30.1.2023

Growth and Adaptation of Pistachio to the Central Golan Region

Summarizing Report, Experiment 2015-2022

Shlomi Kfir, Dr. Amos Naor, Dr. Omer Crane, Suliman Farhat, Haya Rak-Yahalom,
Elkana Ben Yashar, Dr. Miriam Silberstein - Northern R&D - MIGAL
The Ramat Magshimim orchards team
Elisha Tzurgil / Sde Boker.
Dr. Louise Ferguson / Davis University California.

Background

In 2014, under an initiative of the Golan Heights Regional Council, the Government of Israel decided to include a project for the accelerated development of the Golan Heights in the 2015 budget, with a scope of ILS 354 million. The goal of this project was to double the size of the farms in existing settlements and add 750 enlarged farms. The budget included a significant part for research and development. The deciduous fruits and vineyard administration at the Northern R&D - MIGAL submitted a document that contained abstracts of research and implementation programs for advancement of the expansion of Golan Heights farms that grow deciduous orchards and vineyards. The goal of the programs was to prevent local market failures due to the addition of more fruits, over those already found at a certain saturation point, including technology for obtaining late-ripening table grapes, pistachio, persimmon, European pear, as well as almond varieties that constitute a major share of production in the world market and other financially promising fruit species.

The Northern R&D-MIGAL deciduous trees section established two plots in the Central Golan: An almonds plot on designated land of Moshav Avnei Eitan (in the area of Juhader Hill) at an altitude of 630 m ASL (which was reported in detail in 2022 in volume 8 of the *Alon Hanotea* magazine, in an article by Dr. Omer Crane and Shlomi Kfir – in Hebrew). A second plot was planted in the designated land of Ramat Magshimim below mound Tel Fares at an altitude of 710 m ASL. In this plot, pistachio varieties were budded based on plant material from Sde Boker, as well as a persimmon derived from four Japanese varieties which does not contain astringents (which after four years of cultivation was found to be unsuitable to this area).

In the present report we present a summary of an experiment conducted in a pistachio plot that was planted in 2016 and has so far completed seven years of growth.

Pistacia vera

P. vera is a species in the genus *Pistacia* which has numerous representatives in the local wild forest, including *P. palaestina*, *P. lenticus* and *P. atlantica* which serves as a rootstock for pistachio and as a parent with *P. integerrima*, where the hybrid UCB1 serves as the preferred commercial rootstock worldwide.

All the trees of this species are unisexual and dioecious, i.e., there are separate male and female trees. Fertilization is by wind. Pistachio grows naturally in the high plateaus of western and southern central Asia, and requires over 1000 chilling hours (below 7°C) in winter, and uniquely also 2500 hours of heat for its fruit to ripen. The tree is deciduous, with a large canopy (up to 10 m high), deep roots (an essential feature for a semi-arid tree), bears its fruit on perennial branches and has a strong alternate feature. The species enters fertility after six years and reaches full fertility starting from its tenth year.

Pistachio in Israel

In the 1960s, the Jewish National Fund (JNF) conducted a wide operation to combine pistachio groves by planting *P. atlantica* trees at various forest sites and grafting them with pistachio. Traces of this activity can be observed at the Biriya junction near Zefat on Mount Canaan, in the Botna Valley (Botna is an Hebrew name for pistachio) in the Biriya Forest, in the Yatir Forest (including on the northern edge of southern Route 6), in the Kfar Szold cemetery and more. The surviving trees are not going to disappear soon, because *P. atlantica* has a lifespan of centuries. However, the rootstock has overcome the grafted variety in some of these trees, and it has disappeared due to lack of care.

An attempt has been made to grow pistachio commercially at Kibbutz Sde Boker since the early 1960s, where dozens of dunams were planted with a broad range of female and male varieties. This experiment did not withstand the economic test, despite the kibbutz members' persistence over many years. As a member of a young "Kibbutznics" group that helped the young kibbutz Sde Boker during 1966/7, I personally participated in manual pollination of the pistachio plots (hence my motivation to try and revive this crop in Israel).

