PN-ABC-876

AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

DATE: 3/25/88

MEMORANDUM

TO: AID/PPC/CDIE/DI, room 209 SA-18

FROM: AID/SCI, Victoria Ose VO

SUBJECT: Transmittal of AID/SCI Progress Report(s)

Attached for permanent retention/proper disposition is the following:

AID/SCI Progress Report No. C5-224
1st semiannual July 87 - Jan 88

Attachment

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First Semiannual Report to AID-CDR

Project: Pistachio productivity in arid zones (C5-224)

Period: July 1987 - January 1988

Investigators: Avi Golan* and Herman Lips
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Introduction

The project was officially started on 1 July 1987. Work has been initiated both in Israel and Portugal. Pistachio is a seasonal crop and in order not to loose an entire season the project was started immediately upon approval.

To establish cooperative arrangements Dr. Avi Golan visited the Portuguese group. On this occasion, the overall project was planned in detail and sites for the experimental pistachio orchards to be established in Algrave, Portugal were selected. Eng. Abilio Mendes Gaspar and Professor Miguel Mota visited the Israeli group for observation of the pistachio orchard and nursery at the Avdat Farm (Israel), and for discussion of preliminary data.

In this report we describe the preliminary field and laboratory work.

Field Work

In Israel: A pistachio nursery was established with the help of Mr. J. Maurice at the Avdat Farm. A first shipment of 630 seedlings from

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* Principal Investigator

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that nursery was made to Portugal. An experimental plot was planted at INGRA Lameira, (Lameira), Algrave Province with the assistance of Mr. David Mazigh from Israel. Another 1500 seedlings are now in preparation for transfer to Portugal to complete the experimental plots in different locations.

In Portugal: An experimental plot of 1.7 hectars was planted at Lameira with the seedlings obtained from Israel. A trickle irrigation system was installed in that field. A summary table of species and varieties planted and their conditions in June 1987 is presented in Table 1.

Two new sites, with lower mean winter temperatures, were selected for planting in 1988. One site is near Messines and the second site is located at Benafrin Grande near Loule.

Laboratory Work:

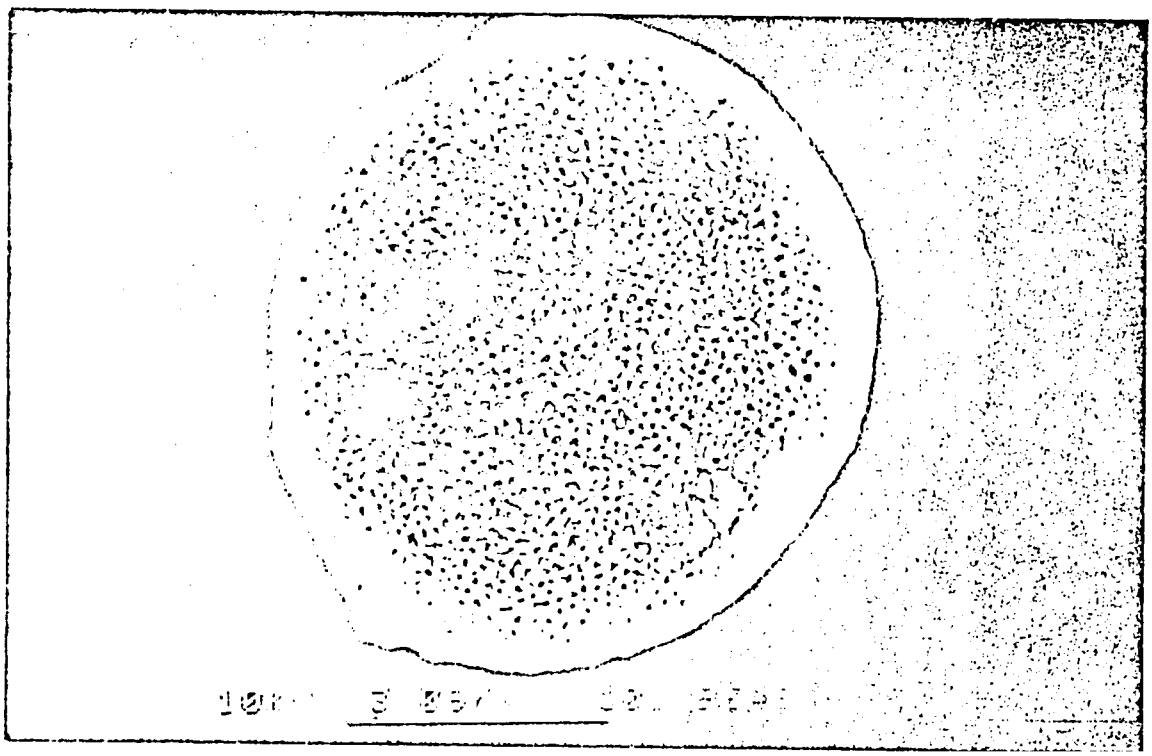
The major scientific problem under investigation in this project is the low fertility of pistachio. We have selected to study mainly the male flower and pollen grain development and biochemical factors involved in its fertility. In the 1987 season male floral buds were collected during growth at six developmental stages from very young buds, smaller than 0.5 cm before spermatogenesis and up to fully developed mature flowers. The specimen were fixed immediately in formaldehyde for light microscopy and in glutaraldehyde for electron microscopy. Those samples are presently being analyzed. Samples of the fixed specimens were sent to Prof. M. Mota for phase contrast microscipic studies. Pollen grains of *Pistacia atlantica* and several *Pistacia vera* varieties were inspected (by Dr. A. Golan and Prof. Mota during the former's visit to Portugal) using a scanning electron microscope (SEM). A characteristic pistachio pollen grain surface as seen in SEM is shown in picture 1.

