**BRITISH COLUMBIA BEE BREEDERS ASSOCIATION**
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**BRITISH COLUMBIA HONEY PRODUCERS ASSOCIATION**
Promoting and encouraging beekeeping in British Columbia since 1920

# Field Assessment for Choosing Breeders

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# Field assessment for Breeding

This guide is an outline of the measures and observations of a hive that will allow you to compare hives and choose breeders using standard measures. It will also help beekeepers to look at their hives from an objective view and to keep records that will help them make management decisions.

Breeders look at survival, production, disease and pest resistance / tolerance and the temperament of their bees. Some bees collect more pollen or nectar. Some bees collect more propolis. Based on the breeder's goals, different values will be placed on the traits of the bees.

**Keeping records for choosing breeders**

Keeping a standard set of records allows the beekeeper to understand what is normal for their local area and reminds them of important timings such as "just when did that hive swarm and when should I expect eggs".

In addition to ongoing record keeping, breeders need to schedule complete assessments in spring and fall. These assessments can be an invaluable tool for choosing breeders.

# Assessment Day

**Behaviour of the Hive**

*Temperament and Aggression: rating of 1-3 / poor to good*

There are two traits controlled by genetics. One can be called temperament the other aggression. The temperament traits relate to calmness on the comb, flightiness of the bees and fanning during inspection. My ratings are 1 for poor, 2 for average, 3 for good. (you may wish to create your own rating scale)

The bees show aggression by whapping of the hands, whapping and focus on the face/veil, following the beekeeper after closure of the hive and stinging. Bees that show no aggression get a 3. Bees that show traits of aggression without stinging get a 2. Hives that sting get a 1. Aggression behavior can change due to weather, nectar availability, queenlessness and size of the hive.

Tracking behavior over time shows consistency in a hive's temperament and aggression. Aggression is a dominant trait so hives that rate 1 continuously should not be bred and should not be allowed to provide drones to the mating area unless you wish to work for several generations to eliminate the behaviour.

**Diseases and Pests**

Visual inspection of the hive for symptoms of disease is a basic assessment. Bees at the front entrance should not be crawling or dragging themselves. Look at the ground in front of the entrance for crawling and dead bees or chalk mummies. Tracheal mites, heavy Nosema and viruses can cause crawling out the front of the hive. Look also for dysentery on the front of the hive. After opening the hive observe the bees wings and look for k-wing.

**Nosema and Tracheal Mite Samples**
Microscopes are required to assess for Nosema and tracheal mite infestations.

Just as you start your inspection is a good time to take your samples for Nosema and Tracheal mite microscope inspection. If you are not doing an immediate exam of the bees then:

a) For Nosema use a paper bag and freeze the bees to dry them out and prevent growth of mold in the sample.
b) For tracheal mite samples place them into isopropyl alcohol

There are two approaches for the Nosema sample. The traditional method is to sample older bees from the entrance or inner cover. Look for balding bees. This approach assumes that older bees will have higher infestations.

In the case of Nosema, the alternative is to sample nurse bees from the brood nest. This is to identify how much Nosema is being passed to the larva. Choose a location for your samples and maintain consistency. The recommended treatment thresholds are based on samples of older bees. When sampling breeder hives be careful not to cross contaminate the samples. A new latex glove for each hive is one option. (Production apiaries are sampled as a whole rather than at the individual hive level) (see Nosema info sheet attached)

**Cappings and Larva**

Next inspect the brood cappings - look for spottiness, sunken cappings, discolouration or holes. This is also a good time to look for variations in the colour of the cappings. Hives with VSH behavior will open and recap cells and variation of colour in the cappings is a clue to that behavior: although some bees uncap and recap without cleaning out varroa so further testing is required.

Inspect open larva for EFB. Be sure to check the outer edges of the laying pattern as larva at the outer edge of the feeding curve may show symptoms of EFB before larva in the centre of the pattern.

Other maladies may be seen: most common are chalk, deformed wing virus (DWV) and sac brood.

**Hive Resource Measures**

Measuring volume of the bees and their resources is done by various scales. You will need to determine the level of information you wish to collect and maintain. I will list the options from least detail to most.