The commercial pistachio plots at Sde Boker were abandoned in the 1990s, and only two plots in poor condition remain to the south of the kibbutz, as well as plots that are integrated into the local landscaping, where residential neighborhoods were built within the plots of the old orchard. Luckily, the crop was accompanied by detailed mapping of the trees according to female and male varieties that were preserved. It was thus possible to obtain plant material from the different varieties with a high level of reliability. The reasons for the cessation of commercial cultivation

at Sde Boker and the fact that the material derived from old wood is problematic in making new plants, are presented later in this article.

This is the place to mention Amram Nevo from Moshav Omer, an Israeli pistachio extension agent, entrepreneur and tireless dreamer. The pistachio was the center of his activity for many years, many of which he spent as an instructor in Iran. Amram Nevo escaped from Iran during the 1979 revolution through an amazing personal ordeal. He cultivated two pistachio varieties and even patented them. Unfortunately, they do not exist in Israel anymore.

He wrote about his professional and personal path in life in a fascinating book, *The Pistachio and Me*, which was published in a limited edition. I met his wife Sara, who was involved in the growing process, at their home in Moshav Omer, which became part of a prestigious neighborhood of Be'er Sheva. Pistachio trees are still found in their yard (the farm was sold and it can be assumed that the preservation of the trees is not among the new owner's concerns).

Economic background

Based on the above, it seems that the barriers to entry into growth are significant in the conventional thinking of the fruit industry economy in Israel, but fortunately, we were preceded by Californians in the US where acclimatization efforts were made over a century ago.

In the preface to the Growing Protocol of the University of California, Davis. The process is defined as "The most successful plant introduced into the USA in the last century".

Hundreds of thousands of acres of pistachio are planted in California's Central Valley, such that California is by far the leading pistachio producer in the world. Competing fruit crops such as almonds are also grown in the Valley, where pistachio brings twice the return to the grower for its perennial cost, despite the delay in obtaining the yield and the strong alternate feature. The worldwide market for pistachio remains robust and shows no signs of becoming oversaturated, thus enhancing the appeal of cultivating this crop.

Now back to Sde Boker: The reasons for the decision to plant pistachio were the cold winter and hot summer, which are characteristic of the Negev Highlands. Examination of the accumulation of chilling hours during the previous decade and the average for mid-March (assuming that this is the last effective date for the accumulation of chilling hours) shows 550 chilling hours. At the same time, there were about 1,000 chilling hours at Mount Canaan, according to the Tzur-Meron-Peres model. In the area of the Tel Fares mound, the average is 1100 for this period. The reason for the failure of pistachio in Sde Boker is thus clear. According to information in my possession, the best yield in Sde Boker was about 150 kg/dunam for marketing, whereas the sensitivity tables in California begin at 250 kg/dunam or more (including the alternate off-years).

Report on the activity at the Tel Fares Plot

Spoiler: There are no crop data at the end of the report.

Establishment of the plantation

With the basic assumptions that the climate at Tel Fares meets the criterion of chilling hours (we did not yet know that there is also a concept of heat hours), we located a corner plot in the Ramat Magshimim plantation on an ex-wine vineyard and received *P. atlantica* seedling plants from the KKL-JNF. We transferred the seedling plants to the Matityahu Farm in December of 2015 for accumulation of chilling and prepared a plot under consultation with Mr. Nadav Ravid, a former Shaham extension agent and consultant to the Wonderful Company in California, which grows various fruits, especially pistachio.

Planting the P. atlantica seedling plants

The *P. atlantica* seedlings obtained from KKL-JNF's Golani nursery were planted on 14 March 2016 at 6x5 m increments in nine rows and in pairs at a distance of 0.5 m between seedlings (At the beginning of my journey in the fruit orchards in Manara, I experimented with grafting and budding pistachio on *P. atlantica* trees in the forest along the fence of the plots and learned how difficult the task was. I could assume that doubling the chance of success might help in setting up an early plantation but did not yet know that this would also not suffice).

In planning the plot, we took the fact that we did not know the wind directions during the flowering season into account. In order to ensure optimal wind pollination, we planted the male trees as the first and last tree in each row, as well as every third tree in the first, last and middle row. About 50 male trees were supposed to be planted, which is over 4 times the norm in California (4%).

