

Varroa mite reproductive biology



Zachary Huang
Michigan State University
East Lansing, Michigan, USA

A collaboration with Asian, French and Australian scientists



Is this a female? Male?
How many of you have seen a male varroa?
Why not?

Varroa destructor Anderson & Trueman (Acari: Varroidae)

Adult female: 1.5 x 1.0 mm



ecto-parasitic mite of the honey bee, *Apis mellifera* L.

<http://www.cyberbee.net/>

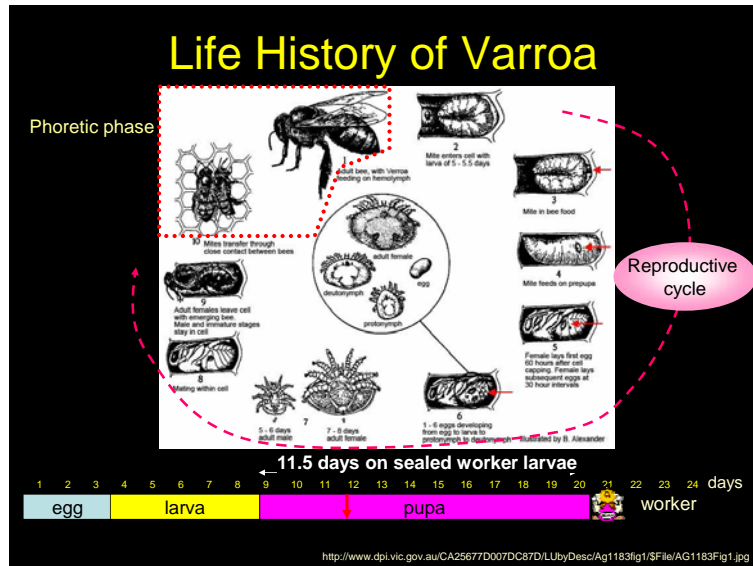
Vectoring viruses
e.g. DWV, IAPV

Inhibit bee's
Immune Response

Reducing
emergence wt
& protein

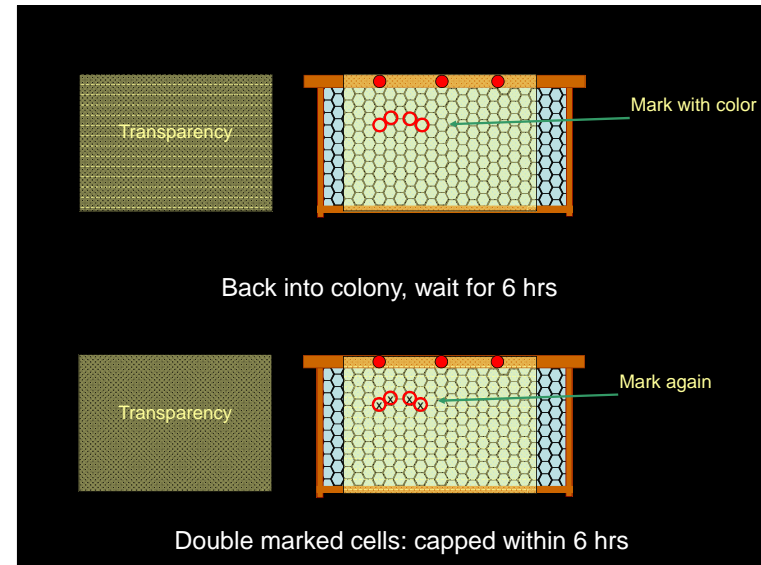
Adults live
shorter

Severe impact on honey bee industry
Economic loss on crops



Methods

- Obtain phoretic mites
- Transfer mites to cells
- Incubate at 34°C, 50% RH
- Checked daily for wax moth
- On day 9 (transfer at day 1), open cells for checking mite progenies



Mites were captured & transferred into newly sealed (within 6 hrs) worker brood cells on mite-free recipient frames. Brood was then incubated at 34°C and 50% relative humidity.

