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OLIVE

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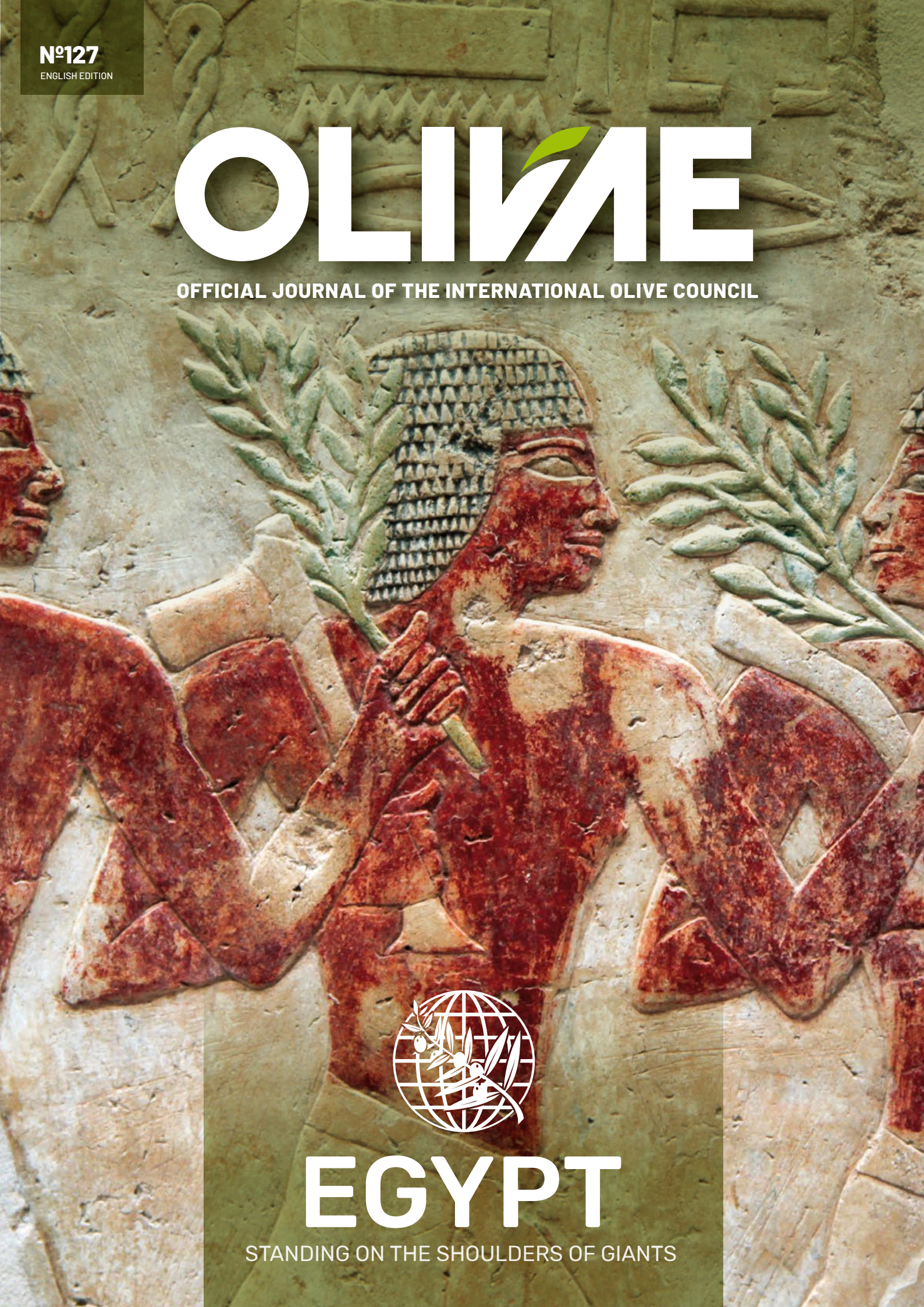

EGYPT

STANDING ON THE SHOULDERS OF GIANTS

OLIVAE

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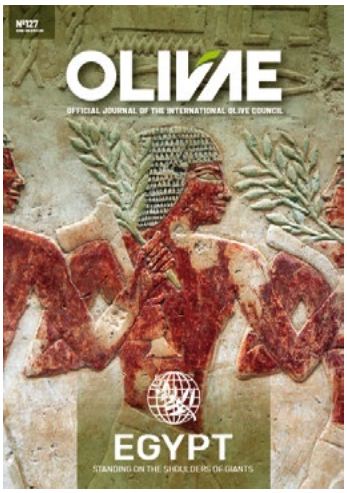

OLIVAE

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EDITORIAL

STANDING ON THE SHOULDERS OF GIANTS

Madrid

In this year's issue of OLIVAE, we welcome Egypt, a country with a long and rich history, and one of the first to sign the International Agreement on Olive Oil and Table Olives.

Egypt worked in perfect harmony with the Executive Secretariat when it held the chair of the International Olive Council in 2019, and our member countries wanted to dedicate this issue to a country that has always been a key player in the international olive sector.

The pandemic that shook the world in 2020 had no impact on the editorial committee the Executive Secretariat set up in Cairo. A dedicated committee of prestigious scientists worked hard to bring you this issue, and we give thanks to the authors.

Together, they created an editorial product of great cultural value. Through the quantity and quality of the content, issue 127 will be an indisputable source of information for the global community.

Egypt's figures are significant, unique and above all promising for the years to come – and there are things in this issue that will surprise you.

The history of this plant lives in these pages. The olive tree has characterised the Mediterranean region for centuries and has become a symbol of its identity. Olive cultivation bolsters both the economic and cultural revival of many rural communities around the world, thanks to the growing engagement of the academic and scientific communities. Olive oil in general and Egyptian table olives in particular are valuable not only for providing a source of income for the people who produce and market them, but also for providing key nutrients and medicine for the people who eat them.

Olive trees and olive products never cease to amaze us, providing elixirs of life both for the planet and for the consumer. They make the world a better place, and it is up to us to protect them. The Egyptians have always known this; we have a lot to learn from them.

We hope you enjoy this issue of OLIVAE as much as we did.

Mr. Abdellatif Ghedira

Executive Director
of the International Olive Council

PREFACE

Cairo

The ancient Egyptians have known about the importance of cultivating olive trees and extracting oil from their fruits for nearly 4 000 years. The holy tree is mentioned seven times in the Noble Qur'an, such as in Surah Al-Mu'minun, verse 20: in the name of Allah, the Most Gracious, the Most Merciful "[We brought forth] a tree issuing from Mount Sinai which produces oil and food for those who eat" [1].

The olive tree has sustained man through his food and medicine and has illuminated his caves and homes since the dawn of history. An official report issued by the International Olive Council [2] found that Egypt is expected to become the leading table olive producer in the 2019/2020 crop year, with overall production climbing to 690 000 tonnes. This will boost Egypt's visibility in markets and attract more competition and investment from around the world. The Egyptian government has launched a number of initiatives to expand the country's olive cultivation, in particular the projects to add 1.5 million feddans (625 000 hectares) of land and to plant 100 million trees by 2022. This is a great opportunity for the Egyptian olive sector to shore up its productivity.

The Ministry of Agriculture and Land Reclamation has worked closely with the International Olive Council and the Academy of Scientific Research and Technology to support the olive sector in a number of specialised projects. Together, they have studied key topics such as olive genetic improvement, conservation, nursery demonstration and, more recently, the sustainable and economic valorisation of olive orchards in the Egyptian desert. The Ministry also plans to expand olive oil production to match table olive production in the newly reclaimed areas in the north east and north west of Egypt, extending from Matrouh and Moghra to the North and South Sinai Governorates. These areas are perfect for planting oil olive trees, and will be key to expanding the Egyptian olive sector and bolstering food security, employment and the national income in the years to come.

Mr. Al Sayed Elkosayer
Minister of Agriculture and Land Reclamation

1 *Translation taken from https://quran.com/23/20*

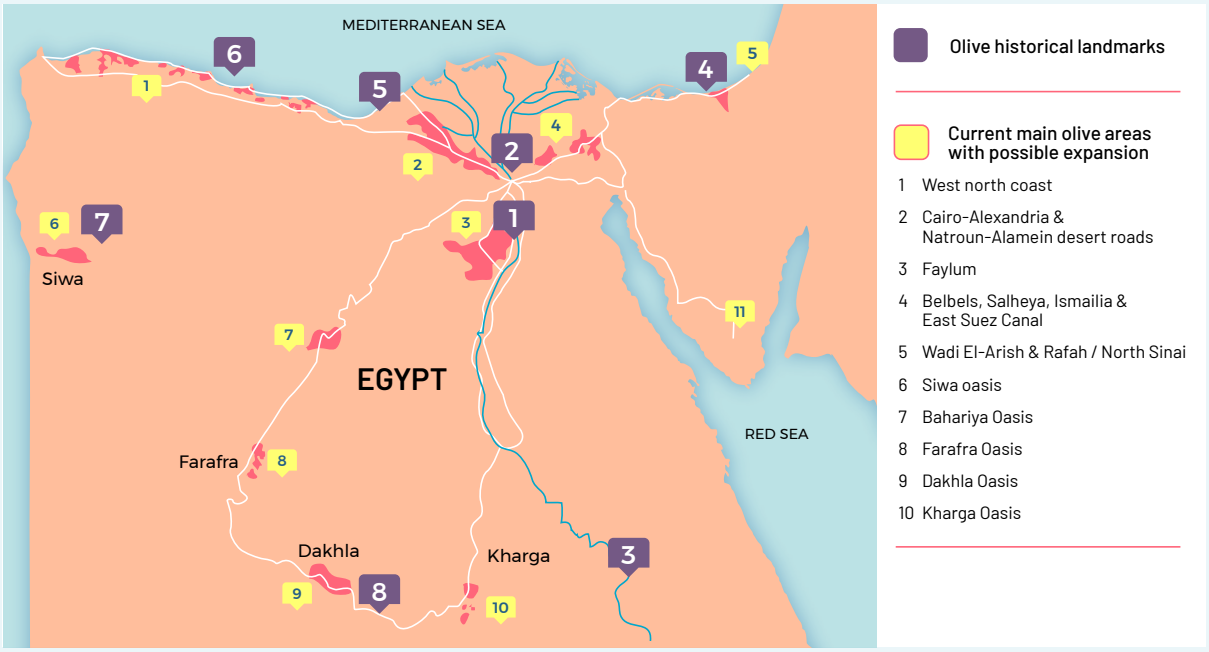
2 *For the full article and a link to the report, see https://www.oliveoiltimes.com/briefs/council-releases-estimates-for-2019-20-table-olive-production/80041*

OLIVE CULTIVATION HISTORY IN EGYPT

Mohamed El-Kholy
Olive Expert & Consultant

Although the challenging climate has restricted agriculture to certain regions, olive cultivation has deep historical roots in Egypt. Ancient Egyptians believed that Isis, the Mother of the Universe, taught mankind to extract oil from olives, and olive oil has been found among valuable treasures buried in the tombs of important prehistoric Egyptians. Indeed, excavations in Karanis (1) have unearthed olive oil jars, indicating how precious and sacred this oil has been regarded for thousands of years. Karanis was an agriculture area: in the Ptolemaic Kingdom founded in 305 BC by Potlemy, a companion of Alexander the Great, it was covered in olive trees. Karanis, known today as Kom Oshim, is located at the northeast corner of the Fayium Oasis, a depression in the desert where olive trees continue to sustain thousands of farmers.

