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COLLECTION, CHARACTERIZATION AND EXCHANGE OF *PISTACIA* GENUS GERMPLASM

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B) Table of Contents

Page

C. Executive Summary

Pistachio represents a potential economic crop in Turkmenistan, however mass destruction of pistachio trees used for firewood, in the past, has led to diminished genetic variability and significantly reduced plantation area. This research and development program is aimed at conserving natural polymorphism of the *Pistacia vera* L. (pistachio) of Turkmenistan and the *Pistacia* genus species of the Mediterranean basin. Producing superior pistachio varieties and establishing plantations has become a national priority of Turkmenistan. Trees growing in natural habitats have vast genetic potential which can be exploited for developing valuable large nut varieties, thus one of the objectives of this program was to select for high quality large fruit varieties. This research activity has broad interest among scientists in Turkmenistan and pistachio growers worldwide.

The world market for pistachio nuts is very large with well-defined quality standards. In efforts to achieve and improve nut quality toward the development of high-value crops, many countries including Turkey, Iran, USA, China and Syria have been conducting long-term research and development programs. Most of the species of the *Pistacia* are underutilized in spite of their biotechnological and reforestation potentials. The main aim of this project was to provide the scientific support for the development of the pistachio (*Pistacia vera*) from a neglected crop in Turkmenistan into a major crop, while conserving the unique germplasm still available before deforestation and desertification processes take place. *Pistacia* genus germplasm conservation and characterization were primary objectives of this project. Identification of molecular markers for early sex determination was among the major targets for characterization. The project also aimed at training young Turkmen scientists in horticultural and molecular techniques for conservation and characterization of germplasm. During the course of the project, seeds of *P. vera* were collected throughout Turkmenistan, germinated and planted in live germplasm collections, both in Turkmenistan and Israel. The project extended and intensified the cooperative arrangements between the Turkmen National Institute of Deserts Flora and Fauna (NIDFF) and the department of Forest Trees Protection and Natural Parks and the management of the Badghiz National Reserve authorities. In light of the high profile of the project at the Ministry of Agriculture of Turkmenistan, the comprehensive report on the status of *Pistacia* research and recognition of the economic potential of this crop in Turkmenistan, Mr. Nury Atamuradov (a young Turkmen scientist trained in Israeli) was awarded , with the most prestigious prize of the President of the State of Turkmenistan for his contributions to promote research and cultivation of pistachio.

The most important achievements of this project are related to the establishment of germplasm collections and experimental plots of *Pistacia* in Turkmenistan and Israel and training of young scientists from developing countries. In the course of the project we have established a laboratory for analysis and evaluation of plant germplasm at the molecular and whole plant levels at the NIDFF. A major achievement of this project at the national Turkmen level is its contribution toward increased awareness of political leaders and decision makers about the importance and economic potential of pistachio for Turkmenistan.

D. Research Objectives

Conservation of understudied and underutilized trees, their characterization and investigation of their potential have broad interest among scientists/agronomists/ biotechnologists worldwide. The *Pistacia* genus, with major representative species in the Mediterranean basin, Middle East, extending to Central Asia regions (*P. atlantica, P. palaestina, P. terebinthus, P. lentiscus, P. khinjuk, P. vera*), falls in this category. In Turkmenistan there are many arid zone plants with unexplored potential - pistachio (*Pistacia vera* L.) being the most outstanding, interesting and with the highest economic potential. The wild woodlands of pistachio in Turkmenistan are among the few last natural resources of this species. Therefore, this project was initiated to study conservation and characterization of *Pistacia* germplasm. in Turkmenistan. The main objective in this project was directed to conserve and characterize the Turkmen pistachio.

The world market for pistachio nuts is very large with well-defined quality standards. In efforts to achieve and improve nut quality toward the development of high-value crops, many countries including Turkey, Iran, USA, China and Syria have been conducting long-term research and development programs for germplam evaluation.

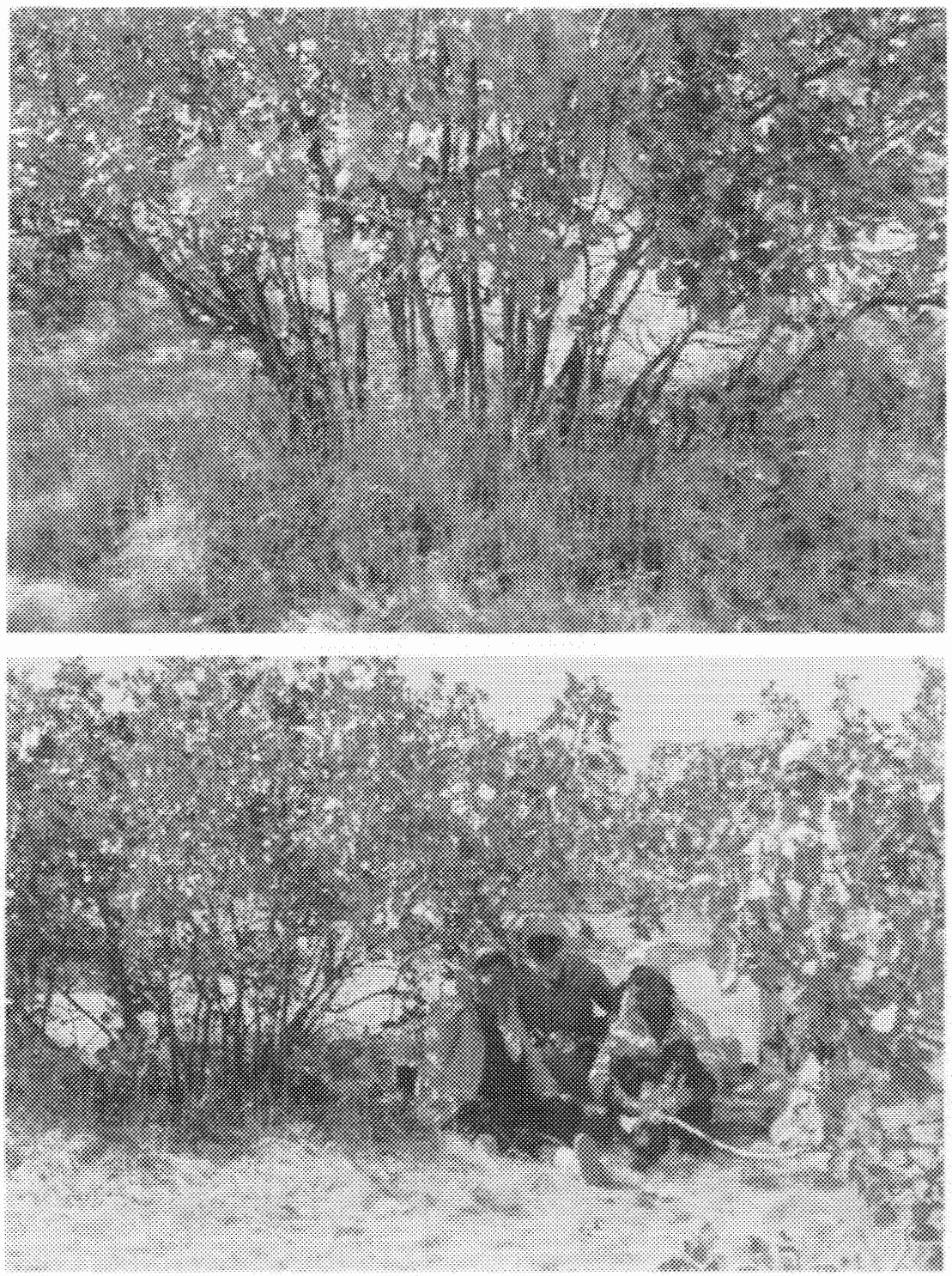
The natural pistachio populations in Turkmenistan contain high variability in fruit size, disease and draught resistance. Pistachio plantations are found in the eastern, central and south-west Kopet Dag, as well as at Kugitang on the Uzbek border in the Hebab region. Most of the pistachio plantations are situated to the east of Kushka river valley. Pulikhatum plantations are 120 km to the west of the same valley. Total area reaches 75,000 ha. The pistachio nut tree is an extremely valuable rain fed crop in Turkmenistan. The organizations engaged with pistachio production make significant contributions to the local economy.

On a global scale the major producers of pistachio nuts are Iran (210,729 ton), USA (63,628 ton), Turkey (47,000 ton), China (25,625 ton), Syria (19,232 ton). Pistachio harvests in Greece, Italy, Afghanistan and Tunisia yield 1,000–4,000 tons while yields in Pakistan, Jordan and Cyprus range from 30-250 ton.

Due to the fact that global demand for pistachio nuts is very high, exporting countries are investing efforts to expand plantation areas. Pistachio is grown on 270,000 ha in the Kerman province of Iran alone, while Syria has ca 60,000 ha of pistachio groves. The number of trees in Turkey has increased from 6.5 million in 1955 to 44 million in 1996. Many countries including USA, Iran, Greece, Cyprus, Spain, Lebanon, and Tunis irrigate their crop, this accelerates crop growth and reduces the rate of transformation into the generative phase (IPGRI Workshop, 14-17 December 1998, Irbid, Jordan, S Padulosi and A. Hadj-Hassan, editors).

In Kushka and near Badkhyz, where pistachio grows in private gardens, it was shown that irrigated trees start to bear fruit after 11-12 years while unirrigated trees bear fruit after 18-20 years. In Central Kara Kums, Takyr, pistachio planted in furrows bore fruit at the age of 14 years. This early fruiting may be explained by the winter rain run-off filling the furrows 2-3 times during the season (K.P. Popov). Thus pistachio development is highly influenced by water supplement and climatic conditions. Therefore the purpose of our work was to improve the technology of pistachio rain crop cultivation. The traditional methods of cultivation (Picture 1) should be improved with modern up-to-date technologies. The following problems were addressed during

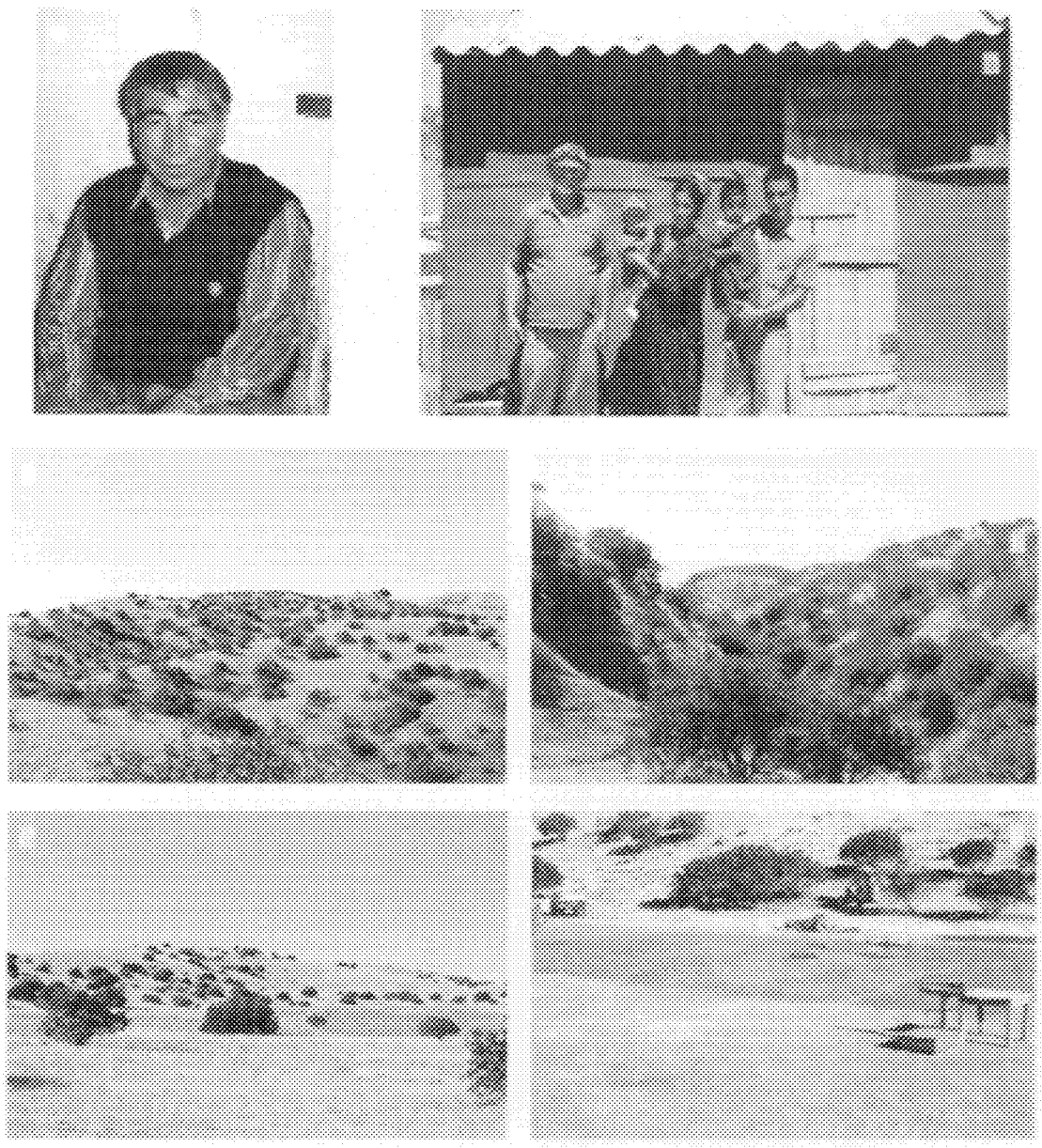
the research period: assessment of agro-techniques on plant development; establishing an experimental plot to compare and select new varieties of highest quality fruits.



Picture 1. Cultivated *P. vera* in Turkmenistan. The orchard is planted in rows 4X8 m. Top - Trees were planted in the 'nested seed' method, 5 - 10 seeds are put in the field directly in each planting hole, resulting in a bushy shrub like appearance of the trees; Bottom - harvesting of seeds is done mainly by women

E. Methods and Results

A detailed summary of the results obtained by the cooperating groups is presented based on data obtained at germplasm collections and experimental fields in Turkmenistan and Israel.



