# IENICA

**Interactive European Network for Industrial Crops and their Applications**

**Forming Part of the IENICA-INFO*RRM* Project**

# REPORT FROM THE

# STATE OF ISRAEL

INFO*RRM*-IENICA is a project funded under the Fifth Framework Programme by DG XII of the European Commission

---

**Prepared by:**

**Prepared by Dr. David Levy**

**Inst. Of Field and Garden Crops**

**The Volcani Center, ARO**

**2002**

**(With updates in 2004)**

# ACKNOWLEDGEMENT

This work was funded under the IENICA workstream of the IENICA-INFO*RRM* project. IENICA is the Interactive European Network for Industrial Crops and Applications. The overall project is funded by the Fifth Framework Programme of the European Commission under the Quality of Life Programme. This project is a development of the FAIR Programme (FP4)-funded IENICA project.

# CONTENTS

# METHODOLOGY

The information presented in this report was collected from various sources in Israel:

**List of Sources**:

Central Bureau of Statistics, State of Israel:

- Statistical Abstract of Israel
- Foreign Trade Statistics Quarterly
- Agricultural Statistics Quarterly
- Survey of Products and Materials in Manufacturing 1995. Pub.No. 1123.
- Agricultural activity account in Israel (1999-2000)

Ministry of Agriculture and Rural Development, Israel's Agriculture, (2003)

Cotton Production and Marketing Board, Israel

International Jojoba Export Council

Center for New Crops & Plant Produce, Purdue University, USA

Agricultural Research Organisation (ARO), Ministry of Agriculture

# EXECUTIVE SUMMARY

The gross agricultural production in Israel (2002) was about US $3.2 billion. The export of fresh products was about US $620 million, ca. 4.1% of the total export from Israel. The Israeli agriculture is a high-input and export-oriented agriculture. To maintain profitability, high yields, high qualities and the best possible prices at the marketplace should be obtained. Production expenses are high mainly due to the high cost of irrigation and the expensive labor.

In large parts of the Middle East, semi-arid and arid conditions prevail in many agricultural areas and fresh water resources are limited. Hence, supplementary irrigation during the winter is commonly needed due to uneven rain-spread or lack of efficient rains. In the spring and the summer seasons full irrigation is needed to ensure yield and quality. Naturally, the most important constraint on Israeli agriculture is the limited resources of water.

The major field crops in Israel are wheat, cotton, sunflower (confection), sweet corn, peas (processing), chickpeas, groundnuts (peanuts), watermelon for seed (confection), beans, tomatoes for processing and forage crops. Out of 400,000 ha of arable land, about 175,000 ha were sown with field crops in 2001/2002.

Cotton is the major non-food crop in Israel. Since its introduction in the 1960's significant advances have been made in the cropping systems, particularly the introduction of fully controlled drip-irrigation with effluent water (85%) and the breeding of higher yielding and higher quality varieties. However, the constant drop of prices in the international markets in recent years, especially of the Acala type, lead to about 60% reduction in the area of cotton grown in Israel. The area of cotton was 9,600 ha in 2000, 14,500 ha in 2001 and 11,600 ha in 2002, almost entirely drip irrigated with Israeli-made equipment.

Jojoba is grown in the southern parts of Israel in arid regions. In recent years, due to advances in growing methods and the planting of elite material bred and selected in Israel, the crop is successful and profitable. Future increases in production depend upon the demand for the special jojoba wax, mainly by the cosmetics industry.

The export of fresh spice crops is another important segment of the Israeli agriculture. Many spice crops are believed to have beneficial effects on the health and well-being of humans, leading to increased demand and reasonable prices. The crops are grown under cover to obtain high quality year round. The main crops are basil, chives, mint, rocket and tarragon. Further developments depend on the expected demands in international markets and the prices that prevail in these markets.

Due to the small size of the Israeli market, the export of agricultural products is essential. The production of high quality products is of great importance in order to obtain high prices in the marketplace. To achieve that, the greater part of the R&D is aimed at the improvement and sophistication of the cultivation procedures and at the breeding of new-improved varieties. In addition, the increasing awareness of consumers to farming in an environmentally-sound way, promotes the development of farming which is compatible to the environment.

