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AVOCADO IN ISRAEL 2003

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ABSTRACT

A condensed overview of the avocado industry in Israel is presented, updated to April 2003. The main topics touched upon are:

1) Production. (Increased to 83,000 ton in 2001/02, reduced to 50,000 ton in 2002/03).
2) Trends in planting. (Planted area has stabilized: 5,500 in 2002/3).
3) Cultivars present ratio. ('Ettinger'- 28 %; 'Hass'- 32 %; 'Fuerte'- 15 %; 'Pinkerton' -10 %; 'Reed' - 7 %; 'Ardith' – 5 %; others – 3 %).
4) Common irrigation methods and practices.
5) Common fertilization practices.
6) Management of tree crowding.
7) Pollenizers and pollinator. (Principal pollenizer - 'Ettinger')
8) Main pests and diseases.
9) Exporting (28,000 tons in 2002/03 [est.] – 39% less than in 2001/02).
10) Present pricipal production problems. (Fruit size in 'Hass'; insufficient national yield/ha; scarcity of irrigatin water; increasing water salinity).

ENVIRONMENTAL GROWING CONDITIONS

Climate:

Israel is located along the southern part of the eastern coast of the Mediterranean Sea, between latitudes 30º and 33º north. The climate in the avocado-growing regions is subtropical: Warm rainless summers and cool rainy winters. The rainy season is mainly from November through March. Annual precipitation varies from an average of 200 mm in the south, to 700 mm in the northern coast.

A major part of the avocado-growing area in the country is along the coastal plain. Typical mean monthly minimum and maximum temperatures for the cold and the hot seasons in that region are as follows: In January: 7^0 C to 18^0 C. In July: 21^0 C to 31^0 C (with a daily evaporation of 6.5 – 7.0 mm in that month).

An additional notable growing area is located in the interior hot valleys, where the respective typical mean temperatures are 9^0 C to 19^0 C in January and 20^0 C to 37^0 C in July, (when daily evaporation is 8.5 – 9.0 mm).

Adverse weather conditions occur occasionally in April and May, a season of flowering and fruit-set. Hot spells, called Hamsines, with temperatures of 40^0 C, and in rare cases - even 46^0 C (accompanied by very low relative humidity), have caused severe crop failures, particularly when they lasted several days and when they occurred just after the end of blooming. Extreme events occurred on a nationwide scale in 1970, 1980 and 1988.

Soils

Most of the avocado in the country is planted on various types of Grumusols, heavy-textured soils containing 8-20% lime ($CaCO_3$), with pH 7.8 – 8.2 and with fair internal drainage. In the coastal plain, some orchards are planted on loamy sand with no lime (pH 7 - 7.3) or, in the Neguev (south-west part), with 5-10% lime. In the Sea of Galilee Valley, some orchards have been planted on very calcareous soils, (40 % $CaCO_3$), with trees grafted on adaptable West Indian rootstocks. (See "Rootstocks").

Irrigation Water

All avocado orchards, like most other tree crops in Israel, are regularly irrigated throughout the dry hot season. Most of the water in Israel is supplied by a government owned company and allocated by the State Water Authority, according to quotas linked to land tenure. Water is either pumped from underground reservoirs, presently containing 60 - 400 ppm Cl, or supplied from the National Water Carrier, starting at the Sea of Galilee, which contains 190-250 ppm Cl. (EC: 0.8 – 1.2 dS/m). Salinity in many underground reservoirs is gradually increasing. The price of water is determined, practically, by the government (presently – around 20 US cents per l m^3).

TRENDS IN PLANTING

In the eighties and the nineties, the avocado-growing industry in Israel suffered from a severe set back due to series of events and factors, of which the major ones were: Successive years of poor return per ton, adverse weather conditions that caused crop failures, and a series of drought years that aggravated the problems of water shortage and water salinity.

All the above resulted in a reduction of the planted area from 11,000 ha in 1984 down to 5,500 ha in the late nineties. (50 %).

However, since the late Nineties the area of the avocado in the country has been stabilized: Up-rooting or neglecting of orchards still goes on (mainly of inferior plantations); but, on the other hand, new orchards are being planted – mainly by successful growers. The area of new, non-bearing orchards (including newly top-worked to other cultivars) can be estimated presently at 7% of the total, i.e. around 400 ha.

