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Confounding Queens

Conversations with beekeepers have illuminated some truly interesting problems with California queen bees this season. The earliest queens were in the mating nucs at a time when the otherwise appreciated rains prevented them from mating as well as hoped. So, it was not surprising when those queens laid a while, then seemed to fail. Depending upon with whom you talk, supersedures did or did not take place.

However, later in the season, queens reared during nice mating conditions also seemed to get going well, then slowed right down. This seemed like queen loss or supersedure, also.

Surprisingly, many of those barely functioning queens later rebounded and laid a beautiful brood nest. It remains to be seen how those colonies are going to get through the winter.

We usually blame early queen failure on poor mating (low sperm count), disease (*Nosema* or some of the RNA viruses), or pesticide damage. But, all those problems ought to be permanent. How do we explain the ability to start up, again, after appearing to be useless?

It is hard to believe that this occurred over a broad geographic area all at once, but about the only explanation for slowing down and speeding up in brood rearing is the amount of brood food (basis for royal jelly) being fed to the queen.

Brood food is produced by the proper age (nurse) bees. They have to have access to a plentiful mix of pollens and they have to be healthy. It has been documented that worker bees infected with *Nosema* or infested with tracheal mites do not produce much of any brood food. *Varroa* mite infested bees do not do much better.

Was it genetics, weather, malnutrition, diseases, parasites, or environmental chemicals? We probably will never know. Let's just hope that the cycle does not repeat before the end of the year.

UK Queen Problems

Roger Patterson, from England, has prepared a text about queen problems in his

country which is pretty similar to the problems that we are seeing. However, he has some interesting additional observations.

Roger kept bees from 1963 to 1987, then didn't keep bees for 15 years. When he returned to beekeeping, in 2002, he found that things had changed. He used to be able to get 90% successful mating of queen cells, now he gets only around 50%.

Roger maintained his membership in the British Beekeepers' Association (BBKA) since the '60's, so he had read about the *Varroa* mite problem. He wrote an article for the BBKA News and asked beekeepers whether or not they were having trouble with queen retention. Responding beekeepers with a few years experience told Roger that his problems were "normal." One person even reported that 15% successful mating was typical in his operation. However, old timers (15 or more years of beekeeping) told Roger that things had really taken a turn for the worse.

In his article, Roger points out the findings of researchers concerning poorer bee performance due to *Varroa* infestation: reduced sperm count in drones; reduced queen mating success; reduced queen weight; high queen mortality; and physical abnormalities in queens.

Then Roger expanded the list from personal observations: 1. Queens emerging with deformed or stubby wings (deformed wing virus?); 2. Queen cells with dead and decomposed larvae in them; 3. Emerged queens that never start to lay; 4. Mated queens laying variable amounts of drone eggs in worker cells; 5. Good egg laying pattern, at first, followed by rearing of "patchy brood"; 6. Eggs off center in cells (larvae off center, too) and multiple eggs in cells; 7. Queen cells reared shortly after queen begins laying; 8. Queens "disappearing" for no apparent reason; 9. Young queens laying only drone eggs on both sides of the queen excluder (so small they can get through?); 10. Young queens quickly becoming drone layers; 11. Some young queens laying in drone cells only; 12. Queens that stop laying, and if they resume, usually with higher % of drones; 13. High % of undersized drones in colonies; and 14. Domed brood capping intermediate in size between workers and drones.

Another observation that is interesting to me is Roger's following statement: "I had become convinced that *Varroa* was the cause because the queen mating problem appeared to have gone up the country [south to north] at roughly the same rate as the spread of *Varroa*, and there were no problems before its arrival."

Originally, a number of local beekeepers blamed the queen problems on weather or birds taking the queens in flight. It was hard for Roger to convince the beekeepers that there had been a real change for the worse. In fact, Roger feels that beekeepers in England and around the world may be in denial about the problem. "It quickly became obvious to me that there was a big problem and, if nothing was done, a large number of colonies would be lost. If it was related to *Varroa*, I couldn't understand why there was little mention from other countries where they had *Varroa* some time before us."

Roger concludes: "I think that we can largely discount the weather, and it seems logical to me that there is a possibility that the problems are caused by *Varroa* or its treatment in some way." He also states emphatically, "We must strongly resist any calls to panic and import queens, as I am sure other countries with *Varroa* will have

the same problems, and it is looking as if the importation of bees may have caused the problem in the first place."

