Chapter 1
Introduction: Date Production Status and Prospects in Africa and the Americas

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Abstract Successful future development of date palm depends largely on evaluating, utilizing, and conserving genetic resources; assessing the value of present and potential cultivars; promoting the best cultivation, processing, and marketing practices; and broadening the number of fruit and tree products. The date palm was domesticated at the dawn of agriculture, new technologies were adopted for its cultivation, the palm was dispersed widely by humans and it has become a major world tree crop with the introduction of modern plantations. France, the USA, and international organizations have contributed to date palm development and more recently domestic programs in the larger producing countries. Creating a new international date palm organization to bring together research and development efforts and to serve as a resource center would be beneficial. Date palm cultivation has a long history across North Africa; Algeria, Egypt, Libya, Morocco, and Tunisia are major world fruit producers. Traditional date cultivation in oases is common, with recent and ongoing expansion of organized plantations. North Africa has potential for increased production given its proximity to existing European markets, but serious pest and disease problems must be overcome. Domestic and international research and development support and familiarity with the crop are assets. In the Sahel and Southern Africa, dates are minor crops but with potential for development to meet domestic demand. Advantages include favorable climatic and soil conditions and lesser pest and disease problems. Similar advantages exist in the Americas. Because they are not included in country chapters, summary accounts of date cultivation in Benin, Kenya, Mexico, and Namibia are provided.

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J.M. Al-Khayri et al. (eds.), *Date Palm Genetic Resources and Utilization: Volume 1: Africa and the Americas*, DOI 10.1007/978-94-017-9694-1_1

Keywords Dispersal and distribution • Domestication • Food value • Modern plantations • Production statistics • Research and development

1.1 Introduction

The date palm (*Phoenix dactylifera* L.) is one of the most valuable domesticated fruit trees because of ritual significance in human societies, health benefits, productive capacity in harsh semiarid and arid environments, and the range of subsistence products from its fruits and other parts of the large palm. In planning this book, the editors strived for complementarity with their earlier book, *Date Palm Biotechnology* (Jain et al. 2011), as well as two books by other authors, *Dates: Production, Processing, Food, and Medicinal Values* (Manickavasagan et al. 2012) and *Dates: Postharvest Science*, *Processing Technology and Health Benefits* (Siddiq et al. 2014). Each of these three books is composed of individual chapters, on a broad range of topics. None of them deals with the date palm status of genetic resources and production in each of the date palm-growing countries.

Additionally in this book, four major themes were identified as exemplified in the book's title. Genetic resources of the date palm are of great importance in the future of the crop, for two reasons. First, the diversity present in the entire *Phoenix dactylifera* gene pool represents an invaluable resource for conventional and molecular breeding of future date palms of high fruit quality, high fruit yield, tolerance to abiotic stresses, and resistance to major pests and diseases. Genetic erosion and genetic sedimentation imperil the date palm. Second, the strong and increasing trend toward cultivation of known elite cultivars, so evident in nearly every new date palm plantation, is being carried on at the expense of a narrowing of the overall cultivar diversity as traditional cultivars are less likely to be propagated and unevaluated seedling date palms (Johnson et al. 2013) are eradicated as if they were weeds. Cultivar assessment, for all but a few well-known elite types, is at a very rudimentary stage of knowledge. Because the unassessed cultivars are often native to a single country, studies of promising cultivars must be organized at the national level, with active collaboration among neighboring countries which may harbor close relatives; in certain instances the same cultivar may be present in adjoining areas within a country, or in adjacent countries, and bears different vernacular names.

