COOPERATIVE EXTENSION UNIVERSITY OF CALIFORNIA

from the U.C. APIARIES University of California

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Newsletter Emailed to You

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New Center for Bees

Periodically, groups of individuals on campus who share an interest in a particular subject matter come together and formally form a "Center" on that subject. Such centers advertise their willingness to share with anyone their collective knowledge on a subject. An excellent example is the UC Davis Olive center. Many experts have agreed to make available information on selecting olive varieties, planting and pruning olives, optimizing olive crops, harvesting and processing olives, marketing olives, and processing and marketing olive oil. Our first-press, extra virgin olive oil, from campus olive trees, won first place at the Los Angeles County Fair competition (world's foremost olive oil competition). Since that time, the olive center has been selling its award-winning oil on campus and through its downtown Davis bookstore.

Eventually, the Robert Mondavi Institute (RMI) for Wine and Food Science began operating the Olive Center and a Wine Economics Center. One of our entomology professors, Dr. James Carey, was so impressed by the success of the olive center that he suggested we start a Honey Center. When contacted, I responded that we really did not have that much expertise on honey no matter how many departments we contacted. The only other person on campus dealing with honey then was Dr. Liz Applegate who is studying how honey influences the performance of athletes.

Despite my equivocation, RMI administrators said that we ought to forge ahead. They selected a date (Oct 21, 2011) and made preparations to hold a monitored honey-tasting event that would include a bring-your-best honey contest and some top-notch singing entertainment by The Honeybee Trio from a high school in Vacaville (three teenagers who sing 1930s and '40s music). Dr. Brian Johnson spoke on how honey bees cooperate to produce honey. Dr. Norman Gary described how best to keep bees in urban areas. Dr. Louis Grivetti reviewed historical uses of honey in foods, and Liz Applegate described the benefits of using honey to provide energy while exercising. Ticket prices had to be reduced and a huge effort made to publicize the event, but in the end the room was filled. Each attendee received a sample packet of Honey Lovers, a honey-filled jellybean-like candy produced by Gimbal's Fine Candies from San Francisco. Sadly, a suitable market for that delicious confection never materialized.

Following that leap over the abyss, the plans to formalize the honey center with campus administration began. The new title for the center, The Honey and Pollination Center, was submitted to the dean of the College of Agricultural and Environmental Sciences for start-up funding, and higher campus administration was supportive. So, the Center officially was born in 2012.

Similar to other centers affiliated with RMI, this center needed a board to run the center. Such a group of individuals was selected from various places and professions. Amina Harris, owner of Z Specialty Food in Woodland was elected as the first director. Board meetings were held and institutional matters like mission statements and other nitty-gritty were thoroughly massaged. Eventually, the goals of the center were listed as:

1. Optimize university resources by coordinating a multidisciplinary team of experts in honey production, pollination and bee health

2. Expand research and education efforts addressing the production, nutritional value, health benefits, economics, quality standards and appreciation of honey

3. Serve the various agricultural stake-holders that depend on pollination services

4. Help the industry develop informative and descriptive labeling guidelines for honey and bee-related products to establish transparency in the marketplace

5. Elevate the perceived value of varietal honey to producers and consumers through education, marketing, and truth in labeling with the end goal of increasing the consumption of honey

On Oct 27, 2012, the Center conducted a second Best Honey event. This time the title was Bounty of Pollination: More than Just Honey. Following initial statements, Rebecca Ets-Hokin spoke on "Varietal Honeys – Blending the Flavors in the Kitchen." Then came the first presentation devoted to the role of bees in pollination. Dr. Neal Williams spoke on "Integrated Pollination Strategies: Managed and Wild Bees for a Sustainable Future." The event was well attended.

In April, 2013, the Center conducted a honey-tasting and children's art project on Picnic Day at the RMI facility. It was very well attended and the children left with their crafted bees in hand. Later in the year, again in October, the third Best Honey event took place on the Davis campus. In addition to a honey tasting, there was live music and a display of touchable, live insects from the entomology department's Bohart Museum. And, for the first time UC Davis Honey was released to the public. The regional, northern California honey will be sold at the campus bookstore, and downtown bookstore, where it is shelved next to UC Davis olive oil and dried tomatoes.