Mite transfer

larva prepupa

Mite extraction

Adult eclosion

1 2 3 4 5 6 7 8 9 10 11

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 days

egg larva pupa worker

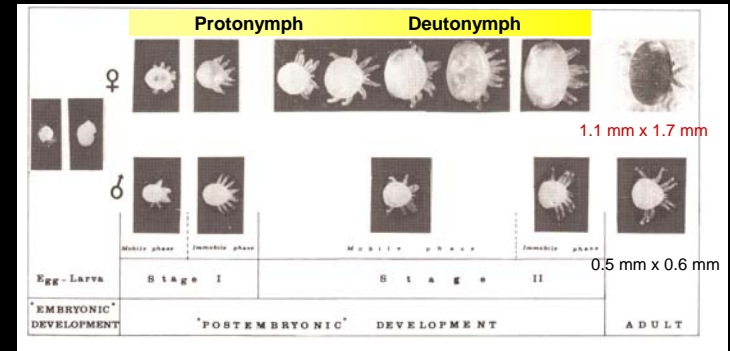
Map newly capped cells



Determining number of offspring per mite

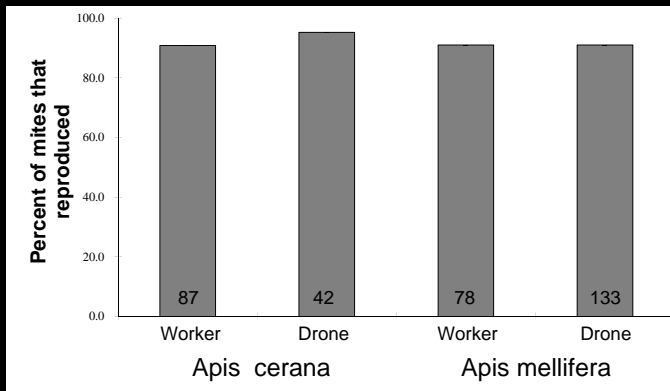


Ontogenetic development of the varroa mite



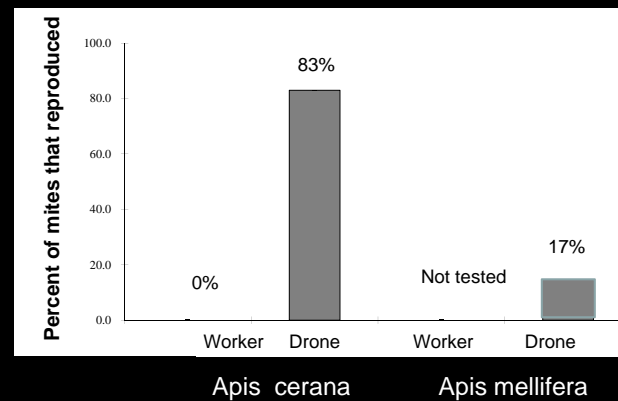
(from Ifantidis 1983)

Varroa from *A. mellifera* (Korea) and transferred to different hosts (Beijing)



Korea haplotype Varroa from *mellifera* can reproduce on both species and on both castes: % mites reproduced almost identical

Varroa from *A. cerana* (Vietnam) and transferred to different hosts (Xishuangbanna)



Vietnam haplotype Varroa from *cerana* can reproduce only on drones of *cerana*. Even on *mellifera* drone it was low.

2. Large cell size reduces varroa reproduction

Workers reared in drone cells:



2. Large cell size reduces varroa reproduction *Varroa from mellifera* transferred to worker larvae That were reared in worker or drone cells

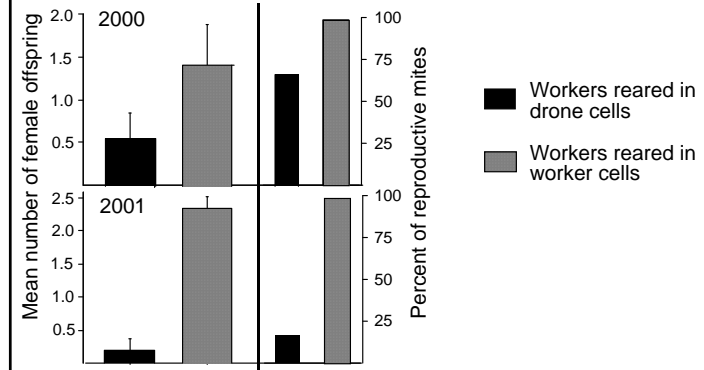


Figure 1. Mean number of female offspring and percent of mites that reproduced on worker brood reared in different cell types. Experiments were conducted in 2000 and 2001 in Beijing, China.

Varroa reproduced better in worker cells, suggesting large cells can inhibit reproduction. It is not clear if workers are different (e.g. more queen-like), or due to actual cell size difference.

