COOPERATIVE EXTENSION UNIVERSITY OF CALIFORNIA

from the U. C. APIARIES University of California

May/June 2014

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Some Great Big 'Thanks'

The first thing that I wish to do in this last "official" newsletter of my salaried career at UC Davis is to thank the many people who have made the past 38 years so enjoyable. I will first praise the beekeepers, of California and across the nation. This is one of the most heterogeneous groups of people one would ever encounter. Beekeepers from nearly every walk of life have a few colonies that they keep for fun. Some beekeepers maintain a moderate number of colonies from which they hope to realize a little income. Then there are the beekeepers whose livelihoods depend on the health and productivity of their colonies to feed, house, clothe, and educate their families. All these individuals have their own ideas about how to "keep bees" and most of them are more

than willing to share that information with me. Discussions with those individuals have kept me on my toes, and I learned something new every time I met with them. I have found beekeepers to be very generous with their time, their bees for experimental purposes, and their pocketbooks (especially Susan and Troy Bunch and the individual members of the California State Beekeepers' Association for making our trip to Maui so memorable).

Another group of associates for whom I have a great deal of respect are the bee researchers across the country. That is a global bee, because the non-*Apis* researchers have opened my eyes to many aspects of bee behavior and lifestyles that are so unique. The bee researchers, on the cutting edge of honey bee knowledge, were willing to share their latest findings with me knowing that their findings were safely cloistered until after publication. It was my job to take as many of those scientific findings as possible and apply the information to productive beekeeping. With colleagues, I was involved in some of that research and determined the impact of aerial spraying for medfly on suburban beekeeping colonies with Dr. Norman Gary; effects of various fungicides on development of immature bees in laboratory culture with Dr. Christine Peng and her students; the selection of tylosin as the replacement anti-biotic for American foulbrood control with Dr. Terry Leighton at UC Berkeley and Dr. Christine Peng; and the effects (none) of exposure of adult honey bees to the pheromone used to reduce reproduction of the light brown apple moth for a California Department of Food and Agriculture study with Susan Monheit, Dr. Mike Johnson and some bee biology assistants. I also conducted a few unpublished experiments that took a heavy toll on beekeepers' bees, but we had discussed that possibility ahead of time.

My associates at the field level, who best know what is going on in their areas of expertise, are the county Farm Advisors. They try to examine every detail of the factors that impact the crops or animals for which they have responsibility. It is truly amazing how deep that knowledge goes. But, there is a limit to how much information a mind can hold. Thus, most Farm Advisors were willing to ask me about pollination and colony health specifics, but otherwise turned the bee questions over to me. This was an excellent relationship and I tried to respond favorably, and quickly, to requests for information and for participation in grower meetings where honey bee questions were likely to be considered. I spent more time with the almond Farm Advisors than the many others, but I did travel around the state trying to help the others when I could.

I've enjoyed good relationships with my departmental peers throughout my career. Each member had tidbits of information that I required from time to time, and they made time available to patiently explain what I desired to know. Those peers conducted the first step in my evaluation processes and were very supportive over time, for which I am truly thankful.

As time went on, I became involved in a number of regulatory issues with both the California Department of Food and Agriculture and the currently named California Department of Pesticide Regulation. As you might anticipate, many beekeepers had strong emotional ties to some of the decisions that have been made over the past. Direct discussions between beekeepers and regulators at times became heated. In those cases, both sides preferred to have me act as intermediary, knowing that I would emphasize the concerns of the beekeepers but not aggravate agency personnel. Most times things settled down relatively well.

The time has come to pass the baton. My next article introduces Dr. Elina Lastro Niño, who will come to the UC Davis campus in September to begin her career as Extension Apiculturist. Since Elina arrives with just a bit more knowledge of California beekeeping than I had (little) when I arrived, I intend to hang around awhile to help Elina become acquainted with people and agencies that she likely will be dealing with in the future. Elina is a very accomplished scientist and she has that type of personality that you appreciate having in your presence. I know that you will really like her.

New Extension Apiculturist

Beginning in September of 2014, California will be served by a new extension apiculturist. Dr. Elina Lastro Niño will be joining the faculty of the UC Davis Department of Entomology and Nematology as the person who will take over the apicultural outreach reins for this position.

