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West Nile Spraying and Bees

Not surprisingly, some of my Davis neighbors were quite dismayed when the Sac/Yolo Mosquito and Vector Control agency had to make aerial applications of an "adulticide" for mosquito control, as the proportion of virus-infected mosquitoes was determined to be climbing, as were the number of human cases of West Nile Disease. Besides a petition and letters of dissent, a demonstration in a city park featured a person in a bee suit stating that honey bees, along with a whole bunch of other good and bad bugs, would be killed.

The Sac/Yolo Vector Control personnel have worked for years with University contacts, right here in the Department of Entomology, including me. When the spraying seemed to be imminent last year, I was contacted and asked about the various chemicals that could be used. After our discussions, they chose to use pyrethrin at one-tenth the dose usually used for agricultural crops. However, unlike the ag formulation, this mix would include piperonyl butoxide, the chemical that you will find on the label of nearly every household insecticide spray on the market. Piperonyl butoxide is a synergist that inactivates an insect's innate ability (cytochrome P450 enzymes) to detoxify small amounts of pyrethrin and survive the treatment. This synergist was the specific target of some protestors, because it is known to be a suspected carcinogen.

Vector Control based its claims, that non-targets would not be affected, on scientific studies done in the past. But, just to be sure, certain researchers on the campus decided to capture various larger insects, cage them, and place them inside and outside the spray zone to see how they survived. Vector Control does the same thing with caged mosquitoes, and they want 70% kill. The first application killed 92% of "exposed" caged mosquitoes and 57.6% of those in vegetated areas in Woodland, an acceptable average of 76%. Mortality in Davis varied from 75% to only 25%, not as good as Vector Control hoped (all data from The Davis Enterprise, August 9, 2006). A second application of pesticide followed the next evening.

Briefly, over two years of this type of study, alfalfa butterflies, dragonflies, garden spiders, pillbugs, beetle larvae, crickets, earwigs, millipedes, and goldfish all have survived the spray. The reason is a matter of dose per body size. Mosquitoes are pretty small, so it doesn't take much to kill them. Bigger insects are not nearly as susceptible. Actually, the "spray" is more like a mist. Only seven tenths of an ounce of Evergreen Crop Protection 60-6 are applied per acre. Drop cloths also were laid on the ground, half in the open and half beneath some foliage. Initial observations suggest that a few ants may have been killed.

Does that mean that these applications are entirely safe for honey bees? No. In one case in Sacramento, a large shopping center left its parking lot lights turned on well into the night. There was something attracting honey bee foragers, even well after sunset. Honey bees flying through the mist picked up enough insecticide to die. In most cases honey bees stay home at that time, and the presence of bee "beards" on the fronts of hives of warm colonies did not result in honey bee mortality.

Lead a Bee to Water

At the 2006 WAS Conference, a beekeeper shared his experience with trying to entice bees to collect water at his source rather than in the neighbor's yard. He started by building and positioning a slant board watering device near his colonies. A few bees found it and used it, but the neighbors still were being visited by too many bees.

Then, the beekeeper had an idea. Why not place a couple micro-misters at the top of the board and spray a fine mist of water into the air? As soon as the water was turned on and started spraying into the air, the bee activity at the board increased immensely.

To determine if that was due to chance, the water to the misters was turned off. Very soon bee visitation dropped back down to the pre-misting level. When the misters were started up, again, the bee visitation increased significantly.

This seems to be a parallel phenomenon to bee visitation at feeders when an odor attractant is added or removed from the sugar syrup. Perhaps the flying bees can detect the water vapor from the misters at quite a distance, down wind, and fly up the breeze to find the water. Bees have water vapor detectors on their antennae, as they have odor detectors.

If you have had trouble enticing bees to your watering device, you might wish to try the misters. You will need a source of water under pressure, like a garden hose, to make the misters operate correctly. Apparently, misters can be purchased for use in greenhouse (plant) settings or for use along the edge of a patio awning (human setting).

Let me know if this beekeeper's experience was a coincidence or a real method of solving a problem that has created tensions between neighbors for decades.

Tips from Award Winner

Serge Labesque was presented the 2006 Thurber Award for Inventiveness at the WAS Conference held recently in Buellton, California. Serge shared his ideas for keeping bees successfully under current beekeeping conditions. His thoughts on honey bee stocks were that natural selection eventually will lead to bees that can tolerate varroa mites, but only if the colonies are not treated with acaricides. The "hands off" approach reduced his apiary to a colony count of one, but the daughters of that queen have headed colonies that have not been treated for mites and have survived for years. Serge believes in screened bottom boards, uses them routinely, and used to manufacture and sell a screened bottom with a custom, removable plastic tray with a molded "moat" around the edges. The product was too expensive to remain competitive as the market expanded.

