Tucson AHB/Mites Conference
RIFA Control

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A total of 92 people registered for the 2nd International Conference on Africanized Honey Bees and Bee Mites held in Tucson from April 10-12, 2000. There were participants from five continents, 14 countries, and 22 U.S. states. There were 62 abstracts in the program and we heard a presentation on nearly every one of them.

Most of the presentations were on the Big Two: AHBs and Varroa. So, I'll mention the other topics that slipped in first. Tracheal mites had three abstracts and one presentation. Two of the research groups, independently, determined that tracheal mites do have effects on adult honey bee respiration. The first study showed that infested bees have lower respiratory rates than do non-infested bees, individually and especially in clusters. However, the rate was not nearly as reduced as that in bees with their first thoracic tracheae filled with wax. The second study was conducted with flying adult bees in a chamber. At normal levels of oxygen, they flew normally. But they couldn't handle low oxygen situations (stress). Both groups concluded that these lowered respiratory rates could effect colonies, negatively, that were wintered in cold climates.

The small hive beetle (Aethina tumida)received the attention of two presentations. It was found that small hive beetles walked into a device, with slots at the top over a reservoir of sawdust (to hold formic acid). The formic acid was replaced with beer, ethyl alcohol, antifreeze and mineral oil. The beetles liked beer. Beetle populations peaked in December and April. Adults overwinter with the clustered bees.

In a separate study, researchers determined what effects various environmental

parameters might have on the beetles' population growth potential. The beetles develop best (quickest and highest viability) at a warm (86ºF) temperature. Soil moisture is important for pupation: at 5% soil moisture they crawl to the surface and search for better digs. They prefer damp sand to clay. If the soil is wet, they remain very close to the surface. Female beetles like to oviposit in tiny cracks. Eggs hatch much better in humid conditions (60% RH and above). At 50% RH or lower hatching drops off rapidly.

There was a presentation of interest to queen breeders. Being familiar with the effects of juvenile hormone on insect development, researchers tried applications of methoprene (a man-made juvenile hormone analog) to the larval food in queen cells. The methoprene was applied to the royal jelly just before the cell was capped. Too much methoprene killed the larvae (it is sold as an insecticide). Proper amounts delayed emergence of treated queens by half a day. They were 12% heavier than untreated queens, had a 30% larger spermatheca (after mating, treated queens had 5.3 million sperm vs. 4.0 million for untreated), and they started laying at the same rate. The treated queens had 11% more ovarioles per queen (272 vs. 244). The researchers hope that this year's studies will show better performance in acceptance at introduction, larger colony size, longer life span and lower supersedure rates in the "super queens."

An Egyptian study on 60 hour storage conditions for mated queens, caged with attendant bees, was interesting also. Without going into all the details, here are the con-clusions from the study. Queens kept at about 68ºF or cooler tended to die and survivors were not well accepted. At the high end (104ºF), all queens died. At comfortable room temperature 70ºF to about 95ºF, the queens did best. Moderate relative humidities are OK. If it is too dry, beginning of egg laying is delayed. If it is too muggy, egg laying is delayed and longevity is reduced. While the amount of light doesn't affect mortality, continued darkness gives best results. As exposure to light increases, the rate of acceptance, rate of egg laying, and longevity all decrease.

More evidence was given that large populations of Varroa mites in a colony do not necessarily mean colony collapse. In South Africa, colonies of African bees are carrying mite loads of 40,000 to 50,000 per colony without noticeable effects on colony performance. The bees are paying no attention to the mites.

In Delaware daily natural mite fall on sticky boards peaked in September at 110

mites per day. That was projected to 4,000-10,000 mites per colony. The colonies were treated. The question is "At what level do we treat?" (The "economic threshold"). In these studies 43-60 mites per day represented about 3,000 mites per colony, which was thought to be a reasonable threshold.

A number of speakers said that Varroa was not so much of a problem in South America on AHBs. So experiments were run in Mexico to see if it is the climate or the bees. AHBs and EHBs were mated among themselves and to each other. Varroa levels in brood were monitored. The pure stocks had least mites (AHB x AHB = 30%; EHB x EHB = 50%). Hybrid crosses varied from 60-75% infestation, depending upon the race of the queen.

