Chapter 7
Date Palm Status and Perspective in Yemen

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Abstract In Yemen, there are more than four million date palms (*Phoenix dactylifera* L.) occupying an estimated area of 14,464–14,955 ha during the period 2008–2012 and producing 55,181–57,849 mt of dates in the same years. More than 321 date palm cultivars are recorded in Yemen, 42 are considered excellent. Most of the date palm plantings in Yemen are irregular, mainly concentrated in the governorates of Hadramaut and Hodeidah. Cultivars of Hamra, Mijraf, Sokotri, Serfaneh, Manasif, Tha'al, and Bqal are dominant. The date palm in Yemen is suffering from several insect and mite pests, namely, the red palm weevil which appeared in 2013; the Dubas bug first recorded in 2000; the stalk and stem borers, *Oryctes* spp.; the lesser date moth, termites, and white scale; storage pests; and the dust mite. Chemical insecticides are used for the control of most of them. Birds, bats, and rodents are among the serious pests. In addition, the diseases soft rot, black scorch, Graphiola leaf spot, and inflorescence rot are recorded. Sanitation is the current means for controlling these diseases. Two factories designed mainly for packing dates have been established, but they are facing problems to work efficiently. Date fruits are marketed locally. Utilization of date palm parts has been known for a long time in Yemen. Date palm growers face problems of poor marketing of their products; lack of handling procedures (packing and processing); high production cost (labor); social and human obstacles such as land fragmentation, poor infrastructure, urbanization, and difficulty of access to soft loans; as well as unavailability of specialized associations and alliances. Because the government of Yemen considers the date palm as one of the most important economic and strategic crop, a national program for promoting the date palm sector is being implemented targeting the following objectives: rehabilitation of old date palm trees, introducing new systems for crop management, and applying integrated pest and disease programs for major insects, mite pests, and diseases. Two tissue culture laboratories have been established.

Keywords Cultivars • Cultivation • Diseases • Genetic resources • Harvest • Historical • Manufacturing • Marketing • Pests • Processing • Propagation

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7.1 Introduction

Since ancient times, date palm (*Phoenix dactylifera* L.) has been considered an important economic and food security crop in Yemen. It was the only food source in arid areas where poverty and starvation periods were recorded in the past. It plays an important role in food production, animal feed, income and employment generation, and foreign exchange earnings, particularly for those growing high-value introduced tissue culture cultivars such as Barhi date by-products are used in some raw materials for local industries. The prevalent climatic and geographic conditions make Yemen suitable for planting and producing date palms. Date palm ranks first among the fruit crops; in cultivated areas, date palm constitutes about 25 % of the total fruit area.

As shown in Table 7.1, the estimated area of date palms ranged from 14,464 to 14,955 ha during the period 2008–2012, producing 55,181–57,849 mt of dates, in the same time period (MoAI 2013a). There are more than four million date palms in Yemen; bearing palms constitute 67.4 % and the males 3 %. Date palm cultivation is found in most governorates of Yemen (Table 7.1 and Fig. 7.1). However, it is more concentrated in Hadramaut and Hodeidah governorates. Hadramaut ranks first in both area and production; the number of date palms there constitutes about 47 % of the Yemeni total. Hamra, Mijraf, Sokotri, Serfaneh, Manasif, Tha'al, and Bqal cvs. are dominant. The majority of date palm trees are old and in traditional plantations where both fruit quality and productivity are low. Local production and supply is insufficient to meet the demands of people. Yemen annually imports about 24,000 mt of dates, at a cost of more than USD 100,000 (MoAI 2013b).

Date palm farmers face a number of challenges, including weak extension services, the spread of pests and diseases, low-quality fruit production, low prices, lack of marketing facilities, and insufficient storage and packing facilities. Date palm farmers in Hadramaut and Al-Mahrah governorates have also experienced a large flood disaster in November 2008, which uprooted about 500,000 date palms.

In addition, date palm farmers also face poor marketing practices in their production, lack of efficient handling procedures (packing and processing), high production cost (labor), social and human obstacles such as land fragmentation, poor infrastructure, urbanization, difficulty of access to soft loans, and unavailability of specialized associations and alliances.

Because the government considers the date palm one of the most important strategic crops, a national program to promote the date palm sector in Yemen is being implemented which includes rehabilitation of old date palms, improving cultural practices and introducing new systems for crop management, and applying integrated pest and disease programs for major insects and diseases. The government has established ten pilot demonstration plots for farmers and nurseries to provide improved date palm cultivars.

Table 7.1 Date palm cultivation area (ha) and production (mt) in Yemen (2008–2012)

Governorate	Area and production	Year				
		2008	2009	2010	2011	2012
Hadramaut	Area (ha)	5,660	5,773	5,833	5,841	5,845
	Prod (mt)	23,762	24,475	24,719	24,833	24,856
Hodeidah	Area	4,934	5,033	5,088	4,986	4,963
	Prod	18,125	18,669	19,224	17,334	16.812
Al-Mahrah	Area	998	1,018	1,032	1,033	1,033
	Prod	3,066	3,158	3,196	3,203	3,219
Taiz	Area	787	803	813	781	733
	Prod	2,480	2,530	2,585	2,459	2,329
Shabwah	Area	555	572	581	586	586
	Prod	2,050	2,071	2,103	2,166	2,149
Lahej	Area	506	516	537	533	546
	Prod	1,918	1,956	2,035	2,008	2,011
Mareb	Area	425	438	454	458	461
	Prod	1,454	1,498	1,552	1,491	1,451
Al-Jawf	Area	352	363	374	374	381
	Prod	1,576	1,623	1,672	1,633	1,703
Sadah	Area	134	134	132	121	119
	Prod	423	427	412	381	359
Hajjah	Area	37	37	40	35	36
	Prod	115	115	132	119	115
Abyan	Area	27	27	31	36	36
	Prod	101	103	114	132	113
Sana'a	Area	21	21	20	15	13
	Prod	56	57	49	35	31
Amran	Area	7	7	6	3	3
	Prod	19	19	15	11	11
Al Bayda	Area	5	5	4	3	3
	Prod	13	13	10	8	8
Raimah	Area	7	7	6	4	4
	Prod	23	23	19	15	14
Al-Daleh	Area	4	4	3	0	0
	Prod	9	9	7	0	0
Sana'a City	Area	4	4	0	0	0
	Prod	8	8	0	0	0
Aden	Area	2	2	2	0	0
	Prod	6	6	5	0	0
Al-Mahweet	Area	0	0	0	0	0
	Prod	0	0	0	0	0
Dhamar	Area	0	0	0	0	0
	Prod	0	0	0	0	0
Ibb	Area	0	0	0	0	0
	Prod	0	0	0	0	0
Total	Area	14,464	14,764	14,955	14,809	14,762
	Prod	55,204	56,760	57,849	55,828	55,181

