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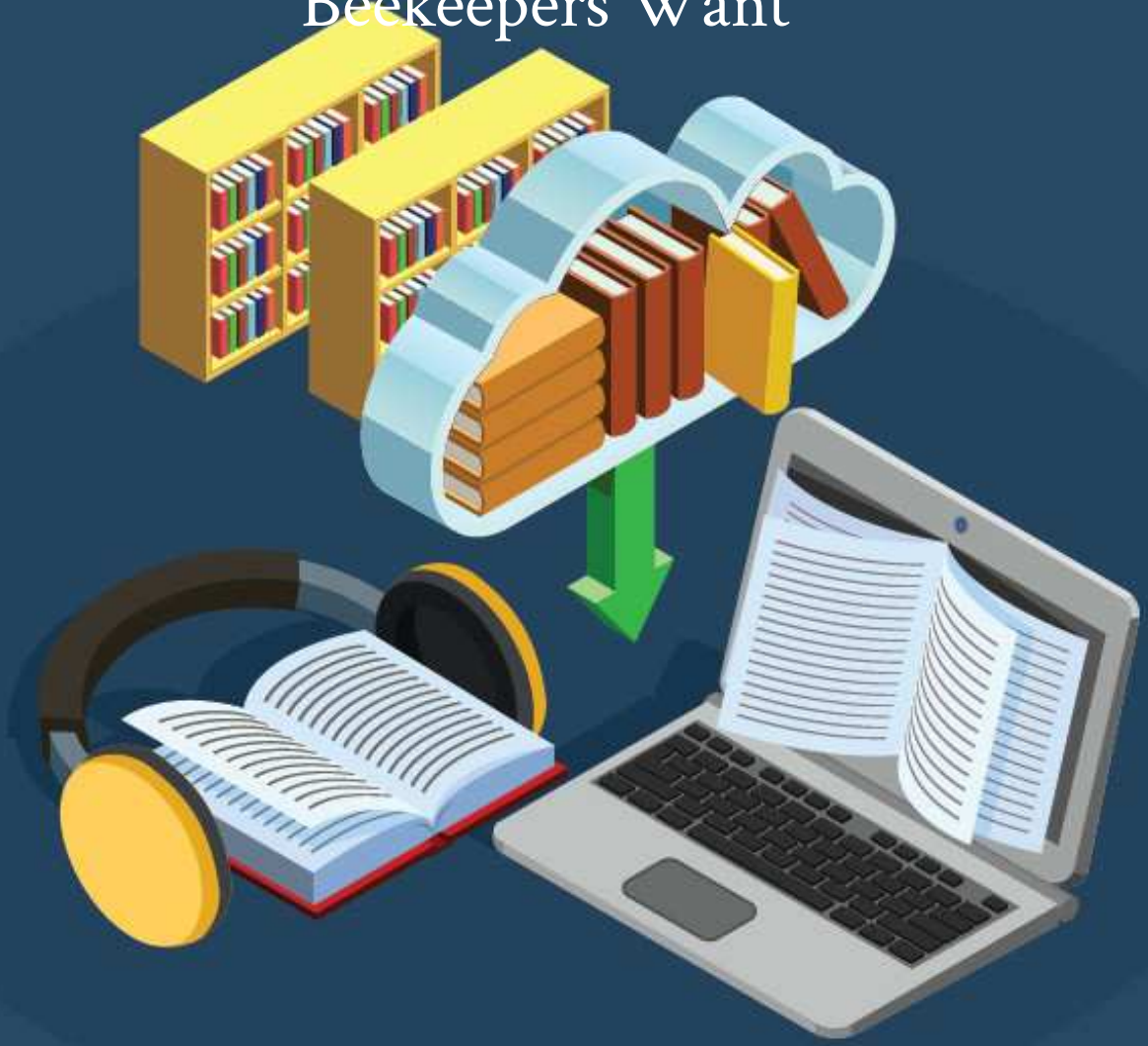
Bee Research: What Scientists and Beekeepers Want



Malcolm T. Sanford

A panel on bee research was convened at the recent meeting of the American Beekeeping Federation. Billed as what bee researchers want from beekeepers and vice versa, presentations from both points of view showed that a substantial divide exists between these groups.

Researchers are primarily driven by the demands of their discipline and the administrators they report to. The latter often require that scientists themselves acquire the substantial funding to carry out their activities from granting and/or commercial sources. As for the former, researchers are called on to publish in journals that are peer-reviewed and read by others in their field. They get little if any credit for publishing in lay magazines. The practical result of this is that a lot of research is not perceived as directly helping beekeepers. In addition, much of it continues to be published in places not readily accessible to the lay public.

