



What pollinates the avocado flower?



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Challenge to peer review paper concerning
wind pollination of avocado trees.

Would it be worthwhile to see if wind plays a
roll in pollination?



To find out, an experiment was conducted.

- Four areas were isolated using nets to control access by insects.
 - In the first netted area, an insecticide was sprayed so that nothing other than the wind would be able to pollinate the avocados.
 - In the second netted area, a beehive was placed and the bees had the ability to fly either within the netted area or go outside the netted area.
 - In the third netted area nothing was done. The net excluded bees from entering but other insects were able to access the avocados.
 - In the fourth area (control) no net was installed.



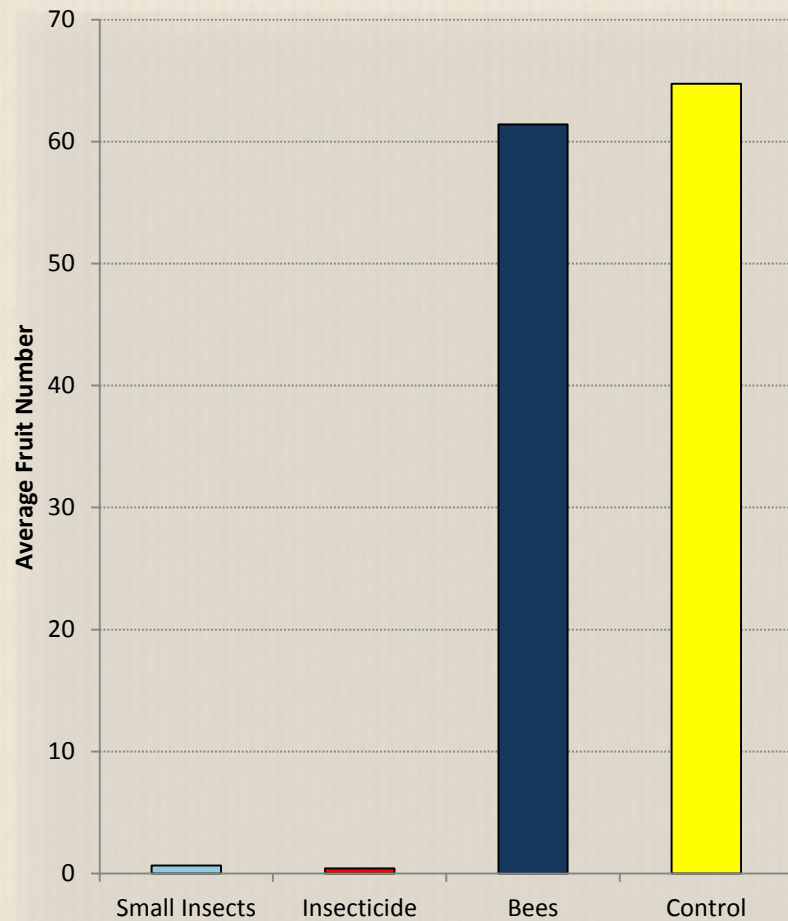
Results

- In the control area with no net, and the area with the net, bees were present and the trees produced many fruit.
- In the two areas with the nets and no bees, virtually no fruit was produced.
- This same study was conducted in Chile with the same results.