Formic Acid Safety

The federal Environmental Protection Agency (EPA) and the California Department of Pesticide Regulation recently registered Mite-Away II for use in mite control in honey bee hives. The formulation is a fully charged (48.4% by weight) formic acid pad. It was registered as a Section 3 formulation, meaning that you and I can purchase and use it without special permits, etc. However, that doesn't mean that the product is without risk – to you or me.

On the label, the safety information comes first, before explaining how to use it in the hives. There is a box of statements concerning First Aid treatments for exposure to the acid. This is followed by the following: "Danger – Fatal if inhaled, absorbed through the skin, or swallowed. Do not breathe dust, vapor, or spray mist. Corrosive. Causes skin burns and irreversible eye damage. Avoid contact with skin, eyes, or clothing. Wash skin thoroughly with soap and water after handling and before eating, drinking, chewing gum, or using tobacco. Remove and wash contaminated clothing before reuse."

Since acids react with metals, the following is included: "Do not allow product to contact metal surfaces. Do not place, even briefly, on metallic hive covers. Store unused product in original container."

The next topic of information covering PPE (Personal Protective Equipment) is the most important and the most foreign to beekeepers, who have not had to worry too much about handling registered mite control products, up to this point in time. "Applicators or handlers must wear standard beekeeping equipment: beekeeping gloves, bee veil with goggles (or safety glasses). [Editor's note: that is actually for "observers," who aren't touching the material.] Applicators and other handlers must wear coveralls over a long-sleeved shirt, long pants, socks and shoes, acid resistant gloves (PVC, neoprene, or nitrile), and protective eyewear. Wear a respirator with an organic-vapor removing cartridge with a pre-filter approved for pesticides (MSHA/NIOSH approval number prefix TC-23C), or a canister approved for pesticides (MSHA/NIOSH approval number prefix TC-14G), or a NIOSH approved respirator with an organic vapor (OV) cartridge or canister with any N, R, P or HE pre-filter. Clean or replace PPE at end of each day's work period. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry."

Re-entry Interval: "Do not enter or allow worker entry into the treated area (bee hive) during the restricted entry interval (REI) of 48 hours. The REI is 72 hours in outdoor areas where average annual rainfall is less than 25 inches a year."

"Appropriate PPE as listed must be worn for re-entry into the treated area (beehive) after the 48 hour REI and within the remaining 21 days. PPE required for entry into treated beehives (that permitted under the Worker Protection Standard and that involves contact with anything that has been treated), is: Wear coveralls over a long sleeved shirt, long pants, socks and shoes, acid resistant gloves (PVC, neoprene, or nitrile), and protective eyewear. Wear a respirator with an organic-vapor removing cartridge with a pre-filter approved for

pesticides (MSHA/NIOSH approval number prefix TC-23C), or a canister approved for pesticides (MSHA/NIOSH approval number prefix TC-14G), or a NIOSH approved respirator with an organic vapor (OV) cartridge or canister with any N, R, P or HE pre-filter." I included some further OSHA details at the end of this article.

"Notify workers of the application by warning them orally and by posting warning signs at entrances to treated bee yards. Posting in the bee yard should read as follows: *'The hives in this bee yard have been treated with Mite_Away II Single Application Formic Acid Pads. Treatment was applied:* Date and time. *Do not open beehives in this yard until after the 48 hour REI unless wearing PPE as stated on the product label at any time within the 21 day treatment period.' "*

Then, you finally come to the use instructions: "Treat only if thresholds [*levels of mite infestation*] are exceeded (refer to State guidelines)." I am not aware of such guidelines for California.

Among the important details of using the pads are: 1. use when outside temperatures are between 50 and 75 degrees Fahrenheit; 2. remove pads if temperature is going to exceed 82 degrees (remember the PPE to do this); 3. up to 14 days of brood mortality may occur; 4. do not apply while honey supers are on the hives; 5. do not treat during a honey flow; and 6. wait at least two weeks after the pads are removed to harvest honey from those hives.

For the system to work properly, there has to be a "chamber" at the top of the hive. Each pad is to be placed, holes in the second plastic pouch face down, on two 4 inch X 0.5 inch X 0.5 inch spacer sticks (not provided) placed 4 inches apart on the frame top bars. Place a 1.5 inch rim on the top box to accommodate the pad, the spacer sticks, and additional 0.5 inch space between the pad and inner cover. Entrance reducers MUST be removed to prevent excessive damage to the colonies. Treat all bee colonies in the apiary at the same time. Allow a minimum of one month between applications.