Source: MoAI (2013a), Agricultural Year Book 2012

Fig. 7.1 Map showing date palm cultivation in the governorates (see Table 7.1) (*Source*: www.gsn-online.com)

7.2 Cultivation Practices

7.2.1 Chronological Account of Research and Development

There are more than 321 date palm cultivars recorded in Yemen; 42 are considered excellent; 65 produce good quality dates and these together constitute one-third of the total cultivars; the remaining two-thirds are considered acceptable or poor. The mean yield varies from 27 to 63 kg per tree, which is low compared with cultivars in neighboring countries.

The government is promoting the date palm as one of the strategic crops (date palm, cotton, coffee, mango, and guava). The emphasis is being given to the rehabilitation of old palm orchards, improving irrigation methods, and upgrading storage and packing facilities and marketing services. Modern date palm farms have been established through a partnership between government and owners with high-yielding tissue culture cultivars and a modern irrigation system.

In November 2008, date palm plantations experienced a flood disaster which uprooted almost 500,000 trees (Fig. 7.2). The Public Corporation for Agricultural Services (PCAS) contracted with the Flood Reconstruction Fund to provide 250,000 tissue culture date palm plantlets during 2011–2012 as assistance to farmers (Ba-Asher and Kasim 2011).

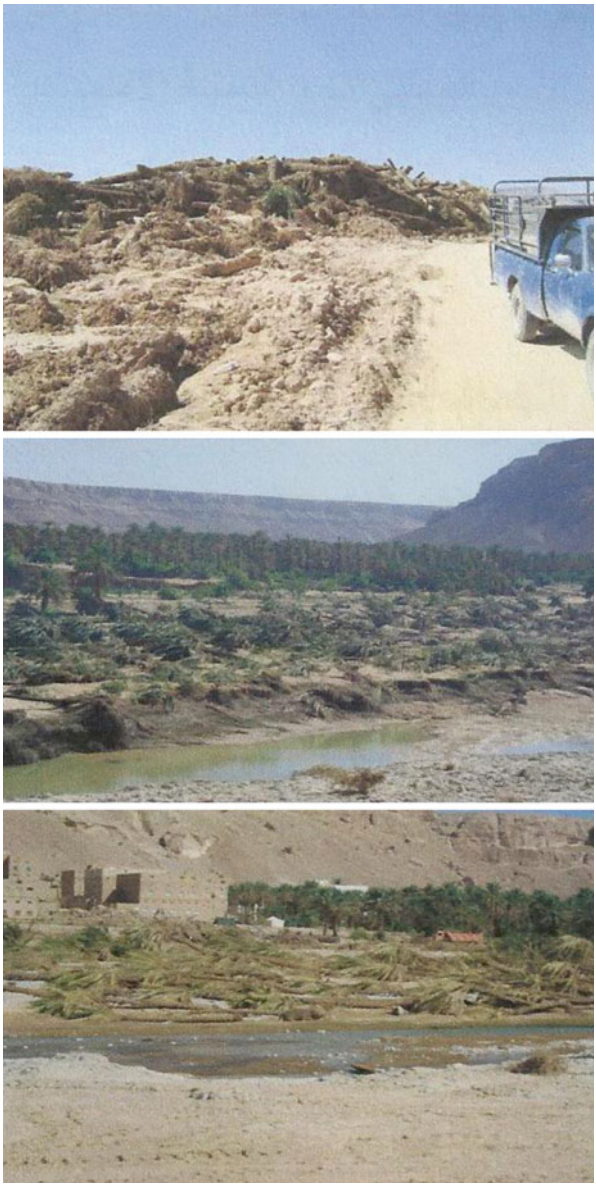

Fig. 7.2 Effect of floods on date palms in Sah (Wadi Hadramaut)

Recently, the Ministry of Agriculture and Irrigation (MoAI) established a tissue culture laboratory at the Seiyun Agricultural Research Center in Hadramaut Governorate for production of well-known date palm cultivars to help meet growing demands for date palms in Wadi Hadramaut. Unfortunately, the laboratory is encountering many problems in carrying out its task.

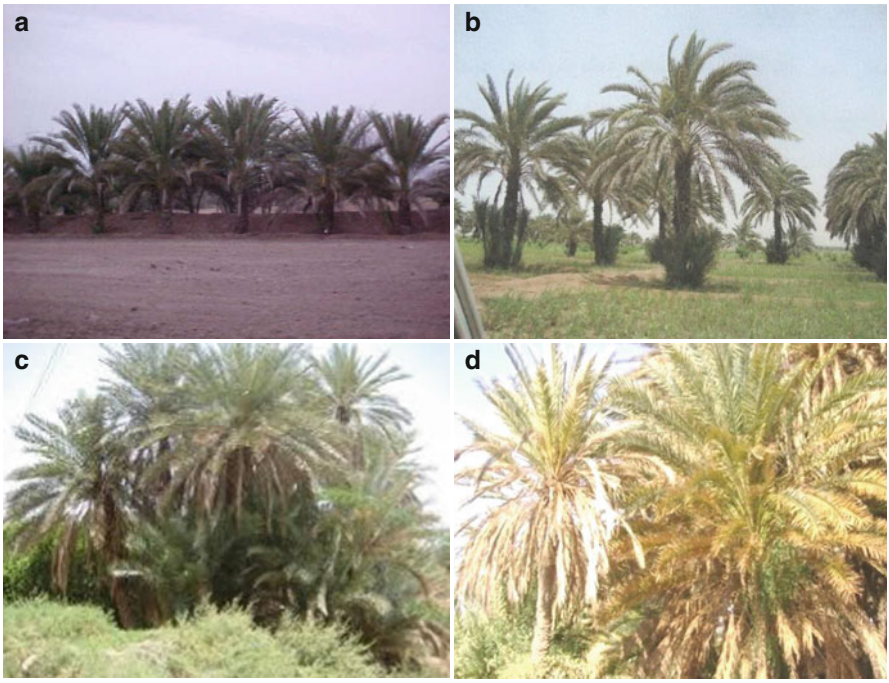

Fig. 7.3 Date palms grown in Yemen. (**a**) Date palms in the Tihama area, Al Hudaidah Governorate; (**b**) date palms in the Habban area, Shabwah Governorate; (**c**) date palm offshoots and parents; (**d**) date palms with old dry unpruned leaves