# FIBRE CROPS

## Cotton

### 1 Opportunities

#### 1.1 Science and Technology

Cotton production in Israel commenced in the early 1950's in the Beth-She'an Valley region. The know-how, varieties and technology were introduced from the United States. Over the years, cotton became one of Israel's major field crops, with peak production of over 100,000 tonnes of lint in the mid-1980s, attained from cultivated areas covering over 60,000 irrigated hectares. At its peak, the sales turnover for the cotton crop reached over 200 million dollars annually, mostly from export of the lint to Europe.

A tradition of an effective agricultural Extension Service aided the farmers with the rapid application of research and development findings and resulted in high yields – a perennial average of about 1750 kg of lint per hectare. The cotton cultivation process is mostly mechanised and the income per employee is among the highest in the agricultural industry in Israel.

Cotton is sown in Israel during the end of March-mid April, when soil temperature is higher than 16$^{o}$C. Distance among rows is 100 cm and among plants 8-10 cm. Irrigation amounts vary

according to the soil types and area - around 350 mm in the coastal plain, about 600 mm in the northern Negev and up to 1000 mm in the hot valleys. Small quantities are grown with partial irrigation or in dryland conditions.

Two types of cotton are grown in Israel. Acala type upland cotton – a cotton with medium staple length, and Pima – a long cotton (Table 1). Naturally coloured cotton (Top-Cot) is also grown. Most of the area is grown with locally bred cultivars.

Israeli cotton serves as a reliable source of quality lint for export (Table 1) and the entire cotton yield is exported, mainly to European countries where cotton is not cultivated and to the Far East. The cotton seed provides quality feed for cattle, and is occasionally used in the edible oil industry. 100% of the seed produced is used locally.

Cotton fibers in the world are traded on the Cotton Exchange in New York. Israel has no influence on this trade, but the price fluctuations affect the area annually planted in Israel. The total planted area has decreased since the mid 1980's, due to economic reasons. Because of the low prices of the Acala-type cotton in the market (Table 1) and the price stability of the Pima (ca 100 U.S. cents/lb), over 80% of the production in 2001 was Pima cotton for export.

Over the years, with the increase in planted areas, novel irrigation technologies were introduced, new varieties were developed in Israel and the use of innovative pest control was introduced. Cotton growth costs were substantially decreased due to the use of treated urban effluents for the irrigation of the cotton fields. This provided a solution for the disposal of the urban effluents, reduced the use of potable fresh water for irrigation purposes, and contributed to water economy.

## 1.2 Industrial Uses and Markets

The entire yield of the lint produced in Israel is exported mainly to EU long-fiber market, and to the Far East. Cotton yields per hectare are among the highest in the world, averaging 5.5 tonnes of raw cotton with 1.8 tonnes of fibre for the Acala cotton, and 5 tonnes of raw cotton with 1.6 tonnes of fibre for the Pima cotton. Only a fraction is used in the textile industry in Israel.

Cotton oil is extracted from the seed. After purification, the oil is used as a source of fatty acids for cosmetics, medicines, pest control, and for the leather, cloth and paper industries. Part is used for poultry feeding, and occasionally in the edible oil industry.

The pulp is mostly used locally for animal feed.

In view of low prices in the international markets of the Acala-type cotton and the price stability of long staple cotton, a major effort is dedicated to breeding new cultivars with improved lint quality. New selections, and some introductions, are tested annually at several sites.

**Table 1 Cotton production (area, lint, seed) and lint prices**

| Year | Area ('000 ha) | Lint production (tonnes) | Seed production (tonnes) | Lint price (cent/lb) | |
|---|---|---|---|---|---|
| | | | | Akala | Pima |
| **1991** | 12.0 | 21.5 | 34.0 | 80 | 113 |
| **1992** | 17.3 | 29.3 | 46.0 | 71 | 97 |
| **1993** | 15.4 | 26.9 | 43.0 | 89 | 113 |
| **1994** | 20.2 | 30.9 | 54.0 | 86 | 104 |
| **1995** | 23.5 | 42.7 | 70.0 | 90 | 123 |
| **1996** | 28.2 | 51.2 | 83.0 | 96 | 118 |
| **1997** | 28.7 | 53.3 | 85.0 | 82 | 107 |
| **1998** | 28.8 | 49.6 | 80.0 | 71 | 102 |
| **1999** | 15.1 | 24.7 | 39.3 | 72 | 97 |
| **2000** | 9.6 | 16.1 | 26.2 | 72 | 102 |
| **2001** | 14.5 | 22.3 | 30.8 | 65-70 | 95-100 |

