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American Bee Journal

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In This Issue:

Milligin's Bees in SW Colorado — **861**

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Volume 150 No. 9 September 2010

Geezer Tips—847

Contents

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Editor-**Joe M. Graham** Advertising Manager-**Marta Menn**

Publishing Department- **Dianne Behnke & Amy Hill**

Articles

Sick Bees-Part II
A Model of Colony Collapse — **865**

Departments

Columns

September Cover Picture

Honey bee collecting pollen and nectar from a white aster. This beautiful photo was taken by Tibor Szabo, RR I, Puslinch, Ontario, Canada.

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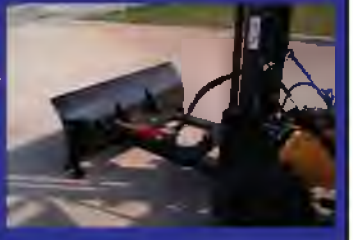

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Letters to the Editor

Send your letters to the editor, Attn: Joe Graham, Dadant, 51 S. 2nd Street, Hamilton, IL 62341, Fax: 1-217-847-3660, or email: abj@dadant.com.
Due to size and content, we may be unable to publish all information received. Thank You!

RANDY OLIVER, YES!

I am a regular reader of the *American Bee Journal*, and I want you to know that my favorite feature is the monthly article by Randy Oliver. I find other articles enjoyable as well, but if his was the only one I read in the entire magazine, I would subscribe to the journal for that one article alone.

Since I notice he is not listed as a "Column" or a "Department," I gather he simply sends in monthly articles and you publish them. I hope you will continue to do this, since it gives me a layman's scientific understanding of bees and beekeeping. He educates me, and shows by his bibliography that there is a large amount of serious research in the world of apiculture. Everything else in your journal is simply frosting on the cake!

Keep up the good work!

Jeanne Hansen
Madison, WI

CALLS FOR SUBMISSIONS: PROFILES OF THE AMERICAN BEEKEEPER

Like most of you I am a beekeeper. I started last year, and plan on taking the test for my Master Beekeeper's Certificate. I have a "Bee Sensei" I will be studying with for the next three years. I am also a professional writer and playwright and worked in Municipal Administration most of my adult life.

I am very interested in collecting as many memoirs of beekeeping experiences including getting started, first experiences, tools needed, different hives, disease, fun, pleasurable experiences and not so pleasurable experiences, scientific data, types of bees and why, winterizing, grants, funding, novice and master beekeeping tales, as well as the processes of queen rearing and whatever else you can dream up.

I will need a release to print your story — in return I plan on having a directory in the back of my book for bee farms, bee supply houses, nuc sales, bee sales, queen breeding/sales, equipment, etc. I am happy to include your name and specialty if you are chosen for the book. I will send either a letter of acceptance which will include further instructions — or a letter of rejection wishing you all the best in your ventures in beekeeping. Be assured — you will receive a response from me personally — one way or the other.

A little about me: You might be wary not knowing me personally, but I have written for several different publishers over the years opening with subjects ranging from horse purchases over the Internet, to ruby glass collecting, to antique sword collecting. Some of these publications include Point of View Publications, Blood-Horse Publications, Militaria International Publications, Virgo Publications, Krause Publications, CanPlay of Canada, and Harris Publications. In addition, I have written various newspaper and magazine editorials. My interviewees include a number of remarkable people such as Jim Lehrer of PBS fame, and Canadian playwright David Carley in regards to his staged version of Margaret Atwood's The Edible Woman in Canada.

I have also had my play *Potato Chips* produced by the Catherine Lindsey Actors/Playwrights Workshop in Darien, CT and sponsored by the Darien Arts Center July of 2003. My play *Final Copy* was performed by the Catherine Lindsey Actors/Playwrights Workshop in Darien, CT June, 2009. My play *Body Shop* is being produced by the Catherine Lindsey Actors/Playwrights Workshop in Darien, CT this summer, June 13, 2010. My plays *Potato Chips, Final Copy*, and *Body Shop* are all being considered for future production at the Palace Theatre, connected with Colgate University, in Hamilton, New York, as well as Slant of Light Theater in Norwalk, Ct.

I am currently writing a timely fiction novel entitled *Queen Bee*, the genre being Eco/Political/Suspense, as well as this compilation of bee-related memoirs entitled *Profiles of the American Beekeeper* which will both hopefully be picked up quickly and published — while waiting for a job position to open up for me.

In three years I plan to live a self-sustainable existence on our 35 acre farm with honey-bees – so far we have Russian honey bees, Great Pyrenees dogs, Ramboulette Sheep, and Champagne D'Argent Rabbits.

Please email submissions and pictures to me at **hive5555@hotmail.com** or, even better, mail me your stories and hard copy pictures to me personally at my NJ address:

Mrs. Mary C. Charest-Professional Writer
and Playwright
608 Washington Drive
Ramsey, NJ 07446
RE: **Profiles of the American Beekeeper Submissions**

CORRECTION

ABJ regrets that Photo 10 of the J. Freeman 2009 article "Things we need to know about small hive beetles" *Am Bee Journal* 149 (10) 947-949 was used without permission of or attribution to the original author. The source was http://www.southernmatters.com/Bee_Plant/htm/images/x--small-hive_beetle_09-02.jpg.

SAGEBRUSH COLONY

Springtime 2010, in Southwest Idaho brought us lots of cool, rainy days interspersed with occasional breaks of near-normal weather. Our swarm season was "on" one day and then "off" the next, as the bees tried to keep up with the weather. Sometimes swarms could find the right weather window to locate a suitable new home. Other times, when caught by the constantly changing weather, swarms resorted to making the best out of a bad situation. On occasion this meant that the swarms would establish their hive in the oddest of places.

Kevin Duesman, a resident Boise beekeeper, found one such swarm building a nest out in the open sagebrush on the outskirts of Boise. On the Fourth of July, he relocated the hive by transferring them from their exposed home to a temporary hive box. The swarm was not the least bit defensive, as Kevin was able to move them into a temporary hive without a smoker or a veil. The bees were even gentle enough that he could make his own "bee beard" and mug this shot for the camera.

Steve Sweet, Chief Drone
Treasure Valley Beekeepers Club
Southwest Idaho

Kevin Duesman, a Boise, Idaho beekeeper, holds a small feral colony he found. (Photo courtesy of Steve Sweet)

MITE AWAY QUICK STRIPS

The State of Montana granted a Section 24(c) Special Local Needs registration for Mite Away Quick Strips (MAQS) on July 22, 2010. Beekeepers in Montana can contact bee supply companies for pricing and availability.

Montana is the second State to arrange for a Section 24(c) registration, after Hawaii. California and Oregon have Section 24(c) applications under review. Other States have expressed interest. Section 18 Emergency Use Registrations are not eligible until the Hivastan registration expires in October. NOD Apiary Products, the developer and manufacturer of MAQS, has applied to the EPA for a full Section 3 registration, expected to take up to a year to complete the review process.

For more information, and a 2-minute video on applying MAQS, see the NOD Apiary Products website at www.mite-away.com, or contact Liz Corbett at 866-483-2929.

SEN. SCHUMER URGES ACTION ON TRANSSHIPPED CHINESE HONEY

We received this letter from Senator Schumer's office recently. It was prompted by a meeting we had with some very powerful American beekeepers and the office of the Senator's staff. The Senator gave permission for the letter to be circulated within the industry.

Ron Phipps
CPNA International, LTD.
Jericho, New York

United States Senate
Washington, DC 20510
July 23, 2010

The Honorable Ron Kirk
U.S. Trade Representative
600 17th Street, NW
Washington, DC 20508

Dear Ambassador Kirk,

The U.S. honey industry is under siege from imports of Chinese-origin honey transshipped through third countries in order to evade payment of U.S. antidumping duties. This transshipping or "honey laundering"—the intentional mislabeling of the country of origin—is costing the U.S. millions of dollars in unpaid duties and threatens the health of the U.S. honey industry and, by extension, the health of U.S. agricultural industries.

U.S. customs data strongly suggests that Malaysia and Indonesia are major transshipment hubs for Chinese-origin honey, and I urge USTR officials to raise this issue with Malaysian and Indonesian officials next week at their meetings in Malaysia and Indonesia. I also respectfully ask that you seek commitments from Malaysian and Indonesian officials to assist in efforts to stop the transshipments.

Since the U.S. imposed stiff antidumping duties on imports of Chinese honey in 2001, attempts to avoid such duties—by sending Chinese honey into the United States from a third country—have proliferated. Customs data reflects the dramatic shifts in imports. Official imports from China, which as recently as 2006 provided over 1/4 of total U. S. honey imports, are now virtually nonexistent. In contrast, imports from countries with no significant commercial honey exporting business—such as Malaysia, Indonesia, India and Taiwan—now account for as much as a third of total imports.

And the transshipment problem only continues to get worse. To date, honey imports from Malaysia and Indonesia are up a whopping 300 and 820 percent, respectively, as compared to the same period last year, while honey imports from China continue to remain virtually nonexistent. The European Union also recently banned imports of honey from India after finding shipments were contaminated with lead, and news reports suggest that the contaminated honey actually originated in China and was shipped through India to the EU. The EU ban is having an additional negative impact on U.S. honey producers as Indian honey exporters are now diverting shipments, possibly of Chinese origin, to the United States.

The impact of the transshipment problem on the health of U.S. honey producers and U.S. agricultural industries should not be underestimated. U.S. honey producers forced to compete with cheap, unfairly-traded Chinese honey—including Chinese-origin honey transshipped through third countries—are struggling to survive. Any threat to their survival also is a threat to the vital pollination services U.S. beekeepers provide for over 50 commercial crops grown in the United States, including at least a dozen grown in my state such as apples, soybeans, grapes and cucumbers.

Stopping Chinese-origin honey transshipment is vital to the health of U.S. honey and agricultural industries, but we will not succeed without the help and cooperation of our trading partners, including Malaysia and Indonesia. I respectfully ask that USTR raise this issue at next week's meetings and announce some progress on cooperative efforts to resolve the transshipment problem. I also ask that you please keep me apprised of developments on this issue. If you have any questions, please contact Stacy Ettinger, on my staff, at 202-224-7945.

Sincerely,
Charles E. Schumer
United States Senator

cc: Ambassador Demetrios Marantis
Deputy U.S. Trade Representative

'HONEST HONEY' CHANGES NAME TO 'TRUE SOURCE HONEY™' TO CLARIFY GOAL OF PROTECTING U.S. HONEY CONSUMERS AND CUSTOMERS

Duty circumvention a threat to U.S. honey industry, honey supply quality

WASHINGTON, DC July 15, 2010 – To further clarify its mission and for trademark purposes, the North American initiative formerly known as "Honest Honey" has changed its name to "True Source Honey." The website for the initiative is now www.TrueSourceHoney.com.

Four North American honey marketing companies and importers – Golden Heritage Foods, LLC, Burleson's Inc., Odem International, and Dutch Gold Honey – launched the initiative in May of this year and pledged to help protect the quality and reputation of the U.S. honey supply, as well as the sustainability of U.S. beekeepers and honey businesses. The initiative seeks to call attention to illegal sales of honey in circumvention of U.S. trade laws, a practice that the organizers estimate cost the United States up to $200 million in uncollected duties in 2008 and 2009 combined. With millions more pounds of circumvented honey entering the U.S. market in 2010, this illegal practice threatens a vital segment of U.S. agriculture.

"Initially we launched this initiative purely as an educational effort, but due to interest by the industry we feel the need to develop a name that can be trademarked for broader use," said Jill Clark of Dutch Gold Honey, Lancaster, Penn. "Honest honey was not available for trademark use, so we've moved to True Source Honey™, a name which works even better in calling attention to the need for true and legal sourcing of this valuable food."

TrueSourceHoney.com is an educational resource providing information about where honey comes from and ways consumers, honey companies, food manufacturers and retailers can take action to eliminate illegally imported honey.

"When honey is imported illegally, no-one can be confident of its true source and

quality. Some products are not 100% honey and have other quality issues," said Clark. "We're asking people who buy and love honey to find out more about how the honey they enjoy is sourced. By raising awareness of unfair trade practices and taking the True Source Honey pledge, we hope to protect consumers and manufacturers who use honey, and to preserve the fair honey trade."

While many Americans purchase packaged honey, an even broader population enjoys honey in such products as cereals, breads, cookies, crackers, breakfast bars, meats, salad dressings, barbeque sauces, mustards, beverages, ice creams, yogurts and candies.

"Pick an aisle at the grocery store and you'll probably find at least one honey product there," said Clark. "It's a product that is added because of its wholesome, pure quality and taste, which is all the more reason why this issue is important.

"We estimate that millions of pounds of Chinese honey continue to enter the U.S. from countries that do not have commercial honey businesses," said Clark. "For example, countries such as Indonesia, Malaysia, Taiwan, Thailand, the Philippines and Mongolia raise few bees and have no history of producing honey in commercial quantities, yet have recently exported large amounts of honey to the United States.

"Honey has earned a special place in people's hearts and minds as a wholesome, natural food. We want to protect that reputation and quality," said Clark.

INSULIN SIGNALING KEY TO CASTE DEVELOPMENT IN BEES

What makes a bee grow up to be a queen? Scientists have long pondered this mystery. Now, researchers in the School of Life Sciences at Arizona State University have fit a new piece into the puzzle of bee development. Their work not only adds to understanding about bees, but also adds insights into our own development and aging.

The study, which appeared in the June 30 online edition of *Biology Letters*, shows that a key protein in the insulin signaling pathway plays a strong role in caste development among bees.

A female bee can become either a worker or a queen. Queen bees are larger and live longer than workers. Queen bees are also fertile while workers are essentially sterile. A queen has only one role—to lay eggs—while workers tend the hive, care for the queen and larvae, and forage for food.

"The incredible thing is that both of these types of female honey bees emerge from the same genome," says Florian Wolschin, an assistant research professor in the School of Life Sciences in ASU's College of Liberal Arts and Sciences, who is the lead author of the study. "So how does that happen?"

Workers determine the fate of the larvae by what they feed them. The amount and composition of food that the larvae receive determine whether they become workers or queens. People have known this for many years, but exactly what happens inside the cells to create this split isn't completely clear.

Wolschin, Gro Amdam, an associate professor, and Navdeep S. Mutti, a postdoctoral research associate, found that the insulin signaling pathway plays a role in caste development. Insulin is a hormone found in humans and many other animals, and insulin-like peptides have been discovered in bees. Insulin moves glucose—sugar—from the bloodstream into the body's cells where it can be used.

The researchers suppressed one of the key proteins in this pathway in honeybee larvae. The protein, called the insulin receptor substrate (IRS), has been linked to growth, development and reproduction in mice. The researchers fed the altered larvae a queen's diet, but they developed into workers, not queens.

IRS is only one component of the process that decides a bee's ultimate fate. Wolschin says several other molecules are known to play a role, including DNA methyltransferase, juvenile hormone and a protein called TOR.

"Those are all very important and fundamental mechanisms," says Wolschin. "One single part cannot alone be responsible. It has to be the interplay between different mechanisms that finally results in the divergence of queens and workers."

The researchers are now looking at the interconnections between several of these factors. "We want to see if maybe there's a hierarchy involved. Several of the components are probably 'upstream' of other processes. So they serve as mass regulators and switches," says Wolschin.

Honeybees are vitally important to our economy through pollination of crops as well as production of honey, wax and royal jelly. Understanding bee biology is crucial to maintaining this industry in the face of problems like colony collapse disorder.

Wolschin adds that bees also provide an important model system that can help us understand our own biology. For example, scientists have successfully reversed many signs of aging in worker bees.

"That is pretty unique," says Wolschin. "You don't have other model organisms in aging research that can do that."

HONEY AS AN ANTIBIOTIC: SCIENTISTS IDENTIFY A SECRET INGREDIENT IN HONEY THAT KILLS BACTERIA

New research in the FASEB Journal shows that defensin-1, a protein added to honey by bees, possesses potent antibacterial properties and could be used against drug-resistant bacteria

Sweet news for those looking for new antibiotics: A new research published in the July 2010 print edition of the FASEB Journal (http://www.fasebj.org) explains for the first time how honey kills bacteria. Specifically, the research shows that bees make a protein that they add to the honey, called defensin-1, which could one day be used to treat burns and skin infections and to develop new drugs that could combat antibiotic-resistant infections.

"We have completely elucidated the molecular basis of the antibacterial activity of a single medical-grade honey, which contributes to the applicability of honey in medicine," said Sebastian A.J. Zaat, Ph.D., a researcher involved in the work from the Department of Medical Microbiology at the Academic Medical Center in Amsterdam. "Honey or isolated honey-derived components might be of great value for prevention and treatment of infections caused by antibiotic-resistant bacteria."

To make the discovery, Zaat and colleagues investigated the antibacterial activity of medical-grade honey in test tubes against a panel of antibiotic-resistant, disease-causing bacteria. They developed a method to selectively neutralize the known antibacterial factors in honey and determine their individual antibacterial contributions. Ultimately, researchers isolated the defensin-1 protein, which is part of the honey bee immune system and is added by bees to honey. After analysis, the scientists concluded that the vast majority of honey's antibacterial properties come from that protein. This information also sheds light on the inner workings of honey bee immune systems, which may one day help breeders create healthier and hardier honey bees.

"We've known for millennia that honey can be good for what ails us, but we haven't known how it works," said Gerald Weissmann, M.D., Editor-in-Chief of the FASEB Journal, "Now that we've extracted a potent antibacterial ingredient from honey, we can make it still more effective and take the sting out of bacterial infections."

BEES HELP TO BEAT MRSA BUGS

'Beeglue' could help to deliver urgently needed new treatments for infection

Bees could have a key role to play in urgently-needed new treatments to fight the virulent MRSA bug, according to research led at the University of Strathclyde in Glasgow, Scotland.

The scientists found that a substance known as beeglue or propolis, originating from beehives in the Pacific region, was active against MRSA, which causes potentially fatal infections, particularly in hospital patients.

The bug was either the underlying cause

or a contributory factor in more than 1,900 deaths between 1996 and 2008.

The research, published in *Phytotherapy Research* journal, is an example of the pioneering work of the Strathclyde Institute of Pharmacy and Biomedical Sciences in developing new medicines for illnesses and conditions including infectious diseases, cancer, heart disease, and schizophrenia. An £8 million fundraising campaign is underway for the Institute's new £36 million building, to expand and enhance its innovative research and education in medicine discovery, development and use.

Dr. Véronique Seidel, a lecturer in Natural Products Chemistry at the Institute, led the research. She said: "MRSA can have a devastating impact on people who contract it and on their families, often compounding illnesses they already have.

"One of the few available drugs to treat MRSA infections is an antibiotic called vancomycin. But new strains have been emerging which show limited susceptibility, or even resistance, to vancomycin.

"This means that there is a pressing need to discover and develop alternatives to current anti-MRSA drugs. We investigated propolis, as part of a program aimed at discovering new antibiotics from natural sources, because bees use it as an antiseptic glue to seal gaps between honeycombs and preserve their hives from microbial contamination.

"Beeglue is also a natural remedy widely-used in folk medicine for a variety of ailments, but little has been known until now about is capacity to target MRSA. Our results have been highly encouraging and we will be taking our research further to understand how active substances in propolis work and to seek the treatments which patients urgently require."

The Strathclyde researchers have been working in partnership with Nature's Laboratory in North Yorkshire, England, a world leader in propolis research and campaigner for deeper scientific understanding of natural medicines. They tested extracts of propolis on 15 MRSA strains obtained from the NHS and isolated two compounds, Propolin C and Propolin D, which showed good activity against all the MRSA strains tested.

The reseach is the first to report anti-MRSA activity in propolis originating from the Pacific region and the first to describe the anti-MRSA properties of Propolin C and Propolin D. These could possibly act as templates for the development of improved anti-MRSA agents.

GLORYBEE FOODS MARKS 35 YEARS IN BUSINESS

Eugene, OR – 2010 is a milestone year for GloryBee Foods, as the company celebrates its 35th anniversary. The company started as a small family honey business, operating out of the garage of Dick and Pat Turanski's home in Eugene, Oregon.

Initially, Dick and Pat were the only employees, processing and selling honey harvested from the Turanski's 25 backyard hives. As demand grew, Dick added more hives and then eventually began to purchase honey from other beekeepers in order to meet his customers' demands. The Turanskis also sold beekeeping supplies, a portion of the business which increased dramatically after Dick taught a local beekeeping class.

Eventually, Dick sold his beehives—which had grown in number to 300—to focus on his growing business. Unsulfured molasses, The first Aunt Patty's product, was added. Not long afterwards, Dick created the five original flavored HoneyStix.

Over the years, the business continued to grow. Additional product lines were added, including Aunt Patty's natural sweeteners, candlemaking and soapmaking supplies, bulk foods and spices, essential oils and more. Eventually, the Turanskis' children joined the business: their son Alan Turanski is the Operations manager, their daughter RaeJean Wilson is the Human Resources manager, and her husband Greg Wilson directs the Distribution and Industrial Sales department. GloryBee currently employs over 100 people in their two Eugene facilities.

NEW POLLEN TRAP ANNOUNCED

Trap offers a simpler design at a reasonable price for beekeepers to easily collect pollen

Betterbee, Inc. is pleased to announce that it has completed field testing a new 10 Frame Bottom Mounted Pollen Trap. After months of research and comparing various traps on the market, Betterbee developed and tested a simpler design that improves greatly upon the common features of collecting pollen that are in the market's current offerings.

"We have been field testing this design for several months now and are pleased to release the product to the beekeeping public" says Justin Stevens, executive vice president and beekeeper at Betterbee, Inc. "All pollen traps on the market offer similar capabilities and the common thread among them is the high cost to the beekeeping public; we said "Why the high cost?".

Close analysis of the pollen market reveals most of the pollen sold in the United States comes from abroad. Countries that have vast fields of mono-cultures can easily ramp up the collection of pollen as part of their beekeeping operations for exports. Pollen that is collected in the United States is often done on a smaller scale with the intention of feeding the pollen back to the colonies in times of dearth. The common thread in the process of collecting pollen is the high cost of labor in cleaning the pollen and the initial investment in the trap. The rewards are simply another product of the hive that can be utilized in myriad ways. Lowering the initial investment to the beekeeper was Betterbee's goal. The existing traps on the market are simply too expensive for no reason at all.

Originally popularized by the Ontario Agricultural College in 1965 and then further enhanced by changes made by Canadian beekeeper Vladimir Shaparew, pollen traps have existed in various forms for decades. One common theme was the cost to the beekeeper in the original investment of the trap itself. Betterbee tackled this challenge on behalf of its valued customers by offering a simple trap that still has all the necessary features of a superb pollen trap for a reasonable price. It simply is a better trap.

Betterbee is pleased to offer this better trap at a great introductory price. See our advertisement in this magazine for details and call Toll-Free 1-800-632-3379 to order.

BLENDING ART WITH SCIENCE AT UC DAVIS HONEY BEE GARDEN

DAVIS—If it takes a village to raise a child, then the art at the Häagen-Dazs Honey Bee Haven at the Harry H. Laidlaw Jr. Honey Bee Research Facility at the University of Calfornia, Davis is a child of the community and the campus.

The ceramic art work being installed at the half-acre bee friendly garden on Bee Biology Road is the work of not only undergraduates in the UC Davis Art/Science Fusion Program but community residents.

A grand opening celebration of the haven is planned for 10 a.m. to 2 p.m. on Saturday, Sept. 11.

"We are so inspired by the learning that happens as students from majors across the campus and community members collaborate to create beautiful and educational artwork," said Art/Science Fusion Program co-director and co-founder Diane Ullman, an entomologist and an artist. "It is exciting to see the learning we can share extended to so many people as a result of connecting art and science in this way."

Diane Ullman, an entomology professor-artist and associate dean for undergraduate academic programs at the College of Agricultural and Environmental Sciences, founded the Art/Science Fusion Program in 2006 with Davis-based artist Donna Billick. However, they trace the beginnings of the program back to 1997 when they began teaching art-science fusion classes on campus.

Ullman and Billick conducted a series of "Community Nights" on campus earlier this year. The community nights drew a wide-age group, from pre-schoolers to senior citizens to entire families.

At the invitation of the UC Davis Art/Science Fusion Program, sixth graders at Korematsu Elementary School, Davis, and community members crafted flowers, pollen

Entomologist-artist Diane Ullman (left) admires the work of 8-year-old Aleta Ballinger. (Photo by Kathy Keatley Garvey)

UC Davis honors student Christine Santa Maria works on honey bee art for the Häagen-Dazs Honey Bee Haven at UC Davis. (Photo by Kathy Keatley Garvey)

grains and bees for the haven.

At one recent community workshop, third-grader Aleta Ballinger, 8, of Davis, finished a handful of ceramic bees and also completed a larger ceramic of a worker bee on hexagonal cells.

Artists Carol Rogala of Folsom, wearing a "Save the Bees" t-shirt, and her friend, T. J. Lev of Sacramento, crafted flowers from clay. They recently participated in the "Bees at The Bee" art show in Sacramento.

Members of two Davis families clustered around a table to work the clay into flowers and bees and paint them. Enthusiastically participating were children Jason Henkel, Sophia Leamy, Nicolas Leamy, and Matthew Henkel and adults Merissa Leamy, Nicolas Leamy and Barbara Friedman.

A special seminar offered by the Art/Science Fusion Program also allowed undergraduates in the Davis Honors Challenge to explore the life and importance of honey bees. Christine Santa Maria, a UC Davis honors student majoring in biochemistry and molecular biology, finished a piece on the life cycle of bees. She included larvae, nurse bees feeding the brood, and worker bees nectaring flowers. She formed a retinue of worker bees around the queen bee.

The grand opening celebration of the Häagen-Dazs Honey Bee Haven will include speakers, educational information about bees and how to help them survive, children's activities and tours. Those planning to attend should RSVP by emailing Nancy Dullum of the UC Davis Department of Entomology by Aug. 31 at **nadullum@ucdavis.edu** and insert "haven" in the subject line. She also may be reached at (530) 752-0475.

Kathy Keatley Garvey
Communications Specialist
Department of Entomology
396A Briggs Hall
One Shields Ave.
University of California, Davis
Davis, CA 95616

2011 NORTH AMERICAN BEEKEEPING CONFERENCE

Save the date for the **2011 North American Beekeeping Conference & Tradeshow,** January 4-8, 2011, at the San Luis Resort in Galveston, Texas. A joint conference of the American Beekeeping Federation, the American Honey Producers Association and the Canadian Honey Council, the 2011 conference will feature the largest beekeeping tradeshow, oustanding educational opportunities and networking events, and an anticipated attendance of more than 1,200 beekeepers. For registration and additional information visit **www.nabeekeepingconference.com**.

NEW HAMPSHIRE

Charles Andros, former NH/VT Apiary Inspector, will hold a beekeeping workshop from 1-3:30 p.m. on Saturday, September 11, at 18 MacLean Rod, Alstead, NH 03602. Look for the "BEE" sign on the south side of Walpole Valley Road. Topics of discussion will include treatment of nosema and mites, winter preparations, winter protein and carbohydrate supplements, and making beeswax handcreams. Bring a veil, if you have one, as we shall be opening some colonies. We'll be inside if it is a rainy day. Water and chair may also come in handy. Registration required. email: **lindena@sover.net** or call 603-756-9056.

CONNECTICUT

Backyard Beekeepers Association

Tuesday, September 28: Stan Schneider "Caste Interactions and Their Role in Colony Reproductive Decisions in the Honey Bee". Dr. Stan Schneider of the University of North Carolina, Charlotte, has conducted several studies on worker-queen interactions and he will discuss how workers may communicate and influence drone population and behavior.

