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Phoenix dactylifera in the United Arab Emirates

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From the manicured date palm orchards among the golden hills of California to the oases in the Al-Hasa region of Saudi Arabia, *Phoenix dactylifera* has a well-established presence in traditional and hi-tech commercial settings. The United Arab Emirates is rapidly raising the degree of international recognition of this region as a future standard-bearer in the cultivation of *Phoenix dactylifera*. With particular zeal the U.A.E. is promoting higher quality date harvests via scientific research and aid to farmers.

The United Arab Emirates was founded in 1971. At that time, there were about 1.5 million date palms in the region. Slightly more than two decades later, generous government subsidies and technical assistance to date palm farmers have enabled *Phoenix dactylifera* to proliferate to ca. 18 million date palms (MAF 1994). The U.A.E. government has an active agenda to increase the number of date palms in the region. Together with research projects that are in progress at the Ministry of Agriculture and Fisheries and other institutes, the United Arab Emirates could soon become a global center for the cultivation and propagation of *Phoenix dactylifera*.

The trend in the U.A.E. is to modernize date palm operations, but some traditional sectors of date palm cultivation will remain intact. One domain is the conservation of water sources for irrigation by maintaining *falajes*, which are traditional and environmentally friendly irrigation systems. Another area is the preservation of some major oases, like the Al-Ain oasis in Abu Dhabi.

With a location of 55.5° longitude and 24.4° latitude, Al-Ain lies 165 km inland from coastal Abu Dhabi, the capital of the United Arab Emirates. The areas of Al-Ain borders Oman, and it is a three-hour drive from the fringe of the expansive Rub Al-Khali desert, i.e., the Empty Quarter. The United Arab Emirates University's Faculty of Agricultural Sciences, which is the region's hub

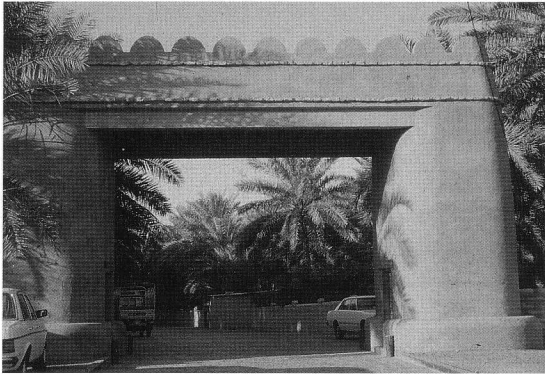
for research into the propagation and cultivation of *Phoenix dactylifera*, is also located in Al-Ain.

Although the Al-Ain region has some *falajes*, its more mountainous neighbor, Oman, has a larger network of *falajal* irrigation. The typical sources of water for *falajes* are subterranean water tables from which water seeps to the surface along valley river beds and the rainwater reservoirs inside mountains. Horizontal drilling into a mountain accesses its water reserves and an irrigation system that may be several kilometers long is constructed to hydrate date plantations at lower levels by the gravity flow of the water. As long as rain replenishes the mountain's water reserves, the farmer always has a reliable water source.

In contrast, wells that have been established through vertical drilling require pumps to raise the water to the surface. In the long term, pumps might extract water more quickly than it can be naturally restored and lower the water table below the reach of the palm's root system. Some of the abandoned date plantations are testimony to this event. Oman's government is keenly aware of the advantages of *falajes*. Consequently, the Ministry of Water and Electricity there has formed a Department of *Falajes*, which maintains a few hundred *falajal* irrigation systems (Fig. 8).

The Al-Ain oasis represents a site that operates in the same traditional manner as it has for centuries. Although urban development has encroached on this oasis of cultivated date palms, ca. 4 km² remain preserved. Its close proximity to the city offers the city dwellers who visit it a respite from the busy urban life. The oasis presents visitors a glimpse into the culture of the community that inhabits it.

The residents of the oasis live in a seemingly planned community. Upon entering the oasis through a lintel-style gate (Fig. 1), one finds a network of cobblestone roads meandering through the oasis which occasionally branch off to provide



1. The entrance to Al-Ain oasis. 2. A date palm plantation, Kitna, Oman.

access lanes to the gates of privately owned date farms. Old-fashioned mud-brick walls line the roads and define farm boundaries. Sprawling palm fronds of 5–10 m high date trees shade the road, which provide the pedestrians with a welcome relief from the baking summer daytime temperatures that average 110°–120°F (Figs. 2, 3).