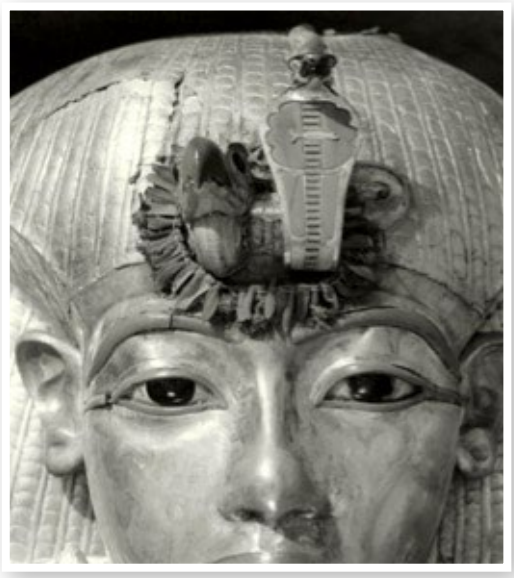
Evidence for olive culture can be seen in many monuments. Close to the Giza Pyramids, scenes on the walls of the tomb of King Teti' (2), the founder of the late 6th dynasty of the old kingdom and ruler from ca. 2345 BC to ca. 2333 BC, show olive fruits and trees. Papyrus manuscripts ca. 1550 BC and temple engravings depict olive tree cultivation and the use of olive oil in cooking, lamps, cosmetics, medicine and embalming. Tutankhamun (3), the famous Egyptian pharaoh who ruled from ca. 1333 to 1323 BC and is known for his richly adorned tomb in Luxor, wore a garland of olive branches as a symbol of honour. It is believed that the branches were brought from Dakhla Oasis, 360 km to the east. Egyptian mummies dating back to the 20-25th dynasties (ca. 1185 BC to ca. 656 BC) have also been found wearing olive wreaths.



Historical Landmarks of Olive Cultivation in Egypt

Following the geographical expansion of ancient Egypt, coupled with increased trade and relations with other civilizations in the Mediterranean basin, olive growing thrived from the Ptolemaic period (305-330 BC) onwards in areas with light, well-drained soils and water resources. At that time, the olive crop played an important role in sustaining the community. It was also used to pay the tithe to the Roman Empire when Egypt became a province in 30 BC after Octavian defeated Mark Antony and Ptolemaic Queen Cleopatra VII and conquered the country. Astonishingly, while more than 70% of the olives grown in Egypt lie within the Mediterranean olive growing belt, some of the areas cultivated with olive trees at that time continue to thrive outside the global belt of olive farming between about 30º and 45º latitude.

• **Karanis** at 29° 33′ and its surroundings within the Fayium Depression. The trees were irrigated by Nile water flowing through an elaborate system of locks and canals constructed under the pharaoh Amenemhat III (ca. 1860 to ca. 1814 BC, 12th dynasty). Olive oil was produced on a reasonable scale, and it was infused with flowers and herbs to produce both medicine and cosmetics. Olive trees still thrive here to this day, extending to the south and southwest.



Coffin face of Tutankhamun honoured with an olive garland.
Photo by Harry Burton - Archives of the Department of Egyptian Art,
© The Metropolitan Museum of Art

• **Wadi Auaris**, Avaris (El-Arish (4) in recent history) at 31° 15′ in Sinai close to the eastern border where rain water was used directly for irrigation or stored in surface catchments to grow olives on the flat coastal plains. The area is still a major olive production area today.

• **To the west of Lake Mareotis** (Mariut or Maryut (5) in recent history) at 30° 54′, a desert area located at the north-western fringe of the Nile Delta. Irrigation water came from shallow wells that seeped from what was then a fresh-water lake, which came from the Canopic Nile branch. The fresh water in the lake gradually receded as the Nile branch clogged with silt. By the end of the 12th century, the lake became saline and the olive groves were abolished except in a few localities where the trees survived on water from either rainfall or aquifers.

• **Scattered spots** (6) along nearly 300km of narrow, western coastline between latitudes 30° 50′ and 31° 15′. Olive trees were grown in small wadi catchments in sandy patches that could hold lots of water as they sat atop limestone substrate. Run-off rainwater was stored in man-built cisterns. Different techniques of water harvesting have evolved in this region over the centuries. The cultivated area has fluctuated in modern times due to rain scarcity and urban development.

• **Siwa Oases** (7) 29° 12′ was part of the 'Tehenu', which means 'the olive land'. In the 'Mountain of the Dead', on the limestone tomb walls of Si-Ammon, dating back to the 3rd century BC, there is a depiction of the sky goddess Nut standing in front of an olive tree pouring a jar of water or oil as a symbol of prosperity.

• **Bahariya 28° 22′, Farafra 27° 06′ and Dakhla** (8) **25° 30′ Oasis**, where later olive pressing flourished in Alqasr, a town built by the Ayyubid kings in the 12th century, probably on the remains of a Roman era settlement. To this day, the main cash crops in all oases remain first dates, then olives.

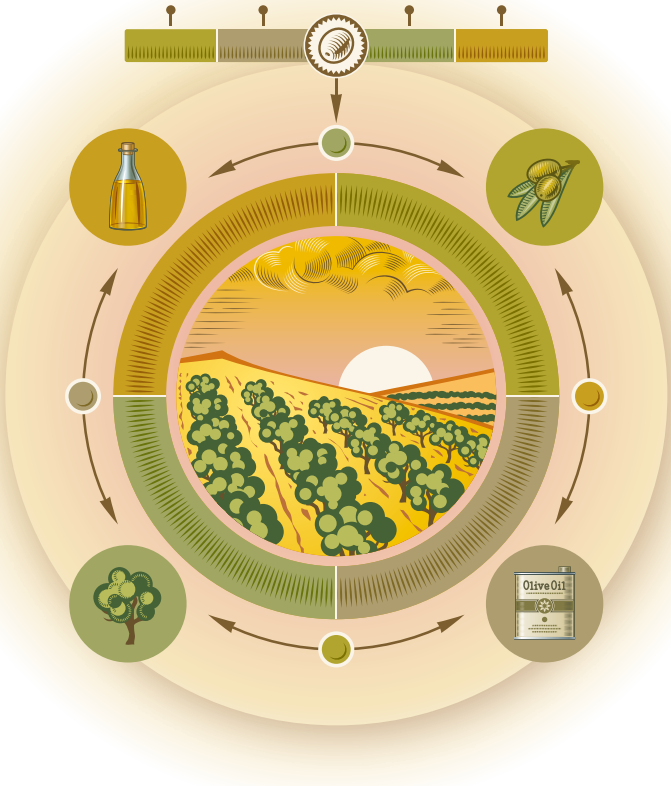
These historical olive growing areas have been in progressive decline due to demographic, urban and environmental changes. However, a 'Renaissance Era', if you will, began in 1985 when more land was allocated to olive cultivation in desert lands on the fringe of the Nile Delta and Valley, where water can be sourced from aquifers. Olive growing has increased by nearly 27-fold in that time, from 3 780 hectares to 100 708.13 hectares in the 2018/2019 crop year. This can be attributed to a number of factors: policies encouraging the private sector to invest in the reclamation of desert lands; modern techniques of irrigation and exploitation of aquifer water resources; the adaptability of the olive tree to the soil and environment of the reclaimed areas; the introduction of new cultivars; research into new methods of cultivation; investments into modern processing systems; and growing consumption around the world of olives and olive oil.

12th century Ayyubid grinder & press.

Sky Goddess "Nut" standing in front of an olive tree.

OLIVES IN EGYPT. CURRENT STATUS AND FUTURE STRATEGY

Ahmed Sabry Mofeed,
PhD Horticulture Research Institute
Agricultural Research Center

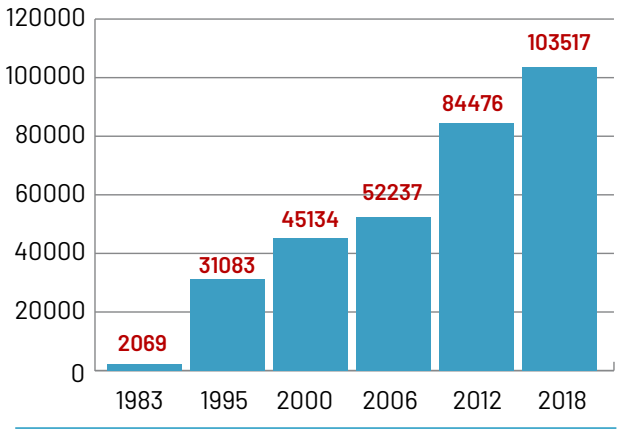


The olive sector is one of the most promising sectors in Egypt. Olive cultivation occupies about 13% of all agricultural land, and it has increased considerably in the last four decades due to land expansion into the desert.

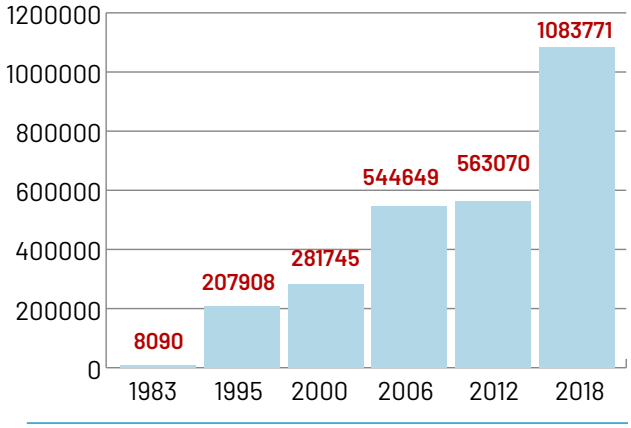
Olive trees have been successfully grown in the newly reclaimed land in Egypt; this may be attributed to their ability to thrive under conditions that other crops cannot tolerate, especially drought and salinity. In the 1970s, 2 023 hectares were allocated to olive growing, concentrated in Faiyum, Arish and Matrouh. In the 1980s, cultivars were imported as part of a project to develop the agricultural systems, such as Picual, Manzanillo, Koroneiki and Coratina, and the wide-scale propagation of olive cultivars by leafy stem cuttings under mist began. By the 1990s, the cultivation area had grown to around 18 211 hectares, increasing by about 2 000 hectares per year. In 2018, the area reached 103 517 hectares, producing 882 029 tonnes of fruit. Most of this fruit was processed for table olives, producing about 600 000 tonnes, and the rest for olive oil, producing around 41 252.5 tonnes.

In many countries, the olive sector is seen as an entire, integrated framework, not just a part of agriculture, given that there are four inseparable chains: production, processing, marketing and research. One cannot proceed without the other, and investors coordinate with research institutions to develop the sector.

Today, there are ever increasing economic, environmental and developmental reasons for expanding olive cultivation, especially since olives can grow so well in the Egyptian climate. With chilling units for



Development of Olive area in Egypt



Development of Olive production in Egypt

many native and international cultivars, and plenty of hours of sunlight, varieties grown in Egypt suffer from fewer pests and fungal diseases. It is also worth noting that Egypt has expanded production much more per hectare than other Mediterranean countries that depend on winter rain to irrigate their crops.

Egypt recently ranked highly in the global production and export of table olive cultivars, trading varieties such as Aggizi Shame cv., which are distinguished cultivars around the world. Around 600 000 tonnes were produced, and nearly 60 000 tonnes were exported. However, oil olive trees have not had as much of an impact in Egypt as of yet, and there is a clear need for the Egyptian government to invest in oil olive cultivars as part of its expansion plan. Research has proven that olive oil has many nutritional benefits, and its production could be a key source of income since it would create more export opportunities. This would make Egypt more visible on the global markets as a producer of this high-end product.