Meetings are at 7:30 p.m. in the Northfield Congregational Church in the Community Room on Norfield Road in Weston, Connecticut. At 6:30 p.m. there is a New-Bees meeting for beginning beekeepers and WannaBees youth group meeting.

Each morning we have timely weekend hands-on inspection workshops, bee school, mentor program and more. All events are free and open to the public. Please check our website for the dates and locations or more information at **www.backyardbeekeepers.com**

2010 BYBA General Meeting Program
October 26: Jennifer Berry "Sub-lethal effects of in-hive pesticides"
November 30: Allan Hayes on his unusual beekeeping tools & gadgets

NEW YORK

The Western New York Honey Producer's
November Potluck Dinner

Date and time: Wednesday, November 17, 2010 6:00 p.m.
Place: First Presbyterian Church
9 Paine Street, East Aurora, New York
Speaker: Dr. Larry Connor- Biology Driven Management
Note: Bring dish to pass, your own utensils, plates, and cups. Beverages provided.
Any questions: Call Fred Thompson at (716) 773-4945
Website: **www.wnyhpa.org**

ALABAMA

The 2010 annual meeting of the Alabama Beekeepers Association will be held in Montgomery, AL at the Taylor Road Baptist Church on October 8th & 9th. Featured speakers include Dr. Keith Delaplane of the University of Georgia, Dr. James E. Tew of Ohio State University, Kent Williams, past president of EAS, and Sherry Ferrell, Bee Lab Coordinator, Ohio State University. Home grown talent includes David Kelton, Roslyn Horton, Elizabeth Whitaker, and others. There will be activities for spouses and children. Contact Phillip Garrison at 256-507-0262 or e-mail Bonnie Funderburg at **funder@otelco.net**. Details and registration form at **www.alabamabeekeepers.com**.

LOUISIANA

Fourteenth Annual Field Day at the Baton Rouge Honey Bee Lab

The Honey Bee Breeding, Genetics & Physiology Laboratory in Baton Rouge, Louisiana will hold its annual Field Day on

Saturday, Oct. 23, 2010. The one-day event will be held at the laboratory building and grounds at 1157 Ben Hur Rd. Gates will open at 9:30 a.m.; activities are scheduled from 10:15 a.m. to 3:30 p.m. A registration fee ($12.00 for adults and $5.00 for children) includes refreshments and a catered lunch.

The field day will include activities for both beginners and experienced beekeepers. A highlight this year will be a queen-rearing workshop in addition to other interactive demonstrations. Beekeepers will have access to a number of activities including a beginning beekeeping course, artificial insemination, grafting, and more.

Those planning to attend must register by October 1 so that refreshments and the catered lunch can be arranged. Please mail your registration check (payable to the Louisiana Beekeepers Assn.) to, Honey Bee Lab, 1157 Ben Hur Road, Baton Rouge, LA. 70820. For more information contact Dr. Lanie Bourgeois (225/767-9299), Alva Stuard (225/261-2032), or the websites for the Louisiana Beekeepers Association **www.labeekeepers.org** and the Honey Bee Lab **http://ars.usda.gov/msa/br/hbbgpru**

IOWA

The Iowa Honey Producers will be holding their annual meeting November 5th and 6th at the Marshalltown Best Western Inn in Marshalltown, Iowa. Speakers will include Marla Spivak, University of Minnesota; Susan Cobey, University of California; and Dee Lusby of Arizona. For more information contact Pat Randol 515-210-7445 or email **Pat@RandolHoney.com**.

CALIFORNIA

The 121st annual convention of the California State Beekeepers will be held Nov. 16-18, 2010 at the Embassy Suites in San Luis Obispo, CA. Besides the informative speakers and the trade show, convention attendees will be able to visit such attractions as Hearst Castle, Cal Poly, Pismo Beach and the beautiful central Pacific coastline. Check our website **www.californiastatebeekeepers.com** for convention updates.

WASHINGTON

Northwest Beekeepers Conference

The Washington State Beekeepers association will be hosting the Northwest Beekeepers Conference on October 28, 29 and 30th at the Best Western Hood River Inn (800) 828-7873 in Hood River, Oregon. The conference will begin with a Reception on Thursday evening the 28th at 7 p.m. and with conference sessions on Friday and Saturday beginning at 8 a.m. through 4:30 p.m. each day.

Speakers from the Carl Hayden Bee Research Center in Tucson will be reporting on a study done on a migratory Northwest bee outfit evaluating the effects of fungicides and nutrition on colony development, a new innovative treatment for varroa using a hop-based derivative and an attractant to varroa mites from brood pheromones. We will have a report by Dr. Dewey Caron on the National Honey Bee Colony Losses and our annual Northwest Pollination Survey by Dr. Burgett. Dr. Jeff Pettis from the USDA-ARS Bee Research Laboratory will be speaking on his research. We will have reports from both Drs. Steve Sheppard and Remesh Sagali on research activities at Washington State University and Oregon State University. A preliminary program will be available with registration information in late August.

A banquet and benefit auction will be held Friday evening the 29th starting at 7 p.m. at the Hood River Inn. Registration information can be obtained from: Paul Hosticka, 517 S Touchet Rd., Dayton, WA 99328 (**phosticka@gmail.com**) or Herb Brasington, 1881 NE Ashberry Dr., Hillsboro, OR 97124 (**treasurer@orsba.org**).

MONTANA

2nd Annual Northwest HoneyFest
Stevensville, MT
Saturday, September 11, 2010
10:00 am – 5:00 pm

- Honey Tasting
- Mead Wine and Honey Beer
- Food Court
- Art, Craft and Honey Vendors
- Demonstrations
- Music
- Education Pavilion

More info: www.northwesthoneyfest.com

MONTANA

State Convention

Kalispell, MT
October 14 – 15, 2010

Hotel: Hilton Garden Inn, Kalispell
1840 US Highway 93, Kalispell, MT 59901
406.756.4500
Refer to this conference to receive discounted room rate.

Registration info: To be mailed to all MSBA members or contact **Nicole@Morrishoney.com**

Vendors: Vendors are welcome to participate! Tables available for vendors and vendor donations are appreciated. Please mail donations and/or door prizes directly to the hotel identifying our conference. Please contact Nicole with any questions at **Nicole@morrishoney.com**

Theft Is Still Rare in Our Small Beekeeping Industry

by NANCY GENTRY
Member, Florida Farm Bureau Apiary Advisory Committee

If you grew up watching Rowdy Yates (Clint Eastwood) every Friday night on *Rawhide*, then you remember that the worst villain on the range was the cattle rustler, who, with his crew of lowdown thieves, would cut off part of the herd from the big cattle drives and then rebrand the steers. He never succeeded, of course, because Yates always tracked him down. Good guys 1, bad guys 0.

GPS tracking has pretty much eliminated cattle rustling in the 21st century, but what about bee rustling? These villains don't wear masks, but could be seen suited up in white wearing a bee veil covering their face. Who are these wild desperadoes? We're talking about beekeepers stealing from other beekeepers, and given that a hive is now worth about the same as a hotel room for the 2011 Galveston beekeeping convention, we may start hearing a lot more about bee rustling.

On June 3rd, a North Florida beekeeper was arrested on two counts of dealing in stolen property after 48 beehives and woodenware were located. Charges have since then escalated after more hives and other equipment were discovered in hidden yards in neighboring counties. According to WALB 10 News (Albany, GA), this same beekeeper was also arrested by Georgia authorities on June 23rd, accused of stealing 40 supers or bee boxes, 25 cases of jarred honey, 12 jugs, and other bee equipment from Clinch County beekeepers. A well-known honey producer and migratory beekeeper, Mike Thomas, Lake City, Florida has already recovered over 100 bees, nucs, or equipment. " I just couldn't figure out who was stealing from me, says Thomas, but this guy was coming to my honey store, buying a couple of buckets of honey and then sneaking back into my yards after dark and helping himself to whatever he wanted."

The Florida Farm Bureau's Apiary Advisory Committee had already taken steps back in April to coordinate efforts with the Florida Office of Agricultural Enforcement after hearing reports of bees being stolen in south Florida. In one incident, the beekeeper was returning to the fields following pollination, only to see his hives being loaded on someone else's truck. Fortunately, the beekeeper could prove ownership of the hives and they were unloaded, but the hives could just as easily have vanished, leaving the beekeeper with nothing but grief over his loss.

Is Florida the only state having to "rustle" with bee rustlers? Evidently not. In the July *ABJ* edition, "Letters to the Editor," "Beekeepers Getting Stung by a Beekeeper," Dale Wolfe, Wolf Honey Farm in Baldwin, WI reported a tricky scheme of these "midnight beekeepers" offering to pick up your bees, winter them in the South and then bring them back in the spring. "You may or may not get all of your bees back, says Wolfe. You may only get half of them and they may not be in your equipment. You might end up with a lot of junk."

The large migratory beekeepers should be seeing the worst of this bee rustling, but according to Dave Mendes, owner of Headwater Farms, North Ft. Meyers, Florida and current president of the American Beekeeping Federation, "It's not as big a problem as you would think. In every industry there are a few bad apples, but with bees you know for sure the only people who will steal hives are other beekeepers. Since we are a relatively small industry, the chances of getting caught are likely greater than with car stereos or jewelry."

What's a beekeeper to do? Stephanie Tarwater, a fourth generation beekeeper out of Maryville, TN "says I make sure my meanest hives are right up front, so that when they try to steal from my yards, they'll learn real quick who they are dealing with!" On a more serious note, J.T. Smith, an investigator with the Office of Agricultural Enforcement, offers these suggestions; "First, as required by Florida law, register your hives with the State Apiary Department and then brand on the boxes your name and FL registration number. Another clever idea is to brand a unique, more secretive symbol on the bottom of your frames and inside your boxes. Finally, file an incident report with local authorities and notify your state bee inspectors of your theft. In Florida, since these crimes involve agriculture, the county agricultural officer with the Office of Agricultural Law Enforcement will also initiate an investigation. Mike Thomas was able to prove ownership, even without any bills of sale by having the number "9" on woodenware built in 2009. Mike also recovered equipment branded with a "4," prima facie evidence this criminal enterprise has been ongoing since 2004.

Should we start protecting our hives with electrode fencing and razor wire? Mendes offers a more positive comment, "I have not had any great problems with theft over the last 35 years… and the bigger story is why there is not more thievery. My belief is that most people and consequently most beekeepers are honest and they respect the hard work that goes into beekeeping. Please include the 'good news' in your article along with stories of crooks and bad people."

UNITED STATES

Despite excessive rain and high temperatures in parts of the country, U.S. honey crops will be better than last year's record poor season. Although early honey flows were good in the Southeast, later flows were down from normal, according to a number of our reporters. On the other hand, most of our crop reports coming from the Southwest have been optimistic regarding total honey production for this season. Rains coming at the right time and extending beyond their normal cut-off times extended honey flows. The East Central and West Central areas have reported spotty honey crops due to excessive rains and flooding. Fortunately, a number of beekeepers were able to dodge heavy rains during their clover, alfalfa and basswood flows and produced normal to excellent crops.

Rainy weather also extended into the Intermountain and West areas, but the added moisture generally helped honey crops in these locations, although early spring build-up weather was not ideal.

Honey buyers at both the wholesale and retail levels are welcoming the new honey crop since inventories were extremely low around the country. Both wholesale and retail honey sales and prices are expected to remain strong this fall and winter. Beekeepers were already reporting brisk sales of their new crop honey at roadside stands, fairs and festivals.

With favorable summer weather, beekeepers have been able to recoup a number of their colony losses from the previous couple seasons. Increases in hobbyist beekeepers around the country have also bolstered colony numbers in some locations.

NORTHEAST—Beekeepers reported much better spring honey crops than last year. Rain held off during some of the major flows allowing more foraging time. The honey production has been of excellent quality as well. Flows mentioned by our reporters include black locust, white Dutch clover, sweet clover, sumac, tulip-poplar, assorted berries, multi-flora rose, basswood and catalpa. Beekeepers have been busy extracting spring honey, as well as adding supers for late summer and fall flows. Some of the later sources include buckwheat, Japanese knotwood, goldenrod and aster. Drier weather and very hot temperatures were a concern in July and August. Some beekeepers have said that they are torn between starting varroa mite treatments now or pursuing a good late summer and fall honey flow.

Beekeepers expect both wholesale and retail honey sales to pick up now that new crop honey is available. Earlier in the year most sources indicated that they were completely sold out of 2009 crop honey.

MIDEAST—Spring honey flows were much better than last year, according to a number of our reporters. Clover flows were especially good in parts of Kentucky and Tennessee. Parts of both states, however, experienced earlier heavy rainfall and some flooding. Summer weather has been drier. On the other hand, parts of Virginia, West Virginia and North Carolina are on the dry side and could use some rain before fall flows begin. Beekeepers in the mountains reported fair to good flows from sumac, basswood and sourwood. Earlier clover flows were very good, but some of the black locust and tulip-poplar flows were worse than expected.

The better honey crops for some beekeepers are long overdue after beekeepers have experienced several previous years of mediocre or poor honey crops. Consumers are also welcoming the new-crop honey since many of them had been unable to buy their favorite local brands for quite some time. Both wholesale and retail honey demand remain strong.

SOUTHEAST—Honey crop reports are varying quite a bit from one report to another, indicating a rather spotty crop. In Florida, the orange flow was generally good, but then later gallberry and palmetto flows were off by as much as 50%. Bees were currently finishing up flows from pepper, palm, mangrove and melaleuca. Spring flows in Alabama and Mississippi were better than last year. Honey is generally lighter than normal due to more honey coming from clover and privet. In some locations beekeepers were hoping for summer flows from cotton or soybeans. In north Georgia beekeepers reported better honey flows from sourwood and sumac.

Colony numbers in the Southeast seem to have stabilized this year and in some locations numbers are up due to increased hobbyist interest. In addition, losses from varroa and small hive beetles have not been as bad this season. Beekeepers are hoping that continued good ground moisture will help fall flower flows in order to augment winter stores. With hurricane season now underway, reporters said they were hoping for no serious and damaging storms.

Honey demand remains strong at both the wholesale and retail levels. Some reporters indicated price increases of 20 cents or more per pound since last season at the wholesale level. Beekeepers do not anticipate having any trouble selling their production this season.

SOUTHWEST—Honey crops are better in many Southwestern states due to abundant rainfall coming at the right time. Earlier spring crops came from wildflowers, clover, alfalfa and various trees. Tallow flows along the Gulf Coast were spotty with some parts of Louisiana reporting excellent flows, while Texas beekeepers have said that their tallow flows were a disappointment. The good ground moisture brought excellent wildflower flows to many Southwestern states that often fight parched summer soils. This nice honey flow, along with normal flows from irrigated crops such as melons, alfalfa and cotton should bring local honey back to honey-deprived local consumers. Poor crops last year had made for shortages of local varietal favorites. This year's sales are brisk at both the wholesale and retail levels.

Continued good ground moisture brought about by timely summer rains will extend honey flows for some Gulf States. The added moisture should help late flows from goldenrod, aster, and Spanish needles.

EAST CENTRAL—Excessive rains have caused spotty honey crops this season. Some parts of Michigan, Wisconsin and Ohio have reported excellent honey flows from clovers, alfalfa, basswood, buckwheat and sumac. On the other hand, parts of Illinois, Indiana and Wisconsin were deluged by gully-washers most of the late spring and summer. In fact, flood warnings were still being issued at the end of July, which is very unusual. Some reporters said that their July was one of the wettest months on record. Unfortunately, in these locations the constant rains kept bees in hives and washed nectar from blossoms. Some beekeepers were counting on late soybeans and fall flowers to replenish colony winter stores. If these late summer

U.S. HONEY, BEESWAX AND POLLEN PRICES FROM OUR REPORTERS

	North-east	Mid-east	South-east	South-west	East Central	West-Central	Inter-Mountain	West
Wholesale								
White lb. Blk.	$1.40-$2.20	$1.45-$2.00	$1.30-$1.70	$1.35-$1.70	$1.50-$2.00	$1.40-$1.75	$1.30-$1.60	$1.25-$1.60
Amber lb. Blk	$1.25-$1.60	$1.20-$1.75	$1.20-$1.50	$1.20-$1.60	$1.35-$1.75	$1.20-$1.60	$1.25-$1.50	$1.20-$1.50
1 lb. CS 24	$50.00-$80.00	$45.00-$82.00	$48.00-$90.00	$51.00-$85.00	$52.00-$75.00	$55.00-$81.00	$60.00-$95.00	$57.00-$92.00
2 lb. CS 12	$59.00-$80.00	$58.00-$72.00	$60.00 $68.00	$58.00-$73.00	$59.00-$79.00	$51.00-$78.00	$57.00-$76.00	$60.00-$77.00
5 lb. CS 6	$72.00-$88.00	$58.00-$87.00	$60.00-$76.00	$57.00-$75.00	$57.00-$86.00	$60.00 $84.00	$59.00-$85.00	$59.00-$88.00
Retail								
Jars 8 oz.	$1.50-$3.00	$1.40-$4.00	$1.25-$2.95	$1.20-$2.90	$1.50-$3.50	$1.40-$2.95	$1.30-$2.60	$1.25-$3.90
Squeeze Bear 12 oz.	$1.89-$3.50	$2.00-$4.00	$1.75-$3.75	$2.25-$4.00	$2.50-$3.95	$2.25-$4.10	$2.50-$3.85	$2.25-$4.25
Jars 1 lb.	$2.50-$5.50	$2.55-$5.25	$2.40-$4.75	$2.50-$5.00	$2.45-$5.25	$2.95-$5.25	$2.75-$5.25	$2.70-$5.95
Jars 2 lb.	$3.99-$6.75	$3.95-$7.00	$3.99-$5.49	$3.00-$6.25	$3.25-$8.00	$3.29-$6.50	$3.25-$6.25	$3.50 $6.50
Jars 1½lb. (Pint)	$4.50-$7.00	$4.25-$8.00	$3.50-$6.00	$3.58-$6.50	$3.25-$5.50	$3.50-$5.50	$3.75-$6.00	$4.75 $8.25
Jars 3 lb. (Quart)	$5.50-$9.75	$5.95-$14.00	$5.79-$10.00	$5.25-$9.25	$5.00-$11.50	$4.50-$10.00	$5.10-$9.75	$5.00-$12.50
Jars 4 lb.	$7.50-$12.00	$8.00-$15.00	$7.00-$10.75	$6.00-$12.70	$8.00-$14.00	$5.50-$13.50	$6.00-$14.50	$6.50-$16.00
Jars 5 lb.	$8.99-$19.00	$7.00-$19.50	$7.50-$17.50	$7.25-$18.00	$8.00-$21.00	$7.75-$18.00	$8.00-$19.25	$8.50-$22.00
Creamed 12 oz.	$2.50-$5.50	$2.50-$4.00	$2.49-$3.95	$2.25-$3.99	$2.50-$4.25	$1.99-$4.25	$1.75-$4.00	$2.25-$5.00
Comb 12 oz.	$3.00-$7.00	$3.50-$8.00	$2.25-$7.25	$2.50-$6.50	$2.50-$5.75	$2.50-$6.50	$2.50-$5.75	$2.75-$7.50
Round Plas. Comb	$4.00-$6.50	$3.25-$5.50	$3.50-$5.00	$3.00-$6.25	$3.25-$5.99	$3.00-$6.50	$3.25-$6.00	$3.50 $7.50
1 Gallon	$15.00-$25.00	$12.50-$26.50	$14.50-$25.00	$15.00 $25.00	$15.00-$30.00	$15.00-$27.00	$15.00-$30.00	$15.00-$30.00
60 lb.	$115.00-$145.00	$84.00-$125.00	$85.00-$120.00	$80.00-$130.00	$82.00-$140.00	$80.00-$135.00	$85.00-$130.00	$80.00-$130.00
Beeswax								
Light per lb.	$1.70-$3.50	$1.70 - $2.75	$1.70 - $3.00	$1.70 - $2.50	$1.70 - $2.50	$1.70 - $2.50	$1.70 - $2.50	$1.70 - $2.50
Dark per lb.	$1.60-$3.00	$1.60 - $2.35	$1.60 - $2.25	$1.60 - $2.25	$1.60 - $2.25	$1.60 - $2.25	$1.60 - $2.25	$1.60 - $2.25
Pollen								
Wholesale per lb.	$3.50-$6.50	$3.50-$8.00	$3.00-$6.00	$3.00 $5.00	$3.25-$6.00	$3.25-$6.00	$2.50-$6.00	$2.50-$5.50
Retail per lb.	$5.50-$15.00	$7.00-$15.00	$6.00-$15.00	$6.00-$10.00	$7.00-$15.00	$7.50 $15.50	$7.00-$12.00	$7.00-$15.00

The above prices are not meant to provide a realistic picture of prices in all states of the particular area. They are intended merely to show what a few beekeepers are receiving for their honey, beeswax and pollen and we realize prices may vary tremendously, even within individual states. The bulk prices for honey are stated per pound, delivered buyer's warehouse, containers exchanged or furnished by buyer, unless otherwise noted. Where prices are not shown, insufficient data were available.

HONEY MARKET FOR THE MONTH OF JUNE 2010

In volumes of 10,000 pounds or greater unless otherwise stated

(From JULY 2010 USDA National Honey Report)

Prices paid to beekeepers for extracted, unprocessed honey in major producing states by packers, handlers & other large users, cents per pound, f.o.b. or delivered nearby, containers exchanged or returned, prompt delivery & payment unless otherwise stated.

-Report includes both new and old crop honey-

(# Some in Small Lot —— +Some delayed payments or previous commitment)

Arkansas - Soybean light amber $1.35
California - Alfalfa light amber $1.29
Orange white $1.58 - $1.60
Sage white $1.58 - $1.60
Wildflower light amber $1.25 - $1.29
Dakotas - Clover white $1.60 - $1.62
Florida - Galberry white $1.60
Galberry extra light amber $1.55
Orange white $1.60 - $1.63
Orange extra light amber $1.55
Palmetto light amber $1.35
Wildflower extra light amber $1.40 - $1.55
Georgia - Wildflower extra light amber $1.55
Wildflower light amber $1.40 - $1.55
Louisiana - Mixed light amber $1.25
Tallow extra light amber $1.30
Mississippi - Galberry white $1.55
Galberry extra light amber $1.55 - $1.60
Soybean light amber $1.45
Montana - Clover white $1.60
Nebraska - Clover white $1.60 - $1.61

Prices paid to Canadian Beekeepers for unprocessed, bulk honey by packers and importers in U. S. currency, f.o.b. shipping point, containers included unless otherwise stated. Duty and crossing charges extra. Cents per pound.

Province Not Reported
Canola white $1.56 - $1.66
Mixed Flowers white $1.61 - $1.62

Prices paid to importers for bulk honey, duty paid, containers included, cents per pound, ex-dock or point of entry unless otherwise stated.

Argentina - Mixed Flowers white $1.45 - $1.60
Mixed Flowers extra light amber $1.30 - $1.59
Brazil -ORGANIC white $1.73 - $1.74
Mixed white $1.54 - $1.59

sources do not produce, then fall feeding will be necessary. In wet locations beekeepers are sometimes having problems with high moisture honey, which is very troublesome for smaller beekeepers who do not have the equipment to lower honey moisture levels.

Honey prices and demand at both the wholesale and retail levels remain excellent, which is great news to those beekeepers who were lucky enough to have excellent honey crops this season. Prices as high as $2.00 wholesale and $6.00 per pound retail were being reported for new crop white honey. However, most pricing was still 20 to 30 cents below this. Illinois beekeepers are happy to report success with their legislative efforts to exempt smaller honey producers who sell honey from having to have a commercial honey house.

WEST CENTRAL—As in the East Central area, excessive rain has been the limiting factor for honey crops in 2010. Those locations that were lucky enough to have sunny weather during their clover, alfalfa and basswood flows will end the season with fair to good honey crops. On the other hand, other beekeepers, especially those who made a number of splits or bought nucs, were feeding bees well into late spring and early summer due to excessive rainfall. In Minnesota and the Dakotas beekeepers still had time to salvage a late crop if the weather settled. On the other hand, beekeepers in parts of Missouri, Nebraska and Iowa said that they had already missed the bulk of the sweet clover flow, so were hoping for late flows from second-cutting alfalfa, soybeans, sunflowers, knapweed and fall flowers. The ground moisture is abundant, so with a nice August, beekeepers could still salvage part of a honey crop.

The honey market remains strong at both the wholesale and retail levels. Beekeepers said that a number of buyers were already making contact in order to lock in honey inventories for the remainder of this year and the early part of 2011. The most common wholesale pricing range on large lots of honey remains between $1.60 and $1.75 for white and $1.50 to $1.65 for amber

grades of honey. New crop honey is expected to sell quite well at local markets, fairs and festivals since there has been a real shortage for about a year.

INTERMOUNTAIN—Honey flows from alfalfa and clover came late, due to a rainy, cool late spring. However, initial reports on the total crop are encouraging. As the flows were still in progress, it was still too early to predict final honey crops. Beekeepers were also hoping for good late flows from knapweed and rabbit brush in order to provide late surplus honey or winter stores. Wholesale buyer interest is good and producers do not anticipate having any trouble selling surplus honey. Retail sales of new crop honey are also reported to be excellent. Much of the honey is grading out as white or extra light amber.

WEST—Honey flow reports from California have been more encouraging this season due to plentiful spring rains that extended beyond their normal cut-off dates. This has helped many wildflower flows from buckwheat, sage, sunflowers, butterfly bush, pennyroyal, daisies and many other sources. In addition, colonies were moved to irrigated alfalfa, safflower and cotton fields for honey production. Most pollination work was finished for the season and full-time pollinators were starting to gear up for fall and winter-feeding chores in preparation for the 2011 almond pollination season. Early information suggests that pollination prices will be similar to the 2010 season. However, sources believe the bee supply should be better because beekeepers had a good build-up season and have been able to replenish many of their earlier colony losses.

In Washington and Oregon, cool, rainy weather delayed the season, but the good ground moisture should help extend wildflower, mint, alfalfa and clover flows.

Even though surplus honey supplies should be better this fall and winter, wholesale prices are not expected to decrease any due to the continuing U.S. and world honey shortage. Local retail sales are also expected to remain strong.

ARGENTINA

As of the end of June 2010, Argentina exported 29,870 MT (metric tons) of honey for US$90.92 million. This represents an export price of slightly over US$3,000 per metric ton. These first semester exports of 2010 are down 19% in terms of volume compared to the first six months of year 2009, when Argentina exported 36,777 MT for US$101 million (US$2,746 per MT). However, 2010 exports are up 11% considering the export price.

The most remarkable difference between these two periods is the predominance of shipments to the USA. Between January – June 2010, the USA imported 10,216 MT versus 10,881 MT shipped to Germany. Both countries represent 70% of current Argentine honey exports. During the same time span of 2009, Germany had already imported over 18,900 MT, while the U.S. share had been just 6,910 MT. According to exporters, this competition between U.S. buyers and European importers will continue to be strong during the remainder of the present year.

For example, during June 2010 Argentina exported 6,356 MT for US$19.65 million (US$3,090 per MT) and while 40% of the volume was shipped to the USA, only 25% of it was delivered to Germany. Apparently, this trend will be firm for the months ahead.

Not unlike previous years, the honey export business in Argentina continues to be an oligopsony shared between a few strong key players. Three companies export 50% of all honey. Regarding the period Jan./June of year 2010, NEXCO has a market share of 19.77%, followed by the cooperative ACA with 18.35% and thirdly the company HONEYMAX with 11.20%

The recently reviewed honey crop for the 2009/2010 season is still considered at no more than 65,000 MT, probably being reduced at a more realistic 60,000 MT level. Stocks of unsold honey remain at beekeepers' warehouses with producers hoping for higher prices as the end of the honey crop takes place in the Northern Hemisphere.