The irrigation systems in the oasis not only supply water to the date palms, but they also provide local bathing areas. The dammed sections of the irrigation system create bathing pools that are accessible from the road. These discreetly located areas allow residents to cool or bathe themselves in clear, clean irrigation water. Although the inhabitants of the oasis lead a provincial lifestyle, their community is within walking distance of the city center.

Upon exiting the oasis, it is a mere five-minute walk to Al-Ain's most popular outside vegetable and fruit market. It is hardly surprising that besides the typical fare of fresh vegetables and fruit, dates are also available. Vendors offer an astonishing plethora of date varieties. Local Al-Ain favorites are Khalas, Barhi, Faradh, Raziz, and Shishi. Additional Emirati dates like Hilali, Khasab, Lulu, and others are among the commercially available dates in the United Arab Emirates.

Not all the dates that are found in the market are locally grown. Consumer preference and targeted usage of the dates are factors that contribute to date imports. Certain preferred date varieties grow outside the Emirates. The Deglet Noor, which is a worldwide favorite, is primarily grown in Tunisia and Algeria. Moreover, climatic conditions outside the U.A.E. are more suitable for the cultivation of particular varieties. Usually, the U.A.E. has hot, humid summers. Most dates that

are used in confectionery require dry summer weather. All of these factors contribute to annual date imports.

The date stalls at the market attract customers with enticing aromas and an array of colors, which range from golden-yellow to chocolate-brown to red. And these dates are available for longer periods now. The use of naphthalene acetic acid to delay ripening and ethereal to promote early ripening have extended the date season. Customers can buy dates in various stages of ripeness, which range from khalal to jubseh.

The date season begins with the arrival of fresh dates in the khalal stage at the marketplace. These yellow or rose-colored dates were crunchy and slightly astringent. The kimri stage precedes khalal, but these young, green-colored dates with their high tannin content are insufficiently mature to market. In the next stage of ripeness, i.e., rutab and tamar, the Khalas date is the Emirate's favorite. This translucent-amber to chocolate-colored date with its ample, soft flesh and small pit is the queen of Emirati dates. The Khalas is best enjoyed with a cup of coffee and it is often offered to hotel guests at the reception desk. Typically, rutab dates are brown or black and are fully-ripened dates. Amazingly, some varieties, like Barhi, can simultaneously share the rutab and khalal stage. This results in a date that is half-brown and half-yellow with a respective sweet and astringent taste. Tamar represents an advanced stage of ripeness, similar to the raisin-state of a grape. A reduced moisture content of 15–20% in this stage concentrates minerals and vitamins. Customers have preferences for particular dates at a certain stage in ripeness and they must be familiar with them since different dates vary in the time they



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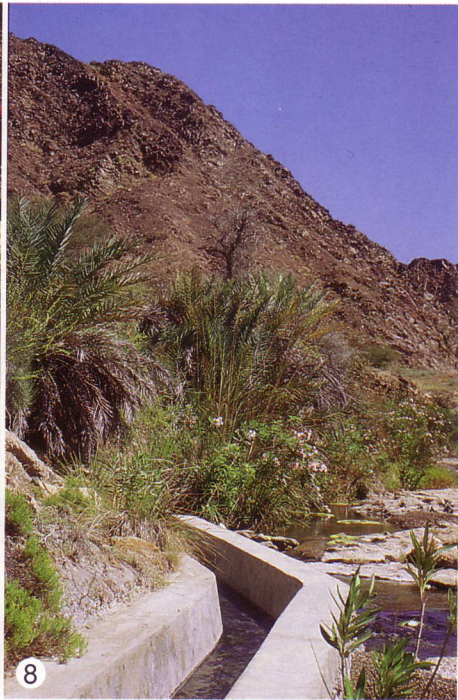


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3. The setting in Al-Ain oasis. 4. Emergence holes of the palm-stem borer. 5. Damage from a palm-stem borer. 6. An inflorescence trader.