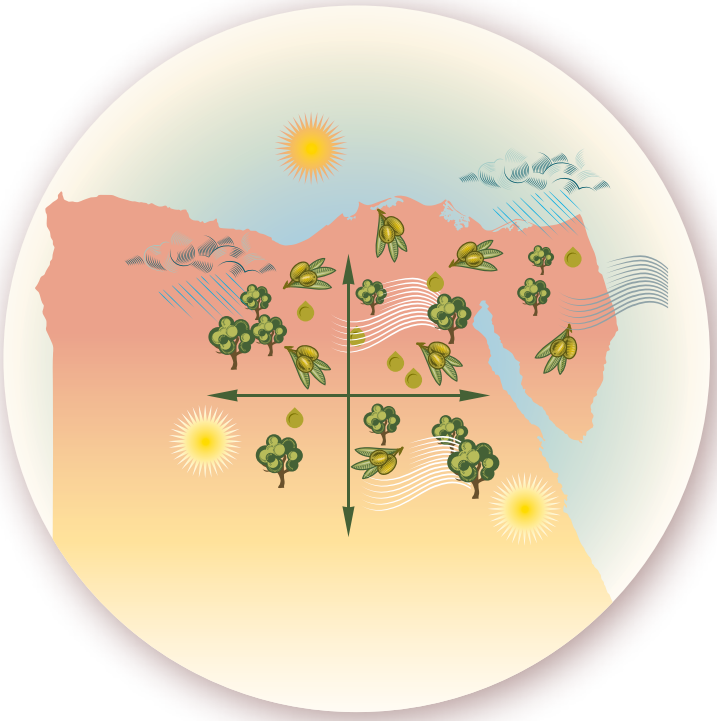
Olive groves require extensive labour in all agricultural practices, especially pruning, winter service (adding organic matter and soil amendments in winter) and harvesting. This creates jobs, providing sustainable opportunities for thousands of farmers, workers and investors, as well as creating other industry and commercial work along the entire production chain, particularly in rural areas. Using the weak and calcite desert soil, which is characteristic of all soils outside the Nile Valley, to grow olives allows Egyptians to expand the agricultural area through large sustainable development projects in new lands with useable water resources.

The future lies in olive crops being cultivated alongside other crops, such as date palm and jojoba. Expanding the cultivation area, and increasing productivity, must continue, especially given that some crops can no longer grow in the newly reclaimed areas due to the highly saline groundwater, the main source of irrigation. While huge companies can invest in reclaiming large areas for olive cultivation, we also need to set up cooperatives and civil societies among small investors, which will encourage new businesses and young people to invest in addition to the scientific supervision of specialised research institutes.

These investments can strengthen the already growing expertise in agricultural practices and industrial mechanisms for handling the olive fruit. Progress is being made at all stages, such as collection, where modern mechanization methods have begun to be studied as an alternative to manual collection to reduce costs and raise quality. It is also important to determine the best time for harvest. This can differ from cultivar to cultivar, but mean the difference between a product meeting the requirements for oil percentage and quality, and not. Also, streamlining the process from harvest to extraction is of the utmost importance, as is meeting the capacity requirements of the newly reclaimed areas. Storage methods are constantly being adapted to make sure oil is kept in the right conditions and in the appropriate packaging. These are just a number of ways in which Egypt can focus its efforts to be a competitive player in the target global markets.

THE OLIVE-GROWING ENVIRONMENT IN EGYPT

***Abdelaziz Mahmoud Aboelkhashab**, PhD*
Horticulture Research Institute
Agricultural Research Center



The climate in Egypt is moderate: in winter, the temperature does not reach 0ºC, while it climbs to 40ºC in summer. Land for olive growing is found in the north-western areas, from Matrooh to Moghra (south of Alamin) at between 18m and 80m above sea level and at a latitude of about 30º north and 28º west, where the climate is ideal for oil production. In the southern regions, at between 100m and 200m above sea level, the higher temperatures are more suited to table olives.

The soil is infiltrate, well aerated and suitable for olive growing, extending east to north and south Sinai, where the olive tree is said to have originated in the holy books. These regions have low temperatures in winter, which start to fall in September and remain cool until March. This is suitable for olive oil production, as cooler climes are best for olive fruiting. At the beginning of winter, the temperature can fall to below 12ºC for at least a month (see table on next page for the average weather patterns in Moghra).

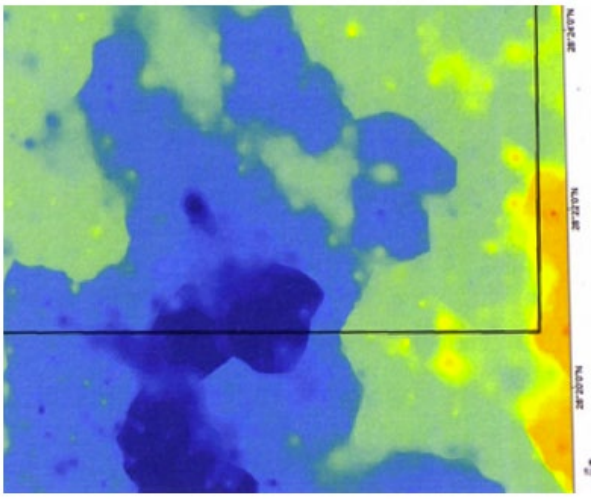
At the end of autumn, the temperature falls to a suitable level for the fruits to produce good quality oil, generating oleic acid and antioxidants tochopherol and polyphenol. These regions can be used to produce both table and oil olives, not only given the Mediterranean climate, but also thanks to the up to 10 hours of sunshine during the day in winter, and 14 hours in summer.

THE MONTH	Temperature			Rain (mm)	Relative Humidity (%)	Wind speed Km/hr	Evaporation (mm/hr)	Sunshine (hr/day)
	High	Medium	Low					
January	19.4	7.5	13.4	4.9	65	8.6	1.8	10.3
February	19.4	7.7	13.8	4.6	64	8.6	2.5	11.0
March	22.6	9.2	15.9	1.4	63	9.0	3.6	11.8
April	27.2	12.2	19.7	0.8	56	8.3	5.3	12.8
May	32.0	16.4	24.2	-	56	7.9	7.2	13.6
June	33.9	19.8	26.9	-	58	7.6	7.9	14.0
July	34.5	21.3	27.9	-	63	7.6	7.1	13.8
August	34.5	21.9	28.2	-	64	6.8	6.5	13.2
September	33.1	26.6	26.6	-	59	7.2	6.1	12.2
October	29.5	23.4	23.4	-	64	7.2	4.7	11.3
November	25.0	19.1	19.1	1.6	64	7.2	2.8	11.4
December	21.0	21.0	15.4	4.1	66	7.2	2.1	10.3
Mean	27.7	14.7	21.2	17.4	62	7.8	4.8	

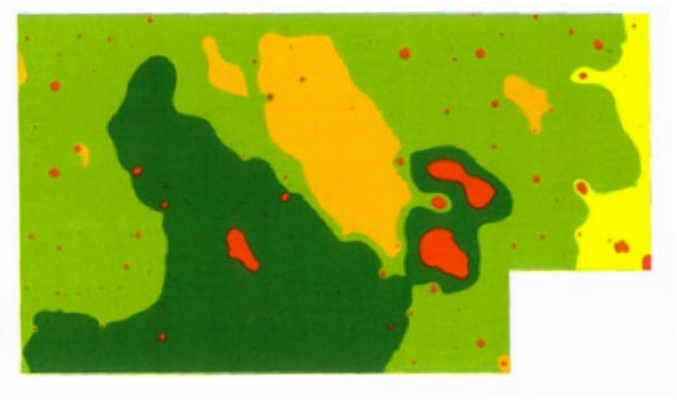
Environmental conditions in the newly reclaimed region (Al-Moghra, Egypt)
Source: www.elreefelmasry.com

This environment lets olive trees grow and produce high-quality fruit for both table and oil olives through continuous biological assimilation and sugar accumulation. As for the soil, the majority of the extended areas have deep and moderately deep, sandy loam and loamy sand soils. The soil is infiltrate, well aerated and suitable for olive growing.

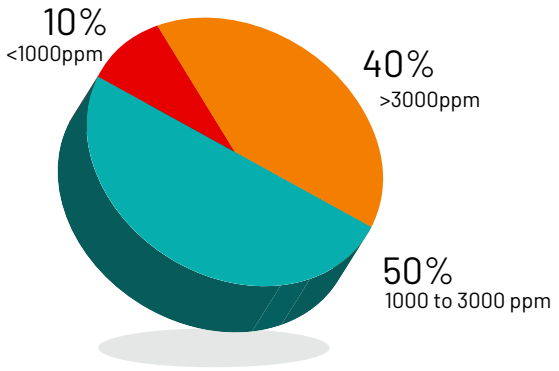
From the physiographical point of view, most of the soil is alluvial at about 17-80m above sea level. The minimum relative humidity is about 56% in May and the maximum is about 66% in December. Wind speed reaches 9 km/hr in March and the evaporation is up to 7.9mm/day in July. On the other hand, rainfall is very low, so these areas depend on underground water for irrigation. In the north, this is good for planting oil olive varieties, like Koroneiki and Coratina, as well as local varieties such as Maraki and genotypes from the genetic improvement programme.



The highest above the see level "Menia region"



The physiographical map of w. Menia



The percentage of salt concentration in the underground water

In the south (Upper Egypt; the Menia region), at about 100-200m above sea level, the physiographical conditions are similar to the north, but the temperature is higher in autumn when the cells expand and accumulate carbohydrates, which may have an impact on the oil. The last areas have an extended cultivation season for local commercial table olive varieties that mature at different rates, such as Aggezi, Tofahi, Aksi, Balady and Osheem, in addition to the table olive genotypes from the genetic improvement programme.

As for irrigation, rainfall is limited to north-western areas like the Matrouh Governorate. The electrical conductivity of most of the soil in areas like the Natron Valley and the Khatatba region does not fall below 2 dS/m. Here, cultivation takes place on about 50m^3 of land, and production reaches 5 tonnes per year the tree volume can reach 50m^3 and production can reach 10tons/ha. Only 3% of the olive orchards here rely on rainfall, while the majority (86%) use drip irrigation from underground water with an elecrtical conductivity of up to 8 dS/m, 40% of which at below 4dS/m. About 50% of these farms are found in new reclaimed areas like Moghra and western Menia.

The water in these areas has a sodium absorption ratio of less than 9. Analysis has shown that there is enough calcium, potassium and magnesium to make the water hard, which gives a soft soil. Under these conditions, salts can be leached or removed from the roots and isolated out of the orchard, especially when organic matter (compost, or livestock manure), and soil amendments (gypsum, calcium super phosphate, and natural elements) are added, and when a balanced system for fertilisation and irrigation is used.

For these reasons, Egyptian soil is sustainable and appropriately fertile for olive growing, and the authorities have planned to plant 1.5 million feddan of land (about 100 million with olive trees are included). Starting in the newly reclaimed areas, about 280 000 feddan will be planted in El-Moghra, and about 500 000 feddan in western Menia in Upper Egypt. Landowners in these regions have already begun planting, using solar energy for irrigation. They hope to focus on oil olive cultivars and genotypes (at Almoghra region) in order to boost olive oil production. The objective is to reach 70% production, instead of 20%, and to continue producing high-quality table olives.

OLIVE CULTIVATION SYSTEMS IN EGYPT

***Mohamed Ghazi El Barbary**, PhD*
Horticulture Research Institute
Agricultural Research Center

Olives are one of the most important crops in Egypt. Cultivated in most governorates, often alone or with other crops, the olive-growing area in Egypt was over 100 000 hectares in 2018, producing a total of 882 029 tonnes, 70% of which was processed to make table olives

Egypt's olive industry is expanding every day, and more land is dedicated to the sector every year. There are several reasons for this growth, including:

- The nutritional and health benefits of olives and olive products, and growing demand from more advanced countries, such as the European Union, Japan and the USA.
- The newly reclaimed areas in the desert, which are only suitable for olive cultivation given the high salt content of the irrigation water and soil.
- The removal of some crops from cultivated areas due to high salinity.
- Gained experience of farmers and manufacturers in dealing with olive trees and fruits.
- The high economic return per unit area.
- High demand for table olives and olive oil.
- The promotion of domestic consumption to raise awareness of the health benefits of olive oil.

