# Honey Bee Research

# WHAT WE DO & WHY

## Research is complicated and expensive. Here's why.

Jennifer Berry

Over the years we've all heard the rumors and read the comments about the corporate sponsored research conducted at universities here in the states; how research labs are funded by drug companies and therefore corrupt their own research; and how results are tainted to favor the interests of those paying the big bucks. In fact the perception still exists that professors and researchers actually laze around in seaside cabanas, drinking high priced bourbon, smoking Cuban cigars, discussing (in their best Old English Shakespearean accents of course) the latest on just how "the expression of the MRJP1 protein found in royal jelly and caffeic acid phenethyl ester derived from propolis may just possibly inhibit the reduction of pro-inflammatory cytokines by activated macrophages." Meanwhile, beekeepers are losing colonies left and right because the uninterested university types are too busy living the high life off the backs of the taxpayers. It's interesting how this kind of information can eventually become fact to some people.

Let me shed some light on the reality of the situation. Let's begin with the money trail and my experience here at the University of Georgia bee lab.

"Show me the Money!" Each year the bee lab receives a small allowance from the University of Georgia's entomology department, in the neighborhood of a few thousand dollars. This pays phone, electric, and water bills here at the lab. It is also used for some gas and repair expenses for our two state vehicles (1989 GMC, 1995 GMC). This money is divvied out from the College of Agricultural and Environmental Sciences to individual departments. Lean years, like those experienced lately, mean less money. The College of Agricultural and Environmental Sciences receives money each year from the state. This amount is determined by the state legislature. That's where the dean of the college comes in. Deans are political advocates for their particular College and hence the university. They spend a large portion of their time rubbing elbows with politicians in order to keep money flowing into their institution.

From time to time some federal money will trickle directly to certain departments. This is called Hatch money. It is usually earmarked for salaries to pay state employees like myself. However, sometimes there's money left over which buys a new copier for the department or replaces old computers for students and staff. Now, once in a blue moon a lab or department will be awarded a one-time gift from the state. In 2000, Dr. Delaplane was awarded money in order to build the lab I work in now.

Since we are located off-campus, we don't fall under the umbrella of the university building maintenance and janitorial services. All repairs and upkeep to the lab are our responsibility. When the AC goes out, we pay for it. When the walls need painting, we paint them. When the landscaping needs trimming, we trim it. There are also numerous items which we use on a daily basis that the lab supplies – things like computers, printers, books, tables, chairs, trash cans, cleaning products, toilet paper all come out of our budget. Lab supplies such as microscopes, dissecting tools, optic lights, alcohol, liquid nitrogen, $CO_2$, balance scales, Pyrex ware, sampling jars, freezers all come out of our budget. Hive tools, supers, queen excluders, frames, sugar syrup, bottom boards, lids, wax paper, pollen, foundation, hammers, nails, glue guns, drills, screws, queens, all come out of our budget. Hourly employees and graduate student assistantships come out of our budget as well. Gas and wear and tear on our state vehicles driving to and from experimental apiary sites come out of our budget. Travel to and from local and state meetings come out of our budget. This is just like any business but with one BIG exception – we don't sell anything. Therefore, we don't make any money. Hence we have to beg or borrow every cent we have to spend.

So, if the department isn't paying and the college isn't paying and the university isn't paying for the lab

*Equipment purchased and assembled for research.*

*Equipment ready for bees.*

to operate on a day to day basis, then who is? Ha, the money must be coming from big corporate drug companies, right? Well, actually no.

The majority of our money comes from competitive federal grants. In fact, since my tenure here at the lab we have had only one corporate sponsored grant. A company asked us to test a product which would possibly enhance the attractiveness of flowers to honey bees. We received $2000 for the project which didn't even cover the labor expenses needed to test the product in the field. We've also received research money generously awarded to our lab from the Georgia State Beekeepers Association for various projects that their board of directors felt were credible. Plain and simple, we would not be able to function as a research facility without grant money.

Each year the granting agencies publicize research agendas and the amount of money available. Therefore they dictate what research will be conducted for that particular year. Scores of proposals will be submitted for consideration with most of them not making the first cut. This can be extremely disappointing because writing a grant is no picnic. It can take months to properly prepare and submit a proposal.

If you are lucky enough (and good enough) to be awarded a grant it can take months before the check arrives to the university. Then depending on how the grant is worded there may be stipulations stating that the university receives 15-20% (or even more sometimes) off the top for overhead. Oh, and one more thing, when the government needs to make cuts to federal programs, guess where the cuts begin.