A program on the improvement of date palm production in Wadi Hadramaut was implemented by the Agricultural Research and Extension Authority (AREA) in cooperation with the Food and Agriculture Organization (FAO) and Ministry of Agriculture and Irrigation. AREA also organized training courses for farmers, technicians, extension agents, and researchers; prepared studies on the control of palm pests and diseases, fertilization, morphological features, productivity of date palm cultivars, and others; organized and participated in relevant local, regional, conferences, seminars, and workshops; and prepared booklets on main date palm varieties (AREA 2013).

7.2.2 Description of Current Cultivation Practices

Date palm culture in Yemen largely remains traditional. Local propagation of date palm is mostly by offshoots. Most of date palm plantings in Yemen are irregular; they are grown either at the sides of irrigation canals (Fig. 7.3a) or scattered in the orchard (Fig. 7.3b). Most of them (more than 95 %) depend on open well irrigation, others on springs and running water. Very few depend on floods that occur every 2–3 years. Old dry leaves are seldom removed, hanging down and impeding the operations of ascending the palms. Climbing trees is usually done by ropes. Older farmers are the only

Fig. 7.4 Tall trees in an old field of date palm in Doan area, Wadi Hadramaut

Fig. 7.5 New established date farm in Wadi Hadramaut

individuals who climb palms; they are always complaining that their sons and the youth never want to climb trees. Normal practice allows offshoots to develop on the parent tree and as a result of not removing them (Fig. 7.3c) for several years, along with the close distance between trees, clumps of unpruned trees are formed with crowded leaves competing with one another for light, water, and nutrients (Fig. 7.3d).

Tall nonproductive palms are also often found on old farms (Fig. 7.4). These random cultivations have led to poor productivity and low fruit quality. Surface irrigation predominates, where underground water is a source of irrigation for 61 % of the date palms, followed by springs 32 % and streams 7 %. General agricultural practices including fertilization, thinning fruits, and crop care are ignored by most farmers and is evidenced by the low productivity (29 kg/tree/year) comparing with neighboring countries.

However, in recently established farms, the date palms are laid out in regular lines facilitating service and harvest operations. Spacing is usually 8×8 m. Bunch management techniques of fruit thinning, bending, and covering are being advocated. Irrigation practices are mostly basin, but drip and bubbler water saving systems are being introduced (Fig. 7.5).

Recent field trials on fertilization have shown that treatments of 460 g N (urea fertilizer) + 460 g phosphorous and 950 g N +460 P gave good yield when tested for Hamra cultivar (Al Bar 2003)

Pollination is done manually by tying a few strands of a male spathe and inserting them among the strands of a female spadix as soon as they burst open. Sometimes,

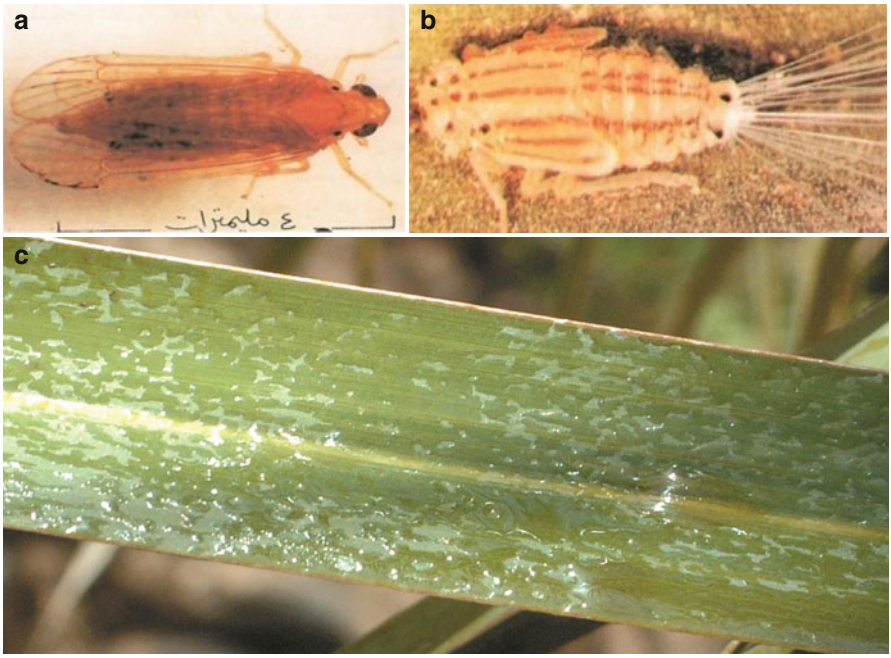

Fig. 7.6 Adult (**a**) and nymph (**b**) of the Dubas bug, (**c**) damage symptoms by Dubas bug

several female spathes open at the same time necessitating four or five visits from a pollinator. Dates in Yemen are harvested by workers climbing to the tops of date palms by stepping on the stubs of leaf bases or using ropes. Ladders are seldom used. The entire fruit bunch is cut when ripe. It is hoped that the use of machines may be coming soon to modernize the operation.

