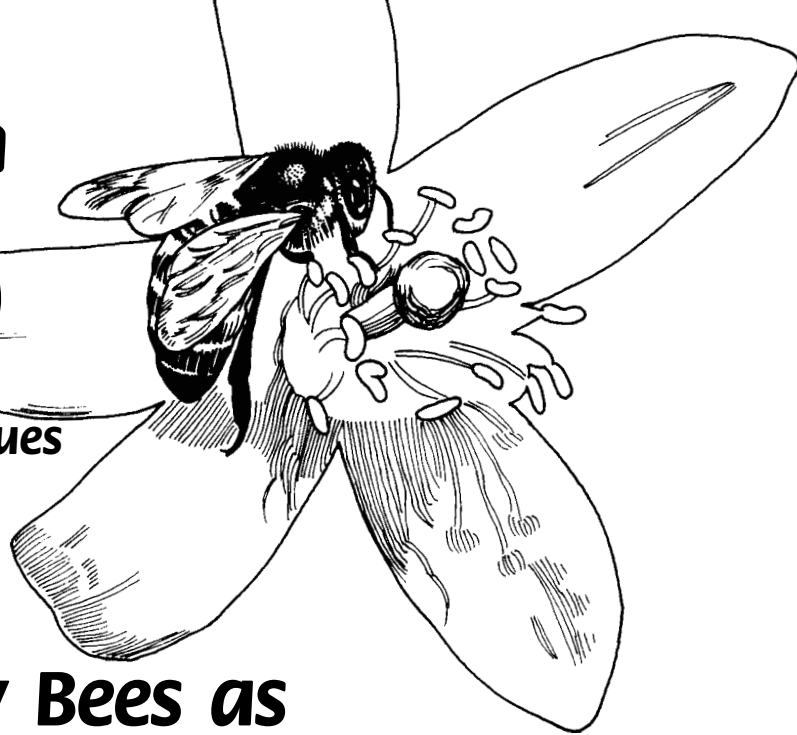


APIS



Apicultural Information and Issues

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Honey Bees as Biological Control Agents: Fungal Control of Fungus

"IT IS DIFFICULT to think how a bee could be more useful." This sentence begins an article in the September 28, 2000, edition of *The Economist*¹. The honey bees' incredible utility may be intuitively obvious for beekeepers, but not for everyone, it seems. According to the article, scientists at Cornell University in New York state have created and patented a honey bee "footbath" that uses the insects to disperse beneficial microorganisms to strawberry flowers².

"Strawberries, along with many other soft fruits, suffer from grey mould, a troublesome rotting disease. Although the fungus mainly damages the fruit, infections actually start in the flowers. One effective treatment is to spray those flowers with another fungus, called *Trichoderma harzanium* 1295-22³. This organism competes with the grey mould in flowers, thus eliminating it before the berries form, but causes no harm to the fruit itself.

"Dr. Kovach's system works by putting spores of *Trichoderma* into a specially designed tray. This is encased inside a plastic housing, which is then fixed into the entrance of a hive. That means that the tray can be removed and replaced as easily as a tray of photocopier toner. Bees pick up the spores on their legs as they walk out of the hive, and deposit them on to flowers they visit as they search for pollen and nectar.

"The researchers say that bee-delivery is nearly twice as effective as spraying the spores around by conventional methods, and uses a fraction of the quantity of spores because the insects deliver them directly to the blooms rather than wasting them on the leaves, stems and ground. The result, they claim, is that bee-delivered *Trichoderma* offers as much protection as the chemical fungicides preferred by most strawberry farmers. And an added bonus is that simply adding a beehive to a field of strawberries improves yields by 20 to 30 percent, because of better pollination.

"Dr. Kovach has high hopes for extending the use of his system. Not only is it likely to be effective with other fruit, such as raspberries; it could also be filled with other biological-control agents, such as beneficial bacteria and viruses, which separate studies have shown that bees can also deliver. Indeed, according to Dr. Kovach, the system could be used to "vaccinate" plants against disease as well as treating them. A group of newly discovered chemicals that can stimulate a plant's immune system to resist infection would be eminently deliverable by bees.