Pads are to be stored in original containers in a cool, dry, and well-ventilated area away from the reach of children. [Editor's Note: Actually, since it is a pesticide, it has to be locked up in an appropriate storage facility.] Avoid heat, sparks, and open flames. Do not eat, drink or smoke in areas of use or storage. Use caution when opening the container, especially in warm weather, i.e. open outdoors and stay downwind [Editor's note – DOWNWIND ??]. Keep separate to prevent cross-contamination of other pesticides, fertilizer, food, or feed.

Like CheckMite+ and Apistan strips, the packaging is contaminated. To dispose of the outer plastic wrap, rinse and air dry empty outer pouch, wearing PPE, and then dispose in a sanitary landfill or by incineration, or, if allowed, by state and local authorities, by burning. If burned, stay out of smoke.

To dispose of used pads, ventilate perforated pouches containing used pads on site, protected from precipitation, for two weeks prior to disposal. Dispose used pads as non-hazardous material, in landfill or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

OSHA requirements for respirators: Employees should institute a complete respiratory protection program that, at a minimum, complies with the requirements

of OSHA's Respiratory Protection Standard [29 CFR 1910.134]. Such a program must include respirator selection, an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, **respirator fit testing**, periodic workplace monitoring, and regular respirator maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly.

Here is a list of "breakthrough times" for various types of protective gloves when contaminated with formic acid. Greater than eight hours: butyl rubber, Saranex, Barricade, Chemrel, and Responder. Greater than four hours: neoprene and polyvinyl chloride (PVC). Only one to four hours: natural rubber, nitrile rubber, Viton and 4H (PE/EVAL). Polyethylene and polyvinyl alcohol gloves are not recommended as they are likely to "degrade."

This is a lot of work and equipment, just to put a moist pad in a beehive. But, you want you and your workers to spend your hours working in the bee yards, not laying in the hospital or the morgue.

Percentage Ingredients Labeling

At the moment, there is an effort in the U.S. to require manufacturers, who use the word honey on their products, to at least have some honey in them. This sounds very similar to a new set of standards that some people are trying to get into Codex Alimentarius. Codex was created in 1963 by UN bodies, the Food and Agriculture Organisation, and the World Health Organization. The objective was to develop food standards and guidelines for codes of practice in the global food chain. The standards are supposed to improve consumer protection (allows them to make an informed choice), fair practice in the sale of food, and facilitation of trade. Many developing countries adopt the Codex standards, since they don't have the means of determining their own and they wish to participate in the "global market."

Europeans are backing the new standards, since they (the EU25 bloc) already are using similar criteria – Article 7 of European Directive 2000/13/EC that determines when the quantity of the ingredients of foodstuffs must be declared on the label. Their stipulations include the following: 1. If the ingredient is in the name or associated with the name of the product, how much is in there? 2. If the ingredient is emphasized on the label, how much is in there? 3. If the ingredient is essential for characterizing the product, how much is in there?

Having no such rules in the U.S., there is no rush by the FDA to require detailed ingredient listing. One of the major stumbling blocks is designating the percentage of an ingredient that would mandate listing.

Even if the U.S. dissents and decides not to follow suit ("harmonization"), manufacturers and distributors who wish to sell products in counties that have adopted the Codex standards will have to follow those rules or remain out of the markets.

Combs Build Themselves

What if you placed a bunch of vials on end and crowded them together, stacked

like cord wood, then poured molten wax down between the vials? When you took the cylinders out, the wax would have round cells, surrounded on six sides by others just like them. If you could heat the wax so that it became very flexible, but not melted, the cylinders would change shape into hexagonal cells. Or, at least, that is the theory of C.W.W. Pirk, H.R. Hepburn, S.E. Radloff and J. Tautz, researchers from Germany and South Africa.

They hypothesize that honey bees build cylindrical cells, then crank up their body heat to "plasticize" the cells into their hexagonal shape. They observed that beginning cells definitely are round and change to the hexagonal shape over time. They also made resin castings of natural honey comb cells and demonstrated that the "bottoms" (midrib) are semi-spherical, not three sided rhombi, which is how we roll foundation cell bottoms. They say that the rhombus idea comes from the visual effect that looks that way when the walls of the cells on the other side are seen through the midrib. This research can be found in Naturwissenschaften 91: 350-353, 2004.

Another team of researchers examined the melting point of waxes of various bees, including honey bees, bumble bees and stingless bees. They formed the wax into cylinders and tested the pressure it took to deform the cylinders at various temperatures.

