Healthy Hives Through Strategic Selection - *Spring*

James Lee, President SBGMI, Founder NQI

One essential strategy in sustainable beekeeping is preparing honey bees properly for winter. Honey bee colonies, particularly for Northern beekeepers, that can survive winter and come out healthy present several key decision-making opportunities that determine the course of your season. Albeit shorter than our Southern compatriots, the season can come fast and furious and end just as abruptly as it starts. One strategy that contributes to survival is without doubt how you manage varroa mites.

Many beekeepers are requesting information on how to begin selecting resistance in their apiaries this spring. There has been much work on a guide with a more comprehensive seasonal response for beekeepers, but in the interim, this is an effort to share first steps with everyone.

Understanding Mite-Resistance

Mite-resistance in honey bees involves several genetic and behavioral traits that enable bees to withstand or minimize the impact of mite infestations. (Because this process can be difficult to define with any one definition or acronym, we will simply define it as "mite-resistance.")

Key traits include:

Acronym	Full Name	Mechanism/Definition	Measurement/Assessment Methods	Key Distinctions/Notes
MNR	Mite Non-Reproduction	Describes the outcome in which mites entering a brood cell fail to produce any viable (or mature) offspring.	Typically determined by dissecting brood cells that contain a single mite foundress and calculating the proportion of cells in which mites show no reproduction.	Often used interchangeably with SMR; variability and low repeatability have been noted in field studies (e.g. Mondet et al.).

SMR	Suppressed Mite Reproduction	It is initially defined as a trait where bees actively suppress mite reproduction largely through behaviors (e.g. brood removal) that reduce the mite's reproductive success.	Similar dissection assays as for MNR, where the reproductive status of mites is recorded; early studies reported reduced mite reproduction in colonies expressing this trait. The Harbo assay encompasses and captures suppression of reproduction regardless of the cause (worker hygienic response or a brood effect).	Over time, evidence revealed that the suppression is primarily due to hygienic behavior, leading many researchers to reframe SMR as part of the VSH spectrum. New research is emerging that the brood themselves may play a role in the active suppression of reproduction
LVG	Low Varroa Growth	A measurement of the varroa population in a colony showing reduced or no growth in comparison to other colonies in similar conditions.	Assessed by tracking mite population dynamics over the season and comparing growth rates among colonies. Recurring sampling methods are used and may include alcohol/soap wash, and mite drop monitoring via sticky boards.	An integrated outcome trait rather than a specific behavior; it is influenced by several resistance mechanisms (including VSH, grooming, brood effects, etc.) and environmental factors.
VSH	Varroa Sensitive Hygiene	A specific behavioral trait where worker bees detect and uncap brood cells infested by reproducing mites, then remove the infested pupa, thereby interrupting mite reproduction.	Measured using standardized brood removal or recapping assays (often with artificially infested cells) that quantify the rate of uncapping/removal of infested brood.	A key heritable behavior actively selected in breeding programs; it is considered the primary mechanism underlying what was once termed SMR.

This table is based on findings from multiple research efforts (e.g. Harbo & Harris, Mondet et al.) and reviews of the literature that discuss the nuances between these traits.

Step 1: Initial Colony Assessment

- **Evaluate Colony Characteristics**: Assess the overall strength and characteristics of the colonies. Strong colonies with a large population of healthy bees are more likely

to be candidates for selection. Along with mite-resistance other colony traits are essential in a breeding program. Traits like honey and/or propolis production, gentleness, and winter tolerance are a few to consider. With selection programs, the potential for false positives always exists. Considering other preferred traits still ensures they remain in your selection pool if there is failure in mite-resistance as a primary attribute. It is important to note that **treated** or **untreated** philosophy will influence next steps.

- **Inspect Brood Pattern**: Examine the brood pattern for uniformity. Regardless of how the colony was treated for varroa previously, a healthy brood pattern will be essential for observing if you should consider further testing.

- **Follow the Seven-Week Rule**: Testing for hygiene and resistance in honey bee populations is best recommended when the workers in the colony are the offspring of the queen you are evaluating. Seven weeks is sufficient time for the brood and adult bee population to have heritable traits from the queen and be impacting hygienic or resistant mechanisms.

Step 2: Define Colony Starting Status

- **Treated:** A colony that was treated at all previously during the last two months. (In this instance SBGMI defines "Treatment" broadly to include non-chemical bio-technical methods to limit mite control as advocated by Disselkoen, Quiney, and Riley in their respective books.)

- **Untreated:** A colony that has not been treated with the queen bee as head of the colony within the last year, or at least two months prior in which brooding has occurred in earnest. (Northern winter months have low brood rates, and thus low mite-reproduction, false positives are more likely when testing for resistance.)

Step 3: Determine What Test to Use

- **Unhealthy Brood Order:** UBeeO™ is an excellent option for beekeepers who are seeking to begin a selection program in their apiaries. You may use this method in both **treated** and **untreated** honey bee colonies. The SBGMI would recommend following Dr. Kaira Wagoner's advisement, "while high-scoring colonies (>60%) are ideal for selection, medium-scoring queens (40-59%) are a good starting point if no high-scoring colonies are available." To learn more about UBeeO™, please visit https://opterabees.com/ or watch the latest SBGMI presentation HERE.

- **Simplified Harbo Assay:** The simplified Harbo assay is a method that the SBGMI recommends is best deployed in **late season**, when the colony is reducing brood rearing and mite populations are likely at their peak. If the colony has been **treated** within the last two months (including hard splitting, brood frame removal, and mechanical reduction of varroa), the potential for false positives are much higher. Dr. John Harbo, the author of the simplified method, indicates that colonies can be tested seven weeks after a resistant queen has been introduced to a colony. It is important to note however, that a varroa load is essential – without pressure from the pest, the assay to measure it's reproductivity is limited. Your results are only as accurate as the tool you are using to measure.