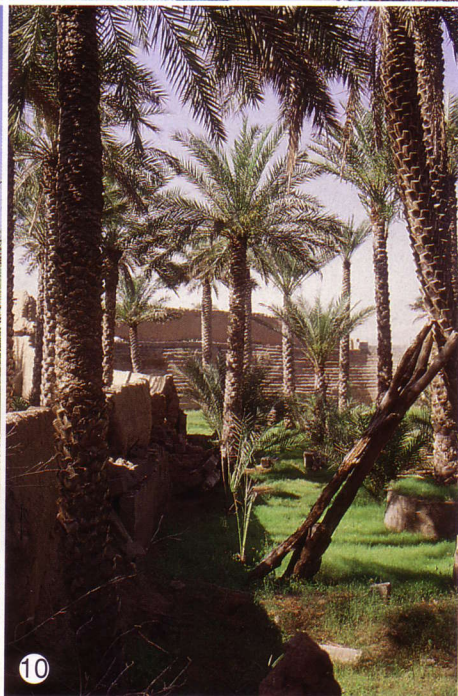
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7. Inflorescence traders. 8. Falaj, Mahda, Oman. 9. Hamasa oasis, Bureimi, Oman. 10. Another view of Hamasa oasis, Bureimi, Oman.

remain in a stage or skip certain stages of ripeness altogether (FAO 1962).

In the jubseh stage, which is colloquially known as *balah jaff* in the Emirates, the date is mummified and has a sandy-beige color. "Concentrated sweetness" best describes the gustatory experience of eating one of these dates. The word "jubseh" is derived from the arabic word for gypsum. True to its etymological source, it is rock-hard. Dates in this stage can be eaten dry or soaked in water first to soften them. Eating a date in the jubseh stage is reminiscent of the jarring experience of eating jaw-breaker candy. In Saudi Arabia, jubseh dates are selected based on their city of origin, such as jubseh Medina or jubseh Najran.

Jubseh dates are especially rich in minerals and are the Arab equivalents to hi-energy bars. Portable and nutritious, jubseh dates quickly restore nutrients that are lost during the performance of physically demanding activities. Women sometimes eat jubseh or other dates to replenish their strength following childbirth. Jubseh dates are also valued since they can be stored for years and serve as a valuable source of nutrients when the date season has passed. The date stalls at Al-Ain's outside market offer a plentiful variety of dates to satisfy customers' preferences. Certainly, the flurry of activity of vendors and buyers negotiating purchases reflects the importance of dates as a food staple in the Emirates.

Each year, between mid-February and early April, farm workers set up stalls beside the date vendors to enjoy some brisk business with the trade of male date palm inflorescences. In addition to customers who visit the stalls to purchase inflorescences for pollinating date palms, some residents visit the stalls to indulge themselves in a seasonal treat. Men will occasionally crumble an inflorescence and mix it with crushed, dried fish, which are also available from nearby vendors. They eat this concoction and purport to benefit from increased energy and a strengthened libido. Dr. Haffar, Associate Professor of Agricultural Engineering at the United Arab University's Faculty of Agricultural Sciences in Al-Ain, readily shared his insight into these local practices and other facets of the inflorescence trade. He frequents the vegetable market at this time of year to collect specimens of inflorescences for his pollen research at the university.

Residents who have their own date gardens and local farmers often require a source of pollen. The inflorescence trade at the market helps to satisfy

this demand. Date farm workers begin to inspect inflorescences from male trees soon after sunrise. The inflorescences must be harvested before they open. Upon opening, they release a burst of pollen which benefits nearby female date trees, but renders them useless for the inflorescence trade at the market. The workers test the inflorescences for ripeness by squeezing the end of the prophyll. When the tip crackles this indicates the prophyll will swell and open later in the afternoon and is ready to be collected for the morning market. By seven or eight a.m., the inflorescence traders (Figs. 6, 7) are at the marketplace. To display the closed bunches of flowers for inspection, the vendors make length-wise, parallel cuts down the spathe, then peel back this wooden tab. Besides scrutinizing the condition of the closed flowers, the buyers also smell the inflorescence to detect the particular aroma that indicates a fresh, ripe inflorescence. The inflorescence trade concludes by eleven o'clock in the morning. The farmers require sufficient time to return to their date palm orchards and pollinate before the flowers fully open and eject their pollen. Although the market provides a limited supply of pollen, the general demand for pollen has risen so greatly that alternative sources of viable pollen are necessary to sustain the increase of date production in the region.