Cultivation practices exhibit considerable variability across the date-growing world. Certain accepted practices have been adapted to local environmental conditions, such as early picking and postharvest ripening because of climatic limitations preventing full maturity of the fruits on the trees. Best management practices have yet to be perfected for date palm growing under a basic set of environmental factors. The country-level practices described in this book provide a point of initiation to begin developing guidelines for growers to assure them with maximum return for their investment and labor. The novel products part of the book title was included to prompt individual countries to examine the products derived from date fruits not marketed as fresh or dried products. Descriptions of derived date fruit products in the various countries demonstrate the cottage-level and small- and large-scale industrialization in existence. These descriptions make possible a cross-fertilization of ideas from country to country to valorize date fruit production to the highest level possible, which represents a potential enhancement of income to producers and manufacturers. Although the novel products described in the book are almost exclusively focused on the fruits, other parts of the date palm tree have a range of other subsistence and industrial products such as those derived from the leaves, petioles, edible heart, and stem wood. These nonfruit date products merit a fresh in-depth assessment to update the earlier publication *Date Palm Products* (Barreveld 1993).

1.2 Agrobotany, Domestication, and Dispersal of Date Palm

1.2.1 Agrobotanical Description

A mature date palm can reach 30 m in height and is the tallest of the *Phoenix* species. The stem has a diameter of 40–50 cm, bearing suckering offshoots at its base during the early years of growth. The leaves are pinnate and erect with numerous stiff leaflets, and the rachis is armed with broad sharp spines on each side. An adult palm has a moderately dense crown of 100 or more leaves 3–6 m in length; each leaf has a lifespan of 3–7 years, and about 12 new leaves are produced each year. The date palm is dioecious, bearing male and female flowers on separate trees. Dioecy in date palm is an impediment to seed propagation and traditional crossbreeding experimentation as equal numbers of male and female plants are produced and their gender is not apparent in the field until flowering begins. Propagated by seed, it reaches sexual maturity at about 5–7 years of age, significantly sooner if by offshoots. Flowering is normally annual. Fruit development from pollination to maturity is reached in about 200 days and is variable in shape, color, and size, 4–7 × 2–3 cm, larger than in any other *Phoenix* species. Yields are highly variable, 20–100 kg per adult tree, and depend upon cultivar, environmental conditions, and cultivation practices. The Medjool cv. produces the largest commercial fruits. Fruits contain a single elongate seed, variable in shape and size, 20–30 × 5–8 mm, containing a useful oil. On average, a plantation has an economic life of about 50 years, although the trees will continue to produce fruit beyond that age, albeit at lower yields. When trees become very tall, they are more expensive to care for and harvest, which negatively affects the production economics.

The true date palm, *Phoenix dactylifera* L., is one of 14 recognized species of the genus (Barrow 1998). It is most closely related to the Cretan date palm (*P. theophrasti* Greu.) of the Eastern Mediterranean; to the Canary Islands date palm (*P. canariensis* Chab.), native to that island group; and to the sugar date palm (*P. sylvestris* (L.) Roxb.) which is native to South Asia. Where *Phoenix* species distributions overlap in the wild, natural hybrids occur; likewise *Phoenix* palms grown in botanical gardens readily hybridize (Gros-Balthazard 2013). This facility makes artificial crossbreeding of species easily achieved. The date palm has 36 chromosomes ($n = 18$; $2n = 36$).

1.2.2 Domestication

The date palm is one of the world's very early domesticates and a traditional Old World fruit. Date palm, olive tree (*Olea europaea* L.), common fig tree (*Ficus carica* L.), and wine grape (*Vitis vinifera* L.) together are a seminal quartet of ancient fruit crops closely associated with the earliest stages of agriculture. The first domestication of the date palm is believed to have taken place at least 6,000 years ago in Mesopotamia, the lands between the Tigris and Euphrates rivers, in what is today Iraq. The area is often referred to as the *cradle of agriculture*. The early history of date palm as a cultivated palm is known only from archaeological records and ancient cuneiform clay tablets. It is presumed that wild date palms were selected for propagation on the basis of their possessing desirable fruit characteristics.

Over an indeterminate period of time following the first planting of date palms, several simple but important innovations took place in Mesopotamia which fostered the development of date palm cultivation. In roughly presumed chronological order, the following took place:

(a) Female and male palms were distinguished.
(b) Organized plantings made with fixed spacing.
(c) Palms under cultivation segregated by gender.
(d) Irrigation and water management.
(e) Artificial pollination.
(f) Separation of offshoots for propagation.
(g) Stages of fruit development recognized and named.