Winter conditions in Argentina were unusually mild until the first week of July. However, as of mid-July very cold temperatures were prevalent over most the territory. A recent federal survey indicates the total number of beehives at 2.4 million, which is 40% lower than 2005 when Argentina had its largest export quantity ever of 100,000 MT. The current of number of colonies may decrease even further this year due to the extremely high price of sugar and HFCS, which make traditional intensive feeding they took for granted during the past decade prohibitive to many beekeepers.

Inflation in Argentina continues rampant at 25% per year, while foreign currencies are kept at an unrealistic low exchange rate by the intervention of the Argentine Central Bank. Most exporters have severe difficulties getting reimbursed for the Value Added Tax they incur when they purchase honey from local beekeepers. This is a tremendous financial pressure that restricts access to credit.

American Bee Journal Editor

M.G. Dadant

by ROY A. GROUT

C.P. Dadant had three sons – L.C. (Louis Charles), H.C. (Henry Camille), and M.G. (Maurice George). All of them as boys at home had learned beekeeping from their father, who in turn had inherited the bees and bee wisdom from their grandfather, Charles Dadant.

By the time C.P. Dadant had built the large brick house in Hamilton and decided to retire in 1904, the bees had been expanded to some 600 colonies, and the firm of Dadant & Sons was widely known as manufacturers and dealers in beekeepers' supplies. L.C. Dadant had graduated from the University of Illinois in 1902 with a degree in mechanical engineering, returning to Hamilton to help his father. H.C. Dadant graduated from the same University in 1904 with a degree in civil engineering, but worked as a surveyor on a railroad for a year or more before coming to Hamilton to join the firm. M.G. Dadant graduated from the University in 1908 with a degree in business and returned to help with the business, having hardened himself "with football and basketball until he was stingproof." [1]

C.P. Dadant bought the *American Bee Journal* in 1912 and moved its offices to Hamilton.[2] Up to this time, M.G. worked with the bees and helped his brothers with the bee supply business, but he was the principal one of the three brothers to show literary ability and to turn his attention to the *American Bee Journal*. His first contribution to the *Journal* appeared in the April 1915 issue[3] and this was followed by a second one the same year. Scarcely a year passed since then that his name did not appear as a contributor to the *Journal*. Thus, over a period of slightly more than 50 years, M.G. Dadant wrote upwards to a hundred articles, and this does not include his monthly page entitled "Crops and Markets."

When C.P. Dadant took over editing and publishing the *American Bee Journal*, it contained a monthly department called "Honey and Beeswax" that published information about the condition of colonies, the extent of the crop, and current prices for honey and beeswax. This department was continued in this manner until the March 1917 issue,[4] which stated: "On another page of this number we are beginning a department of 'Crop and Market Conditions.' …A page of this kind will not succeed unless it has the cooperation of a large proportion of our subscribers. . . We would urge, therefore, that each subscriber obtain a few postal cards and write us the conditions as seen in his section of the country. Make your report as brief as possible and address to 'Marketing Editor,' *American Bee Journal*."

Although the page "Crop Reports and Market Conditions" appeared 19 successive months without the name of the marketing editor, we strongly suspect that this was M.G. Dadant, and that he was responsible for the change. Beginning with the October 1918 issue,[5] "Crop Reports and Market Conditions" carried the words, "Compiled by M.G. Dadant." Although the page's name was changed to "Crop and Market Report," [6] and finally to simply "Crops and Markets," [7] M.G. Dadant's name appeared on the page until the November 1964 issue[8] – a period of just over 46 years. That's a LOT of reporting and it was of untold benefit to the beekeeping industry!

M.G. Dadant was listed as business manager in 1918 and this title was later changed to editor in 1938. He continued to be listed as an editor until his death in 1972.

Without any special announcement, the masthead of the October 1918 issue[9] lists Maurice G. Dadant, business manager; with C.P. Dadant, editor; and Frank C. Pellett is listed for the first time as associate editor. The April 1938 issue[10] lists M.G. Dadant along with G.H. Cale and F.C. Pellett as editors.

But mere titles do not tell the true story of the great amount of time and attention M.G. gave to the *Journal*. In addition to all the articles written over a span of 50 years, in addition to his crop and market reporting for 46 years, he performed many other functions. As business manager, he arranged for its printing and mailing and ever watched these costs as well as those of paper, articles for publication, engravings, etc. He also served as circulation manager, taking every opportunity to increase the number of subscribers and consequently the revenue. He also served as advertising manager selling space in the *Journal* to advertisers as a further source of revenue. And as a member of the Dadant family, he played a large part in determining content and editorial policy of the *Journal*.

We have not previously mentioned his contributions in the way of books. In 1919 he wrote "Outapiaries and Their management" which was published by the *American Bee Journal*. This book was revised and the 2nd edition appeared in 1932. In 1938, together with J.C. Dadant, he helped in an extensive revision of "First Lessons in Beekeeping," a book that is still widely sold. For the 1946 edition of "The Hive and the Honey Bee," he authored Chapter X, "Beehives and Beekeeping Equipment;" Chapter XII, "The Apiary;" and Chapter XXIII, "The

M.G. Dadant was in demand as a public speaker and traveled throughout the country attending beekeepers' meetings. In addition to being editor, he was heavily involved in the Dadant bee supply business and was president of that company for a number of years.

Production of Queens and Package Bees." For the 1949 edition of this book, he revised the last two named chapters, and for the 1963 edition, he wrote Chapter IX, "The Apiary."

Usually accompanied by his charming wife, Helen, M.G. Dadant over the years traveled extensively, especially to the South and the Southeast, where the two became well acquainted and well liked. Many of the articles that he wrote for the *Journal* are stories of these trips, of southern meetings and of the queen and package bee industry.

In later years, M.G. found it necessary to turn over much of his burden to others. He tried to pass his time by working in the *American Bee Journal* library which had been one of his special interests over the years. For example, there is in the library in manuscript form a 1966 work by him entitled, "Early American Bee Literature, Previous to 1865."

In later years M.G. spent his winters in California with his youngest son, Phillip, and his wife, Phoebe and their family. He was also close to a daughter, Mary Elizabeth Ross, and a grandson, Maurice Ross and his family. As time passed and his health failed with age, he made his stay in California longer and longer, so his connection with the *Journal* was small, but his name was still listed as one of the three editors. M.G. Dadant died in 1972 at the age of 86.

M.G. Dadant through his "Crops and Markets" reporting, his many articles, his writings for books, and for the part he played for many years in helping with the editing and publishing of the *American Bee Journal*, will always be remembered. He had the great distinction of having been associated with the *Journal* for a longer period of time than any other person – 50 years of service to the beekeeping industry throughout the world.

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History of the Live Bee Trade

From the "History of American Beekeeping"

by FRANK C. PELLETT*

In the May 1879, issue of *Gleanings in Bee Culture*, A. I. Root proposed a revolutionary idea—the sale of live bees by the pound. He had lost many of his bees, and had nearly a ton of honey in sealed combs just right for building up new colonies. He thought that if he could buy live bees by the quart, it would be a practical means of re-establishing his apiary. By counting and weighing a hundred bees, he came to the conclusion that a quart of bees would weigh approximately a pound, and proposed to pay a dollar a pound for live bees delivered to him at shipper's risk.

He even went so far as to devise a cage in which they might be shipped and described it as follows:

"Get a wire cloth screen such as is used to cover dishes to keep flies away. They can be had from any tinsmith for a few cents each, and can be had of different sizes. Cut out a piece of board so as to just fit inside, and then make a large hole in the center of the board, so as to leave, in fact, only a ring of wood. Tack a piece of tin on the bottom of the board so as to cover this hole, and then fasten a low flat bottle in the center of the hole. A couple of wires twisted around its neck, with the ends tacked into the wood will hold it. Now the space between the wood and the bottle is to be filled with candy. The candy must not be put in until it is nearly cold, or it may break the bottle. Fill the bottle with water, put in a large wick and the bees will have pure sugar, pure water, and plenty of pure air while on their journey, and the shape of the package is such that the expressman will not be likely to tip it over or throw anything on to it."

A drawing of the package was shown along with the description. He further proposed to open a department for publishing the names of those who wished to buy or sell live bees. Thus was a start made in a new direction, a start which was to require a very long time to reach serious proportions, but which in time was to establish an important branch of the beekeeping industry.

This cage for shipping live bees was first suggested by A. I. Root in 1879.

In the next issue the editor told about two shipments of bees which came to him as a result of the announcement. One came from Nebraska without water and with bees nearly all dead; the other from P. L. Viallon, of Louisiana, with not much better success. These were very probably the first shipments of live bees separate from hives in which full colonies were moved. Queens with a small number of escorts were at that time commonly shipped by express.

The winter of 1880-81 was an unfavorable one for wintering bees and heavy losses occurred. In the April, 1881, issue of *Gleanings*, the editor announced that Italian bees were worth $2 per pound in April, $1.50 for May, $1.25 for June, and $1 for July. In the same issue appeared a list of twelve beekeepers from New York to Texas, who would supply live bees at these prices.

In the June number, the editor illustrated a new cage for the purpose of shipping live bees, and also a tin funnel for shaking them into the cage. He reluctantly announced that the price must continue at $2 per pound as in April, due to the very heavy demand. In that issue is first raised the question of the weight of bees, as to whether or not they have been gorged with honey. P. L. Viallon, the correspondent, pointed out that this question must be settled in order to avoid later difficulties. He stated that as much as 25 per cent difference in weight of a given number of bees is possible through the taking of food. Root assumes that enough bees will be added to insure that the customer will get full weight in live bees at the end of the journey.

Although package shipping thus received an auspicious start, many failures resulted. In some cases the bees went through with hardly any loss; at other times nearly all were dead on arrival. Viallon appears to have been the first to achieve fairly dependable results by means of using candy for feed. He described it as follows:

Preparing package bees for shipment in the early days of the industry.

*Former editor of the *American Bee Journal* and author of the book *History of American Beekeeping*.

"I take twelve ounces of powdered white sugar, four ounces of Louisiana brown sugar, one tablespoonful of flour, and two tablespoonfuls of honey, stir well together, and add just enough water to make it like thick mush; then bring it to the boiling point, or if too much water is added boil it a minute or two; then stir it well until it begins to thicken, and pour quickly into each cage."

While this same candy was used for stocking queen cages, it served also for the packages. A variation in the amount of boiling, or some other detail, often resulted in the loss of the bees through failure of the candy, and so many losses occurred that interest soon lagged.

Where syrup was used with a wick, it often happened that the wick became clogged and the bees starved on the journey because they were unable to get the food, or it was wasted by feeding too fast.

The real reason why package shipping did not develop at that time was for lack of consistent demand. Only in seasons of heavy winter losses, when bees were needed for replacement, was there a satisfactory market for the bees. Under such conditions there was no incentive for any shipper to prepare for a demand which might not appear. Accordingly, the idea of shipping live bees in combless packages was all but forgotten for many years, although the business of queen rearing continued to thrive. For a period of about thirty years consideration of the subject dropped out of the magazines.

Revival of interest came with the spread of sweet clover into the farming regions of the West. With expansion of the bee pasture came a new and imperative demand for bees, and this was all that was needed to insure a source of supply. The new interest started where it had been dropped so long before, and the pioneer shippers found themselves faced with all the problems which had confronted an earlier generation.

About 1911 an occasional line began to appear in the advertisements for queens, offering a half pound of bees. A year or two later such ads often carried a line, "Bees by the pound."

In the April 15, 1913, issue of *Gleanings*, E. R. Root wrote that they had sent bees in half-pound and one-pound packages for years, but that only within the last two years had they obtained any degree of success. After failure had attended the many efforts in years past, the necessity of finding some way to ship bees without danger of spreading disease had caused them to renew their efforts in this direction. A package that called for neither combs nor honey, and which could be moved at greatly reduced cost, thus became the object sought. In that article he gave as the reasons for former failure the lack of water in hot weather and, also, the lack of suitable supports for the cluster.

The new cage was provided with narrow wood slats on which the bees could cluster, and a water supply was provided in a tin can, in the underside of which was a hole not much larger than a pin point. Food was provided in the form of queen cage candy in a small pan, turned over a small slit in the top of the cage.

April, 1913, appears to have marked an important milepost in the history of beekeeping. In the *American Bee Journal* of that month, A. B. Marchant, of Apalachicola, Florida, and D. D. Stover, of Mississippi, put forward small display advertisements offering to take orders for pound packages. It would be interesting to know whether it brought any orders. Its appearance at the time of the Root article probably was fortunate and it is likely that the article aroused interest in the offerings. The beginning of the package business appears very definitely to have dated from that time. Root's article was illustrated with a number of good pictures showing the cages with which success finally had been attained and which made it possible for any competent beekeeper to enter the field with confidence.

From this time forward the development of the package business was phenomenal. By 1917 at least a dozen concerns were shipping bees in packages in large quantities. In the spring of that year the *American Bee Journal* sent the writer into Mississippi, Alabama, and Georgia to visit the pioneers in the new business. For the first time the shippers were getting orders for shipments of a considerable number of packages to a single purchaser. In previous years most of the orders had been for from one to a half dozen, for fear of loss. So successfully did the shippers make deliveries in 1916 that the buyers were ready to depend upon package bees for replacement or for increase, and most of the shippers visited at that time reported record breaking orders.

Soon after, the United States entered the World War and a great demand for sweets developed. The demand for package bees seemed unlimited, and the business expanded amazingly.

The development of the western Canadian provinces and the expansion of the sweet clover area in our own country offered a new and extensive market for bees which has continued to grow. The future of the package business appears to be secure, with single shippers selling as high as 15,000 packages in a single season.

In order to save transportation expense, nuclei, composed of one or more frames of brood with queen, were commonly substituted for full colonies when buying bees at a distance. The shipment of nuclei continued to be the common method of meeting this need until the spread of disease made it necessary to move bees without combs or honey. When the package was perfected to the point that losses were negligible, the demand for nuclei subsided and many states prohibited the shipment into their territory of bees on combs.

Until the rapid development of the sweet clover areas, the shipments of nuclei were ample to meet all demands for live bees, but the increase in demand, together with the fear of disease, soon replaced them with packages.

By far the greater part of package bees were moved by express, but they were later permitted to go by mail. In a letter which he wrote to Newman, then editor of the *American Bee Journal*, in 1889, G. M. Doolittle told of what was probably the first shipment of a package of bees by mail. A triangular wire cloth cage, eleven and a half inches in length with the sides four inches across, was sent by E. L. Pratt, of Marlboro, Massachusetts, to Doolittle. The package contained a half pound of live bees, and the package was of equal weight. Doolittle was enthusiastic about getting the bees admitted to the mails and pictured the time when northern beemen would buy packages in the spring from southern breeders to stock their hives.

The idea, however, was not popular with the U. S. Postal Service and many years were destined to pass before bees in screen cages were authorized to go by mail.

One of the early shipments of live bees in screened cages.

The Classroom
by Jerry Hayes

Please send your questions to Jerry Hayes
Email: gwhayes54@yahoo.com

HYGIENIC BEES

The helpful interconnectedness of the beekeeping world is truly amazing. There are lots of good people out there. Here is one small example. I didn't know what the photo below was showing, so I asked colleagues. Dr. Medhat Nasr from Canada said that Dr. Jeff Harris, ARS/USDA, Baton Rouge might know and voila! He did!

Q Jeff, I was sent a photo showing what the beekeeper called "volcanoing". This is where the bees bring up the edges of the caps on brood and it looks like a volcano. The bees never seem to cap the developing brood; they just do this other partial capping activity. It is seen more in the fall than in spring, but can still be spotted throughout the year. What do you think?

"I added some white lines to highlight the areas that look like hygiene. There are trails and two circles around cells that look like recapped pupae." Jeff Harris

A Hello Jerry, I added some white lines to highlight the areas that look like hygiene. There are trails and two circles around cells that look like recapped pupae. The raised uncapped pupae appear to be in the process of being recapped. So, what are the bees chasing? The uncapped pupae with the raised edges are the result of hygienic bees enlarging the cell diameter to chase something (wax moth larva) around the bee pupa. When they recap it afterwards, the entire wax moth trail will have a raised and discolored appearance (as you see along the white trail). So, my first thought is that this is a hygienic track from bees chasing a wax moth larvae. I say that because there are so many recapped cells and a few uncapped pupae in a single path that it must be the result of a local phenomenon. It may be a L1 or L2 wax moth larva that can be easily missed with the naked eye. I often see this kind of trail and under a microscope, you can usually find a small wax moth larva. The only other critter that could lead to a localized hygienic response like that would be small hive beetle larvae, but a trail that large would also probably show some slime or soiling (which is not apparent).

Having said that, if this is an extremely hygienic colony, they may be uncapping most or all pupae, inspecting them, and then recapping all of those that they do not remove. The two circled pupae could be recapped—and all around them are other pupae with a similar appearance of the cap (what looks like a sunken hole in the middle). This is often caused when a hygienic bee uncaps to smell or look inside, and other bees recap the pupa and never remove it. Some highly hygienic colonies will do this, and we don't know why yet.

Q2 Thank you Jeff. Interesting that it may be a seemingly "good trait" like hygienic behavior in response to something else like wax moth or…whatever and then repaired. Question: Can there be too much hygienic behavior?

A2

It is interesting; I have found that many stocks of bees are very sensitive to wax moth larvae. I think that the relationship between that hive pest and bees is older than some of the new problems (e.g. Varroa), and bees in general have developed a very good detection and removal ability using hygiene to remove wax moths. However, colonies good at hygienic removal of wax moths are not necessarily good at removing Varroa, chalkbrood or anything else. This seems a little odd to me EXCEPT that the cues for detection are likely different. In the case of wax moths, the bees need to smell the wax moth larvae and NOT necessarily any odors related to an injured host bee. Detection of disease, dead or sick bee larvae probably involve detection of "sick bee" odors.

Yes, I think there can be too much hygiene. I don't have hard evidence, just a sense of things after many years of selecting for very high hygienic behavior. It seems that extremely hygienic colonies will actually investigate all or about 90% of the capped pupae in a brood nest—uncapping each one, smelling and looking inside, and if they don't remove an infested or diseased host pupa, they will reseal or recap the cell. I have seen several cycles of uncapping-recapping for a single pupa.

The problem with this behavior is probably two-fold: 1. The cell cap is there for a reason (e.g. humidity control within the brood cell) and removing it for prolonged periods of time could be detrimental to the developing larva and 2. Certain bacteria can be transmitted in the vegetative stage (e.g. European foulbrood bacterium) by hygienic bees. So, the very act of patrolling and hygienically inspecting too many cells could actually accentuate propagation of a bacterium that causes disease. Again, this is mostly speculation, but there must be some reason that Nature does not allow hygienic behavior to become as high as we can make it with breeding. There must be a cost to resistance with hygiene, and we still do not fully understand what it is.

Worker Bee Dead Drone Disposal

Frame of drone brood. Varroa mites prefer to lay their eggs in drone cells.

I read your column every month and have read your book. When are you going to have another book? When you use a frame of drone comb for varroa control and you remove it and freeze it, some recommend you feed it back to the bees. How do you go about this? Thanks for any help

Danny

A

EEWH! You are at once praising the "Classroom" Book and making me feel like a slacker. Joe Graham, editor of the ABJ and I talked about another "Classroom" Book a couple of years ago. Maybe I need to work on it.

Well, the technique you mention for varroa control by freezing the *attractive to varroa* drone brood and then returning it to the colony is a component of IPM strategy. When the frozen frame/comb of drone brood is returned to the colony, they are not eating it for its nutritional value. They are, in fact, opening the cells with the dead and decaying drone pupae and larvae and grabbing, shredding and pulling out this "garbage". When a "house cleaning" bee has a hunk of dead drone flesh in her mouth it isn't to eat, it is to get it out of the colony. Just like you would not allow a dead dog or cat to lie in the middle of your kitchen floor for very long before removing and burying it, honey bees are equally hygienic to keep their home and sisters clean and free of disease.

Freeze the frame, put it back in the colony and go do something else. They'll take care of clean up. Another method is to simply discard the frozen comb of drone brood and start with fresh drone foundation.

Adding a Dextrose Containing Flavoring To Creamed Honey

Your name and address were given to me by Pat Ennis, president of the North Iowa Bee Club of the Iowa Honey Producers Association, in regards to a dextrose question, which I presented to Mr. Ennis. Mr. Ennis was unable to answer my question and directed that I submit my question to you, the expert.

I am in my second year of beekeeping and wish to expand my honey marketing by offering creamed honey in addition to my regular raw bottled honey. I wish to offer flavored creamed honey, as well as the natural creamed honey. On a web site, the link below, it is stated that the powdered flavoring contains dextrose and this is of my concern. I realize that honey, in its own ingredients, does contain dextrose as one of the simple sugars and causes honey to become granular through the crystallization of dextrose. As I presented to Mr. Ennis, creamed honey is created through crystallization of the honey, but my concern is whether the dextrose in honey is the same as the dextrose contained in the flavoring agent. And, whether this flavoring agent would help or hinder the creamed honey process because of the contained dextrose. Or is dextrose the same no matter what its source?

Different brands of creamed or spun honey.

The web site http://www.barryfarm.com/nutri_info/flavorings/powderedflavors.htm will direct you to the powdered chocolate flavoring, but I have learned that each of the other flavorings offered by this company also contain dextrose. I would appreciate your reply addressing my concern at your convenience.

Regards,
John Axon
Tripoli, IA

A

This answer may be long-winded, so bear with me on stuff you probably already know. Honey bees collect a sugar solution from some plants and aphids. This sugar solution is made up of lots of different sugars in different ratios, which can stay close to the same or change seasonally with soil moisture, pH, day length, heat, humidity, etc. Some plants like Goldenrod and Aster are pretty consistent and can be depended on at some level for granulation or crystallization. This is because the ratio of glucose to fructose is higher in this nectar and makes this super-saturated sugar solution want to balance itself and precipitate out (force out) the glucose. It does this by forming glucose crystals (precipitate) to get out the extra glucose sugar.

Making creamed honey is one way of controlling this process. This means sometimes starting it (adding extra glucose) and monitoring crystal size. Crystal size is very important if you want a smooth mouth feel or you would rather eat something with the mouth feel of sand, pebbles or rocks better? Honey will replicate the major crystal size that is in the starter. So, having really tiny ground crystal particles from grinding your existing creamed honey or from adding glucose as your starter is important.

Other fun information…maybe. Glucose exists in a couple of forms—one being D-glucose. This is a mirror image of the glucose molecule. The proper name for D-glucose is dextrorotatory glucose. See the word dextrose in dextrorotatory. So dextrose is a form of glucose. It is called as such and the names are interchangeable, especially in the

food preparation industry. So, glucose is dextrose and dextrose is glucose.

All of that to say the dextrose (glucose) in the flavorings is the same as in honey and in other food products. Does this help? If not, give me another try.

John Responds

Thank you very much Jerry. You answered my concerns completely. My thanks to Mr. Ennis for directing me to you. My creamed honey will be created with a starter, i.e., an existing creamed honey, so the granular properties would/should be proper-sized for smoothness.

It is probably best that there is a distance between you and I. As I read your message, I realized that both of us are not content with the "how's and why's" but also the theory. A conversation, over a cup of coffee, about bees could possibly take up the complete day. My special thank you for your time and answerers.

Regards,
John Axon

Q Possible Small Hive Beetle Control?

I read a Letter to the Editor of the *American Bee Journal* regarding light and an observation hive. The author suggests that natural light repels hive beetles because they are not seen in the observation hive at the Dadant branch in High Springs, FL.

Fortunately, I do not have hive beetles (yet?). But I did a quick Google search for opaque panels in order to build hives and supers. I thought that insulated opaque panels would be a good experiment to test his theory. A material such as this http://www.cranecomposites.com/transportation/product_opaqueroof.asp may be good to use. I could donate a small amount to help with an experiment if you wish to test the author's observation.

Darris Friend
Hawthorne, FL

A

In my experience Small Hive Beetles (SHB) do not like light, nor do wax moths and more especially **Honey Bees**. Remember, honey bees "generally" like and require their brood nest area to be dark to protect developing larvae and pupae. When you expose a full size colony to light, they adapt by vacating certain areas of the hive to get away from the light. When you expose an observation hive to light, they have no choice but to decrease brood production and get weaker over time. That is why observation colonies with single frames/comb stacked vertically need replenishment with more bees/brood over time because this small stressed colony can't operate as efficiently as one with more light-protected area.

SHB vacate the light and go to places in the colony that have less light such as the darker corners, bottom, ends/sides, etc. Everything is a trade off. SHB are endemic in Florida. They are everywhere and we are getting into the prime season for SHB (July/August) as temperatures rise and flowering plants slow down and colonies weaken. You have SHB in Hawthorne just like everywhere else in Florida. That is my two cents worth, but Dr. Jamie Ellis is the SHB expert, so I have shared your question with him and am ready to learn from him.

Dr. Ellis Responds

Thanks Darris for your thoughts. I will have to echo what Jerry said. At the end of the day I think a transparent hive would hurt bees far more than it would help them with SHBs. We have some old, relatively preliminary data showing that colonies with bottom screens have fewer beetles (probably due to light abundance and air flow), but that's about as much light as I would be willing to allow into the colony.

Thanks again for your ideas. If you ever try it, let me know how it goes.

Jamie Ellis

Q Baby Boomer Beekeepers

To what do you attribute the increased number of beekeepers, i.e., are we getting more beekeepers to sign up, or are more people going into beekeeping?

Karl Schmidt

A

An opinion is like a nose Karl, everybody has one. And now you get mine.

Years ago in private industry I did a demographic study of "beekeepers". Thirty to 40 years ago there were lamentations that beekeepers were old and when they died, the vocation or avocation would die. The short story is that the majority of beekeepers back then were in their 50's or older. This was just confirmation of what one saw at beekeepers' meetings. However, the pool of 50 year olds and older participants seemed to be regenerating and holding its own. And so this was the model for beekeepers as they got into beekeeping at 50 and at some point retired or passed away and someone else took their place.

Fast-forward to 2010 and the dramatic growth in beekeepers, not only in Florida, but also in the rest of the US, Canada and Europe. From my perspective this is what may be happening, but only on a larger scale to form the perfect storm. The media during the last several years has been awash in concerns about honey bees brought on by Colony Collapse Disorder, the fragile environment and food production sustainability. More people have an awareness of honey bees and their value, on many different levels, than I can ever remember. Everywhere I go if someone hears how I spend my days, they ask, "How are the bees?" So, there is lots of awareness about honey bees due to advertising and marketing. Now couple this with the slug of "baby boomers" now reaching their 50's and 60's and planning for their future. Even in these poor economic times, these people have reached the time when their kids are gone and the SUV is no longer needed. They may have some disposable cash, and their desire to get back to Nature in a small sustainable way has re-surfaced from the 1960's and 70's when they joined the "ecology movement", read *Mother Earth News* and dreamed of moving back to the land. They have the time, resources, awareness and desire to get some honey bees, reconnect and save the planet. There are a lot of them. This has manifested itself in a tremendous growth of part-time recreational beekeepers. It is amazing and welcomed. Now let's see if it lasts.

Q Do People Actually Steal Bees?

I heard through the grapevine that an arrest was made in Florida for someone stealing honey bee colonies. How many were stolen?

A

Yes (as of July) someone is now the guest of the State. In Florida, within the Florida Dept. of Agriculture and Consumer Services, there is an Office of Agricultural Law Enforcement. We just call it Ag Law. Because of the value of Florida agriculture, horticulture, aquaculture and livestock, Ag Law is busy protecting growers, shippers and marketers. The economic value for all sectors is approximately $104 billion dollars. Thus, Ag Law includes protection of beekeepers and their colonies.