Pollen collection has emerged as a significant element in establishing pollen reserves, especially for use in artificial pollination. The Ministry of Agriculture and Fisheries has established Pollen Extraction and Distribution Centers in the United Arab Emirates with its main lab for date palms located in Hamraniyyah, in the Emirate of Ras Al-Khaima. These facilities collect, store, and distribute pollen to farmers.

Khodrey and *Sikkah* are the typical male offshoots in the U.A.E. whose inflorescences are used as a main source of pollen. Vacuum collectors and vibratory shaking methods are used for pollen extraction, although the latter is more predominant. In the vibratory shaking process, the prophyll covering the inflorescence is removed and the inflorescence is hung up to dry for 2-3 days in humidity- and temperature-controlled open rooms. Afterwards, the inflorescences are placed inside a vibrating shaker for pollen extraction.

The vibrating shaker generally yields 10-20 g of pollen per inflorescence, depending on the cultivar. One "super" inflorescence Dr. Haffar viewed during a visit to a local farm weighed 8 kg. This mega-inflorescence had the potential to produce

40 g of pollen, which would have been sufficient to pollinate 25–30 date bunches.

The drying time of the flowers along with the intensity and duration of vibratory shaking all influence the optimum extraction of pollen. Since increased moisture holds pollen grains together and requires a longer shaking period, properly dried flowers more readily release pollen. On the other hand, prolonged shaking of adequately dried flowers causes too much debris, e.g., bits of inflorescence, to mix with the pollen, which reduces the amount of usable pollen.

Staff members from the U.A.E. University's Faculty of Agricultural Sciences have conducted experiments to investigate the most suitable combination of drying time of the flowers, together with the intensity and duration of vibratory shaking to maximize pollen extraction from a number of date palm cultivars (Haffar et al. 1995). This university team's research is contributing significantly to making vibratory shaking an effective means of pollen extraction. A readily available source of pollen will enhance mechanized pollination and help increase date production in the United Arab Emirates.

Since the number of date palms has greatly increased, there is an insufficient pool of skilled workers to pollinate manually the date palms. The Ministry of Agriculture and Fisheries and the U.A.E. University's Faculty of Agricultural Sciences have worked intensively to develop and improve mechanized means of pollination. As a result, hand dusters are available to pollinate palms 4–5 m high, while power dusters can be used for date palms up to 10 m. Maximum efficiency in pollinating the date palms is attained by dusting them 3–6 times with a mixture of fresh pollen and free-flowing wheat flour at a ratio of 10:1. Mechanized pollen extraction and pollination are a few components of a national program for integrated date palm mechanization systems.

The Ministry of Agriculture and Fisheries, each Emirate's Department of Agriculture, and municipalities promote date cultivation by providing a core of basic services that range from land preparation, which includes sand dune removal and land leveling, to crop establishment, harvesting, postharvest management, and crop maintenance/management. Pest control, which lies within the rubric of crop management, offers some challenges in maintaining the health of *Phoenix dactylifera*. The most obvious damage by an especially harmful pest can be readily observed during a walk

through the local oases. Date palm trunks with round, insect-emergence holes, which appear to have been excavated by ravenous woodpeckers, are telltale signs of the palm-stem borer, *Pseudophilus testaceus* (FAO 1982) (Figs. 4, 5). This beetle is one of the primary pests in this region that can have an adverse impact on the cultivation of *Phoenix dactylifera*. Researchers at the U.A.E. University are investigating pest control and numerous other issues that are related to the cultivation and propagation of *Phoenix dactylifera* in the United Arab Emirates.