PRODUCTION

The situation described above (see "Trends in Planting"), together with improved ratio of cultivars (see "Cultivars") and improved practices of orchard management, has led in recent years to an increase in the national average yield/ha: At the Mid-nineties, it was calculated at 8.5 ton/ha, (Fruit Board of Israel), while the average for the last six seasons is 12.5 t/ha. Table 1 presents the national avocado production (and export) in those seasons.

Table 1: Israeli Avocado - Production and Export in recent years. (Figures rounded off)

Season	Production, ton	Export, ton
1997/98	62,000	35,000
1998/99	40,000	24,000
1999/00	73,000	45,000
2000/01	63,000	38,000
2001/02	83,000	46,000
2002/03	50,000*)	28,000

*) Adverse weather conditions lowered the production in this alternant season more than expected.

CULTIVARS

In 1995, the percentage of the main cultivars was: 'Fuerte' - 25 %, 'Ettinger' - 25 %, 'Hass' - 30 %, Reed - 6 %, 'Nabal' - 4 % and all the others (mainly 'Ardith' and 'Pinkerton') - 10 %.

The composition of cultivars has changed to some extent during the last 8 years, and in 2003 it was estimated as follows: 'Fuerte'- 15 %,'Ettinger'- 27 %,'Hass'- 33 %, 'Pinkerton'- 10 %, 'Reed' - 7 %, 'Ardith'- 5 %, and all the others – 3 % (including less than 1 % 'Nabal').

No other cultivar resulting from the local breeding program, or from introduction, has yet reached a stage of being planted more than on a semi-commercial scale (up to a 2 – 3 dozens of hectares of promising new type in the whole country).

Following are some remarks on the main avocado cultivars. All, except for 'Ettinger', have been introduced to Israel from California.

'Ettinger': A local selection of a chance seedling. Harvest season is mainly October through November. Green thin skin. Good commercial size. High internal quality. Yields are good to medium. An important cultivar in new plantings or top working due to being main pollenizer. 'Fuerte': Apparently several clones were introduced to Israel, some of them not productive. The previous trend of drastic decrease in its percentage in orchards has slowed down in view of the encouraging results gained in stabilizing its yields, mainly by foliar applications of substances like Paclobutrazol (during flowering). Harvested from November through February.

'Hass': The common phenomenon of a small fruit size in this cultivar is aggravated under hot, dry summers, in older plantations, under increased soil compacting and under increased salinity of water: All of the above are common events in the industry in Israel. Nevertheless, 'Hass' is a leading cultivar in new plantings. Harvest season is November through April – May. (Sometimes later).

'Reed': Introduced only in 1969. Precocious and productive tree. Fruits are slightly oversized in the coastal plain. The main harvest season for export is April-May, but many growers delay harvest to the summer (June - August) for the local market.

'Pinkerton'**:** A successful and major cultivar in the hot interior valleys. Recently started to expand also in the costal plain. Very productive. Picked in December and January.

'Ardith' ("00-28"): Resulted from the breeding program of Dr. Berg at UC Riverside. Successful mainly in the coastal plain, where it is a popular cultivar in new plantings or top-working. A very vigorous tree, relatively productive. Dark green skin. Picked in March-April.

ROOTSTOCK

In the past, the availability of irrigation water with low content of chlorides has enabled the use of Mexican rootstocks in many orchards. In recent years, the inevitability of gradual shifting towards the use of more saline water for irrigation has enforced also the turning to the sole use of West-Indian rootstocks in most regions. Recent demands are still mainly for nursery trees grafted on selections of seeded rootstocks, primarily of 'Deganya 117', 'Ashdot 17' and 'Tsrifin 99', all local selections of West Indian types. In addition, rootstocks grown from seeds of certain West Indian cultivars are also in demand, like 'Waldin' and 'Fairchild'.

Some selected clonal (vegetative) rootstocks were found to exhibit a significant tolerance to salinity and to high content of lime, such as 'VC 65' and 'VC 66'; some others – tolerance to salinity and Phytophthora root rot (*Phytophthora cinnamomi),* such as 'VC 55', 'VC 66', 'VC 207' or 'VC 256'. However, the local demand for most of those rootstocks is still limited. The main reasons: Higher cost of the saplings, very limited occurrence of the disease in Israel, limited local experience – and the satisfactory performance of the aforementioned seedling rootstocks. Israeli clonal rootstocks are tested now also in other countries.