Another study in Mexico, of 7 lines of bees, determined that the number of Varroa mites on adult bees varied quite a bit but brood invasion was pretty similar. In these studies especially grooming, but also hygienic behavior (taking out infested brood), seemed to be important factors. Attractiveness of brood to mites and failure to reproduce on the brood were not important.

Another study in Mexico determined that AHBs cleaned out 77% of brood cells experimentally infested with Varroa. EHBs in the same experiment removed only 13% of infested brood. In this case an "intermediate" (AHB x EHB hybrid?) colony removed 30%. These conclusions and those that follow, will demonstrate that it is extremely difficult to make a generalized, black and white statement about Varroa reproduction and Varroa control when bee populations and Varroa populations show so much intrinsic variability.

An elaborate Varroa "trap" collected 12% of the total mite population. This was just a well-conceived 8 mesh, wire screen, full coverage, 1/2 inch deep tray at the bottom of the hive. The interesting piece of information was that the modest depletion of the mite population resulted in an average of 6 frames of brood in hives with traps vs. 4 frames in hives without them. The traps also caught wax moths, chalkbrood mummies, bee eggs (after a cold snap - not cannibalized?!), beetles and ants. The hives with traps at the bottom had better bee populations than hives simply "open" at the bottom.

An Egyptian study of Varroa provided some interesting facts. Once on either drone or worker brood, the mites continue reproducing much better if they remain on the same sex. The age of the combs impacts mite reproduction: the mites are more attracted to brood in older combs, but their reproductive rates decline on older combs. As mite populations increase in the colony (up to 3x per day in summer) individual mite reproduction decreases. When

bees were foraging marjoram heavily, failure of mites to reproduce increased from the normal 4-6% to 14.5%. An audience member stated that mite reproduction was reduced by half when bees were placed on foundation impregnated with marjoram (no details given).

Temperature seems to have more of an impact on Varroa reproduction than most people thought. While 95ºF is "brood nest temperature," that temperature fluctuates some with climatic conditions. By carefully controlling temperature, Varroa were found to reproduce best at 93ºF. Performance was a bit worse at 88-91 and 95º. At the lower than brood nest temperatures, the post-capping period is extended about one day per 2ºF. At higher temperatures the post-capping period is not shortened significantly. However, at "brood nest" and higher temperatures, mite reproduction drops way off. In the same study it was shown that 53% of the mites on brood held at 59-68% RH (normal) reproduced normally but at humilities of 79-85% only 2% of the mites reproduced. Hot, humid brood nests are tough on Varroa. Studies of Apis cerana brood nests showed drone brood is reared at 92ºF (perfect for Varroa) and worker brood is incubated at 96-98ºF (too hot for Varroa). Purposely cooling the brood nest in Apis mellifera colonies by using a "thin" hive lid, open bottom board, simulative feeding to spread brood out, and splitting the brood nest with frames of foundation doubled the numbers of mites on the bees.

What about "softer" controls for mites that don't involve "hard" chemical applications? Many researchers are testing essential oils and organic acid fumigants.

A report from a Costa Rican researcher suggested that four applications of 15ml of 85% formic acid, in conjunction with a bottom board trap, might be adequate to control Varroa in the tropics without further treatment. A Costa Rican beekeeper reported that a single application of a strong acaracide is all that is needed. The bees appear to be pretty tolerant of the mites.

A U.S. report on extracts of clove, bay, origanum, cinnamon and thyme concluded that origanum may be the best. Bay did not effect the mites, thyme was too volatile and cinnamon induced severe robbing. The next step is to develop a slow release formulation (probably mixed in a carrier oil and absorbed into a porous plastic strip). This is a contact, not a fumigant approach.

Egyptian studies on additives to smoker fuel, and water infusions (boiled) of certain plants, showed some promise for mite reductions. Burned Lantana grass was among the best, with pomegranate not too far behind. Cypress, sour

orange and lemon teas showed good contact effectiveness. Sugar syrup containing spinach tea was most detrimental to mites. Like Popeye, the spinach didn't hurt the bees.