Honey bees are a valuable commodity. Certainly from a fee-based pollination perspective and honey production, a hive of honey bees has a dollar value. With increasing fees paid for almond pollination and the increase in honey prices, a hive of honey bees looks pretty good. With consistent over winter losses of honey bees in the 30% range and the tremendous interest in recreational beekeeping, supply and demand are in full force. A colony of honey bees is valuable. Once one grows past a few colonies in the backyard, then outyards and remote apiary sites are next. Commercial beekeepers with hundreds, thousands or tens of thousands of colonies can have hundreds of apiaries behind locked or unlocked gates, behind a tree line or a hill or so far off the road, passersby can't readily see them.

But, other beekeepers know because you have to think like a beekeeper. Where would be a good place to put an apiary that has a good road or lane, is remote and in a good area for forage? There simply aren't that many places, so they are easy to locate if one looks around, keeps one's eyes open and listens more than talks. Commercial beekeepers, who have lots of colonies that are being moved all over and back and forth, lose track of how many they really have from apiary to apiary. So, a thieving beekeeper can take a few colonies here and there over four or five years and hide them himself in remote areas. A bad beekeeper can take his own deadout equipment to someone else's remote outyard and dump the bees from the owner's colonies into his own. That poor beekeeper whose bees and queens are stolen now experiences instant CCD! Or, the thief may take full honey supers off, extract the honey and return the supers to the original colonies and *viola,* an instant poor honey season for the original owner.

Laws, rules, and statues are only for good people. Bad people, who have no morals or ethic, can disregard laws and get away with hurting others for a while.

In Florida, we have registration of all beekeepers. With registration comes unique identification numbers. The forward thinking Florida State Beekeepers' Association also pushed for and supported a law 5B-54.013 Identification of Ownership of Honey Bee Hives and in particular (3) "Each beekeeper must have the registration number burned or permanently imprinted on the upper left hand corner of the hive bodies in letters at least one-half inch in height…"

Florida also has an Apiary Inspection Section with 13 full time apiary inspectors who assist beekeepers in all ways to be more successful. Sharp-eyed apiary inspectors were the first to notice something wrong. Colonies secluded in peculiar places with mixed brands on the equipment were the first signs of something fishy.

To make this shorter, beekeepers were contacted to see if they had sold colonies to others recently or were missing colonies. Ag Law was contacted and a bad beekeeper doing bad things to good beekeepers was caught.

The take-home message in my mind is: 1. Support the Apiary Section in your Dept. of Agriculture. They are there to help you; 2. Mark your hardware with a unique identifiable brand—I am talking about frames, hive bodies, supers, bottom boards and lids; 3. Help your fellow beekeeper by paying attention to what you are buying, what you see in outyards, and what is being transported down the road. We are too small of an industry to be stealing from each other. It's goofy. But there are bad people everywhere, so stay away from them and find the good ones.

Q Grumpy Bees Again

I have six hives in my backyard, which is 2/3 of an acre. In the past I have never had any problems with my bees being aggressive while I am out in the yard. This past weekend I did quite a bit of work with my hives (i.e. checking brood, finding queens, dusting and adding screened bottom boards) and even managed to get stung a couple of times in the leg where my suit came untucked. Over the last couple of days, when I have been watering trees in the backyard, I have been bombarded by a couple of bees even though I am at least 20 yards away from the hives. This type of behavior has never been an issue in the past.

My question for you is...do bees remember being disturbed in the hive and continue being aggressive towards the intruder days after the event? Will they continue to attack, even when unprovoked? I have never had this issue before. I am a little concerned because my one-year-old daughter is getting excited to play in the grass. Your thoughts? Thanks for the help.

Brian VanIwarden
Colorado

A

Honey bees can get grumpy and certainly stay grumpy at times. Honey bees do have a memory of sorts and a memory of alarm pheromones, which sometimes take time to dissipate in the colony. The cause sometimes is nighttime harassment by skunks, raccoons and possums. Skunks will hang out at the front of colonies at night, scratch at the entrance and eat the bees as they in turn walk out to see what is going on. Many times you will see skunk feces in front of the colony. Queenlessness can cause grumpy behavior or even a large population and no flowers/nectar/pollen to be able to go out and gather. A change in the weather can also sometimes cause colonies to become more defensive—high humidity, etc. Then, of course, some honey bees are genetically predisposed to grumpiness—African honey bees being an extreme example. Let me know what you may discover.

Brian responds:

Thanks for the reply. One of the six hives was without a queen.

Q The Waxmoth Is Not the Real Culprit

I have been struggling with wax moth and have lost hives from it. Is there any treatment—least toxic of course—and can you use the hives after an infestation? I have frozen the bars after reading that was effective, I use the Kenya Top Bar Hive.

Thank you
Betsy Roberts
Sarasota, FL

Strong colonies will defend their homes from intruders.

A

Many people think that wax moths or even small hive beetles (SHB) have taken over and destroyed their colonies. Wax moths and SHB are secondary predators. A strong healthy colony of honey bees does a great job of policing their home, the colony, to protect it from other predators. A strong colony of honey bees that has an individual honey bee on every inch of comb does not tolerate or allow hive access to creatures, their eggs or young for very long.

The wax moths were taking advantage of a weak colony, so they could raise their own young and preserve their genetics. The unprotected colony was just the buffet that the wax moth needed. The question is: Why was your colony so weak that it couldn't protect itself? Was there disease, uncontrolled varroa, starvation or significant swarming that reduced the population or what? Strong, healthy, populous colonies of honey bees are the best defense against wax moths and SHB. Now it is time for your detective work.

That being said, remember to reduce extra super space when honey flows are over in order to provide less space for the bees to protect. New colonies and nucs also need special care and attention since they have smaller populations and are therefore more vulnerable.

Q Globalization

Before arguing what triggers CCD, there is a crucial question: What is CCD? What are CCD-like symptoms? Is there a similarity between fever and fever-like symptoms in humans? What can be linked to fever?

I think that colony collapse is like fever. It is a general marker for disease, which can be triggered by a long list of biotic and abiotic factors and, of course, by the combination of both. Therefore, the American CCD is probably (in my opinion) not exactly similar to the Spanish CCD. Thus, it is not necessarily expected that the pathogen, which is responsible for fever in one place, will be the responsible factor for fever in another place.

What is your opinion Jerry?

Best wishes,
Eyal

A

As you said and I think what has been found, reported and discovered is that managed genetically based European honey bees are simply not very healthy. This always happens with species that are challenged by new pests, parasites and diseases. As an aside, I remember hearing years ago from some paleobiologist or geobiologist that certainly the majority of dinosaurs were negatively impacted by a huge surge in volcanic activity and/or an asteroid strike in the Yucatan and the global climate change that ensued. This is documented in the geologic record. But, this scientist also said that because of other global changes, land bridges between continents had appeared that previously had not been available. Now other animals and their adapted personal flora and fauna could be introduced back and forth to non-adapted closed populations. In situations like this, life forms always get sick and die.

The dinosaurs in this scenario were already struggling with novel pests, parasites and diseases and in decline when global winter came. These events, the asteroid and hyper-volcanic activity, were simply the tipping point. In my simple mind this sounds very similar to what is being experienced in the world of managed honey bees. So, will there be a tipping point event is my question? What might be our meteorite?

Here is a quote from our famous Dr. Oz from TV: "One of the trade offs of globalization is that as we become more and more connected, countries and cultures inherit one another's baggage."

The Traveling Beekeeper

Colony Needs During Winter

by LARRY CONNOR
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There is an enormous range of recommendations about getting colonies ready for winter. Some beekeepers recommend every colony have 90 to 120 lbs of stored honey and pollen to survive the winter, while others are able to winter colonies on just a fraction of that amount. Parallel to that is the overwintering of huge populations in large brood nests compared to those who winter bees in four and five frame nuclei. Some people winter colonies with no preparations, and others wrap their colonies in thick insulation materials. This contrast list goes on and on.

Part of this just reflects the adaptive nature of honey bee colonies, and their inherited ability to survive under a wide range of environmental conditions. There are variations on how different races and families of bees deal with wintering, with some with many adaptations for survival and others less fit for winter. The other factor, where you winter your bees, makes a big difference, too. If you have bees in an area where winter is only a few weeks long, your focus will be much different than the beekeeper in northern states and Canada who must prepare colonies for months and months of limited flight.

More and more beekeepers accept the reality that preparation for winter must start before the summer is officially over at the autumnal equinox. There are three focus points all beekeepers need to address at this time of the season: 1. The production of healthy 'winter' bees with optimal nutrition stored in their bodies, 2. The management or treatment of colonies against pests and diseases, especially varroa and tracheal mites and nosema, and 3. The colony must be provided with enough food to survive until the reappearance of natural food in the spring.

To get a five frame nucleus to successfully winter, you need to combine a young queen, 25 to 35 pounds of honey or stored food, as well as adequate protein. This colony has protein on it all winter. The photo was taken in early March, 2010 in Michigan.

Anticipate

Prior to the appearance of mite parasites in bee colonies in North America, many bee-

keepers felt that their biggest problems were American foulbrood and pesticide losses. For foulbrood many beekeepers used a calendar antibiotic treatment program to prevent the disease from appearing in their bees. At the same time a number were strongly against this approach, since the colonies were being medicated with an antibiotic that usually was not needed by the bees. That pretty well reflected the attitudes of the medical and veterinary professions before 1980.

With pesticide losses, beekeepers were far more likely to anticipate losses, and most commercial beekeepers either priced pollination rentals to include some bee losses, or they kept their bees away from the fields or orchards being treated with bee-killing insecticides. Small-scale beekeepers often did not know what killed their bees, and were quick to blame disease, swarming or starvation for bee losses rather than consider a pesticide exposure, unless it was so dramatic that it was hard to mistake for something else.

In this post CCD era, more and more beekeepers are PROACTIVE rather than reactive in their bee management. Rather than waiting for problems to develop and for bee colonies to die, more and more are focused on the sampling and testing of colonies for various problems. Last month I discussed Dr. Medhat Nasr's proactive testing for mites and nosema in Alberta, Canada. The beekeepers there are encouraged to treat only when necessary, and to treat in the correct manner.

All beekeepers should develop the habit of sampling for varroa mite levels. This is the premiere problem facing most beekeepers in North America, but this is often linked to other issues (hive-based pesticides, bee pathogens, and poor nutrition). Sampling methods range from the ether spray method, the double jar method shown in last month's column, or using a powdered sugar dusting to count the adult mites that are dislodged by the sugar and fall to a greased sampling tray.

Sampling is one thing, but knowing what the numbers mean is another. A beekeeper spoke of a mite drop of 40 mites. He said it was a natural drop (no powdered sugar or anything else was used), over a three-day period. He thought the number was low. I suggested that it seemed high to me, since I like to see less than 10 mites drop in 24 hours with a powdered sugar dusting. This is the challenge, isn't it? What do these numbers mean? It is frustrating that most of the time it is hard to get good advise on this.

For me, the lower the mite drop, the happier I am. I like to see well-chewed mites, ones with broken shells and torn legs. Get the hand lens out and take a look! Are your bees grooming the mites off themselves?

Here is what we can sample for in a proactive management plan:

Varroa mites – as discussed above, we can use one of the sampling methods and make decisions based on local practices and recommendations.

Tracheal mites — A few dissections under a lower powered microscope will provide evidence of any possible tracheal mite problems. This is useful in the fall and winter, and during spring buildup.

Beekeeper Joe Calme uses powdered sugar on a screen to evaluate mite levels, which may be part of a rigorous mite reduction program the summer before the bees go into winter.

Nosema — A higher powered microscope (compound scope) is needed to check the spore levels in bees, and this is beyond the finances of small beekeepers. But they should put pressure on State officials for testing, if they do not already provide this service.

General beekeeping awareness should dictate elimination of certain colonies with diseases. Colonies with American foulbrood should be quarantined, and local practices followed for treatment or destruction. Colonies with the general symptoms associated with Colony Collapse Disorder are probably not worthy of any effort to save. Colonies with PMS (Parasitic Mite Syndrome, a collection of symptoms that can include European foulbrood-like brood, K-wing, dimunitive wing, and other virus-transmitted diseases) should be destroyed or put into an intensive treatment program with knowledge that few of these colonies can be expected to survive the winter period.

Feeding program

Even before the last of the late summer/early fall nectar is gathered, many beekeepers begin a protein feeding program with the goal of producing a large number of well-fed worker bees that will serve as the Winter Bees. By feeding, it is hoped that they will be 'Fat Bees', endowed with extra proteins, enzymes and other nutritional components needed for brood rearing during the winter. We fed protein patties from mid August to December in 2009, and the limited success we had in wintering bees (after an especially poor season) is credited to the feeding program. We fed thick sugar syrup (2 parts sugar to 1 part water) in division board feeders. The frame feeders with that had built-in chimneys to eliminate drowning certainly had an advantage over feeders with smooth or rough interiors. We want the protein to go into the bees, with any natural pollen being stored in the cells. When the nectar flow is over our minimum carbohydrate feeding goals are:

4-frame nucleus 3.5 frames of honey (or stored sugar syrup)
5-frame nucleus 4.5 frames of honey (or stored sugar syrup)
8-frame hive 7 frames of honey (or stored sugar syrup)
10-frame hive 9 frames of honey (or stored sugar syrup)

In late October or early November we re-evaluate the food storage levels of colonies and add extra frames of stored honey to those colonies that require them. We do not feed colonies with poor chances of wintering since there is no point if investing the time, feed and equipment in colonies that are sure to die over winter. A better plan is to combine a marginal hive with a strong hive, and let the bees sort out the best use for these themselves. Don't combine two weak hives, since they are still unlikely to succeed during the winter.

Many beekeepers medicate with Fumagillin as indicated by microscopic testing and spore counts. Follow the directions and use commonly accepted practices when using antibiotics in the hives. Keep records of the dosage, time and frequency of treatment.

Relocating hives

Wind can be stressful and deadly to hives in the winter. While a ridgetop may be a great place for bees to gather nectar during the summer, it may be lethal to colonies in winter. Move the bees to a wind shadow, where you and the bees can comfortably stand on a windy day. Avoid low and wet spots along lakes, rivers, streams, since they are likely to flood in winter and spring rains. Ask property owners how high the stream has flooded before you put bees into a winter location.

Some beekeepers group their nucs and single hives into groups of 2, 4, 6 and 8, depending on the design of the boxes and the pallets they are on during the rest of the season. The idea is to let each colony help the others out with some degree of heat sharing. They may wrap colonies, making sure each one has proper ventilation and flight openings.

Wrapping & Insulation

As you move north or into the mountains, wrapping is more common, increasing the percentage of live colonies in the spring. The simplest method is to wrap colonies with roofing paper (a.k.a. 'tar paper'), cutting upper entrance holes in the paper to insure both ventilation and flight. During my Al-

Double-deep wintered colony receives additional protein in March. As with the nucleus, protein patties were on the colonies all winter, as access (breaks in the weather) permitted.

berta, Canada visit, Medhat Nasr showed me the wrapped fiberglass insulation that they use at his facility. A four-inch sheet of fiberglass is enclosed in a heavy plastic wrap around the sides of double-deep hives grouped in fours (the pallet system). One sheet of insulation material is placed on the top of the hives, and tied down. A piece of plywood is put on the top of these four hives, and securely tied down to keep the entire wrapping system from flying away as the Alberta clippers move the snow around the hives.

This same method can be used for groups of five-frame nucleus hives as long as insulation does not block the entrance or reduce ventilation. A south-facing location helps the bees to get in cleansing flights when wind protected and the winter sun allows the microclimate around the hive to permit such activity.

The use of the polystyrene five-frame nuc boxes offers small-scale beekeepers an option for wintering with insulation. The boxes can be used all season long, or the bees and frames from wooden hives moved into the polystyrene boxes at the end of the season and fed heavily. Users like the fact that the bottom of the colony doubles as a feeder, that sugar syrup can be placed at the bottom of the feeder and the bees crawl down the frames to clean it up. In winter the syrup can be warm (100 degrees F) and cause the bees to break cluster before the heat dissipates. This might be something to try on a few colonies before jumping in with all colonies.

Economics of Wintering

If you purchase five-frame nucleus boxes or polystyrene hive bodies with frames to fill them (or pull down the strength of larger hives), raise or purchase queens, virgins or queen cells, and make sure each colony has between 20-25 pounds of stored honey or sugar syrup, the cost of each colony should be less than the cost of the average package bee colony or purchased nucleus in the spring. Locally Sun Belt packages sold for $70 or more, and some nucleus colonies were selling for over $100. In 2011 I expect to see these prices to increase again, as there is no apparent decline in the interest in beekeeping or the demand for bees. Further, many of the new crop of beekeepers is expecting to grow their operation.

In certain markets locally adapted queens in over wintered five frame nucleus hives sold for $150 in 2010, and I expect to see these prices increase. This created a double economic incentive. First, each beekeeper needs to evaluate the cost of packages and purchased nuclei against the cost of doing the summer split and over wintered colony on their own, even with a 50 percent success rate. Second, the smart beekeeper can easily sell strong over wintered nuclei colonies at any point in the season. I will repeat my old maxim: *The money in beekeeping is in the bees.*

Off to Georgia's state beekeepers meeting in September. If you have not read Dr. Connor's book *Increase Essentials*, borrow a copy or go to his website, www.wicwas.com to look at all the goodies listed there.

An Open Letter to Honey Bees and Their Masters

by ROBERT D. WEAST
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Research is serious stuff. Bob waits and listens for a breakthrough.

I am sick and tired of being made a fool by my bees, year after year. For far too long they have had it their way. Just about every thing they do is wrong, forcing me to use tricks to beat them into submission to get their honey. This letter is a comeuppance to mend their ways and enter the 21st Century. Really, bees are only good at three things, like making pure white beeswax combs, storing lots of honey and pollinating flowers, but that is all. They are abject failures at everything else. Everybody knows that.

My ultimate objective is to develop a way to communicate with them and tell them what's good for me, I mean, them. They have all kinds of communications with each other, such as pheromones, various odors and behaviors, but we are left out of the discussion (except when they sting). I think the language barrier between bees and beekeepers can be broken down, but more on that later. Meanwhile, here are my gripes with bees, no holds barred. They have it coming.

Queens. Breeders go to great lengths to raise really good queens. We introduce a good one to you, the bees, and what do you do? Half the time you let her lay a few eggs and then you knock her off and raise one of your own. This is stupid! You never know what kinds of riffraff mongrels she will consort with. After all, I spent a lot of money for that queen. Ingrates.

Drones. These world champion free loaders do nothing but eat, fly around some, hang out and with luck (they'll be sorry!) maybe 20 will mate with a virgin queen leaving thousands of drones frustrated and to continue their lazy, profligate lives. Why in the world do you raise so many drones? If a complete frame of drone cells is put into your hive the Dumb Dora queen will fill the comb completely with eggs and produce thousands of good-for-nothings. I know you kick the bums out at the end of the season, but why raise any at all, especially when the beekeeper will provide you with a great new queen every year? Seems like you don't know nothin'. Wise up.

Swarms. What a waste. After working and building up for the honey flow, you scrap it all and depart for places unknown. How maddening for the beekeeper to see more than half his bees simply fly away and leave everything behind, like dollar bills whiffing away. Every effort is made to give you first-class living conditions and do you appreciate it? No sir. You are so stubborn. You keep building queen cells and I tear them down until you finally sneak one through. When the new queen hatches, you all take off. Your first responsibility is to your home. Just stay put and store lots of honey. I need the money.

Drifting. Some of you are careless and lose your way home and fly into the wrong hive. This wouldn't be so bad if you weren't infested with disease and vermin, but you are. Not only that, but if one of you has a bad temper and then enters another hive, you rile up all the peaceful, gentle workers with your alarm signals and incite a riot until they too become enraged. Please pay better attention to where you live and stay home!

Propolis. This is a holdover from primitive times when cracks and openings were commonly sealed from the elements. But you are now living in modern hives and all that propolis gums and glops everything, adding to the woes of the beekeeper as he struggles to free frames and supers. Just stick to nectar and pollen and forget the sticky stuff.

Burr combs. This is an outmoded concept, filling every nook and cranny with bits of comb. I provide you with straight frames and foundation and everything, so stop building all those pesky burr combs. You are just creating congestion and poor air circulation. I don't like traffic jams so knock it off.

Honey bound brood chambers. Geez! What in the world can you be thinking when you fill up every available cell with honey? Where is the queen supposed to lay? You need to plan for tomorrow, not just mindlessly cram up with honey. Zounds! Don't you know anything? Get some common sense and leave some empty combs for the queen or you'll be sorry!

Clustering. When I see thousands of you just "hangin' out" on the front of your hive, I wonder why you don't get to work. Maybe you're just lazy. I give you lots of room to store honey and all you want to do is to keep cool, so you go outside and loaf. I see all kinds of flowers out there and there you sit. Are you kidding me? Give me a break. Get off your duffs and make some honey money.

Stinging. Frankly, you've got an attitude. This is really hari-kari, but like a hare-brain drone mating with a queen, you just don't know what lies ahead – the grim reaper. And you bite – sting that is – the hand that feeds you. Your weapon doesn't do any good against bears and skunks, so what good is it? Just keep out of my face and pants. Don't forget, the beekeeper is your best friend.

Housekeeping. Some of you are lousy housekeepers and are riddled with mites, but you pretend they are not there. You might take the cue from monkeys who groom one another by picking off vermin. It won't be long before you will be replaced by decent, hygienic bees that clean their house. You just don't get it.

The language of bees. Bees use all sorts of ways to inform each other, such as various behaviors, buzzings, scents and pheromones. And queens have their ways too: virgins quahk within their cells, zeep and pipe after they emerge and squeal when bees attack them. And they blaze their nuptial flights with pheromone-scent trails that lure scores of drone squads chasing them in hot pursuit. I don't know which kind of mating is worse, a newly mated drone being eviscerated (to put it nicely) or a hapless praying mantis being eaten alive by his mate. What a way to go. And there are those hula dancing, tail-wagging girl scouts that show the way to new homesteads or where to find pollen and nectar. And those nasty buzzing and acid-laden scents of angry bees that entice others to go on the attack against an intruder. I'm going to tap into this wealth of information and do something about it.

Decoding the Language

I am currently trying to develop a translation program from bee language to English and vice versa using high tech computers to match the bees' communication systems with ours. Here are my proposals. The beekeeper will wear earphones linked to a high tech pocket computer with a microphone input. The beekeeper holds the mike in front of the hive to hear what kind of buzzing is going on. A happy buzz will translate into English "Everything is going fine. We are bringing in lots of nectar and building combs. You are welcome to have a look inside." A nasty buzz will translate into the beekeeper's ears as "Don't mess with us today. Nothing is going well, so buzz off. Don't you dare open this hive, or else." On the visual side a miniature camera will close in on a worker doing her bee dance. Through the earphones the beekeeper will hear "Girls! I just found a great orchard about 1 mile away NW loaded with pollen and nectar. Go help yourself and load up." Or another dancer might say, "I just found a hollow tree that is a swell place to start a new home. Give it a look, it's a cool pad and is 2 miles away SE on the edge of a woods."

At present my research is running into a few snags, so don't hold your breath. Until then, bees will continue to make bad decisions, misbehave and continue their old fashioned ways as we attempt to manage them, or, are they managing us? Dealing with bees is like Bob Dylan's song, "Blowin' in the Wind." I wonder, how did honey bees ever get along without us for millions of years?

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Breakthrough! Bob hears something funny and laughs.

All right, you're old, but that doesn't mean you're through with beekeeping. Or, does it? Sure, your back feels like a dynamite explosion every time you lift a brood chamber, and you can no longer spot the pollen sacks on bees' legs, and your hand shakes too much to re-wax frames or graft a queen cell efficiently. But there's still your omnipresent, bubbling over enthusiasm. So while you can continue, perhaps it is prudent to take precautions. If you are one of these geezers/geezeresses with these concerns, read on. Remember, many beekeepers do not even start their hobby or sideline until after they retire from their regular jobs, so you have lots of company.

As an introductory statement, let me state the obvious: you are not the kid you used to be. You have less strength, less endurance, less agility, poorer eyesight, and iffier balance. So why not reduce your hobby to manageable size. If you have several hundred hives, sign up for Social Security (it's free) and only keep 50 hives. If you have 20 hives, do 7. If you have been tending 5 hives, do 2 or 3. In each instance, the more manageable size will feel like a breeze. You'll avoid the aches and pains that follow a work session, as well as the sense of frustration at not getting everything done. Yet, you'll still witness the bees' enthusiasm, and that in turn will keep your outlook, if not your body, youthful.

Curious? Follow these guides:

● **Adopt a 'we'll see what happens' attitude.** Every year, the bees surprise you. Whatever they do, they do and you've had the privilege of being there, on the edges, watching, helping, but not interfering. If you get a harvest, fine. If you don't that's fine, too. If the bees don't overwinter, no problem. You start anew with a package next spring. There's no more scorecard, comparing last year's production to this year's. I'm basically suggesting a new attitudinal shift, which is the frame of mind of a true hobbyist.

● **Reduce the numbers of customers you supply.** Since you no longer are counting on a specific production, you must tell people who depend on you to get alternate sources. If you supplied three stores, did three fairs a year, and sold out of your house, you might cut back to one store, one fair, and otherwise concentrate on home sales. Suggest beekeepers who might be willing to sell these stores their honey. At your club meeting, solicit potential vendors and give them store numbers. Do the same with fairs. Continuity of supply is much appreciated by merchants who sell local honey.

● **Realize that beekeeping is backbreaking work and take precautions.** It only takes one lifting of a too-heavy hive and your back is permanently derailed. If you want to wince in pain every time you get up from a chair, then continue doing things the way you have been doing them. If you want to maintain your fitness, take precautions. Think before you act. When you accidently pierce a frame and honey starts to leak out, don't go into emergency mode. So what if some honey is lost? Move slowly to retrieve a bowl for recapturing the lost product. Slow down. Instead of tending 10 hives in one session, tend three hives. Take breaks. If you devoted an hour to sugar feeding a half-dozen hives, give it two hours. Even better, fill the containers the night before so you only have to install the jars. Now, you have time to enjoy the activity, and not just take pleasure in crossing the chore off the list.

Consider changing over to three medium or shallow supers to replace the normal one or two deeps you use now for your brood chamber and surplus winter honey. There's a significant weight difference between a full deep and a full medium or shallow super.

● **Hire a kid for spring cleanup and fall harvest.** Pay the youngster the going rate in area for a day's work. In early April, have him scrape clean each frame and box and repaint the older boxes. Have him assist you to replace old foundation with new. At harvest time, he helps you lift off the supers and roll them into the garage. Then, he subdivides the supers into five-frame stacks (you have extra supers now since you're not handling as many hives). The kid does the heavy stuff. You do the supervising and touch-up work.

Plan it out. Of course, you will need an extra bee suit. In advance, prepare a list of 10 chores. Before your helper does anything, review each chore. Give a brief explanation of why it has to be done and how to do it. As he does each chore, watch to see that he does it the right way. If he needs further instruction, give it. The key to instructions is: Explain the whys and wherefores tell how to do it; demonstrate how to do it; then watch as the individual does it. The explaining why gives an overview so that he/she has the overall picture. Who knows? Possibly the assistant will come up with a better way to accomplish the task. The tell, show, and watch method is to drill the procedure into the mind so that it isn't forgotten.

As to how and where to hire the young man or strong young lady, start with neighbors, family members and children of friends. Another alternative is to approach the high school guidance department, saying you have a few days' work to offer someone. Especially in these tough times, youngsters finding it hard to get summer jobs are eager for the chance to earn extra money.