COMMON IRRIGATION METHODS AND PRACTICES

Around 50% of the total area is irrigated by drip irrigation. 2 lines of drippers per row of trees are most common (sometimes 3). 50 cm is a common distance between drippers on the line. The other 50% of the area is irrigated by mini-sprinklers of various outputs and types. Drip-irrigation, renowned as water saving and also as adaptable to the increasing water salinity, is gaining popularity in recent years. It is dominant in most new plantings.

Calculation of daily water consumption is based, in most orchards, mainly on regional or local data on evaporation (from "Class A" pan). Some growers are assisted also by orderly readings of tensiometers (particularly in the costal region of Western Galilee); certain growers – particularly in the internal hot valleys – are assisted by dendrometers.

Irrigation practices are backed, in most cases, by experience and observations - and not by proven results of published research work. Practices differ, to some extent, between the internal hot valleys and the coastal regions (particularly the Western Galilee, comprising one third of the national area). However, typical irrigation practices in mature orchards during the peak season of irrigation (July through September) can be described as follows:

Intervals between irrigations: With mini-sprinklers - 1 to 2 days; with drip – once a day (in some cases in the internal valleys – several times a day);

Water-dose per day: Mostly calculated by a crop-coefficient (fraction of the evaporation): In the coastal plain - around 0.70. In the hot valleys – 0.80, and even more. This means a daily use, during the peak season, of 5 - 5.5 mm in the Western Galilee (around 8,000 m^3/ha per season), and 7 - 7.5 mm in the interior hot valleys (around 11,000 m^3/ha per season).

COMMOM FERTILIZATION PRACTICES

Present practices in most of the orchards are based mainly on results of leaf analysis and on crop load.

The method is "Fertigation" along the whole irrigation season. In many orchards - pre-bloom application of 30 kg/ha N is practiced (by a “technical irrigation” with 1000 ppm of N). A common annual dose per ha of bearing orchards is: 200-300 kg N, (increased when heavy fruit-set is observed), 50 - 70 kg/ha P_2O_5, (mainly in the fall) and 200 - 400 kg/ha K_20. Manuring, with composts, is common in some orchards, mainly in "Bio-organic" plantations (covering around 200 ha).

Chlorosis induced by Iron deficiency is presently less widespread then before, partly due to the increased use of West Indian rootstocks, and partly due to improved irrigation practices. Fertilization with Iron Chelates is a common practice for correction.

MANAGEMENT OF TREE CROWDING

The common planting density of avocado in Israel has been 240-420 trees/ha (according to cultivar and growing conditions). In the past, recommendations regarding management of tree crowding were mainly thinning-out of trees, particularly in vigorous spreading cultivars like ‘Fuerte’. Pruning was recommended for ‘Hass’. However, growers were often late with accomplishing the thinning, and pruning was light or limited to occasional topping. Consequently - the trees grew very tall, and rejuvenation of the orchard became unavoidable in quite a few cases.

The above situation has gradually changed, and since the late nineties the management of tree crowding is being taken care of very strictly in most orchards: Annual hedging and some topping (mechanical or manual) has become a dominant practice in most cultivars, including ‘Fuerte’. An additional procedure is being followed recently in some orchards - mainly with ‘Hass’: “Gradual Rejuvenation”, i.e. heading-back of one main scaffold branch every year.

POLLENIZERS AND POLLINATOR

Local research, supported by Izozym`s technique, has shown that ‘Ettinger’ is a potent pollenizer for ‘Hass’, ‘Pinkerton’, ‘Ardith’ and even for ‘Fuerte’ (in spite of belonging to its “B” group). Application of these findings has taken place in all new plantings, as well as in many bearing orchards where ‘Hass’ was planted in solid blocks (by top-working 10 % -15 % of the trees to ‘Ettinger’). ‘Ettinger’ itself enjoys pollination by ‘Ardith’. ’Reed’ is believed to be pollinated by ‘Nabal’, and vice versa.

Honeybees are the main pollinator of avocado in Israel and most growers rent beehives for this purpose, putting about 3 hives per hectare.

EXPORTING

Until the end of the eighties, export of avocado from Israel constituted 80 – 85 % of its total production. Since then, a considerable increase in local demand for avocado, together with increasing competition on the export markets, resulted in a reducing percentage of exported fruit in the last nine years, down to 55 – 60 %. (See Table 1, above).

The main countries of destination for exported avocado continue to be France (50 %), Great Britain (15 %)and Germany (10 %).