## 1.3 Environmental Aspects

The cotton crop is susceptible to various pests and might be severely damaged by insects such as *S. littoralis*, *Heliothis armigera* and *Erias insulana*. To reduce the use of ordinary pesticides, *Bacillus thuringiensis* preparations were introduced and used. Also, research on the methods of biological control of *Pectinophora gossypiella* by the use of rope dispensers which release a pink pheromone has been conducted. Similar work with pheromones is conducted to control *Bemisia tabbaci*.

The cotton crop, as a non-food crop, is suitable for the use of marginal quality water (sewage and saline). Indeed, treated urban effluents (sewage) are now used for irrigation of over 80% of

the cotton fields, and the use of sludge (left after the treatment of the effluents) is also investigated. A part of the fields in the south of the country are also irrigated with saline water. Trials of irrigation with various amounts of water are also conducted aiming at the reduction of the amount of water used and increased water used efficiency. This will also reduce the risk of possible pollution of water reservoirs in certain regions.

## 2 Barriers to progress

### 2.1 Scientific

The cotton crop is one of the most advanced crops in Israel and produces high yields of high quality lint. However, breeding of cultivars with higher lint quality is essential. Studies of the possible identification and use of molecular markers in breeding for better quality commenced recently and might prove useful.

### 2.2 Technical

None

### 2.3 Environmental

Further development of biological control of pests and diseases is required. Development of better cultivation practices, such as precision agriculture, is important to conserve water and fertilisers and reduce pollution. This should include underground trickle systems for efficient and conservative fertigation and special devices for application of pesticides to confined areas or locations.

### 2.4 Legislative

It still remains to be decided if the EU will allow the use of genetically modified cotton.

## 3 Prioritisation

Strengths:

Very good and advanced cultivation technology including:

- trickle irrigation systems controlled by computers
- locally bred cultivars with high yield and quality
- good soils and available recycled water

- good professional support of the Extension Service and the research institutions
- Cotton production and marketing is well organised by the Israel Cotton Production & Marketing Board Ltd., P.O.Box 384, Herzlia B, Israel 46103 (Tel. 972-9-509491/3; Fax 972-9-509159). The Board is also involved in and supports research and development activities.

Weaknesses:

- completely dependent on international market prices, which have been relatively low in recent years.
- fundamental research levels are not strong enough due to the small size of the country and its agriculture and its limited funding of research.

# OIL CROPS

## Jojoba *(Simmondsiace chinensis)*

### 1 Opportunities

#### 1.1 Science and Technology

Jojoba is a shrub reaching 1-5 m in height. It has xerophytic leaves which contain a high concentration of phenol. Native Jojoba is found in regions with annual precipitation of 80-450 mm and temperatures ranging from 9-50$^{o}$C. The plant is drought resistant and to some extent also salt resistant.

The Jojoba is a dioecious wind pollinated plant. The plant starts bearing seed at age 3 and achieves full yielding capacity after 12 years. The oil content of the seed is high and approximately 40% of the seed weight is cold-pressed by a standard oilseed process with no special requirements. The pulp contains about 30% of proteins.

Jojoba may be propagated by direct seeding, in which case about half of the seedlings are males which should be roughed as 10% of males are sufficient for pollination. The fact that only 50% of the plants bear seed and the large heterogeneity of the plants that originate from seed lead to low average yields. Hence, vegetative propagation that enables the planting of desired proportion of female plants of superior clones is preferred. Rooted cuttings are used for this purpose.

The Jojoba plant originated in the Sonora desert in North America. It is considered adapted to relatively dry climates with annual rain of 500-600 mm. Where annual rains are under 350 mm, supplementary irrigation is required. In the arid areas of Israel, with less than 200 mm of annual rain, supplementary irrigation of about 300-500 mm is applied. Effluents and saline water may be used to irrigate Jojoba.