Picture 2: A visit to the *P. vera* wild woodlands in Turkmenistan at the Badkhyz reserve and Agachli that initiated this project. A - The head of the reserve Mr. Tagandurdi Igshi Muradov; B & C - wild woodlands, August 1996; D - Turkmen family, Echedo Juma and A. Golan, at Kepel in Badkhyz reserve. We stayed the night in their home seen in the back; E - woodlands on steep hills at Agachli, Turkmenistan near Afghanistan border; F - Seeds of *P. vera* collected from the wild, sun-dried before storage.

The experimental plots were set at the foothill zone of Kopet Dag mountains, 400 m above sea level, 8-10 km to the east of Ashgabat. Seeds were selected in the Badkhyz National Park (Picture 2). Soil preparation/plowing began in December 2000. Plots were marked and prepared for planting by digging holes 20-25 cm deep and 40x40 cm wide with 4 m width between rows and 5-6 m inter-row space. The second year planting was conducted in an uncultivated plot without plowing, where natural vegetation (sedge-meadow grass including forbs) was conserved. The first set of seedlings was planted in the field in February 2001 and then every year thereafter during the course of the project.

Characterization of the genetic traits of various pistachios was studied in Badkhyz National Park in 2002. Selection of trees with nuts which, in our opinion, have high scientific and economic value, was carried out by experts at the park. A preliminary description of the trees from which the nut samples were collected, was made. All nut samples (31 mother plants) were characterized and given an identification number (Table 1).

Table 1. Characteristics of nut samples of selected genotypes and seedlings produced from them in 2002-2003

No.	Nut length (mm)	Nut width (mm)	Nut weight (g)	Opening %	Autumn	
					Survival rate (%)	Plant height (cm)
1	17.08	10.05	0.65	71	62	6.5
2	16.03	10.06	0.64	63	85	9.0
3	17.05	10.01	0.90	83	80	9.1
4	19.0	11.02	0.99	80	100	10.6
5	16.0	10.09	0.92	61	66	8.0
6	17.0	10.06	0.74	67	100	10.2
7	18.07	10.01	0.82	63	83	9.2
8	17.09	10.09	0.82	97	60	8.2
9	15.0	10.08	0.65	96	72	8.7
10	16.02	12.0	0.89	95	60	7.1
11	14.04	10.05	0.66	70	84	8.8
12	17.03	12.01	0.86	73	66	8.0
13	19.08	14.03	1.18	10	86	9.5
14	18.03	10.04	0.75	82	60	7.9
15	15.0	10.02	0.79	64	100	10.9
16	17.06	10.05	0.76	91	70	8.6
17	16.05	11.0	0.84	65	95	9.4
18	17.0	10.0	0.72	91	60	7.9
19	17.04	11.03	0.85	90	75	8.9
20	16.05	12.02	0.78	71	60	7.7
21	18.05	10.05	0.79	93	100	12.6
22	20.0	11.0	0.83	93	80	8.9
23	16.03	9.07	0.66	63	92	9.0
24	18.0	10.03	0.80	78	64	7.4
25	17.09	11.0	0.81	95	61	7.7
26	19.05	11.03	0.90	93	100	9.3
27	10.07	10.0	0.74	65	90	9.6

28	10.07	10.0	0.79	85	100	9.2
29	10.05	10.0	0.69	60	80	9.0
30	10.07	10.02	0.91	88	60	6.6
31	10.04	10.0	0.73	75	85	10.0

Part of the seeds from each sample were kept in storage in order to make additional comparisons and tests. The remaining seeds from each sample were sown in a plot, utilizing strip plowing, in holes 8 m between strips. Twenty sowing spots were allotted to each sample. Before planting, the holes were filled-up to the top with moist soil. Two to three pistachio seeds were planted in each hole at a depth of 5-6 cm.
Climatic conditions during the experimental period were monitored and analyzed. Two vegetative years were relatively wet and one year was dry, having an adverse effect on pistachio sown in rain-fed crop condition (table 2).

Table 2. Meteorological data in Archabil st. (Phiruza)

Months	6	7	8	9	10	11	12	1	2	3	4	5	total
2000-2001													
Precipitation (mm)	15.7	3.1	0.3	36.5	13.3	26.9	12.5	6.8	9	28.3	23.2	24	199.6
Temperature (°C)	23.8	26.5	26.3	21.1	12.2	5.9	5.5	0.8	5.8	10.6	16.4	22.1	
Humidity (%)	47	41	44	60	72	77	80	77	60	61	63	51	
2001-2002													
Precipitation (mm)	0	0.3	5.7	0	19	26.9	36.6	47.4	8.8	54.1	111	51.7	361.5
Temperature (°C)	25.5	26.7	26.2	20.1	13.1	9.1	5.8	4.3	5.9	10.6	12.7	17.2	
Humidity (%)	42	38	41	44	70	78	76	76	67	67	81	67	
2002-2003													
Precipitation (mm)	0	15	0	0	1.5	46	30.3	15.6	50.2	72.7	118.2	51.7	401.2
Temperature (°C)	24.7	26.7	26.3	21.5	17.2	9.3	-1.4	3.6	4.2	6.2	12	17.2	
Humidity (%)	48	43	42	42	58	79	82	74	83	82	80	67	

During 2001-2002, total precipitation was ca 200 mm with non-uniform monthly distribution (Archabil st.). 38.5% of the precipitation (50.1 mm) occurred in autumn, with the majority occurring in October when air temperature was relatively high (average 21.1^{0}C), resulting in soil warming. Winter was relatively dry with 14.2% (28.3 mm) of the annual precipitation. Ground drench by the end of February was about 15-20 cm, thus prior to sowing in hollows 30-40 l water per hollow was provided.
The general sowing area was 2 ha. In March-April precipitation was 51.5 mm (relatively low for the given area), but the upper ground layer was moist enough for seeds to germinate normally. The first shoots appeared in the beginning of April. Pistachio plants were observed in 85% of the hollows (table 3).
The height of plants in 2001 reached 6.7 cm. Observations in the middle of June showed that the lower part of the leaves of most plants began to turn yellow and some plants were lost, indicating water deficiency. The average monthly air temperature during this period was high (25.5^{0}C) while relative humidity was low (42%). Therefore in the 3rd quarter of June and at the end of the 2nd quarter of July water was supplied at the rate of 30-40 l per hollow. During autumn 71% of the plants survived reaching a height of 9.2 cm. In the following years the number of plants that survived remained

fairly stable, indicating that in the second year the root system reached an adequate depth where moisture content was sufficient for normal plant development during the summer period, also in light of the fact that this year had ample precipitation. March was relatively warm (average 10.6^{0}C) and pistachio vegetation began early in its second quarter. The average height of plants on the experimental plot in autumn reached 44.4 cm an annual gain of 35.2 cm. During the third year of growth the average height was 59.1 cm and the annual gain was only 15 cm even though this year was very damp. This reduced growth rate may be due to the cool temperatures (average monthly temperature in March was 6.2^{0}C) and up to the middle of April temperatures remained low.

Table 3. Viability, germination and growth dynamics of pistachio during spring and autumn

Cropping method	Sowing period	Plant age (years)	Observation period							
			Spring				Autumn			
			No. holes pcs/ha	No. holes with plant		Plant height (cm)	No. holes with plant		Plant height (cm)	Yearly growth (cm)
				Pcs/ha	%		Pcs/ha	%		
Sowing on clean Plowing	11/2001	1	205	174	85	6.7	145	71	9.2	9.2
		2	-	145	-	30.0	144	70	44.0	35.2
		3	-	144	-	53.9	144	70	59.4	15.0
Sowing on strip Plowing	11/2002	1	205	195	95	11.2	154	75	11.5	11.5
		2	-	154		17.9	154	75	18.9	7.4
	11/2003	1	205	189	92	7.7	176	86	7.7	7.7
Sowing on uncultivated field	11/2002	1	205	160	78	8.2	113	55	8.6	8.6
		2	-	113	55	13.8	30	15	14.5	5.9
	11/2003	1	205	164	80	5.8	41	20	6.0	6.0

Plants began their vegetative cycle at the beginning of April. Active plant growth was observed at the end of April and beginning of May. Growth of the older plants was observed up to the middle of June. So the gain of shoots of the younger plants growing in rain-fed conditions strongly depend not only on the amount of precipitation during winter, but also on prevailing temperatures during active vegetation.

In the vegetative seasons of 2001/2002, precipitation reached 361.5 mm. In autumn it was about 45.9 mm (12.7% of the total annual precipitation). A major rain event occurred in November when air temperatures were relatively low, which allowed moisture accumulation in the ground. Winter for the given area was rather damp. The precipitation was 92.8 mm (27.5% of the total precipitation during the vegetative year). The average monthly temperature was 4.3-5.9^{0}C. Ground drench with rain water in the end of February reached 50-70 cm. Sowing on clean plowed and uncultivated fields was carried out at the end of February. As mentioned above, spring was warm and damp (216.8 mm). The total area used for each method was 2 ha. Shoots of pistachio appeared in the beginning of April. During spring 95% of the plants in the sowing hollows survived in the plowed field and 78% in the uncultivated field. The height of plants during this period was 11.2 and 8.2 cm respectively for plowed and

uncultivated fields. By the end of July drying of lower leaves on the shoots was observed on a small number of plants, indicating that they suffered ground moisture deficiency. During autumn 75% of the plants in the sowing hollows survived in the plowed field and 55% in the uncultivated field.

During the second year of plant growth the number of hollows in which pistachio grew remained unchanged on plowed plots and decreased by 15% on uncultivated plots. The annual gain of plant growth on stripped plowing was 1.3 times higher than that on the uncultivated field. Low viability of plants on the uncultivated field is connected not to the lack of moisture in the ground but to rodent (ground squirrel) infestation on the plots. A significant number of plants had signs of rodent damage and were filled with soil as a result of rodent burrowing activity. Rodent damage and signs of burrowing were rarely observed in strip plowed fields. The action of plowing removes the sedge-meadow herb and seeds of many annual plants, thus natural vegetation in strip plowed plots is almost absent in the first year. Absence of the herb and loosened ground on strip plowed fields hinders the rodents burrowing activity. Annual plant growth on strip plowed fields was 7.4 cm while it was only 5.9 cm on uncultivated fields.

Experiments on strip plowed and uncultivated fields were continued in 2002/2003. The total area sown using the two agrotechnical methods was about 3.5 ha. The vegetative season had abundant precipitation (401.2 mm). Precipitation in autumn, winter and spring was 47.5 mm, 96.1 mm and 242.6 mm respectively. By the end of February ground drench was 80-100 cm. The first pistachio shoots appeared late at the end of the second quarter of April. This was due to relatively low temperatures for this area in March (average 6.2^0C) and beginning of April. At the beginning of May survival rate was 92% on plowed fields while 80% survival was obtained on uncultivated fields. In autumn survival rate decreased slightly in plowed fields, while only 29% of the plants remained in uncultivated fields. Once again this is evidence that uncultivated fields are not suitable for pistachio growth at Badkhyz National Park and the foothills of Kopet Dag, Turkmen conditions, a significant proportion of plants were damaged by rodents.

An orchard was established during the same year on an area of 5 ha from the collected seeds. Nut opening was 60-90% and their weight was within 0.6-1.2 g (table 1). During autumn, plant survival rate in sowed hollows was 60-100%. Analysis of data revealed that seed weight and opening did not affect plant growth and viability, however a correlation between plant survival of each sample and height was observed. Where survival rate was 80-100%, height was 9.7 cm; where survival rate was 60-70%, height was 7.8 cm. We hypothesize that this relation may be due to the mechanical structure of the soil – pistachio viability on condensed light grey soil is relatively low. Further research should be conducted to test this hypothesis and to provide the basis for introducing the proper agro-techniques.

In 2004 experiments were conducted to introduce new clones of *Pistacia vera* into the collection fields. The following activities were performed: sowing pistachio seeds (elite seeds); grafting; evaluating plant growth; vegetative reproduction (plant inoculation). This year 1.5 ha were sown with pistachio, thus the total planted area for the years under review reached 13 ha.

Sowing was carried out in plowed strips 3-4 m in width with 7-8 m between strips. Seeds were stratified before sowing. The seeds were sown in 5-6 cm holes. Sowing was conducted in the middle of February. Seedling germination in spring was 72% and 65% in autumn. Average seedling height was 6,8 cm (Table 4).

Analysis of plant growth dynamics of the 2001-sowings revealed that plant height in

the first year was 9.2 cm, and annual growth reached 34,8 cm in the second year. This was caused by high precipitation during the vegetative period and favorable temperature regimes. In the following two years plant growth was 15.4 and 14.1 cm respectively. Average plant height was 73.5 cm in the 4-th year.

Table 4. Pistachio growth during spring and autumn

Sowing method	Sowing period	Time (years)	Observation period							
			Spring				Autumn			
			holes (pcs/ha)	No. holes with plant		Plant height (cm)	No. holes with plant		Plant height (cm)	Yearly growth (cm)
				Pcs/ha	%		Pcs/ha	%		
Sowing by continuous Plow-up	11/01	1	205	174	85	6.7	145	71	9.2	9.2
		2	-	145	-	30.0	144	70	44.0	34.8
		3	-	144	-	53.9	144	70	59.4	15.4
		4	-	-	-	68.0	-	-	73.5	14.1
Sowing by strip Plow-up	11/01	1	205	189	92	7.7	176	86	7.7	7.7
		2	-	180	85	13.5	180	84	14.0	6.3
	11/04	1	205	147	72	5.0	133	65	6.8	6.8

Soil moisture is an important factor for pistachio establishment and growth. That is why we tested plant response to various soil moisture regimes. Average soil moisture in May was 13.1% in the 0-100cm layer and 11.7% within the 100-150 cm layer.
Within the project period the most intensive seedling growth took place in 2-3-year old plants. In the 2004 season, plant growth was observed till mid-June. Average soil moisture reached 8,8% at the 0-100 cm layer, and 10,2% in the 100-150 cm layer. At the beginning of the second part of July the average soil moisture at 0-100 cm and 100-150 cm declined to values of 5% and 6,8%, respectively. Seedling growth of 2-3-year old plants ceased. Some shrinkage of the first row of leaves was observed in 2004 pistachio sowings, and some plants died. This phenomenon occurred till the end of August; 7% of the seedlings died within that period (Table 4). These results provide evidence that soil moisture in the middle of July is critical for establishment of seedlings in the first year of planting.