Four important elements of Serge's beekeeping deal with other hive components. The first is a telescoping cover and inner cover. The outer edges of his telescoping cover keep rain from running down the edges of the hive boxes. The space under the telescoping cover provides an air space that serves as a bit of insulation between the sun-heated cover and the frames below.

His second recommendation is that the upper, outer edges of the hive bodies be beveled enough to direct water, running down the box sides, to keep going and not seep into the cracks between his supers. This keeps the insides of the hive drier and increases the longevity of the supers. His third recommendation, that also keeps the brood nest area drier, but not necessarily the inside of the hive boxes, is to use a follower board on each side of the brood nest. Any moisture condensing in the hive will be along the walls of the super, outside the combs resting inside the follower boards.

His fourth recommendation is to use weather-proof awnings above the entrances. His are metal, curved, and painted white. They keep the sun off the entrances during the middle of the day when it is hot, and they protect the entrances from rain and from water running off the hive covers.

Honey Bee Genetics

Two student speakers from the Washington State University, Pullman, provided participants at the 2006 WAS Conference information on bee breeding – one very practically oriented and the other descriptive of the current trend in honey bee gene flow.

Marina Meixner described in detail the stock selection program being run at Washington State University. Like most bee breeders they want productive stocks adapted to the local environment, ability to fend off diseases and mites, and exceptional gentleness.

Colonies used in their selection program are located in an isolated (virgin queens could not be mated there until drones were supplied) apiary, so that artificial insemination is not required. Each trait of interest is rated for each individual colony on a scale of one to five, with five being best. All the scores are added and the bees with the top scores get to remain in the program. In exceptional cases, like having an otherwise top score but being quite defensive, even the top scoring colonies get eliminated.

Since new colonies are added to the program every year to maintain genetic variability, the average score of some traits vary considerably. The average defensiveness score went from 4.5 in 2002 down to 3.7 in 2003. That has been brought back up to 4.5 in the last two years.

Hygienic behavior is important to this breeding program. The tests are conducted with liquid nitrogen-frozen brood patches, but it turns out that all bees seem to be much more "hygienic" when there is a honey flow. So, the best test results are those from tests conducted during nectar dearths. Hygienic behavior has been good to excellent throughout this study period, with the exception of 2003. Apparently, in 2003 new, additional stock that was introduced should have been monitored a bit more before being included in the program.

The University program has resulted in eight maternal lines that are performing well. No *Varroa* treatments were administered last fall, but the bees are being watched closely. About one half of the queens produced each year remain in the program. A quarter of the queens are used in Washington State Beekeepers Association sponsored commercial operations (two in western and one in eastern Washington) run by regional associations. They are monitored by graduate students. Another quarter of the queens are shared with other University and USDA breeding programs.

Debbie Delaney explained that formerly it was believed that there were four evolutionary branches of *Apis mellifera* based on morphology (anatomical features): 1. M, from western Europe and related to *A. m. mellifera*; 2. C, from eastern Europe and related to *A.m. ligustica* and *carnica*; 3. O, from western Asia and related to *A.m. caucasica*; and 4. A, from Africa and related to all the African races, like *A.m. scutellata* and *A.m. adansonii*. Using newer analytical tools, like mitochondrial DNA analysis, there seems to be only three ancient lineages, with the former O group belonging with the C group.

Honey bees from the M group were introduced into what is now the U.S. in the 1600's. Between 1859 and 1922, seven more races of bees were introduced into the country, including the well-known Italian, Carniolan, and Caucasian bees. Cyprian, Egyptian, Syrian and three races of African bees eventually were introduced into the country, as well.

For decades, Dr. Steve Sheppard and his students have been collecting and saving commercial and feral honey bees collected in various regions of the U.S. With better diagnostic tools, geneticists have been able to study the gene flow from the earlier samples to today's samples. The results are not good from a gene pool point of view.

In order for an organism to be best adapted to its environment, there has to be a large number of genes, which when acting together in certain combinations, give the organism the ability to survive. If the gene pool becomes limited, then the best combinations may never get together. At this time, we have only three of the eight initially introduced races in our commercial (and hobby) lines. But, even those genetic representatives are limited in size, because only a relatively small number of queens ("small founder populations") actually were imported into America.

Then, we had the introduction of two exotic, parasitic mites that further reduced the honey bee populations, both commercial and feral. The feral population had been a reservoir of genes for the races not commonly used in commercial (and hobby) beekeeping. A further reduction in variety of genes occurs because the commercial queen breeders produce most of the stocks used in our hives.