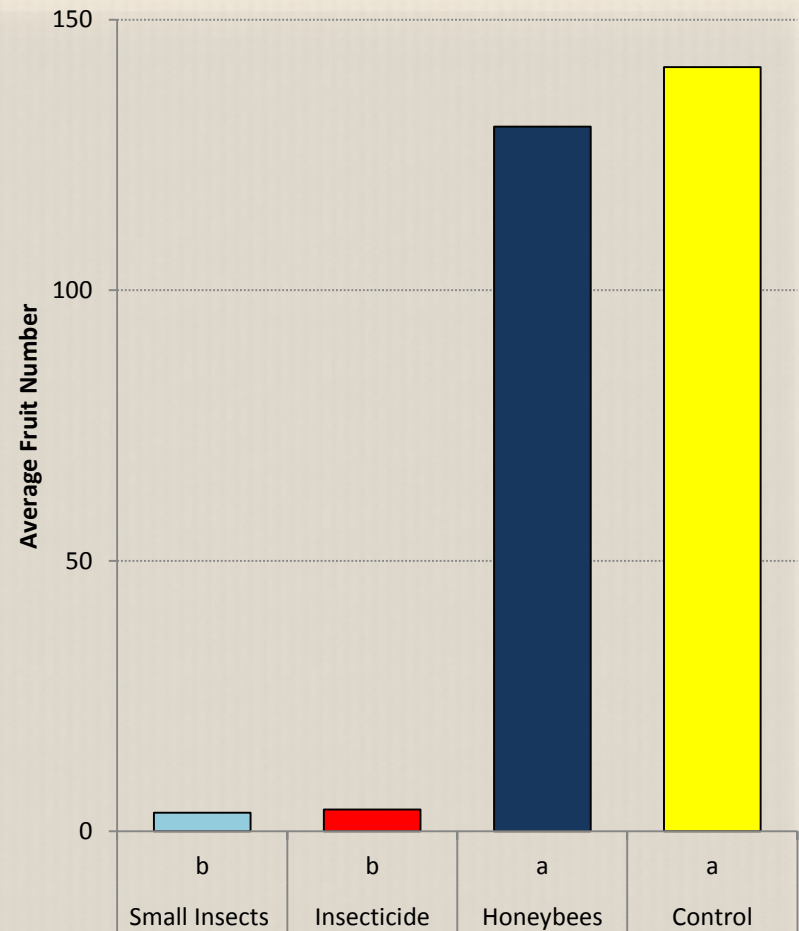


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California Results



Chile Results



How do I get bees to my trees?

- Hope that your neighbor is a beekeeper or has bees.
- Find a beekeeper looking for a home for his bees during the bloom season.
- Rent bees from a beekeeper.
- Become a beekeeper.
- Form a bee co-op.



Beekeepers looking for homes

- Least expensive option
- Little control over placement or number of bees
- Little control over timing of bees



Renting Bees

- Can be expensive depending on needs
- Can influence placement of bees
- Can influence when honey bees are available



Becoming a Beekeeper

- Requires a significant investment of time and money
- Have complete control over placement and timing of bees
- Must frequently check on bees to insure their health and well being
- “Free” honey!



Forming a bee co-op

- Spreads costs and risks between a larger group with same interests
- Less time and investment than going it alone
- Same benefits of control of placement and timing of bees
- More free honey!



Using Honeybees

- Honeybee race
- Paying for bees – how much to purchase and care for bees?
- How many hives? (avg. 2-4 hives/acre)
- Placement (on pallets)
- Keep the hives for the entire flowering season
- If managed well, can my bees be profitable?



Hive placement

- Side of roads – flat space for easy access highly desirable
- Best to place in location where hives will get morning sun
- On hillsides the bees will fly uphill – coming down to hive full and heavy
- Preference is for wildflowers, i.e. mustard



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How many honeybees
per tree are necessary?



How many honeybee
hives per acre are
needed?