Grafting experiments

Grafting experiments were conducted at the Oktokay Woodland-seed Inspectorate. Pistachio rows were plowed in the winter of 2003, creating conditions for moisture

accumulation in the soil and partial weed elimination. Scions were obtained from Karakala station of plant genetic resource and Karrykul, where there are collections of germplasms devoted to development of selected elite pistachio clones of big fruits. Grafting was carried out on June 27, 2003. The success rate of grafts from Karrykul and the Genetic Resource Station was 54% and 10% respectively. This was due probably to the period of time between collection of the scions (buds) and grafting, which was 1 and 2 days respectively (Table 5). The inoculation branches from Karrykul station were 30-40 cm, and the buds were well-formed, while those taken from the Genetic Resources Station were 10-15 cm and not as well-formed buds. During winter, 1-2 big shoots of the selected trees with high nut quality should be developed in order to have good scion inoculation material. Vegetative shoots must be developed before buds may be used for future inoculations.

Table 5. Pistachio grafting.

Location	***Inoculation grafting observation period***	
	16.07.2004	**13.08.2004**
Karrykul (Station of Deserts Institute)	90%	54%
Plant Genetic Resource Station (Maktumkuli etrap). West Turkmenistan near Caspian sea 300 km	45%	10%

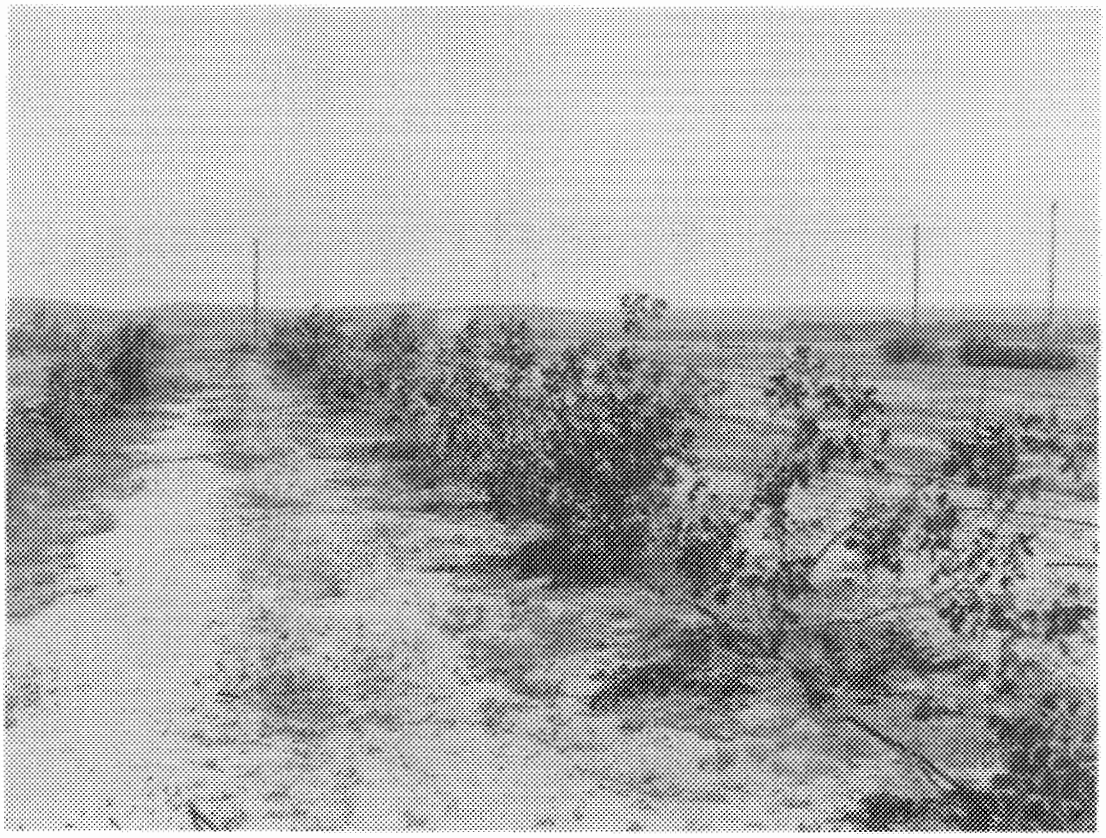
In conclusion, pistachio on rain-fed fields may be sowed annually. Two years during this research were very damp and precipitation provided sufficient moisture for high survival rate of seedlings. One year was very dry. During drought seasons, water must be provided at the rate of 30-40 l/sowing hollow. Survival rate of pistachio seedlings was (70-85%) much higher on plowed plots than on uncultivated fields (20-50%). The main reason for reduced plant survival on uncultivated plots seems to be related not only to lower moisture content in soil but rather to rodent damage. Plant height is 1.3 times higher on cultivated as compared to uncultivated plots. The annual gain of young pistachio depends on both precipitation and prevailing temperatures during active growth.

It is necessary to carry out pistachio sowing after plowing and harrowing the ground. Agrotechnical methods prevent rodent damage and also remove a grassy cover which competes for soil moisture with the pistachio.

In order to assess genetic potential of pistachio germplasm, plots of 31 selected genotypes were established in Badkhyz National Park and the foothills of Kopet Dag mountains. These collections are of significant scientific and economic value.

Germplasm collection at BIDR

In Israel a *Pistacia* germplasm collection was established at the Jacob Blaustein Institute for Desert Research (BIDR) (Picture 3). It contains seven species of the genus: *P. vera* (pistachio); *P. atlantica*; *P. palaestina*; *P. terebinthus*; *P. Khinjuk*; *P. chinensis*; *P. lentiscus*. The collection consists of a large variety of genotypes collected as seeds around the Mediterranean basin, obtained from the University of California at Davis (UCD) germplasm and in Turkmenistan woodlands. The collection functions as a conservation bank for wild germplasm and as a resource for studies on polymorphism,



Picture 3. Turkmen *P. vera* at the BIDR collection

genotype characterization, breeding and biotechnological studies on the potential of *Pistacia* species. A detailed description of the current status of the collection is given in the appendix. The collection site was described and environmental conditions and soil composition were reported (Golan-Goldhirsh and Kostiukovsky, 1997). In the course of this project we made regular measurements to evaluate growth (height, trunk diameter and canopoy size) and phenological traits. Here we present a summary of a representative phenolgical traits, i.e., beginning of new growth in early spring (Fig. 1) and overall plant growth since establishment of the collection (Figs. 2-4).

New growth of *P. vera* and *P. chinensis* starts later than in the other species, indicating the possibility of distinct photoperiodic sensitivity (Fig. 1). Growth and development of *P. vera* expressed in plant height over time was highly similar among accessions from various origins (Fig. 2). There was significantly lower growth of *P. palaestina* from Syria compared to Israeli and Spanish accessions (Fig. 3). Also in *P. lentiscus* there was a substantial difference in the pattern of growth among accessions from various origins. Plants from Cyprus and Israel reached a maximum height after 3 years and stayed at that level (approx. 1 m) in the following years, while accessions from Tunisia continue to grow into their 7th year (Fig. 4).

Development of molecular markers of *Pistacia* to study polymorphism within species (among accessions) and between species in order to identify characteristic markers and study the evolutionary/systematic relationships within the genus were major objectives of the project and training of the Turkmen colleagues and scientists from developing countries. All the species of *Pistacia* are dioecious and early gender-specific molecular marker identification was a specific objective set for the project. The results obtained were summarized and published in reviewed journals and reports. The following is a brief summary of the major findings.

Picture 4: From top to bottom showing Mr. Azat Ataev, who trained in Israel, in the newly established biotechnology laboratory in the course of this project at the Turkmen NIDFF. Middle – grafting at Oktokay experimental plot with Dr. Popov on the right and Mr. Nury Atamuradov second from left. Bottom – germplasm collection plot at the foothills of Kopet Dag

The genetic variability between two populations of Turkmen *P. vera* populations from Kepele and Agachli was evaluated on seedlings grown from seeds collected at these sites (Fig. 5) (Barazani et al., 2003, co-authored by Turkmen and Uzbek collaborators A. Atayev, K. Popov and B. Yakubov). Plant growth rate (Fig. 6) and random amplified polymorphic DNA (RAPD) analysis showed distinct differences between the two populations (Fig. 7). Cluster analysis divided most of the accessions into 2 distinct genetic groups according to their geographic origin (Fig. 7). High similarity values and small genetic differences reflect plausible gene flow between Kepele and Agachli, which are 100 Km apart. Growing the accessions on the same plot, under similar conditions enabled the evaluation of genotypic differences. Continued evaluation of developmental and genetic parameters of *Pistacia* germplasm will be useful in selection of useful genotypes for crop improvement.

The *P. lentiscus* (mastic tree) is well known in Mediterranean countries for its resin, mastic gum, used since antiquity for incense, as a chewing gum for pleasant breath, for spicing liqueurs and jam and in the cosmetic industry (Browicz, 1987). At the BIDR germplasm collection of *Pistacia* spp. there are accessions from different locations around the Mediterranean basin (Israel, Cyprus, Spain and Tunisia) maintained under similar conditions. Therefore, this germplasm affords the possibility to assess the genetic basis for phenotypic variation. We have compared the chemical and morphological variation among accessions in relation to the genetic polymorphism evaluated by RAPD (Barazani et al., 2003). High polymorphism in morphological parameters was found among accessions, with no significant differences in relation to geographical origin, or gender. GC-MS analysis of leaves extracted by *t*-butyl methyl ether, showed 12 monoterpenes, seven sesquiterpenes, and one linear monoterpenic compound (Table 6). Cluster analysis divided the accessions into two main groups according to the relative content of the major compounds, with no relation to their geographical origin. In contrast, a dendogram based on RAPD analysis gave two main clusters according to their geographical origin.

The genetic relationships among Mediterranean *Pistacia* species was evaluated based on the BIDR germplasm collection, using RAPD and amplified fragment length polymorphism (AFLP) analyses (Golan-Goldhirsh et al., 2004). Dendograms constructed from the similarity matrices showed that *Pistacia* species could be clustered into two groups, one group containing all the *P. lentiscus* accessions and the second group containing all other accessions (Fig. 8). The latter group was divided into two groups, one consisting of *P. palaestina* and *P. terebinthus*; the other consisting of *P. atlantica, P. Khinjuk*, and *P. vera*. *P. vera* and *P. khinjuk* were highly similar, as were *P. palaestina* and *P. terebinthus*.

In the course of this project we have identified and characterized a dehydrin-like protein, which accumulates in the bud and bark of *Pistacia* trees during fall and winter and degrades upon flowering (Golan-Goldhirsh et al., 1998; Peri et al., 1999; Yakubov et al., 2005). We have isolated a full-length cDNA clone of the gene from a *P. vera* cDNA library and sequenced it (GeneBank accession no. Y07600). We have suggested that the dehydrin of pistachio may have a dual function, a role in drought and cold tolerances, as well as serving as a storage protein.

We have developed a method for early sex identification in *P. vera* based on a combination of sequence characterized amplified regions (SCAR) primers and Touchdown-PCR (Yakubov et al., 2005).

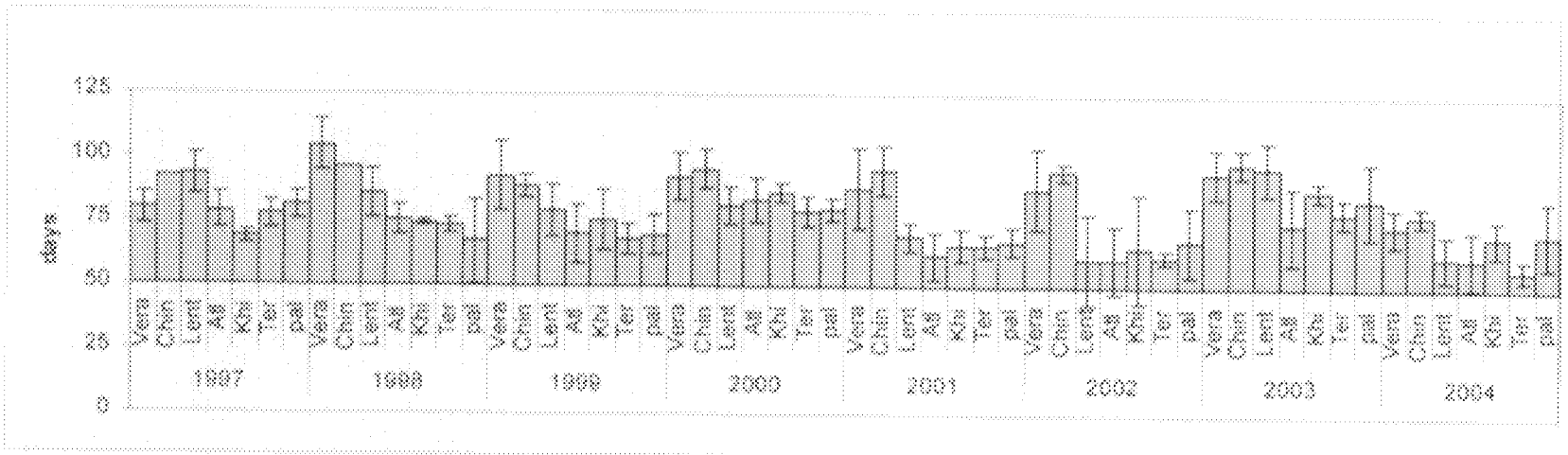


Figure 1. Comparison of time (days) until initiation of new growth from the first of January of each season. Showing all *Pistacia* species in the collection at BIDR from 1997 to 2004