Table 1: Pistachio seedlings planted at Lameira, Algrave, Portugal - situation on June 1987.

Row	Root Stock	Graft	Seedlings Planted	Seedlings Survived	Seedlings Dead
1	*P. atlantica*	-	40	27	13
2	"	-	40	29	11
3	"	-	40	32	8
4	"	-	40	24	16
5	"	-	40	29	11
6	"	-	40	21	19
7	"	-	40	31	9
8	"	-	40	29	11
9	"	-	40	21	19
10	"	-	40	23	17
11	"	-	37	20	17
12	"	-	31	17	14
13	"	-	29	15	14
14	*P. atlantica*	Larnaca	34	25	9
15	*P. atlantica*	Avdat	2	2	-
	P. vera	-	10	8	2
	P. atlantica	Kerman	20	14	6
16	*P. atlantica*	Avdat	4	3	1
	P. atlantica	Vera (male)	10	8	2
TOTALS*			577	378	199

* 53 seedlings were planted at Revilheira.

Picture 1: Pistachio pollen grain surface as seen in Scanning Electron Microscop (SEM) approximately 3000x.



Work Plan

Research work in progress is on the analysis and summary of the microscopic developmental study of pistacio male flower. In the 1988 season, which starts towards the end of March, pollen grains of several varieties will be collected and separated according to *in vitro* viability. Populations of pollen of low and high viability will be separated and their surface proteins will be radioactively labelled. The labelled proteins will be extracted and separated by SDS-Polyacrylamide gel electrophoresis (SDS-PAGE) and marker proteins of each population will be selected for monoclonal antibodies production. During the 1988 season we plan to complete the transplantation and grafting of pistachio seedlings in the experimental plots in Algrave. The establishment and development of these orchards will be followed by physiological and phenological measurements. It is quite essential that, as soon as funding is available, a Portuguese graduate student will join the Israeli group to work on planned field and laboratory experiments, especially on the effect of saline water on pistachio productivity.

The Pistachio as a Study Case for Crop Trees in Arid Zones

C5-224

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Introduction

There are two reasons for a scientist to be involved in a search for crop trees suitable for arid zones. One is the interest in development of arid zones for the betterment of life of human beings in these areas. Another reason is the scientific curiosity and the wish to understand the biology and adaptation mechanisms of plants to arid conditions.

I am very glad to have initiated the cooperation between our Portuguese colleagues of the Estacao Agronomic Nacional (EAN) and our group at the Blaustein Institute for Desert Research of the Ben-Gurion University of the Negev. In the first two years, since we first met, we have been able to establish the pistachio project and make substantial progress. Here, I want to describe the experience accumulated in the pistachio project as a study case. Carob, cork oak and Leucaenae are now under consideration as potential trees for arid zones as well.

It has been shown by M. Evenari and co-workers that pistachio trees adapt to the climatic conditions of the Negev highlands. The trees develope well and produce fruit on runoff water. Our aim now is to better understand the biology of this crop in order to increase its productivity in arid zones.

Pistachio Fertility

The genus *Pistacia* L. (Anacardiaceae) consists of deciduous trees and shrubs which produce single-seeded drupes. It is well known and reported that *Pistacia* species have a very low seed set. There are reports of trees which have not produce

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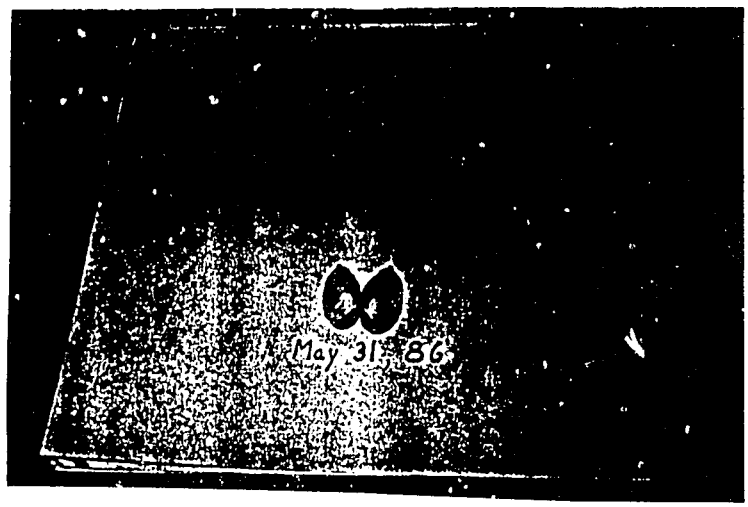
any seed bearing fruits (Grundwag & Fahn, 1969). In a preliminary experiment to estimate biomass production and deposition in the fruit, we found that in one specific tree, out of 4,397 fruits, only three were full. This is of course an extreme case, which, nevertheless, illustrates the problem.

