Citrus Cultivars and Production in Morocco

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HISTORY

Early in this century, the Moroccan citrus industry was very small, with plantings of ≈ 625 ha in 1920, mostly owned by Moroccan farmers (ASPAM, 1986). Major plantings started in the late 1930s, when the French established intensively managed groves. By 1940, the citrus area totaled $\approx 12,500$ ha and, by 1960, $\approx 55,000$ ha. At present, official figures indicate an area of 71,300 ha, all owned by Moroccan nationals (MARA, 1988). The number of citrus farmers is estimated to be ≈ 7400 (ASPAM, 1986).

PRESENT SITUATION : TONNAGE AND AREAS OF PRODUCTION

Available statistics for 1987-88 indicate a total production of $\approx 1,233,500$ t (MARA, 1988) of more than 30 cultivars of citrus (ASPAM, 1986). In 1987-88, Morocco was the 10th largest citrus producer in the world (FAO, 1989a) and the third largest exporter of fresh citrus. It ranked second to Spain in export of oranges and tangerines. A recent FAO report (FAO, 1989b) projects a 48% increase in orange production and a 10% increase in tangerine production between 1987 and 2000. This projected increase is consistent with Moroccan government policy, which provides financial incentives for such expansion (FAO, 1989c).

Groves are located in six major areas (Fig. 1, Table 1). The Seuss valley represents 31% of the total area and 34% of the total production, whereas the Gharb provides 24% of the total hectareage and 35% of the national tonnage. In 1964, the Gharb accounted for 52% of the total area, while the Seuss had only 12% (Burke, 1967). During the period of 1964-88, the area in the Gharb declined somewhat, while that of the Seuss and the Tadla tripled; that of the Oriental region doubled, whereas that of the Haouz remained reasonably constant. Minor production areas include Loukkos and the regions of Fes, Meknes, and Casablanca.

CLIMATE

Moroccan citrus areas lie between lat. 30° and 35° N, within which limits producing districts are localized because of climate, topography, and water availability. The Gharb has alluvial and clay soils. It has some of the oldest citrus groves in the country because it was the first region where citrus was grown intensively. It is located at an altitude of 32 m and has a humid climate with an average rainfall of 500 to 600 mm-year⁻¹. Because of heavy soils, flat terrain, low elevation, and relatively high water table, heavy rainfall creates anaerobic soil conditions, which hasten tree decline. In addition, rains are common from September to November and coincide with the maturation of 'Clementine' mandarin. Such rains are associ-

ated with puffy fruit and rapid fruit senescence. Thus, this area is not favorable for early cultivars.

Seuss is the southernmost citrus region of Morocco. It is an arid area characterized by low rainfall (230 mm-year⁻¹, with temperatures as high as 46°C in the summer and as low as 0°C in the winter. The humidity is low and the number of sunny days (average of 350 days of sunshine/year) exceeds those of other citrus-producing areas. Occasionally, strong hot desert winds, called "chergui", blow from the southeast and make the air even dryer. Irrigation water is mostly pumped from wells. Under this climate, early cultivars, such as 'Clementine', do very well.

The Tadla district is located in the interior and has a semi-arid climate. It lies 400 to 500 m above sea level and has an average

Fig. 1. Citrus growing regions of Morocco.

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rainfall of 360 mm·year⁻¹. Spring frosts occur and minima and maxima are -1 and 44°C, respectively. Irrigation water comes primarily from reservoirs. Under these conditions, citrus does very well in years when there is little or no frost damage.

The Oriental district is located in the northeast region near the Mediterranean Sea. The climate is very favorable to early cultivars, especially 'Clementine' mandarin. The average rainfall is ≈350 mm·year⁻¹. Irrigation water is mostly from reservoirs. Salt is becoming a limiting factor for citriculture in some parts of the district.

The Haouz district is the driest and hottest citrus area of Morocco. In this arid area, rainfall averages <250 mm·year⁻¹, humidity is relatively low, and the average annual temperature is >25°C. Irrigation water comes from reservoirs and wells. Hot "chergui" winds are also common and, because of its inland location, summer temperatures are a few degrees higher and winter temperatures a few degrees lower than those mentioned for Seuss.