7.2.3 Pest and Disease Management

7.2.3.1 Insects

Dubas Bug The Dubas bug (*Ommatissus lybicus*) has emerged as a key pest of date palm since 2000 (Fig. 7.6a, b); it is said to have entered the country from Oman. It was recorded first in Mahrah Governorate and then spread west until it reached Hadramaut and other eastern and southern governorates of the country. Tihama, the second-ranked date-palm-producing area in Yemen, currently is free of the pest. The Dubas bug causes two kinds of damage (Fig. 7.6c) on date palm. First, direct feeding of nymphs and adults on the sap of the leaves and to some extent on fruit bunches. Second, there is indirect damage on leaves and fruit caused by excessive accumulation of honeydew excreted by the insects, particularly during their nymph develop-

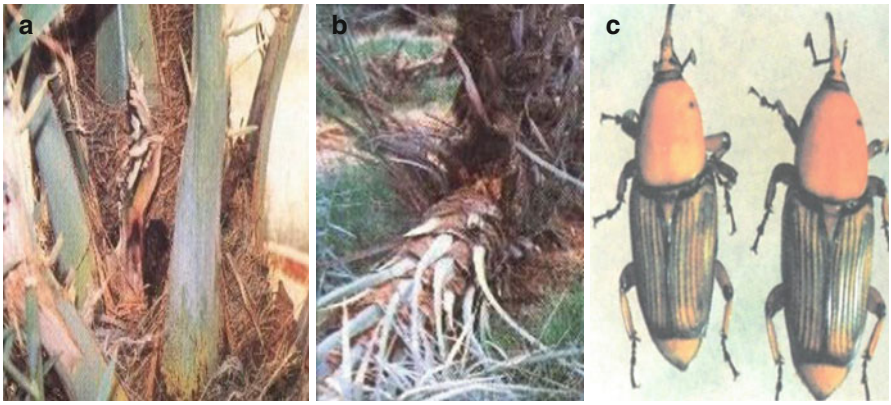

Fig. 7.7 Damage caused by the red palm weevil (**a**) and (**b**) adult weevil (**c**)

ment stages, which interferes with vital biological processes such as photosynthesis, transpiration, and crop harvest operations. Damage due to honeydew deposits also affects intercalary crops within date palm plantations. The pest is controlled by an annual national chemical control campaign using deltamethrin insecticide (Ba-Angood et al. 2009). However, there is a promising predator in the common green lacewing insect (*Chrysoperla carnea*) and a parasite (*Pseudoligosita babylonica*) contributing to the management of the pest in some areas of Hadramaut Governorate.

Red Palm Weevil Until May 26, 2013, Yemen was free of the devastating red palm weevil (*Rhynchophorus ferrugineus* Oliv.) (Fig. 7.7a–c). Strict quarantine measures were being taken to keep the country free from this destructive pest. However, suddenly the pest was first recorded in a farm in Qatn area in Wadi Hadramaut, (Al-Habshi 2014); the pest is said to have come into Yemen with tissue culture offshoots from Saudi Arabia. The MoAI and Seiyun Agricultural Research Centre are doing their best to stop the spread of the attack. An FAO TCP project was expected to help in the management of the pest; but unfortunately, the FAO offices in Sana'a and Cairo offices have been slow in providing assistance and the pest is spreading (Ba-Angood 2014). For the management of this pest, pheromone traps are used for monitoring and mass trapping. Once infected palms are recorded, the entire field is sprayed with fenitrothion insecticide. Some of the infected palms are removed.

Fruit Stalk and Stem Borer A number of date palm fruit and stalk borers were recorded in Yemen; the most important are *Oryctes elegans*, *O. agamemnon*, *O. rhinoceros* (Fig. 7.8a), and *O. boas*. This pest causes considerable damage not only to fruit stalks causing fruit fall but also bores into palm stems; this is particularly a problem in the Hadramaut area (Fig. 7.8b). They also help the red palm weevil to attack stems. Different pesticides have been tried but failed to control the pest; however, mass trapping using light traps (Fig. 7.9) succeeded in reducing the population of the pest (Ba-Angood and Al-Baity 2006).

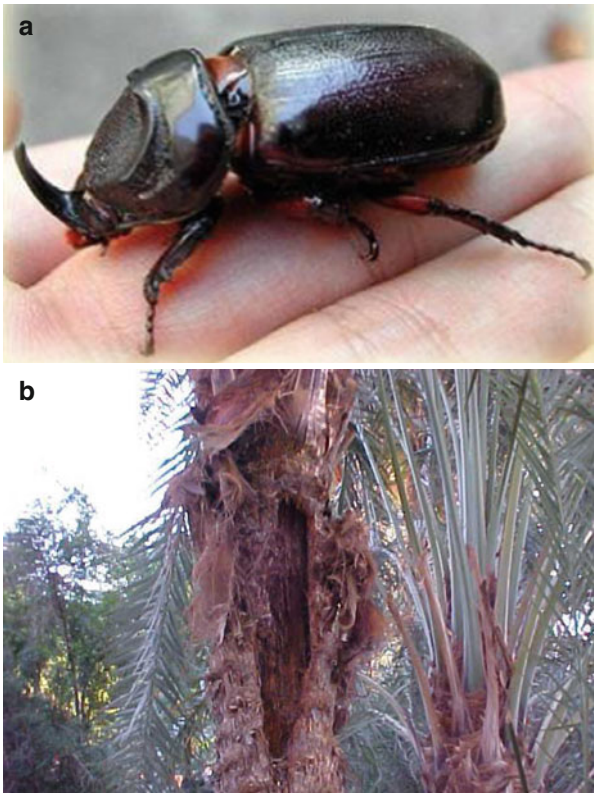

Fig. 7.8 (**a**) Adult *Oryctes rhinoceros*, (**b**) damage by *Oryctes* spp.

The Lesser Date Moth This insect, *Batrachedra amydraula* Meyer., is a very important pest causing 20–80 % damage to fruits in Wadi Hadramaut and Tihama (Ba-Angood 1978, 2012) (Fig. 7.10). Larvae bore holes in the fruits at their early stage of development eating the flesh and moving from one fruit to another by larval strands. This leads to fruit fall in early stages, the fruit color changes from green to brown red, and that is why it is called locally *hummairah*. The pest is controlled by several insecticides such as deltamethrin (Al-Ghurabi and Ba-Angood 2011).