Dr. Louise Ferguson from the University of California, Davis, is a major researcher and central figure in the R&D of the California pistachio industry. She was invited by the Peres Center for Peace to a tour that included a day devoted to farmers from the Palestinian Authority and Israel. We managed to "kidnap" her for a two-days tour that included the KKL-JNF plot in the Biriya forest and our plot at Tel Fares. Dr. Ferguson gave us a detailed report with recommendations for action and interface as well as an unequivocal recommendation to examine the UCB1 rootstock whose basic data show an advantage of over 10% higher yield. Another recommendation was to reduce the irrigation ration provided by the local field extension service. Dr. David Doll from the Californian extension service visited the plot in September 2017 and repeated with the same

recommendation. We found out much later that we should have followed the local instructions due to their long-term experience.

Preparation of the plot

The procedure for establishing a standard plantation in California is: planting the rootstocks in the plot during the winter, budding in mid-summer (95% success). Then, after the bud begins growing, suppression of the rootstock and encouraging the young growth with support. Scraping the rootstock above the budding point is performed later, when the growth is rather thick.
As mentioned, we took plant material from Sde Boker, from the historically popular female variety Karman and the recommended male variety Peters. It was only toward the end of the summer that we obtained an annual growth that meets the criterion for grafting and budding (usually T-budding and sometimes chip budding). Awakening of the buds was observed in the spring of 2017, and presented approximately 33% absorption. The explanations for this lack of success are long and significant:

1. In an annual branch originating from a mature tree, some of the buds differentiate into flowers while others differentiate into vegetative buds, so that a flower bud does not produce growth and vice versa. I understood this fact from the second year onwards, but still did not know how to recognize the vegetative buds. I learned this over time, partially by looking at the position of vegetative and flowering buds on older branches.
2. Anecdote: During a study visit to California, Dr. O. Crane and I met with a worker of the Wonderful Company in a young orchard and I raised the issue of choosing a vegetative bud. The man did not understand what I meant. This is also an explanation – in a young and vegetative tree, all the buds on a young branch are vegetative, whereas we had only mature trees from the very old Sde Boker plantation as a source of plant material.
3. We learned from the Californian consultation that the time for budding is only during the active vegetative growth when the young leaves are red. Growth occurs in a few waves during the summer.
4. The top bud of every branch is vegetative, so I also tried head grafting with a similar success rate.

This can explain the low success rate, that was due first to the inability to distinguish the above and then from a phenological timing that required transitions over the plot in order to diagnose the phenological state of each tree. Furthermore, the process of completing the budding in most of the plot lasted up to a third year and in the margins throughout the life of the plot.

It can be concluded that budding pistachio under the local conditions is a very complex process, more so than any other familiar species.

Varieties

The four existing female varieties included:

- **Kerman**: This has been the most popular commercial variety in the Old and New World until recently. It is named after a city in central Iran. The variety excels in yield and quality and constituted the bulk of the Sde Boker plantations.
- **Larnaca**: This variety is assumed to originate from Cyprus. According to the stories of Daniel Heifetz, a young observant Jew who grows pistachio in northern Argentina, the variety is popular in Italy.
- **Red Aleppo**: This is a variety named after a city in northern Syria.
- **Sfax**: This variety is found in the Sde Boker plantations.
- **Aegina**: This variety is named after an island in the Gulf of Athens. It is interesting for being a variety that grows at sea level, and its chilling requirements are therefore expected to be low. Unfortunately, the source is from trees that were marked on the map of the plot in Sde Boker as Sfax, whereas Elisha Zurgil insisted that these are Aegina trees ("they were grafted by Amram Nevo as Aegina, but the map was not updated"). I therefore named this variety "**Aegina Sfax**" until the variety is proven (mainly by obtaining a crop in relatively hot years or comparing with the help of Marcos Papagaios, a Greek colleague from the island of Aegina who grows it and speaks fluent Hebrew).

New female varieties:

At this point we may return to Amram Nevo, a breeder and extension agent – "the Israeli pistachio man" – who engaged in long cultivation processes and even produced two new varieties that he patented: Shufra and Arie. Mr. Nevo had lengthy negotiations with a grower in California as well as in South Africa and even an agreement that was supposed to afford royalties for the years of strenuous work. I do not know whether these varieties exist in California, but they are found in South Africa. Dr. Anton Muller, a pistachio researcher from South Africa, claimed that the Shufra and Arie varieties exist in the orchards. We already made some steps to bring these varieties from South Africa.