Following the opening activities, the attendees were treated to the award-winning documentary “Wings of Life.” The creator, producer, and photographer of the movie, Louie Schwartzberg, was on hand to discuss production of the movie. This event sold out, at the nominal price of $5 a ticket, since it was an educational outreach project to the general public.

It is likely that the next formal event of the Honey and Pollination Center will be a three-day seminar on mead making. Proposed dates are Feb 6-8. On Friday Feb 8, the center will hold a special Mead Makers Dinner. The dinner may be included in the seminar fee, but also will be open to anyone wishing to purchase a ticket. The meal will begin with a mead cocktail, include a meal with a honey-influenced menu by Chef Mani Niall, and finish up with dessert mead. As you might guess, these sorts of events are expensive to conduct (and to attend = $450 apiece), so the center is very happy to have sponsors step up and help support these activities.

Pollens and Honey Bee Nutrition

You, no doubt, have lost track of how many times I have stated that malnutrition is a leading factor in our unacceptable annual bee colony loss numbers. I have also stated innumerable times that our synthesized bee diets just cannot match the value of nutrients obtained by bees from a mixture of quality pollens. My concern has been that although we have a very good idea of the protein requirements for honey bees; the ratios of essential amino acids honey bees require; and their required vitamins and minerals, etc., we still cannot feed bees on our best diets and keep them alive much more than two months in confinement. Thus, we still are missing some very critical components in our synthesized diets. If we could find those components, could we formulate a diet that would sustain our bees in a healthy condition during “feedlot beekeeping?” I know that feedlot beekeeping is an anathema to many of my readers, but it may become a reality of beekeeping, if it really hasn’t become so already.

A recent study on the effects of honey in the diet of honey bees determined that a component found in honey, ρ-coumarin, stimulates the honey bee immune system to work better. Actually, that chemical is a contaminant of honey that comes from pollen grains that are mixed into the honey during the bees’ processsing cycle. Thus, the bees need only to consume the pollen to obtain the desired results. How many other minor chemicals are there in pollens that are so useful to honey bee health?

Also related to the health aspects of pollens are the microbes which become affiliated with pollens and contribute to the health of honey bees. As new studies add to the information from previous studies (references at end of article), we can see that honey bee food is a dynamic substance with many things to consider. While nectar and honey have roles to play in providing energy to the bees and reducing the quantity and variety of potentially detrimental microbes within the hive, it is the microbial activity in the pollens that is of greater importance.

Floral pollens have microbes on them that originate from various places in the environment. We haven’t done much work on the viruses, but we have taken a good look at the bacteria and fungi. Among other things that we have learned is the fact that we can “plate” (grow in culture) only a very low percentage of the species that occur in nature. We are finding out just how many species we are missing when we conduct metagenomic studies on bee pollens. We find genetic sequences from many organisms that have not even been named. What happens when those organisms are brought back to the hive and incorporated into the pollen stores remains mostly a mystery.

What is known, however, is that the microbes continue to secrete their digestive enzymes as they attempt to solubilize food so that they can absorb the nutrients through their cell walls. In studies on hand-collected, pollen trap-collected, and stored pollen, scientists found that the microbial composition changes rather quickly after the bees collect the pollens, but in a predictable manner. The common, environmental fungi that are found in fresh pollens appear to do some pretty major digestion of pollen very early on. Then, their numbers decline and replacement fungi and bacteria work on the pollen. Those organisms were inoculated into the pollen when it was collected by the bees. The inoculum comes from having eaten stored pollen before the bees became foragers. When they regurgitate a bit of nectar or honey to keep the pollen pellets coalesced, they inoculate the pollen load.

After the initial breakdown of major components, more subtle digestion takes place and the acidity of the newly forming bee bread becomes more intense. Eventually, the acidity inhibits any further biological activity, although live microbes still exist in the stores. In that condition, stored pollen can exist for many months or sometimes years and still provide the bees with important nutrients when the pollen is consumed. Additionally, some of the microbes move into the intestinal tract of the adult honey bees and assist in their digestive processes. As far as we know, honey bee eggs, larvae (at least after their single larval defecation), pupae and newly emerging adults have no microbes in their bodies. As soon as the newly emerged bees consume some pollen, they have inoculated themselves for life.