  Following this logic, a colony that was not previously **treated** may provide enough information to make queen breeding decisions for the season, but with a low confidence level. The SBGMI recommends that if you conduct a spring assay, finding one or two non-reproductive mites increases the confidence level, but should still be confirmed with a **late summer** test. If you do not have starting stock, this can help move in the right direction, but you may consider ordering a resistant queen from the Northern Queen Initiative or other reputable breeders. This can jump-start your program and give you adequate time to properly evaluate **late summer** colonies.

  To learn how to perform a Harbo assay, please visit the SBGMI E-School or watch this video presentation HERE. Dr. John Harbo's most recent guide on finding VSH can be found HERE.

- **<u>Alcohol or Dish Detergent Mite Wash</u>:** In the spring, performing a wash to determine accurate mite-infestation levels is challenging. During this time, both **treated** and **untreated** colonies will have varroa in the brood. It is less likely that varroa mites will be dispersed (phoretic) on adult worker bees. Whether there are fewer mites from having been **treated** or **untreated,** the presence of varroa is difficult to measure without investigating the brood for evidence of reproductive mites early in the season. The SBGMI would recommend establishing a "wash baseline" and monthly monitoring to track increases or decreases in infestation levels. The SBGMI recommends our video presentation with Randy Oliver HERE. Additional resources can be found on his website: www.scientificbeekeeping.com. An article of interest regarding mite washes and the frame-to-frame variation can be viewed by clicking HERE.

- **<u>Sticky Board and Mite Drop Monitoring:</u>** There is research that supports the accuracy of mite drop as a means of monitoring and as a predictive tool for mite-resistance. Currently, the SBGMI has no qualified recommendation of the process in application for selection as it pertains to this guide.

Based on a recent article by William Hesbach of Connecticut in American Bee Journal (March 2025, pp. 321-325), "sticky board drops, and high wash counts agree on the need for treatment." Randy Oliver states, "…you only need to know if the natural daily drop indicates that the mites are at a "tolerable" level on their growth curve. Note that sticky board readings can be wildly inaccurate at the beginning or ending of brood rearing, as mites "transition" from the adult bees to brood, or vice versa. **Stickies are the best sampling method during normal brood rearing periods while brood is emerging."** (https://scientificbeekeeping.com/fighting-varroa-reconnaissance-mite-sampling).

Colonies maintaining low drop rates equivalent to low seasonal wash thresholds would help identify potential candidates for grafting this season's queens and testing later for confirmation of resistance with a Harbo assay. William Hesbach's ABJ article and the table referencing the drop rate and treatment threshold below provide reliable data for use of sticky boards.

Mite Population Calculator

Month	Multiplier	Four-Day Average Drop (Total Drop/4)	Total Population Treatment Threshold
May	30	6	170
June	30	10	300
July	30	17	500
August	30	34	1000
September	30	67	2000
October	100	25	2500
November/December	100	25	2500

Fig. 4 *The total mite populations are calculated by multiplying the four-day drop average by the monthly multiplier. These can be used as treatment thresholds, but they must be validated by your observation of how effective they are at controlling mites in your colonies. The third column shows the maximum average drop before the treatment threshold in column 4 is reached.*

Additionally, an excellent presentation on using sticky boards as part of a selection protocol, Steven Riley of the UK delivers compelling data for the National Honey Show via YouTube HERE. You can also find his practical application of concept in his book HERE.

Conclusion

By using a data-driven decision-based approach during the spring buildup, beekeepers can systematically identify and promote desirable traits, leading to stronger, more resilient hives. Through diligent observation, testing, and record-keeping, beekeepers can contribute to the long-term sustainability of their own resistance breeding programs. All beekeepers

can initiate a program regardless of starting point. They may use their own stock or expedite the process by starting with vetted stock, or a combination of the two.

Freeze Killed Brood (FKB) and Pin Killed Brood (PKB) assays are still viable tests and can be used by beekeepers. These tests have veritably paved the way for the future of mite-resistance. There are many variables to consider when selecting for mite-resistance in honey bee populations. Academic literature does not agree on any unilateral method. In fact, what we do know so far is that there are multiple mechanisms at work in honey bee populations as they adapt to the stressors caused by viruses and varroa mite incursion.

This guide is only meant to be an intermediate resource for beekeepers beginning the process of selecting resistance within their own apiaries. The SBGMI and the Northern Queen Initiative encourages beekeepers to study further into the topic and refine their skill sets performing assays that are most accessible to them now.

What can we expect for the future?

As previously mentioned by Randy Oliver, the SBGMI agrees that mite counts in any form of monitoring during times of increased or decreased brood rearing become difficult to establish consistency. As mites transition to or from brood and adult honey bees, margin of error increases. Whether you are taking a **treated** or **untreated** approach to your management philosophy, you should be planning your breeding decisions a full season in advance. If you are just beginning this process, you can expect to see variability in the initial period as you begin to build a foundation for breeding resistance into your local mating populations and queen rearing practices.

Ultimately, the SBGMI would recommend employing the methods in this guide and confirming results by performing a Harbo assay on your top candidates in late summer. Remember, you cannot achieve mite-resistance if you never start the process.

Today is the day.

Additional References and Reading

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Special thanks to Matthew Kobe of Kobe Apiaries and Kaira Wagoner, PhD of Optera for their editorial prowess and recommendations.

The Northern Queen Initiative: Improving Value, Availability, and Production of Mite-Resistant Honey Bee Queens in Northern Climates

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under agreement number H011171409 through the North Central Region SARE program under project number ONC24-153. USDA is an equal opportunity employer and service provider. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and should not be construed to represent any official USDA or U.S. Government determination or policy.