Some experiments with a beefed up dose of formic acid (300ml of 65%) showed 94.2% mite kill late in the season. That was as good as 4 Apistan® strips (obviously, mites are becoming resistant to fluvalinate in those hives). A good blast of thymol also resulted in 75% mite mortality. Interestingly, following a four week treatment with the above dose of formic acid and an Apistan treatment in October, counts of over 500 mites per colony were found the next spring. That suggests to me that a lot of mites were around when the "wintering bees" were being reared. It was lucky that the bees survived the winter.

The reason I say that is because large numbers of Varroa usually means spread of viruses in the bees. Studies have shown that deformed wing virus (DMV) is the most problematic, causing what we call Parasitic Mite Syndrome. Signs of the disease are described as:

- irregular brood rearing;
- adults with bloated abdomens;
- pupae and adults with deformed wings.

It appears that this disease can become epidemic in a colony, leading to bee-to-bee trans-
mission and colony collapse. Efforts are underway toward preparing a virus-specific antibody using cloned genetic material. Then determinations can be made on the economic threshold numbers of:

1. mites without the virus,
2. mites with the virus,
3. virus in bees without mites

Studies on monoterpenoids (big name for essential oils) determined that only about 1 of 15 is selectively effective on mites and not harmful to bees. Perillyl acetate and myrtenyl acetate showed promise. In field colonies, perillyl acetate killed about 50% of the mites in the colony. With improved delivery systems, efficacy could be enhanced. This chemical is currently used in cosmetics, so it should be considered as GRAS ("generally regarded as safe") and not subject to in-depth reviews by federal and state regulatory agencies.

Another researcher speaking on formic acid said that it could be up to 96% effective against Varroa, but would kill bees and brood if used when temperatures exceeded 72°F. He also found in the lab and in field colonies that Ascosphaera apis, that causes chalkbrood, is susceptible to formic acid fumes. Chalkbrood incidence has fallen dramatically as more formic acid treatments are being used. A trick for better success - smoke colonies well before applying formic acid treatments.

RIFA Control

When it arrived in California, we did not have any pesticides specifically registered for controlling red imported fire ant (RIFA). First thought to be just a local problem in some rural areas of the San Joaquin Valley, legal control was difficult. When the pest was found to be well entrenched in Orange County and had been moved to nearby counties with nursery plants, the state needed something quickly. The consensus approach to dealing with these ants, in urban or rural areas, is to put out bait that contains a sterilant or growth regulator that eventually puts the queens out of business. Colony collapse follows. One of the first products to be put into use is Clinch®. The following article about the product was

published on pages 35, 37 of the September/October 1999 issue of the Blue Diamond Growers' Almond Facts. The material is reprinted with permission of the publisher.

Could this be the answer? Clinch ant bait appears to be winning the ant wars.

"If it does the job like it looks like its doing, it's a lifesaver," says Jim Lynch, Blue Diamond member from Stanislaus County, about Clinch, a new ant bait from Novartis. "And it's relatively inexpensive, about $12 per acre. It's one of the cheapest things I do out there."

"What I'm seeing right now looks good, real good," he adds. "I haven't seen any ant damage when I break open the shells, but that doesn't tell the whole story. I can't vouch for it until I get some grading reports back from the field I put it on."

Jim has been looking for a lifesaver for a long time. "For the last three years, on this one ranch, I've been getting clobbered with ant damage," he said. "It's micro-sprinkled, which makes a perfect habitat for ants. I tried the contact materials, spent a lot of dollars doing it, but couldn't get the ants under control."

This year, Jim applied Clinch in hopes of curbing the problem. Towing an electric applicator behind an ATV, workers zipped through the problem orchard scattering the bait at the prescribed 10 m.p.h. What Jim saw next surprised him. "When we were treating the field, it was amazing," he says. "The machine would go by and I'd look right behind it and the ants were already picking that stuff up. Everybody I talked to said they saw the same thing."

Cautious About Conclusions

Still, the jury is out on Clinch, say those who are watching and waiting for a scientific verdict. And the 1999 crop may not supply the best test. "This year's crop has unusually tight shell seals and, as a result, we should see less ant damage than last year" says Mel Machado, field supervisor in Stanislaus County.