If these microbes are really so important to the nutritional needs of honey bees, what are we doing when we introduce antibiotics and fungicides into the system? We do not know too much about that yet, but some pieces are showing up. Recently, researchers at the USDA bee lab in Tucson compared the fungal microbial populations in pollen trap-collected pollens and stored pollens from field colonies that were located in heavy agricultural areas and in a pesticide-free area around Tucson. Briefly, colonies located near agriculture, even colonies placed on organic almond orchards, had significant amounts of fungicides in their pollen stores. The number of species and the amounts of fungal growths in cultures were very much reduced in locations where honey bees had encountered fungicides. The results were pretty similar, regardless of which fungicides were involved. However, Jay Yoder and his co-authors included the following statement in their paper: "In our study, given the types of fungicides that were sprayed at the approved concentrations that were applied in the field, as long as the bees were provided the opportunity to recover, and perhaps given supplemental food, the colonies could recover."

The exact effects of these pesticide exposures and reduced microbial levels are yet to be determined, but a number of beekeepers are reporting higher incidences of infections with chalkbrood, a fungal disease of larval honey bees, following fungicide exposures. How can that happen in the presence of fungicides? In addition to the nutritional benefits of the normal fungal assembly, those tend to produce chemical compounds that inhibit other fungi from growing. This can provide immunity to infections that bees cannot adequately provide for themselves, such as chalkbrood.

As researchers continue to try to improve upon our supplemental bee feeds, they may have to consider the possibility of inoculating a semisolid formulation of the diet with fresh pollen and stored pollen so that a natural microbial complex can do its things and make the food appropriately fit for consumption by honey bees. A previous study using only a single species of *Lactobacillus* to ferment a supplemental feed led to a fermented diet that the bees refused to consume.

Gilliam, M. 1979. Microbiology of pollen and bee bread: the yeasts. Apidologie 10 (1) 43-53.

Gilliam, M. 1997. Identification and roles of non-pathogenic microflora associated with honey bees. FEMS Microbiology Letters 155: 1-10.

Yoder, J. *et al*. 2013. Fungicide contamination reduces beneficial fungi in bee bread based on an area-wide field study in honey bee, *Apis mellifera*, colonies. J.

Toxicology and Environmental Health, Part A, 76:587-600.

Mao, W. *et al*. 2013. Honey constituents up-regulate detoxification and immunity genes in the western honey bee *Apis mellifera*. Proc. Nat. Acad. Sciences (US) 110 (22): 8842-8846.

EPA like CA

In a recent attempt to limit exposure of honey bees to neonicotinoid pesticides, EPA (U.S. Environmental Protection Agency) has borrowed heavily from California pesticide regulations. The California regulations were implemented in the 1960s to alleviate colony losses (nearly 50 percent, annually) occurring in agricultural fields. Between the initiation of night-time applications and the more stringent notification requirements, annual colony losses to pesticides are closer to 10 percent currently.

The California regulations of note include:

1. Pesticide applicators are required to submit a "Notice of Intent" to the office of the county agricultural commissioner before applying restricted materials. The notice includes the particulars of the intended application including the chemical, the dosage, the field location, the time of day, etc.

2. Staff in the commissioner's office determines whether the product is toxic to honey bees. If so, the commissioner reviews the notice, and occasionally contacts the applicator or the PCA (licensed pest control adviser) to discuss possible changes to the application to protect bees (this is called conditioning the permit).

3. When the details have been worked out, staff checks for apiary locations within one mile of the application site. If one or more apiaries are located within that one-mile radius, the applicator must contact the beekeeper and leave the detailed information about the proposed application at least 48 hours before the application will be made. An exception is made to this requirement when the potentially affected beekeeper fails to register apiary locations with the commissioner's office. Even then, they try to find the beekeeper.