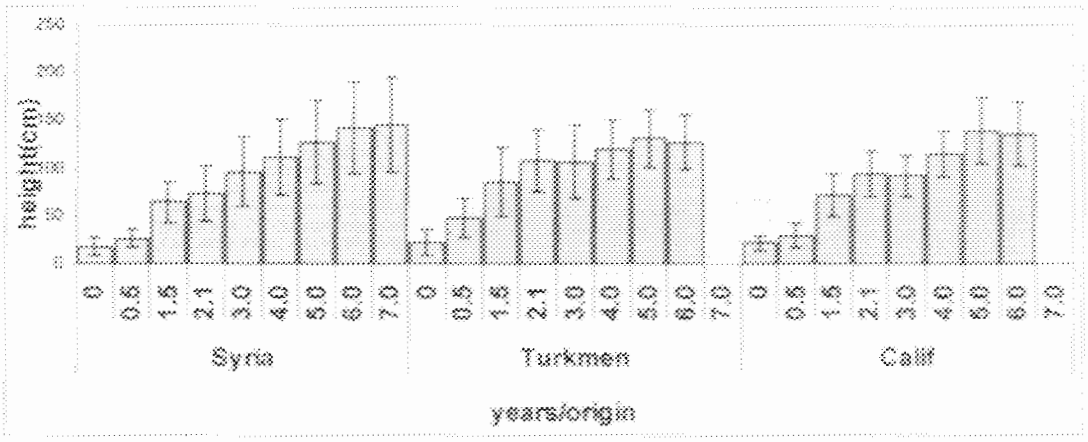


Figure 2. Comparison of plant height of *P. vera* plants from various origins growing at BIDR germplasm

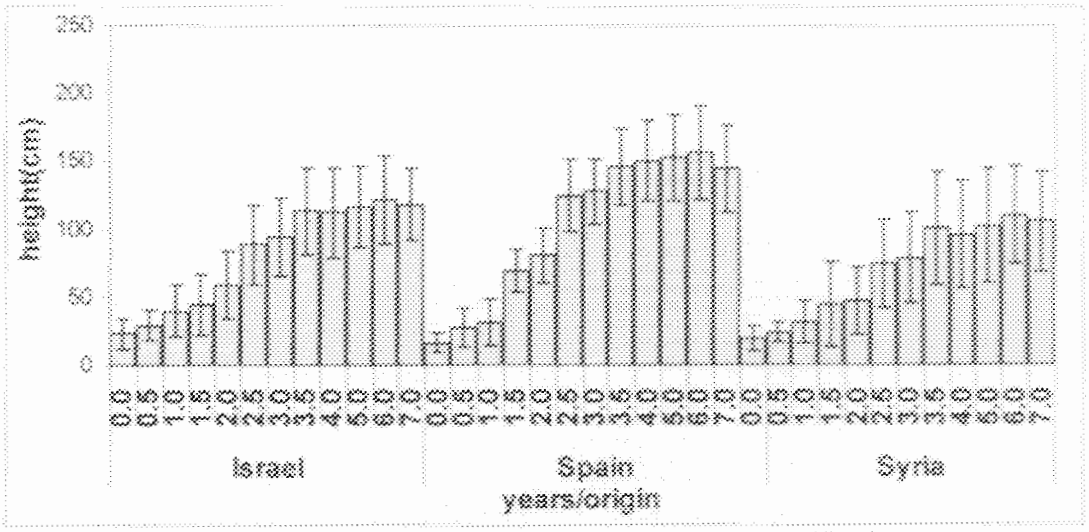


Figure 3. Comparison of plant height of *P. palaestina* plants from various origins growing at BIDR germplasm

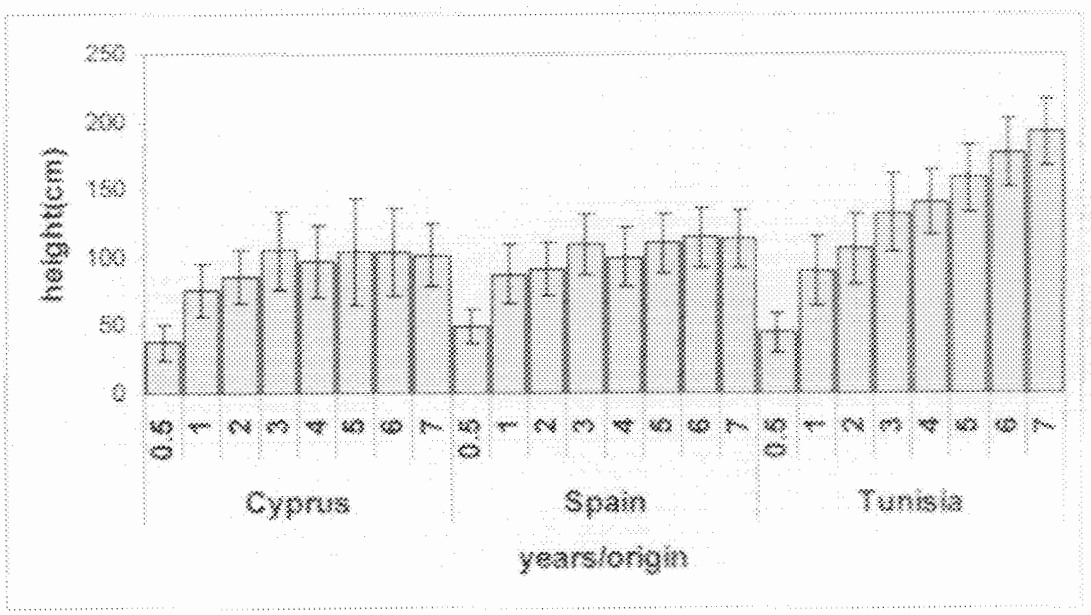


Figure 4. Comparison of plant height of *P. lentiscus* plants from various origins growing at BIDR germplasm

Fig. 5. Map of Turkmenistan showing seed collection sites at Kepele and Agachli

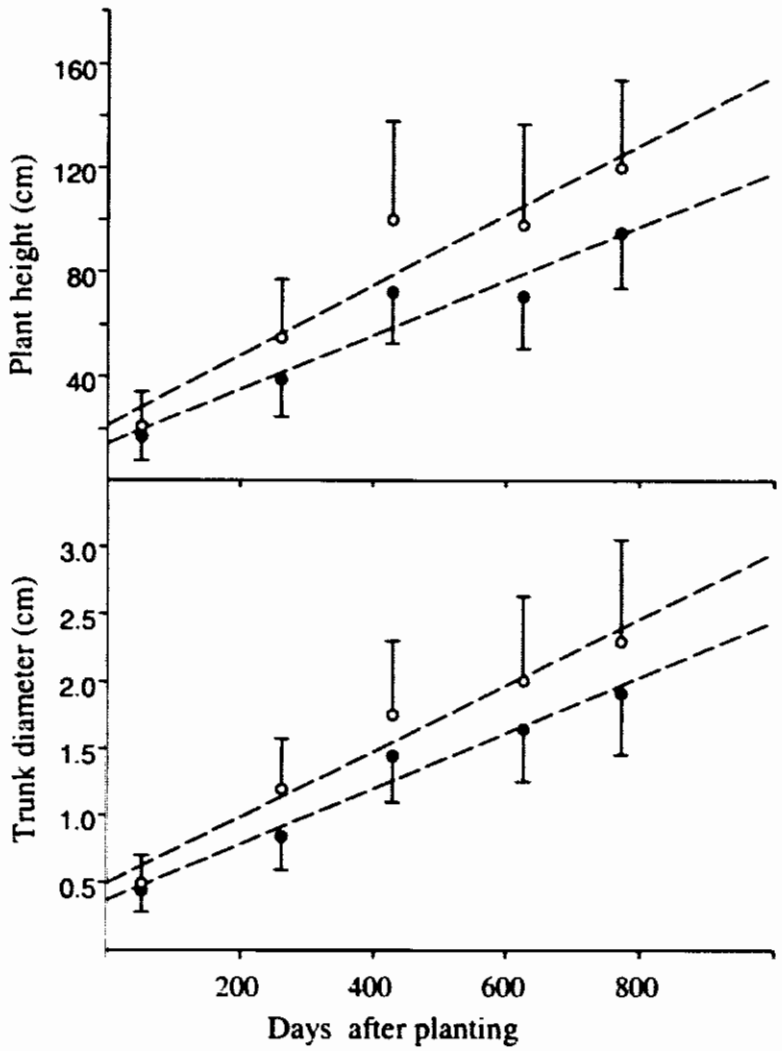


Fig. 6. The average plant height (cm) and trunk diameter (cm) of *Pistacia vera* L. accessions of Agachli (▫) and Kepele (●)

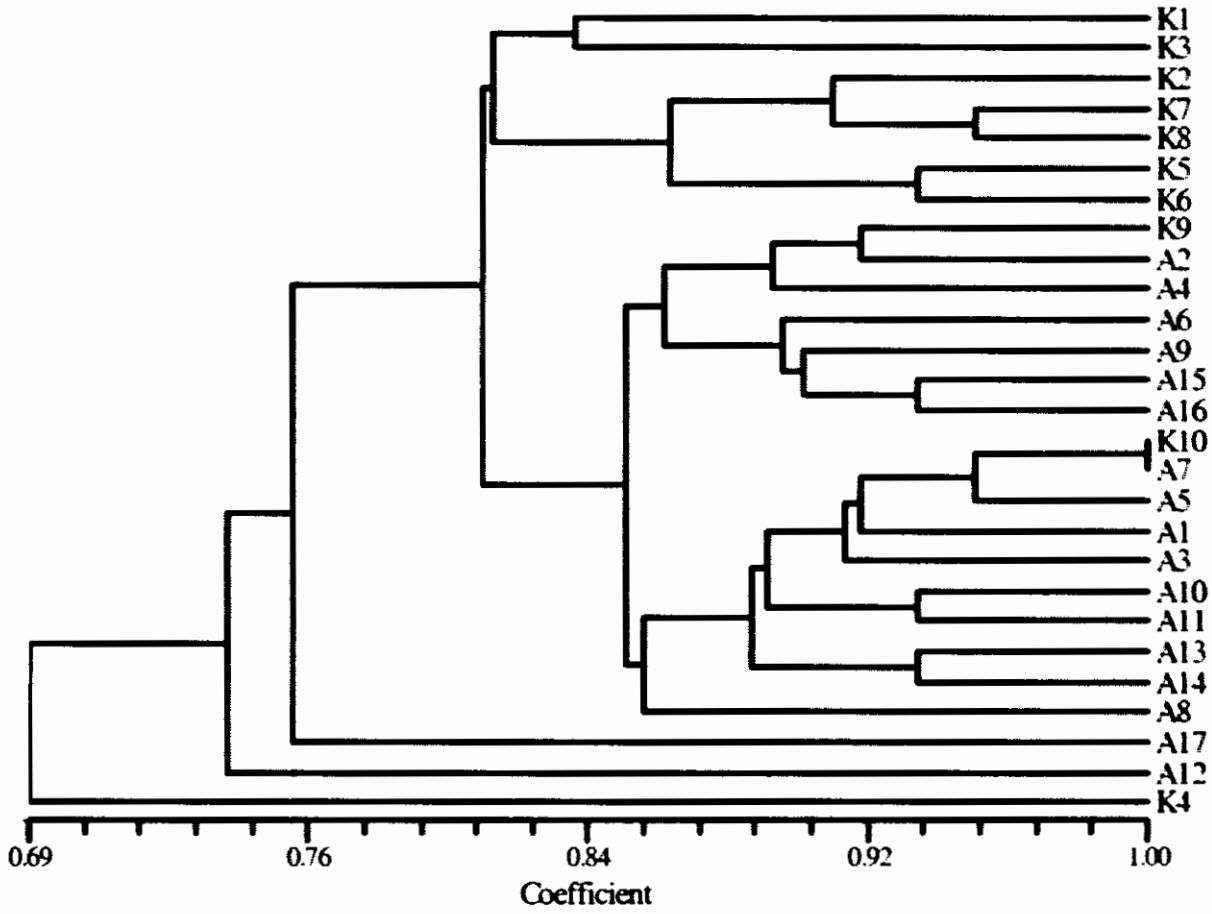


Fig. 7. Dendrogram of *Pistacia vera* L. accessions from Kepele (K) and Agachli (A), obtained by applying unweighted pair group method with arithmetic averages (UPGMA)

TABLE 6. ESSENTIAL OIL CONTENT OF *PISTACIA LENTISCUS* LEAVES

		Essential oil content (%)*															
Compound	RI**	Is-m	Is-f	Cy-m	Cy-f	Tn-m1	Tn-m2	Tn-f1	Tn-f2	Tn-f3	Tn-f4	Sp-m1	Sp-m2	Sp-f1	Sp-f2	Sp-f3	Sp-f4
α-thujene	923	0.0	0.0	0.3	0.0	0.5	0.0	0.0	0.5	0.0	0.0	11.1	0.0	0.0	0.0	12.3	0.0
α-pinene	933	13.8	16.2	24.1	49.0	18.7	42.7	35.1	19.0	22.0	26.0	22.7	5.1	6.5	22.3	19.4	13.2
camphene	950	0.5	1.0	0.0	1.2	0.0	0.9	0.0	0.4	0.0	0.7	2.8	0.0	0.0	0.9	2.7	1.3
sabinene	972	0.7	0.7	1.2	12.2	32.8	12.6	19.9	24.1	42.3	45.8	24.3	11.0	10.2	9.6	28.6	21.7
β-pinene	979	1.9	3.9	7.4	8.6	14.1	4.6	3.0	6.3	5.1	2.0	4.4	0.0	0.9	7.3	3.5	2.1
myrcene	988	1.9	1.1	1.6	1.0	0.8	0.6	1.1	0.8	0.8	1.2	1.1	1.3	1.5	0.3	1.6	0.4
α-phellandrene	1007	1.1	0.4	0.0	0.8	0.7	1.3	2.8	4.7	2.3	1.3	4.0	0.0	1.1	0.0	0.3	0.0
limonene	1029	45.5	29.5	40.6	6.1	5.4	6.7	15.4	9.3	8.1	7.3	3.3	28.7	29.7	1.6	3.7	0.7
β-phellandrene	1031	3.3	4.2	1.2	6.4	4.9	5.6	9.9	8.6	8.2	6.4	3.0	0.9	1.2	1.5	3.1	1.0
β-ocimene Z	1034	0.0	0.2	0.0	0.0	0.0	1.7	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
β-ocimene E	1044	0.0	0.6	0.0	0.0	0.6	5.2	5.3	1.9	0.0	1.8	0.0	0.0	1.4	0.7	0.0	0.0
γ-terpinene	1057	0.0	0.0	0.0	0.2	1.0	0.0	0.2	0.5	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
2-undecanone	1293	1.1	0.7	0.3	0.0	0.8	0.5	0.0	0.0	0.0	0.8	0.0	0.0	0.5	0.6	0.2	0.8
β-elemene	1388	1.1	0.0	2.9	0.0	0.0	0.0	0.9	0.0	0.6	0.0	0.0	0.8	0.8	0.0	0.7	0.9
caryophyllene	1418	5.4	13.2	0.0	3.7	3.7	7.1	1.1	2.8	0.8	3.1	10.7	22.4	20.7	6.0	9.0	6.8
α-humulene	1454	1.3	2.4	1.2	0.7	1.4	0.0	0.0	0.5	0.4	0.0	1.8	3.2	2.9	3.0	1.8	2.7
γ-muurolene	1476	0.0	0.0	0.4	0.0	1.3	0.0	0.0	1.0	0.5	0.0	0.0	1.1	1.0	2.2	1.7	1.0
germacrene D	1480	22.3	26.0	18.8	10.0	11.8	10.4	3.7	18.7	8.3	3.4	10.2	23.7	20.3	41.1	9.7	45.9
α- muurolene	1498	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.8	0.6	0.4
δ-cadinene	1519	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.8	0.7	0.0	0.3	1.3	1.1	2.1	1.3	1.1
Total		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Total μg/g		974	545	1181	1084	1305	706	829	671	1347	683	793	904	762	749	1040	1514