Olive cultivation systems in Egypt:

The high-intensity cultivation system is used for about 90% of the land allocated to olives in Egypt (4*6 – 5*6 – 6*6m). Some regions used the traditional system, in which planting distances are large and trees are irrigated by rainfall (8*8 – 10*10m).The main problem with the intensive farming system in Egypt is the dependence mainly on human labor, which is the highest in costs. In addition, good labor is in constant decline.

The main problem with the intensive system is the dependence on human labour, which is expensive, and good labour is in constant decline.

Harvesting by hand also takes a long time, and this affects the quality of the oil obtained in the case of oil olives. The alternatives to manual harvesting in intensive farming in Egypt are various types of semi-mechanical harvesting machines, including:

- Mechanical combs, whether reciprocating or circular, which are widespread.
- Different types of limb shakers, which many farmers have started to try.
- Trunk shakers, which have not been tried yet due to the particular nature of the soil and the potential effect of this type of harvesting on the trees.

Some 20 years on, the high-intensive cultivation system is still one of the most modern systems in the world. Some farms have recently started to implement this system in Egypt, but it is still in the testing stage, given that only a limited number of varieties succeed under it and also because water is limited and more than 78% of it is saline with an electrical conductivity of 4-8 dS/m. This system is used for cultivating oil olive varieties only, although there have been recent experiments to apply it to table olives. The system is expensive, which makes some investors fearful given that it is impossible to calculate any potential risks. However, this system slashes crop harvesting time to approximately 3 hours per hectare, and the oil can then be extracted quickly. Also, the fruits are removed entirely from the tree, meaning the quality of the oil is higher.

There are only a few varieties that can be grown under conditions of high-intensity cultivation in Egypt. These are mainly foreign varieties, such as Koroneiki, Arbequina and Arbosana, although studies have shown that some of these varieties do not perform well when grown under Egyptian conditions. For example, the chemical properties of Egyptian Arbequina olive oil do not match the standard specifications, and the jury is still out on the

Arbosana variety – so far, it has performed weakly on quality parameters. Hopefully, local varieties and new genotypes can be tested under this new agricultural system and reliable varieties can be found that work well and that can provide a good future for olive planting in the Egyptian desert.

Finally, the high-intensive cultivation system is preferred in large areas of more than 100 hectares so that the economic return is acceptable, while the intensive cultivation system is applied in small areas only.

SUSTAINABLE OLIVE CULTIVATION AND INNOVATIVE TECHNIQUES

Ikram saad eldin Abou shanab, PhD

Sanaa Ibrahim Laz, PhD

Horticulture Research Institute
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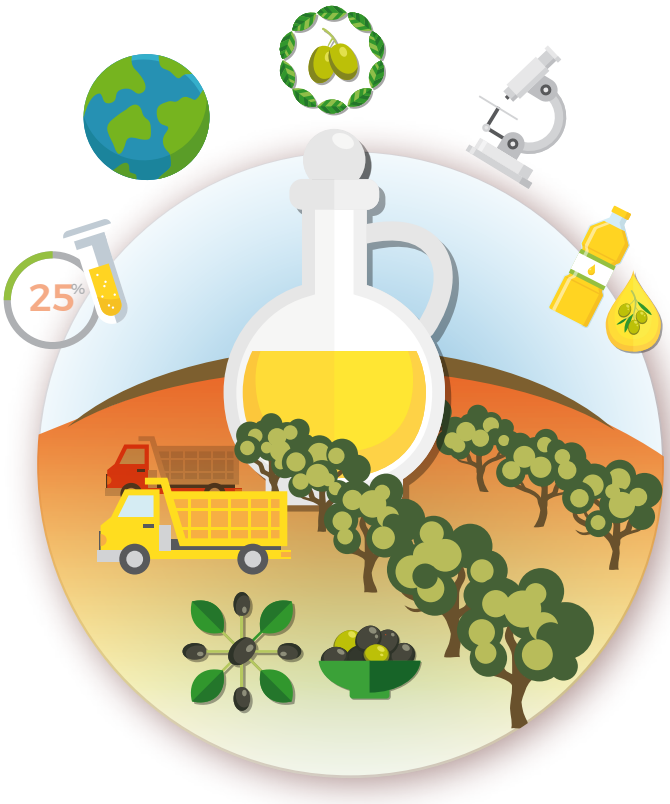

Development and progress depend on what man possesses in terms of knowledge and science, especially if this science and knowledge combine to benefit the community. Here, we refer to the role of research in enhancing efficiency in the olive industry and providing workers with the skills and technology they need to help the sector reach its full potential. This has been achieved in Egypt through cooperation between the Olive Research Department at the Horticultural Research Institute and the International Olive Council, as well as the Academy of Scientific Research and Technology.

In this regard, a number of key collaborative projects have begun, including the Genetic Improvement Olive Project. In this project, local varieties were crossbred with foreign varieties to make hybrid plants that produced more and higher quality fruit. Local cultivars, like Aggezi, Toffahi and Hamed were bred with foreign culivars, such as Kalamata and Manzanillo for pickling, and Koronneiki, Chemlali, Picual, Arbiquin and Leccio for oil. Researchers were then able to select recognized genotypes, survey the genetic resources and assess them for their resistance to salinity, drought and pests.

Another important project was the Identification, Preservation, and Utilization of the Genetic Resources of the Olive Tree, which was carried out alongside Algeria, Morocco, Syria, and Tunisia. The olive genetic improvement project was principally related to this project. Researchers identified the most agronomically and technologically prominent varieties of each country and modified them through a controlled breeding programme using selected material from northern Mediterranean olive producing countries.

CLONE SELECTION AND BREEDING

FOR TABLE OLIVES

Aggezi	16
Kalamata	24
Kalamata	32
Kalamata	54
Kalamata	67
Manzanillo	55
Manzanillo	91
Manzanillo	97
Manzanillo	99
Manzanillo	102

FOR OLIVE OIL

Al-Salam	31
Giza	48 (Coratina ♀ x Toffahi ♂)
Koroneiki	52
Giza	66 (Toffahi x Arbequin)
Giza	69 (Toffahe X Kalamata)
Giza	138 (Arbequin♀ x Hamed ♂)

The objectives of the project were to collect, characterise and conserve olive germplasm in order to determine and describe the genetic make-up of olive growing in the participating countries. Researchers also planned to include each genotype in five national germplasm banks in the participating countries, as well as in two international germplasm banks. Researchers drew up a database of the olive varieties, including indigenous ones, that had either been neglected or known only to local farmers and scientists, so that they could improve production capacity in the long term, develop a common database management system for these five countries, and exchange the promising cultivars from each country with other participants. This project gave rise to 19 genetic resources in Egypt, which can now be found in the regions of Giza, Faiyum, Arish and Siwa. These data are invaluable for both the breeding and selection of varieties.

A national collection was set up at the Horticulture Research Institute in the Giza Governorate, and it holds 19 accessions, some of which were established through grafting. Varieties were chosen for the agronomic and technological characteristics that lead to the best quality oil, and for their tolerance to common pests. Participants were then able to exchange the most promising cultivars.

A third project was the Economic Valorization Of Olive Genetic Resources: Creation Of Pilot Demonstration Nurseries (Quality Enhancement Through Nurseries Development). Algeria, Morocco, and Tunisia also took part in this project, and it was considered to be phase II of the project above. The objective was to establish modern and innovative nurseries that can produce at least 25 000 transplants per year for each country, in order to enhance the annual production of top quality olives. It is important to identify the olive plants that comply with varietal and phytosanitary standards so that farmers can guarantee the quality, yield, health and pest resistance of their plants.

The Olive Research Department is also in the process of conducting another project with the Academy of Scientific Research and Technology entitled 'Sustainable Economic Valorization of Olive Trees, Creation of Demonstration Orchards and Development in the Egyptian Desert'. The objective was to identify and distribute the new genotypes as mother plants for private nurseries and growers. The new genotypes were identified in a workshop and through visits to two olive growing areas, western Menia and Moghra.

Transplants of high quality genotypes were propagated at the Horticulture Research Institute nursery to meet the needs of the expanded olive growing areas. Master training sessions were held in the educational farms to raise awareness and share the latest technology for olive cultivation and processing in Moghra and western Menia, and to explain model nurseries and the methods used to produce certified olive seedlings. Moreover, a study was carried out on the morphological characteristics and chemical analysis of the genotypes and commercial oils and fruits.

And finally, samples were taken from the collection at the Horticulture Research Institute and from a private orchard 64 km from the Cairo-Alexandria Desert Road and from both the Moghra and Western Menia regions. Their morphological characteristics and oil extraction were recorded, and the chemical analysis of some samples of oil is still pending. Today, the Olive Department continues to promote olive oil to Egyptian consumers, raise awareness on the nutritional benefits of olives, and apply the Good Agricultural Practices.

INTEGRATING OLIVE MANAGEMENT IN EGYPT

***Abdelaziz Mahmoud Aboelkhashab**, PhD*
Horticulture Research Institute
Agricultural Research Center

The olive tree is the universal symbol of peace, and it is an integral part of a number of landscapes and cultures, though its ecological importance has only recently been acknowledged.

Olive oil has been the main source of healthy fats for the inhabitants of the Mediterranean for centuries, and it is its most valuable export. Olive trees have been cultivated for centuries in Egypt, mainly in Sinai, Faiyum and the Siwa Oasis. They are also one of the most cultivated trees in the newly reclaimed desert, thanks to their tolerance for heat, drought and salt stress. These areas are prone to intense soil degradation, such as erosion, soil organic poverty and soil salinization. What is more, when no organic matter or amendments are added to the soil, the effect on biodiversity can be devastating, and non-productive olive groves are often abandoned. To prevent the soil from losing its fertility, Egyptian farmers must use innovative agricultural techniques, and make sure that these have a low impact on the environment.

Concentrated olive trees are put to the test in the desert, where about 90% of the soils are deep and moderate deep soils of sandy loam and loamy sand. The government plans to cultivate over 1.5 million feddan in the Egyptian desert, and 100 million olive trees. Here, the soil consists of more than 70% fine and coarse sand that degrades through erosion and has a very low organic matter content. The irrigation water has a high salt content and the soil has few cations and anions, not to mention the lack of biodiversity. So it is important to have sustainable systems in place for olive production, given the delicate nature of this region.

Aerated static pile composting

It is possible to obtain high yields of high quality crops while protecting the environment, as long as the microbiological soil fertility can be controlled. This can be achieved by adding organic matter and soil amendments, such as gypsum (CaSO4¬), calcium super phosphate, natural elements like rock phosphate or rock potassium (feldspar) and leguminous cover crops for nitrogen. Green manure and pruning residues can also be added to the soil with sufficient irrigation and fertilization. Sustainable soil management can give plants have access to the necessary amount and quantity of nutrients for growth, preventing build-up in the soil and leaching risks, improving irrigation efficiency, and limiting soil erosion and root asphyxia. These sustainable practices can also enhance the activities and complexity of soil microbial communities. Making the best and most innovative use of environmentally friendly agricultural techniques has positive effects on soil, yield, and quality as they encourage microbial biomass activity and complexity.

Sustainably managing the soil biochemistry and microbial genetic diversity has been found to have particularly positive results in olive groves. To obtain high and stable production in a suitable climate, it is important to minimise costs and be sure that the olive tree is reaching its potential in terms of growth and fruiting by using mechanical pruning and harvesting techniques, although these tend to have the highest costs. Before planting, it is important to know the average heat summation; find the sources of water, wind and fog; analyse the soil and its chemical properties; and make use of the models of olive growing and fruiting typically used in the given region. As for climate, the olive tree needs the temperature to fall below 7ºC for at least one month in winter for flowering and fruiting. The low temperature in winter also significantly reduces the threat of olive pests and diseases, such as fungi, olive fly, olive scales and olive moth. Applying IPM programmes in olive orchards is also very important in pest control.