As for getting stung, I like author Sue Hubbell's approach to hiring an assistant. She stung a person every day for 10 days until the person became used to it. However, since this hiring is for limited duration, you might sting a person once in the shoulder to show that a bee sting isn't terribly painful. And, of course, you need make sure you hire someone who is not allergic to bee stings!

⬢ **Use tools.** Anything that reduces the strain on your back helps. Dollies are indispensable for moving super stacks. The lid opener tool is excellent for opening 5- gallon plastic tubs. Rope is good for tying together multiple frames. The back brace vest is a good protection device. Headbands reduce sweating and help maintain vision during hive visits. Porto-tables on wheels are useful for installing packages or replacing frames. Anything that allows you to stand up helps. The idea is not to make you a gadget freak. Rather, it's to make your beekeeping experience as painless and comfortable as possible.

⬢ **Divide boxes in half if weight is an issue.** Ten full honey frames in a box may be too much. Moving five full frames may be the right weight for you. So, whenever you extract honey, the first thing you want to do is to divide the frames into two boxes. Handling a box with five frames, whether honey super or brood chamber, is manageable. Putting three frames on one end and two frames on the other helps balance the load. Otherwise, it will be lopsided and awkward to handle. Even if you have a helper during the harvest, you will inevitably have to lift supers during the honey processing, so reducing them to five-frame boxes may be an option for you.

⬢ **Become a mentor.** After 25 or 30 years as a practitioner, perhaps it's time to share your knowledge, experience, and insights with others. Maybe passing on the torch is the next stage of beekeeping for you. After all, you won't be around forever, and you want the bees to continue after you are gone. This unique vision you've evolved can be your ultimate gift to the bee world. Who knows, becoming a teacher might open you up to new possibilities. Maybe you'll take over the bee school for your club. Possibly, you'll discover a gift for communication, and hiring yourself out as a public speaker might become a new sideline.

Don't worry, old timer. This won't compromise your life as a beekeeper. Rather, it will make for a more fruitful experience. That's a better alternative than sitting in a rocking chair, and saying to your grandchildren, "I remember my days as a beekeeper." Because you still can be one, in one way or another.

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Honey Bee Biology

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Bees, Cherries, Night Foxes . . .and Bees Again

Early spring has finally vanquished most of winter. The bees have been out searching for flowers, the first blooms of the season. From the still leafless woods, foragers flow back, landing at the entrances. Loads of greenish-yellow pollen are packed on their hind legs. The pollen, now in such demand after a long winter, comes from the little red flowers of the maple trees. Greenish-yellow pollen from a red flower is an odd color mismatch—nonetheless a welcomed sight.

It's a warm sunny afternoon, and I pop out of the back door heading for my apiary behind the house. Suddenly my mental swarm alarm goes off – EEK! – triggered by a distinctive hum of honey bees heard overhead. An electric jolt fires through me, a split-second compression, just out of memory's reach, of all the swarms I've ever seen fly away, watched helplessly from the ground, starting with the first as a kid. Thankfully, most of those lost swarms are forgotten – but each left a scar.

Finally, after an eternity of inner turmoil, really just a speck of a moment, I come to my reasoning senses. Swarm season is at least a month away. Even strong colonies rarely swarm this early in the spring. Swarm season, a busy and crazy time for bees and their keepers, surely is coming, but it's not now. Make no mistake about it, the hum is real and loud as it emanates from a chorus of bees, thousands of them flying above.

On the way to the apiary, my sound shock comes from passing close to our huge cherry tree, now bursting in full bloom (see Figure 1). Its trunk, two feet in diameter, supports mega branches, themselves like fair sized trees. Still leafless so early in the spring, the tree is a white cloud of little cherry blossoms, oodles of them, beckoning thousands of bees to come. And as the pollinators fly from flower to flower, a collective hum flows from the tree. If that sound were light, the tree would be a glowing beacon of early life sprung forth in a still sleeping woods. I doubt its pollination could be better with 30 hives close by (and I have had up to 60 in the home apiary).

The cherry tree blooms every spring and calls forth my bees, who set it humming. And before the peak bloom passes, inevitably I walk by and get shocked. After a few years, you would think I would learn. It's not that simple. Early spring is already busy, even before swarm season. Math classes have not finished, and colonies need attention to set them up for experiments later in the season. Heading for the apiary behind the house, I'm distracted with a long mental list of things that need completion. In a blink, that hum deletes my to-do list and is replaced by – swarm, before I remember the bees are pollinating the cherry flowers. That overhead hum is too strong for me, more like a reflex honed from decades of apiary work.

With plenty of annual bloom and pollination, Suzanne and I imagined big annual cherry crops, more than we could pick. It sure seemed so after the first summer, which

Figure 1. Part of the cherry tree in full bloom. To a bee it's a sea of flowers and food.

Figure 2. Every branch loaded with cherries, an uncommon sight.

Figure 3. A woodpecker dining on a cherry. The cherry, out of view, is right in front of the bird, held in place by a notch in the branch.

Figure 4. Pecking open the cherry.

may have been a lucky start. The tree does not yield cherries every season, just sporadically. Most summers there's nothing, demonstrating that it takes more than proper pollination to secure a crop.

This summer was the exception, a heavy crop, only the second in eleven years (see Figure 2). Suzanne picked several bowls from the lower branches. The rest, virtually all of it, we gladly relinquished to our closest nosy neighbors, who come calling unannounced anytime, day or night – the wildlife. The cherries show how bee pollination contributes to their food sources. Not surprisingly a host of birds flitted among the tallest branches, pecking at the cherries. The most unusual one was a woodpecker (see Figure 3). This bird will come to bird feeders and will feed on the ground, an unusual behavior for a woodpecker. In the cherry tree after picking one, the woodpecker would fly to a place in the tree with a notch in the branch, and peck it open (see Figure 4).

The seeds dropped by the woodpeckers, and hundreds more accumulating under the tree in the weeks to come, attracted a pair of chipmunks. They live under the shed where I store some of my beehives. Out on a seed-collecting mission in the uncut grass beneath the cherry branches, the slightest odd sound would send them zipping back under the shed. The small rock-hard seeds are considered a tooth-jarring annoyance in the human world, the price of consuming delectable cherries. For the chipmunks the pits are a meal eaten on the spot, as told by the little empty shells, or they are stored safely away to stave off starvation in the winter.

As the cherries ripen, each passing breeze shakes them loose. Hundreds lie scattered in the grass below attracting the next visitors who wait until just after the sunset, preferring to come shrouded in the twilight. Completely silent, floating ghost-like out of the tall grass, gray blurs loom closer in the growing darkness. Then, the eye can finally discern their form – foxes. These secretive and stealthy night hunters have a taste for sweet ripe cherries. Circling the tree sniffing out the falling fruit, an easy feast that cannot flee or fight, the foxes eat their fill. And vanish. Only the camera flash unmasks them in a strange unnatural light (see Figures 5 and 6).

Later on something else is out there in the pitch-black. Scratching sounds are coming from the tree trunk. A quick fire of the camera, a blind shot into virtually nothing but night, reveals the next player taking the stage – a raccoon (see Figures 7 and 8).

Figure 5. Peering from behind the cherry tree with radiant eerie eyes – a fox.

Scampering up to almost the tall treetop, the raccoon seems gone again. Not so. Against the barely lit night sky, the small twig-like branches up there snap back and forth giving up their cherries and revealing right where the night harvester works.

For about a week, by day and night, this succession of wildlife consumers came to the tree dining on cherries. It was a subtle race against time since some of the cherries began decaying, still attached to the branches, which in turn created a new opportunity for an unexpected visitor to the tree.

I pop out of the back door again, headed for the apiary, and BAM! My swarm alarm goes off. There's not a swarm for miles. It's summer well *past* swarm season. That cherry tree. It's humming again. Though not nearly as loud as its spring performance, the bees are back, for an encore serenade. Without any flowers in the tree, what would they want? As the cherries decay, holes form in the skins. With little else to find during a June dearth (in this area), the bees will take

Figure 6. A fox coming around the trunk of the cherry tree. Sniffing out fallen cherries at night, there's a feast on the ground free for the finding.

Figure 7. A raccoon right in the moment it zips up the trunk of the cherry tree.

Figure 8. A raccoon pausing on a big lower branch. Then it will climb up to the top of the tree and eat cherries in the moonlight. My camera aim is off since I see just darkness through the viewfinder.

sweetness from most any place. They have returned to the flower sites, once a time of beauty and plenty, to forage among decaying cherries, still attached on the branches, sipping the juice through the holes (see Figures 9 and 10). A miniature cherry-juice flow, which hardly makes a dent in the daily deficits as the colonies consume far more calories than they collect during this time. (For example, the nearby scale hive continued to lose weight.)

While I watched the bees forage on cherry juice, it reminded me of some contentious episodes in the history of apiculture in the late 1800's between fruit growers and beekeepers. Fruit growers claimed bees chewed through the skin of the fruit to take the sweet juice, damaging the crop. They said the beekeepers should be liable for their losses. These situations could become quite bitter – burning apiaries even occurred, as suffered by J. S. Harbison, a California beekeeper. The beekeepers stated bees did not chew through the skin of the fruit. Rather, the bees came after the holes occurred (by decay or possibly made by wasps or other insects). In the end, the beekeepers were correct. Convincing fruit growers, maddened by crop losses, was another matter.

True to the beekeepers' convictions, while the bees foraged on cherries, they never chewed holes in the cherry skins to obtain the juice. The bees did not even enlarge preexisting holes to reach further into the cherries to obtain additional juice, a reach that is somewhat limited by their tongue length. When bees chew at an object, their heads pivot from side to side, a behavior easily seen by putting a small piece of crumpled newspaper in an observation hive. Working from the edge of the paper and having no tolerance for that object in the hive, the bees will chew it into a fine frass. In contrast, when bees take in fluid (nectar, honey, sugar syrup, water, cherry juice, etc.), the head remains motionless.

Next spring I expect the cherry tree will light up the surrounding bare woods with its burst of white flowers. The bees will come, and the whole thing will hum. I'll burst out of the back door, busy as ever, and get a shock. As for cherries, I doubt we'll see even one. Maybe in another ten years or so. Suzanne and I will miss all the wild critters, the menagerie of cherry pickers, who came calling, most surprising the stealthy night foxes. Who knew that foxes were so fond of cherries?

Figure 9. Removing cherry juice. Note the stance of the bee, particularly the hind leg. It's almost a hugging grip to insert her tongue as deep as possible into the cherry.

Figure 10. A bee and a hole in a cherry. The bee has finished with this cherry and does not try to enlarge the hole. She just flies off seeking another cherry. Tiny white specks begin forming on the cherries. Some kind of fungus I suppose. In the end, it claimed a fair amount of the cherry crop.

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Global Honey Bee Decline and Its Effects on Agricultural Production

by JERRY HAYES
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Anyone having had an interest in honey bees for at least the last five years has heard about CCD and has seen the annual survey data of a 30% winter loss of honey bee colonies. Certainly honey bees as the foundational pollinator of dependent agricultural crops are important. Most of the fruits, nuts and vegetables we eat require pollen to be transferred from one flower part, the male anthers, to another flower, the sticky part, the female stigma, for this process pollination to occur and set up the next step of hopefully successful fertilization.

Not to bore you, but a good example might be a watermelon. Pollen, the male element carrying half of the genetic information, must be picked up/collected from a specialized male flower by a honey bee. Then this pollen is physically flown to the female flower having a pollen receptive stigma and attached ovary, which is the undeveloped watermelon. Seeded watermelons can have lots of seeds, as I am sure you can attest to after eating them this past hot summer. Each seed must have its very own individual pollen grain to contribute male genetic information. This is a transportation, logistical gamble. If the honey bee had not done this critical work, the seed would not have been fertilized. If a seed is not fertilized, the watermelon plant is under no obligation to build watermelon flesh around this empty seed site. Commercially grown watermelons cannot have flat sides or funky shapes due to incomplete pollination. Insect pollination is critical.

Grocery stores and consumers have come to expect perfectly shaped fruit and vegetables. The value of flat sided, curved or oblong produce is low or of no value. They may not meet USDA standards and can't be sold at all. They become a disposable waste product.

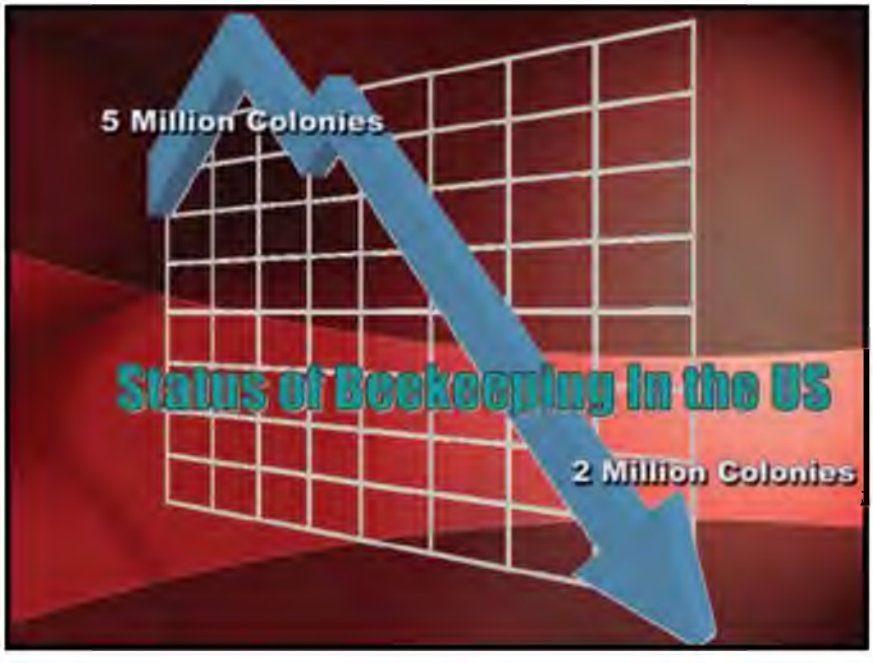
All of this is true. This is what we know.

After several years of reported significant losses of honey bees in the U.S., why aren't they all gone and fruits and vegetables rising dramatically in price or disappearing from store shelves?

The question is what really is the status of honey bees? After several years of reported significant losses of honey bees in the U.S., why aren't they all gone and fruits and vegetables rising dramatically in price or disappearing from store shelves? What is happening globally? What is happening in the US?

I recently came across a couple of reports that I want to share with you that I found interesting; Aizen, MA (2008). "Long-term Global Trends in Crop Yield and Production Reveal No Current Pollination Shortage, but Increasing Pollinator Dependency?" — and Aizen, M.A. (2009) "The Global Stock of Domesticated Honey Bees is Growing Slower than Agricultural Demand for Pollination".

These are actually easier, more interesting



reads than they appear at first glance. Let me see if I can give you the "Reader's Digest" version of these reports.

Aizen asked the same questions we are. Basically, what do all these terrible things we are hearing about the demise of honey bees really mean from a global perspective? If we are running out of honey bees (pollinators), then agricultural production of pollinator-dependent crops should be suffering shortages. Without data this is all supposition. So, where does one find information on global agricultural production? It is and has been collected for decades by the Food and Agricultural Organization (FAO). The data exists and is there. Aizen looked at the period of time from 1961 to 2006 approximately.

Let me share with you first some population numbers I dug out. Based on Census data, the US had a population of 179,323,175 in 1960. Population from the current census which won't be available until April 2011 is calculated to be about 310,000,000. Almost a doubling in 50 years. Canada had a population of 17,870,000 in 1906 and 34,150,000 in 2010. Just about a doubling also. World population was 3 billion in 1960 and 6.8 billion in 2010, which is more than double. That is a lot of extra bellies to fill or partially fill. Where is the food coming from?

Let's look at agricultural production independent of honey bee pollination. These are wind-pollinated crops, the cereal grains, wheat, rice, corn. Then, other food crops such as potatoes and yams. "Many fruit and seed crops require neither pollinators such as peanuts, soybeans and lentils nor targeted pollination like bananas. Others are self-fertile, but insect pollination increases quantity and quality of production, e.g. canola, cotton, peppers, sunflowers and tomatoes." **FAO data shows agricultural production that does not need insect pollination doubled over this period.** This wind-pollinated food production has paralleled the increase in population growth. This took increasing the area of agricultural production, lots more cropland and marginal cropland, pesticides, fertilizer and hybrid seeds. Total agricultural land increased 23% over the last 50 years. Bellies were being filled and human reproduction increased.

With incomes rising in the developed and

developing world and demand for fruits, vegetables, nuts and berries increasing, the land cultivated with pollinator dependent crops increased nearly 100% in the developing world. These are high value crops such as apples, pears, cherries and mangos. The land devoted to pollinator-dependent crops in the *developed world* grew from 18.2% in 1961 to 34.9% in 2006, almost a 100% increase.

> HONEY BEE COLONIES HAVE GROWN DRAMATICALLY AS WELL. HOWEVER, THE 45% GROWTH (GLOBALLY) OF THE NUMBER OF HONEY BEE COLONIES SEEMS PRETTY INSIGNIFICANT TO THE 400% INCREASE IN POLLINATOR DEPENDENT CROPS.

In this same 50 years the number of honey bee colonies in the world for honey production primarily has grown an equally astounding 45%. However, in the U.S. the number of colonies has decreased in the same period of time about the same amount. The U.S. commercial beekeeper could not compete with developing world low cost honey production. Now the U.S. is down to approximately 2.4 million colonies of honey bees. Down from a high of about 5 million 50 years ago. The key is Third World honey producers can produce honey much more cheaply than U.S. beekeepers.

"In modern agricultural systems, intensive farming practices create massive demands for pollinator services by raising crop densities." As an example, the State of California produces 1/3 of the world's almonds. Almond growers need approximately 2 million colonies of honey bees for pollination. They have imported honey bees from Australia to fill gaps left by shortages of U.S. honey bees. If the U.S. has only 2.4 million colonies, there are shortages if there are only 2 million available. Almond growers are looking at alternative pollinators such as Blue Orchard Bees and a self-fertile almond is being developed that may require less honey bee pollination flower visits. Almond pollination is driving the U.S. commercial honey bee industry because by the numbers every single honey bee colony is needed just for almond pollination.

Without managed honey bees in the U.S. "7 out of 60 agricultural crops that are crucial to our economy would be left without honey bee pollination. In Europe 84% of the 264 crops are honey bee pollinated." Managed honey bees and their keepers are vital!

Aizen collected data from FAO which confirms that *globally* farmers have increased production of crops, corn, wheat, rice that don't need honey bees to match the doubling of the Earth's population to 6.8 billion. During the same 1961 to 2006 time frame the demand for **insect-pollinated crops** (apples, cantaloupes and cashews, etc) has **quadrupled**. Honey bee colonies have grown dramatically as well. However, the 45% growth (globally) of the number of honey bee colonies seems pretty insignificant to the 400% increase in pollinator dependent crops.

Let's go full circle now. According to Aizen, there does not appear to be a global honey bee crisis as of yet. Honey bee colonies have increased globally because they are an easy addition to general and specialty agricultural food production. Honey production is easy compared to growing 500 acres of some tree fruit or row crop. Honey

bees for honey production do not require lots of land, fertilizer, pesticides, tractors, combines or people. A developing world farmer can include honey bees as an addition to everything else and increase his income. That is why China is now such a large honey exporter directly and through transshipments from second or third countries. This has severely dented the U.S. honey market for domestically produced honey. Their cost of production is dramatically lower than U.S. cost of production. Globally, this change in honey bee interest has caused the increase of colonies and honey production which, in turn, has negatively impacted U.S. commercial beekeepers who focused on honey production in the past. There were approximately 5 million honey bee colonies fifty years ago and now about 2.4 million. However, this is a minor blimp in the Global colony count. Europe and other developed countries have also shown a drop in colony numbers. These drops are only significant locally or regionally or on a per country basis. Aizen pointed out the huge increase (400%) in fruit, vegetable and nut crops dependent on pollinators in the last 50 years. Growers and beekeepers have adapted to shifting agriculture and its fee-based pollinator needs by shifting honey bee availability and repurposing them from honey production to pollination in and wherever those crops are grown. It is simply supply and demand. Cost of production determines where food is grown. It is a commodity. Commodity sales go to the low cost producer.

I am continuously being told by beekeepers of all levels of interest that the health of honey bees is being neglected by researchers, government agencies and crop growers. I could disagree with this strongly, but by the same token there is no crisis in the U.S. Honey bee biology has made sure of that. If you have two cows and one dies, you can't cut the other cow in half and recover your loss. Have two bee hives, lose one and you can split the remaining one and your loss has been corrected on paper. Lose 1000 colonies out of 2000 and you can recover. This is not a great business model and not efficient, but it works and disguises the actual loss. It allows the beekeeper to keep going and the grower to continue to receive pollination.

Growers of fruit, nut and vegetable crops in the U.S. use a lot of inputs (fertilizer, pesticides, herbicides, irrigation, pollination) to produce as large and as valuable a crop as possible. Honey bees in the form of the pollination input are an expense, an overhead to produce the crop. In the grower's mind this is an input only required for a short few weeks once a year. S/he doesn't really care what happens to the bees the other 48 weeks of the year. Honey bees are an expense like fertilizer. Regardless of all of the gloom and doom of CCD and honey bee health, the capitalist market kicks in and honey bees always seem to be available. Beekeepers, if they want to make money, adjust. The USDA already projects that 40% of our veggies will be coming from someplace else in the world in just a few years and that the U.S. will be a net food importer in the next 50 years. The market is adjusting to the low cost producer.

Are honey bees being neglected in the U.S. because the decision at some level has already been made that we are going to outsource our food supply in a generation? One could argue that the U.S. already has a shortage of honey bee pollinators. This is a temporary problem until all of our food is grown someplace else. If it were not for the Interstate highway system, semi-trucks and diesel fuel to transport honey bee colonies all over the U.S., there would be a significant shortage. Honey bee colonies do not exist in the numbers needed where they are required for pollination. They have to be brought in because there is a shortage. The important question is what can be projected? If honey bee health issues such as CCD are added in—the rising cost of fuel, varroa, nosema and premature colony death—what is the tipping point? What is the point at which the beekeeper can't afford the overheads and the pollinator-dependent growers shift production to Asia, South America or Africa?

THE USDA ALREADY PROJECTS THAT 40% OF OUR VEGGIES WILL BE COMING FROM SOMEPLACE ELSE IN THE WORLD IN JUST A FEW YEARS AND THAT THE U.S. WILL BE A NET FOOD IMPORTER IN THE NEXT 50 YEARS. THE MARKET IS ADJUSTING TO THE LOW COST PRODUCER.

Our U.S. farmers' ability to compete against imported fruits, vegetables and berries from other areas of the world as a specialty commodity is retreating fast. China has thousands of acres of pears that are human pollinated with goose feathers — not enough insect pollinators. They have an advantage short term. It is profitable to have people with feathers pretend they are pollinators?

Aizen says it well, "The relatively slow growth in hive numbers probably cannot satisfy the increased demand for agricultural pollination or mitigate any loss of native pollinators."

It appears that at some point there may not be enough pollinators to satisfy the growing demand for healthy fruits, nuts and berries in some areas of the world. But, other areas of the world, because of cost of production, may step up and fill the gaps. The market will prevail. The market provides what people will pay for. Take a look at country-of-origin labels the next time you are in your Big Box Grocery Super Center. Enjoy!

Marla Spivak
Getting Bees Back on Their Own Six Feet

Part 1 of 2 parts

by M.E.A. McNEIL

Marla Spivak is something more than a bee researcher and professor at the University of Minnesota, but there is no good word that sums her up. If there were, it would apply to people who can pick up a stereogram and see its hidden 3-D picture in the field of abstract images — those who can look at the big picture and pick out ideas that make sense of it, like an athlete who sees a path to the goal through a maze of moving bodies.

Dr. Marla Spivak is as at home in the bee yard as she is in the lab. She is developing the connection between research and beekeepers.

Case in point: a dirty Jeep windshield. Spivak was riding along a Northern California back road, on her rounds to visit queen breeders. She was deciphering the glass covered with Pollock-like patterns of bright yellow bee droppings–dots, stripes and plops. The driver, Dennis vanEnglesdorp, the astute Pennsylvania State Apiarist, joined the game: The little ones, they decided, were from new foragers taking orientation flights, the long ones, cleansing flights from bees that have been cooped up, and the splats were Nosema, a fungal pathogen that causes diarrhea–a problem that they had come to test for. Spivak had brought along VanEnglesdorp for his practical advice in solving the big puzzle beyond the windshield: how to turn back the decline of the honey bee.

Most experts have come to agree that the cause is what Jeff Pettis of the USDA Beltsville bee lab calls "a cumulative effect." The story of Zac Browning, an Idaho commercial beekeeper is typical: Over the last five years, he has increased medications and feed for his bees and still lost a third of his colonies at almond pollination this year. He calls it "a perpetual cycle of diminishing returns." His loss is around the national average, which Pettis calls "unsustainable."

With some researchers charged with the task of finding out what is wrong, Spivak has devoted her career to promoting what's right. She calls her task "getting bees back on their own six feet".

Why bees? In the "stuck places in life," Spivak said, "bees and beekeepers have somehow been there for me. I owe them." For one, when she'd fallen gravely ill while traveling in Peru, the doctor who cured her was a beekeeper, and she took care of his bees while recuperating.

Her fascination with bees had begun in college in Arizona, when she was so deeply drawn into a book about bees that she stayed up all night; she never came out. She interned with New Mexico beekeeper Jerry Cole and, after finishing her BA in biology at California State University at Humbolt, she volunteered at the Tucson USDA bee lab, supporting herself by driving an ice cream truck. "That was an enlightened lab. There was so much good research energy there, it was great–Steve Taber and Martha

Dr. Marla Spivak (center) with her right hand man, Gary Reuter, and graduate student Katie Lee with mating nucs for the Minnesota Hygienic bees. The stock was developed at the University of Minnesota as a prototype for beekeepers, who can now select for the behavior from their own lines. (Photo courtesy of Marla Spivak)

Age-painted bees removing freeze-killed brood from an observation hive for experiments on hygienic behavior done around 2004. (Photo courtesy Marla Spivak)

Harvesting mated Minnesota Hygienic queens from Minnesota beekeeper Darrel Rufer's nucs in Texas in 2004. (Photo courtesy Marla Spivak)

Gilliam; H. D. Spangler was there, too.

"Taber taught people how to think. He was my mentor that way. Every step of the way he would challenge your thinking. How long does it take eggs to hatch? You'd say three days, and he'd say, how do you know that? And he made you go back and question everything you knew, test it on your own. He was a really creative thinker."

She'd eschewed graduate school as "so far removed from reality," but during six months in Venezuela as the beekeeper setting up grad students' experiments for Chip Taylor's African bee research, she was drawn to study Africanized honey bees (AHB). The reputed "killer bee", she could see, "had a lot of good characteristics. They were a smart bee. There was a lot of behavioral variation among Africanized colonies, and therefore probably a lot of room for selection."[1] She spent two years in Costa Rica studying AHB and received her PhD from the University of Kansas under Taylor in 1989.[2]

During her post-doctoral research at the Center for Insect Science at the University of Arizona, she saw a pattern in the decline of the bee that would guide her work until the present: "Despite our tendency to try to control nature, it is not healthy for the bees to be fully domesticated, for them to be totally reliant on us. Since the introduction of Varroa mites, we have made our European-derived bees chemically dependent on our medications for their survival, and this is not a wise strategy. Bees really need to develop their own defenses against diseases and parasites."[3] What she calls a co-evolutionary arms race with pathogens serves as a selective process, allowing for the emergence of traits to combat infection.