In studies from the early 1990's, it was determined that 308 breeder queens from southern states and 295 breeders from western states produced the nearly one million queens sold around the country. In the early 2000's, things had not changed much. A total of 255 southern and 218 western breeder queens produced nearly the same number of marketed queens as a decade earlier. This number of queens replaces about one-third of the U.S. stocks each year. So, the question is, are the gene pools changing?

In the early 1990's, M and C lineages could be found in southern and western lines, but A was not around. The bees in the southern and western geographic regions were genetically distinct. In the southern populations the C lineage is increaseing and the M is shrinking. In the western lines the same phenomenon is occurring. But, with better analytical testing procedures it can be determined that within the western C line, there were three subtypes of C. And, in the past ten years, one of those three types has disappeared. The final data for the southern lines are still being generated.

What does this mean to U.S. beekeepers? The gene pools of commercial and feral populations, with the notable exception of the A group, are shrinking. Genes for important functions in honey bee life may be disappearing. In this researcher's opinion, it would be a good idea to select some good stocks from the geographic origins of these races and re-introduce their genetic material back into our stocks of bees.

2006 Almond Bees

Dr. Frank Eischen devoted full days and long nights this spring collecting and summarizing data from colonies of honey bees located in commercial almond orchards. His goal was to determine the relative performances of five different categories of colonies: 1. Australian four pound packages installed in December, 2. Australian three pound packages installed in January, 3. Australian four pound packages installed in January, 4. U.S. six-frame colonies and 5. U.S. eight-frame colonies.

Pollen was trapped for twenty days. Total weights of pollen collected daily tended to increase from February 11th to March 2nd (weather permitting) in all but the packages installed in December. It appears that many bees in those colonies had succumbed to old age and brood rearing wasn't adequate to replace them. Thus, pollen collection was very low.

The Australian three-pounders took nearly two weeks to start to collect significant amounts of pollen. The U.S. six-framers were over twice as effective as the Australian three-pounders. The larger Australian packages installed in January collected about 1.5X the amount of pollen as the U.S. six-framers. But, it was the U.S. eight-framers that outperformed the rest, substantially. They were twice as effective as the Australian four-pounders installed in January and three times as effective as U.S. six-framers.

As an interesting aside, Frank noticed that there was a distinctly different, orange colored pollen being collected by the bees. U.S. bees only collected a little of this pollen (0.1%?). Australian bees collected considerably more (up to 1%).

Brood Pheromone: A Pollination Tool?

Dr. Tanya Pankiw, from Texas A&M University, shared results from her studies on brood pheromone at the 2006 WAS Conference. As honey bee adults age, they change in the jobs they can do best. When they are younger (9-12 days) they produce brood food best from their hypopharyngeal glands. At that time the glands produce large amounts of proteins for feeding the queen and larvae. As the bees age to foragers, the hypopharyngeal glands change to producing invertase, an enzyme that converts sucrose to glucose and fructose. Foragers that collect pollen get feedback information from the hive. If there is quite a bit of stored pollen, they don't collect as much as when stored pollen is in short supply. If there are a large number of larvae to feed, pollen collection is increased. A smaller number of larvae reduces the pollen demand.

Honey bees don't count the number of larvae in the combs, but that value is communicated. The messenger is "brood pheromone." That chemical complex can be extracted from larvae by a hexane bath, or it can be blended from laboratory stocks. The lab chemicals can be very expensive in highly purified forms, but Tanya has found much less expensive substitutes that still give good results.

Within an hour of placing brood pheromone in the hive, pollen foraging increases dramatically. Within an hour of taking the pheromone out of the hive, pollen foraging drops back to normal. Increased pollen foraging (up to 150%) is just one of the effects that brood pheromone has on honey bees. The newly recruited foragers start working close to home, so the proportion of crop pollen to non-crop pollen goes way up. It also: 1. increases the number of non-pollen foragers; 2. recruits younger bees to become foragers; 3. lengthens the time that hypopharyngeal glands produce brood food; 4. increases the size of pollen loads; 5. speeds up pollen foraging visits; and 6. increases the number of pollen grains on non-pollen foraging bees.

Interestingly, all that extra pollen foraging does not increase the amount of stored pollen in the hive. So, where does it go? Directly into brood food, that eventually results in more bees emerging over the next couple of weeks. Brood pheromone also stimulates bees to consume pollen substitute twice as fast as they do without the extra pheromone. But, just like previous studies in California, pollen substitute was utilized by the bees only when some natural pollens were being collected. Expectedly, the extra brood rearing resulted in larger adult bee populations.

The final step in this effort is to develop an effective, time-release formulation that can be placed in hives when extra pollen foraging is desired, like at almond pollination time. Tanya has turned that chore over to a commercial company that specializes in producing such products.