The U.A.E. University's support of research in the cultivation of *Phoenix dactylifera* is highlighted by a generous grant it awarded to the Faculty of Agricultural Sciences for The Date Palm Project. This U.S. \$160,000 grant is being allocated over four years to advance research into a myriad of projects, such as: using dates as animal feed for camels and fish; date palm protection from disease and pests; utilizing dates to manufacture jam and syrup; studying the water requirements of date palms; and investigating cultural practices and production issues of *Phoenix dactylifera*, which range from the effect of low temperature on the storage capability of dates to chemical fertilization and its effect on the productivity and fruit characteristics of date palm cultivars. The holistic benefit from the research that is conducted in The Date Palm Project should be reflected in an economically efficient approach to improving the cultivation/propagation of *Phoenix dactylifera* and the increased productivity of date palms.

The Ministry of Agriculture and Fisheries has also mobilized its resources to promote date palm propagation. In 1989, the Ministry of Agriculture and Fisheries in collaboration with the U.A.E. University established the Al-Ain Date Palm Development Research Unit. Originally, the Tissue Culture Laboratory there had the capacity to produce 120,000 date palm plantlets per year. As a result of their success in tissue culture technique and the rising demand for vast quantities of superior date palm cultivars throughout the Emirates, the facilities were expanded in 1994, and currently have the lab capacity to propagate 1,000,000 plantlets, annually.

Clonal propagation at the tissue culture lab is performed by organogenesis (Rhiss and Almai 1977, Poulain et al. 1979, Rhiss et al. 1979). This method of propagation, which has the benefit of producing mutation-free clones, has become the preferred date palm tissue culture method in the

Emirates. Primarily, the date palm tissue culture lab propagates popular cultivars, such as Khalas, Barhi, Khanazi, Khadravi, and even Sultana and Nabtat Saif, which are elite cultivars from Saudi Arabia.

Dr. Rhiss, Director of the Date Palm Development Research Unit, recently gave the author a tour of the tissue culture lab and reviewed the stages of clonal propagation by organogenesis. The explants that are cultured in organogenesis are obtained from the date palm heart. Then, the palm heart is dissected and the apical tip and surrounding tissue are cut into 20–30 sections of 2 mm³. These explants are cultured in vitro in a solid medium that contains nutrients and growth hormones, which are modified for each particular stage in the process. In the first stage, which occurs in a dark room, the sections of explant are cultured to produce and multiply organogenesitic tissue. This initial step takes 8–12 months, depending on the cultivar. Not all of the explants produce tissue and these are discarded.

Stages 2 through 4 take place in fluorescent-lighted and temperature-controlled growth chambers, which are maintained at 28°–30°C. Stage 2, and each subsequent stage, takes one month to complete. In the second stage, the organogenesitic tissue is cultivated to produce and multiply buds. The tissue that is cultured from the initial 20–30 sections is sufficient to produce 10,000 buds. With a 2.5× rate of multiplication, these buds, in turn, will multiply to 25,000 buds. Generally, 15,000 of these buds continue to stage 3, while 10,000 buds are retained for additional multiplication. Surprisingly, as long as the nutrients and growth hormones are replenished each month, the buds can be used to reproduce for as long as five years.

Bud elongation occurs in stage 3. When the buds elongate to 10–12 cm, they are ready for stage 4, which results in root formation. Upon completion of this final stage in the lab, the combined length of the root and leaf is ca. 14 cm and the plantlets are ready to be transplanted. Acclimatization of the newly transplanted plantlets follows in growth tunnels, which are regulated to provide an environment with 80% humidity and a temperature of 28°–30°C. After one month, the plantlets are transferred to a humidity-controlled greenhouse. Once the plantlets have acclimatized, their cultivation can continue outside.

Presently, the national rate of date consumption in the U.A.E. has outstripped the country's

resources of date palms to satisfy it. The Al-Ain Tissue Culture Laboratory is a good example of the country's effort to increase its stock of date palms. In the future, clonal propagation of premium cultivars should help meet the consumer's demand for this food staple.

Since its founding 25 years ago, the U.A.E. has made noteworthy progress in the areas of date palm research, technology transfer to farmers, and date palm propagation and cultivation. The international date palm community should surely benefit from the body of scientific information that will be generated from ongoing projects. In the near future, the United Arab Emirates could very well position itself to become a worldwide center for the cultivation and propagation of *Phoenix dactylifera* (Figs. 9, 10).

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