Taber and Gilliam, at the USDA lab in Tucson, had picked up on old work on hygienic behavior of bees: Park and Pendell saw the trait in the 30's. In 1942, Woodrow and Holst reported observing bees uncapping and ridding the hive of larvae with American foulbrood in the latent, non-infectious state–with the spore-carrying adult bees not infected. Rothenbuhler picked up the research in the 50's, coining the term "hygienic behavior". He knew that it did not sort out cleanly as a Mendelian trait, but not how it is controlled by a number of genes in a complex way. It was not until the 80's that Taber reexamined the behavior, and he and Martha Gilliam found that it produced resistance to chalkbrood as well as foulbrood.

"I decided to ask, said Spivak, "Is hygienic behavior a mechanism against Varroa and why hasn't anybody selected lines for it? Is there a problem with this trait? We've known about it since 1930; what's going on here? Is it because it's just easier to treat with antibiotics or does this trait compromise honey production or make the bees neurotic or what? So I decided to breed these lines just to look at the behavior."

She took her quest to the University of Minnesota, where she became an assistant professor in 1993. In a group of honey producers interviewing her for the job, American Beekeeping Federation president David Ellingson recalled that "She looked at the whole picture and she had this vision of something that would work." Asked about mites, "Marla said the resistance would build up. Boom! Just like that, it happened."

She came at the problem with scientists – chemists and ecologists, as well as a neurobiologist exploring the neuromechanisms that modulate bee behavior. She and Gary Reuter, her inventive technician, developed what is known as the Minnesota Hygienic line of bees – gentle, productive bees that detect and rid the nest of infected brood before pathogens can spread.[4]

Presenting the work, "I noticed everyone's glazed eyes when I was done," Spivak said. "Finally one gentleman stood up and very politely asked, 'How does a little thing like you lift those honey supers anyway?' I realized they didn't hear — and didn't understand — my words because they couldn't make the connection between me on the podium and me in the bee yard. I found it to be a genuine question, and funny, and I learned from it."

Liquid nitrogen testing for hygienic behavior in Darrel Rufer's colonies in 2005 at one of his apiaries in Minnesota, where he brings his colonies for the summer. Abdullah Ibrahim, left, and Kathy Jez are former grad students. The N2 freeze-kills the circle of brood, which is checked in 24 hours to see what proportion are removed by hygienic behavior. Rufer's open-mated colonies now test as well as the original instrumentally inseminated Minnesota Hygienic line.

Gary Reuter working with Minnesota beekeeper Jeff Hull on selection for hygienic behavior on his hives in Louisiana. The trait is now strong in Hull's bees.

Working with the beekeepers, Spivak and Reuter set up field trials in Minnesota and North Dakota to test the bees under commercial pressures. Ellingson, among the first to try the new line, found that he was able to reduce the miticides he used. In addition to support from the The National Science Foundation, USDA Sustainable Agriculture Research and Education, and the National Honey Board, backing for the work came from the beekeepers themselves – honey producers from Minnesota and Wisconsin, beekeepers' associations of North Dakota, South Dakota, Iowa and California.

The stock had an olfactory ability to identify American foulbrood, chalkbrood and Varroa, which it removed. In 2001, a cross was made with the VSH (Varroa Sensitive Hygiene) line created by John Harbo and Jeffrey Harris at the USDA Baton Rouge lab. That further reduced mite loads and increased the degree of hygienic behavior.

Spivak's goal was never to produce the uber-bee: "I didn't want to promote a monoculture." The idea was to demonstrate the trait with the goal that "beekeepers can select from their tried and true lines." She was asking others to take the pattern, not the product.

Handing over this project was the next step in the vision. Its one thing to create an instrumentally inseminated line and quite another to put it out to the vagaries of open mating. But three Minnesota queen producers now breed naturally mated colonies that, Spivak is delighted to tell, test as well for the hygienic trait as the instrumentally inseminated queens from the University breeding project.[5] It is a notable accomplishment, given that half the genetics of any given beekeepers' open-mated colonies come from the bees of other apiaries. Because the hygienic trait is recessive, it takes an environment of drones bred for the behavior to create such a phenomenon. Sweet success.

Spivak teaches several courses at the University, including basic beekeeping, which has been taught there since 1922. She took over from the respected Basil Furgala and still follows his practices, which she has found to be "so sound; a great way to keep bees." Disease management in the course, though, has changed; preventative practices trump prophylactic treatment. Some of her classes are open to the public, including bee management, queen rearing, and a web class, "Healthy Bees".[6]

Attention from the University for her work has benefited her goals. She wears the honorific title Distinguished McKnight Professor lightly, but she relished the invitation to teach a credit course of her choosing. She created Entomology 4021: Honey Bees and Insect Societies, which focuses on cooperative behaviors of social insects. It was a prescient choice to delve into the evolution of individual and social behaviors, given her larger goal of keeping honey bees healthy. At a scientific meeting, she attended a talk on European ants that reduce bacteria in the ant mound by bringing in resin globules. "I thought, oh, of course. I was sure that was what the bees were doing with propolis," she said – an example of social immunity.

Many species of bees have long been observed collecting and using resins as propolis. The few honey bee resin foragers pack resin on their corbiculae like pollen. It is unloaded by other bees with effort, mixed with wax and used by "cement bees" for sealing cracks, creating smooth surfaces to attach comb, entombing predators. Feral colonies line their nest interior with a "propolis envelope". A large body of research for human medicine has established that propolis has antimicrobial properties. But how it affects the microbes in the hive or the immune systems of the bees had not been explored.

"My graduate student, Mike Simone-Finstrom and I had to gear up to understand how to study that kind of thing in honey bees. I asked for help from Jay Evans at the Beltsville bee lab, the expert in the U.S. on the bee immune system," said Spivak.

What they found is that in the presence of propolis, the bees' immune system is quieter – because, it appears, the propolis takes over the job of killing general microbes in the nest. To determine this, Simone-Finstrom was able to measure the amount of gene transcript producing antimicrobial proteins in the bees. He found a significantly lowered expression of two honey bee immune-related genes and lowered bacterial loads in the propolis-treated colonies. They cite this as the first direct evidence that the bees' nest environment affects immune-gene expression.[7]

An intriguing phone call from a technician at a med school HIV lab inspired a new exploration of propolis. Spivak's caller had treated a cold with propolis, as she had learned to do growing up in Russia. She re-

Spivak's lab investigated the beneficial use of propolis by bees. In feral colonies, bees secure comb to the hive wall with propolis. As seen here, the attached cells will sometimes also have a thin coating of propolis. (Photo: Michael Simone-Finstrom)

A resin forager returns to the nest to a "cementing site", where workers will laboriously unload it and mix it with wax to be used as propolis. Spivak and her colleagues have shown that the antimicrobial properties of propolis quiet the immune systems of the bees. Here, propolis can be seen at the tops of two frames. (Photo: Michael Simone-Finstrom)

Jerry Cohen is a plant biologist at the University of Minnesota who is working on a collaborative project with Marla Spivak to find the active antimicrobial components in propolis. (Photo courtesy of Jerry Cohen)

ported that she'd then experimented with it in a Petri dish against HIV, which it successfully killed. "I wondered how to pursue it," said Spivak. "I don't do human research. And then it dawned on me — it was one of those moments — that we shouldn't do the work on humans, we should test propolis on bee diseases."

Her idea was to fractionate (break up into smaller chemical components) the propolis, identify and then test the components against various bee diseases. Once the active ingredients were known, they could be tested for humans. She enlisted two of her colleagues from the first propolis study, Jerry Cohen and Gary Gardner, chemists and plant biologists, and they came up with the methods to do the analysis using propolis from a variety of sources.[8] They can, for example, culture American foulbrood, put a component of propolis in the solution and measure the optical density: It is dense when it is full of bacteria and clears as they are killed. They are able to run these samples rapidly.

But viruses can't be cultured, Spivak explained; they have to be studied in the bees. So the team reared infected larvae in an incubator and fed them royal jelly with different concentrations of propolis.

Cohen thinks the fractions contained in propolis may number ten times the 300-500 in the current data. Graduate student Mike Wilson hopes to isolate antimicrobial properties, keeping in mind that in humans there is growing resistance to antibiotics, most of which come from fungal sources.

"Within several years we'll have identified fractions that are active against bee pathogens for sure," said Spivak. "Of course, a long-term hope is that after testing propolis components on bee diseases and viruses, we can find components that would be helpful to treat human viruses, particularly an inexpensive treatment for HIV for developing nations." And "beekeepers may be able to diversify their income by harvesting and selling propolis."

To get to that point, Spivak wanted to better understand this tiny minority of resin gatherers who bring such benefit to the colony. Graduate students Simone-Finstrom and Joel Gardner have determined that these specialists are more sensitive to tactile stimuli such as gaps and rough surfaces. They sense sucrose at greater dilutions than pollen foragers. How the researchers discovered these characteristics, described in their paper, is as interesting as the facts they gleaned.[9]

Each new understanding prompts more questions. Experiments are underway to find out: If propolis has an effect on Varroa; if propolis changes the bees' immune systems when disease is present; what prompts resin foraging (do bees self-medicate?).

At the same time, Spivak is pondering a larger question: How can these ways that the bees help themselves benefit a wider population? She surprised herself with the simplicity of her answer. In Northern California, where most of the queen bees are bred in the continental U.S., a technical team could be established – like farm advisors for beekeepers, a liaison between producers and researchers. As she rolled through the countryside that afternoon contemplating the evidence on the windshield, Spivak was on her way to making the idea a reality.

Part 2 of this article describes the establishment of this new advisory team as well as Spivak's projects to place bees in land reclamation areas and establish a new bee lab at the University of Minnesota.

Footnotes

1 Her measured interview on the television show MonsterQuest last June provided balance to the goal of the program to induce fear.

2 See Michael D. Breed, David J. C. Fletcher, Marla Spivak *The "African" Honey Bee,* Westview Studies in Insect Biology, 1991. 435 pp.

3 Spivak, Marla, "Bee Health: Putting Control in Last Place", The *American Bee Journal*, November, 2008.

4 Spivak, Marla and Gary Reuter, "New Direction for the Minnesota Hygienic Line of Bees", The *American Bee Journal*, December 2008, 1085.
Spivak, Marla, Gary Reuter, Katie Lee, Betsy Ranum, "The Future of the MN Hygienic Stock of Bees is in Good Hands!" The *American Bee Journal*, October 2009, 965-967.

5 Darrel Rufer (612) 325-1203; Mark Sundberg (218) 721-5942 mdsund2000@yahoo.com; Jeff Hull (218) 205-6426.

6 University of Minnesota public bee classes: www.extension.umn.edu/honeybees/components/publiccourses.htm
Beekeeping in Northern Climates; Successful Queen Rearing; Bee Management, a 3-week, hands-on course that includes management of honey bees and native bees, including bumblebees and blue orchard bees. A web-based course called "Healthy Bees" teaches sustainable methods of controlling diseases and pests of honey bees.

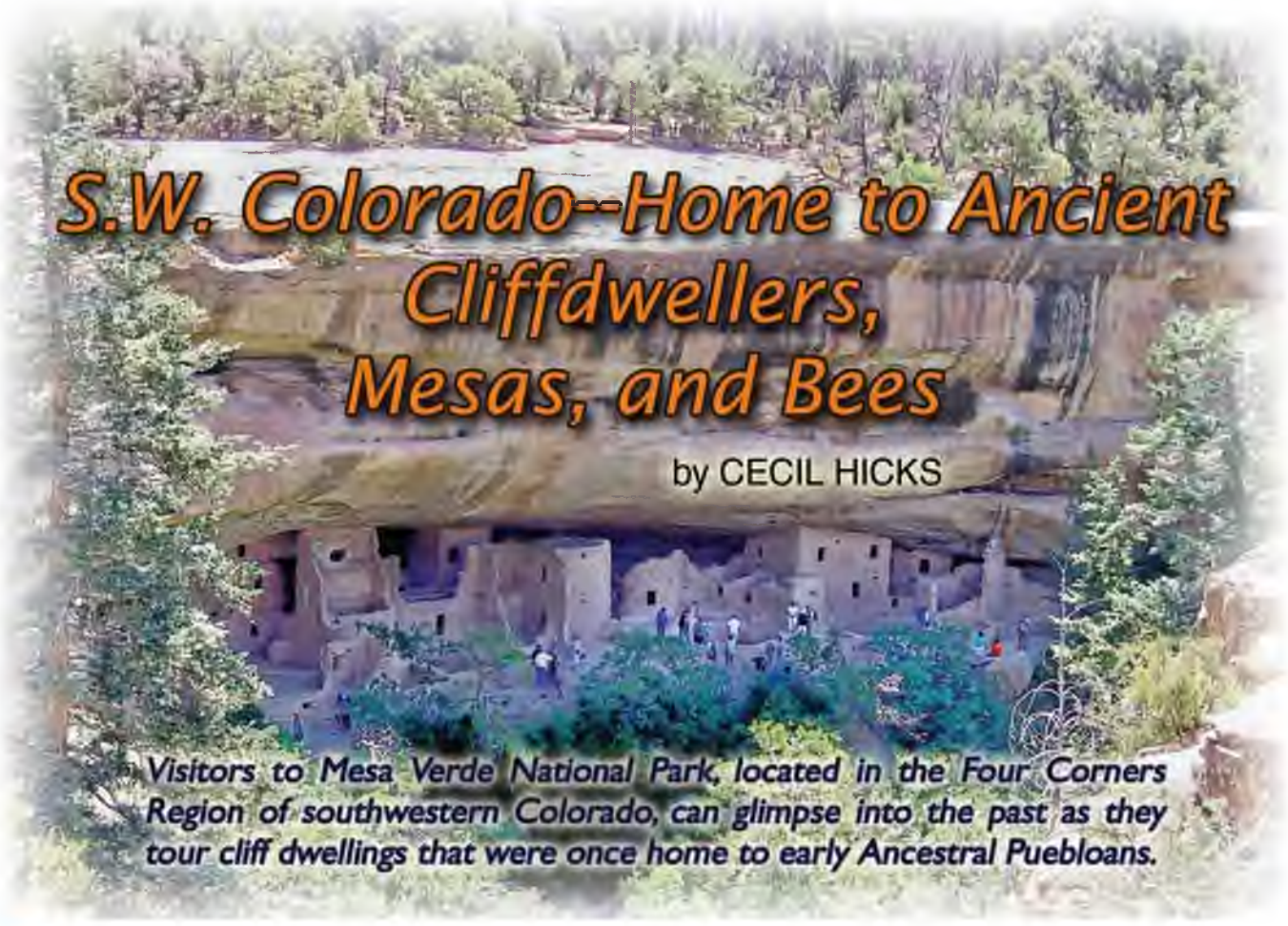
7 Simone, Michael, Jay D. Evans, and Marla Spivak, "Resin collection and social immunity in honey bees", *Evolution* 63-11: 3016–3022.

8 The collaborative project included PhD students Jessica Burtness and Mike Wilson, University of Minnesota Department of Horticultural Science.

9 Simone-Finstrom, Michael, Joel Gardner, and Marla Spivak, "Tactile learning in resin foraging honeybees", *Behavioral Ecology and Sociobiology*, April 2010

S.W. Colorado--Home to Ancient Cliffdwellers, Mesas, and Bees

by CECIL HICKS



Visitors to Mesa Verde National Park, located in the Four Corners Region of southwestern Colorado, can glimpse into the past as they tour cliff dwellings that were once home to early Ancestral Puebloans.

Geographically speaking, the region west of the San Juan Mountain Range in the Southern Rockies in southwestern Colorado is part of the Colorado Plateau and the waterways of the area all drain into the Colorado River. The region was also once home to an ancient Anasazi civilization that existed between 2,000 to 700 years ago. For centuries these early Ancestral Puebloans' built stone homes on mesas and high desert shrub lands. They later moved into cliff dwellings until abandonment.

A glimpse into the past lifestyle of these early Ancestral Puebloans can be seen in a visit to Mesa Verde National Park that is located a few miles southeast of the farming town of Cortez (population 8,000) in the

Commercial beekeepers, Gary (right) and Brad Milligin, stand in their honey extraction room where they also store bee boxes. In recent years they've started painting bee boxes green as opposed to the traditional silver.

Gary Milligin, the family's first generation beekeeper and the honey farm's official candle maker, shows some of the finished products he makes. He normally melts about 3,000 pounds of beeswax per year making candles that are sold at regional arts and craft shows, farmers markets, on line and at retail outlets.

Welcome to the Milligin's Bee Farm at Lewis, Colorado. Brad (left) and Gary stand in front of the door to their extraction room.

Gary (in the foreground) and Brad extract about 150 barrels of honey per year from some 2,000 beehives. The Milligin's Bee Farm has been in business since 1969.

Four Corners Region where the states of Arizona, Utah, New Mexico and Colorado meet.

The main farming crops raised by these early inhabitants were corn, beans and squash that was supplemented by gathering wild plants and hunting wild game.

With the arrival of settlers into the region in the late 1800's, agriculture shifted largely to cattle ranching in the surrounding rangeland which consisted mostly of grass and desert land shrubs. The town of Cortez sprang up when large-scale irrigation projects began in the region in the 1880's and workers needed housing.

Today, this corner of Colorado has both a large dry-land farming area, as well as an irrigated region. At one time pinto beans were the main crop raised, however with the arrival of water, a variety of different agriculture crops prevailed on the farms including various hay crops (primarily alfalfa and clover).

The largest commercial beekeeper in the area is Brad Milligin of Lewis, Colorado. Lewis is a small farming community located some dozen miles north of Cortez along Hwy 491. It would take about three to four seconds for a car driving the speed limit to pass through Lewis, which consists solely of a gas station, a convenience store and a post office. The elevation of this rural area of Montezuma County is 7,000 feet.

Brad, a second generation beekeeper, owns Milligin's Honey Farm and runs between 2,000 to 2,200 beehives. He is a member of the Colorado State Beekeepers Association and the American Honey Producers. He lives with his wife Kaari and their four children (ranging in age from 19, 18, 12 and 9) on a small 35 acre irrigated farm about a mile from Lewis. Kaari maintains the household and handles the books, supervises honey sales at farmers markets and craft shows and makes lip balm and hand lotions.

While he raises and irrigates a grass hay crop on his own land, another local farmer cuts and bails it. Brad said that the farm is located at about the border between where irrigation farm land ends and dry land farming begins. There's also some CRP land set aside in a government reserve land program in the area. Irrigation water for their region comes from McPhee Lake (the second largest lake in Colorado) that is located east of their property a few miles just below the San Juan Mountains.

Brad said they're lucky if they get eleven inches of rain per year. Although, they do get two to three feet of snow on the ground during the winter months.

At the age of 70, his dad Gary, the family's first generation beekeeper, is semi-retired but calls himself "the candle maker" and runs the candle-making operations in a separate room constructed inside in the beeshop. Gary claims he'll usually goes through about 3,000 pounds of beeswax a year making candles. These candles are then sold at a retail outlet store in Durango, farmers markets, craft shows and also on line.

Gary explains that due largely to health issues with his legs he couldn't handle the rough ground any more and had to stop working bee yards. During the summer months he and his wife Sharon live in a parked fifth wheel at the farm, but when the weather turns cold, they haul the RV to warmer weather in Arizona for the winter.

Gary first began beekeeping in 1969 when he bought 53 hives. At one time he built up his business to where he had 3,300 hives, but he explained, "It was just too many hives and he had to cut back." Before buying his own bees, however, he gained experience while working for another beekeeper for a year and a half. Gary said he was fortunate to find a "jewel" of an instructor to follow around and learn about beekeeping.

As a child beginning at the age of 8 or 9, Brad said he had no choice, but to help with his dad's bees. Then, as a teenager he began supering in the yards. As a young adult Brad's career choice was law enforcement instead of beekeeping. In 1991 he trained 16 weeks at the Colorado Law Academy and began working as a deputy with the Montezuma County Sheriff's Office in Cortez, Colorado.

Seven years ago, after 15 years of working in law enforcement, Brad chose to drop out of police work and help his dad with the

Their bulk honey tank holds 15 barrels of honey. From the large flow spouts they can fill a 55 gallon drum in ten seconds.

Brad stands in front of some 7,200 supers stacked and stored in their bee shop.

bees. Prior to that time his dad had retired from beekeeping and sold his bees. However, the contract wasn't being fulfilled with the person he'd sold the bees to, so he had to repossess the bee operation and take the bees and equipment back. He needed help, so that's when Brad joined him.

Brad said he really missed being a police officer, so he recently made a decision to return to police work, but now with the Cortez Police Department, but he still works the bees as time permits. In order to do so, he had to hire two full-time beekeepers to replace him.

During the first week of May 2010 Brad was complaining about the cold weather still lingering in the area. The previous week the overcast skies dropped several inches of snow onto the region and put him behind with his nuc making. He was also waiting for the dandelions to start blooming once it warmed up as they are the first wildflowers of the season.

Thirty days later Brad was again commenting about the weather when temperatures in early June soared into the mid 90's. He said, "I don't know what happened to spring it seems like it went from winter to summer, although it did jump-start the honey flow season. Usually during a normal spring the weather's good and the summer season extends from Memorial Day to Labor Day."

However, this year the cold, wet spring forced him to have to buy a load of syrup to feed his bees.

Brad ships his bees via six to seven contracted semi-trucks to the almond orchards around Fresno, California each winter and said although it was wet there this year, his bees did quite well. "I sent only good healthy hives including some weaker hives that were combined and they came back in good shape."

Brad said there are some wildflowers in the area, but there are not a lot of agriculture crops that can be grown at the high altitude of Lewis. He said farming in this area is mostly alfalfa and clover. Besides setting yards in area hay fields, the past couple of seasons he's set bees on the 5,000 acre farm owned and farmed by the Ute Mountain Indian Tribe on the Ute Indian Reservation near the New Mexico border. On this farm they grow about 400-500 acres of a hybrid sunflower seed that is shipped to Europe, and they need the bees for pollination.

The pollination of the sunflowers begins about mid-July on tribal farm lands. He said these pollination contracts provide a nice added income above and beyond his honey production sales and almond pollination in California.

Currently, he sells most of his honey (approximately 150 barrels a year) wholesale by the drum to Honeyville (the largest local packer and honey retail outlet marketer located near Durango since 1918). He also sells extracted bottled honey, beeswax, candles, lip balm and hand and body lotions (made by Karri and Sharon) locally at a Farmers Market in Durango, plus on line through their website www. thebeetree.com.

When they sell honey at the farmer's market, it is priced at $5 per pint; $10 per quart; and $95 per 42 lb. bucket.

Although the family normally handles the sales at the Durango Farmers Market during the summer months, they opted not to sell honey at the local Cortez Farmers Market, thus allowing another smaller regional beekeeper the sole opportunity to sell at this venue. They do, however, place honey at several retail sales outlets in Durango and around the Four Corners area.

They also attend two large craft shows in Las Vegas, Nevada in the spring and fall to sell their honey wares. Brad said that at these shows they also sell additional honey products (in a joint-promotional effort) supplied by Honeyville, owned and operated by the Culhane family.

Brad said the Milligin's have a strong beekeeping connection with the Culhanes (Danny, his wife Sheree and son Kevin). In 1990, when the Culhanes opted to modernize their Honeyville plant and concentrate on selling honey products out of their Durango-area store, they sold their 1,500 beehives to Gary Milligan.

As a commercial beekeeper, Brad said one negative part of sales is the amount of local phone calls he and his family received by people asking for honey. In order to eliminate these unsolicited phone call requests for honey all winter long, six years ago the Milligins decided to hold a one day only (on a Saturday in September) once-a-year Bulk Honey Sale. They place ads in the local newspapers (*The Durango Herald* and *The Cortez Journal*) and via strong word of mouth. People are given directions to their beeshop and told to bring their own containers.

Brad said last year they sold about 4,000 pounds of honey in one day at a discounted price of $2.25 per pound as people supplied their own containers. The only problem was the dual large spouts on their 15 barrel stainless steel holding tank that is capable of filling a 55 gallon drum in ten seconds. "We had to use funnels in order to fill all the milk jugs, mason glass jars, buckets and even ziplock plastic bags. Most folks brought containers for themselves, as well as for their neighbors and relatives."

Brad said from the time they opened and began to pour honey, there was a constant flow of customers all day long and at times there would be at least a couple dozen people waiting in line for honey. "To say the least, this honey sales promotion idea is extremely popular."

The Milligin's beeshop is a large 55 feet by 75 feet metal building. They later added an extraction room (set up with a 120 frame

(l) Commercial beekeepers, Gary and Brad Milligin from Lewis, Colorado, lean against one of their flat-bed bee trucks in front of their large bee shop. (r)Brad checks one of his 65 bee yards that are located in three counties of southwestern Colorado. Note the solar-powered electric bear fence surrounding the yard. The Colorado Fish and Game Department provides bear fences for commercial beekeepers as part of their bear management program.

Cowen extractor) and a hot room. The storage warehouse, with its 35 feet high ceiling, this spring held more than 7,200 supers. They've also constructed a candle making room inside the beeshop.

Brad said one of the strong selling features for them buying their farm was the large already constructed warehouse with its high roof that would be good for storing honey supers.

For bee hauling and moving equipment they have three bee trucks; two one tons and one two ton. They load hives with a standard Swinger 110 fork lift.

Brad said that normally by the first week in June they've began supering their yards, but this year the first super didn't go out until June 16th. They have 65 bee yards spread out in a three county-wide area located across southwest Colorado. Brad said they'll place 32 hives in each yard and they try to check on them about every 10 days to two weeks. "If the bees are looking good and I think it might be some time before I get back, I'll place two supers of the hive instead of one."

Brad explained that about 80 percent of all their beeyards are surrounded by electrified bear fencing charged by solar-power. He said if the weather is dry they have black bear problems, but when it is wet not so much. The hot weather kills off the high mountain wild berries and the bears come down looking for food. He said the fencing material including the fence wire, posts, and solar chargers are supplied to commercial beekeepers by the Colorado Fish and Game Department as part of their bear management program.

Three years ago was a bad bear year and that season they lost about $20,000 worth of honey and damaged hives. "That year we even had a black bear crawl into our beeshop through an opened screened window. He must have been attracted to the lingering honey smell, although we didn't have any full honey boxes in the shop at that time."

Brad said that for the past 40 years Milligin's Honey Farm has beat the Colorado state average of 72 pounds of honey per hive.

As their bee boxes and supers wear out, Brad said they've started replacing the old oil-based silver paint with a green latex paint. "It's less expensive as we had to find ways to watch our budget and there are less fumes which allows for painting inside. The last silver paint I bought cost $55 per gallon. Besides I was bored with the silver color."

Another money-saving feature is when the semi's return from dropping off bees in the almond orchards of California—they return carrying newly purchased pallets from the Fresno area instead of returning empty. Brad said they've also found it is cheaper to buy pre-made pallets and lids instead of making them.

Although they've had no major bee losses in the past four to five years, according to Brad, they've lost about 1,500 hives during that time period due to usual hive management problems and other new and unknown problems. These losses figure out to about 10 to 20 percent.

As if Brad Milligin didn't have enough to do between his family responsibilities and activities, beekeeping work and police officer duties, he's also County president of his local Colorado Farm Bureau chapter. Some folks might say he's "busy as a bee," but in his case it would have to be a southwestern Colorado bee.

SICK BEES

PART 2

A Model of Colony Collapse

by RANDY OLIVER
ScientificBeekeeping.com

Over the past year, I have watched the experimentally-induced collapse of an apiary. The experience has helped me to understand the progression of colony collapse due to multiple parasite infection.

The California Trial

Last year I was approached by Nitzan Paldi, chief technology officer of the Miami-based company Beeologics (and a beekeeper himself), to run a trial of their new product Remebee™—an antiviral drug that targets Israeli Acute Paralysis Virus (IAPV), and to some extent the closely-related Kashmir Bee Virus and Acute Bee Paralysis Virus. Remebee works by activating the bees' natural antiviral immune response (via RNA interference; Maori 2009). The treatment had previously been demonstrated to help protect bees from IAPV in both cage and field trials (Maori 2009; Beeologics, unpublished), so the company funded two concurrent long-term controlled trials in Florida and California, following a strict FDA-approved protocol.