- **Shufra**: This variety has high yields and extreme alternate bearing, but with a very good perennial harvest average of about 350-400 kg/dunam.

- **Arie**: This variety has a moderate perennial harvest average of about 250 kg/dunam, but with premium quality that brings a high price.

In California, new varieties from local cultivation on Golden Hill and Lost Hill are being planted. These varieties have higher performance than the Kerman variety.

Male varieties:

As a rule, the male tree is larger, where the recommended variety **Peters** was budded in the area, as detailed above.

After discussing the problem of timing, the bloom (see phenology chapter) and the need to continue to include varieties from Sde Boker, I budded three additional male varieties in the plot: **Nazareti**, **Chico** and **504**. My observations indicated that the male buddings were more successful.

These varieties are located on the edges of the plantation and were uprooted to a new nearby site when we had to leave the plot. It seems that they survived the relocation process with 95% success (a pistachio tree does not like relocation), but may need two more years to recover.

We also planted those varieties at the Matityahu research farm in 2018, with the hope that the Sde Boker plots will survive for years, so that we may ensure the survival of all varieties in Israel.

Another male variant is a *Pistacua Vera* tree (probably *P. palaestina*) which we examined and which has a late flowering characteristic, so that we may solve the flowering gaps due to a delay in the flowering of the females and an early flowering of the males. The intention is to ensure that the male pollen from the variety is potent enough, so we carried out some controlled manual pollinations. At this stage we will call it "**Kfir**" (for some reason!).

In an article from a professional paper from the late 1960s (a copy of the article in my possession does not mention the author's name or the date of publication), the pollen from various sources was examined, and the pollen from *P. palaestina* was found to be preferable in terms of yield and in terms of opening the shell.

Rootstocks

As mentioned, we established a plot based on KKL-JNF forest seedlings that are planted after germination (local protocol similar to the Manual) in molds for many plants per unit, and are ready for planting only after about a year, when the volume of the roots for the seedling is minimal and accordingly also its viability.

When we learned from Dr. Ferguson about the commercial rootstocks UCB1 (hybrid of the Chinese male tree *P. integerrima* and the female *P. atlantica* tree), we initiated the importation of seeds with the help of Dr. M. Silberstein who brought the seeds herself from a Californian nursery in the fall of 2016. We followed the germination protocol of the Californian Manual. The seeds were germinated successfully with the help of Shoshi Peles from Northern R&D (relatively successful compared to professional nurseries that have experience with this protocol), and we obtained beautiful seedlings. We budded them with partial success at the nursery of the research farm and planted them in the spring of 2018 as a second tree at the original seedling sites where we did not have a budded pistachio. The percentage of successful budding was also an advantage. The UCB1 trees developed better and had more vigorous growth compared to *P. atlantica* that demonstrated milder growth (there were also some *P. atlantica* trees with residual problems at the budding point).

Figure 1: Our nursery of 8 months old UCB1 rootstocks, ready for winter planting.

Plant Protection

Diseases:

Several diseases are mentioned in the Californian Manual, but we did not really pay attention to them. In summer 2015 we monitored some unidentified leaf diseases that we blamed for causing early leaf drop in the pistachio trees at the Biriya junction on Mount Canaan. We consulted with Prof. Moshe Reuveni of the Golan Research Institute (Shamir Institute today) and Amotz Farber from the "Shahaf" company regarding these diseases. We carried out an extensive observation during the summer of 2015 and tested some fungicides from the end of July 2015, which were sprayed with six treatments until the beginning of October. Galben Mancozeb and Tebuconazole demonstrated efficacy. Prof. Reuveni also identified *Alternaria* and an examination of the PPIS showed *Botryosphaeria*.

In the field: We did not treat the plot at all during the first two years, and during July the trees lost much of their foliage and vitality. Here we turned to researchers in California. Dr. Themis J. Michailides identified *Alternaria* from photographs that we sent. In the following spring we began foliage treatments with fungicides for the above diseases, in alternation from an early growth stage, according to the recommendation of Amotz Farber (who monitored *Puccinia* as well). We sprayed every three weeks or so throughout the growing season and the problem was solved visually. Growth remained vital until late autumn.