There are a number of sustainable agronomic practices that can help boost production in olive orchards, and using organic matter or compost is one of the most important. Adding such products can affect soil permeability, water retention and the supply of nutrients; boost CO2 uptake and carbon fixation; and reduce soil erosion. Olive pomace, or crude olive cake, is made after the first extraction and can be watered down with olive mill wastewater, another product of olive milling, or with another organic material, to make a product that can supply nutrients to plants. This is also an efficient way of repurposing olive mill residues.

Suitable management practices for integrated olive growing, such as conservation tillage, cover crops, compost amendments, green manure, pruning residues, irrigation and fertilization, are recommended to save conventional water, restore soil organic matter, and reduce pollution. The positive role of biofertilizers in plant growth, productivity and protection against stresses makes them a powerful, eco-friendly and comprehensive supplement for plants. Usually, soils are inhabited by various types of microbial species. The co-existence of these species is determined by ecological factors in the soil. Many of these species have been leveraged in biofertilizers and they have been shown to improve plant growth and fruiting, besides being tolerant to the saline conditions. Biofertilizers are also more cost-effective than chemical fertilizers and are eco-friendly. These days, biofertilizers are considered advanced biotechnology and are required for the development and integration of clean, green and sustainable agriculture.

'We will continue our research to uncover the truth and build the future.'

EGYPTIAN OLIVE GENOTYPES

***Salah-Eldin mohammed Elsayed**, PhD*
Horticulture Research Institute
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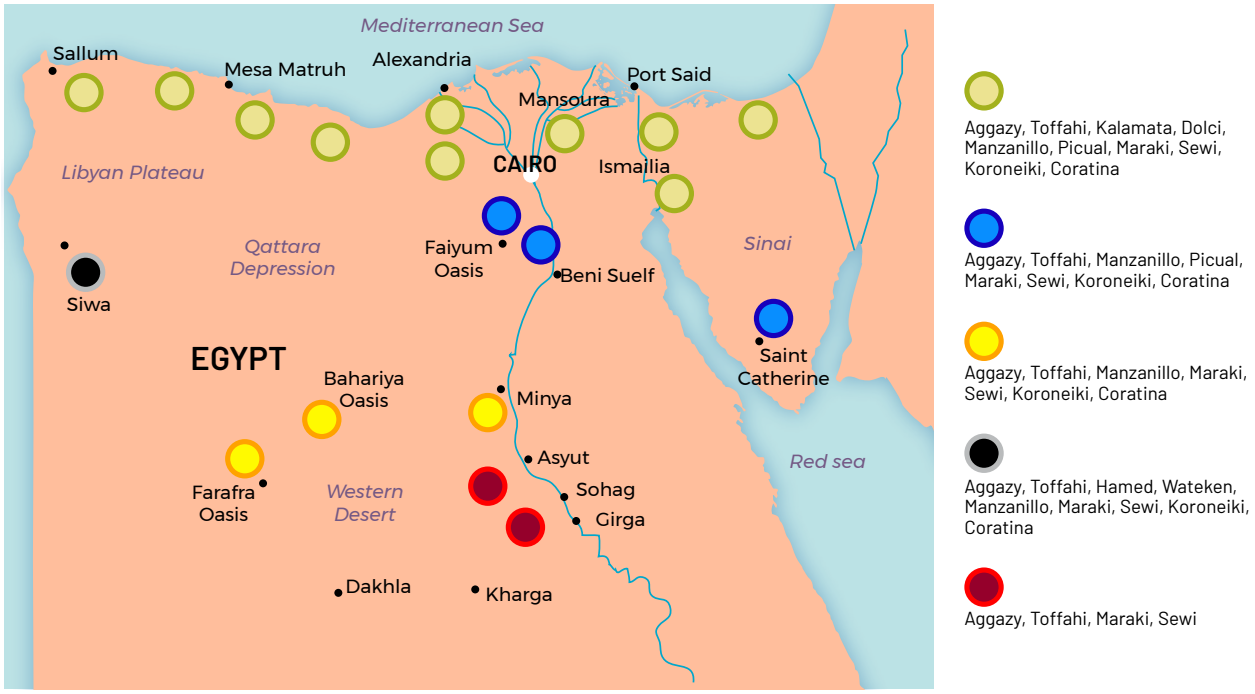
One of the most important factors in the success of olive cultivation is choosing the right variety for the local climate and the given commercial purpose. Growers must consider the availability of water and the appropriate irrigation regime as well as the nature of the soil and the extent to which the environment allows for substantial root growth and sustainable carbohydrate synthesis. The latter is reflected in tree growth and fruiting, allowing the crop to achieve its highest production potential and quality, and tolerate environmental stress, salts and drought. Considering all these factors and adapting accordingly can drastically reduce costs and maximise production. Ensuring a variety can withstand agricultural machinery also helps to reduce costs. In Egypt, olive cultivation has been established in a number of regions following these parameters: the Sebhawi and Abu Munqar varieties are grown in the Sinai Governorate; Toffahi, Aggezi Shami and Aksi are grown in the Fayoum Governorate; and the Siwa area is famous for Hamed, Maraki, Siwee and Watakin.

After the Egypt-California project, Egypt began to collaborate with the International Olive Council on the propagation of olive trees. The genetic improvement project on imported and local varieties resulted in excellent genotypes for producing olive oil, such Giza 48, 52, 66, 69 and 138, and for producing table olives, such as Aggezi 16, Manzanillo, 55, 91, 97, 99 and 102 and Kalamata 24, 32, 54 and 67, as well as salt-tolerant genotypes, such as Giza 61 and Giza 138. The Egyptian government plans to expand the country's olive growing land by 1.5 million feddan, including the planting of 100 million olive trees in the newly reclaimed areas in the Moghra region, north-western



The map shows olive cultivars distribution in Egypt

Egypt. This region is well suited to both oil and table olive varieties. Here, the low temperatures in winter are appropriate for chilling units, and the air starts to cool from September, which is when olives begin to accumulate oil and generate fatty acids and antioxidants. In the western Menia region, where the sun shines for 14 hours per day, table olives grow best, such as Aggezi, Toffahi, Aggezi, Kalamata and Manzanillo, as the climate is right for forming carbohydrates and producing good green and black fruits throughout the fruiting season.

The most important olives grown in Egypt are the Toffahi variety: the fruit is large, round and weighs 8-16g. The stone is scabrous and slightly stuck to the flesh, taking up 13% of the total weight. These olives are used for green pickling only, and they ripen early from late August to the end of September.

Aggezi Shami is another local variety – its fruit is large and tends to be elongated, weighing 7-10g. The fruits are used for green pickling only and have a long shelf life, making them suitable for both natural and Spanish-style fermentation. The fruits ripen from late August to late September.

Aksai is very similar to Aggezi Shami, but the fruit is smaller, weighing 6-8g. The fruit is broad-based and tapered with a slight curvature. These olives are best for green pickling, and for natural and Spanish-style fermentation. They ripen from September to October.

As for Maraki, a dual-purpose local cultivar, the fruit is medium-sized at 4-6g, with a higher oil content than most varieties in Egypt, reaching more than 25%. The harvest season for oil olives starts from late November until December. This variety has one of the highest percentages of oleic acid of the olives grown in Egypt, reaching 76%. The fruit is large at 8-10g, has a good oil percentage of 20-22%, and has a high oleic acid content at about 71%. This variety is suitable for green pickling only.

Aggezi aksi

Toffahi

Aggezi shami

Maraki

Siwee

The genetic improvement project cooperation between Egypt and IOC.

This project resulted in superior genotypes such as

Giza 97, the Egyptian genotype obtained from open pollination with Manzanillo. It produces a medium fruit at 4-6 g, with 91% flesh, and is suitable for green and brown pickling. These olives ripen in October and November.

Giza 102 was obtained from open pollination with Manzanillo. This medium fruit weighs 4-6.5 g, has a relatively loose stone and 90% fruit flesh. It is suitable for green and black pickling.

Giza 48, obtained from (Koroneiki × Toffahi), has a small fruit 2-3 g, a flesh percentage of 79%, and ripens in late October-November. The oil content is 22%.

Giza 52 was obtained from open Koroneiki pollination, and is a small fruit of 2-3 g, ripening in November with an oil content of 20-23%. This variety has a weak fruit removal force and is suitable for super high-density cultivation.

Giza 97

Giza 102

Giza 48

Giza 52

Giza 66 was obtained from (Toffahi × Arbequina) erect growth, small fruit 2-3 g, and oil content percentage 18%. This olive plant is suitable for cultivation in a super high-density system.

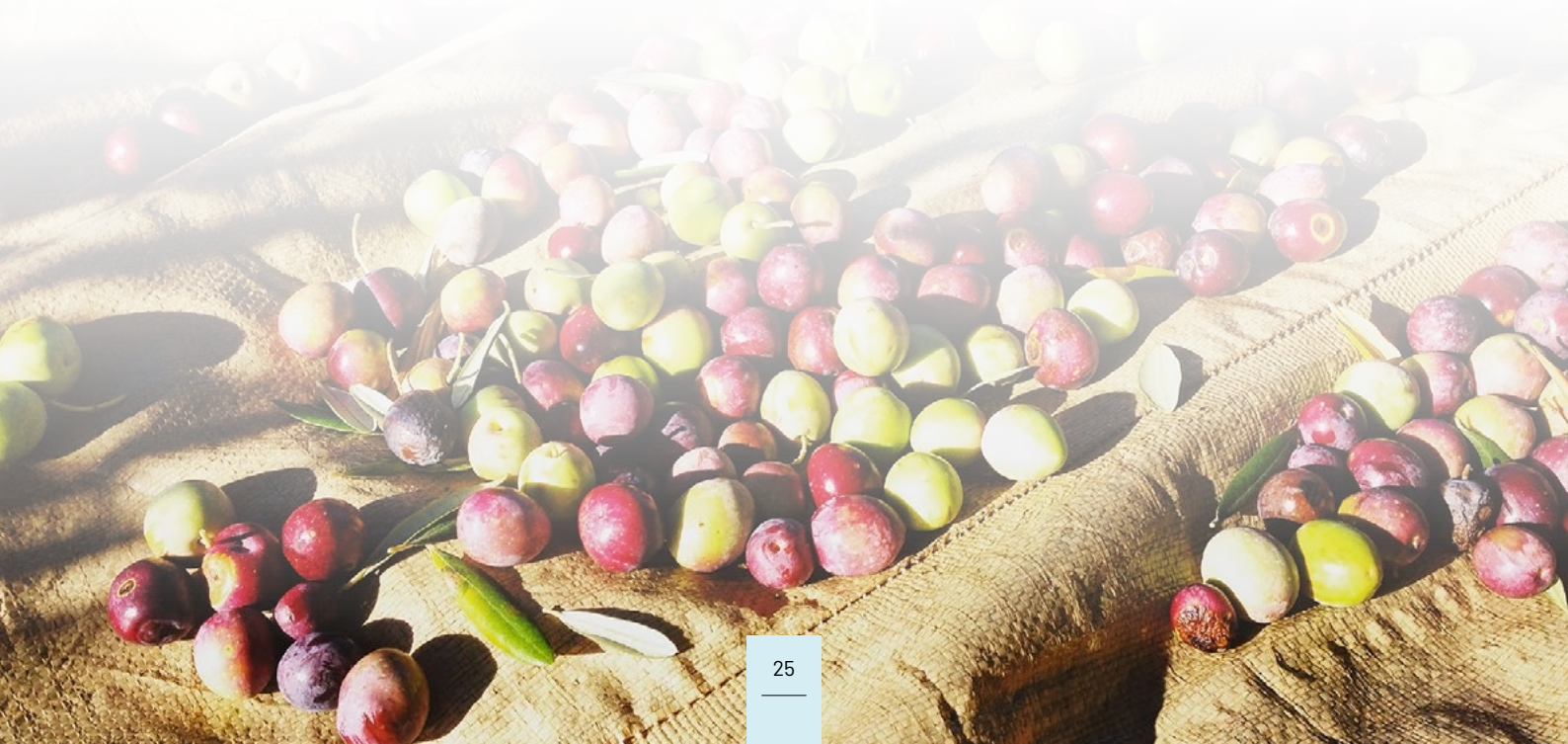
Giza 69 was obtained from (Toffahi × Kalamata); these have a predominantly erect growth form and produce small fruits at 2-4 g. The oil percentage is 18-20%, and this variety is suitable for super high-density cultivation.