Elina will be coming from The Pennsylvania State University where she obtained her Ph.D. working under the guidance of Dr. Christina Grozinger on changes that take place in honey bee queens after they mate. Those studies examined the impacts of oviduct manipulation, insemination volume, and insemination substances. The induced changes included measurable behavioral, physiological, and molecular alterations that occur, including differences in behavioral interactions between queens and worker bees. Those responses depend upon signals (pheromones) of mating status and mating quality of the queens. Elina also is working concurrently on the genomics of pheromone production and the evolution of pheromone signaling by honey bee queens. Elina will remain involved in such basic studies (≈ 30 percent) since they provide insight into basic honey bee biology necessary for moving the applied research forward. Even the information that she currently has acquired will have practical implications for our queen breeders. Elina will devote the greater portion of her time and energies (≈ 70 percent) to conducting practical, problem-solving, research projects and interacting with the beekeepers and industry concerns.

Elina comes to UC Davis with an interesting background in entomology. While working on her B.S. degree at Cornell University, she was involved in studies on darkling beetle control in poultry houses, pan-trapping of horse flies, and surveys of mosquitoes in New York State. In North Carolina, she studied dung beetle nutrient cycling and its effects on grass growth; effects of methoprene (insect growth regulator – IGR) in field and laboratory settings; and assisted in a workshop on forensic Entomology while obtaining her master's degree. And, currently as a USDA-NIFA-AFRI post-doctoral fellow at Penn State, she is contributing to honey bee stock improvement programs through her studies on proteins in honey bee semen. She also is cooperatively reviewing the effects of Israeli Acute Bee Paralysis Virus (IAPV), Deformed Wing Virus (SWV), and *Nosema* on honey bees. The virus studies involve molecular approaches.

While at Penn State, Elina taught basic and advanced queen rearing sessions under the title "Annual Queen Rearing Workshop." She has coordinated more than 25 community outreach events, many featuring a pollination theme. She also has given scientific presentations at local, national and international conferences.

I am looking forward to having Elina on board. We will be on an "introductory shakedown cruise" for a while until Elina becomes better acquainted with the California beekeeping industry and its many related tentacles throughout the state and

across the country, but the future looks absolutely great.

Presidential Memorandum on Bees

Probably most of you have heard about the Presidential Memorandum that aims to create a federal strategy to promote the health of honey bees and other pollinators. I believe this is the result of pressures on Congress from bee-related (*Apis* and native bees) individuals and NGOs, and from within the system, with little doubt that Michelle Obama was a supporter.

The goals and aims of the effort are quite similar to issues that various groups all over the country have been trying to accomplish at the local level. Some of our efforts have been quite successful. Some have encountered roadblocks that we felt were a bit unreasonable. However, here is an example of the types of problems that we need to address. In many cases, when a new parcel of land is transferred to a land agency, a plan is written to cover the management of the land over a specified period of time, including what can be done on the land. If cattle grazing is a possibility, then cattle grazing is included in the document. We might think that if cattle can graze there, then why can't bees? It is because bees were not written into the plan as an approved use at the beginning. So, nothing in the plan **prohibits** beekeeping, but nothing in the plan **allows** it. The documents can be "opened up" and changed, but opening the documents gives everyone, who might wish to obtain previously prohibited access, the right to request access. Each request has to be analyzed and accepted or dismissed, individually. Documents rarely are opened before their expiration dates.

There is no reason for me to list all the various items in the memorandum. However, it is interesting that just about every federal department has been assigned a specific duty, and their department heads (or designees) will be serving on a task force that is being co-chaired by the Secretary of Agriculture and the Administrator of the Environmental Protection Agency. The Department of Agriculture has been assigned many tasks, including 1) developing best management practices for enhancing pollinator habitat on federal lands, 2) establishing a seed bank for use in cases of post-fire rehabilitation and restoration activities, and 3) substantially increasing both the acreage and forage value of pollinator habitat in the department's conservation programs. If you wish to read the memorandum in full, please use the following url: http://www.whitehouse.gov/the-press-office/2014/06/20/presidential-memorandum-creating-federal-strategy-promote-health-honey-b. It may be quicker to put a few key words into your browser – all roads lead to Rome.

Harmonizing Pesticide Labels

For decades there have been contentious discussions about what verbiage to place on a pesticide label to ensure honey bee protection. The beekeepers really wanted the "Do Not Apply …" sort of mandate on any product that would kill bees or negatively impact colony health. On the other hand, applicators desired to have much more specific information, such as: How toxic is this to honey bees? How long does a bee-damaging residue persist after an application? What information can help us decide how to more safely use the products?