Continued on Page 4

¹ <http://www.economist.com/>

² http://www.economist.com/printedition/displayStory.cfm?Story_ID=383001

³ <http://www.nysaes.cornell.edu/ent/bcconf/talks/harman.html>

Oral Health and National Honey Board Efforts: More Official Respect for Honey

THE NATIONAL HONEY BOARD⁴ has released information that honey researcher Dr. Peter Molan, associate professor of biochemistry at the University of Waikato, New Zealand, will speak at a symposium titled "Functional Foods for Oral Health," organized by the University of Illinois College of Dentistry on March 9, 2001. The symposium is part of the American Association for Dental Research annual meeting being held in Chicago. In his presentation, "Honey for Oral Health," Dr. Molan will present the results of laboratory research to test the effect of honey on the species of dental plaque bacteria believed to be responsible for dental caries.

Honey contains an enzyme that produces hydrogen peroxide, which is believed to be the main reason for the antimicrobial activity of the sweet. Types of

honey differ greatly in their antimicrobial activity by as much as a hundred fold on occasion. Processing honey using heat and/or filtration also may affect its pharmacological properties⁵. The research shows that honey not only stops the growth of dental plaque bacteria, it reduces the amount of acid produced, which inhibits the bacteria in the mouth from making dextran. Dextran, a component of dental plaque, is the gummy polysaccharide that the bacteria produce in order to adhere to the surface of the teeth. Dr. Molan's research reveals the potential for the use of selected highly antimicrobial types of honey in the treatment of periodontal disease and gingivitis, inflammatory conditions resulting from gum infection. The factors involved are similar to those found in inflamed and infected wounds. Clinical research shows that

honey is gentle on tissue and rapidly removes swelling and pain. It also stimulates cells that repair the tissues damaged by infection.

According to the release, "Dr. Molan heads the University of Waikato Honey Research Unit, recognized for its expertise in the composition of honey, including antimicrobial activity. In New Zealand and Australia, honey producers have batches of honey tested in the laboratory to identify the samples with high activity. Those types are now labeled and marketed as 'antiseptic.'"

"The National Honey Board⁶ is now coordinating efforts to have varieties of honey found in the United States tested to identify the floral types that have good antimicrobial activity." ■

Biological Control of Foulbrood: Bacterial Control of Bacteria

THE CURRENT SITUATION with reference to American foulbrood and its resistance to one legal control, Terramycin®, is troubling⁷. However, there is research being done, which might result in a biological control of this important honey bee disease. It is based on an old biological principal, competition, and parallels another story in this newsletter that discusses fungal control of fungus as distributed by honey bees on plants.

A paper found on the World Wide Web at the Cardiff University site of Dr. Brian Dancer⁸ states: "Arising from the comparative studies on *Paenibacillus larvae* subsp. *larvae pulvificiens* we discovered that like subsp. *larvae*, subsp. *pulvificiens* produces active antibiotics as it sporulates which are active against a wide range of bacteria. Among the latter are *M. plutonius*, which causes European foulbrood in honeybees. As is common in bacteria, the antibiotic(s) are not inhibitory to their producers nor to the other subspecies, subsp. *larvae*. However, during growth *pulvificiens* produces a bacteriocin that is toxic for subsp. *larvae*, causing it to lyse. These observations have been patented and are the basis of ongoing investigations to determine whether spores of subsp. *pulvificiens* can be applied to hives to prevent or treat both bacterial diseases of honey bees. The strains of subsp. *pulvificiens* are unmodified and derive from hive material; as such they would make a welcome alternative to applied purified antibiotic and could help to reinforce the healthful image of honey and other bee products⁹." ■

The Clock Gene in Honey Bees: Also Affects Foraging

A PRESS RELEASE dated 3 July 2000 from the University of Illinois at Urbana-Champaign discusses further research in Dr. Gene Robinson's laboratory¹⁰. Current study shows that a gene associated with the biological clock, sometimes called circadian rhythm, in many organisms¹¹ has yet another function in honey bees.