3. Chemical mimicry of mites to different species of honey bees

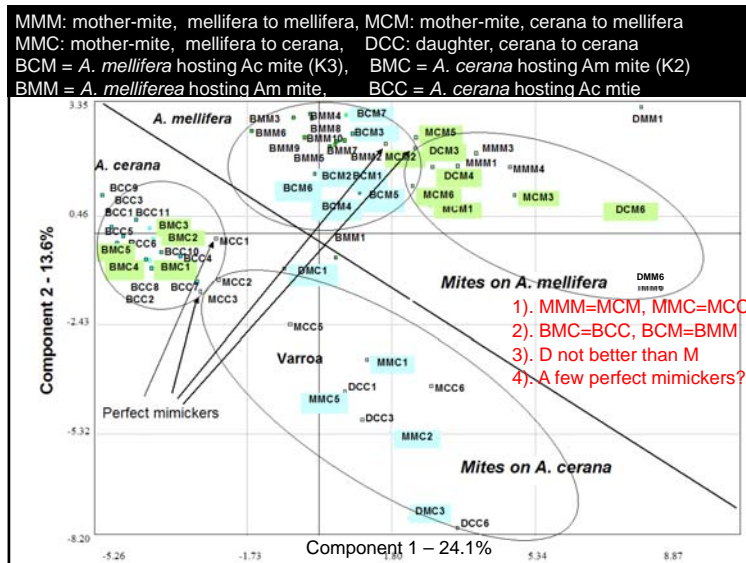
Previous studies have shown that the varroa mites can mimic the host cuticular hydrocarbons, perhaps enabling them to escape the hygienic behavior of the host honey bees.

Martin C, Salvy M, Provost E, Bagnères A, Roux M, Crauser D, Clement J, Le Conte Y. 2001 Variations in chemical mimicry by the ectoparasitic mite *Varroa jacobsoni* according to the developmental stage of the host honey-bee *Apis mellifera*. Insect Biochem Mol Biol. 31: 365-79.

3. Chemical mimicry of mites

- Transfer of mites from *Ac* brood
 - *Ac* brood (MCC)
 - *Am* brood (MCM)
- Transfer mites from an *Am* brood
 - *Am* brood (MMM)
 - *Ac* brood (MMC)

After 8 days, the mother mite, their daughters and the host pupae were extracted from cells and washed in hexane. The chemical signatures of both *Apis* pupae and their *Varroa* parasites were determined by GC/MS.



3. Chemical mimicry of mites to different species of honey bees

Summary:

1. Regardless of previous hosts (*cerana* or *mellifera*), mites transferred to *A. cerana* are more similar to *A. cerana* pupae profile
2. Regardless of previous hosts (*cerana* or *mellifera*), mites transferred to *A. mellifera* are more similar to *A. mellifera* pupae

Mites are able to mimic their hosts, even when the hosts are of different species! Remarkable ability to use chemical camouflage.

4. Do phoretic mites prefer nurse in a colony setting?

Although mite biology has been well studied, we still do not know:

Whether Varroa mites prefer nurse bees over older and younger bees in colonies.

-- Prior studies used petri-dishes/caged bees

Materials and Methods

4. Preference for phoretic hosts

Triple cohort colonies:

500 of each: foragers, nurse bees and newly emerged bees
 + a frame of honey, a frame with pollen, and a queen



Mite source:
Sugar dusting adult bees



~200 mites introduced into the triple cohort colony

24 hrs later, workers in each group recovered with forceps

Killed in alcohol and mites recovered



Statistical analysis

Hosts	# of bees	# of mites
Foragers	394	22
Nurses	425	56

Observed Frequencies for Rows, Columns

	Column 1	Column 2	Totals
Row 1	372	22	394
Row 2	369	56	425
Totals	741	78	819

Summary Table for Rows, Columns

Num. Missing	0
DF	1
Chi Square	13.679
Chi Square P-Value	.0002
G-Squared	14.168
G-Squared P-Value	.0002
Contingency Coef.	.128
Phi	.129
Cty. Cor. Chi Square	12.813
Cty. Cor. P-Value	.0003
Fisher's Exact P-Value	.0002

StatView outputs

5. Why phoretic mites prefer nurse in a colony setting?

Several possibilities:

1. Foragers should be avoided due to higher risk
2. Nurses are close to larvae, more opportunity to jump in
3. Nurses may have different nutrition, resulting in higher fitness?