One of the suggestions, years ago, that did not meet with my favor or that of the beekeepers, was to try to put on a label an "RT" (residual time) at which time the residue would kill only 25 percent or less of the bees that contacted it. I suggested then, as I still will now, that any other person

maintaining animals for a living would be intolerant of losing 25 percent of his or her chickens, cows, or fish to pesticide poisoning, so why is it okay for honey bees? I expressed this opinion at a hearing on the topic held in California a long time ago. In response to that comment, biologists from the California Department of Food and Agriculture (in charge of pesticide registration and use at that time) stated that 25 percent of honey bees die naturally every day, anyway. After the hearing, I wrote to those biologists with the mathematics of a colony losing 25 percent of its foragers, daily, and 25 percent of its total population, daily. I used the absurd (under these conditions) number of eggs laid and adults emerging of 1,000 per day. A25-percent forager loss led to a four-frame population. A 25-percent total bee loss led to a two-frame colony. Neither of those populations would be of any value to a beekeeper. The biologists never responded to my letter.

My second misgiving with defined RT times is that they can be quite variable. A 25-percent death RT time for a pesticide applied in California in the summer is quite likely to be much shorter than that for the same dosage of the same product applied on a crop located in a region where the temperatures are much cooler and clouds obscure the sunlight much of the time. Which RT should be placed on the label? Do we have the data to back up the claims?

Apparently, the federal government has the answers and has just published a document that will provide that data to anyone. The information was gleaned from "registrant-submitted data submitted in order to fulfill the data requirements for *Honey Bee (*Apis mellifera*) Toxiciity of Residues on Foliage* study (OPPTS Guideline 850.3030). This study is conditionally required if the honey bee acute contact (or oral) median lethal dose (LD_{50}) value – obtained from a honey bee acute toxicity test such as OCSPP 850.3020) – is less than 11µg per bee." It is titled, "Information on Residue Toxicity Time for Growers and Beekeepers." The URL is: http:-//www2.epa.gov/pollinator-protection/information-residue-toxicity-time-growers-and-beekeepers. It is a 15-page pdf that can be downloaded and printed. The final statement on the information page is: "EPA plans to update this table as a more robust data set becomes available."

Some of the RTs are pretty long: guthion on alfalfa (if it still is being used) = 312 hours or 13 days; full dose fenpropathrin (Danitol® on citrus) = 336 hours or 14 days. Most others range from a few hours to a couple days. The neonics are listed, but only as topically sprayed in the field.

It will be interesting to see what changes occur when this information becomes better distributed to beekeepers and growers. Much of the information has been included in our extension publications for many years, and beekeepers still lose bees to poisoning. What's still missing from all this are uses which seem to be safe but are not. One problem is that a grower who does not see any beehives nearby can reason that no bees are on a crop or field weeds that are in bloom. Since the bees will fly up to four miles to find attractive weed bloom in a field, that idea may be way off. The only way to know if bees are foraging in the field is to go into the field and listen or watch for them.

The second issue that seems to becoming very problematic is the trend of PCAs and growers to prefer to tank mix a number of chemicals to deal with numerous pest problems, and apply them all in a single spray session. Somehow some of the mixes, of what we think are bee-benign products, are proving to be toxic to honey bees. Often it is a brood loss problem, but this last

season, blends applied to almond bloom apparently were toxic to both adult and immature honey bees. An estimated 80,000 colonies from Fresno to Bakersfield suffered severe adult bee and brood losses in 2014. We do not have tables to show us the consequences of tank-mixing various products and applying them where honey bees are foraging.

It appears as though outside pressures have motivated some agencies to disseminate information that has been available to them for some time, but quite difficult for us to find. As this information becomes better distributed, we will know more about the bases upon which our regulatory decisions are being made. And perhaps, we will prevent some of the damage being inflicted on the bees.

Drivers of Honey Bee Declines and Losses

A six-member group of reviewers from the EcoHealth Alliance in New York City pored over 99 publications that they found on honey bee colony numbers and colony losses. The first section of their review was on long-term colony decline. In the U.S. they tried to determine the environmental, socioeconomic, and agricultural changes that impacted the bees. They graphed the number of colonies from 1947 to 2010. Interestingly, they pointed out a significant increase in the number of colonies from 2008 to 2010. However, 2011 colony numbers dropped to the 2009 level, and then perked back up in 2012 to the 2010 level. Perhaps that suggests that we have leveled off for the time being. They also mentioned that the NASS colony estimates were reduced in the 1980s when beekeepers, reporting on five or fewer colonies, were eliminated from the data base. So, they decided that key political and socioeconomic factors were primary factors in the decades-long colony declines.

In contrast, year-to-year variations correlate to other factors. They feel that failing to include other seasonal losses than just "winter losses" have made things look rosier than they really are. The extraordinary ability of honey bees to build up quickly from a split to a functional colony masks the true intensity of the losses.

