Measuring Varroa Sensitive Hygiene

Varroa sensitive hygiene (VSH) is a heritable trait of the honey bee that controls varroa. This trait can be added to any population of bees and may be naturally present in many others, but only by knowing how to measure the level of VSH can a bee breeder add VSH to an existing bee population or enhance what is already there. The following describes how VSH works and how to measure it.

Common techniques for evaluating colonies for hygienic behavior or mite infestation do not measure VSH. A freeze-kill hygienic test does not measure VSH. Counting mite drop onto the bottom board and counting mites in a sample of adult bees are only designed to estimate mite populations.

VSH is Tested in Brood Cells

Varroa sensitive hygiene is expressed only by adult worker bees that are over 10 days old. Therefore, a colony cannot be evaluated until the queen being tested has produced a group of workers that are at least that old. This takes about 6 weeks. During those first 5 weeks the presence of a VSH queen has no effect on the mite population.

Hygienic removal of varroa-infested cells takes place only during a brief segment of the mite's reproductive cycle and only in worker brood that we estimate as being 4 - 6 days post capping. Therefore, we only measure VSH in worker brood that is aged 7 - 11 days post capping, immediately after the mites have passed through their two or three days of vulnerability (Figs. 1 and 2).

Unique Characteristics of VSH Bees

(1) During that span of two or three days (4 – 6 days postcapping), worker bees with the VSH trait will disrupt mite reproduction in a varroa-infested cell ***if*** the foundress female (the adult mite that entered the cell) has produced progeny. Disruption involves removing the bee pupa, which causes the death of all mite progeny and an uncertain future for the foundress.

(2) If a foundress mite has **no** progeny, her cell is **not** disturbed, and because of this second component, we can estimate the extent of varroa removal without knowing the initial rate of mite infestation.

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Accurately measure VSH with a 20-minute examination of brood

We can do this because of a fact about varroa that is independent of VSH; about 15% of the mites that enter brood cells will not produce progeny. The frequency of non-reproducing mites varies somewhat but is rarely greater than 20% of the mite-infested cells. If a colony has none of the VSH trait, reproductive mites will survive beyond the 6th day postcapping, and the proportion of non-reproducing mites will remain below 20%.

However, when VSH workers are present to remove some or all of the reproducing mites, the proportion of nonreproducing mites jumps to 30% and beyond. When non-reproducing mites represent 40, 65, or 100% of the infested cells, the workers have 50, 75 or 100% of the VSH trait, respectively. This relationship is a rough estimate, but it serves as a good working model.

Nonreproducing mites are easy to miss when examining brood. Some are found dead at the bottom of the cell. If the mite died before the host bee had spun her cocoon, the mite may be at the bottom of the cell on the other side of the cocoon ("entombed" by the bee's cocoon). However, in most cases a non-reproducing foundress is alive but not producing progeny (Figs. 3 & 5).

Examining Cells

- Use a sharp forceps to uncap a cell to see if the bee pupa is between 7- and 11-days post capping (when the pupa is purple eyed and older) (Fig. 2).
- If it is, remove the pupa and check for evidence of mites on the bee and in the cell (see Figs. 3, 4, & 5).
- If you find an infested cell, record whether or not the mite has progeny.
- When you have checked 100 cells, you are finished.
- Score your colony using the table in the Scoring Guide.
- It takes about 20 minutes to examine 100 cells.

Finding few infested cells

The Scoring Guide presents a solution. If you find one infested cell per hundred examined, that is good enough. If you want to feel more confident, count another hundred cells now or later. Finding no mites is probably the most difficult to score because you risk assigning the highest level of VSH without finding a nonreproducing mite. If a colony has a high level of VSH, one may not find any infested cells, especially if the colony has been expressing the VSH trait for over 3 months. If the colony has a

VSH history, one might assume that this colony has VSH at a high level. If you need to be more confident in assigning the correct level of VSH, the best option is to add a frame of young, capped brood from a varroa infested colony and then evaluate that brood frame exactly 7 days later.

Recording scores

Once the progeny of a queen has been evaluated there is no need to evaluate her progeny again. A queen may have as many as 3 VSH scores attached to her (her score, the score for the semen in her spermatheca, and the score for her progeny). Those scores stay with the queen for her lifetime. (see the Scoring Guide).

FIG 1

This bee pupa is about one day too young to evaluate. After uncapping the cell, move on to the next one. White body *with purple eyes* is the youngest stage to evaluate for VSH.

