BEE VET

Diagnostic Approach Part 2

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In my high school and early college days, I had the privilege of shadowing several James Herriot types of veterinarians. From flying over the country-side in some old jalopy to the next dairy farm (with no GPS) to rattling off mile-long prescription drug names, I can remember innocently (and somewhat naively) marveling at how they could possibly know and do "everything". I wondered if they received some special bolt of knowledge from the heavens upon graduation from vet school. After 21 years of being a veterinarian, the idea and expectation of knowing "everything", just makes me laugh. So how does one approach the diagnosis of all diseases in all animals? Well, veterinary school and life experience has taught me a few things . . .

Examination of healthy brood frame.

Allow me to share some insight that you may find amusing. In veterinary school, I was introduced to the DAMNIT diagnostic system, a mnemonic acronym and perhaps a somewhat sarcastic commentary on the way docs may feel regarding the task of searching for diagnoses that may be illusive, vague, deceptive, life-threatening, and even unknown. Each letter in DAMNIT stands for a certain category of disease and is meant to direct us through a systematic, scientific, diagnostic method for every animal and every disease situation we encounter. The categories are as follows:

Degenerative
Anomaly, Anatomic
Metabolic
Nutritional, Neoplastic
Infectious, Immune, Idiopathic, Infarct
Traumatic, Toxin

With the exceptions of Neoplastic and Infarct categories, I believe the other categories could apply to various honey bee pathologies. Note that "Idiopathic" is a major category. "Idiopathic" literally means the disease makes an idiot of us. CCD sound familiar? Unfortunately, even with our modern medical technologies some diseases in human and animal medicine remain unknown. Bee maladies are no exception, but we keep learning each day.

These DAMNIT categories allow doctors to first consider widely the possibilities and then narrow the focus on what may be causing the disease. We will develop what is called a "differential diagnosis" list or a list of diseases we consider to be the most likely cause or causes of the issue at hand. We will then decide which diagnostic tests will be helpful in ruling in or ruling out possibilities on our differential diagnoses list. Many diseases in humans and animals, including bees, have similar clinical signs and presentations. Performing diagnostic tests are objective ways to obtain data that will support the most accurate diagnosis or diagnoses, which will hopefully lead to the best treatment, recovery, economic savings, and/or course of action.

One hard rule I learned early on as a veterinarian, is that there is no rule that says there must be only one problem, one diagnosis, one pathogen causing the animal's disease. This fact, of course, further complicates the diagnostic process, but complete and accurate medical diagnosis is not easy. In honey bees it is certainly not uncommon to see multiple stressors and pathogens contributing to the collapse of a hive. For example, if a beekeeper says their hive died of starvation or "Winter" . . . ok but why did they die of starvation? If bees simply died due to Winter, we would have zero bees left after one year. There were likely other underlying cause/s.

An objective diagnostic approach can even be helpful during a post-mortem exam of a hive, or what we would call a "necropsy." A necropsy exam can be performed, and diagnostic samples may still be taken to determine the cause or causes of the hive's demise. Finding a definitive diagnosis will be helpful in taking steps to preserving any remaining hives and may guide the beekeeper on necessary management changes.

Of course, experience working hives measured in both years and "mileage" can be invaluable in making the most accurate hive assessments. Combining beekeeping experience with the best objective data gathering is a win-win for beekeepers, bees, entomologists, and veterinarians. Much data we currently have about hive death is based on survey data, often utilizing non-specific diagnosis categories, and educated guesses from a variety of levels and types of beekeepers. Continuing to "team up" on ways to obtain the most accurate data will improve our collective ability to assess what is objectively happening to our hives.

Diagnostic tests

Diagnostic tests can be performed in the field or in a laboratory setting. Field tests are performed first and may be good for screening for disease and/or developing tentative diagnosis/ses,

Dead bees at a hive entrance warrants further investigation.

but they rarely absolutely confirm a diagnosis. Confirmatory and gold standard tests are typically sent out to a laboratory.