Pests:

The orchard borders a wine vineyard on its western side, and damage by Cicadellidae was spotted relatively early in each season, leaving their mark on the annual foliage of growth. We applied treatment with Confidor (Imidacloprid) only after the onset of symptoms (which is late). Additional treatments were added, according to monitoring, by spraying the canopy.
In the young growth we spotted damage due to mites, especially on *P. atlantica* growth. The mites were treated in accordance with visual monitoring, once a season.

Weeds:

The plot was treated with Goal (Oxyfluorfen) in the autumn and with Diurex (Diuron) in the spring. We had to treat some summer weeds by spraying spots. Later we also treated the weeds with Alion, that was effective for two seasons.

"Spraying machinery":

As the orchard was only 10 dunam (1 hectare), using a regular sprayer was a waste of materials since the canopies of younger trees filled a small percentage of the sprayed volume. In order to save on materials, and to take the wind regime, efficiency and costs of loaned machinery into account, we usually used a back sprayer (carried on my own back!). The "fan" sprayer is sensitive to wind and is therefore less effective.

Climate

Winds:

The area is very windy, and we therefore had to learn from experience. Observations on *Pistacia* trees in the vicinity indicated that *P. atlantica* is resistant to winds, and so maybe also varieties of pistachio that originate in the windy plains of south-central Asia. Dr. Michailides asked us for the wind data, and for the first time we uploaded the data of the plantation area. As an example,

we sent data for a week in July where the day's high did not fall below 40 km/h and even reached over 50 km/h. We received the following answer: "I wonder how it would be possible to grow pistachios when there are such strong winds". Dr. Michailides emphasized possible loss of fruit during the ripening stage, but we did not observe any problems with the few clusters that we had. However, it was necessary to support the trees from northwestern winds and the inclination of growth to the southeast.

Pollination:

Placement of males according to wind direction was not completed. We have not reached the stage of examining the effect of wind direction during the flowering season.

Electricity turbines:

During the summer of 2021, we had to relinquish all the male trees and three female trees in each row on the western side for an electricity turbine which was being built just a few meters from the plot (i may prove how windy this site is). See the attached photo in Figure 2 from July 2022 (the stain in the center is a fracture in the lens coverage on the cellphone). The plantation is presented at its best.

Figure 2: Pistachio plantation in July 2022. In the background are the electricity turbines under construction (and a broken camera stain).

Winter chilling

In figure 3. I assum that the dormacy breake begins in mid-March for pistachio. On a multi-year average 1100 chilling hours are expected until this point, which is slightly above the required minimum. In most of the years, we used treatments that seem to help to break dormancy and

encourage growth of lateral fruit branches. . This is recommended from our understanding to the process of entering fertility, and perhaps also as a routine (we can see it on trees in Matityahu with less accumulation mostly).

In the spring of 2019, after a cold winter, the trees were sprayed with Armobreak 1%, TDZ 200 H.M. and ammonium nitrate 10%. In the spring of 2020, after a cold winter, the trees were sprayed with Armobreak 1%, ammonium nitrate 10% + Luna Exp (disease prevention). In the spring of 2018 and 2021, after a "hot" winter, the trees were sprayed with Dormex 3% + Trytone on March fifth. All treatments were carried out as observations versus a control. The impression is that the above treatments did not cause any harm.

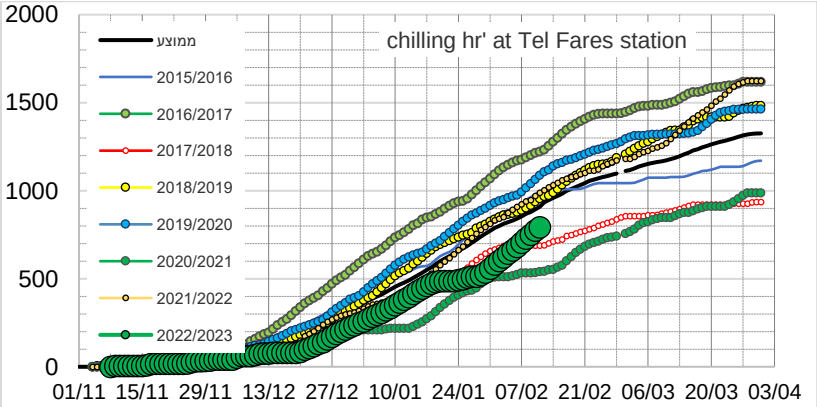

Figure 3: Data on the accumulation of chilling hours at the station near the plantation
The black line shows the mean number of chilling hours.