Their studies show that beeswax indeed does absorb a lot of heat and becomes very malleable, before it finally becomes liquid. So, maybe the hexagons could form on their own.

There also is the question of whether or not 2-heptanone, a known solvent and component of beeswax, could be involved in softening the wax while it is becoming hexagonal. Studies in Israel showed that 2-heptanone does not dissolve beeswax. Studies on stingless bees showed that their mandibular gland secretions do liquefy their comb wax materials, but the secretions have no heptanone among their components.

AFB and Electron Beam Irradiation

Various researchers have demonstrated that hive bodies and frames can be rendered free of infectious spores of American foulbrood with adequate exposures to irradiation. Sources of irradiation vary from the very powerful gamma irradiation facilities (cobalt 60) to the much less powerful electron beam (similar to x-ray) facilities.

In Canada, Don Nelson, Adony Melathopoulos, and Kerry Clark demonstrated that electron beam radiation, as produced commercially in the Iotron facility, in Port Coquitlam, British Columbia, could be used to decontaminate hive equipment. Iotron advertises its services to Canadian beekeepers in a number of Canadian journals.

Another group of researchers, Rheal Lafreniere, David Ostermann, John Barnard, Terry Stepanik and Don Kost experimented with an electron beam produced in a somewhat different manner in the Acsion Industies, Inc. facility in Pinawa, Manitoba. The researchers tested contaminated, empty (honey-free) combs at 2, 5, 7, and 10 kGy. [1 kGy is equivalent to the "old" 100 kRad.] They also ran supers filled with empty combs and supers with combs containing various amounts of honey.

As might be expected, the electron beam did not penetrate the supers and combs

of honey nearly as well as the radiation from cobalt 60. Irradiation at 7 kGy and 10 kGy was adequate to inactivate spores on empty frames outside the supers. The two-sided beam was able to inactivate the spores in an empty super at 10 kGy. Even four-sided irradiation with 10 kGy was not adequate to inactivate all the spores in a super full of honey combs [Editor's comment: even gamma irradiation of 10 mRad, or 100 kGy, in my previous experiments couldn't do that job]. Honey absorbs a very large amount of radiation (remember how quickly it warms up in the microwave?). With gamma irradiation, the honey forms tiny bubbles that eventually disappear. However, that bubbling can pop off the cappings and drip honey all over the radiation chamber, if not adequately confined.

In this study, the researchers determined that the equipment at Acsion Industries could inactive AFB spores if hive equipment containing no honey was irradiated from two sides at 10 kGy. The company estimated that such a treatment would cost approximately $7.50 (Canadian) per super, or less with larger orders. If there is some honey present in the combs, then the treatment probably would have to be four-sided and the cost would escalate.

This information was reported in the Summer 2005 issue of The Beekeeper, the publication of the Manitoba Beekeepers' Association. The article begins on page 10 and ends on page 12.

Sublethal Doses, Again

As you are aware, I am one of the chief spokespersons for requiring studies of sublethal effects of pesticides on honey bee adults and immatures. So far, my pleas have fallen on mostly deaf ears. But, data continues to build up in that area.

Recently, Dr. Lora Morandin and her colleagues at Simon Fraser University in British Columbia, Canada, conducted studies on the effects of a new type of insecticide on bumble bees. The chemical is produced extracted from cultures of Actinomycetes and is called Spinosad®. Spinosad commonly is used for controlling caterpillars and thrips in many countries.

In these studies, Spinosad was added to pollen fed to bumble bee colonies. The doses hovered around those expected to be encountered in a real field situation.

There were no acute poisoning or detrimental immediate colony effects. However, bumble bees that emerged after being fed the chemical as larvae had problems with foraging tasks. They were slower than normal. It took them longer to figure out how to negotiate the artificial flowers and receive the syrup reward. They also "trembled" and were not able to hold onto things as well as normal.

Dr. Morandin stated: "Adult bees that have been exposed to a pesticide during larval development may display symptoms of poisoning that are not detected with current tests required by regulatory agencies."

Jacqueline Ali, who wrote this article for the media reports that the researchers "… conclude that testing of new pesticides should include examination of lethal and sublethal effects on wild bees." I would be happy if we just could get such studies done on the honey bees. Then we could project the effects to non-*Apis* pollinators, based on a few comparative studies to show the proportionality of effects.

The abbreviated report was published in Bee World 86(2): 50, 2005, under the title: Canadian Study Suggests Natural Pesticide Impairs Bumble Bee Foraging Ability. The original was published in Pest Management Science.

Sincerely,

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