It seems the gene is more active in the brains of older honey bees, especially foragers whose jobs are outside the hive. The levels of so-called "messenger" material (mRNA) rose and fell during the day in both young and old bees. This cyclic activity is a signature of all clock genes. However, levels of mRNA were twice as high in older bees and in precocious foragers, those forced into foraging at an earlier-than-normal age. The latter discovery, according to Dr. Robinson, suggests an association between foraging activities and high levels of period gene activity. The elevated levels "cannot be caused solely, if at all, by increased chronological age, foraging, flight, or exposure to the sun," as foragers confined to the laboratory and isolated in darkness away from their social environment for several days also maintained high levels¹². ■

⁴ <http://www.ifas.ufl.edu/~mts/apishtm/threads/nhboard.htm>
⁵ http://www.ifas.ufl.edu/~mts/apishtm/apis_2000/apaug_2000.htm#6
⁶ <http://www.nhb.org>
⁷ http://www.ifas.ufl.edu/~mts/apishtm/apis_2000/apjan_2000.htm#1
⁸ e-mail: Dancer@cardiff.ac.uk
⁹ <http://www.cf.ac.uk/biosi/research/biodiversity/staff/bnd.html>
¹⁰ <http://www.ifas.ufl.edu/~mts/apishtm/apis97/apoct97.htm#2>
¹¹ <http://www.eurekalert.org/releases/clock-gene.html>
¹² <http://www.eurekalert.org/releases/uiuc-bcg070300.html>
¹³ <http://www.beedata.com/description.htm>
¹⁴ <http://www.ifas.ufl.edu/~mts/apishtm/apis92/apjun92.htm#3>
¹⁵ http://www.pollinatorparadise.com/Solitary_Bees/SOLITARY.HTM
¹⁶ <http://www.data2.com/>
¹⁷ <http://www.data2.com/success/ag-frm.html>
¹⁸ <http://bee.airroot.com/beeeculture/digital/2000/column28.htm>
¹⁹ <http://www.xrefer.com/entry/165886>

Complementary Pollination: Breaking the Either/or Paradigm

A RECENT ISSUE of *The Beekeepers Quarterly* (No. 64, February 2001), published by my good friend Jeremy Burbidge in the United Kingdom, the owner of Northern Bee Books¹³, features an article billed as a “pollination debate”: *Osmia rufa* (the red mason bee) vs. *Apis mellifera* (the honey bee). Contributors Bill Clarke, Geoff Hopkinson and Chris O’Toole weigh in on the topic with some zest.

Mr. Clarke says that *O. rufa* is certainly an interesting and useful bee, but surely not as good as “our honey bees.” He is concerned about the mathematics of it all. Conservatively he judges that simple division using conservative numbers reveals that one red mason bee must do the work of 180 honey bees. He is also “unhappy” about the comparison of the two bees.

“It is all very well to note how quickly the two types of bee gather their pollen or nectar, perhaps both simultaneously, in a race with each other, but it is what happens between that time that counts. Whilst she is building her pellet of nectar and pollen, *Osmia* will return at about 15-minute intervals, some three to four times. One bee nesting in my door lock took around a fortnight (two weeks) to make fourteen cells, that is some 68 visits to the field to pollinate, add another two or three visits each day to top up her energy supply, then she has made over 100 pollination trips. In the meantime, the honey bee has dumped her load with her sisters and returned time after time – if the hive is in an orchard then she would easily make a hundred excursions in three to four days.”

Mr. O’Toole ripostes that the data supporting the fact that *Osmia* spp. are more efficient pollinators of orchard crops is in the public domain and backed up by a wealth of observations. He too uses arithmetic. “The female part of any apple flower comprises 5 stigmas borne in a subdivided style, 5 carpels with 2 ovules per carpel. Thus, a fully cross-pollinated apple flower requires the transfer of at least 2 pollen grains from flower of a pollinizer cultivar to EACH of the 5 stigmatic surfaces of the pollinated flower during the short period of stigma receptivity. All this boils down to the number of pollen grains delivered per bee visit. For anatomical and behavioural reasons, *Osmia* bees deliver more pollen per stigmatic surface than honey bees: their pollen is carried in dense,

dry masses on the underside of the abdomen and, unlike honey bees, they always land directly on anthers and stigmas and actively scabble for pollen in a violent manner. By contrast honey bees at apple flowers often make side-visits only, which result in little or no pollination. Pollination results with *Apis* which are considered adequate depend on the ease of ensuring blanket coverage to offset the low efficiency of individual workers.”