I ran the California trial, assisted by local beekeepers and monitored by Dr. Eric Mussen, in the Sierra foothills at 2600 ft elevation, where we have a cold, wet, snowy winter (we intentionally wanted to cold stress the bees), followed by a hot, dry summer.

We started in late August by homogenizing, splitting, and then meticulously equalizing colonies at my *Nosema ceranae* test yard into 72 single deep hives. We requeened each hive with a fresh sister queen from a producer whose bees had not been exposed to varroa (in the expectation that they might lack resistance to viruses).

The trial site took place on an organic farm surrounded by wildlands, so that agricultural chemicals would not be a factor. I had not used synthetic miticides for 10 years, and most combs were of recent origin, so comb contamination was minimal. I purchased Apistan strips, and treated for two brood cycles prior to the start of the trial in order to eliminate most mites. For the next several weeks we equalized for strength and weight, fed syrup and pollen substitute, and replaced any poor queens with reserves from nucs in the yard, made from the same hives. Each colony received one dusting with Terramycin. The hives were color coded, and arranged into three circular groups of six sets of four hives, each group rotated 30 degrees, so that all treatments received equal sun/weather exposure.

The hives used had largely not been moved for two years (a few had gone to almond pollination), and had been largely untreated for nosema the past season except for a single feeding of fumagillin the previous fall. Average spore counts had run in the 2-

The California crew weighing and grading colonies for strength in the Remembee™ virus treatment trial, prior to inoculating the hives with the virus cocktail. The two beekeepers in the far back are waiting for foragers to return so that they can take samples to test for *Nosema ceranae*. Photo by Eric Mussen.

10 million range (entrance bees) for about two years, but the colonies were thriving and had made a good crop of honey.

The trial began on September 30. We weighed each hive, and two inspectors graded every frame independently for bee coverage. All colonies were in good shape (one was removed due to queenlessness), with plenty of brood, stores, and fresh pollen. We then began a feeding program in which each colony received a half liter of 2:1 sugar syrup each week—one test group receiving Remebee each week, one every 4 weeks, and a control group fed only syrup. We fed for 20 treatments, with a break during the coldest weather when the colonies wouldn't take syrup (for those of you doing the math, that means that we painstakingly mixed treatments for some 1400 feeder jars).

Concurrent with the field trial to this point, I ran cage trials in an incubator in which I inoculated bees with a virus extract (cultured in pupae that we had hand injected with squashed bee juices from lagging colonies in my operation). The virus extract did not cause noticeable bee mortality in the cages, so collaborator Dr. Wayne Hunter supplied a purified virus "cocktail" (mostly IAPV) originating from sick colonies from beekeeper Jeff Anderson's commercial operation, which had suffered CCD in California the previous year. This strain finally appeared to cause a sudden spike in mortality at about 9 days in some, but not all, cages (this incubation period was confirmed by Dr. Hunter in Florida). We now had a viable, virulent virus (say *that* three times real fast) inoculum on hand and were ready to roll!

So at this point we had 71 equalized, apparently healthy colonies at 6-frame minimum, still actively rearing brood in late November, with few of the common CCD suspects present:

- The bees were well fed, with natural pollen in the combs,
- Mite levels were low,
- *Nosema ceranae* was present, but the colonies had been building well.
- Each hive had a fresh young queen of good stock,
- There was no known exposure to insecticides or fungicides (notably no exposure to neonicotinoids),
- There was presumably no comb contamination from miticides, other than the small amount of fluvalinate from the Apistan strips,
- The hives had not been trucked, and the apiary was not crowded,
- Oh, I doubt that it is important, but all groups were equally exposed to any cell phone radiation.

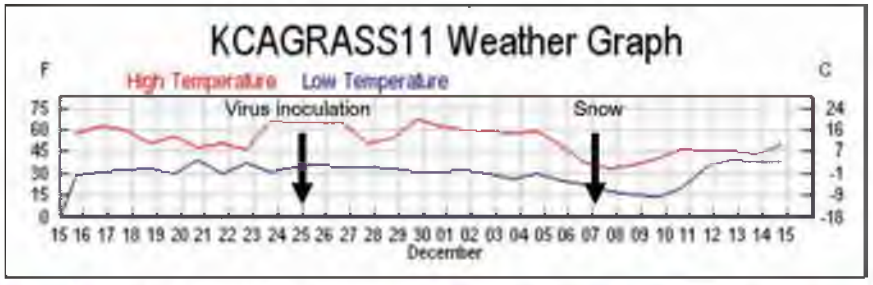


Figure 1. A hive showing evidence of recently having had five large frames of brood, but which suffered collapse in mid May (nearly five months after the virus inoculation). This colony reached the "starvation" stage due to its inability to muster a field force—there was little honey or pollen in the combs, despite plenty of forage available.

Things were about to get interesting! On November 25(Day 0) we inoculated all the hives with the virus cocktail in the syrup feeder jars. The last part of November was unseasonably warm, and the bees had been flying, gathering pollen. There was fresh egglaying in the three colonies that we checked on inoculation day.

The weather turned cold two weeks later, and snow fell the night of Day 12, which prevented noticeable bee flight for two days. On Day 14, there were handfuls of dead bees in the snow on the landing boards of many colonies—the dead bees were full of nosema spores. ***Upon inspection, these colonies appeared to have lost much of their population in the 12-day period between virus inoculation and the start of the snow***, since there were not enough dead bees present in the hives to account for the drop in population. This observation suggests that the bees had sickened quickly from the virus and abandoned the colony prior to the snowfall.

By Day 21, a number of colonies were in full collapse, and some were dead within a week. Since we didn't have any formal uninoculated controls, I checked the few extra nucs that I had taken from the yard to a nearby location—they were not suffering mortality. Neither were any of my other several hundred colonies within the county. It was clear to me that things had started to go badly only for these colonies that received a virus inoculation. (I did not ask until the trial ended, but things went similarly in the concurrent Florida trial).

We discontinued Remebee treatments on February 24, which left all the remaining colonies on their own to fight the viruses. It continued to generally be cool and rainy, with weekly snowfalls until the end of May, but there were continuous nectar and pollen flows from the last week of February on. Colonies that could maintain enough field strength put on honey most weeks until the end of the trial in July. ***Despite the generally favorable conditions, many colonies were either unable to build up, dwindled, or collapsed suddenly despite having good sized broodnests (Fig.1).***

The queens and nurse bees made heroic, but often futile efforts to expand the broodnests. It was heartbreaking to watch the dramatic losses occur in slow motion, despite conditions that afforded excellent forage, but it gave me valuable insights into the process of collapse.

Treatment with Remebee

This article is about colony collapse, not about the effect of Remebee, but as you are likely curious, I will give you a sneak preview. I was blinded until completion of the experiment (and have only recently received the final stats), but it wasn't hard to tell dur-

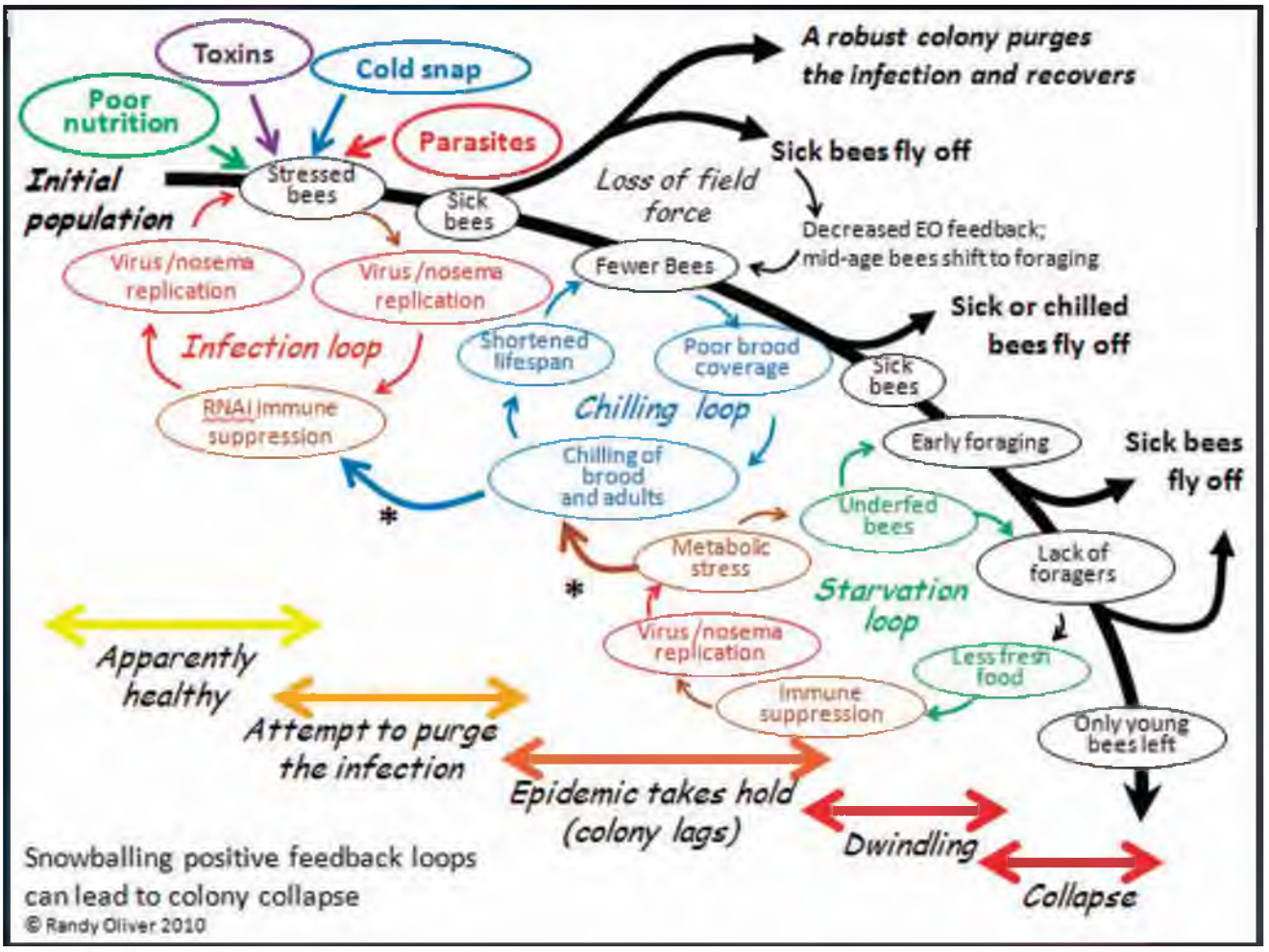


Figure 2. A tentative general hypothetical model of what occurs during colony collapse due to infection by a parasite or combination of parasites. Note how the positive feedback loops play into one another (asterisks), and can result in either rapid depopulation or slow dwindling. The three feedback loops are shown separately for clarity, but in actuality overlap. I've color coded each of the factors to help illustrate their interactions.

ing the trial which group did not receive treatment! ***(This observation strongly supports the hypothesis that the critical factor that took the colonies down was indeed the virus).***

Although many of the colonies were unable to handle the combination of cold weather, *N. ceranae*, and the virus cocktail, ***those that received Remebee substantially outperformed those that didn't receive treatment. The treated colonies were stronger and produced more honey.*** Unfortunately, I can't yet tell you how well Remebee would have performed under "normal" circumstances, with stronger hives and a more realistic exposure to viruses, or had we treated for nosema. Had they started out as strong as I generally overwinter colonies in my climate, I suspect that more would have been able to shake the infection and rebound.

A Hypothetical Model

In order to make sense of a phenomenon, it often helps to attempt to create a model that explains your observations. I've attempted to do just that in Figure 2. In the diagram I have tried to incorporate (as simply as possible) the major stages of colony collapse that I observed in this trial, in my previous experiences, and from reports of others. ***I also attempted to illustrate three major positive feedback loops that I feel are involved in the collapse process.***

In positive feedback loops, an initial push away from equilibrium leads to a self-amplifying chain reaction (as with, for example, explosives). ***In colony collapse, the normal colony-level immune response to a parasite infection can go haywire if it is not successful at purging the infection, and then snowball into the rapid depopulation of the hive.*** The collapse can take place in a matter of days, but generally progresses over several weeks or even months, largely dependent upon weather and temperature.

Please refer back to the diagram as I go through each of the stages of collapse. The model begins in the upper left hand corner with a healthy colony being subjected to the stress of one or more of the "Four Horsemen of Bee Apocalypse" (see my previous article), and then progresses through the cascade of events that can result in either recovery, stagnation, or full collapse. The path to collapse could initiate with any of the stresses, and its resulting feedback loop, but it generally takes some combination of Horsemen to bring down a colony, and a multiple parasite infection to thwart the normal recovery of the colony from stress. I will go into more detail in subsequent articles.

The "Healthy" Colony

Every hive (and perhaps every bee) deals with parasites, especially viruses. As I mentioned in the last installment, our bees have not yet come to terms with all the new parasites that have invaded hives in the past few decades, and even the equilibrium with well established parasites is constantly changing. ***In general, though, a colony can simply outbreed the parasites***—Lloyd Harris' (pers comm.) data indicates that a healthy colony's population can grow by 10,000 every 12 days during the spring growth phase!

With all those ready replacements, then the most important thing is for the bees to exhibit behaviors that minimize parasite

transmission to the replacement bees. Hygienic bees actively remove sick larvae and pupae, and if they do so before the parasite generates infective spores or virions, they can often "shake off" the infection (unfortunately, varroa works against them by serving as an active vector of several parasites, notably viruses). It appears that if a nurse bee itself gets sick, then it quickly shifts to foraging duty, apparently so as not to infect the brood or queen with the parasite (Dr. Gro Amdam, pers comm).

How about older bees that get sick as adults (this includes those that became infected as larvae or pupae)? Just as bees fly outside to defecate in order to avoid fouling the hive, evolution has hard wired in a similar behavior called "altruistic suicide" in which sick or aged bees use their last bit of energy to fly (or crawl) out to die. I'm not sure that "suicide" is really the right word, since the bees appear to engage in foraging behavior up to the end, but with a vengeance—they'll forage even in poor weather that would keep healthy foragers indoors.

There is a substantial adaptive advantage to such a behavior—by removing its sick or aging self from the hive, a bee saves its sister undertakers considerable work, plus more importantly, removes its pathogen-ridden corpse from the hive environment. This process can be very effective at "purging" a colony of infected bees. The self sacrifice of those bees allows the rest of the colony to recover and survive. This phenomenon takes place, largely unnoticed by the beekeeper, on a regular basis as the colony deals with the constant onslaught of the ever present parasites (mites, foulbrood, chalkbrood, nosema and viruses).

There are (at least) two important factors involved in the phenomenon—vitellogenin levels, and ethyl oleate inhibition of "aging". The "aging" of bees has more to do with vitellogenin (Vg) levels and behavior than with chronological age. Bees that maintain high levels of Vg live for a long time, those with low levels die fairly quickly (see my Fat Bees articles). Such a shift occurs naturally as bees progress from wintering or nursing to foraging. But what is relevant to CCD is that bees that get sick accelerate the process, and immediately shift to "foraging" behavior (Tofilski 2009).

So far, so good. But what then happens when those sick foragers don't return? The regulation of the house bee to forager ratio is dependent upon the inhibitory feedback from foragers to the mid-aged bees via the pheromone ethyl oleate (see my Primer Pheromones series). So when sick foragers die, younger bees quickly take their places. This works fine as long as there aren't too many sick bees dying, and as long as there is plenty of emerging brood to take their places.

But if there is a parasite epidemic that knocks off the nurses and older bees faster than fresh bees can take their places (this is where the heavy black population arrow forks at the top of the diagram), then a vicious feedback loop can begin to take place, potentially leading to the depopulation of the hive! ***Any time that average bee longevity is decreased to the point that the colony can't replace the workforce as quickly as it dies, then the population will inevitably plummet.***

There is one additional point that I'd like to make. ***It is of benefit to both the parasite and to the colony, to have its sick workers drift to other colonies.*** For the parasite, such drift is essential for transmission to other hives; for the bees, it is a chance to knock out the competition (other colonies)! So we would expect to see drifting of sick bees to other hives. This effect has been documented for nosema-infected bees (Kralj and Fuchs 2009), ***which may help to explain the observation that CCD appears to slowly spread across an apiary from sick colonies to apparently healthy ones*** (this slow spread is very different from what we would expect if the transmission were due to robbing).

The Infection Loop

All colonies are infected with various viruses and other parasites, but the combination of the individual bee immune system and the colony-level immune response generally keeps the colony relatively healthy. However, a combination of pathogens, a novel pathogen, or an exceptionally virulent strain of an established pathogen can sometimes get a toehold in the hive, especially if others of the Four Horsemen are involved—generally a chill event or poor nutrition that stresses the bees.

In the California trial, the viruses in the cocktail, and likely *Nosema ceranae,* were players. I'm still processing samples, and will let you know more later. There are certain aspects of the bee antiviral response via RNA interference and nosema-induced metabolic stress that come into play. Each virus produces "suppressors" of the bee antiviral response, and multiple virus infection becomes complicated by viruses competing against one another. ***We are only beginning to understand the complex virus/virus and virus/nosema interactions within the poor bee!***

Cutting edge virologist Eyal Maori (2009) suggests that strains of ***bees previously infected with a virus may contain virus sequences in their genome that lie dormant like land mines, biding their time until they are triggered by infection by another pathogen***. Or viruses may exist in the "latent" form, similar to the way that the herpes virus is present in virtually all adult humans, just waiting to be triggered to reproduce by either stress, or another virus infection (again, I will detail more on this fascinating subject later).

For now, let's just say that it is common for collapsing colonies to be simultaneously infected with three or four viruses, varroa mites, *Nosema (ceranae* and especially *apis)*, and trypanosomes (Evans 2010), and that there are interactions between the pathogens and bee immune function.

The colony response to infection is to get the sick bees the hell out of the hive! The adult bees that are sick fly off, and the nurse bees remove (and perhaps cannibalize) the sick larvae and pupae (which may lead to further infection of both nurses and brood by viruses). The result, if all goes well, is to purge the hive of the infection. But if the colony is unsuccessful at fighting the infection, things can start to go downhill as the colony is overwhelmed by opportunistic pathogens that take advantage of the stressed bees.

In this particular case, the inoculation with the virus cocktail was apparently a "tip point" that initiated the parasite infection cascade, and from which, either directly or indirectly, most colonies eventually succumbed.

This is the dwindling phase of collapse, which can progress very quickly in some cases. The lack of foragers can be stunning! I really noticed it when I tried to vacuum returning foragers from the entrances for nosema sampling—there just wasn't any forager traffic. In collapsing colonies, there might be bees in the broodnest, but they are all busy trying to keep the brood alive—there just aren't any foragers to speak of!

The progression of colony collapse was recently described by Dr. Jerry Bromenshenk and colleagues (Debnam 2009):

"Regardless of whether the condition expresses itself in the spring or summer, organization within the hive shows slight changes. Brood nests are slow to expand. Instead the colony shows a tendency to maintain a brood nest centered in a single hive body. After the adult bees emerge the brood cells are abandoned and not reused. A midday inspection will reveal that many bees are out foraging and that the remaining bees are widely dispersed throughout the hive. This symptom may vary, depending on time of day and the ambient temperature. Moreover, the population stops increasing during the growing season."

The above was typical in this trial of colonies attempting to purge the infection. I also saw the same in 2004 and 2005. This is a huge point—the mere presence of a colony in the hive does not mean that that hive is going to be a productive unit. We can't simply categorize colonies as either "live" or "dead"—there are also "zombie" colonies that lie somewhere in the limbo between the two classifications.

"The bees may appear to be restless. When viewed from the outside, flight activity may appear to be normal, giving the illusion of a strong colony. Smaller hives often abandon the upper brood chambers and the bee population is completely contained within a few frames in the lower hive body. This is often the easiest and quickest sign of CCD for beekeepers to notice."

That and the fact that the colony isn't building normally. These signs appear as the epidemic takes hold of the colony. Also look for lack of forager flight and spotty brood. An indication of sick hives during a flow is that the bees don't glue the lids

Figure 3. A colony at mid collapse, with listless, restless bees not properly covering the brood, which is suffering from neglect. Colonies can hang on in this sorry condition for many weeks.

down, and white wax is not present. The bees in collapsing colonies are often listless and nondefensive, and may cluster away from the brood (Fig. 3).

"In the earliest stages the brood pattern may appear to be solid, but if the pupal caps are removed, it likely consists of brood of all ages, due to the replacement of dying brood. As this condition advances, the lack of adult bees results in an inability to cover the brood. Capped brood cells may be abandoned and unattended. Removal of chilled brood is still obvious and abandonment and chilling can be seen on brood frames because of the 'holes' in the pattern. The removal of dead larvae and pupae results in a 'shot gun' pattern on brood frames. Healthy colonies can keep up with the removal of chilled brood, which makes the 'shot gun' pattern of CCD colonies a strong indicator."

This is when the chilling feedback loop starts to come into play.

The Chilling Loop

An observation by vanEnglesdorp (2009) is important:

Figure 4. A rapidly-collapsing colony with an obviously low bee-to-brood ratio. Note that the brood is still alive and white, but that there are no longer enough bees left in the hive to tend to it.

"The premature loss of forager bees, the older cohort in a colony, results in younger bees prematurely becoming forager bees. If these replacement bees die at a rate that exceeds the colony's ability to replace them, the result would be rapid depopulation, a reduction in the bee-to-brood ratio, and eventually colony failure."

"Eventually" can be in a matter of days! But the term that I want to bring to your attention in the above quote was something that I first heard in a presentation by Dr. Frank Eischen—the "bee-to-brood ratio." This is something that I really noticed in the trial—that in collapsing colonies, there simply weren't the expected number of bees that should be there to cover the amount of brood present (Fig. 4).

Although the altruistic suicide of the sick adult bees is of great benefit to the colony, the downside is that unless they can be quickly replaced, the bee-to-brood ratio will drop, and in cool weather, the bees may then simply not be able to keep the brood warm. We are all familiar with the phenomenon of "chilled brood," in which we see dead brood on the landing board the morning after a cold snap; the colony quickly recovers. The effects of chilling in collapsing colonies are more subtle, but much more devastating.

As I wrote in my "Old Bees, Cold Bees" series, bees are warm-blooded animals, and chilling causes them great stress. ***There is suggestive evidence that their antiviral immune response is temperature dependent, meaning that when they are chilled, they may not be able to fight off virus infections. Ditto for chalkbrood and nosema, both of which thrive in slightly chilled bees.***

Brood that is slightly chilled may appear normal the next day, but if the chilling allows the ever present viruses to explode in their bodies, the removal of their corpses may spread that virus into the young workers that chew them out—a positive feedback to the nascent epidemic (Figure 5).

Nosema infection also comes into play here. Two recent papers from Dr. Dhruba Naug's lab offer some intriguing suggestions. They found that bees infected with *N.*

Figure 5. Chilled brood in a collapsing colony. The bees will uncap and remove the chilled or virus-killed larvae and pupae, resulting in a spotty pattern of uneven-aged brood. Unfortunately, the process of removal is likely to further transmit the viruses.

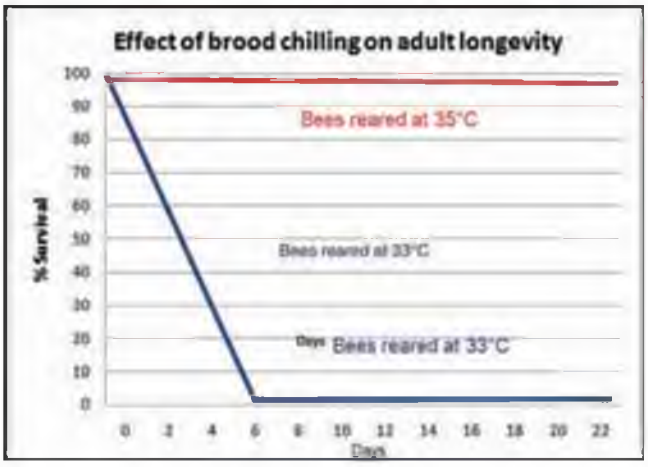


Figure 6. The effect of slight chilling of the brood upon adult bee survival. Compare the survival of normally-reared workers (which would live an average of about 56 days), to that of those that were slightly chilled as pupae (which in this particular experiment all died by day 6; in two other experiments, death came at day 10 or 14). *Note how such an effect can cause worker depletion in a hive to snowball!* After Medrzycki (2010).

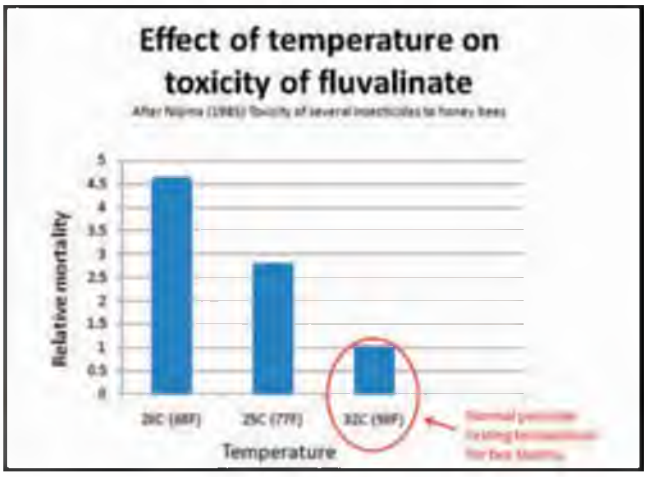


Figure 7. This is a little-addressed phenomenon when we speak of pesticide, or in this case, miticide toxicity to bees. The normal testing of pesticides at broodnest temperatures may not truly indicate their toxicity to the older bees at the outside of the cluster. Note that the common miticide fluvalinate is four and a half times more toxic to bees if they are chilled. It is possible that the chilling that occurs in collapsing colonies could enhance pesticide toxicities that would not normally be noticed.

ceranae preferred warmer temperatures, and were not able to generate body heat as well, especially if not satiated with nectar (Campbell 2010). And Mayack (2010) found that ***even relatively low levels of* N. ceranae *infection put forager bees under energetic stress***, and kept them from maintaining their normal levels of the storage sugar trehalose in their haemolymph (blood). Trehalose is the major "blood" sugar of bees, and critical for the effective use of their flight muscles for both flight and the heating of their bodies (and thereby thermoregulation of the hive).

Even more insidious is the effect upon the adults which later successfully emerge from brood that was slightly chilled. Researchers (Tautz 2003, 2008; Jones 2005) found that bees that were chilled even slightly as pupae emerge as adults lacking in short-term memory. And that ain't the half of it! They may not even live long enough to make it to foraging age! Medrzycki (2010) found that "Our results showed that lower rearing temperature had no significant effects on larval mortality and adult emergence, but adult bee mortality was strongly affected" (Fig. 6). ***Again, we have a nasty positive feedback loop at play—loss of adult bees causes chilling of the brood, which then leads to shortened lives for emerging bees, and even quicker adult bee loss!***

But we're not done with chilling yet! Medryzcki also found that chilling increased the bees' susceptibility to pesticide poisoning! This should be of special interest to those whose combs are contaminated with miticides. I found an interesting piece of old data regarding the most commonly used miticide, fluvalinate. In general, pesticide and miticide testing on bees is done in an incubator held at about 32°C, which would simulate the temperature within a hive. But on a cool night, or during winter, the temperature of the bees may drop to as low as 10°C. ***Niijima (1985) found that fluvalinate was 4-1/2 times more toxic to bees at 20°C than at 32°C*** (Fig. 7)! Another potential case of unexpected positive feedback!

