POLINIZACION DE PALTOS EN ISRAEL
Gad Ish - Am

Sociedad Gardiazaral, y Magdiel, Ltda.
Regions of Avocado growing in Israel

Altitude: mostly in the coastal plain and in the internal valleys. Sometimes on hills, up to 300 m. above sea level.

Precipitation: mostly in the rainy regions. Not in the desert area.

Temperatures: within the mild and the hot regions only.

Last 28 years of avocado cultivation in Israel: orchard area and average yield

Avocado Cultivation History in Israel

- Orchard Area (Hectare)
- Average Yield (Ton per Hectare)

Year
1976
1981
1986
1991
1996
2001

Yield
0
2
4
6
8
10
12
14
16
18
20

Orchard Area
Average Yield
Reasons for avocado orchard area decrease (from the mid 80’s):

Shortage of fresh water: Due to successive dry years.

Decline of avocado fruit price: mainly in the European market.

Rising of orchard expenses: owing to the agriculture crisis in Israel.

Average yield increasing:

2000 and later: average yield has been stabilized around 14 ton/ha.


Reasons for the relative low-yield years (happens once in 5-10 years):

Climate disaster: mainly a heavy “Hamsin” during bloom and fruit set.

Bad pollination condition: due to severe competition for pollination.

“Off year”: usually after a very high-yield year.

The relatively high-yield years are a product of an infrequent combination:

Good pollination season: under condition of very low competition for pollination.

Mild spring: with no “Hamsin” spells.

This infrequent combination may appear when a hot and dry winter is followed by a cool spring.
Which factors produced the yield increase?

A. Adding pollinizer trees to solid-block orchards

Bergh et al., 1966, California; Guil et al., 1986, Israel

Bergh et al., 1966:
'Topa-Topa' trees were inter-planted every 10'th row in 'Fuerte' plot as wind breakers.
The yield of the adjacent 'Fuerte' rows was almost doubled.
The yield of the other rows was practically not influenced.

Factors that produced the yield increase

B. Spraying with a growth regulator during bloom

Adato, 1990; Peterman et al., 1999, Israel
Factors that produced the yield increase

B. Spraying with a growth regulator during bloom
Adato, 1990; Peterman et al., 1999, Israel

![Graph: Growth-regulator spray on 'Hass'](image)

Factors that produced the yield increase


Hive density was raised from 0-2.5 hives/ha. To 3-4 hives/ha.

More attention has also been given to hive quality.
More factors that affected yield increase

D. Improving of irrigation, fertilization and pruning methods.

E. A selective elimination of low-yielding orchards.

What is the ultimate yield potential of the avocado in Israel?

Experiments in improving the honeybee efficiency as an avocado pollinator (1)

A. Kalman, 1976, Israel: Feeding the bees with sugar solution containing avocado flowers. 
No positive results.

B. Melamud, 1981, Israel: Spraying the trees with attractive scent or with sugar solution. 
No positive results.

C. Ish-Am, 1984, Israel: Distributing water basins throughout the orchard. 
No positive results.
### Experiments in improving the honeybee efficiency as an avocado pollinator (2)

- **D. Melamud & Eisikowitch, 1982, Israel:**星能蜜蜂捕捉到花粉-陷阱到蜂箱入口。
  
  **No positive results.**

- **E. Ish-Am, 1994, Israel:**星能蜜蜂捕捉到蜂箱入口，每天达到 avocado花期高峰。
  
  **No positive results.**

- **F. Melamud, 1983, Israel:**移动蜂箱在果园内每隔几天。
  
  **No positive results.**

### Experiments in improving the honeybee efficiency as an avocado pollinator (3)

- **G. Melamud, 1983, Israel:**引入年轻的蜜蜂到开花的果园。
  
  **Pollination improvement for a few days.**

- **H. Ish-Am, 1998, Israel:**引入蜂箱到果园内每隔几天。
  
  **Pollination improvement for a few days.**

- **I. Vithanage, 1990, Australia; Ish-Am, 1994, Israel; Hofshi, 2000, CA:**增加蜂箱密度到10蜂箱每公顷。
  
  **Significant improvement of pollination!**
Experiments in improving the honeybee efficiency as an avocado pollinator (4)


Experiments with Bumblebees as avocado pollinators

Bombus terrestris is a native social bumblebee that lives in Northern Israel.

It was domesticated in Israel during the early 90’s, mainly for tomato pollination.

Experiments were conducted by Ish-Am et al., 1995-2000.
Life cycle of the Bumblebee

The bombus is a semi-social bee: the whole nest dies in the fall, and the queens only stay for the winter.

Active period of the nest lasts from early spring to late fall.

Advantages of the Bombus over the honeybee as a pollinator of the avocado

The Bombus:

Carries much more pollen on its bigger and more hairy body.

Works faster: visits 20 flowers/min., while the honeybee visits only 6-9 flowers/min.

More efficient as a cross-pollinator.

May less prefer other flowers to the avocado.
**Experiment design**

**Treatments:**
- Honeybee hives only, normal density (control).
- Honeybees and bumblebees, normal density each (HB+BB).
- Bumblebee hives only, normal density (BB).
- Honeybee hives in double density (HBx2).

Experiment were run for 6 years in 4 regions in Israel. BB treatment only for 2 years in one location.

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**Experiment difficulties**

1. Distance between treatments must be more than 2 km.
2. The BB treatment should placed where no HB hives exist, within radius of at least 2 km.
3. Towards the end of the season, hungry honeybees may aggressively enter BB hives and rob them.
Bombus experiment: Pollination rate and cross-pollination progenies

Bombus significantly increased cross-pollination progenies' percent.

Bombus improved mainly cross-pollination.

Bombus experiment: Yield, and yield-ratio of “far Hass” to “near Hass”

Bombus increased 'Ettinger' yield in 4 of 5 years (+36% on average), and 'Hass' yield in 3 of 5 years (+14% on average).

Bombus increased 'Hass' yield ratio in 3 of 5 years (+18% on average).
The avocado (Persea americana) is native to the Sub-Tropical region of Central America.

The avocado native pollinators should be much better adapted for its pollination than the European honeybee.

The study was carried out in Mexico and Guatemala, by Ish-Am et al., 1996-1999.

The native avocado pollinators are mainly social stingless-bee species.
Experimental import of Scaptotrigona hives from Mexico to Israel (Ish-Am et al., 2000-2003)

Thirteen modern Scaptotrigona hives were brought to Israel at the end of 2002, for experimental use as avocado pollinators.

All the imported colonies died in April 2003, during a very heavy “Hamsin”.

What should be done for the future?

For a heavy avocado crop one needs...

Modern hives of Scaptotrigona mexicana, as they are grown in Mexico.

Enough honeybees in the orchard...

And adjacent pollinizer, of an adequate cultivar.
Thank you...