From the latter are derived the five sequential stages of fruit growth which were named: hababauk, kimri, khalal, rutab, and tamar. Somewhere along the way, the first cultivar was given a name, which may have been Zahidi in the Basrah area of present-day Iraq, a cultivar prominent in that area to the present. The foregoing is summarized from Dowson (1921, 1923, 1982), Popenoe (1973), and Pruessner (1920).

Since the date palm was initially domesticated, new cultivars have repeatedly been created as a result of seedling propagation and the selection of those of superior fruit quality subsequently propagated by offshoots and assigned individual names. Cultivar names typically derive from either the particular fruit characteristics, the locality where the palm originated, or the name of the farmer who selected it.

1.2.3 Dispersal and Geographic Distribution

From its presumed homeland in Mesopotamia, over succeeding millennia, date palms were dispersed by humans to the east, west, and south and took hold wherever climatic conditions and water sources were favorable for fruit production. Initial dispersal was clearly by means of seed. Even when abandoned, dates persisted and became naturalized where conditions allowed. Munier (1973), in a general study of date growing, described dispersal of date palm in two major historic routes. One route is from Mesopotamia south into the Arabian Peninsula and eastward to undivided India. A second route begins in Egypt (itself the location of an independent domestication of date palm) across North Africa west to Morocco. The caravan trade and the Nile River may have been the means of spreading date palms southward into the Sahelian countries and Sudan in the early days. From North Africa, dates were carried to Spain by the Moorish invasion in the eighth century, or possibly earlier. Seedlings dates were grown successfully for fruit in southwestern Spain, although the climatic is marginal for carrying fruits to maturity on the tree. In the sixteenth century, the Spaniards successfully introduced date seeds to the Americas, initially to Peru and later to Mexico, and achieved modest fruit production. In the mid- to late 1800s, there are reports of seedling dates being grown in Southern Africa, Australia, and New Caledonia (Johnson 2010). In the past 100 or so years, as offshoots have successfully been transported over long distances, modern date palm plantations employing elite cultivars have emerged or are emerging in countries such as the UAE, Oman, Kuwait, the USA, Mexico, India, Israel, Jordan, Namibia, and Australia, as well as in several Sahelian countries in Africa.

1.3 The Rise of Modern Date Palm Plantations

Scientific literature on date palm published before the twentieth century consists mostly of brief accounts of date growing in a few countries or entries in reference volumes; an exception is the book *The Date Palm in India* (Bonavia 1885), which brings together information about date growing in the Persian Gulf and British India.

The US Department of Agriculture created a program in the 1890s to promote an irrigated commercial date industry in the American Southwest and in 1904 established a date experiment station in Mecca, California, later moved to Indio. Offshoots of recognized cultivars were imported from North Africa and the Middle East and provided to pioneer farmers. Commercial date production began in 1912. Needing a source of technical information, in 1924 the date growers created the Date Growers' Institute, which organized technical meetings each year and published an annual review (DGIAR 1924–1979). The USDA published a number of technical studies on date growing in the USA (e.g., Nixon and Carpenter 1978; Swingle 1904) as well as bulletins on date cultivation in other countries such as Egypt (e.g., Mason 1923). Three general books have helped to popularize dates in the USA (Dunham 1948; Paulsen 2005; Simon 1978). US scientific publications on date palm have made a major contribution to modern date growing. However, scientific research on date palm in the USA was greatly reduced after cessation of the date growers' annual meetings in 1979 and closure of the date experiment station a year later.

