Bee Mites And Mineral Oil
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I wish to apologize for the delay in publication of details of my work on this subject.

The reasons are unintentional and compelling. There were many questions that I felt needed to be answered (some of which I am still pursuing) and because I suffer from double vision (from a bout with hyperthyroidism) that induces severe headaches after periods of field work, reading, use of word processor and other tasks that require eye strain. Although the project is incomplete, I feel that my findings are significant and valuable to beekeepers who may wish to implement them. Also, my findings may be valuable to other investigators who may wish to perform related work on this subject. Hence release of present findings is considered appropriate at this stage. (Technical language and statistical data has been carefully limited).

Background:

Born and raised on a farm, I was initiated with animal husbandry chores as a very young child. I started caring for sick animals by smuggling them into pens heavily crowded by my "patients." I still recall my parents' admonitions for "wasting" time and money on "worthless" causes, especially my mother's for using her castor oil to treat leg mites on chickens and ear mites on rabbits. My experience with mineral oil continued when as a young veterinarian I used mineral oil for treating ear mites on cats. Later in my career, mineral oil became part of my professional "tool bag" when as a government supervisor of food plants, I approved the use of food grade mineral oil for maintenance of food preparation equipment.

I observed the first Varroa mites in 1983 while working with honey bees in Spain. From that date, I became fascinated with the ability of the little creatures for attacking honey bee colonies and eventually destroying them. At the time, Fulvex was the chemical of choice in Europe for treatment and cure of bee mites. I suspected mites would eventually develop resistance to Fulvex as most often happens with chemicals used for disease control, fact that was later corroborated by other investigators (Faucon et al, 1955; Lodesani et al, 1955; Smodgen et al, 1955). The potential need for a different agent to treat bee mites in case the mites develop resistance, led me to wonder if my "oil treatment of old" would be as effective for the treatment of bee mites. While pondering about this possibility, many other questions arose in my mind. 1. would mineral oil affect honey bees? 2. mode, quantity and frequency of application of the oil. 3. would the oil affect bee larvae or the egg laying ability of the queen? 4. could the oil be applied all year long or be limited to seasons? 5. what would be the mechanism of action of the oil?

From my previous experience, I knew that oil kills mites. I became intrigued with the idea of finding the answer to this puzzling question and started researching literature on mite biology, anatomy, physiology and other factors that could lead to the answer deriving the following data.

1. the body of the bee mites is flat, thus having a high ratio of surface volume (factor also used by Italian researchers of bee mites as expressed on a recent post to Bee-L), charac- teristic that make bee mites vulnerable to treatment with oils.

2. mites, like honey bees, breathe through spiracles. The bee/mite body size differential ratio may be utilized to attack the mites with oil without harming the bees.

3. mites utilize body pores for diffusion of gases and for moisture intake (Gary et al, 1989; Gary et al 1991b; Pugh et al 1992). A study with female mites has demonstrated that mites control gaseous exchange through adjustment of components of their respiratory system (Pugh, PJA; King, PE; Fordy MR Na: Experimental and Applied Acarology, Vol. 15, No. 2, pp 123-139, 1992).

4. mites have a short life cycle (12 days for tracheal mites and 18 days for Varroa mites) and are most vulnerable to treatment during their ectoparasitic phase.

After eleven years of consecutive loses of bee colonies to mites and the economic impact that these parasites were having on apiculture worldwide, it was obvious that it was imperative to find an effective treatment for the parasites. Realizing that after continued treatment of my colonies with Apistan strips, mites continued to proliferate and that colony health and size were diminishing, I determined that a vigorous form of treatment had to be implemented.

On 1 April 1996, I applied Apistan strips (three strips per colony) between frames in the brood chambers. After six weeks of treatment with Apistan, four colonies had perished and mites continued to proliferate in all remaining colonies. Based on my knowledge of success- ful treatment of mites on domestic animals, treatment was switched from Apistan to mineral oil. All the Apistan strips were removed (after waiting two weeks to allow Apistan to wear off) before starting use of mineral oil in an effort to eliminate the possibility of cross effect between the two agents. Treatment with food grade mineral oil was initiated on 1 June 1996 on twenty colonies while five colonies (randomly selected) were used as controls.

Rationale:

Mineral oil is effective in the treatment of mites on domestic animals. Food grade mineral oil is approved for use in food processing plants in the United States because it is not toxic and because it does not contaminate food products. Hence, mineral oil, if effective against bee mites, could be utilized for the treatment of bee mites during the entire year contrary to other acaricides that have seasonal limitations. The two species of bee mites existing in the United States (Acarapis woodi and Varroa jacobsoni) spend some of their life span on the surface of their host bee. Because of the known house keeping and grooming habits of the honey bee, it was reasoned that bees would "transfer" oil from their legs to the rest of their body and to other parts of the colony if they came in contact with oil. Food grade mineral oil does not contaminate honey or honey bee products and is not toxic to honey bees, provided that the oil is not applied in excessive quantities (see description of different methods of application employed). Twelve consecutive months of work with oil have revealed amazing (positive) results in the treatment and control of bee mites.