Date Palm Dust Mite This mite (DPDM) *Oligonychus afrasiaticus* (McGregor) (Acarina: Tetranychidae) is known to occur in most date-growing areas of Yemen (Fig. 7.11). The pest is very damaging to dates in the early stages of fruit development, attacking fruits and covering them with dust. Studies by Ba-Angood and Bass'haih (2000) have shown that it has an adverse effect on some of the physiochemical characteristics of dates in Wadi Hadramaut. Infested dates of Mijraf, Madini, and Hamra cvs. were smaller in size, malformed, and unripe, compared with healthy ones. They also had a lower content of total soluble solids particularly sugars and lower percentage of water content compared with the healthy fruits. Unless treated by a protective spray before date

Fig. 7.9 Light trap used for trapping fruit stalk and stem borers *Oryctes* spp.

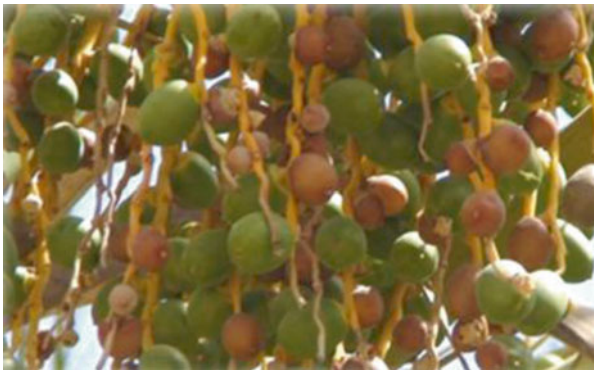

Fig. 7.10 Damage on date palm fruits for the lesser date moth (*hummairah*)

palm flowering and as soon as the symptoms of attack are detected, the damage can be extremely severe. Spraying of dust mites with Vertimec insecticide is a very effective means of control (Ba-Angood 2004).

Fig. 7.11 Damage caused *by* date palm dust mite *Oligonychus afrasiaticus*

Fig. 7.12 Infestation by the white scale insect *Parlatoria blanchardii*

Termites *Microcerotermes diversus* and *Microtermes najdensis*, particularly in the Tihama area, are the most serious termite pests which attack date palms, from the roots to close to the tops of the date palms. Chlorpyrifos and reagent insecticides are applied at the bases of offshoots during planting and in basins around date palms for control. But infestation could be very severe in some localities in the Tihama area.

Scale Insects White scale insect (*Parlatoria blanchardii*) is widely distributed throughout most of the date-palm-growing areas of Yemen. Under favorable conditions (high planting density and high humidity), the scale can spread over the surface of the foliage and fruit of date palm, covering them with live and dead insects (Dhouibi 2002). The insect feeds on succulent tissues at the base of the leaf stalk, which is an inaccessible place (for control) on the palm. Heavy infestations cause the pinnae to wither and die (Fig. 7.12). Infestation on fruit reduces its commercial value and may render fruit unfit for human consumption. Sanitation methods by pruning is usually used; sometimes Sumicidin insecticide is sprayed for control (Ba-Angood 2008; Dhouibi 2002). In some areas, the pest is found to be under the biological control of the predator heather ladybird beetle *Chilocorus bipustulatus* (Ba-Angood 2008).

7.2.3.2 Vertebrates

Birds The house sparrow, *Passer domesticus*, and other birds are destructive pests attacking dates on the palm in the sweet khalal and rutab stages of fruit development. Farmers usually cover bunches with jute or cloth bags to reduce bird damage to some extent. Birds can also be driven away by loud-sounding devices or making

Fig. 7.13 Saw-toothed grain beetle, *Oryzaephilus surinamensis*

some humanlike structures to scare them, but they continue to be a major cause in reducing yield and lowering fruit quality, in some areas.

Rats and Bats Rats were reported recently to attack parts of the date palm in some areas of Tihama and Hadramaut. They also dig underground galleries damaging the palm roots and irrigation systems. Bats are also reported to attack fruits at Taiz, Al Jawf, and Tihama. However, no control method now exists.

Storage Pests Some serious pests are known to attack dates on the palm as well as in storage. The most important one is the saw-toothed grain beetle *Oryzaephilus surinamensis* L (Fig. 7.13). Some moths of *Ephestia* spp. are sometimes recorded. For control of these pests, stored and packed dates are fumigated with Phostoxin tablets to keep them pest-free.

7.2.3.3 Diseases

A survey of date palm diseases has shown that Yemen is still free from the devastating bayoud disease caused by *Fusarium oxysporum* f. sp. *albedinis*. However, other major diseases in the country include the soft rot diseases caused by the fungi *Aspergillus phoenicis*, *Helminthosporium* spp., and a mold, *Alternaria spp*. and followed by Graphiola leaf spot *Graphiola phoenicis* and other leaf spot diseases (Fig. 7.14) caused by the molds *Cladosporium herbarum* and *Alternaria* spp., followed by the black scorch fungus *Thielaviopsis paradoxa* and root rot *Fusarium* spp., *Diplodia phoenicum* fungi, and other physiological diseases (Al-Sakaff 2012). These diseases are not being controlled chemically; infected parts are usually pruned off as a sanitation measure. Sanitation is usually the means of control.

7.3 Genetic Resources and Conservation

Yemeni climatic diversity with its transitions from the extremely dry to humid conditions facilitates a parallel change in date cultivar distribution from dry dates to semidry and soft dates in different governorates.

Fig. 7.14 Leaf spot disease

The biodiversity in Yemeni dates makes them ideal for local selection and cultivar improvement. Morphologically, diversity is exemplified by fruit color, size, shape, and time of maturity, seed, fruit stalks, fronds, leaflets, spines, fiber, crown, and other features.

The names of some date cultivars are based on fruit shape like brides fingers *Asabia el Aroos* or fruit color at khalal (bisr) stage, like Manasif and Ahmer. Some of the cultivars refer to specific areas; Sokotri cv., for example, refers to Socotra Island in the Indian Ocean. The island is a part of Yemen and dates are its primary commercial crop.