The French also made important contributions in the twentieth century to modern date cultivation in their North African colonies by organizing the first two international date palm conferences. In 1931 a weeklong meeting was held in Biskra, Algeria, with presentations on broad climatic, agronomic, and economic aspects of date production. One of the recommendations was to promote the Deglet Noor cultivar (Sem Dattier 1931). It was not until 1950 that a second such conference took place in Tunis, Tunisia. Among the recommendations made were to conduct scientific research on date palm agronomy and adopt uniform fruit export standards (Cong Int Datte 1951). French scientists produced numerous articles and technical reports on dates in Africa, broadening the knowledge base. Pereau-Leroy (1958) authored the first national study of dates on Morocco, and Munier (1973) the first general scientific study of date cultivation.

International backing for data palm development was provided by FAO in the second half of the twentieth century. This was initiated by sponsorship of three technical conferences on date palm: one in Tripoli, Libya, in 1959 and two in Baghdad, Iraq, in 1965 and 1975. No proceedings were published, but the presentations by leading date specialists from around the world generated background materials for the issuance by FAO of a series of important books on date palm (Dowson and Aten 1962; Dowson 1982; Barreveld 1993; Zaid 1999, 2002). Another contribution made to date palm science was *The Date Palm Journal* (FAO 1981–1988).

A recent contributor to date palm development is the International Center for Agricultural Research in the Dry Areas (ICARDA), recently relocated from Aleppo, Syria, to Beirut, Lebanon. One of its projects focuses on increasing date production among smallholder farmers in Iraq (Mazid et al. 2013), ravaged by war; another involves enhancing date palm production systems in the GCC (Gulf Cooperation Council) countries (ICARDA 2011). This project is being led by an ICARDA date palm specialist based in Oman. A study of date harvest and postharvest handling was a part of the project (Kader and Hussein 2009).

With the major contributions outlined above from the USA, France, FAO, ICARDA, and numerous lesser but important efforts, a firm scientific foundation has been established for the cultivation and processing of dates, upon which the future of the crop is being built.

1.4 Research and Development

Apart from the international development efforts described above which have fostered modernization of date palm production to varying degrees in individual countries, national programs also have played an important role. Major common problems shared by all date-producing countries are associated with cultivation practices, pests and diseases, soil and water conditions, harvest and postharvest practices, processing facilities, technical support and extension, the agricultural labor force, as well as domestic and international marketing. The best example of differences is pests and diseases. Remote areas of date growing in Southern Africa and the Americas have few such problems to contend with, whereas Morocco and Algeria are experiencing significant crop and tree losses given the occurrence of bayoud disease and the red palm weevil. Climatic factors present problems only in certain countries such as Pakistan and India where annual monsoon rain occurs before date fruits mature, but in Saudi

Arabia, for instance, climate presents no hindrance to date growing. Each date-growing country has a unique set of impediments to improving production, and the severity of each should set the agenda for domestic R & D.

This book provides information on the research centers carrying out research on date palm on various aspects, supported by mainly the federal government in academic institutions and private investment. A close link exists between the magnitude of date production and the funding to support date palm R & D. Egypt, Iran, Iraq, Saudi Arabia, and Pakistan, each ranking among the top six producers worldwide, have established research institutes devoted to date palm, which are funded by the federal governments. In other date palm-producing countries, including Algeria and Morocco, date palm research is carried out by the national agricultural research centers. In Syria and Palestine, date palm currently is considered as a minor crop, with annual production of 3,986 and 3,600 mt, respectively. The paucity of federal government funding becomes a major obstacle in developmental efforts. Therefore, these countries must fall back on larger date-producing countries for importing improved date palm cultivars, technologies to control pests and diseases, and agro-food-based products and other by-products. Any important factor in domestic support for date palm research depends on the priority of the national governmental support in creating date palm-based agro-food industry and local and international marketing boosting local economy.

Throughout the date palm world in general, insufficient attention has been given to programs of genetic improvement employing emerging biotechnology procedures. This neglect may be attributed to the limitation of research funds, inadequate advance research infrastructure, and scarcity of experts in many of the date palm-producing nations. Interrelated issues include the need for precise knowledge of the genetic resources present in a country, including that contained in seedling date populations, and the effective means to conserve genetic resources through germplasm gardens and cryopreservation.