Method:

A. Laboratory work:

1. Mineral oil was applied with the tip of a prove directly to mites seen on bees. Close observation revealed that mites would drop off the bees (time was not measured).

2. Live mites were carefully collected from various colonies, placed in open glass jars and brought home. Some mites were treated with oil directly in the jars, others were carefully removed (to prevent physical harm) and placed on a glass surface coated with a film of mineral oil, or, on waxed paper or seran wrap coated with a film of mineral oil. Some mites were allowed to remain untreated in the glass jars, surviving for several days. Mites exposed to oil were observed to become motionless almost immediately, however, some remained active (lethal doses or lethal times were not evaluated) for some time.

B. Field work:

Several methods of application of the mineral oil have been tested in a period of time spanning 51 weeks, (1 June 1996 - 24 May 1996).

1. Sheets of waxed paper or freezer paper were coated with a film of mineral oil and placed on the bottom boards of the colonies. Dead mites were collected and counted. Yields varied between ten in a small colony to 112 in a large colony.

2. Strips of waxed paper (10 inches long x 1 1/2 inches wide) were coated with a film of mineral oil and placed between frames in the brood chambers. The number of strips varied between six and ten depending upon the size of the colonies. Coated strips of paper were replaced every two weeks while this form of application lasted. .

3. A continuous bead of mineral oil (up to 2.5 cc) spread on top bars of the frames.

Evaluation of treatment:

Effect of the mineral oil treatment was measured by counting mites by uncapping brood cells. Yields varied according to degree of infestation, size of the colonies and length of treatment. Initial count yielded as high as 54 infected cells per one hundred cells opened. Mite count varied between one to three per cell. Mite count per hundred brood cells uncapped dropped drastically (54 % in some colonies to four percent in others) as oil treatment continued. It was acknowledged that the procedure was labor intensive early in the process.

Other avenues of treatment were sought in order to make the procedure cost effective to commercial operations dedicating special attention to varying quantities of oil applied. The most successful method was determined to be when oil was applied in a continuous bead along the surface of the top bars.

At first, the amount of oil was measured and applied with a graduated eye dropper (available to any beekeeper), arriving at 2.5 cc of oil as a safe quantity (before the bees became soaked in oil). At present, oil is applied from a bottle (similar to a honey bear) with a spout with an opening of 1/16" diameter. Oil is applied steadily, along the top bars leaving a continuous line of oil measuring approximately the size of a thin noodle. In the beginning of the operation, it was thought that the oil should be sprayed on the bars or spread by hand. In the course of the applications it was determined that it is not necessary to spread the oil, the bees spread the oil as soon as they walk on it.

I have now designed a board (from bakelite) that blocks the bees inside the brood chamber while the oil is applied. The board is fitted with slits that coincide with the top bars allowing application of the oil while perfectly barring the bees inside to prevent stinging and applying the oil directly to the bees.

Observations:

After 51 weeks utilizing food grade mineral oil in various ways the following observations have been made:

1. Food grade mineral oil can be utilized effectively to control bee mites (acaricide) with quantities ranging from a mere film applied on waxed paper and up to 2.5 cc applied on the top bars of the frames.

2. Mite count per hundred capped cells examined diminished drastically, (54 % to 4 %).

3. Application of mineral oil in the form described above has not affected the queen's laying ability.

4. All five colonies utilized as controls perished. (Test colonies were distributed in three sites at least ten miles apart and each site had control colonies).

5. Of the twenty colonies utilized for treatment with mineral oil: One absconded; two were small and died due to pilferage. Seventeen remaining colonies are thriving and building very large populations. Two colonies have two brood chambers and eight honey suppers each. Two colonies have two brood chambers and six honey suppers each.

6. Control colonies perished quickly due to a combination of factors: Parasitized bees became weak and abandoned their house keeping habits. Stores were quickly robbed. Queens stopped laying and the bees died fighting the robbers, from disease and lack of food. Nosema was observed in two of the heavily parasitized colonies.

7. The use of sheets of waxed paper smeared with oil and placed on the bottom boards was abandoned promptly because these were observed to become covered with debris thus reducing the effectiveness of the oil. Waxed paper or other impervious type paper placed on the bottom boards while treatment is taking place maybe valuable if used for the purpose of collecting and counting dead mites.

8. Capped cell exams revealed mites within drone cells as well as in worker bee cells.

9. Worker bee samples were collected, dissected and examined for tracheal mites. No tracheal mites were found during the test period.

10. Mineral oil was applied continuously every two weeks during the test period including the winter months. The use of mineral oil did not affect egg laying of the queens nor the health of the developing larvae. While it may seem that oil applications should be made more frequently (judging by the presence of mites after 51 weeks of treatment) economics tend to indicate that more frequent applications might be prohibitive. This remains as one of my questions still under study.

Conclusion:

Contrasted to the characteristics of other oils, lard, Apistan or menthol (used as acaricides), mineral oil seems to offer a preferable medium based on per unit cost, physical characteristics (odorless, flavorless, does not deteriorate, does not contaminate honey or bee products, can be utilized all year long) for utilization as an acaricide.