At the convention, several conclusions were reached. Quality research isn't easy. It takes patience, time, money and adequate controls. In 1985, I wrote an essay about the latter issue with reference to tracheal mite control. In part it read, "…no experiment is worth much without a control, an untreated colony in the exact same state genetically, qualitatively (same stores, amount of brood) and infested to the same degree as the colony being treated. This provides the basis for comparison to show a material's effectiveness. In bee research, developing effective control colonies is often the most difficult part of an experiment. This is true because to be shown to be generally effective under field conditions, experiments must usually be conducted on a large scale, involving a great number of both infested and control colonies." Finally, any study must be repeatable by both the originator and others, resulting in the same conclusions, in order to be taken seriously by the scientific community.

Many beekeepers see scientists as employed to solve applied problems and publish the results in accessible trade journals. They often have little patience for research published in scientific journals, especially that which they perceive has little practical value. A good many researchers, on the other hand, view beekeepers as supplying little, if any, funding. As a consequence, they have little sympathy for what they often see as complaints by a cadre of folks who are not informed about what really is involved in bee research.

Unfortunately, this conflict sometimes leads to beekeepers becoming fed up with researchers, and vice versa. In the worst-case scenario beekeepers may accuse researchers of complacency, even complicity, in ignoring their needs. At the same time scientists can lose respect for beekeepers, who they perceive as ungrateful for research even when it does directly affect their livelihood.

This brings to mind a recent flap that has mostly escaped the readers of *Bee Culture* who are not part of the enlarged online beekeeping community that routinely uses electronic communications. I wrote the following about the September 2005 edition of *Bee Culture* magazine:

"Hans-Otto Johnsen discusses commercial beekeeping in Norway. He describes Varroa control in the country employing artificial swarms and splits, breeding and biotechnical methods. Much of the article discusses an experiment in small-cell beekeeping. Discussion of this on the bee-l list revealed a distinct difference between how those who read *Bee Culture's* pages deal with the information presented. Even though several have complained about the methods used, others seemed to care more that the information was published so they themselves could determine what others are doing and do the due diligence on the study's validity themselves."

Indeed publication of this study also printed in *The Beekeepers Quarterly*, a British magazine, resulted in several strong responses. Some in the bee-l community saw the article as vindicating arguments that small cell size should be further investigated as a means to control Varroa and other bee maladies. When I inquired further about this article from some of those who collaborated on the project, I received the following: "Illegal publication of test results!…It is important for the Norwegian Beekeepers Association to point out that the test is not finished, that the results in the mentioned articles (sic) is taken out of a larger context, and that Johnsenhas published some of the preliminary results without the approval of the Norwegian Beekeepers Association."

Soon after I wrote that, a rebuttal came from Mr. Johnsen: "My article is about my surviving as a truly organic beekeeper. In the concept for me surviving with my 600 colonies, small cell size is a vital part and the figures are mentioned to give the background for why small cell size is important in my concept. The mentioned figures are results from hives which I've got with the design described." It is important to note that this quote did not come directly from Mr. Johnsen who apparently does not use a computer and so did not see the original online postings, but indirectly from two other persons who reportedly got feedback through personal communication with him.

This provoked other replies concerning validity of the information reported. The discussion can be gleaned from the Web and is not the focus of this article. However, Jim Fischer whose words have graced *Bee Culture* in the past concluded in one of his replies: "…if one is participating in an organized research effort, it is generally assumed that one will follow a specific protocol, contribute one's data, and let all the data be analyzed before making any possibly rash statements about what is seen in a mere subset of the data.

"It is a shame that the actual paper may be blocked from being published in a peer-reviewed journal due to this 'pre-publication' of partial data by one 'loose cannon' among the large number of people who participated in the effort. Peer-reviewed science journals most often flatly refuse to publish research that has been already reported on by the popular (layman's) press or another journal before being published in their journal.

"The net result may be to take hard work by many people resulting in good hard data, and make it all seem 'questionable' or 'unpublishable' simply due to this error in judgment by one participant. That's a shame when the goal seems to have been to do a large-scale study and have the results be accepted as 'Science' with a capital 'S'.

"So, it is not about 'freedom of speech', its not about 'turf', it's not about 'ego', and it's certainly not about what any one participant THINKS he might be able to conclude from his hives alone. It is about doing science, working as a member of a team, and refraining from grandstanding to get one's 15 minutes of fame. This is expected in any multi-researcher effort. Violate these basic rules, and no one will ever want work with you again in this lifetime.