*For abbreviations see Table 1

** Retention Indices

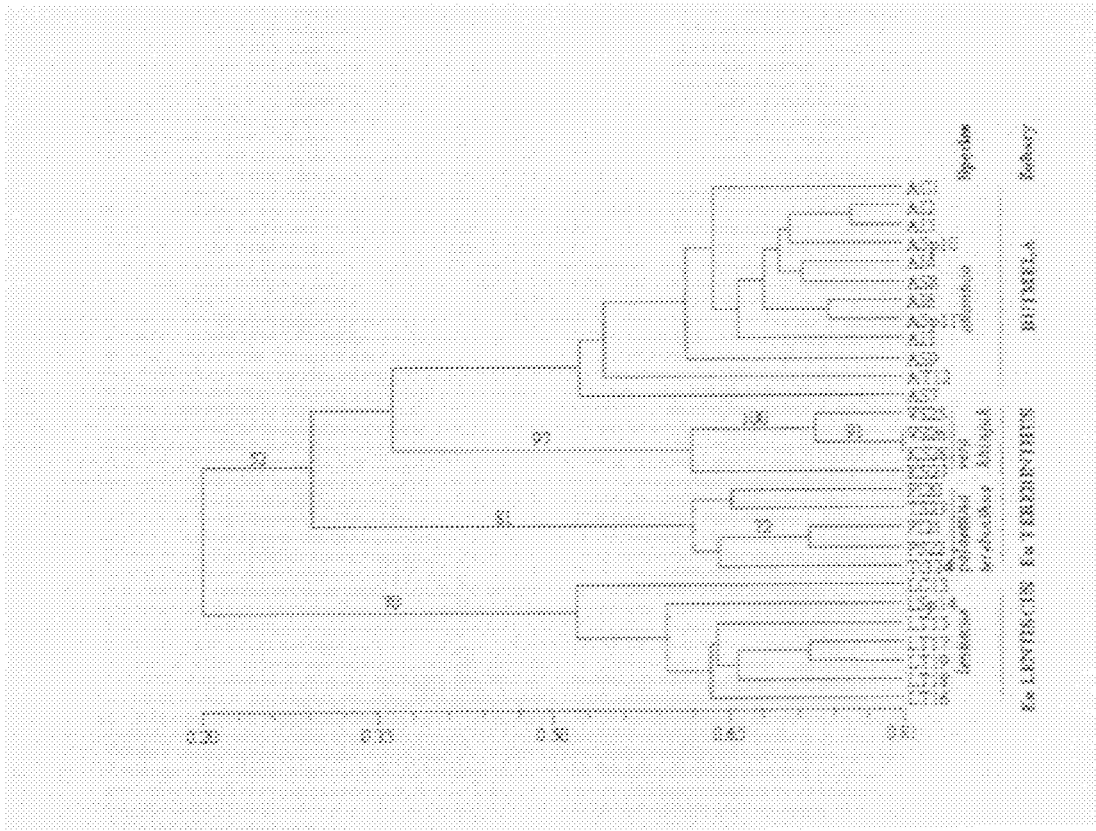


Fig. 8. Dendrogram of Mediterranean *Pistacia* generated by the UPGMA method using a Jaccard similarity, based on RAPD marker analysis. The numbers on the tree branches indicate the percentage of replicates included in a given node calculated out of 100 bootstrap replicates.

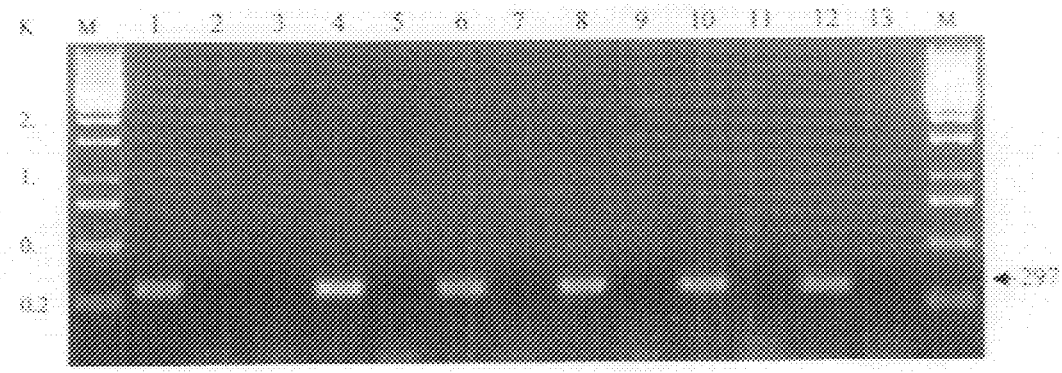


Fig. 9. *Pistacia vera* L. sex identification by Touchdown PCR using the SCAR primers PVF1 and PVF2. Lanes 1-13 represent DNA amplification products from individual trees without previous knowledge of their sex. The arrows indicate the position of the 297 bp female-specific fragment. Lanes 1, 4, 6, 8, 10, and 12 identified female trees and lanes 2, 3, 5, 7, 9, 11 and 13 identified male trees. The molecular weight marker, MW, and fragment sizes, Kb, are indicated on the left-hand side of the figure.

F. Impact, Relevance, and Technology Transfer

An early attempt to produce superior pistachio in Turkmenistan was made in the beginning of the 20th century. An experimental pistachio plantation, currently with an area of 20-25 ha, was sown from seed at Bogar. This experimental plantation was unsuccessful due to high planting density and choice of low quality seeds, yielding small low quality fruit. The current US-AID-CDR-CAR project is the first time since that early attempt to initiate pistachio germplasm collection and evaluation in order to improve nut/product quality of pistachio for the Turkmen farmers and consumers. A significant percentage of nuts in Turkmenistan are collected in natural pistachio groves, some of which may be superior in quality to those currently grown in the world. Upon becoming a Newly Independent State (NIS), Turkmenistan national efforts could be channeled to developing an independent economy, including the development and expansion of pistachio plantations, as a valuable source of income. The National Institute of Desert Flora and Fauna (NIDFF) under the Turkmenistan Ministry of Nature Protection, conducted research and developed technology for pistachio cultivation from 2000 to the present. Research was conducted in two experimental plots, located in different areas with unique environmental conditions. One plot was located at Kopet Dag foothills in the Forest seeds Growing and Natural Park Protection Inspectorate, with a sown area of 13 ha. Another plot was located in the Central Karakum desert at Karrykul station (NIDFF), with 15-year old pistachio trees. These fruit bearing trees afford some prospective for future selection work. One of the outcomes of these experiments was the demonstration that pistachio is capable of passing maternally inherited properties through cultivation by sowing seeds. Selected seeds, gathered in annual collection expeditions, were sown on the experimental plots. Research was conducted to optimize sowing and planting techniques, as well as to investigate the possibilities of grafting buds and shoot. Pistachio tree growth and development was investigated under irrigation at different elevation zones in Bogara: in the mountain at an altitude of 1200-1400 m, in ravines (800-1000 m), at foothills (500-700 m), in the southern part of Central Karakums (90 m).

In light of the high profile of the project at the Ministry of Agriculture of Turkmenistan, the comprehensive report on the status of *Pistacia* research and recognition of the economic potential of this crop in Turkmenistan, Mr. Nury Atamuradov (a young Turkmen scientist trained in Israeli) was awarded, with the most prestigious prize of the President of the State of Turkmenistan for his contributions to promote research and cultivation of pistachio.

The impact of the project was in establishing physical and human infrastructures for germplasm conservation and characterization in Turkmenistan. In the course of the project new germplasm/experimental plots were established and a new biotechnology laboratory for germplasm evaluation and DNA analysis was constructed. A scientific group interested in promoting pistachio cultivation in Turkmenistan was organized around the group that was involved in this project and trained in Israel. This group succeeded in getting the decision makers at the Agriculture and Nature Protection ministries aware and interested in promoting pistachio research and development. These efforts culminated in a research proposal submitted to the Turkmen government with a detailed plan of action (see section I).

G. Project Activities/Outputs

The entire project was initiated during a visit of the former head of the Turkmen NIDFF, Prof. Babaev A.G. at BIDR in 1995 and a meeting with Prof. Golan. On that occasion our common interests in pistachio were discussed and led to a visit by Golan to the NIDFF in 1996. In that visit a seed collection expedition was organized and the outlines for a joint proposal to AID-CDR-CAR were drafted. This US-AID funded project formally started in 1999.

1. Meetings in the course of the project

In September 2000 A. Golan visited the Turkmen group to set-up the experimental outlines and plans for the project. The visit included meeting with the pistachio team members, Babaev A.G., M. Durikov, M. Nepesov, A. Rima and interviews of young Turkmen students for potential training in Israel. During that visit seeds of pistachio were collected for the germplasm collections in Israel and Turkmenistan.

In April/May 2004 M. Durikov visited the Israeli group at BIDR and the project was summarized and concluded by drafting the outlines of future plans (see section F) for continued pistachio germplasm collection, screening and characterization for production of high quality Turkmen nuts.

2. Training

Trainee	Time	Purpose	Where	Notes
A. Atayev	Dec. 1999-Oct. 2000	Molecular markers	BIDR – Golan	Training included B.Yakubov from Uzbekistan And V. Kostiukovsky
A. Rima	Nov. 2000- Jan. 2001	Desert Agrobiology course	BIDR	Stayed further for M.Sc. and Ph.D. programs
M. Nepesov	Nov. 2000- May 2001	Desert Agrobiology course and experiments on salinity effect on pistacia seedling growth	BIDR - Golan	
N. Atamuradov	March. 2004- Aug 2004	Molecular markers	BIDR - Golan	
	April 2005 – May 2005	Proteins and essential oils	BIDR - Golan	Got the The Turkmen President award for his research on pistachio, May 2005

3. Publications
* coauthored with Turkmen scientists
** coauthored with scientists from other developing countries

*Barazani, O., Atayev A., Yakubov B., Kostiukovsky V., Popov K.P. and Golan-Goldhirsh, A. 2003. Genetic variability in Turkmen populations of *Pistacia vera* L. Genetic Resources and Crop Evolution, 50, 383-389.

Barazani, O., Dudai, N. and Golan-Goldhirsh, A. 2003. Comparison of Mediterranean *Pistacia lentiscus* genotypes by random amplified polymorphic DNA, chemical and morphological analyses. J. Chem. Ecol. 29, 1939-1952.

**Golan-Goldhirsh, A., Barazani, O., Wang, Z.S., Khadka, D.K., Saunders, J.A., Kostiukovsky V. and Rowland, L.J. 2004. Molecular characterization of Mediterranean *Pistacia* germplasm by RAPD and AFLP markers. Plant Syst. Evol. 246, 9-18.

Barazani, O. and Golan-Goldhirsh, A. 2004. Conservation of the genetic variability of Mediterranean *Pistacia* spp. J. Arid Land Studies 14S, 41-44.

**Yakubov, B., Barazani, O. and Golan-Goldhirsh, A. 2005. Combination of SCAR primers and Touchdown-PCR for sex identification in *Pistacia vera* L. Scientia Horticulturae. 103, 473-478.

**Yakubov, B., Barazani, O., Shachack, A., Rowland, L.J. Shoseyov, O. and Golan-Goldhirsh, A. 2005. Molecular cloning and characterization of *P. Vera* dehydrin-like gene. Trees Structure and Function 19, 224-230.

H. Project Productivity – The project accomplished its major goals as outlined in detail in sections F and I.

I. Future Work

Future research and development of pistachio cultivation in requires a sound R&D project supported by the Turkmenistan Ministries of Agriculture, Nature Protection and other governmental and non-governmental organizations. Toward this aim the following actions should be taken and the parties that should be involved are listed:

1. Conduct an inventory of the all pistachio in Turkmenistan - The Ministry of Nature Protection, Ministry of Agricultural and joint stock company "Geok gushak" joint.
2. Thin out pistachio tree plantations by removing some trees from rows - The Ministry of Nature Protection, Ministry of Agricultural and joint stock company "Geok Gushak" joint venture.
3. Conserve and preserve state collection of pistachio garden located at the station of plant genetic resources (Mahtumkuli Etrap) - Ministry of Agriculture.
4. Intensify joint work on developing cultivation methods and establishment of pistachio plantations - NIDFF and Forest seeds growing and Natural Park Protection Inspectorate.
5. Collect grafting material and conduct inoculation work on experimental fields in the first half of summer in organized expedition to Karrykul plant genetic resources station - NIDFF.
6. Conduct expedition to Badkhyz state reservation, Kushka forest farm and to Plant genetic resources station. In cooperation with relevant organizations conduct survey of pistachio trees and develop survey map with geographical coordinates for each sample location. The outcome is expected to reveal the potential of elite pistachio forms in Turkmenistan for future cultivation – NIDFF

7. Conduct research on the unique phenology, ecology and biology of pistachio (beginning of blooming and pollination, forming fruits, annual growth, soil moisture dynamics of pistachio sowings, treatment, climatic data), during the vegetation period - The collaborators of NIDFF.
8. Conduct sowings in polyethylene containers for future inoculation (after 3-4 years) in December - The Forest Seeds Growing and Natural Park Protection Inspectorate jointly with collaborators NIDFF.
9. Exploitation methods and program of scientific-research on the theme "Restoration of junipers and pistachio forest resources in Central Kopetdag" to period 2006-2010 - Department of Forest and Rangelands of NIDFF.
10. Conduct pistachio sowing pistachio and planting on an area of 10 ha, January, 2006- Forest Seeds Growing and Natural Park Protection Inspectorate jointly with Department of Forest and Rangelands NIDFF.
11. Start work to create National Pistachio Center and intensify training of a group of researchers who will be involved in pistachio cultivation and research.
12. Investigate extension and cooperation possibilities with international organizations and institutes on pistachio cultivation and research (Ben-Gurion University of the Negev the Jacob Blaustein Institutes for desert research, TICA, IPGRI). Introduction of modern technologies and methods in this area will facilitate the sustainable and progressive development pistachio production in Turkmenistan.