Here's a conservative scenario. A three-year research proposal submitted for 2006 with two other institutions with a budget of $100,000 becomes a $90,000 grant for the 2007 fiscal year. After the three-way cut and the univ ersity's take, this leaves $24,000 to fund a project for three years; labor and supplies not included. The next time you hear about all this "easy money" the government gives to research, think again.

Beekeepers often ask why it is that research takes so long. Let's look at the research aspect of the equation. Honey bee research on average takes several years, especially field research. The actual steps vary from project to project but here are the fundamentals. First an experimental design is created to test a hypothesis. Then funding attempts are made. Next equipment, bees and personnel must be conscripted and put into place. Then data needs to be collected and analyzed. If the data is worth reporting, a peer-reviewed paper is written and submitted. Extension personal then disseminate the information at local, state and national meetings. Our experience here at the lab has been on average two to three years from start to finish.

Let's start with designing the experiment. Research is the pursuit of causality: cause and effect. We want to pin down causation hence we design an experiment which will hopefully answer the question we seek. In order to pursue this answer, treatments are assigned. Treatments denote the different procedures whose effects will be measured and compared[1]. Here are a few examples of some pretty straightforward treatments we've used in the past: screened bottom boards-solid bottoms, small cell-conventional cell, old comb-new comb, resistant queens-non resistant-queens, isolated apiaries-non isolated apiaries, and nematodes-no nematodes.

In order for the conclusions of an experiment to be as accurate as possible, replications must be included as part of the initial experimental design. Research only examines a sub-set of an entire population. For example, we could not possibly examine every colony in every county and state. Therefore, an appropriately designed project requires as many replicates as physically and financially possible. By replicating, the experimenter increases the likelihood of detecting differences between the established treatments and at the same time decreasing experimental error. Experimental error includes all types of extraneous or unmanaged variation. Experimental error must be taken into account or the conclusions drawn may be false. Results of an experiment may not only be affected by the action of the treatments but also these outside sources which can alter the effect being examined. Natural sciences, especially field studies, are full of experimental error. Climate difference from year to year is an example of experimental error. That is why one must replicate over both time *and* space.

Another issue to consider when designing an experiment is how uniform are the experimental units being examined. The best way for me to explain is through an example.

For grins let's say we want to test a new concoction which has been flaunted as the next best thing for *Varroa* mite control. We have two colonies in the back yard that seem perfect for the project. We pour the potion into colony one but not into colony two. Two days later (as advertised by the producer of the product) we return and collect data on mite populations. Colony one we examine 100 cells of *worker* brood for mites. We find that colony one is completely void of mites. Excellent! The next day we return and count mites from the colony two. We examine 100 cells of *drone* brood and discover it is loaded with mites. This must mean the product works, because colony one had zero mites and colony two had lots. Well, not exactly. I realize this is an extremely simple example, but it is a good way to explain statistics.

*Bee packages acquired from university hives awaiting assignment.*

*Grafting our own queens for experimental use.*

*Experimental colonies on their way to the cotton fields.*

Varroa *free packages being prepared.*

*Examining sticky sheets for* Varroa *mites.*

First, we didn't standardize the experimental colonies. Colony one, which received the concoction may have been mite-free from the beginning, but since we didn't measure the mite or bee populations before we treated we don't know if was the action of the concoction that caused our measurements to show no mites or not. Then, we measured mites on different days *and* in dissimilar ways – worker-drone brood. Again, we did not standardize our data collection method. If the experimental units are not the same then what we measure isn't the same, and what we find can't be compared. That is why a fool-proof design is imperative.

Collecting data is a time consuming and laborious job. Trust me – I do it for a living. If data collection isn't done right, the results of the best planned experiment aren't worth the paper they're printed on. Bottom line: research is only as good as the researcher.

Moreover, statistical results can be presented in such a way as to support any theory you desire. Hopefully, the consciousness of the researcher wouldn't allow for unethical representation of the data, but I wouldn't be surprised if it's happened before. A great quote my dad always says "figures don't lie, but liars can figure." And there's another one I heard: "Lies, damn lies, and statistics." That is why we submit our research for peer review before it can be published. It's the scientific community's way of checks and balances. Research builds upon itself, but if the foundation is weak, that is, if bad research is depended upon, it is only a matter of time before it collapses.

See ya! BC

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*Jennifer Berry conducts honey bee research at the University of Georgia bee lab in Athens, Georgia. She is a frequent contributor to these pages.*

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1. *Cochran, WG & GM Cox (1992) The Contribution of Statistics to Experimentation. In Experimental Designs. John Wiley & Sons, INC.*