Giza 138 was obtained from (Arbequina × Hamed). It produces a small fruit 2-3 g which ripens in November with an oil content of 18-22%. This variety is suitable for super high-density cultivation.

Giza 66

Giza 69

Giza 138



OLIVE NURSERIES IN EGYPT

***Amr Salah Mohamed**, PhD*
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Olives are an important and profitable commodity in Egypt, and the climate is well-suited to cultivating them on a large scale. So olive planting is high on the agenda for authorities and growers alike, especially given the success of the country's table olive industry in recent years.
The health of an olive tree can ultimately come down to good preparation and proper management even before planting: transplants must only be taken from well-sourced, certified plants. For this reason, the state issued ministerial decree No.830/2011 on the rules and procedures for standard, certified

Methods of olive propagation in Egypt.

In 1983, a collaborative project between researchers in Egypt and the US state of California began propagating local and imported cultivars. Through national projects, Egypt planned to cultivate 100 million olive transplants through established olive nurseries. The olive department at the Horticulture Research Institute at the Agricultural Research Center has since adopted a number of important projects, on topics such as olive genetic improvement (1995-2000), the preservation of Egyptian olive resources (2000-2005), and the preservation of olive resources in demonstration nurseries (2013-2017).

Imported and local cultivars have since been propagated on a larger scale, as have varieties of the genotypes identified in the genetic improvement project. The latter were taken from the mother plants of table and oil olives and distributed to growers and private nurseries.

To obtain certified olive trees in the newly reclaimed areas, it is important to:

- **Upgrade the nurseries at HRI;**
- **Establish new nurseries at research stations;**
- **Certify mother plants: this is the most important step for producing high-quality transplants.**

The following structures have been built and implemented in nurseries around Egypt:

- **Green houses for**
  - **propagation under mist.**
  - **adaptation and distribution.**
  - **grafting.**
  - **. mother plants.**
- **Areas to provide training on transplant handing**

Since the area for planting olive trees was extended, the HRI has planned to produce 1 million transplants every year. Recently, Egypt has produced many olive transplants that are true to type and variety, some of which are exported. These transplants meet the standard criteria and allow the export of transplants from licensed nurseries to confirm the source, type and quality of the transplants.

The Ministry of Agriculture issues licenses for establishing nurseries and certifying seeds through the central administrations of horticulture and research. Obtaining a private nursery license is very simple, and observation and monitoring make sure the varieties are consistent with the standard characteristics.

The newly reclaimed areas for growing olive trees, in north and central Sinai, Dabaa, Alamein Road, the Natrun Valley, the East Siwa Oasis and Almoghra, receive olive transplants from properly licensed nurseries, either state or private, and handle them under the technical supervision of agriculture research centres.

Characteristics of mother plant farms.

The model nursery farms should have certified mother plants as the best cutting should be taken from the active without bearing fruits branches. It is preferable to take the rootstoks from vegetative propagation by cuttings and can tolerate salinity, drought and verticillium. Pruning for the mother plant should be continuous to confirm the existence of the new growth for cuttings continuously, meantime the irrigation, fertilization, pest, diseases and nematode control. Cuttings from the mother plants should be taken early in the morning, moisten, rolled and put in isolated bags and reserved in the refrigerator for some days. Then the cuttings can be prepared with a length of 15 cm and has 4-5 internodes with 4 apical leaves then dipped in antifungal solution dried and dipped in growth hormones ABA for 10 seconds, then put under mist.

THE FUNDAMENTAL ROLE OF PHYTOSANITARY MEASURES IN PROTECTING THE NATIONAL DEVELOPMENT PROGRAMME FOR OLIVE CULTIVATION

***Ahmed Hussien ElSayed**, PhD*
FAO Regional Office for the Near East and North Africa Region (RNE)

Olive plantlets and propagation materials are among the most important items traded in agriculture, particularly as many countries outside the Mediterranean basin, like China, have recently shown interest in producing olives. Many countries that have traditionally grown olives are making plans to expand their cultivation, such as Egypt, whose government set an ambitious target of planting 100 million olive trees. Many businesses are also planning to boost olive oil production, either by growing new cultivars, or by using intensive cultivation techniques, which up until recently were not widely known in Egypt. Such companies' interest comes from the growing commercial opportunity of exporting olive oil, thanks to rising demand around the world and rising consumption in countries whose cuisine does not traditionally include olive oil. As the nutritional benefits of olive oil become more broadly known, places like China, Japan, Korea and the Gulf have begun to import olive oil on a massive scale.

However, the subsequent rise in the trade of materials to propagate olive plants has also resulted in a dramatic rise in the risk of transboundary pests and diseases. Trading these plant materials gives pests a shortcut to new, uncontaminated locations. Olive knot, *Pseudomonas savastanoi* pv. *savastanoi*, and olive fly, *Bactrocera oleae*, are already found in most Mediterranean countries and parts of the United States, but they are quarantine pests in Japan and China, which are both planning to launch their own

domestic production. In addition, propagation materials are being traded for other plant species that are hosts to pests that affect olives, especially *Xylella fastidiosa*. This bacteria causes olive quick decline syndrome, and it was most probably imported to the Mediterranean on infected ornamental plants. Unfortunately, the pest crisis is amplified by farmers failing to recognise it as a serious threat, and a lack of knowledge on effective control practices. Also, when a pest arrives in a new area, the agroecosystem lacks the natural defences to stop its spread and maintain the ecological equilibrium.Transboundary pests and diseases also threaten the international development of agriculture in general, and the olive plantations of the Mediterranean in particular. Many of these plantations have high socio-economic and cultural importance to these communities. And, since the problem is 'transboundary', olive-producing nations must coordinate their efforts to establish an efficient system to mitigate it.

The measures to manage the risks inherent to this kind of trade can be classified into two main categories: preventing and containing pests, and reducing the economic impact.

Most important of all is plant quarantine, which is the first line of defence in protecting a nation's crops. First, phytosanitary regulations prohibit the import of propagation materials from infested countries or areas. Then, a well-designed plan of inspection and sampling manages arrivals, using not only visual examinations but laboratory testing as well. Also, a surveillance system makes sure that 'leaked' pests, which may get through illegally or by mistake, can be detected early. And, when reporting a pest for the first time, it is crucial to have a pre-defined emergency plan that requires thorough field survey so that pests do not infest new areas, and implement control measures that may help completely eradicate the problem, or at least minimise the economic damage.

Plant quarantine and phytosanitary measures are an inevitable necessity of any olive cultivation development plan. Without these measures, investments in agriculture will be high risk, and may render the efforts of authorities and companies – either governmental or private – 'dust in the wind'.

SIWA
THE OLIVE OASIS

INTERVIEW WITH A SIWA CITIZEN / SHEIKH MOSALLAM ABDALLAH

Interviewer: Ahmed Sabry, PhD

The Siwa Oasis is an urban oasis that lies between the Qattara Depression and the Great Sand Sea in the Western Desert. The Siwa Oasis is one of Egypt's most isolated settlements, located far from major cities and with a population of about 33 000. Mostly Berbers, the Siwi have a unique and isolated desert culture, including a distinct dialect and language they speak alongside the Egyptian dialect of Arabic, or 'Masry'.

The ruins of an oracle of Ammon lie here, and they draw many tourists every year. In fact, the ancient name of the Siwi Oasis was Oasis of Amun Ra, and it played an important role in ancient Egypt.

I met with one of the head farmers of Siwa, Sheikh Mesllam (Sheikh means leader). Like many who live here, he tends an old and unique olive orchard.

We had a short conversation about his cultivation style and his relationship to the olive tree. We also spoke about the effect this blessed tree has on the extraordinary Siwi society.

- ***Ahmed Sabry:*** *Peace, mercy and blessings of God be upon you Sheikh Mesllam.*

- ***Sheikh Mesllam:*** *Peace, mercy and blessings of God be upon you. Welcome, dear brother.*

- ***A.S.:*** *Today, we want to talk with you, my dear esteemed Sheikh, about olives in the Siwa Oasis from the point of view of one of the most important sheikhs of this beautiful region. What is your relationship with this tree?*

- ***S.M.:*** *First of all, praise be to God, and may blessings and peace be upon Prophet Mohammed: may God bless him and grant him peace. Now, the Siwa community – the Siwa Oasis is in Matrouh, and Siwa itself is more than 300 km to the west of this governorate. The people of Siwa depend on God first and then on the cultivation of local varieties of olive. They mainly use a cultivar with a high percentage of oil, because olive oil has many benefits and uses. It is used in all Siwi dishes because it protects against cancer, it dilates the arteries and repels many diseases. And, of course, it is a blessed tree and is mentioned in the Holy Quran. The most popular dishes in Siwa get their flavour from olive oil, such as Trafent, Al Houji, Tagalantini, Assida, Aighyarn, Emmalaln, and Labsis. These are the Siwi (Amazikh) names – these dishes are not common in the rest of Egypt. Olive oil is also used in meals of beans and cheese and for general cooking. It is also used to treat varicose veins, rheumatism and arthritis. It is used to make soap, and as a hair balsam. It is thought to be the best kind of oil as it calms the nerves and helps cure constipation. Olive oil is good for the heart and blood vessels, it cleans the liver and it strengthens teeth. It can cure digestion problems, encourage weight loss, prevent stress and headaches, reduce cholesterol ... the list goes on.*

With thanks to Mosallam AbdAllah Mosallam, Siwa.

Siwa oasis, Kibian Desert, Egypt.
Image: Vincent Battesti

OLIVE PESTS MANAGEMENT

***Ahmed Hussien ElSayed**, PhD*
FAO Regional Office for the Near East and North Africa Region (RNE)

Good pest management is one of the most important pillars for successful and efficient olive production. Pests and diseases may cause up to 20%-40% losses to crops according to the Food and Agriculture Organization of the United Nations. Every year, trade in olives and olive products (table olives, olive oil, olive press cake and wood) amounts to US$ 11 billion, while global production reaches US$ 25 billion. So pests and diseases can wreak havoc on the industry, with the potential to cause up to US$ 10 billion in economic losses.

For instance, the olive fruit fly Bactrocera oleae continues to affect olive growers, stores and the processing industry in all major producing countries in Europe, Africa, Asia and North America. The damage caused by this fly is not limited to the larvae feeding on fruit flesh, which causes the fruits to fall prematurely. It can also invite opportunistic bacteria and fungi, which rot the fruits and reduce their market value. These flies disfigure table olives and reduce their quality due to the added peroxide, which ups acidity and lowers shelf-life. Many countries have managed to control olive fly using bait, but the Sterile Insect Technique, a pest control method whereby insects are mass-reared and then sterilised before being released into target areas, proved unsuccessful and needs further study.

The olive moth Prays oleae can affect the leaves, flowers and fruits of olive trees. These moths can produce three generations in one year. Fortunately, it is only the larvae that cause damage, as they feed on the olive fruit. A simple and well-structured management programme can keep the damage caused by

the pest population below a set economic threshold. The integrated programme consists of preventative measures such as sanitation (remove debris and fallen fruits), weed management, pruning suckers and water sprouts. In addition, the pest population can be monitored using pheromone traps. Direct intervention involves the use of biological control agents like Trichogrammat and Bt, and if necessary, organophosphate pesticides can achieve good results.