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APPENDIX

Pistacia germplasm collection at BIDR

Plot 1 - lane 1 29

No.	Spec.	Country	Site of origin	Notes about site	Coordinates	Collection date	Germination date	Planting date
1.101	Atl	Cyprus	Emba village	On wadi bank	34 48 N 32 26 E	31/10/95	9/11/95	10/10/96
1.102	Atl	Cyprus	Emba village	On wadi bank	34 48 N 32 26 E	31/10/95	9/11/95	10/10/96
1.103	Atl	Cyprus	Emba village	On wadi bank	34 48 N 32 26 E	31/10/95	9/11/95	10/10/96
1.104	Atl	Cyprus	Emba village	On wadi bank	34 48 N 32 26 E	31/10/95	9/11/95	10/10/96
1.105	Atl	Cyprus	Emba village	On wadi bank	34 48 N 32 26 E	31/10/95	9/11/95	10/10/96
1.106	Atl	Cyprus	Emba village	On wadi bank	34 48 N 32 26 E	31/10/95	9/11/95	10/10/96
1.107	Atl	Cyprus	Emba village	On wadi bank	34 48 N 32 26 E	31/10/95	9/11/95	10/10/96
1.108	Atl	Israel	Bad 1, north side of road to Borot Lotz	Near road Many fruits	30 42 N 34 45 E	8/9/95	9/11/95	10/10/96
1.109	Atl	Israel	Eshtaol Nursery	Origin unkno	-	Fall 2003	-	19/4/04
1.110	Atl	Israel	Bad 1, north side of road to Borot Lotz	Near road Many fruits	30 42 N 34 45 E	8/9/95	9/11/95	10/10/96
1.111	Atl	Israel	Bad 1, north side of road to Borot Lotz	Near road Many fruits	30 42 N 34 45 E	8/9/95	9/11/95	10/10/96
1.112	Atl	Israel	Bad 1, north	Near road	30 42 N	8/9/95	9/11/95	10/10/96

			side of road to Borot Lotz	Many fruits	34 45 E			
1.113	Atl	Israel	Bad 1, north side of road to Borot Lotz	Near road Many fruits	30 42 N 34 45 E	8/9/95	9/11/95	16/10/96
1.114	Atl	Israel	Chanion Ha'ela Kadesh Naphtali	Double trunk tree	33 06 N 35 33 E	12/9/95	9/11/95	16/10/96
1.115	Atl	Israel	Chanion Ha'ela Kadesh Naphtali	Double trunk tree	33 06 N 35 33 E	12/9/95	9/11/95	16/10/96
1.116	Atl	Israel	Chanion Ha'ela Kadesh Naphtali	Double trunk tree	33 06 N 35 33 E	12/9/95	9/11/95	16/10/96
1.117	-							
1.118	Atl	Israel	Chanion Ha'ela Kadesh Naphtali	Double trunk tree	33 06 N 35 33 E	12/9/95	9/11/95	16/10/96
1.119	Atl	Israel	Chanion Ha'ela Kadesh Naphtali	Double trunk tree	33 06 N 35 33 E	12/9/95	9/11/95	16/10/96
1.120	Atl	Israel	Chanion Ha'ela Kadesh Naphtali	Double trunk tree	33 06 N 35 33 E	12/9/95	9/11/95	16/10/96
1.121	Atl	Israel	Chanion Ha'ela Kadesh Naphtali	Double trunk tree	33 06 N 35 33 E	12/9/95	9/11/95	16/10/96
1.122	Atl	Israel	Chanion Ha'ela Kadesh Naphtali	Double trunk tree	33 06 N 35 33 E	12/9/95	9/11/95	16/10/96
1.123	Atl	Israel	Chanion Ha'ela Kadesh Naphtali	Double trunk tree	33 06 N 35 33 E	12/9/95	9/11/95	16/10/96
1.124	-							
1.125	Atl	Israel	Eshtaol Nursery	Origin unkno	-	Fall 2003	-	19/4/04
1.126	Atl	Israel	Eshtaol Nursery	Origin unkno	-	Fall 2003	-	19/4/04
1.127	Atl	Israel	Borot Lotz entrance road	Tree in the wadi on left		8/9/95	9/11/95	16/10/96
1.128	Atl	Israel	Borot Lotz	Tree in the		8/9/95	9/11/95	16/10/96

			entrance road	wadi on left				
1.129	Atl	Israel	Eshtaol Nursery	Origin unkno	-	Fall 2003	-	19/4/04
1.130	Atl	Israel	Borot Lotz entrance road	Tree in the wadi on left		8/9/95	9/11/95	16/10/96
1.131	Atl	Israel	Eshtaol Nursery	Origin unkno	-	Fall 2003	-	19/4/04
1.132	Atl	Syria	Balash area			27/9/95	23/12/95	16/10/96
1.133	Atl	Syria	Balash area			27/9/95	23/12/95	16/10/96
1.134	Atl	Syria	Balash area			27/9/95	23/12/95	16/10/96
1.135	Atl	Syria	Deir Atiah			28/9/95	23/12/95	16/10/96
1.136	Atl	Syria	Tartous-Ad--Drekish road	S10/208		1/10/96		9/3/98
1.137	Atl	Syria	Tartous-Ad--Drekish road	S10/208		1/10/96		9/3/98
1.138	Atl	Syria	Tartous-Ad--Drekish road	S10/208		1/10/96		9/3/98
1.139	Atl	Syria	Tartous-Ad--Drekish road	S10/208		1/10/96		9/3/98
1.140	Atl	Syria	Tartous-Ad--Drekish road	S10/208		1/10/96		9/3/98
1.141	Atl	Syria	Tartous-Ad--Drekish road	S10/208		1/10/96		9/3/98
1.142	Atl	Syria	Tartous-Ad--Drekish road	S10/208		1/10/96		9/3/98
1.143	Atl	Syria	Tartous-Ad--Drekish road	S10/208		1/10/96		9/3/98
1.144	Atl	Syria	Tartous-Ad--Drekish road	S10/208		1/10/96		9/3/98
1.145	-							
1.146	Atl	Israel	Eshtaol Nursery	Origin unkno	-	Fall 2003	-	19/4/04
1.147	-							

1.148	Khi	Syria	Morek		N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	23/10/96
1.149	Khi	Syria	Baha area		N: 33 53 937 E: 36 36 426	28/9/95	23/12/95	23/10/96
1.150	died	Syria	Baha area		N: 33 53 937 E: 36 36 426	28/9/95	23/12/95	23/10/96
1.151	Khi?	Syria	Morek	Planted as Khi Looks vera	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	23/10/96
1.152	Khi?	Syria	Morek	Planted as Khi Looks vera	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	23/10/96

Plot 1 - lane 2

No.	Spec.	Country	Site of origin	Notes about site	Coordinates	Collection date	Germination date	Planting date
1.201	Pal	Israel	Chanion Ha'ela Kadesh Naphtali	Hill above the Chanion	33 06 N 35 33 E	12/9/95	9/11/95	21/10/96
1.202	Pal	Israel	Chanion Ha'ela Kadesh Naphtali	Hill above the Chanion	33 06 N 35 33 E	12/9/95	9/11/95	21/10/96
1.203	Pal	Israel	Chanion Ha'ela Kadesh Naphtali	Hill above the Chanion	33 06 N 35 33 E	12/9/95	9/11/95	21/10/96
1.204	Pal	Israel	Meron Field Sch. Right trunk	On lawn front of office	32 59 N 35 26 E	12/9/95	9/11/95	21/10/96
1.205	Pal	Israel	Meron Field Sch. Right trunk	On lawn front of office	32 59 N 35 26 E	12/9/95	9/11/95	21/10/96
1.206	Pal	Israel	Meron Field Sch. Right trunk	On lawn front of office	32 59 N 35 26 E	12/9/95	9/11/95	21/10/96
1.207	Pal	Israel	Meron Field Sch. Right trunk	On lawn front of office	32 59 N 35 26 E	12/9/95	9/11/95	21/10/96
1.208	Pal	Israel	Meron Field Sch. Right trunk	On lawn front of office	32 59 N 35 26 E	12/9/95	9/11/95	21/10/96

1.209	Pal	Israel	Meron Field Sch. Right trunk	On lawn front of office	32 59 N 35 26 E	12/9/95	9/11/95	21/10/96
1.210	Pal	Israel	Meron Field Sch. Right trunk	On lawn front of office	32 59 N 35 26 E	12/9/95	9/11/95	21/10/96
1.211	Pal	Israel	Meron Field Sch. Right trunk	On lawn front of office	32 59 N 35 26 E	12/9/95	9/11/95	21/10/96
1.212	Pal	Syria	W. of Hama	Tree 1	N: 35 02 794 E: 36 19 250	26/9/95	23/12/95	21/11/96
1.213	Pal	Syria	W. of Hama	Tree 1	N: 35 02 794 E: 36 19 250	26/9/95	23/12/95	21/11/96
1.214	Pal	Syria	W. of Hama	Tree 1	N: 35 02 794 E: 36 19 250	26/9/95	23/12/95	21/11/96
1.215	Pal	Syria	W. of Hama	Tree 1	N: 35 02 794 E: 36 19 250	26/9/95	23/12/95	21/11/96
1.216	Pal	Syria	W. of Hama	Tree 1	N: 35 02 794 E: 36 19 250	26/9/95	23/12/95	21/11/96
1.217	Pal?	Syria	Al Zaenieh (N Jesr Al--Shogour)	S1/199		30/9/96		9/3/98
1.218	Pal/A?	Syria	Balash area	S21/219		5/10/96		9/3/98
1.219	Pal?	Israel	Entrance to Mei Ami from Wadi Ara, small seeds	53b Seed coll. Avi/96		10/8/96	10/9/96	9/3/98
1.220	Pal?	Israel	Entrance to Mei Ami from Wadi Ara, small seeds	53b Seed coll. Avi/96		10/8/96	10/9/96	9/3/98
1.221	Pal?	Israel	Entrance to Mei Ami from Wadi Ara, small seeds	53b Seed coll. Avi/96		10/8/96	10/9/96	9/3/98
1.222	Pal?	Israel	Entrance to Mei Ami from Wadi	53b Seed coll. Avi/96		10/8/96	10/9/96	9/3/98

			Ara, small seeds					
1.223	Pal?	Israel	Entrance to Mei Ami from Wadi Ara, small seeds	53b Seed coll. Avi/96		10/8/96	10/9/96	9/3/98
1.224	Pal?	Israel	Entrance to Mei Ami from Wadi Ara, small seeds	53a Seed coll. Avi/96		10/8/96	10/9/96	9/3/98
1.225	Pal?	Israel	Meron field schl steps to restaurant	45b Seed coll. Avi/96		8/8/96	10/9/96	9/3/98
1.226	Pal?	Israel	Nachal Nachash near Nachal Yagur, Nof Carmel Reserve	43 Seed coll. Avi/96		7/8/96	10/9/96	9/3/98
1.227	Atl/ Pal?	Israel	Entrance to Mei Ami from Wadi Ara, small seeds	53a Seed coll. Avi/96		10/8/96	10/9/96	9/3/98
1.228	Atl/ Pal?	Israel	Entrance to Mei Ami from Wadi Ara, small seeds	53a Seed coll. Avi/96		10/8/96	10/9/96	9/3/98
1.229	Atl/ Pal?	Israel	Entrance to Mei Ami from Wadi Ara, small seeds	53b Seed coll. Avi/96		10/8/96	10/9/96	9/3/98
1.238	Vera	Syria	Izra (1)	cv Batoury	N: 32 50 718 E: 36 14 384	24/9/95	23/12/95	24/11/96
1.239	Vera	Syria	Morek	cv Batoury	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	24/11/96
1.240	Vera	Syria	Morek	cv Bayadi	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	24/11/96
1.241	Vera	Syria	Morek	cv Bayadi	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	24/11/96

1.242	Vera	Syria	Morek	cv Nab Al Djamal	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	24/11/96
1.243	Vera	Syria	Morek	cv Nab Al Djamal	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	24/11/96
1.244	Vera	Syria	Morek	cv Ashoury (white)	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	24/11/96
1.245	died							
1.246	Vera	Syria	Morek	cv Ashoury (white)	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	24/11/96
1.247	Vera	Syria	Morek	cv Ashoury (white)	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	24/11/96
1.248	Vera	Syria	Morek	cv Ashoury (white)	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	24/11/96
1.249	Vera	Syria	Morek	cv Ashoury (white)	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	24/11/96
1.250	Vera	Syria	Morek	cv Ashoury (white)	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	24/11/96
1.251	Vera	Syria	Morek	cv Ashoury (white)	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	24/11/96
1.252	Vera	Syria	Morek	cv Ashoury (white)	N: 35 23 060 E: 36 40 645	26/9/95	23/12/95	24/11/96

Plot 1 - lane 3

No.	Spec.	Country	Site of origin	Notes about site	Coordinates	Collection date	Germination date	Planting date
1.301	Len	Cyprus	Hy-Limassol to	by the road		30/10/95	9/11/95	22/10/96