Small Hive Beetle Coming

Dr. Dewey Caron, from the University of Delaware, described the biology of the small hive beetle and what it has been doing in beekeeping operations in eastern states. The beetle is a nitidulid, or sap beetle. Usually, nitidulids are scavengers that breed in overripe fruit or vegetables, and the small hive beetle has passed multiple generations in cantaloupes and a few other fruits. However, this species (*Aethina tumida*) prefers to enter beehives and eat bee products (and brood).

The small hive beetle comes from southern Africa. Is there a large hive beetle? Yes, but it doesn't seem to be a problem. Specimens of *A. tumida* were collected in 1996 and 1997 in S. Carolina and Georgia, but it wasn't until 1998 that taxonomists identified it correctly, in Florida. For quite a while it had limited distribution in the eastern states. However, it is getting around.

In 2002 it seems that the beetle was introduced into Canada in beeswax from TX. It was introduced into Alberta, Canada, recently, but appears to have come from Australia (DNA tests). It currently has made its way to Portugal and New Zealand. The beetles have been found in packages of bees, bee colonies, bee swarms, bee equipment, and soil.

The adult beetle is a solid color, but that color varies from reddish-brown, like *Varroa*, to black. It is about 1/3 the length of a honey bee, with short, clubbed (distal end swollen) antennae that it tends to hide under its wide thoracic cover. Like *Varroa*, the adult beetle can live six months or longer in a beehive. Female beetles can lay very large numbers of eggs, so it is good that the honey bees try to harass, corral, and isolate the beetles from the brood nest. The beetle normally lays its eggs on the combs. If capped larvae are available, the beetle will puncture the capping and lay eggs in the cell. If the beetle is trapped in a cell in the brood nest and is surrounded by capped larvae or pupae, it will oviposit through the cell walls into all six cells surrounding it. The eggs are smaller than honey bee eggs and hatch in two to six days, as long as the humidity is high enough. The larvae can eat pollen, honey, or bee brood. The feeding larvae inoculate their left over food with microbes that produce a horrible smelling slime in the colony. The slime runs down the inside walls of the hive (and sometimes bleeds to the outside) and collects on the bottom board. The larvae in that mess remind one of a heavy maggot infestation in high moisture, rotting organic matter. By this time, the honey bee colony is doomed.

Fully fed beetle larvae are attracted to light and in the evening, they crawl out of their food mess and head for the soil to pupate, leaving a heavy slime trail behind them (makes snails look good). Dry soils will kill them (as will chickens and red imported fire ants), but in moist soil they will emerge as adults in about three to four weeks. Following mating flights, the adult beetles, again, are attracted to functioning bee colonies, sometimes up to five miles away.

African bees have little tolerance for these beetles. They meet them at the entrance and try to keep them out of the hive. They fill cavities, where the beetles might hide or lay their eggs, with propolis. They clean out beetle larvae and imprison the adult beetles. And, if the beetles get overwhelming, AHBs abscond. So, do our EHBs, but they wait too long before they leave.

20 Virgins a Day: How I Keep Up

Sorry, but Tom Glenn’s presentation title was too good to pass up. Tom spoke to the 2006 WAS Conference about his queen rearing operation in San Diego County, since the arrival of Africanized Honey Bees. He started his presentation with a detailed and highly illustrated discussion of sex and genetics of honey bees. Speakers who followed him were very content to have had him explain the “complex stuff” so well.

Since Tom cannot produce “open mated” queens, now that AHB drones fly around his operation, he explained the process of confining and holding drones and collecting semen from them. Then he discussed rearing queens in confinement and preparing them for artificial insemination. Each inseminated queen is marked with a code, and a marked thumb tack follows her around, all the way to the customer.

Tom also shared his opinions on queen introduction. Despite the various queen cages designed for that purpose, Tom prefers the "push in screen." It can be used with or without a "candy" release. Tom places the queen and the screen over areas of emerging brood and moves the screen every few days, if the queen is to remain confined. Tom watches the behavior of the worker bees toward the new queen. When it looks like she and the bees are getting along well, then he will let the queen join the others.

Like all intensive breeding programs, Tom keeps stacks of records on many traits of interest of colonies headed by queens of specific genetic crosses. Ability to cope with pests and diseases are high on his list, predictable queens demand a high price on the market, but bee breeders and satisfied as are gentleness and tendency to produce good honey crops. Such pampered and beekeepers will tell you that it is worth the expense.

Tom can spend all that time fussing with the bees because his wife Suki handles all the paperwork, shipping, etc. But, Suki is not confined to the office, and she can tell you anything you wish to know about the stocks and beekeeping in general.

Sincerely,

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