The Loukkos area has a humid climate with an average rainfall of 700 mm·year⁻¹. There, citrus is grown mostly on sandy soils.

CULTIVARS AND ROOTSTOCKS

Because Morocco is reasonably free of tristeza (at least the virulent strain), citrus trees are almost exclusively budded onto sour orange (*Citrus aurantium* L.). This rootstock is well-adapted to the various climatic zones and is highly compatible with all of the cultivars grown in the country. A few plantings are on 'Troyer' citrange [*C. sinensis* (L.) Osb. × *Poncirus trifoliata* (L.) Raf.], but mostly for experimental purposes.

A recent national survey indicates the presence of at least 30 different commercial cultivars (ASPAM, 1986), of which the most important are shown in Table 2. 'Clementine' mandarin occupies the largest area (32% of the total), followed by the 'Valencia' (30%) and the navel (25%) oranges. The first is a seedless cultivar due to its self-incompatibility. It is an easy peeler with thin skin, strong aroma, excellent quality, and it matures early (mid-September to early October). However, the fruit keeps poorly, especially in rainy years, and it is very susceptible to mechanical damage, and, subsequently, to decay via wounds from harsh handling. In addition, it is difficult to transport this cultivar successfully. Several clones have been selected (Devaux, 1981) for earliness or lateness to avoid overproduction and market saturation by the standard clone. These clones have mostly arisen as mutations of the common 'Clementine' or of each other. Early cultivars include 'Carte Noire', which often has excessive fruit set, resulting in small fruit size. It matures as early as mid-September. The 'G.P.' clone matures a bit later and is harvested before the common type. Late-ripening types include the 'Nour', maturing in late January to early February, the 'Late January Azemmour', the 'Late January Rabat', and the 'Late April', all of which have a thicker, firmer peel, allowing them to with-

stand long on-tree storage as well as long-distance transportation. Also, these late-maturing strains have fewer rind blemishes than the common strain, probably a result of their thicker and firmer peels. These strains are being tested in various regions to determine their adaptation.

By extending the growing season and varying the cultivar profile, the Moroccan citrus industry is expected to be more competitive in the international market by filling in the existing production gaps. The 'Wilking' mandarin used to be an important cultivar in Morocco because of its large size, good eating and keeping quality, and lateness in production. However, it is highly seedy and pollinates the 'Clementine'. Since consumers spurn seedy fruit, all of the 'Wilking' plantings have been destroyed and, by law, planting 'Wilking' mandarin is banned. Other minor mandarins, and hybrids thereof, include 'Ortanique', 'Temple', and 'Monreal'.

The most common orange is 'Valencia'. It is a firm fruit with good keeping quality and it matures late (March–April). It constitutes >40% of the total tonnage produced

from only 30% of the total national citrus hectareage (Table 2). 'Washington' navel orange is the most important cultivar of the navel group. It matures early (November), keeps well, and is of excellent eating quality. Blood oranges are still common, although they occupy only 6% of the total area and production. The main blood cultivar is 'Washington Sanguine', which has only low concentrations of anthocyanin pigments in the endocarp and even lower concentrations in the peel. It is very juicy with a thin peel and is of excellent quality. It matures in January–February. Other minor orange cultivars include 'Salustiana', 'Hamlin', 'Navelina', 'Sanguinelli', and 'Verna'. Other citrus types include lemons (<1000 ha, mostly 'Eureka') and grapefruit (<150 ha) (MARA, 1988).

The most recent survey (ASPAM, 1986) shows that 50% of the trees are between 10 and 24 years old, 21% are 25 to 34 years old, but only 12% are >35 years old (Table 3). The youngest groves are the 'Clementine' (82% are <24 years old) and the oldest are the blood oranges (52% are >25 years old). However, the latter occupy a small percentage of the total hectareage and, due to

Table 1. Moroccan citrus area and production, by region (1987–88).^a

Region	Major city	Total area		Total production	
		ha	%	t (×1000)	%
Souss	Agadir	21,870	31	418.0	34
Gharb	Kenitra	17,100	24	426.0	35
Oriental	Berkane	10,740	15	136.0	11
Tadla	Beni-Mellal	8,970	12	116.5	9
Haouz	Marrakech	4,820	7	45.7	4
Loukkos	Larache	2,260	3	42.8	3
Other	---	5,550	8	48.5	4
Total		71,310	100	1233.5	100

^aData from MARA, 1988.