Mr. Hopkinson says Mr. Clarke’s concern regarding the mathematics of hive population are well presented, and follow a line of thought fundamental to any essay on the dynamics of fruit population. A possibly contentious statement, he says, is that “any flower visited by the honey bee will be adequately pollinated.” Pollination is not the same as fertilization, according to Mr. Hopkinson, who concludes, “the aim is surely to supplement existing pollination agencies,

at a time when the *Apis mellifera* populations are in the decline.” Mr. O’Toole adds: “Because of their differing flower-handling behaviours and resource needs, *Osmia* spp. and *Apis mellifera* do not threaten each other competitively and I would advocate that *Osmia* spp. be used to complement rather than entirely replace *Apis*.”

In reality, comparison of the two kinds of bees, one a solitary, few-crop specialist and the other a social, cosmopolitan pollinator of a wide variety of plants, is a futile exercise¹⁴. It very much is in line with the classic statistical statement, “one cannot compare apples and oranges.” Thus, the either/or paradigm in pollination probably should be replaced with a more bee-friendly complementary message. This is also the approach taken by others, including perhaps the most complete solitary bee site on the World Wide Web, which uses the phrase: “Solitary Bees: An Addition to Honey Bees¹⁵. ■

Honey Bees and Bar Codes: The Closing of the Tucson Bee Laboratory

IN A SURPRISE, but not fully unexpected move, the January 2001, edition of *The Speedy Bee* reports the closing of the USDA Carl Hayden Tucson Bee Laboratory on March 23 by the Agricultural Research Service (ARS). This brings to a close some 60 years of beekeeping research at that facility.

A recent example of one of many lines of study carried out at the Tucson lab was development of the latest version of the world’s smallest bar code, designed for honey bees. It was required by Dr. Stephen Buchman and developed by Data2, Inc.¹⁶ According to a press release from the company on its web site, “The bar code label had to be miniaturized, lightweight (so as not to affect the bees’ aerodynamics), durable, and provide first-scan readability. We developed a paper label 1/20th the weight of the pollen a bee carries, shaped to fit a bee’s thorax. To enable us to produce such tiny labels, the bar codes were created using our photocomposition process that prints individual lines as small as 1/1000” wide. To apply the labels, each bee was put to sleep for two seconds with a

short burst of carbon dioxide, giving the researchers enough time to quickly glue a tiny label on the bee’s back. A laser scanner mounted over the tunnel-shaped entrance to the hive then recorded their activities¹⁷.”

Latest information from Data2 is that the company maintains an interest in selling this product; interested persons can contact the firm through e-mail (Butch@Data2.com).

Dr. Buchman is no longer associated with the Tucson research facility, choosing instead to become involved with The Bee Works¹⁸. Although there will be a “quid pro quo”¹⁹ by ARS administrators in terms of funding shifts and other compensation from the Arizona to the Weslaco, Texas, bee research facility, the inevitable results of this closing mean a poorer pool of honey bee research funded by United States tax payers. Late word is that the closing has been delayed until later in the year. This appears to mean that those interested in keeping the facility open are not without their supporters. ■

Feral Honey Bee Comeback

I FIRST HEARD about feral honey bees making a comeback in France back in 1997, when on sabbatical in Aix-en-Provence²⁰. The only evidence were anecdotal reports of a larger-than-normal number of swarms. Many said it meant nothing; the swarms were from mite-treated colonies. Nevertheless, it struck a chord; more recent information suggests that Canadians are also using French stock in an effort to incorporate this trait²¹. There seems little reason to believe that feral honey bees might not rebound after being challenged by mites for a period of years no matter the geographic setting.

