THE AVOCADO FLOWER AND THE POLLINATION-FRUITSET PROCESS: Ideas from a California Perspective

Mary Lu Arpaia
University of California, Riverside

Reuben Hofshi
The Hofshi Foundation
www.avocadosource.com

THE AVOCADO FLOWER

The flower is the reproductive organ of the plant. The avocado has a "perfect" flower and contains both male and female organs. The floral sex parts are:

Female – Pistil which is comprised of the stigma, style and the ovary

Male – Six stamens each one is comprised of an anther, which contains the pollen grains and a filament. The pollen is released after the anther flaps have opened.

Pollination – The transfer of pollen from an anther to the stigma.

Self Pollination – the pollen deposited on the stigma is from the same flower.

Close Pollination – the pollen deposited on the stigma is from a nearby flower of the same variety.

Cross pollination – the pollen deposited on the stigma is from a different variety.

The avocado stigma surface is "sticky" and produces nutrients and amino acids which can recognize the pollen which helps the pollen grain "germinate".

Pollen germination – the pollen germinates like a seed and produces the pollen tube.

The *pollen tube* is an outgrowth from the pollen grain that conveys the sperm down the style to the ovule.

Fertilization – the fusion of the sperm with the egg. In avocado and other flowering plants a second sperm fuses with 2 nuclei contained in the central cell. This will form the endosperm.

Retention of fruitlets – The fertilized egg gives rise to the seed and if conditions are adequate begins to grow. Other tissue in the pistil gives rise to the edible portion of the fruit.

Multiple pollen grains – minimum number required for effective pollination – although one pollen grain can grow a pollen tube and successfully fertilize the egg, there is a better chance for success through increased number.

Effective pollination occurs when sufficient pollen grains are deposited onto the stigma. A minimum of 6-20 pollen grains is needed. The idea of the population effect is that a large number of pollen grains assure competition among them in a similar way sperm count is done in humans.

POLLINIZERS FOR CROSS POLLINATION

The avocado flowering cycle (technically termed synchronous dichogamy) is believed to favor cross-pollination. Avocado varieties can be classified as "A" and "B" flower types. The question is what pollinizer to use. Research has demonstrated that certain varieties are more effective pollinizers (Israel, Ettinger; Chile, Edranol; California, Zutano, Fuerte and Bacon (Degani, Gandolfo, Bergh, Clegg)).

Things to consider when selecting a pollinizer variety for 'Hass':

1. Synchrony of flowering cycle with the 'Hass' flowering cycle (Ish-Am, Clark)
2. Multiple pollinizers give a better overlap (the DeBusschere experience; the Hofshi multiple pollinizer method).
3. Spatial placement of pollinizers. There is plenty of research indicating that pollinizers do best at close proximity to the Hass because honeybees tend to forage in a limited area often no more than 1-3 trees. (Arpaia.)

THE NEED FOR INSECTS – *a sometimes controversial topic*

Most researchers believe that an insect vector is needed for the pollination of avocados. In the avocado's native environment in Mexico and Guatemala, stingless bees appear to be the pollinator vector. In areas with Mediterranean climate the European honey bee does an adequate job and is the only commercially available pollinating insect.

Why insects?

The avocado flower is a specialized flower with large spherical pollen grains (30-40 microns). The pollen grains are moist and stick together with the aid of an electrostatic charge. Approximately 30 minutes after the anther flaps open the pollen grains are released as a group (Davenport, Ish-Am).

Considerations for the use of honey bees:

1. Bees need clear paths to be able to fly and visit not only the top of trees. There is a minimum density of bees per square meter of canopy that will affect adequate pollination (Ish-Am).
2. Bee placement distance is important. They need to be preferably placed in a sunny location with the opening of the hive facing east at the lowest part of the grove, if possible. Thus they fly empty and return loaded. The most adequate distance is less than 200 meters between apiaries.

3. The number of hives per acre is dependant on the amount of competing bloom in the area. In normal years, 4; dry years, 1-2; and when there is lots of competing bloom, 5+ hives per acre are needed. Bee activity during drought years with limited wild flowers is higher and a noticeable increase in initial fruit set is typical.
4. Avocado attractiveness to bees – the European honeybee will visit the avocado flower but prefers other forage such as mustard for pollen and citrus and sage for nectar. Thus needed bee hives number is correlated to the amount of competing bloom, more competing bloom more honey bees are needed.
5. There are three functions for foraging bees: pollen collection, nectar collection and nectar/pollen collection. The type of bee needed to visit the avocado flower is not the pollen collector but the nectar collector. The bee needs to pollinate the receptive stigma in the female stage. The bees pack the pollen into a pollen load which does not serve as the source of the pollinating pollen. The pollen that can affect pollination is the pollen that is carried on the bee's hair.
6. The bees, during hot and dry days need water to dilute the crystallized sugar of the nectar. Placing buckets of water with a floating platform can help keep the bees from spending time looking for more distant water source.
7. There should be some beehives in the grove throughout the bloom period. There are fruitset opportunities during the winter months that can produce a good part of the crop, especially if girdling is practiced (DeBusschere observations).

THINGS TO PONDER

- Expensive flowering – a lot of energy is spent on nectar production and nutrient and water requirements for the flowers, could it be a situation of 'male fitness' when you consider that a mature avocado tree can produce over a million flowers but typically only bears 0 to a few hundred fruit to maturity?
- Can we benefit from understanding 'metaxenia' (the effect of the pollen parent on fruit characteristics)?
- The dichogamous flowering system how much does it really matter? Can we just saturate the environment with all sorts of avocado varieties regardless of flower type?
- Many experiments showed that bees are more important than pollinizers, but pollinizers are important insurance policy depending on the flowering environment (Clark, Köhne)
- Other things are also important in determining in the process of flowering, fruit set and overall productivity such as temperature (disrupts flowering cycle), relative humidity and overall tree health.

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