Field tests

Field tests start in the beeyard with exams or hive inspections. The exam itself is a diagnostic test and a very valuable one. Exams in honey bees start with a visual inspection of the exterior of the hive. Much can be learned without even opening the hive, including, the strength/population of the hive, hive activity/behavior, normal morphology of adults, the presence of dysentery and/or any abnormal dead bees at the entrance. If scales are utilized, hive weight and hive weight patterns over time can be assessed.

Very few diseases have what is called a "pathognomonic" sign. A pathognomonic sign is a clinical sign found on a physical exam that is absolutely diagnostic for a specific disease. A couple of bee diseases do have pathognomonic signs, one is "Chalkbrood", caused by the fungus *Ascophaera apis,* is seen at the entrance of hives as discarded, white, mummified brood.

After a thorough exterior exam, an internal exam should be performed. Ideally, internal exams should be avoided in harsh or cold weather conditions. Four major items should be assessed while in the hive: nutritional status, queen status, brood status, and adult bee status.

The hive should be assessed for adequate stores, both honey and pollen. Brood frames should be evaluated for an even and seasonally appropriate patterns to assess both the health of capped brood, open brood, and the queen. Adult bees should be observed for normal behavior and anatomy as well. As much of the hive as possible should be examined to gain an adequate and thorough evaluation of the hive's health status. Many brood diseases and viral diseases, affecting both brood and adults, can have similar clinical signs. *Varroa* mites should always be considered as a primary, underlying, or contributing cause of hive abnormalities.

If brood disease is suspected based on hive assessment further diagnostics should be performed. The Match Stick test and Holst Milk tests are field tests that can be performed quickly with few materials to help determine if AFB is to be suspected. Commercially available antibody tests for EFB and AFB are also available and can be performed in the field.

Varroa mite count should be performed on a routine basis (monthly to every other month during the beekeeping season) during regular inspections and with sick hives. Alcohol washes are the preferred method for accuracy. Nosema spores can be detected by collecting whole adult bee samples for later examination in the lab. Whole honey bee samples are macerated and then viewed under a microscope to detect Nosema spores.

Confirmational tests

Confirmational tests are sent out to laboratories. The USDA Bee lab in Beltsville, MD provides testing for foulbrood as well as antibiotic resistance screening on samples. A few university animal diagnostic labs (Penn State University) are starting to offer AFB testing as well. Viral testing can be found at a few university labs in the U.S. and Canada (see reference links below). The Bee Informed Partnership certainly offers a variety of diagnostic opportunities including testing for *Varroa* and Nosema. Turn around time for these tests should be considered when deciding on the initiation of treatment.

Field tests can be very helpful in developing a diagnosis.

Beautiful bee entrance with normal actitity and behavior.

Treatment – what if it cannot wait?

Ideally, it is best to have a proven diagnosis before treating any disease. Using drugs/chemicals haphazardly can lead to further harm to the bees and can lead to drug resistance. However, there are a few exceptions, namely, American Foulbrood. If AFB is suspected in the field immediate action and treatment should ensue. The state apiarist should be contacted, and state and federal laws should be followed for treatment.

Veterinarians are permitted to start treatments immediately based on a tentative diagnosis if they find it appropriate. State apiarists, the beekeepers and veterinarians can all work together to be sure that proper treatment is initiated and samples are also sent off to a lab for confirmation of AFB.

In the final portion of this article series, I will address in more detail the development of treatment plans as we make our way full circle back to the best treatment: prevention. BC

Some bee laboratory resources for confirmatory testing:

https://bee-health.extension.org/usda-ars-bee-labs/

https://www.ars.usda.gov/northeast-area/beltsville-md-barc/beltsville-agricultural-research-center/bee-research-laboratory/

https://www.ohiostatebeekeepers.org/2017/announcements/news/nagc-launches-beecare-testing-for-honeybee-diseases/

https://www.gov.mb.ca/agriculture/animal-health-and-welfare/vds/pubs/vds-lab-manual-honey-bee.pdf

https://beeinformed.org/