Summer heat

The concept of heat hours did not exist in the local jargon of deciduous trees. We obtained the accumulation formula for the required heat hours. Pistachio requires about 2500 to 2800 hours of heat according to the following formula: (daily minimum temperature + daily maximum temperature) divided by 2, minus 4.5 degrees Celsius. The accumulation is measured from dormancy break to harvesting (subtraction of 4.5 degrees Celsius was determined due to the lack of response to a temperature lower than this). According to this calculation, we are at the upper end of the heat hour requirements.

Soil

Tel Fares is a basaltic area, with many rocks of various sizes, and no big boulders. We carried out soil tests and it was found to contain components characteristic of this soil: 33% sand, 46%

silicate and 21% clay. The minerals level is significantly higher at a depth of 30-60 cm, probably due to the remains of a vineyard that was uprooted a few years earlier.
The impression was that there should not be any drainage problems, and we did not consider planting in ridges. However, in practice we experienced two winters with a large amount of precipitation, which resulted in standing water in some of the areas, causing mortality and damage to the size of some of the trees.

Irrigation and fertilization

Irrigation:

We were connected to the water systems under control of the irrigation team of the Ramat Magshimim plantation and enjoyed excellent cooperation. The equipment included one line per row with a 1.6 L/h dropper every 0.5 m. Due to the large gap between the trees, we left three drippers for pairs of young trees, and closed the rest. The water was allotted according to recommendations from Dr. Amos Naor, an irrigation researcher, and Moti Peres, an extension agent (with adaption to the recommendations of Dr. Ferguson and Dr. Doll).
Water was given according to the calculation of the number of drippers/site x the number of sites (site ! because the trees were planted in pairsin each site).
According to the accepted quantity, we were under-irrigating until mid-2018 when, with the involvement of Shimon Antman, an extension agent, we switched to a dose based on local knowledge and obtained a reasonable annual growth.
When calculating the annual dose, we reached about 250 m^3/year. In 2020, the dose was about 400 m^3/year, which is perhaps acceptable in our terms, and it is likely that here we had difficulty in reaching a required canopy (compared to our impression from the young orchards in California).

Fertilization:

About 18 units of nitrogen and potassium and 6 units of phosphorus were given every year (a survey of organic matter under the drippers did not show any difference).

Phenology

The dormancy brake of pistachio varieties occurs relatively late in the early spring, compared to other deciduous fruit species, with only slight differences between the varieties and the sexes, as I learned from one orderly follow-up year (2022) at several sites (after a relatively cold winter).

Over the last year, we carried out an orderly follow-up at a number of sites: the Golan site, the collection of varieties in Matityahu (young trees from 2018), and in Sde Boker (very partially emerging during the dormancy break season). The most accessible trees, at the Matityahu Farm, showed that the male varieties Peters and Chico emerge about 4 days earlier, on average, compared to the Nazarti and 504 varieties, and concomitantly to the Kerman variety.
In the Tel Fares plantation, the dates of Peters and Larnaca were similar, whereas the Peters variety at Sde Boker was at the end of flowering when the Kerman variety had not yet bloomed. The multi-annual impression is that the males are earlier and there is a lack of pollen for covering the entire potential fertilization range. This must be considered with caution due to the young age of the trees in the north. Follow-up is necessary in order to detect phenological matches between the male and female varieties.