4. Once notified, the beekeeper has to determine which options best suits the situation. One possibility is to move the colonies out of harm's way, but the logistics are hard to imagine. Here are some complexities involved with those decisions:

a) Beekeepers with thousands of colonies spread all over the San Joaquin Valley can get up to 20 calls per day – you can't run away from them all! Also, if you move the bees out (often one colony per acre on fields of 640 acres) you would have to return them back to the exact same locations when you bring them back, since the bees remember exactly where home should be. Foragers trying to get into the wrong hives can cause extreme bee fighting and loss of bees. Also, where will you locate moved colonies? Is the new site bee-toxic pesticide-free?

b) Beekeepers with thousands of colonies spread all over the San Joaquin Valley cannot travel all over trying to cover the entrances of the hives to keep the bees from flying into areas being sprayed. While plastic can work for a few hours in the morning, if the residues are toxic, the bees will have to be limited in flight for at least a day. To accomplish that, wet fabric, like clean burlap, has to be placed over (not stuffed into) the entrances. The bees need to be able to ventilate the hives and the bees use the water for evaporative cooling of the brood nest area in the hives. Often the fabric has to be re-moistened due to hot, dry conditions. Then the fabric has to be removed at the appropriate time. The cooped-up bees often escape the hive in an Africanized bee frame of mind.

One informal survey that I conducted suggested that beekeepers try to intervene with potential poisoning problems in about one case out of seven (about 14 percent of the time). The rest of the time, the bees just remain there and "take their licks."

An additional set of regulations were instituted for use of bee-toxic chemicals on blooming citrus trees. Briefly, agricultural commissioners in counties with significant citrus plantings must choose dates (vary a bit with weather each year) when the citrus is officially in bloom and when bloom officially ends. During the bloom period, bee-toxic materials can be used only on an emergency basis, as determined by the commissioner. But, this is a "loophole," if that word is appropriate. With advancing populations of Asian citrus psyllids, will neonicotinoids come into common use in the orchards?

The new EPA requirements for applications of four nitro-guanidine neonicotinoids around honey bees are written mostly for spray applications. The criteria involving 48 hour notice are very similar to those of California. The criteria for restricting their use are more stringent than even most of our commissioners' "conditions:" "… the product may not be applied while bees are foraging. Do not apply this product until flowering is complete and all petals have fallen." But what about cotton? They flower for weeks, and the pests can abort the blossoms, damage the seeds, and produce honeydew that sticks all the lint into a gooey mass. Bloom treatments of some kind will be likely. Also, if it is windy near the end of almond bloom, the petals drop days before the blossoms cease producing nectar that remains attractive to nectar foragers. In my examples, neonicotinoids may not be the pesticide of choice, but I fear that this sort of verbiage might become common on many insecticide labels in the future. If so, how will it cover the problem of leaky "chemigation" systems that deliver irrigation water containing field-dose strengths of insecticides directly to water-collecting bees?

Then, there are the loopholes. "The application is made due to an imminent threat of significant crop loss, and a documented determination consistent with an IPM plan or predetermined economic threshold is met." In California we have PCAs and agricultural commissioners to monitor those types of decisions. Who does that across the rest of the country?

Finally, none of this relates to the possible effects of exposure of honey bees to sub-lethal effects of the neonicotinoids. We still do not have a good idea of exactly what such exposures do to adult or immature honey bees. Studies indicate that exposure causes detoxification genes to up-regulate to produce detoxification enzymes. Adult honey bees in that condition appear to be less capable of suppressing *Nosema* infections in their bodies. What else is going on?

The new regulations do not address dust from treated seeds escaping into the environment, but the verbiage appears close enough to cover that. I believe that type of loss was reduced significantly this spring in some locales, so perhaps we are headed in the right direction.

<u>Honey Bee Sting Allergy</u>

Renewed interest in honey bee sting allergy has surfaced as beekeepers approach their local agencies with requests to remove prohibitions, or become more lenient, with beekeeping, especially in urban and suburban settings. Eventually, the discussions focus on the topics of liability. Who will be responsible if problems develop and who will intercede in mitigating the problem?

The most difficult topic is human allergies to honey bee stings. What is the definition of allergy, for this purpose? What percentage of the population is allergic to honey bee venom? Can anything be done to alleviate such allergies?