We tested hypothesis #3: do mites which had previously fed on nurses show higher fitness?

Experiment 5

All mites harvested from pupae
Mites let to feed on caged bees (three types of hosts) for 3 days



9 days later, mite reproductive success were evaluated

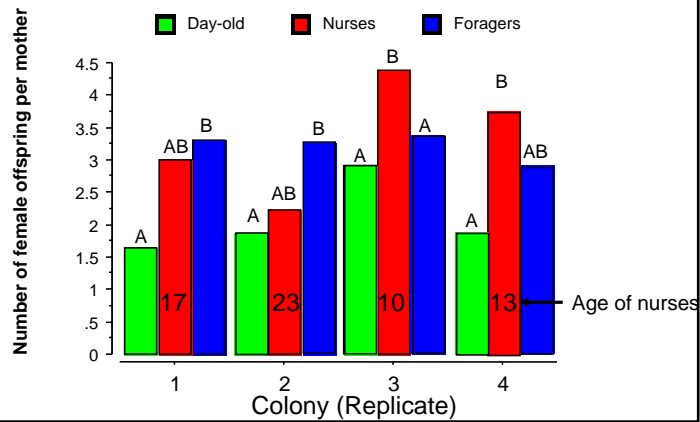


5. Effect of host type on mite reproduction:

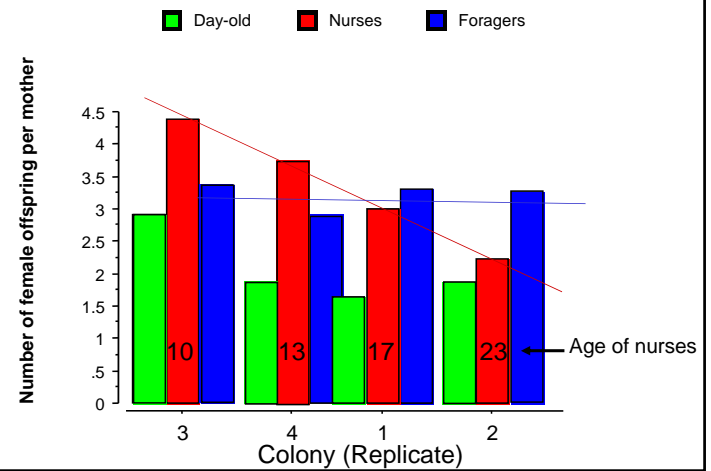
Day-old bees: consistently give mites lower fitness

Foragers: quite constant

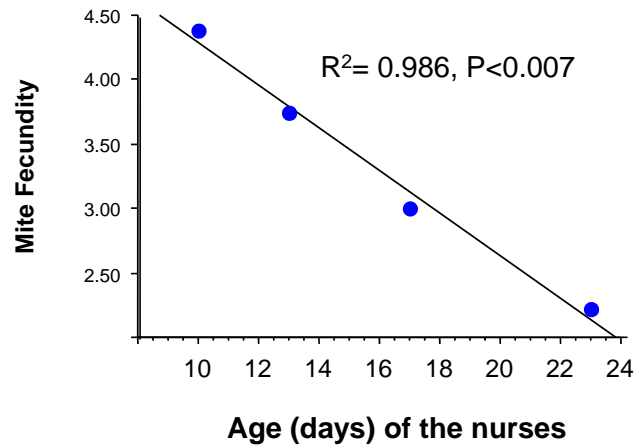
Nurses: variable



5. Effect of host type on mite reproduction:



There is a significant negative relationship between the age of the phoretic hosts and mite fecundity



Summary

4. Do Varroa mites prefer nurse bees over older and younger bees?

-- Yes, not only in petri dishes or caged bees, but also in more natural colony settings.

5. Is mite reproduction affected by feeding on different phoretic hosts?

-- Yes, and there is an inverse relationship between age of nurses and mite fecundity.

Conclusions

- Mite reproductions affected by many factors:
 - Pupal host type
 - Cell size
 - Phoretic host type
- Mites clearly prefer nurses, perhaps mainly due to a fitness gain.
- Mites have remarkable ability to mimic their host cuticular hydrocarbons.

www.beetography.com

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bees@msu.edu

Thank you!