## 1.2 Industry

Jojoba wax and its derivatives have a wide range of industrial uses, mainly in cosmetics (skin lotions, moisturisers, massage oils, smoothing creams), in hair care products (shampoos, gels and mousses), lipstick, makeup and nail products. The cosmetic industry accounts for ca 80%. There are potential uses in pharmaceuticals and in industries such as extenders for plastics, printer's ink, gear-oil additives, lubricants, etc.

## 1.3 Markets

All of the jojoba grown in Israel is exported; there is no known domestic use. The total world market potential for Jojoba oil at prices of US $4.00 – 6.00 per kg has been estimated to be 64,000 tons, and the projected uses are cosmetics – 18%, pharmaceuticals – 23%, lubricants – 15%, wax replacement – 15% and other uses – 29%. In the year 2000, Israel exported 130.3 tonnes of wax for 10 US$ per kg.

**Table 2 Jojoba cultivation and seed production for year 2000**

| Country | Hectares | Seed Production (metric tonnes) |
|---|---|---|
| Argentina | 4800 | 950 |
| Australia | 400 | 8 |
| Egypt | 140 | 15 |
| Israel | 675 | 1000 |
| Mexico | 470 | 90 |
| Peru | 300 | 75 |
| USA | 2000 | 1455 |

Sources of information:

International Jojoba Export Council, website: **http://ijec.net/**

Purdue University, Center for New Crops & Plant Produce

Website: **http://www.hort.purdue.edu/newcrop/CropFactSheets/jojoba.html**

## 2 Barriers to progress

### 2.1 Scientific

Improvement of yield and wax content

### 2.2 Technical

Improvement of harvesting machinery

### 2.3 Environmental

None

### 2.4 Legislative

None

### 2.5 Economic issues

Dependent on demand and price in the international markets

## 3 Prioritisation

Strengths

- Eestablishment of plantations of superior female clones selected in Israel
- Development of a successful vegetative propagation system
- Development of special machinery for harvest
- Drip irrigation with treated effluents
- Good support of the research and development in Ben-Gurion University of the Negev.

Weaknesses

- Dependent on demand and prices in international markets

# AROMATIC PLANTS

## 1. Opportunities

### 1.1 Science and Technology

Research and development of the cultivation of aromatic plants in Israel was significantly enhanced about 20 years ago. The focus was on Mediterranean herbs such as oregano, sage, savory and thyme, which thrive in the wild under the climatic conditions of Israel. High quality types were selected from germplasm collected from several locations in Israel and abroad. Acclimatization and selection were done at the experimental fields in Neve Ya'ar site. Other commercially important herbs like sweet basil, parsley, sweet marjoram, mint, caraway, coriander, etc. were introduced from commercial sources. Acclimatisation and breeding took place in Neve Ya'ar Experimental Station.

The production of dry herbs in Israel includes parsley and oregano and the total production is about 15 million USD per year. During the 80's there was a small essential oil industry, mostly three pilot plants. The main species were geranium and sage (about 100 ha). However, due to financial constraints, mainly low prices during the early 90's the production was stopped.

The only successful export of a dry spice is the export of paprika powder that reached 15 million USD. Local breeding in Israel resulted in new varieties with higher yields and better quality. Total production in 2001-2002 was estimated to be 8,000 tonnes, ca 7,200 tonnes (90%) of this was exported, and ca 800 tonnes (10%) was sold on the domestic market.

Fresh herbs production is the main activity in recent years. In 2001-2000, the total production of fresh herbs and spice crops was 33,000 tonnes. 27,210 tonnes of this was used domestically, and 5,700 tonnes, worth ca 36 million Euros, were exported to the UK, the USA, France, Germany and the Netherlands. The leading crops are basil, chives, mint, rocket and tarragon. There is also production of potted herbs for home gardening, approximately 2 million USD per year. In some of these crops, local varieties are grows.

In addition, local wild aromatic plants, that are not widely known in the western world, like *Origanum* sp. *Micromeria fruticosa, Salvia* sp., *Achilea* sp., *Artemisia* sp., are used as medicinal plants or spices by local residents for many years. Selection and examination of such plants as a potential source of essential oils or oleoresins with interesting biological activities are now part of the R&D.