Given the problems shared by date-growing countries, it would be of great benefit to create an international date palm center. The advantages of such a center include the following:

(a) Avoid expensive duplication of effort in addressing major pest and disease problems.
(b) Enhance opportunities for collaborative research both at the bilateral and international levels.
(c) Develop and disseminate information on best practices in date cultivation, harvesting, postharvest handling, and marketing by developing an interactive website. An excellent model for date palm exists in the Coconut Timeline (http://cocos.arecaceae.com/).
(d) Develop international industry descriptors and standards for fruit quality and packaging and marketing.
(e) Maintain a database of world date palm cultivars and their conservation status.
(f) Maintain information on date palm genetic diversity, genetic erosion, conservation, and utilization of germplasm.

(g) Develop programs on health benefits of dates and various commercial food products.
(h) Develop date palm functional genomics for studying useful genes leading to genetic improvement of date palm growing under climate change, enhanced fruit quality, and industrial products.

1.5 Date Fruit Production Statistics

During the planning of the present book, available data on date production were critically evaluated in order to determine the relative importance of the crop within a country based on national production in relation to global production quantities. The Food and Agriculture Organization of the United Nations (FAO) collects data from member nations and publishes annual agricultural production data on major crops. These data are the most comprehensive available and of primary concern in this book. In addition, FAO publishes data on the value of crops, as well as import and export quantities, but those data are of lesser importance given the focus of the book on production.

Domestic production statistics in most countries are incomplete or difficult to access. The exceptions are Saudi Arabia and Morocco which have published detailed accounts of their date palm cultivation which include some data on the numbers of palms being grown and area under cultivation, along with cultivar descriptions (INRA 2011; Min Agr Saudi Arabia 2006).

Aggregate world date fruit production for 2012 amounted to 7,548,918 mt, according to FAOSTAT (2012). Table 1.1 lists reported producing countries in descending order of magnitude. The production figures given in Table 1.1 reflect the extent of date growing around the world. These data are a mixture of production figures provided by the various countries and FAO estimates. Burkina Faso, Ethiopia, Mali, and Senegal, discussed in this book, are not included in FAO data, apparently because commercial date production hardly exists yet.

There are some serious problems with the FAO data that have a bearing on this book and need to be discussed; date production reported for five countries is incorrect. The production reported for China of 150,000 mt represents the production of the red date fruit, rather than the true date palm. Red date or jujube is scientifically *Zizyphus jujuba* (L.) H. Karst., a tree or shrub of the Rhamnaceae or buckthorn family. China has no production of true dates. A similar situation is found with respect to the reporting of 31,675 mt of date production in Turkey. In this instance, the figures represent production of the common fig. This misunderstanding arises from the same Turkish word being used to refer to dates and figs. Albania's reported production of 12,935 mt of dates is a reflection of date imports from other countries being considered as national production; the country's climate is unsuited to commercial date production. Swaziland's reported production of 330 mt is incorrect, because there is no commercial date cultivation within the country (McCubbin M, personal communication, 2014). The neighboring Republic of South Africa has some date

Table 1.1 Date fruit production by country, 2012, in mt.

Ranking	Country	Production (mt)
1	Egypt	1,470,000
2	Iran	1,066,000
3	Saudi Arabia	1,050,000
4	Algeria	789,357
5	Iraq	650,000
6	Pakistan	600,000
7	Sudan (former)	433,500
8	Oman	270,000
9	United Arab Emirates	250,000
10	Tunisia	190,000
11	Libya	170,000
12	China*	150,000
13	Morocco	113,397
14	Yemen	55,181
15	Israel	42,866
16	Kuwait	34,600
17	Turkey*	31,765
18	USA	28,213
19	Mauritania	22,000
20	Qatar	21,843
21	Chad	20,000
22	Niger	17,000
23	Bahrain	15,000
24	Somalia	13,000
25	Albania*	12,935
26	Jordan	10,417
27	Mexico	6,012
28	Spain	4,000
29	Syria	3,986
30	Palestine	3,600
31	Benin	1,300
32	Kenya	1,100
33	Cameroon	600
34	Namibia	400
35	Peru	400
36	Swaziland*	330
37	Djibouti	86
38	Colombia*	30