**Frames of bees**

1. Looking from the top of a box, simply count the number of frames occupied by bees. (This is risky, as the bees may be spread out width wise but have no depth into the box)
2. Look from the top and the bottom and count how many frames are covered by bees from top to bottom.
3. Remove frames of bees and any with 75% of the frame covered by bees one layer thick will be considered a frame of bees

*Note: I consider a Dadant honey super size frame as half a Standard size frame and a Langstroth shallow frame as 1/3. All measures are recorded as Standard sized frames.*

**Brood Area Count, Pollen Area Count, Honey Area Count**

1. Frames of brood – if a frame has brood count it (not very useful or comparisons if brood only covers a small area on the frame)
2. Use a count of portions of a frame. ¼, ½, 1/3 etc. (this is difficult to add up an compare and not a very sensitive measure, but will be adequate for some beekeepers)
3. Use a grid and count the squares of brood. A grid can be of various sizes and the smaller the grid the more detail provided. Grids can be made out of plexiglas with lines or metal mesh.

**Honey Production and Stores**

1. Honey can be counted by frames – width of frames is lost in the measure
2. Honey can be weighed
3. Ranges of honey can be recorded. For instance boxes removed can be qualified as light (<20kg), medium (20-30kg), heavy (>30kg)
4. Whole hives can be weighed and compared if the equipment is equivalent.

# Varroa Infestation Assessments

**Screened Bottom Board Natural Drops**

The screened bottom board is the most sensitive test for varroa mites. The lowest level of mite infestation will still be detectable by a natural drop assessment. This measure is not related to population and is difficult to use for comparisons between hives.

Clean the bottom board and wait 24 to 72 hours. A basic 24 hour drop may not be accurate due to variations in the drop between days. Days when bees hatch out more may have higher numbers of mites dropping. However, waiting too long after cleaning the board makes it harder to read the drops. It is best to do routine drop counts through the whole year.

Adjust your drop count by the number of hours between cleaning and counting.

*Formula*

*(# of mites dropped / hours of drop) x 24 = 24 hour drop.*

**Alcohol wash or powdered sugar shake**

Mites are attracted to the area of the brood nest where there is open larva so take a sample of bees from there. Use a jar marked for a 300 bee level (100ml / .42 cup). Use the formula below to compute infestation percentage of the hive.

$$\textbf{One hive \% infest} = \frac{\textbf{(mites in 300 adult bees from one brood frame) times by 2}}{\textbf{Divide by 3}}$$

$$\textbf{Apiary \% infest (24 to 84 hives) (sample every 5}^{\textbf{th}}\textbf{ colony)} = \frac{\textbf{mites in 8 samples of 300 bees}}{\textbf{Divide by 12}}$$

*This formula is based on research by the University of Minnesota.*

### Brood Infestation Level

Choose a frame of white to pink eye brood and open 100 worker cells and record the number of adult mites. This will give you a brood infestation percentage level.

## Varroa Measures of Resistance

### Grooming

There is no definitive test for identifying grooming hives in the field. However, there are measurements that will identify the probable grooming hives. Based on research it has been determined that bees that groom remove mites from their bodies, while non-grooming bees put up with the attached mites or are unable to remove them. Also, the bees do not tend to really start to groom until there is a minimum infestation of 10%.

***Differential Variance Between Measures.***

Hives that have high mite drops onto the bottom board, but have lower levels of mites in alcohol and sugar shakes can indicate grooming or hygienic behaviour. Not a perfect test but a good place to start.

***Rate of Increase method***

The equation to track the rate of population growth of the varroa mites is:

Rate of increase = Percent Increase / number of days

R=Inx/d

The beekeeper measures mite levels during willow pollen and then 65 days later counts again.

Example: At willow pollen an estimate of infestation is 100 mites. 65 days later an estimate of mites in the hive is 580.

r = In(580/100)/65 = .027.
In this case the growth rate is 2.7% per day.

This measure can be used to compare hives. Groomers or hygienic bees will have a slower growth rate than other hives.

***Reduction of Varroa over Broodless period***

The beekeeper takes a reading of the infestation level of the bees just after the beginning of a broodless period and then takes another reading just before brood laying begins again. The percent infestation in non-grooming hives will remain static or go up. Grooming hives will have a reduction in the percent of infestation. (Note: As bees die during this period, so will some of the mites usually causing the infestation level to remain about the same.)

