has proved especially interesting to students and researchers and has been visited by many farmers from other arid areas who have asked questions, made suggestions and offered advice.

- ❖ **Arabic language website** A website for JUST in English and Arabic, linked to the current MERC website would also be useful. An Arabic language website will reach even more interested parties and be very much in keeping with the underlying principles of the MERC program.
- ❖ **This website is currently being designed at JUST**

F. Future Work: The most important work for this coming year in Jordan is the sprouting, growing out and eventual transplant of the germplasm imported from Israel and the trees testing in the agricultural and agroforestry formats around JUST.

In Israel, work continues with the wild germplasm and the search continues for the Jordanian myrrh tree in hopes that it remains as a relict species on the extreme southern border.

After planting, evaluation and follow-up of the health, adaptability, suitability and development of the germplasm is being monitored closely.

Initial Stages. Initial evaluation will take place after the release of germplasm from quarantine. Healthy germplasm will be planted out in the introduction sites. Any suspect plant material will be incinerated.

- a. **Introduction sites** Both the AIES and JUST have appropriate space for the introduction of the exchanged germplasm.
- b. **Evaluation Relative to Format.** A year after planting out, the germplasm will be evaluated relative to format. Adjustments will be made if the plants or species are found to be in a format that is not promoting health and development.
- c. **Monitoring** The phytomonitoring system will be used to gather basic information about the physiology of the germplasm and to aid in germplasm evaluation. The phytomonitoring system records sap flow, leaf temperature, stem and fruit diameter, and soil moisture as well conditions and temperatures in the plant's immediate environment. This information combined with observation and monthly measurements reveals much about the health and development of the germplasm and can allow the researchers to adjust certain factors to facilitate growth. Currently JUST is in the process of purchasing a system compatible to their technological infrastructure.
- d. **Other stages of evaluation.** Some crop candidates will be evaluated relative to their suitability as a cash crop or suitability as a permacultural element. This will take place after the first yields. Decisions and adjustments can be made as soon as the involved researchers reach agreement.

- e. **Open house for researchers and farmers.** An open house for local researchers and farmers would greatly facilitate the introduction of successful crop candidates to other sites and speed their introduction into mainstream agriculture.
- f. **Integration of successful germplasm** Extension work and good relations with local farmers will be necessary to integrate the successful germplasm into current agricultural systems.

Biomimicry: The JUST Department of Natural Resources and Environment is primarily concerned with the establishment of permacultural systems as keys to the reclamation and regeneration of arid areas. Permaculture is a conscious effort to create a useful productive ecosystem, a healthy landscape with room for plants, wild creatures, domesticated animals and man, which can nourish and support them all. A permaculture system may contain many crop plants but the practice of ecological biomimicry melds them together into a synergistic whole.

Xerophyte planting: Taking the principle of biomimicry one step further means that arid lands permaculture in the Arava and Jordan should resemble the possible natural templates, that is, the oasis, the xiji or the acacia grove. This is an untried but logical progression in the search for sustainable and kindly land use in arid and saline lands and the reclamation of these lands. After the xerophytes are reintroduced and propagated, it may be possible to plant them out in appropriate wadis and alluvial fans with little or no supplementary water.

Domestication: Dr. Samer Talozzi has visited Dr. Solowey twice since December 2008., assistant professor of Forestry, is hoping to work with Dr. Solowey in December 2008 to consult on the subject of the domestication of wild species and to pick up additional seeds and cuttings. He was particularly interested in the progress made in the domestication of *Argania spinosa* which is now being planted as a water saving crop in several places in southern Israel.

Formats for Semi Domesticated Germplasm. At JUST, the marula and sapodilla will be planted as sustainable orchard trees, while the argania, sapotes and cactus apples will be integrated into the permaculture plantings. Comparisons between the permaculture format and the agroforestry format at the AIES should yield a harvest of interesting information.

e. **IFT: Lalob.** The genetic material from the wild trees in Jordan in the course of Project M24-004 will provide enough of a base to begin the process of breeding and selection. The balanites have been planted in the sustainable orchard format and the xerophyte format at the AIES.