"That didn't happen. Two magazines got conned, and so did an entire national beekeeping group. That's sad." In addition responding to another statement, he said, "I think it was made clear that it was all about statistical significance."

Since the above discussion, several items have come to my attention regarding the scientific publication process. An article appearing in *The Economist (September 3, 2005, p. 72)* took on the topic of scientific accuracy and its relation to statistics.

"Theodore Sturgeon, an American science-fiction writer, once observed that '95% of everthing is crap'. John Ioannidis, a Greek epidemiologist, would not go that far. His benchmark is 50%. But that figure, he thinks, is a fair estimate of the proportion of scientific papers that eventually turn out to be wrong.

"Dr. Ioannidis, who works at the University of Ioannina, in northern Greece, makes his claim in *Plos Medicine*, an on-line journal published by the Public Library of Science. His thesis that many scientific papers come to false conclusions is not new. Science is a Darwinian process that proceeds as much by refutation as by publication. But until recently no one has tried to quantify the matter." Some of the cited studies in Dr. Ioannidis' work now found to be wrong, according to *The Economist* article, include safety of hormone replacement therapy, coronary health improvement due to vitamin E. intake, and the relative effectiveness of stents over balloon angioplasty in coronary artery repair.

A major source of error is an "unsophisticated" reliance on "statistical significance," according to the article, which says: "To qualify as statistically significant a result has, by convention, to have odds longer than one in twenty of being the result of chance. But, as Dr. Ioannidis points out, adhering to this standard means that simply examining 20 different hypotheses at random is likely to give you one statistically significant result. In fields where thousands of details have to be examined…many seemingly meaningful results are bound to be wrong just by chance."

Another problem many in bee research can relate to is small sample size. The greater number of colonies to which experimental treatments are applied, the better will be the resulting information. However, the more colonies one includes in a study the more difficult and expensive it becomes. There are also more insidious sources of error, which often can equally affect beekeeper-initiated research listed by Dr. Ioannidis. These include studies showing "weak effect," such as a drug that works only on a small number or patients (bee colonies), or poorly-designed research allowing fishing for results beneficial to commercial interests (pesticide manufacturers) or that confirm pet theories.

According to *The Economist* article, "when Dr. Ioannidis ran the numbers through his model, he concluded that even a large, well-designed study with little researcher bias has only an 85% chance of being right. An underpowered, poorly performed study has but a 17% chance of producing true conclusions. Overall, more than half of all published research is probably wrong." The article concludes: "..he (Dr. Ioannidis) makes a good point—and one that lay readers of scientific results, including those reported in this newspaper, would be well to bear in mind. Which leaves just one question: is there a less than even chance that Dr. Iaonnidis's(sic) paper itself is wrong?"

Another article in *The Economist* (September 24, 2005, p. 97) discusses the future of scientific publishing: "All this could change the traditional form of the peer-review process, at least for the publication of papers. The process is organized by the publisher but conducted, for free, by scholars. The advantages afforded by the internet mean that primary data is becoming available freely online. Indeed, quite often the online paper has a direct link to it. This means that reported findings are more readily replicable and checkable by other teams of researchers. Moreover online publication offers the opportunity for others to comment on the research. Research is also becoming more collaborative so that, before they have been finalized, papers have been reviewed by several authors."

Finally, it must be kept in mind that many times the details of publications are not fully examined by readers. The Devil is in the details when it comes to analyzing research as noted by Richard Lewontin relating the story of the wonder-rabbi of Chelm, who had a vision of the fiery destruction of a school in the city of Lublin fifty miles away (Lewontin, R. 2000, *It Ain't Necessarily So: The Dream of the Human Genome and Other Illusions).* Some time later, all offered sympathy to a visitor from that city, but he said there had been no such event and on hearing the source asked, "what kind of wonder-rabbi is that?" One of the rabbi's disciples replied, "Well, burned or not burned, it's only a detail. The wonder is he could see so far."

Short courses designed with a research component may help beekeepers better understand what is involved in bee research. Perhaps the gold standard in this kind of training is the online beekeeping course, of the University of Montana's School of Extended and Lifelong Learning (SELL).