When to test? In our area, the bees tend to be broodless by November and a second reading could be taken at the end of December or early January. Even if there is a little brood for the second

reading, Dr. Rob Currie reported that the mites present in a hive do not all enter the brood at the very beginning of the new brood cycle.

***Assessment of Damage to Mites***

Dr.Rob Currie stated at our recent workshop that studies of damage to mites found on bottom boards is a poor method and not effective in identifying grooming bees.

Dr. Currie also recommended a paper on grooming by Pia Aumeier in Apidologie 32 (2001).

**Varroa Sensitive Hygiene**

The VSH test requires set up and a second visit to the apiary. Firstly the bee breeder will need highly infested hives with at least a 10% infestation rate from which they can take a frame and place it into potential VSH hives. Prior to placing the frame into the hive, the frame is assessed for varroa infestation level - cells of newly capped brood are opened and mites counted.

Bees that are VSH remove mites during the white eye stage of the developing pupa. Not only do the VSH bees remove the mites, but for some reason, the mites left behind in a recapped cell are very likely to become infertile. Hives that recap and are not VSH do not show the same infertility rates. The VSH test is done over a 7 day period. When the frame is removed cells directly in line with the previously opened cells, are opened and mites counted. The number of infertile mites (adults without eggs or progeny) are also counted. This test is assessing removal level and infertility level of potential VSH hives.

A quicker 48 hour test is also an option, but will not determine the level of infertility inflicted on the varroa, only the percentage change in cells with mite infestation. The 48 hour test initially looks at the bees just prior to the white eye stage and then after at the purple eye stage.

In the field the identification of hives with cells open at the white eye stage can be noted so that further assessment can be made. Hives with cells open at the purple eye stage are more common, especially in hives with high levels of varroa. This is not an indication of strict VSH.

**Hygienic Testing with Liquid Nitrogen**

The liquid nitrogen freeze test for hygienic behavior is a quick method for identifying hygienic bees. A level of 85% removal in 24 hours is a good benchmark for choosing breeders. Hygienic behaviour is a very good indicator for hives that show resistance to diseases and varroa mite infestations.

Results for this test can vary with environmental conditions and treatments in the hive. For this reason the test should be repeated at least twice in sets of 2. This means freezing a sample and counting and then within a week repeating the test. That is one set. Then again some time later (a month?) repeating the test 2 more times within 7 days. This repetition will ensure you identify your most hygienic bees.

Hygienic testing should be done on bee pupa of white to purple eyes. (see info sheet)

*Formula*

$$\% \text{ hygienic} = \frac{100 \times \{(\#\text{ of cells in freeze sample} - \text{misses}) - \text{brood not removed}\}}{(\#\text{ of cells in freeze sample} - \text{misses})}$$

"misses" are those cells in the sample that start without any brood in them.

## Setting Up Your Trials

If you serious about becoming a commercial breeder and testing your stock you will want to take steps to start your trials by equalizing the populations at the starting point of your project. This will allow you to watch the changes and variations in your hives. You may also want to commit some of your hives to no treatments. To do VSH tests you will need varroa growers that are kept separate from your regular apiary. Also, if you treat continuously you will never know which hives are resistant. Government funded studies usually infest their hives.

I recommend that hives that fail to resist are treated and the queens replaced as soon as practical. However, I sample all of my hives and allow those who are managing without help to continue untreated.

Beginning with equal sized packages or equal numbers of frames of brood and stores is recommended. However, this is not always possible when you have a mix of situations in your apiary. If you have many hives, you may wish to identify those you consider your "best" using your intuition and general observations and then move forward to full assessments. This work is time consuming, but worth the effort to the serious breeder.

# Development stages of the Worker Bee

| Day | |
|---|---|
| 1 | egg standing |
| 2 | egg tilting |
| 3 | egg laying down |
| 4 | larva |
| 5 | c-shaped larva |
| 6 | squished curved larva |
| 7 | stretching larva |
| 8 | laying out larva |
| 9 | capped cell |
| 10 | larva |
| 11 | prepupa |
| 12 | prepupa |
| 13 | white eye pupa |
| 14 | pale eyed pupa |
| 15 | pink eyed pupa |
| 16 | purple eyed with white body |
| 17 | purple eyed with tanning joints |
| 18 | tanned body with white wing pads |
| 19 | grey pads to black head |
| 20 | general adult |
| 21 | bee emerges |