

## Combination of bumblebees and honeybees for optimal pollination

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Last season brought new experiences with the use of bumblebees in various fruit crops. In 2005, several trials have been conducted in apple, pear and sweet cherry. These trials demonstrated that bumblebees together with honeybees gave a positive contribution to yield and fruit quality. At a temperature of 18°C there were five times as many honeybees than bumblebees in the crop. This is normal, since honeybee colonies have much more workers per colony. This article describes the results of last years' trials.

### The importance of pollination

Wind pollination hardly contributes to the pollination of apple, pear and sweet cherry. Most varieties are cross-pollinators and strongly depend on insect pollination.

Historically honeybees play the most important role. However the interest in bumblebees is growing due to the reduced availability of good quality honeybee colonies, more intensive growing systems and increased importance of fruit quality.

From the economical perspective, the use of bumblebees has become more interesting



than 10 years ago. Bumblebees have some positive features that are very beneficial to fruit crops. They fly at low temperatures (from 8°C), on cloudy days and also with stronger winds. In comparison with honeybees, bumblebees mainly visit flowers to forage pollen, and transfer more pollen to the stamen with each flower visit. More pollen grains arrive on the stamen, increase the chance for successful fruit set. Obviously fruit set also depends on other factors like the right pollen, climate conditions etc. Good pollination and fruit set are required for best fruit quality and highest yields.

### Trials

In field trials the flying activity of bumblebees, their distribution in the orchard and the effect on yield and fruit quality have been compared. Trials were done in the Netherlands and Israel. Bumblebees for Dutch trials were supplied in weather resistant boxes containing three bumblebee colonies (TRIPOL).

In presence of sufficient good quality flowers, the bumblebees will mainly fly in a radius of approximately 50 meter around the hives. This has been taken into account when designing the trial setup.

### Apple

There was one trial on an apple plot with variety Elstar. The numbers of pips per fruit was counted to measure the effect of the bumblebees. Honeybees were not introduced in this orchard, nor were they present in the neighborhood. A sample of 100 fruits was collected randomly within a radius of 50 meter around the TRIPOL. Number of pips per apple was counted. Another sample of 100 apples was taken more than 150



meter away from the TRIPOL. Apples from around the TRIPOL had 2.3 pips per fruit, where the bumblebees had not pollinated the apples had 1.8 pips per fruit. Trials in 2004 showed smaller differences: 0.1-0.2 extra pips per fruit in presence of bumblebees.

## Pear

Variety Conference was used for the trials in the Netherlands. Fruit quality was determined by counting the number of pips per fruit, as well as assessing the number of misshapen fruits (in Dutch, so-called ‘bottles’). So far the bumblebees gave no different results in Conference. The effect of bumblebees on the number of pips may depend on the variety.

In Israel, an independent researcher<sup>1</sup> determined the effect of bumblebees on pear pollination in the varieties Sfadona and Costia. On a hectare basis, 2.5 honeybee colonies and 3 units of TRIPOL were introduced. In both varieties the combination of bumblebees and honeybees gave the best results: most pips per fruit and highest yield. Note that the climate conditions during this trial were relatively favorable for honeybees.

Pips per fruit	Sfadona	Costia
Honeybees only	5.9	5.9
Honeybees and bumblebees	7.0	6.8

## Cherry

Two plots of cherries were compared: one with bumblebees only, the other with bumblebees and honeybees together. Distance between plots was approximately 300 meters.

### *Bumblebees only*

The plot with *bumblebees only* had seven TRIPOL boxes per hectare. The owner of the plot had recorded the yield every year, thus it was easy to compare the results with previous years. Despite the late frost, the yield from this plot was more or less the same as in previous five years. It was the second highest from the last five years. Some honeybees were spotted in this plot, often in the same numbers as bumblebees. An estimated 80% of the pollination was accomplished the bumblebees. Honeybees were totally absent at lower temperatures (<13°C).



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### *Bumblebees and honeybees*

A 1.8 hectare cherry orchard had three TRIPOL hives on one side and 6 strong honeybee hives in the middle. Honeybees were fed with extra sugar solution to boost



their pollination capacity. Bee counts during walking routes in this plot at 18°C showed five times as many honeybees than bumblebees. Observations at 13°C in the same plot showed similar numbers of honeybees and bumblebees. To put this in perspective: one TRIPOL has approximately 400 workers, while one honeybee hive contains 10,000 – 20,000 bees; that is 25-50 times as many! But bumblebees work more hours per day, visit more flowers per minute and consequently bring more pollen on the stamen. The effect of honeybees only and *honeybees and bumblebees* together on the results of the variety Regina could be compared. Combination of both pollinators gave highest yield: 23% more than honeybees only.

Comparable trials in 2005 in Israel<sup>2</sup> gave similar results. The combination of both pollinators gave best results in the variety Burlat. The plot with honeybees had 14 colonies per hectare; the one with both pollinators had 14 honeybee colonies and four TRIPOL hives per hectare. Honeybees only resulted in 30% fruit set; combination of pollinator 49%.

### **Pesticides and bumblebees**

Steward (indoxacarb) should not be used during flowering, since it is harmful for the development of the brood, with a persistence of 3 days. Workers are killed so they cannot feed young bumblebees larvae with pollen. This can cause starvation of the young larvae, resulting in strong decrease of pollination.

The new pesticide Runner (registered for use in apples and pears in the Netherlands) is a good alternative for caterpillar control and safe for bumblebees.

It is possible to apply the insecticide Calypso (thiacloprid) during flowering provided that the bumblebees are locked inside the hive with the BEEHOME system from the moment of application until the residue has dried up.

### **Introduction numbers**

Although honeybees are used for decades, there is still discussion about the rates of introduction. For cherry for example, recommendations range from 3 to 10 honeybee colonies per hectare. This complicates the advice for bumblebees. Based on actual experiences, the advice for apple and pear is to place 2 TRIPOL hives per hectare. For cherry this is 3 per hectare. Above numbers are general guidelines. For varieties with difficult fruit set, a higher number of bumblebee hives will benefit the result. From the trials described above, the combination of honeybees and bumblebees appears most successful.

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<sup>2</sup> Research done by Biobee, together with Dr. Arnon Dag, Institute of Horticulture, Agricultural Research Organization, Gilat Research Station 85280 Israel