The beekeeper-researcher debate will no doubt continue. Andy Nachbaur's historic challenge to the Bee-L discussion list is one example. The following is his response to the legislative proposal that the National Honey Board (NHB) turn some of its efforts to bee research by further assessing honey:

"That is nice…and I can guarantee that all will be spent, and all will be back for more, as beekeeping research funding is the original black hole. If anyone can name 10 useful beekeeping tools, management schemes, PC software, or any other useful beekeeping advancement recognized and used by a bare majority of US beekeepers as being the product of so called 'public funded beekeeping' research in the last 20 or even 30 years I will do my best to match the $500,000 myself. I am sure all of this pie in the sky 'beekeeping' research money will end up replacing tax payer funded programs and I am for that but not if I have to replace it with my own limited funds after writing that big $500,000 check I am a little short."

This quickly brought replies from several individuals who listed extender patties, artificial bee diets, swarm and pollen traps, and instrumental insemination syringes as being qualified. Though not a direct response to this challenge, Dr. Keith Delaplane, who was on the panel and also is extension apiculturist at the University of Georgia, has written three articles in Bee World [Vol. 77, No. 2, 1995, pp. 71-81 and Vol. 78 No. 1, pp. 5-11 and No. 4, pp. 155-164, 1996] which pertain to the issue. All are published under the same title "Practical Science — Research Helping Beekeepers."

His first article focuses on tracheal mites. The history of the mite is given in some detail and reveals how both beekeepers and scientists pieced this complicated story together over time. He then discusses research in controlling these mites with menthol, formic acid and vegetable oil. Finally, he describes research contributions in controlling tracheal mites using colony manipulation and bee breeding.

In a second article, Dr. Delaplane discusses colony manipulations for honey production. These include studies confirming that 1) bigger populations are better, 2) bigger combs are better, 3) swarming reduces honey yield, 4) good queens stimulate honey production, and 5) empty comb and moderate crowding stimulate honey production. Of those, according to Dr. Delaplane, perhaps the most profound way this research has influenced beekeeping is a shift by beekeepers from tolerating swarming to discouraging the activity, and the realization that larger colonies are more efficient on a per-bee basis. Widespread implementation of these has resulted in larger honey crops.

Dr. Delaplane's final article homes in on the one organism that has been most responsible for changing the face of Apis beekeeping worldwide, the parasitic bee mite *Varroa destructor*. Although over 140 chemicals have been tested for Varroa control, he only examines five in detail. These include fluvalinate (Apistan®), flumethrin (Bayvarol®), bromopropylate (Folbex®), formic acid and aromatic or botanical extracts (Apilife VAR®). He also describes mite detection using ether roll, capping scratcher and bottom board inserts, and developments in determining proper thresholds for treating, the fundamental principle behind Integrated Pest Management or IPM

Finally, Dr. Delaplane describes manipulations to eliminate drone brood and efforts in bee breeding. He concludes: "The most notable accomplishments…are the discovery and development of effective bee-safe miticides, application methods for miticides, IPM-based recommendations that reduce chemical reliance, hive manipulations that reduce Varroa populations, and discovery of mechanisms of genetic mite resistance in *A. mellifera*."

Another document that contributes to the subject at hand is this, which incorporates the efforts of the USDA's honey bee research laboratories and other related organizations.

To be fair, many research accomplishments in beekeeping cannot be attributed to one person or organization. There is also a considerable body of study developed in other countries, funded by both beekeepers and governments.

Finally, Dr. Delaplane concludes the beekeeper must also be considered a full partner in much of the research that has been accomplished to date. "We can thank practical-minded beekeepers for inventing beekeeping equipment, working out basic beekeeping techniques, accumulating untold hours of natural observations, and identifying applied research needs. And we can thank generations of scientists who have pieced together bee biology, disease etiologies and treatments, parasitology, genetics and breeding. Clearly, the relationship between beekeepers and bee scientists is mutually beneficial. But it never hurts to remind ourselves how important that relationship is."

Fortunately, it appears the tension between the groups noted above is lessening somewhat, given the new kinds of research initiatives that have appeared recently. Most significant is information being generated by contributor Randy Oliver and the efforts of Projpect Apis m, initiated primarily by the almond industry, which has a contemporary interest in and become a major force in the topic of honey bee health. This field is now attracting more scientists from outside the traditional apicultural area. Most notably is Plose One, a major open-access scientific journal, which has both the capability of searching for highlights as well as a full collections option.

Unfortunately, research in general is becoming more of a "political football." Part of this is the current state of what is being called "bad science." Recent rhetoric by politicians has not helped this situation as they take advantage of the public's general ignorance about how science is done and the value it provides society. Hopefully this article will provide a more positive response to those who would denigrate science from being simply "untrue," to a downright "hoax."