'Bout a 100 – Sideline Beekeeping

FACING THE CHALLENGES OF SIDELINE BEEKEEPING – COLONY CONTAMINATION

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Fear of contamination

Next on my list of the **Ten Challenges Facing Sideline Beekeepers** (Number 5): *Fear of Contamination of hives and hive products from chemicals.* Many beekeepers consider pesticide contamination to be one of the key factors in Colony Collapse Disorder (CCD), even though there has been no defining pattern from the research conducted and reports to date. There is growing evidence that varroacides (pesticides specifically labeled for *Varroa* mite control) may leave residues in the hive, especially in beeswax. Both "lab chemicals" and natural chemicals have been linked to hive contamination. What do these contaminates do? They appear to shorten the life of bees, reduce the production and fertility of queens and drones, and cause bees to die earlier. The results are so threatening that you wonder why beekeepers use them!

The chemistry of the beehive

The source of a chemical does not make it safe or dangerous. Laboratory molecules may be very risky or completely safe, while so-called "natural" materials can be just as lethal as anything developed by a modern chemical company. All this has to do with the way molecules work, and if they attach to products inside the hive, like beeswax. Several years ago ARS-USDA researcher Eric Erickson (now retired) compared the wax comb of a beehive to the liver in a mammal. The wax serves to capture natural environmental contaminates and protects the colony in the process. This is not necessarily the case with human-made chemicals and natural products not ordinarily exposed to the colony. Then the wax serves to not only store the chemical(s), but also serve as a release system to continuously re-expose the colony to the material. This "timed-release" dosage mechanism may be responsible for long-term sub-lethal effects that do not show up in routine screening experiments that chemical companies and researchers routinely use to test a compound prior to release.

Contamination can come from the environment as well as the beekeeper.

In August 2008, Penn State researcher Maryann Frazier reported at the meeting of the American Chemical Society that there are "unprecedented" levels of fluvalinate and coumophos (miticides used to reduce *Varroa* mite levels) in "all" hive samples (especially beeswax, which is harvested and rendered into new wax comb foundation). More important there were lower levels of 70 other agricultural pesticides and their metabolites in pollen and bees. In November I listened to a French chemist and commercial beeswax processor report that in addition to fluvalinate, they found large residues of Thymol in certain wax samples. This was a preliminary report, and I want to emphasize that fact.

The large number of chemical contaminates inside the beehive, brings into play the issue of *chemical synergism*, where one plus one is not two but much more than that; the interaction of two or more molecules may be far more serious than either of them taken alone. When you add so-called "safe" chemicals from modern life – lawn treatments, agricultural fungicides and even landscape herbicides – these may have a boosting effect on miticides and cause problems. Further, the use of chemicals for *Varroa* control that beekeepers consider safer and less likely to be an issue for colony health may be a dangerously incorrect assumption. All chemicals are suspect, and require extensive, meticulous testing in combination with other common compounds.

The only way to win the war against *Varroa* is not to play.

War Games is a 1983 teen-drama movie that flirted with nuclear war only to conclude *that the only way to win the war is not to play.* In the movie a secret government computer that controlled missile launch is hacked into by a teenager who starts to play "Global Thermonuclear War", therein starting the real thing! The computer is programmed to play a game, and tests all possible combinations and, in dramatic Hollywood fashion, reaches the *To Win, Don't Play* conclusion.

> "It takes less genetic programming to develop a social behavior than to develop specific genes to fight each disease that comes into a hive, and is thus more efficient as a controlling strategy."

This is a growing thought among many beekeepers: the only way to win the chemical battle against the *Varroa* mites is not to play the game. There is a growing movement to eliminate ALL pesticides from the beehives in an effort to develop a healthier bee stock. In addition to hygienic behavior that I will address in a moment, many beekeepers want to eliminate pesticide use completely from their hives and allow the bees to go through the selection pressure Nature will provide and ultimately come up with a stock that shows survivor characteristics: they can live without chemical treatments in an area loaded with *Varroa* mites.

In January 2009, Michigan State University Emeritus

Professor of Entomology Roger Hoopingarner wrote an essay he circulated on the Internet in which he reported observations made on his visit to South Africa. He discussed the methods beekeepers there used to treat *Varroa* mites. His words ring true, and I will use my former University Advisor's words once again as a source of direction:

The bees (Apis mellifera scutellata) *are very hygienic bees. The beekeepers have almost no problems with diseases like AFB or chalk brood. They also no longer have any problems with* Varroa. . . . *The real reason for the lack of trouble with* Varroa *is that when* Varroa *came to South Africa, all the beekeepers decided to not use chemicals to control the mites. (The decision may have been somewhat economic, but it turns out that was the right decision.) Initially, the beekeepers lost colonies, but in four years they were back to beekeeping just as if nothing had happened. They eliminated the susceptible colonies and only the strong survived.*

Enter the honey bee genome

A few years ago, when the genes of the honey bee were analyzed as part of the Honey Bee Genome Project, researchers were surprised to learn that honey bees have fewer genes to protect them from natural diseases than even mosquitoes. This makes the honey bee less equipped, genetically at least, to fight disease than the common mosquito. The honey bee has an advantage over the mosquito because of the social structure of the hive. As the result of the evolution of certain behaviors, bees are able to manage diseases without having specific genes to provide such protections. Most of us have knowledge of hygienic behavior of bees, a complex set of behaviors that allow the colony to detect, uncap and remove unhealthy larvae and pupae from inside the brood combs. This one behavior provides protection against multiple diseases and also mite infestation: Research has shown that hygienic behavior is an effective method of control of American and European foulbrood, chalk brood, sac brood and is helpful in the reduction of *Varroa* mite infestations. Bee behavior controls these health challenges, although the nature of the behavior may have a genetic basis. One might conclude that it takes less genetic programming to develop a social behavior than to develop specific genes to fight each disease that comes into a hive, and is thus more efficient as a controlling strategy.