Source: FAOSTAT (2012)
Countries which erroneously are reported to have date production are indicated with an asterisk

growing focused on Medjool cv. in the Limpopo Region (McCubbin 2007), which does not appear in FAO statistics for the RSA. There are no FAO trade data on date imports and exports between the two countries, so it appears unlikely there is any connection. FAO has reported date production for Swaziland each year since 1999, all based on either an estimate or imputation methodology. The most plausible explanation is that the production reported as dates is for some other fruit. Finally, the statistic that Colombia produced 30 mt of dates is not from domestic production but rather from imports and exports. Climatic conditions in the country also are unsuited for commercial date growing. Inclusion of these five countries in world production totals resulted in an overstatement of 195,060 mt in 2012. India should be but is not included in Table 1.1 for unknown reasons, and data are either not collected in the country or, if they are, not submitted to FAO. Whatever the case, according to data from a newspaper estimate cited in Chap. 14, India's date production was estimated in 2010/2011 to be at least 120,000 mt, which would place it among the top 12 world producers.

The quality and accuracy of national date production data vary, irrespective of the significance of the crop to the individual country's agricultural sector. Among the factors at play are the following:

(a) The mix of modern formal plantation cultivation and traditional date growing where densities vary and other crops are grown in association such as is typical in oases. Statistical data on the former are much easier to gather and are more accurate.
(b) Planting densities in some countries are highly variable; hence it is difficult to take data on area under cultivation and derive the actual number of trees being grown.
(c) Data from farmers may be understated in countries where taxes are assessed on the basis of total production and likewise the quantities of dates consumed by growers and their families or used as livestock feed are poorly known.
(d) The level of proficiency of the national agency collecting agricultural production data is again highly variable.
(e) Data from one producing country may be double counted. For example, Mexico's small date production takes place just south across the border from the Yuma, Arizona, and Bard, California area, one of the two most important production regions of the USA. An indeterminate quantity of Mexican dates is known to be shipped to Yuma, Arizona, and sold through the large cooperative processing facilities in that city. Other such examples likely exist in some African countries.

Regarding production data by date cultivar at the national level, data are nonexistent. National date production statistics in even the most advanced agricultural countries such as the USA are aggregated and not collected by cultivar. As indicated in the country chapter in these volumes, the most prominent cultivars are identified, but their relative ranking as regards total national production is unknown. The most reliable production data by date cultivar is derived from farm or research station records of per tree productivity.

The lesson to be drawn from this discussion is that date palm production statistics for each country must be appraised for their accuracy and reliability within the context of the conditions which are known to exist in that country.

1.6 Food Value of Dates

In the human diet, date fruits are rich sources of sugars, protein, fiber, minerals, and certain vitamins. A quick energy source because of the high sugar content, dates have been called *nature's candy*; they are an excellent snack food and currently being recommended as such. When the fruits reach maturity (tamar), sucrose inverts into glucose and fructose. Dates contain reasonable amounts of vitamin A, thiamin, riboflavin, and niacin and are a good source of minerals such as potassium, calcium, and iron, as well as of dietary fiber. The burgeoning natural foods sector is promoting date consumption as a functional food and as possessing antioxidant qualities. Dates are included in the group of recommended healthy food choices for individuals suffering from type 2 diabetes. Each date cultivar has an individual profile of nutritional values. Table 1.2 gives the nutritional values for two common commercial cultivars: Deglet Noor and Medjool. Ahmed et al. (2014) provide a good current summation of research of the composition and nutritional value of date fruits, and Vayalit (2014) of the bioactive compounds and functional properties of the fruit.