Chemical characteristics like reduced sugar concentration in various stages of fruit development are also factors contributing to the biodiversity among date palm cultivars. Kassim and Hussein (2008) found that the percentage of reducing saccharides among soft date cultivars from Hadramaut Governorate varies from 51.5 % (Baglah Safra) to 72.7 % (Gzaz); in dry dates, it ranges from 67.1 % (Sarorah) to 88.2 % (Mijraf). Certain cultivars in Wadi Hadramaut contain more than 90 % reduced sugars, which is similar to the elite cultivars in Saudi Arabia, the UAE, and Libya.

There are no breeding programs for date palms in Yemen, but the effort to maintain outstanding natural selections has continuously been going on. Date palms with shorter stature, stouter stems, fewer spines, higher yield, and better fruit quality are desirable, and some local cultivars have some of these characteristics.

In every date-growing area, there are few palms that are famous for their unique qualities. Fruits of cultivars such as Madini, Barhi, and Mijraf are kept for

consumption only by their owners and close friends. Natural selection by adaptation to environment and human selection based on morphological and chemical characteristics has led to the current array of date cultivars in Yemen.

A recent germplasm collection farm of local and tissue culture propagated date palm introductions from Saudi Arabia was established at Seiyun Agricultural Research Centre.

7.4 Plant Tissue Culture

Tissue culture as a quick means of propagation for production of true-to-type, disease-free plants has been introduced recently in Yemen. Two tissue culture laboratories have been established.

The first was established in 2006 at PCAS. The laboratory was propagating mainly potato, strawberry, pineapple, banana, and date palm. Unfortunately, due to technical problems the laboratory is not functioning well. However, there are efforts to provide funds to operate it efficiently and to propagate other tissue culture date palms imported from outside Yemen.

Another tissue culture laboratory was established at Seiyun Agricultural Research Centre to propagate date palms, but unfortunately due to financial and technical reasons, it has not yet produced any tissue culture palms.

The PCAS formerly imported disease-free, true-to-type micropropagated date palm plantlets from Date Palm Developments (D.P.D. Ltd) in the UK. Plants supplied are with minimum 20 cm shoot length and a minimum three juvenile leaves. These plants were kept in the PCAS nurseries for hardening and then distributed to farmers (Fig. 7.15a, b). These cultivars included Khalas, Nabout Safe, Nabout Sultan, Barhi, and others (Ba-Asher and Kasim 2011).

7.5 Cultivar Identification

Date palm cultivars usually are identified using genetic and morphological characteristics. Cultivars vary in crown structure, fruit shape, size of leaflets and thorns, and chemical composition at various stages of fruit development (Ba-Miftah et al. 2010).

Currently in local laboratories, fruits and seeds are weighed using sensitive balances. A vernier scale is used to measure length and width of fruits and seeds. Leaflets, thorns, and inclination angles are also measured to identify some cultivars.

Chemical characteristics are determined by concentrations of total sugars, proteins, and trace elements. To characterize cultivars chemically, fruit samples are examined at successive levels of maturity (khalal, rutab, and tamar stages). Several scientists worked on chemical contents of date fruits from most of the date palm

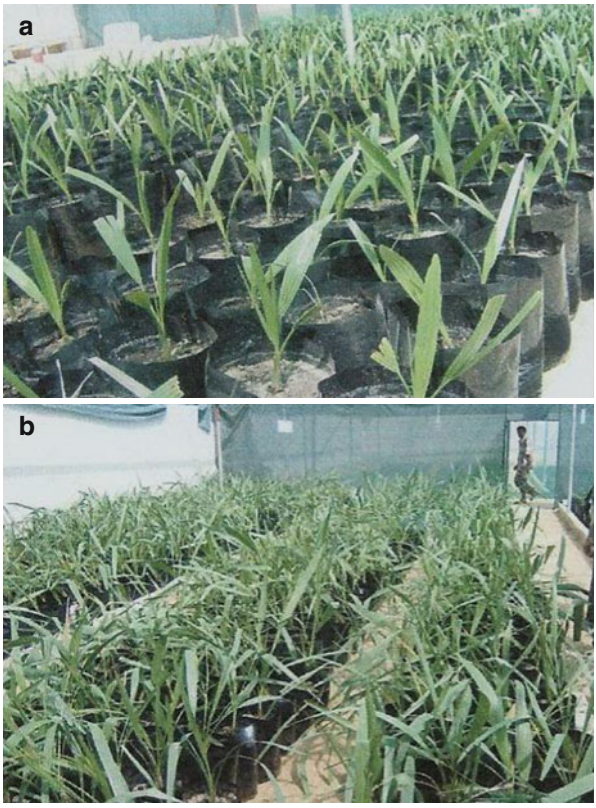

Fig. 7.15 Date palm plants introduced from the UK hardened in the nurseries of PCAS (**a**), ready for distribution (**b**)

growing locations in Yemen. Recently, Kassim and Hussein (2008) made an assessment of sugar content of Yemeni commercial date cultivars at khalal and rutab stages in the Hadramaut Governorate and found that reducing sugars varied from 51 to 82 %, reaching more than 90 % in a few samples.

Unfortunately, genotyping of biodiversity to characterize variability at the DNA level using molecular marker techniques is not available in the laboratories in Yemen. The genetic resources of Yemeni date cultivars are hard to trace as date cultivation has been carried on since ancient times, and there is so much variation within local cultivars. Some cultivars are believed to have been brought in from Saudi Arabia and the UAE. Indigenous cultivars of seed origin are countless. These have no individual names, but generally are called Baglah, Tos, and Sabyah in the Hadramaut Governorate and account for 5–6 % of the cultivars there. In Tihama, they are known as Mwaleed or Shabat, constituting 0.3 % of the cultivars; in Socotra Island they are called Nakadha, representing only 0.1 % of the total cultivars there. These seedling dates contain unique germplasm and merit further study (Ba-Miftah et al. 2003).