Pruning and training

The Californian Manual is very detailed, beginning with the height of the budding point about 50 cm above the ground, the stages of growing and handling the breakthrough of the bud. The height of the canopy splitting at about 1.1 m above the ground. This is followed by pruning the tree according to age and growth with the goal of splitting into about 3 branches of growth in each annual trim in the winter to a length of about 60-70 cm, for obtaining a broad crown (in 6x5.5 m increments, which give 30 trees/dunam) and trees with a large volume. Since we did not obtain the hoped-for growth, only some of the trees look a reasonable size for their age of 5+ (a recommendation for additional summer trimming by 30 cm did not bring a sufficient result of further fragmentation and additional fruit branches).
It should be noted that while the great advantage of growing pistachio is low human labor requirements, a large amount of individual manual labor is required at the stages of establishing the plantation, in order to obtain the desired tree and shorten the stage of entry into full yield (6-10 years!).

Conclusion

Ostensibly, we did not reach the goal of examining the potential for possible agricultural cultivation in the Golan, even after investing great effort and an adequate budget. However, we undertook to re-learn the breeding and we did! The information presented in this report, beginning with the basic conditions, plantations, varieties and rootstocks, plant protection issues, plus accumulated practical knowledge, will allow continued development if a grower is found who will move the potential forward.

The areas that meet the basic conditions are located in the Golan, mainly due to the extensive areas and climatic conditions (except for the issue of winds, which has not been fully tested). In my opinion, there is a good economic alternative here, and the involvement of Golan farmers is needed to promote it.

Misgav Am:

As part of the government's support in locating crops and technologies for the "victims" of Amendment 27 to the Water Law, we contacted Kibbutz Misgav Am for the establishment of a model plot in the mountain areas adjacent to the kibbutz. We were joined by a commercial entity with an interest, "Hishtil Nurseries", that wanted to test the green micro-grafting technologies that they were already using in vineyards and apple orchards.

Production with this technology is currently unsatisfactory due to basic problems such as thickness ratios between the young green rootstock and the annual growth branches. The breakout of the green growth is usually greater than the diameter of the growth of the rootstock (seed germination that starts with a thickness of "0" and its growth duration is several months). We are preparing for planting (at the time of the printing of this article we are not yet in the ground) in the hope that the exploitation of marginal soil will not jeopardize examination of the crop and that we will reach the harvesting stage. Growing for years will require support for covering the minimal costs of water, tools and manpower, and hopefully this support will be found.

Retention of genetic material:

As mentioned above, the sources of the varieties are commercial plots that were abandoned in Sde Boker and it was important first to verify the sources of the varieties according to the maps of these plots. We received much assistance from Elisha Zurgil, an old friend and a farmer himself, who gave us preliminary information and mapping to reach the varieties. The traceability was maintained even in the last stage of the uprooting of the plot, with about 25 trees remaining as a long boulevard. It is our intention to continue growing those trees with the help of the staff of Ramat Magshimim. Some of the trees were moved this winter to the alternative location. This species is, by nature, not very tolerant of this drastic action due to its deep roots. We hopethat those trees will survive the coming spring.

We Contact Dr. A. Muller from South Africa, who may help bring the Arie and Shufra varieties back from South Africa. However, the regulatory restrictions must be overcome, including the

consent of the owners and the plant protection services. A source for funding this process must also be found.

Acknowledgments

We thank the Chief Scientist at the Ministry of Agriculture, the Jewish National Fund, Northern R&D-MIGAL, with help by Ramat Magshimim.

References

Ferguson, Louise & Haviland, David P. (Technical Editors) (2017). Pistachio Production Manual, 8th Edition, Visalia CA (https://books.google.com/books?id=F5tfvgAACAAJ&printsec=frontcover&source=gbs_atb).

2. Course presentations.

3. A photographic report from the planting leaflet from 1965 (no information about the author, number and date of the leaflet).

4. Tour report "The California Pistachio Industry" in Alon Epstein's September 1985 booklet.

5. " The Pistachio and me" by Amram Nevo.

6. Maps of Pistachio plots from Sde Boker accompanied by personal knowledge of Elisha Zurgil and Zvi Remek.

7. Meetings and correspondence with: Nadav Ravid, Rob Goff, Dr. Louise Ferguson, Dr. David Doll, Dr. Themis J. Michailides. involved in industry and research in California.

8. Conversations in good Hebrew with: Marcos Papagiorgio from the island of Aegina, Greece and Daniel Chaifetz, (a Jew with fluent Hebrew) from northern Argentina.

9. Disease monitoring by Prof. Moshe Reuveni and Amotz Farber.