In the last decade, farmers have given increasing reports on the devastating effects of the leopard moth, or Zeuzera pyrina . This moth has long been known as a secondary pest that only affected unattended groves, but recently, it has proved to be capable of killing olive trees in under 10 years. This is a shocking example of emerging pests that move from secondary to key pest status and can cause significant economic losses. Researchers usually attribute the emergence of these pests to environmental disorders that may be caused by excessive or improper pesticide use, and failure to alternate the active ingredient.

Sooty mould is another example of a secondary pest that has become a primary cause of loss. This mould arises from fungi that grow on the sugary excretions of piercing-sucking insects like scales and aphids. The fungi grows on the leaf surface and blocks sunlight, thereby hindering photosynthesis. Managing this pest is mainly focused on controlling the primary cause of the infection, which is the insect itself, and then washing the leaves to remove the insect residue.

Soil-borne pathogens, on the other hand, are another common secondary pest that are generally not capable of causing losses unless the olive tree itself is subject to other stresses, such as nematode infection, soil or water salinity, soil lodging, and bad fertilization.

Olive trees shall always be seen as a single unit that requires integrated efforts from specialists to seek the best practices for fertilization, irrigation and pruning, as well as pest management. Olive trees cannot be protected from pests if they are subject to incompetent fertilization and irrigation. Pesticide should not be a 'magic bullet' that gets rid of pests. Excessive use of pesticides adds to production costs, removes natural defences and disrupts the agroecosystem, which results in the emergence of secondary pests and boosts resistance to pesticides. Experts must consider that each olive grove is a special case, and no general programme can be applied to farms with different agroecological systems. Furthermore, even determining the economic threshold largely depends on the target markets of the product. For example, high-value olive cultivars that target international markets would require more attention than nearer reaching varieties. The agroecosystem of each olive grove should be analysed, and natural enemies recognised, in addition to pest history, previous strategies and the surrounding cropping system.

Pest management is a dynamic process that requires the collection and analysis of lots of data, but this approach is usually challenged by stubborn markets that are not in favour of investing in this kind of management and testing. The traditional sector prefers the 'standard magical recipe' known to agriculture consultants, cutting corners to solutions, but these are usually not maintained and can still generate long-term losses.

TABLE OLIVE TECHNOLOGY

Shaker Mohamed Arafat, PhD

Samah Said Allam, PhD

Food Technology Research Institute
Agricultural Research Center

In recent years, Egypt has been ranked among the top producers of table olives in the world, coming fourth after the European Union, Turkey and Algeria. This distinguished position is thanks to the success of certain agricultural strategies and policies the government has implemented to expand olive cultivation in the country.

Table olives are one of the main components of the traditional Mediterranean diet, and have been ubiquitous in Egypt since ancient times – pickling techniques have been found on papyrus dating back to the pharaonic period. The table olives industry is therefore an important part of Egypt's food industries and a major source of income for farmers throughout the country. The environmental conditions favour the crop, and local olive varieties, such as Agiazi, Toffahi and Hamed, which are famous for their quality and shape, are high and early yielding. A number of foreign varieties can also be grown here, such as Kalamata, Dolci, Picual and Manzanilla, which are high yielding, produce good quality fruit and have given Egypt a competitive advantage on the international market for over 30 years.

The fruits of these varieties tend to be medium to large in size, produce a fine-looking pulp with a small kernel, have a smooth outer shell and tolerate handling. Non-adherent to the kernel, the fruits are relatively durable and have good flavour after processing. These olives also produce an acceptable amount of oil.

The technology used to produce table olives in Egypt has developed remarkably in recent years. First produced in the home, often in the countryside, befo-

Toffahi variety

Agaizy variety

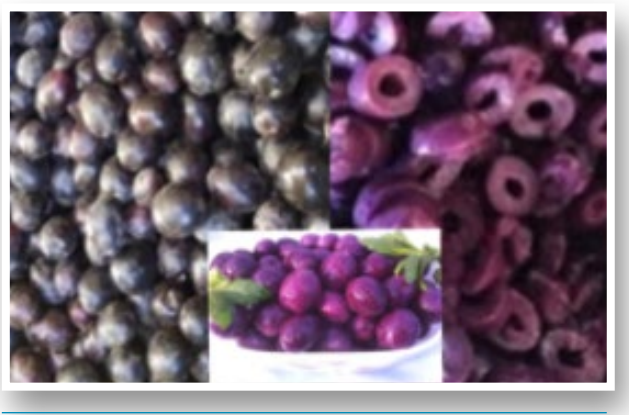
re advancing to rudimentary factories and pickling plants, the table olive sector is now a booming industry, generating thousands of tonnes of ready-to-eat olives using the latest technology. Through collaboration between industry and the scientific community, the sector has shared experiences with international players and introduced new techniques, such as modern Spanish and Californian processing methods, to bring about qualitative technological growth. This international cooperation has contributed to the production of Egyptian table olives in addition to other processing methods and helped the country meet and satisfy the demands of its consumers.

To produce table olives, the raw fruits are placed in a brine solution in airtight containers, either in barrels or fermentation tanks. Under these conditions, various natural, chemical changes occur due to osmotic exchange between the brine solution and the fruit juice. The resulting growth of lactic acid bacteria is what gives table olives their distinctive characteristics, such as taste, texture, aroma and colour.

To begin, the most important first step is to determine the right time for harvesting. If the fruits are not at the right level of maturity when plucked, this can have an impact on processing and the final product. Olives are collected mostly by hand in Egypt, using skilled labourers. This is the best method for table olives, since manual harvesting is less likely to damage the fruits than machinery. The fruits are then transported in perforated, well ventilated plastic containers. The percentage of damaged fruits, leaves and impurities is calculated, and batches are weighed on arrival at the factory. Olives are then mechanically separated into different sizes, and washed to remove dust and impurities. They are then transported to barrels or storage tanks, which are filled to a third of their capacity and then topped with a brine solution and sealed to prevent air exposure. Now begins fermentation. The barrels are regularly monitored using proven tracking methods, such as adjusting the brine or acidity, controlling the pH, and recording the rate of growth of lactic acid bacteria.

To process green table olives, the fruits are kept in a 10% saline solution. Citric or lactic acid is used to control the pH and give the fruits their distinct taste, odour and colour. However, this method takes longer than the Spanish method.

For black table olives, the most common method in Egypt is to pick the fruits when they turn purple, brown, or black, and then keep them in a 10% brine solution together with acid and alkali solutions, to control the degree of acidity.



Natural Black olive

To process green table olives using the Spanish method, the fruits are treated at certain concentrations of an alkaline solution of sodium hydroxide (for rapid hydrolysis of the bitter oleuropein glucoside compound) until the alkaline solution penetrates two thirds of the fruit pulp. The alkaline solution is then removed either by rinsing the fruits in water two or three times, or by rinsing them in water once, then washing them with hydrochloric acid. The fruits are then transferred to the fermentation tanks through transfer pumps, a 10% saline solution is added, and the tanks are sealed tight.

Spanish style

To process olives using the Californian method, the fruits are treated with an alkaline solution at a certain level of maturity and then exposed to air. Alternatively, the fruits are treated with an alkaline solution and air is passed inside the tanks at a constant rate while the contents are stirred until they turn the desired colour. The fruits are then transferred to storage tanks at pH 3.4 with colour stabilizers such as certain concentrations of iron gluconate.

Californian style

Possible defects

Of course, it is always possible that the olives are exposed to air or contaminants during fermentation or storage. This may result in one or more of the following defects:

1 Fruit tenderness and softness: where the fleshy part or pulp of the fruit becomes soft and inconsistent. This is due to pectin enzymes secreted by contaminated microbes that dissolve the protopectin that keeps the pulp hard. The pulp turns from an insoluble state to a dissolved state, but this can be prevented by adding calcium chloride. However, this defect can be prevented by controlling the conditions of anaerobic fermentation and by adjusting the salt concentration, pH and temperature.

2 Gas pockets: where gas produced by microbial activity accumulates, pollute the olive fruits, storage tanks and solutions. Low concentrations of salt solution can offset this defect, especially in green olives. The concentration of the salt solution can be adjusted by adding an appropriate concentration of citric or acetic acid.

3 Hollow olives, when bubbles of hydrogen gas form under the fruit peel, cause the peel to separate from the pulp. This happens when the salt concentration

falls below 5%, and when the amount of lactic acid bacteria falls. This may be due to genetic defects or the presence of yeasts and fungi. Avoiding contamination with harmful microbes and maintaining the salt concentration to above 5% are the best ways of preventing this defect.

4 Sticky olives: This defect appears as a result of the presence of some bacteria that may surround themselves with a capsule, or others that dissolve the pectin in the outer wall of the fruits. It can be prevented by controlling the salt concentration, and by ensuring proper hygiene during manufacturing. It is not advisable to re-use the fermentation solution.

5 Blackening of fruits: This is due to some types of bacteria that form hydrogen sulphur gas, which is associated with iron, forming black iron sulphur. This can be avoided by preventing the growth of contaminated bacteria, and by avoiding materials and tools that contain iron.

6 Zapatera: A rotten smell produced by a mixture of volatile fatty acids.

7 Growth of mycoderma: This is a group of yeasts that grow on the surface of the fruit, forming white or grey films, which affect the level of lactic acid responsible for flavour. This can be avoided by preventing the growth of yeasts in the tanks.

There are some other defects, such as the formation of dark spots on the surface of the fruit, especially in green olives, and the shrinkage or cracking of the fruits. These can be prevented by controlling the salt concentration and the pH and by monitoring free acidity.

OLIVE OIL TECHNOLOGY

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Egypt is located on the Mediterranean basin, where olive oil is an important source of vegetable fats in the traditional diet. Olive oil, the natural juice of the olive fruit, is one of the most nutritious and versatile of the edible oils. It is naturally extracted, either by press or centrifugation, without chemical or heat treatment, and it is distinguished by its organoleptic properties and the balance between mono- and polyunsaturated fatty acids. Papyrus scripts and pharaonic murals depict ancient Egyptian extracting olive oil and using it to prepare food, mummify the dead and light temples. Figure 1 shows a scene on a wall in a tomb in the Saqqara region dating back over 2500 BC. The olive tree has been taken as a symbol of peace since the Christian era.

Fig 1.
Extraction of olive oil in the Pharaonic era

Olive varieties are split according to their content and the ratio of pulp to kernel as follows:

1 Oil varieties: the fruits are small with a high oil content, such as El-Maraqi (Egypt), Coratina (Italy) and Koroneiki (Greece). The high oleic acid and antioxidant contents are used to indicate quality.

2 Table olive varieties: the fruits are large, have a high pulp to kernel ratio, and a medium to low oil content, such as the Kalamata (Greece) and Al-Agaizy, Toffahi, and El-Hamed (Egypt). The easier it is to separate the kernel from the pulp, the better the variety for pickling

3 Dual-purpose olive varieties: the fruits are of medium size and have a medium oil content, and a medium pulp to kernel ratio, like Al-Wateqin (Egypt), and Picual and Manzanilla (Spain).

Ancient Egyptians extracted olive oil for thousands of years, using primitive methods that have been heavily adapted over time. With scientific progress and growing knowledge on the nutritional importance of olive oil, a number of advances in extraction technology have been made in order to keep pace with developments in the industry. Many standard specifications for grades of olive oil as well as regulations and laws have been set up by the concerned authorities, especially the International Olive Council, to promote sound agricultural practices and good productivity. This development has also encouraged countries to closely monitor production so that the consumer can have safe, non-adulterated, high quality, and nutritious olive oil.

