POLLINATION OF AVOCADO IN ISRAEL: PRACTICE AND EXPERIMENTS – A SHORT REVIEW

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Detailed Abstract

The avocado plantations in Israel are located mainly in the costal plain and the internal valeys. It is not grown in the mountain regions, nor in the desert part of the country. The avocado orchard area in Israel increased from 3,000 ha in the mid 70's to more than 10,000 ha in the mid 80's. Since then it is decreasing, down to about 5,000 ha today. The reasons for this decrease are shortage of fresh water, decline of avocado fruit prices and rising orchard expenses. Throughout this period the avocado yield increased gradually, from an average of 6 Ton/ha in the mid 70's to about 14 Ton/ha today. The yield increase was mainly a product of the addition of pollinizer trees to solid-block orchards, and of the use of growth-regulator spray on the blooming trees. It was also influenced by the (small) increase in honeybee-hive density in the orchards, by the improving of irrigation, fertilization and pruning methods, and by the selective elimination of low-yielding orchards. Very low-yielding years, which happen once in 5-10 years, are caused by either climate disaster or by a bad pollination season, of severe competition for pollination. They may also be influenced by a preceding very high-yield year. There also occur relatively high-yield years, which are the product of an infrequent combination of a good pollination season and a very mild spring.

Experiments in improving the honeybee efficiency as an avocado pollinator have been conducted in Israel since the mid 70's. Kalman (1976) introduced a sugar solution containing avocado flowers to the bee-hive enterance; Melamud (1981) sprayed the trees with sugar, or attractive scent solution; and Ish-Am (1984) distributed water basins throughout the orchard. All of these did not succeed in increasing bee activity on the avocado bloom. Melamud and Eisikowitch (1982) starved the bees by attaching pollen traps to the hive enterance; Ish-Am

(1994) starved them by blocking the hive enterance, to be open at the daily peak of the avocado bloom; Melamud (1983) moved the hives within the orchard every few days. Again, with no positive results. Some improvement, for few days, in avocado pollination was demonstrated by introducing young swarms to the blooming orchard (Melamud, 1983), and by introducing the hives to the orchard in several waves, every few days (Ish-Am, 1998). However, a significant improvement was achieved only by a major increase of hive density in the orchard, up to 10 hives per ha (Vithanage, 1990; Ish-Am, 1994; Hofshi, 2000). An avocado preferring honeybee race is developing in an on-going experiment, with promising results (Dag et al., 2003).

A five year experiment with bumblebees as avocado pollinators was implemented in Israel (Ish-Am et al., 1995-2000). *Bombus terrestris*, a native bumblebee of Northen Israel, that was domesticated in the early 90's, was used for the experiment. The bombus is a semi-social bee: the whole nest is active during the spring and the summer, dies in the fall, and the queens only stay for the winter and the next year. The bombus shows some meaninful advantages over the honeybee as a pollinator of the avocado: It carries much more pollen on its bigger and more hairy body; It works faster, visiting 20 flowers per min, while the honeybee visits only 6-9 flowers per min; It is more efficient in cross pollination, due to its higher mobility during the collection flight; and it may not prefer other flowers to the avocado to the same extent that the honeybee does. The experiment included four treatments: (1) only honeybees in the normal density (control); (2) honeybees and bumblebees (HB+BB), both in normal density; (3) bumblebees only in norml density (BB); (4) honeybees in double density (HBx2). The distance between the treatments set to be more than 2 km, and the BB treatment was located in an isolated small avocado orchard, that had no honeybee hives within a radius of more than 2 km. The bombus improved pollination rate in all the checked cases, increasing mainly the cross-pollination rate. A very significant increase was found in the percent of 'Hass' cross-pollination progenies, that was only monitored in one year. The 'Ettinger' yield increased in the BB treatment in 4 of 5 years, with an average of 36% yield addition (significant). The 'Hass' yield increased in the BB treatment in 3 of 5 years, with an average of 14% yield addition (close to significant). The yield-ratio of "Far Hass" to "Near Hass" increased in the BB treatment in 3 of 5 years, with an average of 18% addition (not significant).

A study of the native avocado pollinators in Central America was perfomed in Mexico and Guatemala (Ish-Am et al.,1999). The avocado (*Persea americana*) is native to the Sub-Tropical region of Central America, therefore its native pollinators there should be much better adapted for its pollination than the European honeybee. Several stingless bee species, of the sub-femily

Meliponinae, were found there to be the main avocado pollinators. An experimental import of 13 hives of the domesticated stingless bee *Scaptotrigona mexicana* to Israel failed, since these colonies could not stand a very heavy “Hamsin” (a few successive days of very hot, dry and windy weather), that occurred in April 2003.

Summary: According to our understanding the main limiting factor of the avocado yield in Israel is the pollination. The only available technology for a significant improving of avocado pollination is maintaining a high density of honeybee hives in the orchard durind the bloom, and assuring a suitable pollinizer adjacent to every tree.