Table 2. Moroccan citrus area and production, by type (1987–88).^a

Type	Area		Production	
	ha	%	t (×1000)	%
Clementine mandarin	23,030	32	302.5	25
Valencia orange	21,310	30	500.0	41
Navel oranges	17,630	25	263.0	21
Blood oranges	3,970	6	78.0	6
Other citrus	5,370	7	90.0	7
Total	71,310	100	1233.5	100

^aData from MARA, 1988.

Table 3. Age of trees for major citrus types (1985–86).^a

Type	Unit	Age (in years)					Total
		0–4	5–9	10–24	25–34	>35	
Clementine mandarin	ha	1020	1493	15,846	2,821	1235	22,415
	%	4	7	71	13	5	
Navel oranges	ha	2273	1540	6,641	2,761	3250	16,465
	%	14	9	40	17	20	
Valencia orange	ha	2652	1235	7,457	6,470	2896	20,710
	%	13	6	36	31	14	
Blood oranges	ha	185	41	1,289	1,142	456	3,113
	%	6	1	41	37	15	
Total	ha	6130	4309	31,233	13,194	7837	62,703
	%	10	7	50	21	12	

^aData from ASPAM, 1986.

their loss of favor in the market, very little planting and grove renewal of these cultivars is taking place.

REGIONAL DISTRIBUTION OF VARIETIES

The distribution of citrus types by region of production is shown in Table 4. Most of the 'Clementine' mandarin is located in the Seuss (39%) and the Oriental (28%) regions, as the climate is very suitable for this cultivar and allows production of good-quality fruit. Navels are mostly grown in the Seuss, the Gharb, and the Oriental districts, but 'Valencia' oranges are concentrated in Gharb (41%) and Seuss (34%). Blood oranges are more suitable for the climate of Gharb. The citrus areas of Tadla and Houz are about equally divided between 'Clementine', navel, and 'Valencia'. 'Clementine' is the dominant cultivar in the Loukkos district (43% of total) because it does well on the sandy soils of the region.

FRUIT MARKETING

Moroccan citrus is produced mainly for export. In 1987-88, nearly 50% of the total tonnage was exported (Table 5), but export fruit can reach 70% to 75% of the total produced, depending on market needs and fruit availability worldwide. 'Valencia' oranges accounted for ≈48% of total exports and 'Clementine' 23%. The domestic market consumed 32% of the total production (mostly 'Clementine'), whereas the rest was processed into concentrate juice (Table 5). 'Fruit for processing is unexportable or the result of overproduction. 'Valencia' oranges constituted ≈48% of the tonnage converted to juice and other by-products such as essential oils, pectins, and animal feed, while 'Clementine' mandarins accounted for only 9%. Most of the concentrate is exported to Europe.

Most Moroccan fresh citrus exports go to

the European Economic Community, which accounted for 71% of the total exported in 1987-88 (Table 6). Fully one-third of total exports was absorbed by France and one-sixth by West Germany (Table 6). Shipments to Scandinavian countries, Canada, and Saudi Arabia accounted for most of the remaining 29% of total exports. Much interest is now being devoted to developing new markets, especially with the expansion of the EEC and keen competition from other citrus-producing countries.

PROBLEMS OF CONCERN

Small fruit size is one of Morocco's most significant problems, especially for the alternate-bearing 'Clementine' mandarin, where small fruit account for 20% to 50% of the nonexportable crop. This problem is exacerbated by heavy production during on-years. Poor fruit set is also a problem with this cultivar, and the use of gibberellic acid at 10 to 20 ppm during bloom to increase production is a common practice. Small size of 'Valencia' oranges can also be of concern, but the seasonal magnitude of the problem is unpredictable. Rind blemishes constitute an important cause of low pack-outs of all the citrus types; these blemishes are worsened by strong winds, particularly in the windy areas such as the Seuss valley. Oleocellosis is another major cause of low pack-out, especially on degreened fruit early in the season. Puffing is a problem mostly on 'Clementine'—particularly late in the season. This defect is aggravated by rain. Regreening is a common problem of 'Valencia' oranges and is most severe in years with hot spring days. It can account for >40% of the unexportable fruit.