Monitoring honeybee-hive density

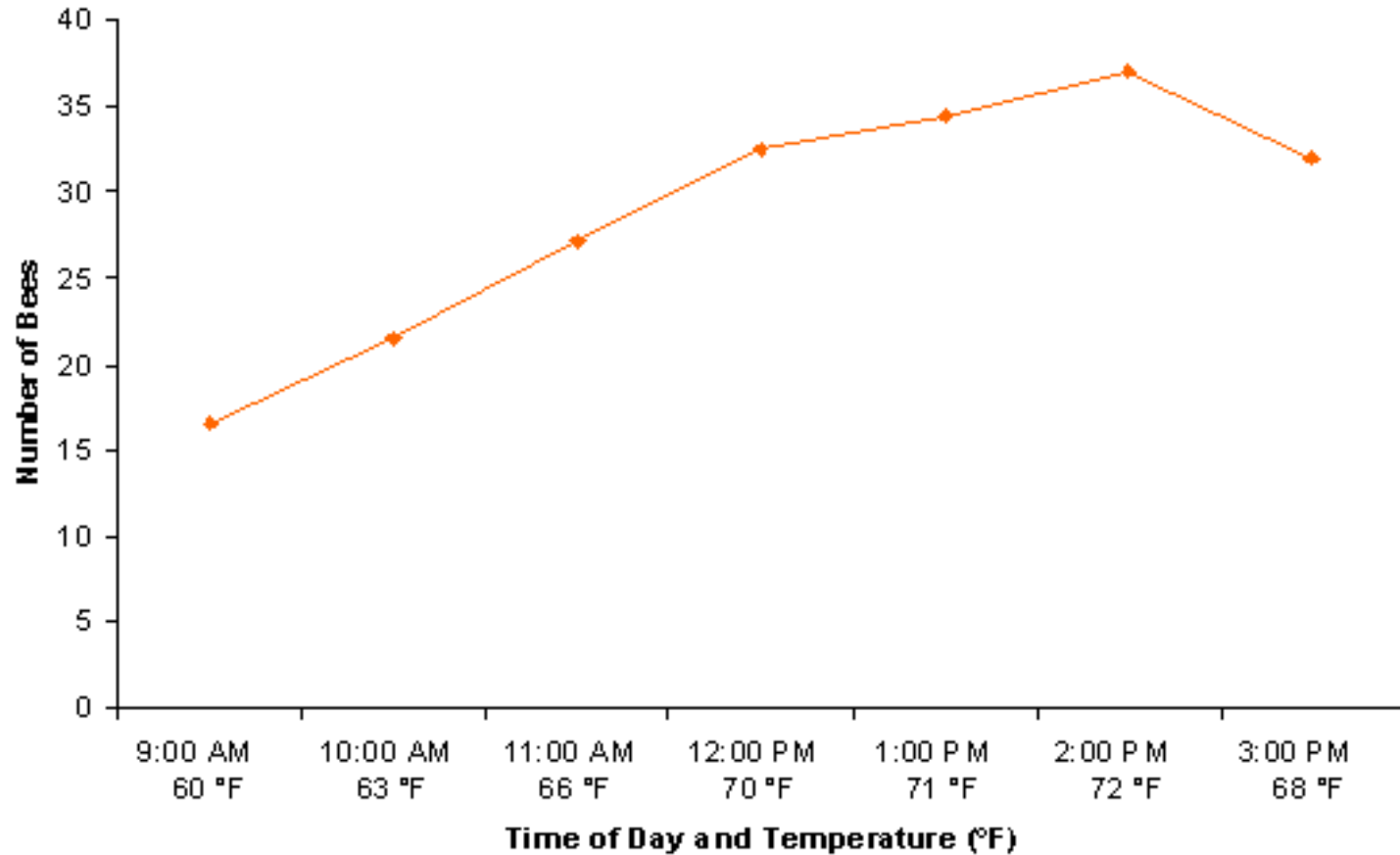
Bees per tree	Self-fruit set	Cross-fruit set	Adding hives
0	none	none	necessary
1 - 4	none	none	necessary
5 - 9	few	none	necessary
10 - 25	many	few on the 1 st row	recommended
26 - 55	many	on 1 st to 2 nd rows	may be helpful
more than 55	many	up to the 4 th row	not needed

Source: Ish-Am, 1994. PhD Thesis



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Honeybee activity is affected by daytime temperature.



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Time Taken: 11:49 AM
Date Taken: 5/11/2010
Exposure: 1/1879 sec.

Temp.: 16.1 Deg. C
Humidity: 52%
Barometer: 761.1 mb
Solar Rad: 434 w/m2



30 SECONDS BEES

MAY.11,10 11:49 AM



30 SECONDS FLOWERS

MAY.11,10 11:49 AM

Time Taken: 1:16 PM
Date Taken: 5/11/2010
Exposure: 1/7515 sec.

Temp.: 16.1 Deg. C
Humidity: 54%
Barometer: 763.3 mb
Solar Rad: 1018 w/m2



30 SECONDS BEES

MAY.11,10 01:16 PM



30 SECONDS FLOWERS

MAY.11,10 01:16 PM

How does the pollen move from
the honeybee to the stigma?