Kefuss-Bolt bees in November 2008. This is one of hundreds of colonies developed from breeding families of bees that have not been treated in Kefuss's Live and Let Die breeding scheme.

The limits of hygienic behavior

At least two challenges exist with the use of bees selected for hygienic behavior. First, colonies must be hygienic from both the queen and drone side, and second, even the most hygienic colony does not deal effectively with in-migration of mites from dying, non-hygienic colonies.

Marla Spivak and Gary Reuter, University of Minnesota researchers who developed the Minnesota Hygienic Strain of bees, will tell you that in order for a beekeeper to obtain real benefits from these bees, they must keep all the colonies in the apiary headed by pure hygienic queens that have mated to at least fifty percent hygienic drones. Since the breeder queens for these stocks are instrumentally inseminated but daughters are not, the drone supply in the area where the daughter queens are mating must be predominately hygienic-gene carrying drones. Functionally improbable for the smaller beekeeper, this is an enormous challenge for the large beekeeper, and will require extensive investment in queens and labor for success.

The hygienic mechanism controls mites at the brood level, and does not provide the colony with one bit of protection from an influx of *Varroa* mites from other colonies. This can and will happen when a colony in the area of hygienic bees collapses from *Varroa* mites. The worker bees scatter to other colonies, as do surviving drones – all of them potentially carrying adult female *Varroa* mites and a source of re-inoculation. If the queen is not mated to 50 percent hygienic drones, or is a daughter supercedure queen, that colony is at risk for building *Varroa* numbers and being affected by the disease. I know that many beekeepers distrust migratory beekeepers who place colonies in their area at the end of the pollination season at just the time of colony collapse from *Varroa* mites. It may be possible to deal with a small number of colonies with colony collapse disorder, but to have large apiaries filled with collapsing bees nearby can be an overwhelming biological event.

In areas where non-hygienic colonies are not treated for *Varroa*, or have mites that have developed resistance to the miticide, or the beekeeper is not treating properly, colonies will eventually collapse and spread mites to other colonies in the area. Undoubtedly this is why all colonies in South Africa benefited by being untreated. The use of chemicals in some colonies profoundly delays the benefit from a strong selection against the mites.

Live or let die

In November I visited Toulouse, France where American-born commercial beekeeper John Kefuss has used no chemicals for ten years, and has limited his bees to those without a history of chemical control. Of course he suffered great losses at first, but now his stock demonstrates very low levels female mite reproduction (he monitors this by making annual brood counts). Kefuss is quick to point out that he does not use the hygienic model of selection and testing, since it only selects for one set of behaviors. Instead, he wants the final bees to possess as many mechanisms of *Varroa* control that they can possibly have. There is evidence of *Varroa* control through adult bee grooming, and a suggestion of other mechanisms as well. Kefuss has set up a system where all such mechanisms are allowed to develop in a miticide-free environment. He does not treat for *Nosema*, foulbrood, chalk brood or sac brood. All are allowed to follow the same path of natural selection for resistance.

It is an enormously gutsy approach for a solitary commercial beekeeper. But now the bees have low mite reproduction, from whatever mechanisms, and the bees are productive. His breeder queens sell for the equivalent of $650, making them the most expensive breeder stock I know. One of his customers is an Australian queen producer selling packages in the United States. Welcome to our global beekeeping economy!

Roger Hoopingarner finished his article with the following quote:

There are some areas, and some beekeepers, that seem to be able to survive without chemicals. I suspect that these beekeepers have either a naturally isolated area, or through persistence they have saturated the area with genes for resistance. This last method may work for many beekeepers, and eventually the country. However, that is a long process that takes real perseverance on the part of the beekeeper. Not only does s/he have to select (or buy) the queens for their colonies, but they have to make sure that when a queen is superseded that they replace the queen immediately so that no non-resistant drones are placed into the free-roaming population. Past experience with the hygienic genes would place the saturation of the gene pool of an area at from four to six years. The four-year time-frame from South Africa now makes sense.

It is fortunate that we already have some resistant bees, such as the VSH strain and the Minnesota hygienic bees. Remember though that when you put these queens into your colonies that they should be marked and their life span kept track of very carefully as a supercedure queen will dilute the selection for resistance.

Eventually maybe these pockets of resistance will coalesce and we will have resistance throughout the country. I think it's sad that it will take at least 25 years to get resistance to Varroa. *A process that could have been accomplished in four or five years – just like South Africa.* BC

Dr. Connor is currently planning road trips for 2009. He has preliminary plans to be in Oklahoma and Texas in April, and is trying to plan a queen rearing and bee-breeding program for the Northeastern states in the Spring. If you are on the way to or from these locations, and want to plan a visit, contact him at ljconnor@aol.com.