Dr. David B.K. Golden (MD) has been studying this topic for many years. He combined his results with the results of 51 other studies to write a summary paper, "Advances in Diagnosis and Management of Insect Sting Allergy," published in the Annals of Allergy, Asthma, and Immunology 111 (2013): 84-89.

Dr. Golden's first topic is determining how many people actually are allergic. As a generality, 5 percent of our population is allergic to honey bee venom. However, how they respond to stings varies. We think of allergic response as anaphylaxis, leading to inability to breathe and possible death. The statistics demonstrate 1 percent of children and 3 percent of adults have endured such reactions. Another 5 percent or more have endured a "large local reaction," with abnormally large and often persistent swelling around the sting site. Skin tests of adults have demonstrated that 20 percent will test positive to honey bee venom, rising to 30-40 percent in the weeks following a sting. But, if no systemic symptoms develop, most people lose the positive skin test in a few years. Those who still show a positive test are about 15 percent likely to have a systemic reaction with the next sting. However, while having the immunoglobulin E (antibody IgE) is necessary to have an anaphylactic response to bee venom, its presence alone is not sufficient to predict an anaphylactic reaction.

Trying to test for honey bee allergy is fraught with difficulties. In experiments with challenge stings, 40 percent of folks who already had suffered severe reactions had a subsequent one. Systemic reactions occurred with 23 percent of those who had moderate systemic reactions previously. Only 17 percent of those with cutaneous reactions developed more severe reactions. Although we have been told that wasp venom is cross-reacting among species, tests suggest that there are two different types of wasp venom. A negative test to one type does not mean that the other will test the same.

Skin tests do have a degree of value in predicting reactions to bee stings. The most sensitive patients are more likely to have stronger reactions. Those barely responding to prick tests are least likely to have major sting problems. However, there is enough variation in true responses to stings to suggest that the skin reactions are not truly reliable indicators of things to come. Up to 30 percent of patients who already had systemic reactions test negative in prick tests. But, half of those patients do test positive for venom-specific IgE in their blood. The remaining 15 percent give no physiologic clues that they still remain very susceptible, and about six percent of them do have subsequent anaphylactic responses.

Two newer tests are being studied. Basophil activation tests can be run on the patient's blood cells. If the patient is allergic, either the basophils release a mediator of an allergic response or activation markers for a number of "clinically significant outcomes." The second approach is even more complicated: using recombinant venom allergens to determine if the reaction is due to bee and/or wasp venom. It is thought that the cross reaction to both venoms is due to "cross-reacting carbohydrate determinants," but that has yet to be proven. The wasp venom components are predictable. There is considerable variation in the bee venom component.

The final conclusion is that if someone had a previous severe reaction, it is likely (70 percent in adults; 30 percent in children) to happen, again, even 10-20 years later. Interestingly, these patients share another measureable trait. Their baseline serum tryptase levels make them more likely to: 1) have a severe reaction following a sting or from use of bee venom to try to desensitize them, or 2) not get the expected results (failure) from venom-immunotherapy (VIT). An elevated tryptase baseline occurs in about 10 percent of patients who respond severely to stings. It occurs in 25 percent of those whose blood pressure drops when stung. Normally, an elevated baseline suggests underlying mast cell problems, such as mastocytosis.

The paper finishes with an in depth discussion of the use of venom immune therapy (VIT) to desensitize patients. It discusses screening patients to determine when the treatment is appropriate. It describes details of doses and shot regimens: standard (15-20 weeks); modified rush (6-8 week); rush (2-3 days); and ultrarush (3-6 hours). The information covers the use of various medications with VIT, how long to maintain the shot routines, and when to stop getting the shots – can be up to a lifetime, but more often 5 years or less.

This is likely more information than you would ever need to know for an interview, but it is nice to have the facts. The paper can be found at: http://dx.doi.org/10.1016/j.anai.2013.05.026.

2013 WAS Conference

The next WAS Conference will be held in Santa Fe, NM, Oct 16-19. Please visit the WAS website for details: ucanr.edu/sites/WAS2 .

Sincerely,

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