Electrostatic Induction

$$F = K \frac{q_1 q_2}{r^2}$$

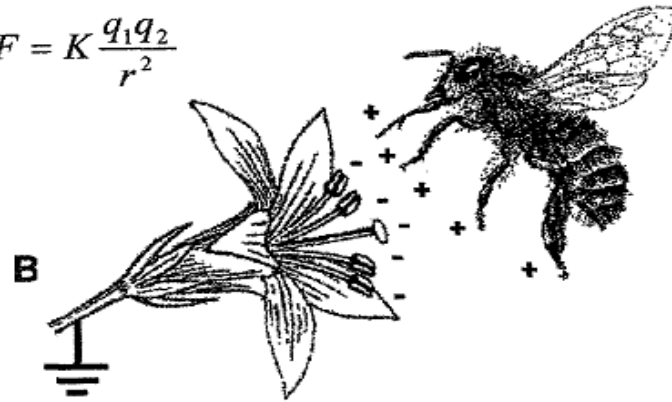


Fig. 1. A scheme of electrostatic induction. (A) A positively charged sphere approaches an earthed sphere and induces an opposite charge; (B) a positively charged bee, carrying pollen grains on its body, approaches an earthed flower and induces an opposite charge, especially on the edges of the flower. In both cases the induction causes temporary forces of attraction between the charged bodies (F). These

The stamen of the avocado flower have a negative charge while the pollen grains on the bee carry a positive charge. These opposite charges result in the pollen being pulled from the bee to the stamen aiding pollination.

Should I allow other plants
in my avocado orchard?



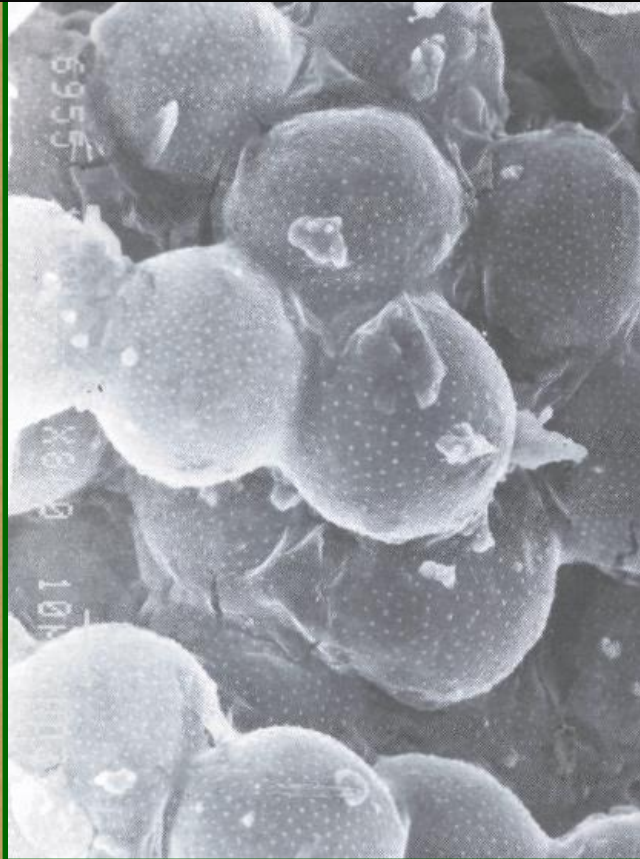
Pollen collection

- Like **mustard** pollen
 - Pollen shape, easier to pack into pollen load
 - Good protein source
- Will collect, but do not prefer, **avocado** pollen
 - Spherical shape makes it difficult to load

Allow mustard plants in your orchard or on sides of road

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Close-up of pollen in the honeybee's pollen load