1.7 Date Production in Africa and the Americas

Date cultivation in Africa is dominated by the countries across North Africa, from Morocco to Egypt. Deglet Noor from Algeria, Medjool from Morocco, and Zaghloul from Egypt are major commercial cultivars originating from North Africa. Egypt is predominant with date production that far exceeds that of all other countries of the continent combined and which made it, in 2012, the largest producer in the world. This group of countries includes the world's largest date producer, as well as the smallest, Djibouti, with reported production of 86 mt in 2012.

North Africa suffers from two major pest and disease problems which are present to varying degrees depending upon the country. The most serious threat is posed by bayoud disease, a fungus (*Fusarium oxysporum* f. sp. *albedinis*), which originates from southern Morocco and has spread eastward to Algeria and south into Mauritania. Bayoud is extremely difficult to control because it is a soilborne fungus. Control measures include restricting the transport of date palms out of infected areas and destruction of infected trees. Research into selecting and breeding trees with resistance has shown some encouraging results, but the disease represents a major threat to date palm growing worldwide. In recent decades, the red palm weevil (*Rhynchophorus ferrugineus*) has spread westward out of Asia through the region and crossed the Mediterranean Sea into southern Europe, largely by the

Table 1.2 Nutritional value of Deglet Noor and Medjool cv. dates (nutrient values and weights are for edible portion)

Nutrient	Unit	Value per 100 g	
		Deglet Noor cv.	Medjool cv.
Proximates			
Water	g	20.53	21.32
Energy	kcal	282	277
Protein	g	2.45	1.81
Total lipid (fat)	g	0.39	0.15
Carbohydrate	g	75.03	74.97
Fiber, total dietary	g	8.0	6.7
Sugars, total	g	63.35	66.47
Minerals			
Calcium, Ca	mg	39	64
Iron, Fe	mg	1.02	0.90
Magnesium, Mg	mg	43	54
Phosphorus, P	mg	62	62
Potassium, K	mg	656	696
Sodium, Na	mg	2	1
Zinc, Zn	mg	0.29	0.44
Vitamins			
Vitamin C, ascorbic acid	mg	0.4	0.0
Thiamin	mg	0.052	0.050
Riboflavin	mg	0.066	0.060
Niacin	mg	1.274	1.610
Vitamin B_6	mg	0.165	0.249
Folate, DFE	μg	19	15
Vitamin A, RAE	μg	0	.7
Vitamin A, IU	IU	10	149
Vitamin E	mg	0.05	–
Vitamin K	μg	2.7	2.7

Source: US Department of Agriculture National Nutrient Database for Standard Reference, Basic Reports 9087 and 9421, accessed 18 Sept 2014

shipment from North Africa of unknowingly infected date palms destined for ornamental use.

A considerable number of seedling dates exist in oases in North Africa, the Sahel and Southern Africa, providing subsistence and/or famine food for local people. Where seedling dates are present, there exists the potential for enhancing production with better cultivars and the adoption of best practices for cultivation. Seedling dates are being studied for their resistance to bayoud disease, a trait which could potentially be transferred to elite date cultivars.

North Africa is the presumed origin of date palm seed conveyed to Spain where plantings were established and later seed carried to the New World during the Spanish conquest of the sixteenth century. In coastal Peru and Baja California, in northwestern

Mexico, climatic conditions were conducive to date cultivation, and several oases of seedling dates were established and have persisted to the present day. In the New World, modern plantations from offshoots of elite cultivars from North Africa and the Middle East were established in the USA early in the twentieth century.

Three African counties (Table 1.1) are not discussed specifically elsewhere in this volume: Benin, Kenya, and Namibia. Mexico, a minor date producer, is likewise not covered. Below are brief accounts of the information available about date production in each of these countries.

1.7.1 Benin

According to an FAO estimate, Benin produced 1,300 mt of dates in 2012. The Alibori and Atakora departments in the northernmost part of the country have a climate suitable for date growing. No published information could be been found on date production in Benin.