The unique embryology of the pistachio hints at the complexity and potential stages at which developmental failure could occur. The fruit and seed do not develop simultaneously. The pericarp reaches its final size and the endocarp becomes sclerified 5-6 weeks after pollination (Picture 1).

Picture 1: Pistachio fruits six to eight weeks after pollination. The pericarp is fully developed.

During this time the ovule is still small and occupies only a small part of the locule (Picture 2). The fertilized ovule starts to develop rapidly 10-12 weeks after pollination. Full ripening of the fruit and seed occurs about 5 months after pollination.



Picture 2: Pistachio ovule six to eight weeks after pollination. The ovule has not developed yet.

From the embryological point of view, the low seed production of P. vera may be a result of several factors: 1) low pollen fertility and some abnormal pollen development; 2) abnormal female flower development which prevents pollen from reaching the stigmas and/or ovule; and 3) high rate of degeneration of the developing embryo either because of developmental abnormalities or environmental factors. In this project we focus our experimental efforts on pollen fertility using biochemical and microscopic techniques.

Inspite of the low fruit set, yields of up to 12.0 kg per tree were obtained under desert conditions on runoff water alone (Spiegel-Roy et al., 1977). It indicates that pistachio can be productive and may be economical even before the problem of fertility is solved.

Establishment of Experimental Pitachio Orchard in Algrave

Accompanying the basic research on the biology and development of the pistachio, we have started establishing a new experimental pistachio orchard in Algrave. The first site was planted last year (1987) at Lameiras and two new sites were planted last week (on 18 March 1988) at Messines and Benafrim Grande.

The landscape of the site at Lameiras before planting (October 1986) is shown in Picture 3. The same area after planting (August 1987) is shown in Picture 4 (thanks are due to Prof. Mota for providing me with Picture 4).

Picture 3: The site of the pistachio plot at Lameiras on October 1986 before planting the seedlings.

Picture 4: The site of the pistachio plot at Lameiras on August 1987 with the pistachio seedlings, which were planted in February 1987.

Forseeing the need for pistachio seedlings for this project we started a pistachio nursery at Avdat (Picture 5).

Picture 5: A general view of the pistachio nursery at Avdat.

The major objective of this nursery method was to develop a normal seedling with a small volume and weight of root suitable for air transportation. This was achieved by air pruning of the root system. The preparation of the seedlings for transportation includes several stages and treatments. The seedlings were dug out of the soil and the soil then washed off in water (Picture 6). The seedlings were then disinfected (Picture 7) and wrapped in wet paper towels and put in bags for shipment.

Picture 6: The first steps in the preparation of the pistachio seedlings for shipment. Getting the seedling out of the soil and washing off the roots in water.

Picture 7: The seedlings are disinfected and wrapped in wet towels to keep them wet during transportation.

The first shipment of 630 seedling weighed approximately 80 kg. This method of preparing the seedlings in the nursery for overseas transplanting has been developed by Mr. J. Maurice and is continuously being modified and improved.

Summary

The study of pistachio provides us with two avenues of human endevour: 1) basic biological research on infertility in plants and 2) development of techniques and methodologies for growing, transplanting and establishing trees overseas. This project enjoys very enthusiastic cooperation Prof. Miguel Mota and Eng. Abilio Mendes Gaspar of the Estacao Agronomica Nacional (EAN) in Portugal and the Plant Adaptation Research Unit of the Blaustein Institute for Desert Research in Israel. This pistachio project can hopefully provide a good study case for other tree crops suitable for arid zones.

Picture Legend

Picture 1: Pistachio fruits six to eight weeks after pollination. The pericarp is fully developed.

Picture 2: Pistachio ovule six to eight weeks after pollination. The ovule has not developed yet.

Picture 3: The site of the pistachio plot at Larmeiras on October 1986 before planting the seedlings.

Picture 4: The site of the pistachio plot at Larmeiras on August 1987 with the pistachio seedlings, which were planted in February 1987.

Picture 5: A general view of the pistachio nursery at Avdat.

Picture 6: The first steps in the preparation of the pistachio seedlings for shipment. Getting the seedlings out of the soil and washing the roots in water.

Picture 7: The seedlings are disinfected and wrapped in wet towels to keep them wet during transportation.