Caper Wild caper plants from Jordan may provide a needed boost to the domestication and development process of the mustard caper, which was initiated in project M20-018, and further the adaptation for the spiny caper to arid lands agricultural formats. Domestication has begun now with the Egyptian caper, *Caperis aegyptica*.

Basalm, Frankincense, Coffee Senna and Myrrh These other IFT species disappeared from Israel 1,400 years ago. Their reintroduction may have considerable ecological importance, especially if they can eventually be returned to the wild. So far only a few seeds and cuttings have been acquired but they are vigorous and in good condition.

f. **Cash crops:** These species have been cultivated from three to fifteen years at the AIES. The AIES has much experience and genetic material to share as well as information about export, markets and packaging of these crops, important plants if Project M24-004 is to successfully develop sustainable and ecologically sound alternatives to the Mediterranean zone crops currently cultivated.

Time Chart

1 Seasonality: A project such as project M24-004, which involves nursery work, planting and seed collection, has to be built around the distinct seasonality of the desert.

In the Arava, the rest of the Rift, much of the Jordan and the Southern Negev, the winter is the “growing” season. Plants can be started or planted out in the spring or fall. Fruit is usually harvested in fall or spring. The summer is the “fallow” season.

2. Amendments: The time chart will be amended with the agreement of the staff of the AIES and JUST, if and when necessary, in recognition of the fact that project M24-024 is dealing with living plants in an unstable landscape and a precarious political situation.

3. Time Chart (subject to change):

Element	Approximate date
First reciprocal visits	Fall 2007
Germplasm prep.	January 2008
Seed collection	March 2008
Preparation of introduction sites	Summer 2008 at JUST
Germplasm exchange	March 2008
Website and link	July 2008
Planting out AIES	Feb 2009
Monitoring (AIES)	Feb 2009
Monitoring (JUST)	continuously
Meeting of MERC staff	April 2009
Assistant exchange	April 2009
First harvest of cash crops	Fall 2010
First evaluation of cash crops	Fall 2010
First evaluation of permaculture elements	Before 2012
Evaluation of IFT	Before 2012
Yearly meeting	When possible
Student exchange	April 2009
Second evaluation of cash crops	Fall 2011
Second evaluation of permaculture elements	Fall 2011
Evaluation of IFT	Fall 2011
Yearly meeting	April 2011
Final evaluations	April 2011
Open house	April 2011
Final papers and report	June 2011

4. Further Plans: The successful germplasm from project M24 004 will enter the agricultural base of the arid zones of Jordan and Israel, giving crop choice, acting as reclamative plants and permacultural elements. These activities will facilitate the utilization of the knowledge and plant material of the project. The successful IFT will be reintroduced to appropriate wadis and alluvial areas in the region of the AIES where they can be monitored.

- a. Distribution of information locally in Israel and Jordan.
- b. Distribution of germplasm to interested parties.
- c. Integration into existing agricultural systems.
- d. Cooperation with local R and D.
- e. Continued extension work.
- f. cooperation on the domestication of wild species.
- g.. Continuation of the website.

Section II Project Management and Cooperation

- A. **Managerial Issues:** The main obstacle to this project was the lack of a suitable partner. Fortunately MERC USAID saw fit to extend support and patience until a suitable partner was found. Now the AIES is working with JUST, a well regarded university with comprehensive facilities and experienced scientists. This has caused some changes to the timetable and the budget and of course, the staff of the project. But now progress is being made rapidly toward the project goals.
- B. **Special Concerns Issues.**
- C. **Cooperation, Travel and Training.** Since the last report, another two trips have been made. Both were meetings at the AIES between the AIES and JUST teams. Dr. Talozzi met with Dr. Solowey over the course of two days at the AIES. The third and fourth germplasm exchange took place, as well as visits to the AIES site, consultations regarding finishing the building at

JUST and discussion of the already exchanged genetic material, which had been transferred to JUST in the first exchanges. In addition,

The training and publication phases of this project are just beginning this summer..

D. Other than the request for no credit extension there are currently no requests for USAID actions from the AIES.

Sincerely,

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