7.6 Cultivar Description

Results of a survey of date palm cultivars in Hadramaut, Tihama, and Socotra Island (Ba-Miftah et al. 2003) have shown that the total number of local date palm cultivars recorded in these areas was 209. Of the total, 65 occur in Wadi Hadramaut (Fig. 7.17b), 59 in Tihama, 48 in Socotra Island, and 37 in the coastal areas of Hadramaut. In addition there are 11 cultivars which have been introduced from neighboring countries. Hamra cultivar is the most widespread in Wadi Hadramaut (35 %), Sokotri (89 %) in the coastal areas of Hadramaut, Serfatah (82 %) in Socotra Island, and Tha'al (Munasif) (45 %) in the Tihama area. Seedling cultivars such as Baglah, Sabyah, and Nos in Hadramaut (5–6 %), were not included. The most productive cultivars are Zargey and Fariedey found in the Tihama area, which yield 100 kg/tree, but unfortunately fruits are classified only as acceptable or poor quality. The least productive ones were Asba'a Al Aroos and Saig in Hadramaut which in some areas yield only 5 kg/tree but the fruits are classified as good.

Ba-Miftah et al. (2004) also carried a similar survey in Shabwah Governorate which showed that there were 20,771 date palm trees, 57 % of them bearing, and males constituted 2.3 %. Shabwah has 32 different cultivars; 8 are considered excellent (Fig. 7.16), 8 are very good, 10 are good, and 5 are acceptable, in addition to one non-fruiting cultivar. Barhi, Khnaizi, and Rthanah cultivars are said to have been imported from Saudi Arabia.

A survey of date palms in Al Jawf and Ma'reb carried out by Ba-Miftah et al. (2009) indicated that the number of date palms had reached 23,797, 48.7 % are fruiting and males constitute 4 %. In Al Jawf Governorate 26 cultivars were identified; 38.5 % of them are classified as excellent, and Abyadh cultivar is widespread. Cultivars Sukkari, Rothata, Khalas, Nabout Saif, Barhey, Nabtat Sultanah, Sag'ee, Zamley, and Maktoum were introduced from Saudi Arabia. In Mareb Governorate, there are 19 cultivars recorded; 32 % are excellent. There are three introduced cultivars (Barhi, Nabout Saif and Nabtat Sultanah); Nabout Saif is the most widespread (29.3 %).

Another survey of date palms in Al Mahra Governorate (Obad et al. 2003) has shown that the number of date palms reached 22,249, 56.5 % are fruiting and 4.9 % males. A total of 97 cultivars were identified; most of them are in the Man'ar area; 24 of them are classified as excellent, 30 are very good, 30 are good, 7 are acceptable, and 6 are of poor quality.

The main commercial date palm cultivars in Yemen are described according to Ba-Miftah et al. (2010) as follows:

Mijraf Classified as excellent, consumed soft and locally as tamar, color of fruit brown, shape oval long. Mean percentage of reducing sugars in date fruits 88.4 %, average yield of 47 kg/tree, and mean offshoot production is 4.

Gzaz Classified as excellent, consumed soft and locally as tamar, color of khalal fruit yellow, tamar brown, shape oval, mean percentage of reducing sugars 90.5 %, average yield of 52 kg/tree, and mean production of offshoots is 7.

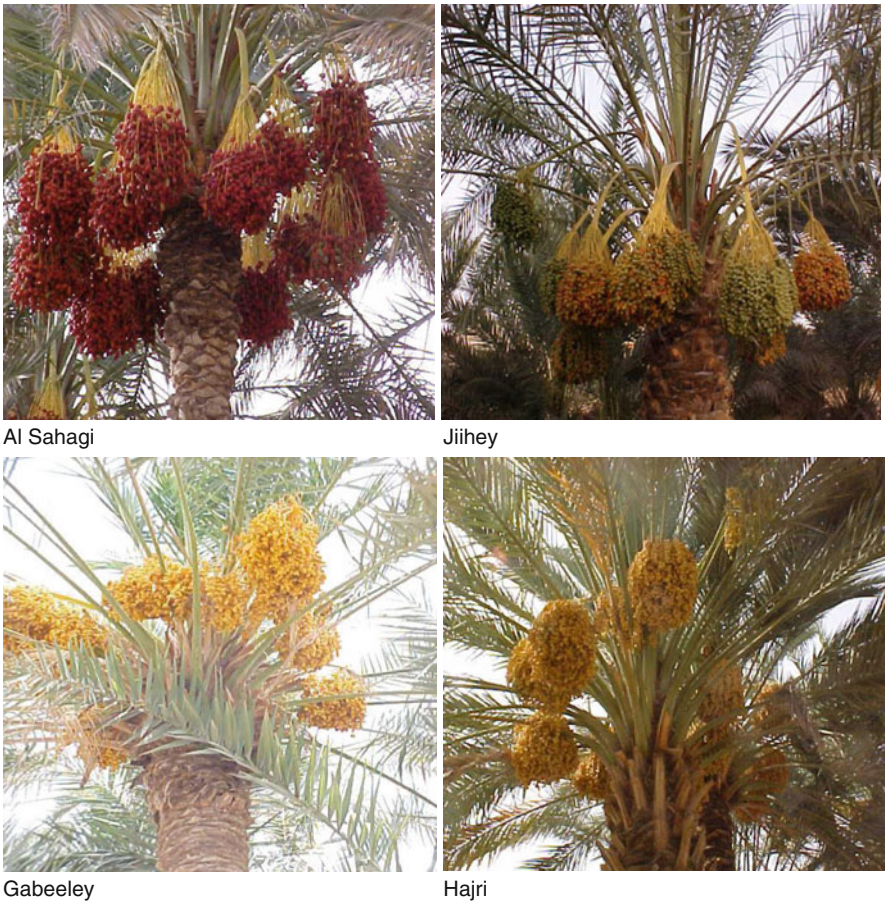

Fig. 7.16 Some cultivars of date palm grown in Shabwah Governorate

Hajri Classified as very good, eaten soft and locally as tamar, color of khalal fruit yellow, tamar black, shape inverted oval, mean percentage of reducing sugars 86.8 %, average yield of 37 kg/tree, and mean production of offshoots is 4.

Asbua Alaroos Classified generally as very good, eaten soft and locally as tamar, color of khalal fruit red, tamar black, shape elongate oval, average yield of tree 38 kg/tree, and mean production of offshoots is 4.

Sokotri Classified as good, eaten soft and locally as tamar, color of khalal fruit pale red, tamar black, shape elongated oval, average yield of 49 kg/tree, and mean production of offshoots is 6.

Hamra Classified as good, eaten soft and locally as tamar, color of khalal fruit red, tamar black, shape inverted oval, mean percentage of reducing sugars 69.5 %, average yield of 47 kg/tree, and mean production of offshoots is 6.