Gerry Guthrie, Kern County field supervisor agrees: "Growers who have tried it are very pleased with the results. They watch the material disappear, then the ants disappear, and they are getting good crop grades, so they are convinced that Clinch did a good job for them. But from a scientific standpoint, I don't think we can say the low ant damage this year is solely due to Clinch, because we are seeing similar results in orchards that did not have clinch applied."

Machado has also heard a lot of enthusiasm for the material, but he is watching, waiting and learning. "We are seeing some interesting things happening," he said. "The ants pick up the bait and take it home, but they may be taking

it too fast. Fire ants are so aggressive they clean it up in 24 hours and don't leave anything for the pavement ants to feed on." That experience prompted the advice from Novartis to split the applications — even rows one week, odd rows a week later. "That appears to work better in controlling both species of ants," Machado says.

Clinch's killing effect also surprised Machado. "The material takes them down fast," he said. "We didn't expect to find dead ants for about three weeks; we found them in five days. The concern could be that it is killing workers before they get enough material to the queen." Whether or not that is the case will take weeks to determine.

New from Novartis

The California Department of Pesticide Regulation registered Clinch Ant Bait for use in California to control fire ants on almonds, citrus and walnuts. Clinch became available for use in almonds in July 1999, barely in time for harvest.

Developed by Novartis, Clinch ant bait contains the active ingredient abamectin, a naturally derived substance produced by a soil micro-organism. It is not related, chemically, to any other ant bait registered for agricultural use. The active ingredient is dissolved in soybean oil and, along with an antioxidant to protect the bait from deterioration, is coated over corn grit.

Abamectin is a slow-acting stomach insecticide that is extremely effective against fire ants, including the red imported fire ant and the southern fire ant.

Applied at the rate of one pound to the acre, Clinch is moderately toxic to fire ant workers and queens. It slowly kills worker ants while they transport the bait back to the mound. Slow action is important to allow time for the workers to distribute the bait throughout the colony and to the queen. Clinch's primary effect is to interfere with the queen's egg production, but it may kill her outright.

With egg production curtailed, the worker population declines until the colony ceases to exist, usually four to six months after Clinch is applied. This is the amount of time it may take for all of the eggs produced by the queen before she ingested abamectin to develop and die natural deaths. However, Novartis says a reduction in the worker population and ant activity should be noticeable a few weeks after treatment.

Safety Precautions

Clinch is sold in 25 pound bags and requires some precautions regarding its storage and use. It is hazardous to humans and domestic animals. It is harmful if swallowed or absorbed through the skin. Avoid breathing Clinch dust

and avoid contact with eyes, skin, and clothing. Wash thoroughly after handling it.

Clinch is also toxic to fish and wildlife, so do not apply it to water or areas where surface water is present. It may attract rodents or domestic animals and should be stored in a secure, cool, dry place.

To assure its maximum effectiveness, use the entire bag immediately after opening. If you don't use it all, close the bag tightly and use the remainder as soon as possible. Empty the bag into the application equipment and dispose of the empty bag in a sanitary landfill, or by incineration, or if allowed by state and local authorities by open burning. If you burn the bag, stay out of the smoke.

Abamectin binds tightly to soil and is considered essentially immobile in soil. Soil microorganisms degrade the compound, consequently it does not accumulate in the environ-
ment.

Application

Novartis advises applying Clinch when ants are actively foraging, when the soil temper-
ature is above 60°F. Apply one pound of Clinch per acre using a properly calibrated ground rig to assure the right dosage and uniform distribution.

For best control, apply Clinch 21 days prior to harvest. For year-round control, it can be applied in spring, summer and fall. Apply after dew or rain-
fall has dried and, for best results, do not apply if rain fall is anticipated within four to eight hours after applica-tion. If you plan to use a contact insecticide in conjunction with Clinch, allow seven to ten days after applying
Clinch to allow worker ants time
to distribute the bait through-
out the colony.

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Novartis warns against using Clinch ant bait in pastures or rangeland grazed by cattle, sheep or domestic animals, including horses. And do not use it on crop land.

For up-to-date information on Clinch use, availability and results, contact your PCA or Novartis.

Sincerely,

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