			Nicosia					
1.302	Len	Israel	Eshtaol nursery			2003		25/4/04
1.303	Len	Cyprus	Hy-Limassol to Nicosia	by the road		30/10/95	9/11/95	22/10/96
1.304	Len	Israel	Mevasseret Zion			2001		3/3/02
1.305	-							
1.306	Len	Cyprus	Hy-Limassol to Nicosia	by the road		30/10/95	9/11/95	22/10/96
1.307	Len	Cyprus	Hy-Limassol to Nicosia	by the road		30/10/95	9/11/95	22/10/96
1.308	-							
1.309	Len	Israel	Mevasseret Zion	Oz				3/3/02
1.310	Len	Israel	Mevasseret Zion	Oz				3/3/02
1.311	Len	Israel	Mevasseret Zion	Oz				3/3/02
1.312	Len	Israel	Mevasseret Zion	Oz				3/3/02
1.313	Len	Israel	Mevasseret Zion	Oz				3/3/02
1.314	Len	Israel	Mevasseret Zion	Oz				3/3/02
1.315	died	Israel	Mevasseret Zion	Oz				3/3/02
1.316	Len	Israel	Mevasseret Zion	Oz				3/3/02
1.317	Len	Israel	Mevasseret Zion	Oz				3/3/02
1.318	Len	Israel	Mevasseret Zion	Oz				3/3/02
1.319	Len	Israel	Chavatzelet	Oz				3/3/02
1.320	Len	Israel	Chavatzelet	Oz				3/3/02
1.321	-							
1.322	Len	Israel	Mevasseret Zion	Oz				3/3/02
1.323	Len	Israel	Mevasseret Zion	Oz				3/3/02
1.324	-							
1.325	Len	Israel	Mevasseret Zion	Oz				3/3/02
1.326	Len	Israel	Chavatzelet	Oz				3/3/02

1.327	Len	Israel	Chof Yam 5	Oz				3/3/02
1.328	Len	Israel	Chof yam 5	Oz				3/3/02
1.329	Len	Israel	Eshtaol nursery			2003		25/4/04
1.330	Len	Israel	Eshtaol nursery			2003		25/4/04
1.331	Len	Israel	Eshtaol nursery			2003		25/4/04
1.332	Len	Israel	Eshtaol nursery			2003		25/4/04
1.333	Len	Israel	Eshtaol nursery			2003		25/4/04
1.334	Len	Israel	Eshtaol nursery			2003		25/4/04
1.335	Len	Israel	Eshtaol nursery			2003		25/4/04
1.337	Len	Israel	Eshtaol nursery			2003		25/4/04
1.338	Len	Israel	Eshtaol nursery			2003		25/4/04
1.339	Len	Israel	Eshtaol nursery			2003		25/4/04
1.340	Len	Israel	Eshtaol nursery			2003		25/4/04
1.341	Len	Israel	Eshtaol nursery			2003		25/4/04
1.342	Len	Israel	Eshtaol nursery			2003		25/4/04
1.343	Len	Israel	Eshtaol nursery			2003		25/4/04
1.344	Len	Israel	Eshtaol nursery			2003		25/4/04
1.346	Ter	Syria	Kabous area		N: 35 05 495 E: 36 18 852	2/10/95	9/11/95	27/10/96
1.349	Ter	Syria	Kabous area		N: 35 05 495 E: 36 18 852	2/10/95	9/11/95	27/10/96
1.350	Ter	Syria	Kabous area		N: 35 05 495 E: 36 18 852	2/10/95	9/11/95	27/10/96

Plot 1 - lane 4

No.	Spec.	Country	Site of origin	Notes about site	Coordinates	Collection date	Germination date	Planting date
1.401	Chin	Israel	Purchased M. Ben-Shachar Ltd	Origin China (California)			9/11/95	22/10/96

1.402	Chin	California	UCD campus, tree on right hand side of entrance to Manulab			31/8/97		23/2/98
1.403	Chin	California	UCD campus, tree on right hand side of entrance to Manulab			31/8/97		23/2/98
1.404	Chin	California	UCD campus, tree on right hand side of entrance to Manulab			31/8/97		23/2/98
1.406	Chin	California	UCD campus, tree on right hand side of entrance to Manulab			31/8/97		23/2/98
1.407	Chin	California	UCD campus, tree on right hand side of entrance to Manulab			31/8/97		23/2/98
1.408	Chin	California	UCD campus, tree on right hand side of entrance to Manulab			31/8/97		23/2/98
1.409	Chin	California	UCD campus, tree on right hand side of entrance to Manulab			31/8/97		23/2/98
1.410	Chin	California	UCD campus, tree			31/8/97		23/2/98

			on right hand side of entrance to Manulab				
1.411	Chin	California	UCD campus, tree on right hand side of entrance to Manulab		31/8/97		23/2/98
1.412	Chin	California	UCD campus, tree on right hand side of entrance to Manulab		31/8/97		23/2/98
1.413	died	California	UCD campus, largest trunk tree		28/8/97		23/2/98
1.414	died	California	UCD campus, largest trunk tree		28/8/97		23/2/98
1.415	Chin	California	UCD campus, largest trunk tree		28/8/97		23/2/98
1.416	Chin	California	UCD campus, largest trunk tree		28/8/97		23/2/98
1.417	Chin	California	UCD campus, largest trunk tree		28/8/97		23/2/98
1.418	Chin	California	UCD campus, largest trunk tree		28/8/97		23/2/98
1.419	Chin	California	UCD campus, largest trunk tree		28/8/97		23/2/98
1.420	Chin	California	UCD campus, largest trunk tree		28/8/97		23/2/98
1.421	Chin	California	UCD campus, largest trunk tree		28/8/97		23/2/98

1.422	Chin	California	UCD campus, largest trunk tree			28/8/97		23/2/98
1.423	-							
1.424	Chin	California	UCD campus, largest trunk tree			28/8/97		23/2/98
1.425	Chin	California	UCD campus, largest trunk tree			28/8/97		23/2/98

Plot 1 - lane 5

No.	Spec.	Country	Site of origin	Notes about site	Coordinates	Collection date	Germination date	Planting date
1.501	Atl	Turkey		T9/237, in a Wheat field		9/96		15/3/98
1.515	Vera	Turkmen	Badghiz4, road to Kepele. Big tree purple pericarp	110 grand list		21/8/96	2/9/96	8/3/98
1.516	Vera	Turkmen	Kepele30,Badghiz reserve. commercial Harvest Mixture of trees	136 grand list		23/8/96	2/9/96	8/3/98
1.517	Vera	Turkmen	Kepele30,Badghiz reserve. commercial Harvest Mixture of	136 grand list		23/8/96	2/9/96	8/3/98

			trees					
1.518	Vera	Turkmen	Kepele30,Badghiz reserve. commercial Harvest Mixture of trees	136 grand list		23/8/96	2/9/96	8/3/98
1.519	Vera	Turkmen	Kepele30,Badghiz reserve. commercial Harvest Mixture of trees	136 grand list		23/8/96	2/9/96	8/3/98
1.520	Vera	Turkmen	Kepele30,Badghiz reserve. commercial Harvest Mixture of trees	136 grand list		23/8/96	2/9/96	8/3/98
1.522	Vera	Turkmen	kepele	Nepessov		2000		2/3/04
1.523	Vera	Turkmen	Kepele30,Badghiz reserve. commercial Harvest Mixture of trees	136 grand list		23/8/96	2/9/96	8/3/98
1.524	Vera	Turkmen	Kepele30,Badghiz reserve. commercial Harvest Mixture of trees	136 grand list		23/8/96	2/9/96	8/3/98
1.525	Vera	Turkmen	Kepele30,Badghiz reserve. commercial Harvest Mixture of trees	136 grand list		23/8/96	2/9/96	8/3/98
1.526	Vera	Turkmen	Agachlli28,Afgan border	134 grand list		23/8/96	2/9/96	8/3/98
1.527	Vera	Turkmen	Agachlli28,Afgan	134 grand list		23/8/96	2/9/96	8/3/98

			border					
1.528	Vera	Turkmen	Agachlli28,Afgan border	134 grand list		23/8/96	2/9/96	8/3/98
1.529	Vera	Turkmen	Agachlli28,Afgan border	134 grand list		23/8/96	2/9/96	8/3/98
1.530	Vera	Turkmen	Agachlli28,Afgan border	134 grand list		23/8/96	2/9/96	8/3/98
1.531	Vera	Turkmen	Agachlli29,Afgan border.Saparov commercial harvest. Mixture of trees	135 grand list		23/8/96	2/9/96	8/3/98
1.532	Vera	Turkmen	Agachlli29,Afgan border.Saparov commercial harvest. Mixture of trees	135 grand list		23/8/96	2/9/96	8/3/98
1.533	Vera	Turkmen	Agachlli29,Afgan border.Saparov commercial harvest. Mixture of trees	135 grand list		23/8/96	2/9/96	8/3/98
1.534	Vera	Turkmen	Agachlli29,Afgan border.Saparov commercial harvest. Mixture of trees	135 grand list		23/8/96	2/9/96	8/3/98
1.535	Vera	Turkmen	Agachlli29,Afgan border.Saparov commercial harvest. Mixture of trees	135 grand list		23/8/96	2/9/96	8/3/98
1.536	Vera	Turkmen	Agachlli29,Afgan border.Saparov	135 grand list		23/8/96	2/9/96	8/3/98

			commercial harvest. Mixture of trees					
1.537	Vera	Turkmen	Agachlli29,Afgan border.Saparov commercial harvest. Mixture of trees	135 grand list		23/8/96	2/9/96	8/3/98
1.538	Vera	Turkmen	Agachlli29,Afgan border.Saparov commercial harvest. Mixture of trees	135 grand list		23/8/96	2/9/96	8/3/98
1.539	Vera	Turkmen	Agachlli29,Afgan border.Saparov commercial harvest. Mixture of trees	135 grand list		23/8/96	2/9/96	8/3/98
1.540	Vera	Turkmen	Agachlli26,Afgan border	135 grand list		23/8/96	2/9/96	25/5/97
1.541	Vera	Turkmen	Agachlli27,Afgan border. Mixture of 3 trees	133 grand list		23/8/96	2/9/96	8/3/97
1.542	Vera	Turkmen	Agachlli24,Afgan border	135 grand list		23/8/96	2/9/96	25/5/97
1.543	Vera	Turkmen	Badghiz14, road to Kepele	120 grand list		21/8/96	2/9/96	8/3/97
1.544	died	Turkmen	Agachlli25,Afgan border	131 grand list		23/8/96	2/9/96	8/3/98
1.545	Vera	Turkmen	Agachlli24,Afgan border???	135 grand list		23/8/96	2/9/96	25/5/97
1.546	Vera	Turkmen	Agachlli26,Afgan border	135 grand list		23/8/96	2/9/96	25/5/97

1.547	Vera	Turkmen	Agachlli26,Afgan border???	135 grand list		23/8/96	2/9/96	25/5/97

Plot 1 - lane 6

No.	Spec.	Country	Site of origin	Notes about site	Coordinates	Collection date	Germination date	Planting date
1.601	Atl (Mutic	Calif.	UCD-Winters coll. 06A			9/97		28/5/98
1.602	Atl (Mutic	Calif.	UCD-Winters coll. 06A			9/97		28/5/98
1.603	Atl (Mutic	Calif.	UCD-Winters coll. 06A			9/97		28/5/98
1.604	Pal	Israel		Eshtaol nursery		2003		18/4/04
1.606	Pal	Israel		Eshtaol nursery		2003		18/4/04
1.607	Pal	Israel		Eshtaol nursery		2003		18/4/04
1.608	Pal	Israel		Eshtaol nursery		2003		18/4/04
1.609	Pal	Israel		Eshtaol nursery		2003		18/4/04
1.610	Pal	Israel		Eshtaol nursery		2003		18/4/04
1.611	Pal	Israel		Eshtaol nursery		2003		18/4/04
1.612	Pal	Israel		Eshtaol nursery		2003		18/4/04
1.613	Pal	Israel		Eshtaol nursery		2003		18/4/04
1.614	Pal	Israel		Eshtaol nursery		2003		18/4/04
1.615	Pal	Israel		Eshtaol nursery		2003		18/4/04
1.616	Pal	Israel		Eshtaol nursery		2003		18/4/04
1.617	Pal	Israel		Eshtaol nursery		2003		18/4/04
1.618	Pal	Israel		Eshtaol nursery		2003		18/4/04
1.619	Pal	Israel		Eshtaol nursery		2003		18/4/04

1.620	Pal	Israel		Eshtaol nursery	2003	18/4/04
1.621	Pal	Israel		Eshtaol nursery	2003	18/4/04
1.622	Pal	Israel		Eshtaol nursery	2003	18/4/04
1.629	P.atl	Israel		Eshtaol nursery	2003	30/5/04
1.630	Pal	Israel		Eshtaol nursery	2003	18/4/04
1.631	Pal	Israel		Eshtaol nursery	2003	18/4/04
1.632	Pal	Israel		Eshtaol nursery	2003	18/4/04
1.633	Pal	Israel		Eshtaol nursery	2003	18/4/04
1.634	Pal	Israel		Eshtaol nursery	2003	18/4/04
1.635	died	Calif.	UCD-Winters coll. (Salih)	276 in grand list	9/97	27/5/98
1.636	Hyb? Vera?	Calif.	UCD-Winters coll. (Salih)	281 in grand list	9/97	27/5/98
1.637	Hyb? Atl?	Calif.	UCD-Winters coll. (Salih)	281 in grand list	9/97	27/5/98
1.638	Hyb? Khinj?	Calif.	UCD-Winters coll. (Salih)	281 in grand list	9/97	27/5/98
1.639	died	Calif.	UCD-Winters coll. (Salih)	279 in grand list	9/97	27/5/98
1.640	Khinj? Atl?	Calif.	UCD-Winters coll. (Salih)	279 in grand list	9/97	27/5/98
1.641	Khinj? Atl?	Calif.	UCD-Winters coll. (Salih)	279 in grand list	9/97	27/5/98
1.642	Khinj? Atl?	Calif.	UCD-Winters coll. (Salih)	279 in grand list	9/97	27/5/98
1.643	Khinj? Atl?	Calif.	UCD-Winters coll. (Salih)	279 in grand list	9/97	27/5/98
1.644	Khinj?	Calif.	UCD-Winters coll.	279 in grand	9/97	27/5/98