David Green in South Carolina²² recently wrote: "I was impressed by the number of locations where I found foraging honey bees where, to my knowledge, there were no domestic bees within range. I did not announce this observation last fall, thinking I'd wait to check on spring survival. Now I think I am definitely seeing a trend in the area. I believe many of the

honey bees I'm seeing are feral, and have been feral for more than one season." He concludes: "I am noticing a high proportion of honey bees seen foraging that are a decided gray color. This interests me, in that I have never kept a gray bee, nor do I know of any other domestic bees in the area that are gray. The gray color is a characteristic of Caucasian bees, is it not? They have never been popular here, and I have no experience with them. Has someone introduced them at some point, and do they have a Varroa resistance mechanism that the Italians and Carniolans don't have? Which has caused a gradual rise in their proportion in feral populations? I am thinking that the crash in pollinator populations was caused by a coincidence of two factors, pesticide misuse (in the wake of mosquito spraying after hurricanes in the region) and Varroa mites. I believe that we are also seeing some significant (but not complete) recovery. I'm looking for confirmation or refutation of this."

Other observations indicate that Florida may also have some feral honey bees on the rebound. These include areas on both coasts where a lot of managed colonies do not necessarily exist. Latest information, for example, is that loggers in the Big Bend region of the state are finding more and more wild, untreated nests of honey bees in trees. The Jacksonville area has also been implicated in this phenomenon. Other references suggest it might be happening in California²³. It's worth everyone keeping their eyes open to possibilities of Varroa tolerance being developed in North American honey bees as appears to have happened in South and Central American populations²⁴. ■

Apitherapy Course Offered

THE CHARLES H. MRAZ Apitherapy Course for the year 2001 is announced for July 27 to 29 at the Drawbridge Inn, Ft. Mitchell, Kentucky. This is a comprehensive conference covering all aspects of apitherapy from bee venom administration to use of honey. It addresses such topics as the rules of apitherapy, apitherapy and the law, and the limits of its use. For more information see the American Apitherapy Society's World Wide Web page,²⁵ and/or contact The American Apitherapy Society, 5390 Grande Rd., Hillsboro, OH 45133. Phone: 937-364-1108; Fax: 937-364-9109; (E-mail: AAS_Office@apitherapy.org). ■

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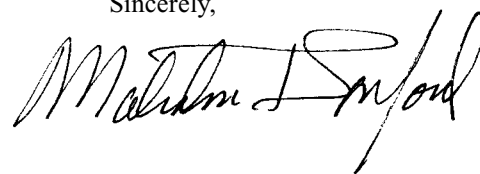
"Bee lovers around the world need not be concerned, however. The actual payload carried by the insects is very small, and their fungal footbath has no effect on their health. Honey lovers need not worry either. *Trichoderma* is found naturally on strawberry flowers, and in any case the honey produced during strawberry-bloom time is eaten by the bees themselves; the stuff harvested for human consumption is made much later in the year.

"The system does have a couple of draw-

backs. Bees will fly about only in good weather, so if your crop blooms on a rainy day, too bad. And bees are fickle. Although they can be trained to feed on a particular crop, if they find a sweeter, more delectable flower nearby they will be tempted away to new pastures."

The article concludes, therefore, that although a good idea, it is not necessarily the bee all and end all. Biological control never is, however, whether in berries or honey bees themselves²⁶. ■

Sincerely,



²⁰ <http://www.ifas.ufl.edu/~mts/apishtm/letters/aixind.htm>

²¹ <http://www.foxnews.com/science/081100/superbees.sml>

²² <http://pollinator.com>

²³ <http://listserv.albany.edu:8080/cgi-bin/wa?A2=ind0001B&L=bee-l&P=R942&m=30070>

²⁴ http://www.ifas.ufl.edu/~mts/apishtm/apis_2000/apsep_2000.htm#1

²⁵ <http://www.apitherapy.org/aas>

²⁶ http://www.ifas.ufl.edu/~mts/apishtm/apis_2001/apjan_2001.htm#1

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