Close-up of 'Ettinger' pollen in the pollen load of a honeybee

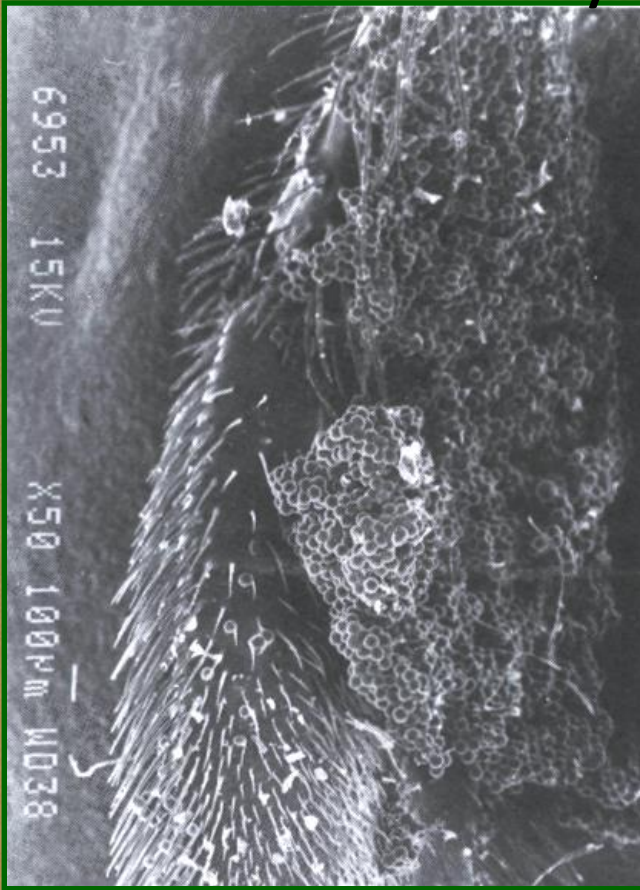


Close-up of White Mustard pollen in the pollen load of a honeybee

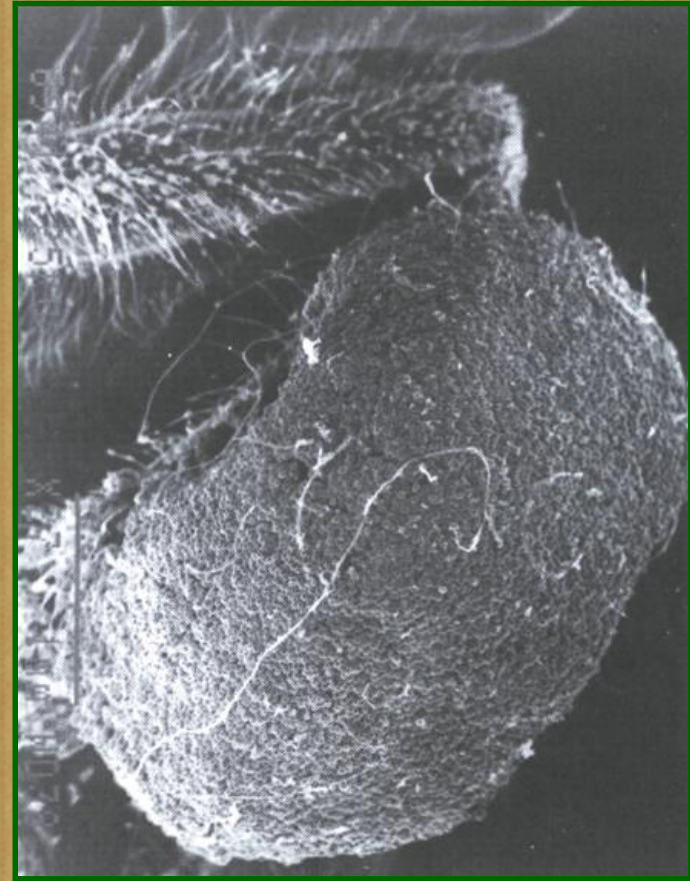
Source: Ish-Am, 1994. PhD Thesis

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Avocado pollen is not organized well in the honeybee's pollen-load



Pollen load on hind leg of a honeybee containing Ettinger pollen.



Pollen load on hind leg of a honeybee containing White Mustard pollen.

Source: Ish-Am, 1994. PhD Thesis

Honeybees as Pollinators in Avocado Orchards

- Avocados are not wind pollinated.
- Bees are much better pollinators than other small insects found in California.
- Beekeepers will rent hives to avocado farmers during the bloom period.
- Bees need a source of water provided for them near the hives.
- Bee hives should be distributed throughout the grove.