1.7.2 Kenya

Random introductions of date palm to Kenya occurred beginning in the early twentieth century from seeds originating from Iraq, Bahrain, the USA, Aden, and Pakistan and test planted at various locations. Subsequent introduction of offshoots of named cultivars was brought in from Pakistan to Turkwell, Turkana District, which is at present the largest concentration of date palms in the country. Among the cultivation problems encountered were minimal offshoot production from imported trees, poor survival of separated offshoots, inadequate crop management practices, irrigation system failures, nonflowering male palms, and complications of communal land ownership (Wasilwa et al. 2007). Records of introductions appear to have been poorly kept; Gammell (1989) reported that only 6 of 15 cultivars imported from Pakistan in 1974 which showed promise could be reidentified some 3 years later. These were Mazwati, Chakri, Bagum Jangi, and Assil under their Pakistani names and Kaekerongole and Ome, local names given to unidentified introduced cultivars. Kenya has suitable climatic areas for date cultivation and could become a much larger producer if technical and social constraints can be overcome. In 2012, date production amounted to 1,100 mt.

1.7.3 Namibia

This southwest African country has climatic conditions appropriate for date cultivation and was the venue of an international symposium in 2000 to promote the crop within the country (Min Agr 2000); the Namibia Development Corporation owns and runs the plantations. Modern plantations were established from tissue-cultured plants, with emphasis on Medjool and Barhi cvs., with fruit chiefly for export. Based on general information from the Internet, there are at least three date plantations in Namibia; two sites named are Eersbegin and Naute. Unseasonal rainfall and alkaline soil conditions are mentioned as problems of date production. Apparently, there has not been a recent scientific study of the situation in Namibia. Based on production data, it is obvious that there have been difficulties. According to FAO, in 2003 Namibia's estimated production was 651 mt, but in 2008 and 2009, official production was 333 and 276 mt, respectively. Estimated production in 2012 amounted to 400 mt. Namibia certainly has the potential to market khalal stage Barhi and tamar stage Medjool fruits to the Middle East and Europe in the off-season.

1.7.4 Mexico

The early date palm oases established during the Spanish colonial period have persisted in certain locations in the Baja California Peninsula and provide small quantities of fruit for local consumption (Johnson et al. 2013). Modern date production in Mexico did not begin until the late 1960s when plantations were established in extreme northwestern Sonora State, immediately south across the international border from Yuma, Arizona. The new plantings were modeled after cultivation practices in the USA, which was also the source of offshoots. The major cultivar grown is Medjool. There is favorable potential for expansion of Mexican date growing given local water resources and lower labor costs than in the USA. Fruit production in 2012 amounted to 6,012 mt.

1.8 Conclusions and Prospects

The chapters in this volume describe date production in 16 African countries and 3 in the Americas. Although the date palm has been dispersed throughout the African continent, significant commercial production is yet to be realized in those countries to the south of the traditional producers along the Mediterranean Sea. Introduction of the date palm to the Americas has led to commercial production in the USA and Mexico. However, the magnitude of production is relatively small (the USA produced 28,213 mt in 2012) as measured against the countries in North Africa and the Middle East such as Egypt, Iran, and Saudi Arabia, each with production in excess of 1 million metric tons.

Three distinguishing characteristics of date production are represented in Africa and the Americas. One concerns the fact that in the dispersal of date palms to regions far distant from the core production areas (i.e., North Africa and the Middle East), major pest and disease problems such as bayoud disease and the red palm weevil are avoided. Neither Southern Africa nor the Americas have recorded these problems in date-growing areas. With vigilance, these two serious plagues of the date palm can be prevented. A second related issue is that areas free of these two organisms are safe sources of uninfected offshoots for expanding production anywhere in the world. The third issue concerns genetic resources. Climatic and soil conditions in Southern Africa and the Americas are unlike those found in the core production areas. Over generations of seedling dates propagating by themselves in remote areas, new forms have certainly arisen and may represent valuable germplasm resources for traditional and molecular breeding purposes.

Issues one and two above also give an opportunity to expand date cultivation in these remote areas and, in southern hemisphere locations, export dates to northern hemisphere markets in the off-season.

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