	Atl?		(Salih)	list				

Plot 1 - lane 7

No.	Spec.	Country	Site of origin	Notes about site	Coordinates	Collection date	Germination date	Planting date
1.701	Atl	Spain	Mas Bove Collection 0-120	Origin Syria ACSAD	41 10 N 1 00 E	6/10/95	9/11/95	28/10/96
1.702	Atl	Spain	Mas Bove Collection 0-120	Origin Syria ACSAD	41 10 N 1 00 E	6/10/95	9/11/95	28/10/96
1.704	Atl	Spain	Mas Bove Collection 0-120	Origin Syria ACSAD	41 10 N 1 00 E	6/10/95	9/11/95	28/10/96
1.706	Atl	Spain	Mas Bove Collection 0-120	Origin Syria ACSAD	41 10 N 1 00 E	6/10/95	9/11/95	28/10/96
1.708	Atl	Spain	Mas Bove Collection 0-120	Origin Syria ACSAD	41 10 N 1 00 E	6/10/95	9/11/95	28/10/96
1.709	Atl	Spain	Mas Bove Collection 0-120	Origin Syria ACSAD	41 10 N 1 00 E	6/10/95	9/11/95	28/10/96
1.710	Atl	Spain	Mas Bove Collection 0-120	Origin Syria ACSAD	41 10 N 1 00 E	6/10/95	9/11/95	28/10/96
1.711	Atl	Spain	Mas Valero IRTA Station 0-156	IRTA Collection	41 10 N 1 00 E	6/10/95	9/11/95	28/10/96
1.712	Atl	Spain	Mas Valero IRTA Station 0-156	IRTA Collection	41 10 N 1 00 E	6/10/95	9/11/95	28/10/96
1.713	Atl	Spain	Mas Valero IRTA Station 0-156	IRTA Collection	41 10 N 1 00 E	6/10/95	9/11/95	28/10/96
1.714	Atl	Spain	Mas Valero IRTA Station 0-156	IRTA Collection	41 10 N 1 00 E	6/10/95	9/11/95	28/10/96
1.715	died	Spain	Mas Valero IRTA Station 0-156	IRTA Collection	41 10 N 1 00 E	6/10/95	9/11/95	28/10/96
1.716	Atl	Spain	Mas Valero IRTA	IRTA	41 10 N	6/10/95	9/11/95	28/10/96

			Station 0-156	Collection	1 00 E			
1.717	Atl	Spain	Mas Valero IRTA Station 0-156	IRTA Collection	41 10 N 1 00 E	6/10/95	9/11/95	28/10/96
1.718	Atl	Spain	Mas Valero IRTA Station 0-156	IRTA Collection	41 10 N 1 00 E	6/10/95	9/11/95	28/10/96
1.725	Atl	Israel		Eshtaol nurser		2003		27/5/04
1.728	Atl	Israel		Eshtaol nurser		2003		27/5/04
1.730	Atl	Israel		Eshtaol nurser		2003		27/5/04
1.732	Atl	Israel		Eshtaol nurser		2003		27/5/04
1.733	Atl	Israel		Eshtaol nurser		2003		27/5/04
1.735	Atl	Israel		Eshtaol nurser		2003		27/5/04
1.739	Atl	Israel		Eshtaol nurser		2003		27/5/04
1.741	Ter	Calif	UCD-Winters coll.	277 in grand list		9/97		27/5/98
1.742	Ter	Calif	UCD-Winters coll.	277 in grand list		9/97		27/5/98
1.743	Ter	Calif	UCD-Winters coll.	277 in grand list		9/97		27/5/98

Plot 1 - lane 8

No.	Spec.	Country	Site of origin	Notes about site	Coordinates	Collection date	Germination date	Planting date
1.801	Lent	Spain	Lleida Province Torrebeses 'El Grau'	Near a P. vera orchard	41 48 N 0 06 E	19/9/95	9/11/95	29/10/96
1.802	Lent	Spain	Lleida Province Torrebeses 'El Grau'	Near a P. vera orchard	41 48 N 0 06 E	19/9/95	9/11/95	29/10/96
1.803	Lent	Spain	Lleida Province Torrebeses 'El Grau'	Near a P. vera orchard	41 48 N 0 06 E	19/9/95	9/11/95	29/10/96
1.805	Lent	Spain	Lleida Province Torrebeses 'El Grau'	Near a P. vera orchard	41 48 N 0 06 E	19/9/95	9/11/95	29/10/96

1.806	Lent	Spain	Lleida Province Torrebeses 'El Grau'	Near a P. vera orchard	41 48 N 0 06 E	19/9/95	9/11/95	29/10/96
1.808	Lent	Spain	Lleida Province Torrebeses 'El Grau'	Near a P. vera orchard	41 48 N 0 06 E	19/9/95	9/11/95	29/10/96
1.809	Lent	Spain	Lleida Province Torrebeses 'El Grau'	Near a P. vera orchard	41 48 N 0 06 E	19/9/95	9/11/95	29/10/96
1.810	Lent	Spain	Lleida Province Torrebeses 'El Grau'	Near a P. vera orchard	41 48 N 0 06 E	19/9/95	9/11/95	29/10/96

Plot 1 - lane 10

No.	Spec.	Country	Site of origin	Notes about site	Coordinates	Collection date	Germination date	Planting date
1.1001	Lent	Tunisia	Takrouna (Le Kef)		N: 36 17 236 E: 8 28 410	9/11/95	23/12/95	30/10/97
1.1002	Lent	Tunisia	Takrouna (Le Kef)		N: 36 17 236 E: 8 28 410	9/11/95	23/12/95	30/10/97
1.1003	Lent	Tunisia	Ain Sebaa (Jendouba)		N: 35 57 439 E: 8 56 326	10/11/95	23/12/95	30/10/97
1.1004	Lent	Tunisia	Ain Sebaa (Jendouba)		N: 35 57 439 E: 8 56 326	10/11/95	23/12/95	30/10/97
1.1005	Lent	Tunisia	Rehaiette (Beja)		N: 36 42 267 E: 9 18 157	10/11/95	23/12/95	30/10/97
1.1006	Lent	Tunisia	Rehaiette (Beja)		N: 36 42 267 E: 9 18 157	10/11/95	23/12/95	30/10/97
1.1007	Lent	Tunisia	Rehaiette (Beja)		N: 36 42 267 E: 9 18 157	10/11/95	23/12/95	30/10/97
1.1008	Lent	Tunisia	Rehaiette (Beja)		N: 36 42 267 E: 9 18 157	10/11/95	23/12/95	30/10/97
1.1009	Lent	Tunisia	Rehaiette (Beja)		N: 36 42 267 E: 9 18 157	10/11/95	23/12/95	30/10/97

1.1010	Lent	Tunisia	Rehaiette (Beja)		N: 36 42 267 E: 9 18 157	10/11/95	23/12/95	30/10/97
1.1011	Lent	Tunisia	Rehaiette (Beja)		N: 36 42 267 E: 9 18 157	10/11/95	23/12/95	30/10/97
1.1012	-							
1.1013	Lent	Tunisia	Aindrham (Jendouba)		N: 36 49 503 E: 8 41 957	10/11/95	23/12/95	31/10/97
1.1014	Lent	Tunisia	Aindrham (Jendouba)		N: 36 49 503 E: 8 41 957	10/11/95	23/12/95	31/10/97
1.1015	Lent	Tunisia	Aindrham (Jendouba)		N: 36 49 503 E: 8 41 957	10/11/95	23/12/95	31/10/97
1.1016	Lent	Tunisia	Ain Sebaa (Jendouba)		N: 35 57 439 E: 8 56 326	10/11/95	23/12/95	31/10/97
1.1017	Lent	Tunisia	Ain Sebaa (Jendouba)		N: 35 57 439 E: 8 56 326	10/11/95	23/12/95	31/10/97
1.1018	Lent	Tunisia	Ain Sebaa (Jendouba)		N: 35 57 439 E: 8 56 326	10/11/95	23/12/95	31/10/97
1.1019	Lent	Tunisia	Ain Sebaa (Jendouba)		N: 35 57 439 E: 8 56 326	10/11/95	23/12/95	31/10/97
1.1020	Lent	Tunisia	Ain Sebaa (Jendouba)		N: 35 57 439 E: 8 56 326	10/11/95	23/12/95	31/10/97
1.1021	Lent	Tunisia	Ain Sebaa (Jendouba)		N: 35 57 439 E: 8 56 326	10/11/95	23/12/95	31/10/97
1.1023	Lent	Tunisia	Ain Sebaa (Jendouba)		N: 35 57 439 E: 8 56 326	10/11/95	23/12/95	31/10/97
1.1024	Lent	Tunisia	Ain Sebaa (Jendouba)		N: 35 57 439 E: 8 56 326	10/11/95	23/12/95	31/10/97
1.1025	Lent	Tunisia	Takrouna (Le Kef)		N: 36 17 236 E: 8 28 410	9/11/95	23/12/95	3/11/97
1.1027	Lent	Tunisia	Takrouna (Le Kef)		N: 36 17 236	9/11/95	23/12/95	3/11/97

					E: 8 28 410			
1.1028	Lent	Tunisia	Takrouna (Le Kef)		N: 36 17 236 E: 8 28 410	9/11/95	23/12/95	3/11/97
1.1030	Lent	Tunisia	Takrouna (Le Kef)		N: 36 17 236 E: 8 28 410	9/11/95	23/12/95	3/11/97
1.1031	Lent	Tunisia	Takrouna (Le Kef)		N: 36 17 236 E: 8 28 410	9/11/95	23/12/95	3/11/97
1.1032	Lent	Tunisia	Takrouna (Le Kef)		N: 36 17 236 E: 8 28 410	9/11/95	23/12/95	3/11/97
1.1033	Lent	Tunisia	Takrouna (Le Kef)		N: 36 17 236 E: 8 28 410	9/11/95	23/12/95	3/11/97
1.1034	Lent	Tunisia	Takrouna (Le Kef)		N: 36 17 236 E: 8 28 410	9/11/95	23/12/95	3/11/97

Plot 1 - lane 13

No.	Spec.	Country	Site of origin	Notes about site	Coordinates	Collection date	Germination date	Planting date
1.1301	Vera (Kerm)	Calif	UCD-Winters coll.	283 in grand list		9/97		4/3/98
1.1302	Vera (Kerm)	Calif	UCD-Winters coll.	283 in grand list		9/97		4/3/98
1.1303	Vera (Kerm)	Calif	UCD-Winters coll.	283 in grand list		9/97		4/3/98
1.1304	Vera (Kerm)	Calif	UCD-Winters coll.	283 in grand list		9/97		4/3/98
1.1305	Vera (Kerm)	Calif	UCD-Winters coll.	283 in grand list		9/97		4/3/98

1.1307	Vera (Kerm)	Calif	UCD-Winters coll.	283 in grand list		9/97		4/3/98
1.1308	Vera (Kerm)	Calif	UCD-Winters coll.	283 in grand list		9/97		4/3/98
1.1309	Vera (Kerm)	Calif	UCD-Winters coll.	283 in grand list		9/97		4/3/98
1.1310	Vera (Kerm)	Calif	UCD-Winters coll.	283 in grand list		9/97		4/3/98
1.1311	Vera (Kerm)	Calif	UCD-Winters coll.	283 in grand list		9/97		4/3/98

1.1312	Vera	Calif	UCD-Winters coll.	283 in grand list	(Kerm)	9/97		4/3/98
1.1313	Vera	Calif	UCD-Winters coll.	283 in grand list	(Kerm)	9/97		4/3/98
1.1314	Vera	Calif	UCD-Winters coll.	283 in grand list	(Kerm)	9/97		4/3/98
1.1315	Vera	Calif	UCD-Winters coll.	283 in grand list	(Kerm)	9/97		4/3/98
1.1316	Vera	Calif	UCD-Winters coll.	278 in grand list	Boz 50C	9/97		25/3/98
1.1317	Vera	Calif	UCD-Winters coll.	278 in grand list	Boz 50C	9/97		25/3/98
1.1318	Vera	Calif	UCD-Winters coll.	278 in grand list	Boz 50C	9/97		25/3/98
1.1319	Vera	Calif	UCD-Winters coll.	278 in grand list	Boz 50C	9/97		25/3/98
1.1320	Vera	Calif	UCD-Winters coll.	278 in grand list	Boz 50C	9/97		25/3/98
1.1321	Vera	Calif	UCD-Winters coll.	278 in grand list	Boz 50C	9/97		25/3/98
1.1322	Vera	Calif	UCD-Winters coll.	278 in grand list	Boz 50C	9/97		25/3/98
1.1323	Vera	Calif	UCD-Winters coll.	278 in grand list	Boz 50C	9/97		25/3/98
1.1324	Vera	Calif	UCD-Winters coll.	278 in grand list	Boz 50C	9/97		25/3/98

1.1325	Vera	Calif	UCD-Winters coll.	278 in grand list	Boz 50C	9/97		25/3/98
1.1326	Vera	Calif	UCD-Winters coll.	278 in grand list	Boz 50C	9/97		25/3/98
1.1327	Vera	Calif	UCD-Winters coll.	278 in grand list	Boz 50C	9/97		25/3/98
1.1328	Vera	Calif	UCD-Winters coll.	278 in grand list	Boz 50C	9/97		25/3/98

1.1329	Vera	Calif	UCD-Winters coll.	278 in grand list	Boz 50C	9/97		25/3/98
1.1330	vera	Turkm	Kepele	Block 34		2001		24/3/02

Plot 1 - lane 14

No.	Spec.	Country	Site of origin	Notes about site	Coordinates	Collection date	Germination date	Planting date
1.1401	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1404	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1405	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1406	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1407	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1408	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1409	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1410	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1411	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1412	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1414	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1415	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1416	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1417	Vera	Turkmen	Kepele	Nepessov		2001		18/11/04
1.1418	Vera	Turkmen	Kepele	Nepessov		2001		18/11/04
1.1419	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1420	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1421	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1423	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1424	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1425	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02

1.1426	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1427	Vera	Turkmen	Akarcheshme	Azat		2000		24/3/02
1.1428	Vera	Turkmen	Kepele	Nepessov		2001		18/11/04