**Table 3 Aromatic plants grown in Israel**

| Common name | Italian name | Area (ha) |
|---|---|---|
| Basil | *Ocimum basilicum* | 40 |
| Celery | *Apium graveolens* | 20 |
| Chives | *Allium scheonoprasum* | 80 |
| Coriander | *Coriandrum sativum* | 275 |
| Dill | *Anethum graveolens* | 270 |
| Lemon grass | *Cymbopogon citrates* | 50 |
| Lemon thyme | *Thymus citriodorus* | 5 |
| Louisa | *Lippia citriodora* | 20 |
| Lovage | *Levisticum officinale* | 2.5 |
| Marjoram | *Origanim majorana* | 2.5 |
| Melissa | *Melissa officinalis* | 2.5 |
| Mizuna | *Brassica rapa* | 2.0 |
| Oregano | *Origanim vulgare* | 3.0 |
| Parsley | *Petroselinum sativum var.crispum* | 300 |
| Parsley | *Petroselinum sativum* | 150 |
| Peppermint | *Mentha piperita* | 2.5 |
| Rocket | *Eruca vesicaria subs.sativa* | 2.5 |
| Rocolla | *Eruca vesicaria subs.sativa* | 20 |
| Rosemary | *Rosmarinus officinalis* | 18 |
| Sage | *Salvia officinalis* | 18 |
| Savory | *Satureja hortensis* | 2.5 |
| Sorrel | *Rumex acetosa* | 5.0 |
| Spearmint | *Mentha longifilia* | 70 |

| | | |
|---|---|---|
| Spinach | *Spinacia oleracea* | 50 |
| Tarragon | *Artemisia dracunculus* | 20 |
| Thyme | *Thymus vulgaris* | 20 |
| Za'atar | *Origanum syriacum* | 30 |

Source: Division of Aromatic Plants, ARO, Neve Ya'ar Research Center, P.O.Box 1021, Ramat Yishay, Israel.

All the production of aromatic plants in Israel is done in greenhouses to ensure the production of high quality products year round. Heating, cooling and supplementary light may be employed according to the season and the crop needs.

A post-harvest and shipping technology was developed to facilitate good keeping quality and good appearance at the market place. Immediate pre-cooling is applied upon harvest and new types of polymeric bags, that maintain the high quality of the products are used for packaging. This special packaging creates modified atmosphere and prevents water loss.

## 1.2 Industry

The product is sold to the U.S. and EU markets for fresh consumption.

Dry paprika powder is used as spice and as a natural color for food products.

## 1.3 Markets

The EU and the US are the main markets to which the Israeli aromatic plants are exported.

The total value of the exported fresh herbs reaches US$45 million, and additional US$15 million is the value of the exported paprika powder.

In recent years, the strong competition from other countries in the Middle East and in Africa, pose a significant challenge to Israeli producers. Hence, quality product and good growing practices could be of essential importance in the near future.

### 1.4 Environmental

Water, fertilisers and pest control are extensively used in cropping aromatic plants (except for paprika that is grown in the open field like any other field crop). Improvement of cultural practices, which include efficient water and fertiliser use and integrated pest management are of high priority.

## 2. Barriers to progress

### 2.1 Scientific

Breeding for tolerance to diseases, i.e., tolerance to fusarium wilt in Basil.

### 2.2 Technical

Improvement in mechanisation. Harvest and handling of aromatic plants for fresh marketing requires much labour.

### 2.3 Environmental

Recycling of water and fertilisers

Integrated crop management

### 2.4 Legislative

Need to meet the EURO-CAP requirements

### 2.5 Economic issues

Reduce the cost of production, especially the cost of labour.

## 3. Prioritisation

Strengths

- Well established production
- The growers are organised in a ‘herb club’

- Export logistics done by Agrexco (Agricultural Export Co. Ltd.)
- Mechanisation of the paprika harvest
- Breeding of paprika and aromatic plants

Weaknesses

- Increasing competition from producers in the Mediterranean region and in Africa.

# ANNEX

See **www.ienica.net** for the Annexes:

Production of Main Products (1948-2000)

Agricultural Output, by Purpose and Branch (2000)