Table 1 presents data on yearly national avocado registered production and exports for the last six seasons, each running mainly from October through April.

AGREXCO Ltd. is still the main avocado exporter from Israel (80%). The others are TOP (a merger of formerly Tnuport and Mehadrin) and KEDEM.

PESTS AND DISEASES

Avocado in Israel is not greatly troubled by pests, probably due to several factors, mainly the careful conservation of natural biological balance, the strict quarantine measures taken during the introduction of avocado propagation material, and also the ban on the import of avocado fruits. The repeated events of extreme high and low temperatures may have also an effect of hindering the development of some avocado pests prevalent in the tropics.

There have been ups and downs regarding the infestations with some pests, like the looper *Boarmia selenaria,* the Pyriform Scale *(Protopulvinaria pyriformis*), The Greenhouse Thrips (*Heliothrips haemorrhoidalis*) and the Orchid Thrips *(Chaetanaphothrips orchidii)*.

It should be emphasized, that biological control has been so far the sole practice of pest control in avocado in Israel.

Diseases: The climate in Israel is unfavorable to the development of diseases of fruit or canopy of avocado, and they have never been observed in the orchards.

Avocado Root-rot *(Phytophthora cinnamomi)* was first identified in Israel in 1982. So far its scattered spread has been very limited (altogether less than 30 hectares), mainly in moist spots of very heavy soils or other sites with poor drainage.

Previously, a phenomenon of inflorescence dieback has caused serious damage in some years, mainly in 'Hass', by reduction of yields of infected trees. Since the mid nineties - that episode had disappeared. No pathogen has ever been identified, and it seems that the phenomenon was probably associated either with improper irrigation and fertilization practices, (that have been improved since) and/or with inferior soil types (where orchards have been eliminated since).

PRESENT PRINCIPAL PRODUCTION PROBLEMS

1) Insufficient national yield/ha

The average national Yield/ha for the last six years (12.5 t/ha) could be rated as very good when compared to national averages in Mexico, California or Spain. Nevertheless, this yield cannot be considered as sufficient for the Israeli producer - under the present and the foreseen local costs of production (particularly - cost of irrigation-water) and the costs of post-harvest phases. The tendencies in the avocado world trade may put additional constraints.

Following are some production problems that could be involved in the insufficiency of the national yields/ha:

a) Flowering and fruit-set of the main commercial cultivars take place from March through May, a season of very unstable weather with events of adverse temperatures that are too high and/or too low for optimal pollination and fruit-set.

b) Severe damage to the avocado crop on a national level has been caused, once in a while, by extreme and prolonged heat waves shortly after fruit-set.

c) There is often a marked reduction in bee activity (pollination) in avocado orchards during the main flowering season of the major cultivars, which coincide with the flowering of very strong competitors for bees, like the vast areas of citrus and of wild vegetation.

Despite all the above, the long-term average yield in quite a few of the well-cared avocado orchards in Israel has reached more than 20 tons/ha, even with the traditional cultivars of 'Hass' and 'Ettinger'. The considerable difference in yields between such orchards and the others (within the same region and with the same cultivars) demonstrates the unexploited potential of increasing the average national yield/ha of avocado - even without the contribution of newer, more productive cultivars (like 'Pinkerton'): The above difference can be explained only by large differences between growers in regard to the level of orchard care. Therefore it seems, that intensifying extension activities and further rising of the professional and managerial levels of growers could greatly contribute to an increase in the national average of yield/ha.

2) The small size of 'Hass' fruits:

Local ecological factors (see "Cultivars") downgrade the fruit-size of this leading cultivar, which becomes smaller than desired in the trade. The efforts to breed or introduce a bigger 'Hass' have not yet resulted in any satisfactory replacing type or cultivar.

3) Scarcity of water:

Increasing prices and the scarcity of irrigation water starts to create a severe constraint to the whole avocado industry. This issue can be identified, perhaps, as the most crucial production problem in the long run.

4) Increasing water salinity

The salinity of irrigation ground water in major avocado producing regions is gradually increasing. This phenomenon can be related partially to a tendency of over-exploiting the underground reservoirs. This tendency is apparently revised recently, to some extent, which may contribute to slowdown of the aforementioned process.

Increased salinity in irrigation water could be responsible for some of the cases of decrease in yields, particularly where orchards were planted on Mexican rootstock. Gradual replacing such orchards with new plantings that are based on West Indians rootstocks is already taking place in recent years, and alleviates the problem.