Psorosis constitutes one of the major virus-related problems of citrus. It is prevalent in old groves and can be found on all cultivars. Exocortis and stubborn are very rare,

Table 6. Moroccan fresh citrus exports by country of destination (1987-88).^a

Country	Quantity	
	t (× 1000)	%
France	195.3	
W. Germany	85.1	
Great Britain	56.5	
Holland	50.1	
Belgium	27.5	
Total EEC	414.5	71
Scandinavia	91.9	
Saudi Arabia	46.2	
Canada	25.1	
Other	3.7	
Total non-EEC	166.9	29
Grand total	581.4	100

^aData from MARA, 1988.

and tristeza (at least the virulent strain) is believed to be nonexistent. New groves are composed of locally produced trees certified as free of these major virus or virus-like diseases. In recognition of the serious problem caused by virus and virus-like diseases, Morocco has a national citrus grove renewal and expansion program that provides financial incentives to replace old groves with, or plant new groves to, certified trees.

The most common fungus disease is *Phytophthora* spp. rot of tree roots, trunks, stems, and fruit, especially in wet areas and during wet seasons. *Penicillium* spp. constitute the major postharvest threat to fruit, especially with the appearance of fungicide-resistant strains.

Insects of concern to the industry include California red scale, mites, aphids, white flies, and Mediterranean fruit fly. The last is more of a problem in the Seuss area as it uses the argan [*Argania spinosa* (L.) Skeel] as an alternate host, especially during the summer when the argan fruits are mature and citrus fruits are still green and not very susceptible to the fly. In general, control of Mediterranean fruit fly in Morocco is excellent. The semi-endoparasite *Tylenchulus semipenetrans* is the major nematode attacking citrus in Morocco, but the effect on yield is still unclear.

The fact that both 'Clementine' and navel production peak during the months of November through January is of concern, particularly during heavy production years. Since this is also the season when citrus matures in the other northern hemisphere countries that export citrus, local and export markets are saturated, leading to a substantial drop in price. Efforts are being devoted to diversify the export market by diversification of the cultivar profile. Emphasis is on early and late-producing 'Clementine' clones (as stated earlier) and production practices that lead to excellent internal and external quality. Also, attention is being paid to maintaining a regular supply of citrus in Morocco's major export and domestic markets.

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Table 4. Citrus distribution (in ha) by region of production (1987-88).^a

Region	Citrus type					Total
	Clementine mandarin	Navel oranges	Valencia orange	Blood oranges	Other	
Souss	8,910	4,210	7,250	250	1,250	21,870
Gharb	1,720	4,180	8,750	1860	590	17,100
Oriental	6,420	3,110	110	100	1,000	10,740
Tadla	2,020	2,830	2,470	800	850	8,970
Haouz	1,480	1,330	1,000	200	810	4,820
Loukkos	980	580	460	70	170	2,260
Other	1,500	1,390	1,270	690	700	5,550
Total	23,030	17,630	21,310	3970	5,370	71,310

^aData from MARA, 1988.

Table 5. Exports, local consumption, and processing of Moroccan citrus by type (1987-88).^a

Type	Exports		Domestic consumption		Processing		Total	
	t (× 1000)	%	t (× 1000)	%	t (× 1000)	%	t (× 1000)	%
Clementine	135.8	23	144.5	36	22.2	9	302.5	25
Navel	91.3	16	108.1	27	63.6	25	263.0	21
Valencia	279.0	48	99.7	25	121.3	48	500.0	41
Other	75.3	13	47.1	12	45.6	18	168.0	13
Total	581.4	47	399.4	32	252.7	21	1233.5	100

^aData from MARA, 1988.

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