Next they considered the impact of pathogens and pests. Beginning with *Varroa destructor*, they listed all the negative impacts the mite has on honey bee individuals and colonies. However, they suggest that consequences of infestation are difficult to state definitively since beekeepers and scientists do not conduct standardized surveillance programs; studies lack consistency in results; and the "complexity of transmission dynamics hampers an assessment of their true significance." They cited recent studies on *Varroa* in Hawaii that demonstrated increased prevalence and intensity of infection by deformed wing virus, as well as the dominance of a single strain of that virus, as the types of studies that provide information useful for predicting future impacts of the mites.

Next, they considered what is known about infections of adult bees by *Nosema ceranae*. Other than stating that researchers in Spain feel that *N. ceranae* can cause colony mortality, a single paragraph ends in the following: "Further research is needed to understand the role of *N. ceranae* in honey bee losses and any possible additive or synergistic effects it may have with other stressors."

Agrochemical Drivers is the title of the next section. The authors determined that except for studies demonstrating acute toxicity, it was difficult to determine whether exposure to neonicotinoid insecticides resulted in colony damage. That paragraph ends with the statement: "The most difficult challenge facing experimental

researchers lies in deducing whether sublethal effects on individuals play a role in colony loss under real field conditions. Also, although there are studies that demonstrate some effects of mite control product residues on bees, the authors felt that "additional research into the potential additive and synergistic effects is still needed."

The authors included a paragraph on other causal hypotheses, but they did not find solid correlations between colony problems and poor genetic diversity, weather events, stress of colony transportation, or inadequate nutrition. Agricultural expansion, especially in monoculture acreage, was thought to possibly affect colony health, but they said solid research is lacking to demonstrate a causal effect.

Using some mathematical formulae, the authors tried to rank the factors in possible importance in colony decline and losses. They discounted immune suppression because of lack of "rigorous health surveillance," although immune supression often is used in wildlife studies. They stated that effects seen in the lab on isolated bees do not necessarily relate directly to individuals in the colony. They found that the fairly recent introduction of *Varroa* and its related virus transmission probably are the main factors contributing to poor colony health. This conclusion seems to echo the proclamations of some agrochemical companies.

The authors then suggested the types of studies that might better expose the important factors that cause colony decline and death. Besides continuing to do what we have been doing, we should add modeling, risk analyses, and strong inference methods that provide a measure of the role of each driver (potential cause). Additionally, we should consider a macroecology approach that would include more environmental factors than we look at in our narrowly focused approaches. This sounds fairly similar to the approach of the Bee Informed Partnership. But, the authors admit that the data required for such a study probably is not available, other than at specific limited spots across the country.

The authors also looked at the intensification of beekeeping in the U.S. Between 1987 and 2002 we lost around 40 percent of our small scale and sideline beekeepers, while our commercial operations gained 66 percent more colonies, similar to livestock. But, honey bees are much less regulated, examined, and documented than are the livestock. The authors feel that more attention to colony health inspections, with better documentation, might be a basis for better decisions in colony management as operations intensify. They suggest that "trained bee health consultants" (extension, agency, and veterinary) help during the transition to this data-heavy type of management. To me, this sounds like a formalization of the approach taken by the "Tech Teams" that are working under Drs. Marla Spivak and Dennis vanEngelsdorp. I think that Marla has visions of this approach spreading over the country, if it proves to be valuable enough to generate self-funding. Beekeepers involved with these teams are extremely satisfied.

The paper authors also suggested some changes in our pesticide studies. Why are losses occurring in some places, and not others? What are the appropriate doses of chemicals to introduce into hives for toxic effects studies? What methods should be used to study pesticide effects? That final issue may be impacted by the results (BEEBOOK) of a Herculean effort (COLOSS) by scientists worldwide to standardize scientific protocol, so that all studies can be integrated into a single database.

In their final conclusions, the authors compare our level of husbandry sophistication to be similar to that of the livestock industries in the "early twentieth century." Ouch! They suggest that we do not understand our pest and disease problems and we need to produce a solid set of management guidelines (Best Management Practices) to overcome our problems.

You are right. They are not "bee people" and probably not too familiar with beekeeping practices and reasons for making the decisions beekeepers make. However it never hurts to see how someone from the outside views our industry. Let's take away some things of value from this critique.

Smith, K.M., E.H. Loh, M.K. Rostal, C.M. Zambra-Torrelio, L. Mendiola, and P. Dasraz. 2014. Pathogens, pests, and ecomomics: Drivers of honey bee declines and losses. EchoHealth DOI: 10-1007/s10393-013-0870-2.

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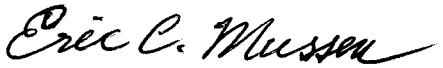

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