7.7 Date Production and Marketing

Most date palm plantings in Yemen are irregular and most gardens are small in size, not exceeding 0.8 ha in most cases. Some more recent gardens have been established, mostly planted with tissue-cultured cultivars, which are relatively large in area. A program to improve date palm production in Wadi Hadramaut in cooperation with FAO and the MoAI was implemented. It involves ten pilot farms (Fig. 7.17a, b) in Wadi Hadramaut (in Saiyun, Tarim, Shibam, Sah, Al-Qatn, and Hraidhah) each 10 ha in area. In these fields, local cultivars, Mijraf, Gzaz, and Jahmi, are grown, and four tissue culture cultivars, Barhi, Khalas, Sultanah, and Sukkari, are grown in regular rows with spacing of 10×10 and 11×11 m. All are irrigated by a drip and bubbler network. The cost of harvest is high in some areas; it reached more than 40 % of the total cost of production in Tihama (Ba-Miftah et al. 2003). Some farmers cover the fruit stalks with perforated sacks to protect against birds, rats, and insects soon after fruit forming. Harvest is manual, climbing the tree and cutting the bunches, sometimes lowering them to the ground by ropes. Handling, storage, and transport usually are done in simple containers such as sacks, bags, and skins.

Dates are sold in a number of ways. Some are auctioned when they are still on the tree. Some are sold in the local market either fresh or more commonly dried

Fig. 7.17 (**a**) A pilot farm in Seiyun, (**b**) date palm trees in Wadi Hadramaut

(tamar stage). Traditional date markets appear to be important to farmers and consumers. Some cultivar dates are sold to packing factories. The farmer usually stores the best dates for his own use at home.

Al-Hebshi (2014) reported that as a result of the action of middlemen, only a small portion of the value-added chain benefits go to the farmers. The prices offered to the farmers in markets or for packing factories often do not cover production costs, meaning little or no profit.

7.8 Processing and Novel Products

Traditional date processing in Yemen started long ago. Dates have been a food security product in periods of hunger that have occurred in some areas of Wadi Hadramaut during periods of war. Dates are a popular edible fruit prepared in various ways as food.

Date paste, with the addition of spices and ghee, is a well-known product that is consumed throughout the country. Some people use it at home in confectionary products, others sell such products as cookies called locally *Ka'k Bu Tamr*.

Date palm parts are used for many purposes such as thatching of houses and for fencing and rope. Making date palm parts into mats, containers, furniture, and other novel items has long been known in Yemen. Mats are woven from leaflets and containers from bunch stalks stitched together with leaflets, beds, furniture, and baskets from the leaf rachis.

There are two pilot packing and processing plants for dates in Yemen. The first was established in 1984 in a fairly old existing facility. It did not operate for almost 15 years but resumed activities in 2004. It still faces major problems since the supply of good quality dates has decreased due to lower prices being offered. Recently, the factory has operated for only 4 months a year. The other factory was established in Al Hudaidah Governorate in 1986, with funding from the French Government. It also faces the same problems mentioned above. It stopped operations for 10 years. Recently, it resumed date processing with 50 % efficiency. Both plants are now packing dates in smaller consumer packs which are sold in local markets (Ba-Asher and Kasim 2011).

Production of alcohol from inferior quality dates is carried out using traditional methods and consumed locally. Although alcohol is prohibited, its use is informally tolerated.

7.9 Conclusions and Recommendations

Date palm has long been recognized as an economic and food security crop in Yemen. Traditionally, date palm production has relied on more than 321 local cultivars; however, only 42 are considered to produce fruit of excellent quality. Recently,

a government policy has been adopted to promote diversification by introduction of tissue culture cultivars and local selection from among indigenous seedling dates. The PCAS contracted with the Flood Reconstruction Fund to provide 250,000 tissue culture date palms in 2011–2012, as a relief measure for farmers who lost their farms due to massive flooding in 2008. Cultural operations are mainly traditional but modern techniques are being introduced in field operations, palm and bunch management techniques and fruit handling, and packaging to facilitate marketing and to meet growing consumer demands. Yemen is still free from the devastating bayoud disease, but yield is impaired from the attack of various insect pests, namely, the red palm weevil, Dubas bug, stalk and stem borers, the lesser date moth, white scale insect and the dust mite, vertebrate pests including rats and bats, and fungal diseases including soft rot, black scorch, and leaf spot cause damages.

There are two pilot plants in Yemen for date packing and processing, but they are not operated efficiently. Dates are sold in a number of ways, but marketing services and postharvest operations need to be strengthened.

The government has recognized date palm as one of the strategic crops and there are plans to rehabilitate old orchards, develop new irrigation techniques, as well as to improve storage and packing facilities, and marketing services. Implementation of the following recommendations would contribute to improving date palm production in Yemen:

(a) Rehabilitation of old date palm orchards.
(b) Increasing date production by improving cultivation practices by promoting mechanization for harvesting, modern irrigation techniques, and new systems for crop management and adopting integrated pest and disease management programs for the major insects, mite pests, and diseases.
(c) Establishment of pilot demonstrations for farmers and nurseries to provide improved date palm cultivars.
(d) Strengthening infrastructure through supporting well-equipped tissue culture and research laboratories, as well as modern packing house and packaging facilities.
(e) Strengthening plant protection and quarantine facilities to assure protection of the date palm, especially from bayoud disease.
(f) Upgrading the quality of postharvest handling and packaging techniques of Yemeni dates to meet international standards.
(g) Improving marketing facilities and strategies.
(h) Enhancing local technical staff capacities and involving them in postgraduate programs, training courses, conferences, and seminars.
(i) Promoting agricultural extension services and emphasizing media campaigns, including greater awareness of the importance of date palm among Yemenis.
(j) Building dams to maximize the utilization of water and to protect date palm trees from the risk of floods.
(k) Establishing a National Palm and Date Center as a lead institution to promote the date palm sector in Yemen. National institutions should interact with regional and international institutions and become a member of date palm

regional and international organizations, to exchange information and coordinate collaborative efforts to handle issues encountered in the development of date palms in general.

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