FIG 2

Bee pupae with tan bodies are probably 8 or 9 days postcapping, well within the age to remove and evaluate.

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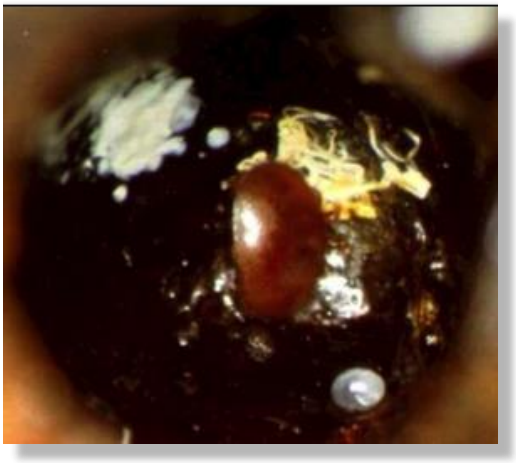

FIG 3

Looking down into a cell after removing the pupal bee, we find only a foundress female (brown) and one egg (at 5 o'clock). The material above and to the right of the mite is the bee's shed larval skin. The white mass at 10 0'clock is the mite's fecal patch. Score this infested cell as non-reproductive because the egg would not have been present 4 – 6 days postcapping.

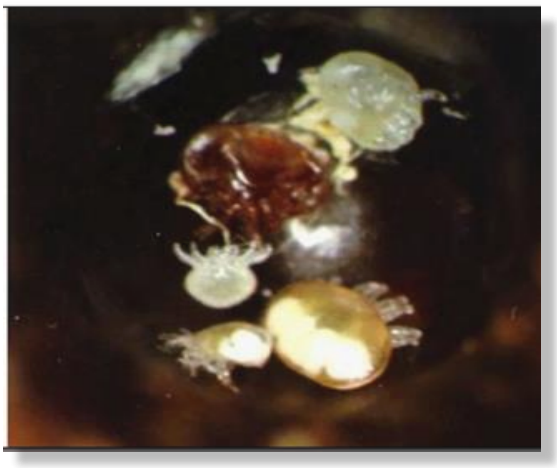

FIG 4

A foundress mite at the bottom of a cell after the host pupa has been removed. The other mites are her progeny. Note the fecal patch on the cell wall and in Fig. 3, both at 10 o'clock .

FIG 5

A non-reproducing mite often leaves her fecal patch on the bee (in this case the bee's abdomen) rather than on the cell wall. No, I don't know why.

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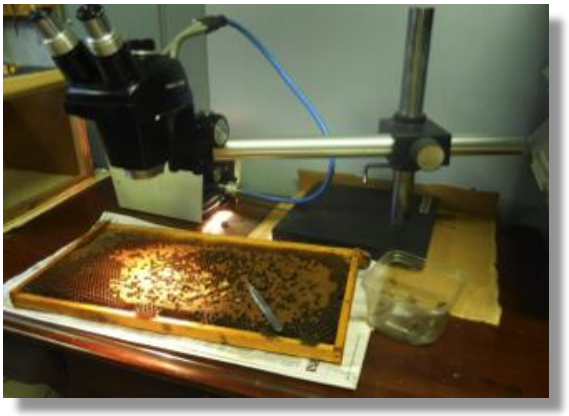

FIG 6

To evaluate brood, I collect a comb with worker pupae at least 7 days postcapping (purple-eyed or older). I use 4X magnification and focus a bright light on the bottom of the cell where the mites are usually found, it takes about 20 minutes to examine 100 cells.

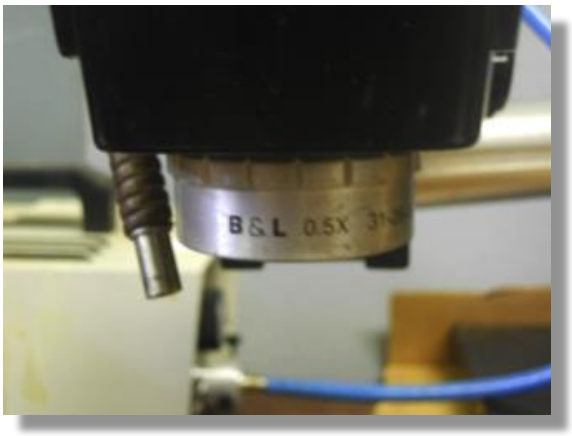

FIG 7

A 0.5 objective reduces the magnification. More importantly, it increases the depth of field and the focal distance, providing more working space between the scope and the comb.

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