Egyptian olive oil consists of 97% triglyceride and 3% non-glyceride compounds. It is characterized by its high content of single-bond oleic acid, reaching about 77% in the varieties grown in the country, with the exception of the Arbequina and Arbosana varieties. The oils produced from these fruits have a percentage of oleic acid of less than 55% and linolenic acid higher than 1%, and they have a low phenolic compound content and tocopherols, meaning they do not comply with the standard specifications.

Olive oil contains natural antioxidants (tocopherols and phenols), vitamins A, D, E, and K, pigments, squalene, terpenic alcohols, and volatile compounds. It also contains oleuropein, oleocanthal and Oliacin compounds. These components are what give olive oil its highly nutritious profile as well as its protective properties against many diseases.

The oil content of the fruit and the quality of the oil are affected by many factors, including the variety, level of maturity, climate, soil, water irrigation, the area of cultivation, agricultural treatments, bearing of the tree, and fruit quality.

Fig 2 . Egyptian olive oil

Olive oil extraction procedures:

In Egypt, olive oil extraction technologies are constantly changing in line with global developments in the industry. Traditionally, fruits are collected manually, but methods of semi-automatic harvesting have recently been introduced for oil olives. These new, modern methods are suitable for Egyptian soil, and the latest technology is also used in Egypt, such as centrifuges (two- and three-phase), decanter multi-systems (Fig 3), stainless steel storage tanks (Fig 4) and automatic packaging devices. These methods produce higher quality olive oil than others.

Fig 3 . Decanter multi-systems

Fig 4 . Stainless steel storage tanks

The most important considerations to be followed to produce high quality olive oil:

- Monitor the fruits on the trees throughout the planting season, to avoid infestation with insects;
- Collect the fruit when at the right level of ripeness, taking care to not damage them with machinery. This ensures the resulting olive oil meets industry standards. Transport the fruits in perforated, well-ventilated plastic boxes.
- Press the fruits and extract the oil directly after harvest. Do not store the fruits except when necessary.
- Remove leaves and wash the fruits before pressing (Fig 5).
- Avoid adding water during malaxing, except when needed to preserve the natural antioxidants, accounting for the malaxing time.
- Use only clean machines, equipment and stainless-steel storage tanks and regularly remove sediment from the oil as often as necessary (Fig 6).
- Use modern filling processes (under vacuum or with inert gas) and high-quality packages that are impermeable to light and oxygen to avoid light, air and heat exposure during handling and storage.

Fig 5 . Wash olive fruits

Fig 6 . Olive oil separator

OLIVE WASTE MANAGEMENTS

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Olive oil is a major agro-industry in the Mediterranean region. However, although economically important, olive oil extraction generates huge quantities of olive mill waste (OMW) and, unfortunately, the lack of control over its disposal poses a serious environmental threat, especially given the continued expansion of the industry.

Egypt is one of a number of Mediterranean countries that are looking for ways to attractively develop the production of olive oil. Since ancient times, the oil was traditionally obtained by pressing. After production increased, olive oil was extracted using one of two types of olive oil mill: the three-phase system and the two-phase system, or more recently, the multiphase system. The three-phase system produces large quantities of OMW, a brown effluent that changes to black, called olive vegetable water (OVW). If not disposed of correctly, this waste can have a serious impact on the environment. However, olive pomace (OP), a solid, causes no problems since it can be treated to extract the remaining oil, and re-used in the industry. The two-phase system produces oil and wet olive pomace, which can be converted into a solid form and repurposed. In Egypt, most mills discharge their OVW without treating it, often due to a lack of knowledge or the high costs of treatment and transport. Some store OVW in evaporation ponds, but this produces a foul odour and causes infiltration problems, and the resultant dry waste is not always handled properly.

As OVW is phytotoxic, adding it directly to the soil may harm surrounding vegetation. It may cause antimicrobial effects, increase soil hydrophobicity and decrease water retention and infiltration. It may also

have an effect on acidity, salinity, nitrogen immobilisation, microbial activity, nutrient leaching, organic acids, the concentration of lipids, and naturally-occurring phenols, which may lead to contamination and inhibit plant growth. Similarly, untreated OVW has a strong odour and may pollute natural streams and cause severe ecological damage to aquatic animals.

In recent years, there has been growing interest in developing sustainable and cost-effective treatment methods for managing OMW. For example, disposing liquid waste in evaporations ponds that are designed to prevent leakage to ground water (Fig. 1). This can also minimise OVW by using two-phase decanters to reduce water consumption and produce only wet pomace, which can then be dried, treated and made into compost, biomass fuel and livestock feed. Several studies have shown that OMW is an economic resource that contains a large amount of both organic and inorganic matter, so repurposing it is very important.

There are chemical, nano-technological and biological methods to reduce the harmful environmental impact of phenols in OVW. Adding it to agricultural land can improve soil fertility, increase bacterial activity and thus help plants absorb nutrients from the soil. According to several studies, recycled OVW is at its best from January to April. There are several methods for using OVW: it can be sprayed on trees at a distance of 0.5 to 1m from the tree trunks, at a rate of 48-72L/tree (Fig. 2); twice a week, 48L can be added to water in the drip irrigation system; or, OMW can be made into compost tea at 50% compost (2 compost:1 OP) with 50% OVW. The soil should be chemically analysed before using OVW to determine the pH and electrical conductivity (salinity) in order to identify the values at which these parameters become toxic for the plants.

Composting olive pressing and pruning residues, or the leaves left in mills, is an affordable way to recycle waste. This produces a useable product that is free from pathogens (mycelia or bacteria) and weeds, and rich in stabilised organic matter and nutrients. It can be used in agricultural land, especially when the content of organic matter falls below 1%. This is particularly relevant in hot and arid regions, where the environmental conditions make it particularly hard to maintain soil fertility, which in turn can exacerbate desertification.

Interestingly, this kind of fertiliser helps enrich and sustain the soil by making mineral fertilisers more effective. Composting should therefore be considered an important, sustainable agricultural practice, like pruning and irrigation, provided that the resulting products are distributed evenly (using equipment with an adjustable flow rate) and the recommended rates are respected, in order to maintain microbial activity and soil sustainability.

Figure 1: OVW evaporation lagoons

Figure 2: OVW spreading between the olive orchard rows

SAINT CATHERINE OLIVE TREE

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Saint Catherine is a historical walled city located in Egypt's Sinai Peninsula. It has a different climate to the rest of the region: temperatures can fall to -9 oC in winter, the relative humidity is low and it rains less than 50 mm/year. It was declared a World Heritage site by UNESCO, as in it lies one of the oldest monasteries in the world – Saint Catherine's Monastery, which represents the three heavenly religions.

The olive tree and Sinai are linked and celebrated in the Holy Qur'an. God Almighty said, "And a tree (olive) that spring forth from Mount Sinai, that grows (produces) oil, and (it is a) ***sibghin*** (relish) for the eaters." ***20 Surat Al-Mu'minin***; and God Almighty said, "By the fig and the olive * By Mount Sinin" ***1-2 Surat At-Tin***.

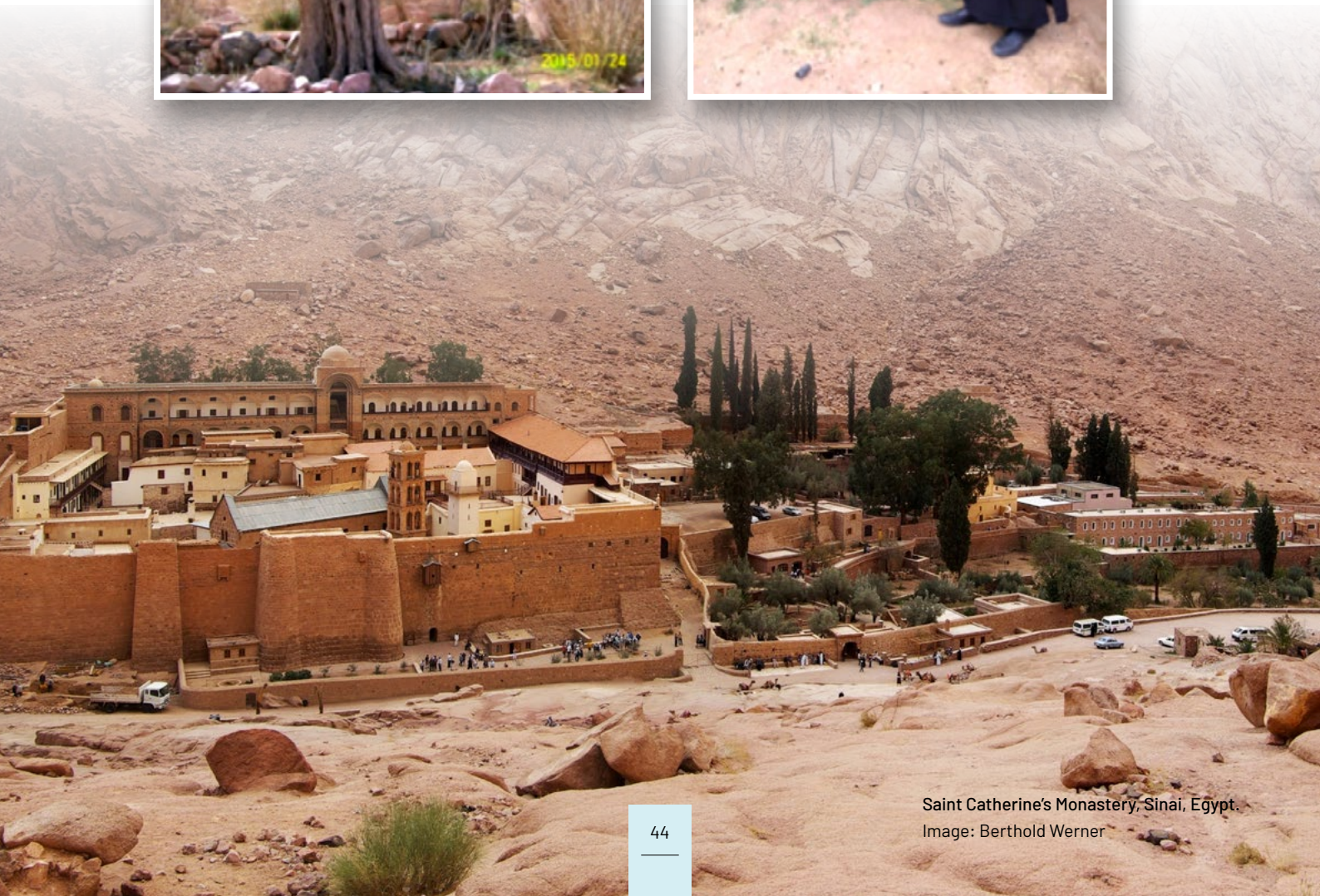
Olive cultivation in Saint Catherine has developed under harsh conditions, both due to human and environmental factors. The blessed tree is said to return to the holy place, and provide a source of life. Father Michael, the monastery's secretary, believes in the importance of the olive tree: there are 2 000 growing organically in the grounds, some of which are more than 500 years old. Not only an important source of nutrition, the olive oil made from these trees is used as fuel to light the monastery.

The local community joins Father Michael in holding the olive tree in high regard. For them, it is a source of food, medicine and shade, and a symbol of generosity: indeed, no Saint Catherine garden is without its olive tree. There is an area in the valley, or wadi, of the mountain called Zouatin, which means the abundance of olive trees. Olive oil is ubiquitous year-round,

and used in all manner of products. A popular Saint Catherine dish is made with cheese, olive oil and mountain thyme. Locals also make dakka with olive oil, add it to salads and pickle it with salt and thyme. Olive oil is used in hair styling, to make medicine, in particular to treat joint and dental pain, and to relieve snake and scorpion bites. Its many uses have earned it the name of hawi, or magic oil.

Father Michaele

Olive tree in St. Catherine



Saint Catherine's Monastery, Sinai, Egypt.
Image: Berthold Werner

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