Figure 8. An apparently healthy colony in mid May. Note the solid brood and plenty of pollen stores (there was freshly-stored honey in the super above—not shown). Note also the normal bee-to-brood ratio. Compare this photo to Figure 9.

Figure 9. A brood frame from a hive adjacent to the colony shown above. This colony is in the final stage of collapse. The still-living (white) brood is clear evidence that collapse came rapidly. Although the area of brood is similar to that in Figure 8, note the lack of pollen stores due to the depleted forager force that preceded the final collapse.

Pesticide and miticide exposure were not factors in the collapses that I observed (nor in historical collapse events), so are certainly not necessary components. However, there are many operations today in which they could well be contributing factors.

The Starvation Loop

The most surprising observation that we made was how strongly the premature loss of foragers could affect the colony's nutritional intake! Dr. Mussen and I looked at two side-by-side colonies—one with a broodnest overflowing with fresh pollen and nectar, making white wax, and putting on honey, while the struggling colony right next to it was starving in the midst of abundance because it simply could not maintain a forager force (Figs. 8 and 9)!

I watched a few colonies starve to death on nights when there was an overnight cold snap, *during a substantial honey flow!* I wouldn't have believed it if I hadn't seen it with my own eyes (Fig. 10). Even supplemental feeding of these sick colonies may not help.

As I noted in my "Primer Pheromones" series, the presence of fresh pollen around the broodnest is of paramount importance to nurse bee function and regulation. Young bees that go hungry start foraging prematurely (Toth 2005), and the absence of fresh incoming pollen appears to induce a rapid loss of the forager force (Mattila 2007).

Dr. Jürgen Tautz explains that the presence of cells of nectar in the middle of the broodnest is critical to thermoregulation of the broodnest temperature by "heater bees." So the lack of fresh nectar and pollen due to lack of foragers has severe consequences upon the health of the colony and the aging of the bees; again an example of positive feedback that can lead to rapid collapse.

And let's return again to the Naug group's recent studies of the effects of *Nosema ceranae* infection. They found that unless the infected forager bees that they studied were fed sugar solution to satiation, that they could not maintain the necessary sugar levels in their "blood" necessary to produce heat and forage for extended periods. ***So it would not be surprising if nosema infection contributes to the demise of collapsing colonies simply by thwarting their ability to generate heat.***

In this final stage of collapse, when foragers are unable to keep the broodnest stocked with adequate fresh nectar and pollen, "starvation" starts to have an effect—even in the midst of plenty! The lack of proper provisioning of the brood area has the effect of accelerating the "aging" of young bees into foragers, which, coupled with the shortening of the lives of bees due to chilling and disease, can finally topple the colony, despite heroic efforts of the queen and few remaining young workers (Fig. 11).

Practical Applications

It is clear that colony collapse can be initiated, and continue for months until it eventually decimates an apiary, simply by the introduction of one or more virulent strains of virus. The presence of nosema is likely contributory, but at least in this trial, the virus was key, as evidenced by the observation that those colonies treated against the virus were noticeably stronger. As I write this article, some eight months after inoculation, the difference between the treated and untreated colonies is unmistakeable!

Beekeepers everywhere ask, what can we do to prevent or cure CCD? I've spoken to a number who have recovered, or have avoided it (so far) while others suffered. Their management suggestions are pretty much common sense:

1. Learn to recognize the early signs of colony collapse: lack of normal buildup, low bee-to-brood ratio, spotty brood, lack of stored nectar and white wax when expected. You may wish to move sick colonies to an isolated yard.
2. Make sure that your colonies are well nourished—plenty of honey reserves, and adequate pollen forage. If not, the feeding of several pounds of high quality pollen supplement during times when colonies are nutritionally stressed can make the difference between boomers and dead-outs. (Although in this case, colonies succumbed despite good nutrition).
3. Keep mite levels low. Varroa acts as a vector for viruses, as well as causing major stress to bees. (Again, mite levels were low in this trial).
4. Treat for nosema if levels get high. Just how high is the question! The colonies in my yard did just fine with *N. ceranae* levels in the few millions for two years, until I added the virus inoculum.
5. Avoid the added "Horseman" of toxins by minimizing the exposure of your hives to pesticides, including beekeeper-applied miticides, which have been strongly implicated in several studies with colony losses. (Again, not a factor in this trial).
6. It's pretty clear that the one factor that is most difficult to specifically control for is viruses, to which your bees ***will*** be exposed either through transport to almonds, or even from visiting flowers (Shen 2005). Remebee™ is the only specific antiviral product that I know of, and it could prove to be a godsend to those with stressed bees; the company hopes to have it commercially available in a few months (followed by a multivirus product). There are also some indications that

Figure 10. This colony starved overnight, despite having honey stored on the periphery. Note the green grass, as this happened during spring weather under good foraging conditions with an ample nectar and pollen flow. There simply weren't enough foragers to restock the stores each day!

Figure 11. The end result of a dwindling collapse. This was a common sight—a colony that had dwindled down to a healthy queen heroically laying eggs (see multiple eggs in some cells), a handful of young bees, and a patch of brood about the size of a silver dollar. In warm weather, colonies could hang on like this for weeks!

certain essential oils may also help to control viruses—Dave Wick is currently setting up trials to get some actual data.

7. Start yards of fresh colonies with broodless shook (or package) bees, treated to eliminate most mites. This practice serves to break both the varroa and virus epidemics in the hive. The resulting colonies are generally very healthy for the first year, and Dr. Jerry Bromenshenk has documented that virus levels generally remain very low.
8. Don't combine collapsing colonies with healthy colonies! Collapsed deadout equipment appears to become less infective after "aging" in a dry environment for a month or so, or after sterilization with bleach, formic acid, or radiation. I'm currently setting up a continuation of this trial in which I am going to restock the deadout equipment from the untreated control group.
9. Propagation of resistant stock. It's equally clear that bees (at either the colony or population level) are able to develop resistance to any virus that comes along (one, but only one, of the unmedicated control colonies in my test yard is thriving, despite having been inoculated). Breeding from survivors is our best long-term hope for dealing with colony collapse, no matter what the cause(es).

Closing Thoughts

All colonies of bees are forced to deal with the Four Horsemen (parasites, chill, toxins, and poor nutrition) on a regular basis, yet they generally don't collapse. In my California trial, collapse was clearly initiated by the introduction of virus(es). The other Horsemen may stress a colony severely, or even kill it outright (like a pesticide kill, or winter starvation), but unless a parasite epidemic is raging within the hive, any challenge would be unlikely to cause the type of progressive collapse observed in CCD.

Will CCD "go away" as have the other instances of "disappearing disease"? Most viral epidemics do eventually either disappear, or morph into opportunistic background infections. We are in the midst of the Deformed Wing Virus epidemic, which started shortly after varroa arrived, but shows no signs yet of abating. ***As pointed out earlier in this series, bees are currently coming to terms with an onslaught of novel parasites and their interactions, so we may be seeing sick bees for a while.***

Complete collapse is not inevitable. Some colonies may collapse quickly, seemingly overnight. Others may stay "stuck" at just a few frames of healthy-appearing bees and brood, for weeks or even months. And others may dwindle to a couple of frames of bees, and then, if they manage to purge the infection, spontaneously recover (especially if they are on a good pollen and nectar flow in warm weather).

A few things surprised me during the California trial, like our success at inoculating the colonies with virus by the feeding in sugar syrup. It is unlikely that each bee in the hive fed directly from the feeder jars (which each had only one small hole), so I must assume that the virus was passed throughout the hive via trophallaxis, and that it was infective via the gut. We tend to associate virus infections with varroa, but in this case, varroa levels were still quite low when we checked in May, so either the virus alone, or in combination with *N. ceranae*, was able to increase to lethal epidemic proportions.

I was also surprised by how quickly ostensibly healthy colonies collapsed after the virus inoculation, even before cold weather hit. It was not so surprising that the remainder struggled during the cold, wet winter. As beekeeper Zac Browning told me after he suffered major losses last winter, "Bees don't get better over the winter." However, they generally ***do*** get better once they are on a good spring nectar and pollen flow. But in this case, most didn't. ***This was the most unexpected observation of all—that many colonies were not able to rebound during the spring, and continued to collapse even during excellent foraging conditions in early summer!***

I would have expected the virus, or virus/nosema infections to go "away" after the initial kills, and for the surviving colonies to recover. Jeff Anderson (from whose bees we obtained the virus cocktail) tells me that many of his colonies dwindled to about two frames, and then spontaneously recovered. So my questions are, why were so many of my colonies unable to recover during spring, and what were the pathogen dynamics during this time? I currently have samples in for testing, and am slowly slogging through other samples to determine how much of a role nosema played.

To be continued…

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I'd also like to tip my hat to the heroic efforts of Dennis vanEnglesdorp, Jeff Pettis, Diana Cox-Foster and Nancy Ostiguy and the rest of the Penn State group, and to all the others who are working so hard at finding the causes of Colony Collapse Disorder.

A special thanks to my friend and colleague in this experiment, California Extension Apiculturist Eric Mussen, with whom I bandied thoughts and observations in the field.

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Family Liliaceae—The Lily Family

The story of the origin of hybrid onions is in my opinion quite interesting since nearly all the onions we see on the grocery shelf today rely on one onion found back in 1925.

Depending on the text consulted, the Liliaceae consists of about 240 genera and between 3000 and 4000 species. One of the major characteristics of the Liliaceae is that they are all monocots. The true flowering plants (angiosperms) were once divided into two subgroups, which most of us learned as the monocots and the dicots. This has now changed into the monocots and the eudicots (the true dicots) and a small group that doesn't fit well into the eudicot definition. This last group doesn't appear to be of much importance to the beekeeper, and for the purposes of this discussion, we will deal with only the monocots and eudicots. The monocots have only one seed leaf (cotyledon) compared to two in the eudicots**.** This is the first green leaf to emerge from the seed and contains sugars and other nutrients that are used by the plant during its initial stages of growth. In addition to the single cotyledon, the monocots have their vascular transporting system (xylem and phloem) located throughout the stem rather than in the periphery of the stem as in the eudicots. The first root to emerge during the germination of a monocot seed generally dies, and there is, therefore, no tap root system as is common in the eudicots. Instead, the "roots" (called adventitious roots) are derived from the underground part of the plant, which is mainly stem tissue, not true root tissue. The pollen grains of monocots have only one pore or furrow while those of the eudicots have three. The flowering parts are usually in threes (three petals, three sepals etc) compared to the usual fours and fives in the eudicots. The leaves of monocots are generally elongated and have parallel veins. Be aware that there are some exceptions to these generalizations. While the monocots make up only about 25% of the angiosperms, some of the monocots are important to beekeepers and include the agaves, skunk cabbages, palms, lilies and the grasses and their kin (example corn)[24 & 31].

The Liliaceae is generally distributed over the earth, but is most abundant in the temperate and subtropical regions. Members of the family are mostly perennial herbs, which after the seedling stage, form food storage and reproductive organs: bulbs, corms, rhizomes and occasionally tubers[1].

The leaves, which only rarely persist throughout the year, emanate either from the underground storage structure or from the stem, in which case they are usually placed alternately or whorled around the stem and are only rarely placed oppositely. The leaves are typically elongate and narrow and parallel-veined, but occasionally are broad and net veined as in the trilliums.

The flowers are usually bisexual, radially symmetrical, often showy, and arranged in various types of inflorescence. The tepals[2] are of similar size, shape and orientation and usually occur in groups of three, less often in groups of two or four, and there are generally as many stamens as tepals. There *may* also be a corona[3].

The ovary placement ranges anywhere from superior to inferior[4] and generally has three cavities (locules) in which the several to many ovules later become seeds. Each ovule is attached to the central axis of the ovary (axial placentation). Nectaries are often located on the outer tepals. The fruit is a berry or a capsule[5] with few to many seeds.

The above description follows that advocated by Cronquist[9] and includes plant groups that are sometimes placed in other families, for example the Alliaceae and Amaryllidaceae (both of which sometimes are credited with containing the onions). It also includes the Asparagaceae (asparagus), Trilliaceae (trilliums) as well as some others of less importance to North American beekeepers. The above description of the family Liliaceae seems to have become largely accepted, though this may change as a result of our relatively new capabilities in the area of molecular genetics.

1 **Rhizome**: a horizontal underground stem from which new plants can arise; **Bulb**: an underground stem with thickened modified leaves that serves as a food storage organ, as in an onion; **Corm**: a short thickened underground stem without thickened leaves, as in a gladiola; **Tuber:** a usually terminal, thickened part of a creeping underground stem (rhizome) that serves as food storage and often reproduction, as in a potato.

2 **Tepal**: A term that is used when it is not clear if the part being discussed is a petal or a sepal (one of the segment of the calyx). Many of us would think of them as petals. In some cases, as in the trilliums, the outer set is narrower and greener than the inner set and we would have little trouble calling these greener structures sepals.

3 **Corona**: A crown-like structure between the tepals and the stamens as in a daffodil.

4 **Superior**: Ovary placed above the petals and calyx; **Inferior**: Ovary placed beneath the petals and calyx.

5 **Berry**: a fleshy fruit developed from a single pistil with several to many seeds (example a tomato); **Capsule:** a dry fruit composed of more than one carpel that opens at maturity to release its seeds.

Onion

Scientific name: ***Allium cepa***

Synonyms: Under *Allium cepa*, the USDA Plants Website[28] lists the varieties *aggregatum, cepa, multiplicans, proliferum* and *solaninum*.

Origin: We apparently don't know the origin of the onion. It is clear that it has been associated with our species for many years, but onions leave little trace for archaeologists to document this relationship. Handcock[10] suggests that onion was first domesticated in the Mediterranean region, including Egypt, between 8000 and 4000 years ago and in China about 4000 years ago. Some archaeologists, botanists and food historians believe that it originated in central Asia. Others believe onions were first grown in Iran and western Pakistan[33]. Hortus Third[15] states that *A. cepa* is known only from cultivation.

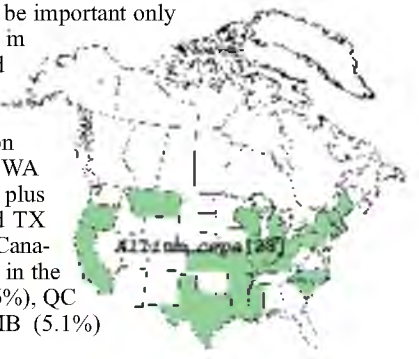
Plant description: When onion is grown for greens or its bulb, it is treated as an annual and harvested its first year, during which it rarely gets more than a foot tall and no seeds are produced. There are generally 4 to 6 hollow leaves that are more or less cylindrical, but narrow and becoming pointy toward the top. When onion is grown for seed, the mother bulb is replanted either in the late fall or is held over in a cooler for spring planting. The plants during the second year produce from 1 to as many as 20 leafless, hollow swollen flower stalks (scapes) that often reach heights of 3 to 4 ft. The leaves are much as during the plant's first year and are considerably shorter than the scapes. The flowering inflorescence is an umbel[6], which can be as much as 6 to 8 inches across and may contain as many as 50 to 2000 individual florets. The perianth (the petals and the calyx collectively) is whitish green and generally less than 0.2 inches long. The style extends from a three-lobed ovary. There are two circles of three stamens, which all extend beyond the perianth. The nectar is secreted between the shallow lobes of the ovary at the base of the inner stamens, and "unless the nectar is rapidly removed by insects, it can be easily seen glistening in the sunlight like a tiny jewel[18]." The anthers of the inner stamens open first and shed their pollen and then the outer ones open. All of the pollen of an individual floret is shed 24-36 hrs after the flower opens and before the style has grown to approximately the height of the stamens at, which time the stigma becomes receptive. It is, therefore, impossible for self-pollination to occur within a single floret, but because the florets of a given plant open over an extended period of time, self-pollination is possible, even likely.

The tops of *several* onion bulbs planted closely together. Notice that there are two types of upright growth, the ones carrying the flowered umbels (the scapes) and the structures that are without umbels, which for lack of a better name, I call leaves. Photo taken in the W. J. Beal Botanical Garden on the Michigan State University campus on 6/2/2010

An individual onion umbel. Notice the large number of individual florets this structure has. Photo taken in the W. J. Beal Botanical Garden on 5/25/2010.

Onions are divided into three groups. The **Cepa group** has single bulbs and produces no bulbils[7] in the inflorescence and usually is produced from seed. This is the group that most of us most often think of as onions. The **Aggregatum group** has no bulbils in the inflorescence, is often sterile, and is propagated by lateral bulbs or shoots from the mother bulb. Members of this group are often called potato onions, multiplier onions, ever-ready onions, and shallots. The **Proliferum group** is propagated by bulbils that are produced in the inflorescence. These are often called tree onion, Egyptian onions, top onions and Catawissa onions.[15, 18 & 23].

Distribution: As mentioned above, Hortus Third[15] states that the commercial onion is known only from cultivation. Gleason and Cronquist[9] state that it only occasionally escapes cultivation. Onions would, therefore, be important only to beekeepers located in commercial onion seed production areas. In the order of decreasing US acreage during 2008, onion production by state was WA (17.2%), CA (16.1%), ID plus Eastern OR (15.3%) and TX (9.4%)[34]. During 2009, Canadian onion acreage listed in the same order was ON (46.6%), QC (34.4%), AB (7.0%), MB (5.1%) and NS (4.4%)[35].



Blooming period: There is much diversity within the onion world, and the blooming date will depend on the cultivar in question and the area in which it is being grown. Onions are essentially biennials and different cultivars are often developed for particular regions. The respondent to the Ayers and Harman questionnaires[1] for the central Valley of California provided a blooming period of June 1 to July 1.

Importance as a honey plant: Oertel[22], from his questionnaires, found onion to be of at least some importance in CA, IL, UT and CO. For all his onion data, he provides only the genus *Allium*. For the first three states he refers to "onion" and the last he refers to as

[6] **Umbel: a flat topped or convex flower arrangement where the individual flower stems come from approximately the same point on the inflorescence stem.**

[7] **Bulbil: a small bulb.**

"wild onion". Probably only the first three refer to *Allium cepa.* The respondents to Ayers and Harman's questionnaires indicated that onions were of some importance in CA, WA OR, ID, and AZ with all respondents indicating that pollination services were supplied by beekeepers[1]. A short article by R. J Colburn[3] suggests that before the original prairie was destroyed, the wild onions growing there provided considerable amounts of honey.

Honey potential: Based on honey stomach samples, Gary et al.[7] reported that the nectar sugar concentration ranged between 22.3 to 54.8 % (average 44.3%) and the load volume ranged between 0 and 40 µl[8] (average 7.7 µl). No differences in concentration or nectar volume were found between the bees foraging the male sterile and the pollen donor plants. Lederhouse et al.[13], based on honey stomach contents, found the sugar concentration in the pollen plant to range between 35 and 52.5%, and for the male-sterile plant to range between 32 and 50%. Nye et al.[21], based on honey stomach contents of bees foraging either male-sterile or pollen donor plants, found the average nectar sugar concentration to be 41% for both groups.

Honey: Onion honey apparently at first has an onion smell and flavor that largely disappear with age. The article by Mr. Colburn cited above, states, "The onion flavor thus passes off, and when the honey is ready to be sealed you could not tell it from white clover[9]; though I extracted some of it three years ago, and my better-half always insisted that she could taste the onion flavor." John Lovell[16] states, "The Honey is amber-colored, and the peculiar onion odor and flavor almost disappear as it ripens." Pammel and King[23], cites what appears to be a personal communication from a Mr. Reppert of Burlington, Iowa, who after producing an onion-flavored honey, moved the producing apiary to sweetclover after which the hives yielded an "abundance of honey free from onion flavor." Pellett[23] quotes what appears to be a personal letter from Raymond Newell, who kept bees in connection with the Harris Seed Co. at Coldwater, NY that indicated that his bees produced about 10 lbs of onion honey, which Newell found lost its onion flavor when fully ripened, and then was not unlike clover honey. Harvey Lovell[16] provides information from a beekeeper in Roswell, NM that "heating removes the onion odor and leaves a delicious honey."

Pollen: Onion pollen apparently loses its viability relatively quickly. Nye et al.[21] found that pollen taken from flowers opening in the morning was two to three times more viable than that taken from flowers in the afternoon. I judge that the pollen tested in the afternoon was pollen that had become available in the morning because the authors state, "pollen from freshly dehisced anthers was as viable in the afternoon as in the morning." Onion pollen from traps did not germinate even though all other pollens in the pollen trap germinated to some extent (10 to 80%). While the pollen deteriorates quickly, Moll[19] found under the usual field conditions encountered in southwestern Idaho that the stigma showed little or no loss in receptivity within the first three days *after* it became receptive. This could be important if the pollen parent opened a little later than the seed parent. Under laboratory conditions, there was no loss in stigma receptivity until five days after the stigma became receptive. Receptivity ceased entirely under both laboratory and field conditions 6 or 7 days after the stigma became receptive.

Additional information: Honey bees are effective pollinators of open pollinated onion crops because both nectar and pollen are available in each umbel[18]. The situation becomes more complex with the production of hybrid seed. Onion was one of the early crops for which the production of hybrids became popular, and today most available onion varieties are hybrids [18 & 27]. Onion is a biennial, and, therefore, doesn't flower until the second season. This adds some complexity to the production of hybrid seed since the first season's bulbs must be overwintered in cold storage facilities, or less frequently, in the field[27], and how bulbs are overwintered can greatly affect later seed production[11].

The method used to produce hybrid onion seed is probably unique within the world of hybrid seed production. In 1925 H. A. Jones, a professor at the University of California, Davis discovered an onion that produced no pollen and when grown in isolation from pollen producers, produced no seed, but instead produced large numbers of small bulbils in the flower heads, which could then be planted to perpetuate the onion asexually. This single plant is almost certainly the most important onion ever produced and is given the pedigree number 13-53. If not pollinated, 13-53 produces only bulbils, but when it is adequately pollinated by another variety produces both hybrid seed and bulbils. The bulbils can then be used as the male sterile component of a cross to produce more hybrid seed. Using this method of hybrid seed production, only two onion lines need to be maintained, the female line (grown from bulbils) and the male-fertile line (maintained from seed).

While the above system works, it provides only limited breeding flexibility, and a somewhat more complicated system with far greater breeding potential has been worked out, again using 13-53. When a normal bisexual onion is crossed with 13-53, three types of offspring are produced; plants that produce all perfect (bisexual) flowers, plants with both perfect flowers and some female flowers with no pollen, and plants that produce all female flowers. When the all female offspring are again crossed to the original pollen parent (backcrossed), all the progeny are female. With each backcross, the progeny look more and more like the pollen parent line. During this transition the females are maintained by making backcrosses to the original pollen parent. This system is more complicated than the one described above, because three onion lines must be maintained in the breeding program; a female line (A-line), a pollen parent line (B-line) to produce seed needed for the final large scale hybrid seed production, and another male line (C-line) for the final hybrid seed production. While this system is more complicated than the first system, it allows much more breeding flexibility and allows the development of hybrids with the desirable characteristics of most major onion lines.

The Genetics of Hybrid Onion Production

Male sterility is essential for hybrid onion seed production and results from an interaction between a gene found in the nucleus and a cytoplasmic[10] factor. Because the pollen essentially transfers no cytoplasm the cytoplasmic factor is inherited only through the female, which in the case of developing a hybrid is the male sterile part of the cross. The cytoplasmic factor is designated by an N for the normal fertile cytoplasm and S for the sterile cytoplasm. The nuclear component is designated as Ms__ [11] for the normal fertile condition and ms/ms for the sterile condition. Ms is epistatic to S, and N is epistatic to msms[12]. Male sterility can be maintained only when an S msms female is crossed with a N msms pollen parent. The genotype of the three lines are:

A-line= S msms (♀); B-line=N msms (♂) and C-line=N MsMs (♂)

For those who find this story interesting and would like to read more about it, I suggest starting with references 35 and 36 and then Sidhu et al.[27].

The bees and the onions

While onion pollen is abundant, and onion nectar is rich in sugar, neither is very attractive to bees. Because onions are not especially attractive to bees, onion fields sometimes experience serious competition from other surrounding crops. Carlson[2] noted bees leaving a field of onions in full bloom for carrot and safflower when they

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[8] µl: microliter—one millionth of a liter (1.057 qts)

[9] A little later he states that the honey color is as white as that from clover. A longer, but slightly edited quote from this article can be found in Pellett[23].

[10] Cytoplasmic: outside of the nucleus (in the cytoplasm).

[11] The indicates that the second gene can be either Ms or ms i.e. Ms is dominant to ms.

[12] Epistatic to: While dominance masks the expression of a recessive gene at the same location on the chromosome, as I use it here an epistatic gene masks the expression of a gene or genes that resides at another location. Example used in text: both S Ms__ and a N msms plants are male-fertile.

began to bloom. During the switch, bee counts fell from one bee per five heads to one bee per 100 heads. Williams and Free[30] found bees ignored onions for *Brassica* crops, and Nye et al.[21] found bees preferred to collect carrot pollen over that of onion. Gary et al.[9] used an interesting method to assess relative attractiveness of the different crops in a situation where there were each two fields of onions and safflower and a single field of carrots located within an area containing a scattering of 14 apiaries. Bees in the different fields were tagged with loosely glued numbered iron tags, which were collected at the hives with strong magnets. The researchers used the "mean"[13] flight distances bees were willing to fly to the different crops as an indication of relative attractiveness. The mean flight distances were: onion 857m and 295m, safflower 1552m and 1444m and carrots 2250m.

Studies by Waller et al.[29] incriminate high potassium levels in the nectar as the cause of the relative unattractiveness of the nectar. They found the potassium levels of onion nectar ranged between 3600 and 13,000 ppm, or about ten times higher than nectar potassium levels of competing flora. As additional proof, they found that the addition of any of 11 potassium salts to 30% sugar solutions provided in artificial flower feeders decreased honey bee 'nectar' uptake as the potassium levels increased. In addition, an unusual cross-species *Allium* hybrid with nectar potassium levels in the range of those of competing forages was more attractive to honey bees than the common onion.

In general the literature seems to support the idea that male-fertile plants are more attractive to honey bees than the male-sterile counterpart. Lederhouse et al.[14] found that bee populations were 2.05 times more common per row and 2.9 times more common per flower head on male-fertile plants than on male-sterile plants. The bees also spent 1.56 times more time on male-fertile flowers than male-sterile flowers. Movement within a row was common, but movement between rows occurred in only11.09% of the total flower-to-flower movements.

Williams and Free[30] found most bees collected nectar only and none collected pollen only. In addition most bees that became covered with pollen while collecting nectar removed it from their bodies and discarded it, and only a few packed it into their pollen baskets. This seems to suggest that onion pollen is not a favored pollen source. The bees spent less time visiting male-sterile plants than male-fertile plants and they also visited more male-fertile than male-sterile umbels /row. The authors concluded that the greater attractiveness of male-fertile plants than male-sterile plants could not be explained by greater pollen availability and that the differential attractiveness probably was related to the nectar, most probably either differential sugar concentration and/or differential production or perhaps to some other factor or factors having to do with its attractiveness. Despite the seeming predilection for male-fertile plants, bees in this study apparently moved sufficiently between the two groups of plants to provide adequate pollination as judged by seed set on the male-sterile plants.

In varietal tests Nye[20] found that inbred lines differed significantly in their attractiveness to bees. While it may be true that bees generally are more attracted to male-fertile lines than to male-sterile lines [14 & 31], this was not the case in four of the five 'varietal trials' performed by Nye[20], where the pollen parent seemed generally less attractive than male-sterile lines. In a fifth trial, however, the number of bees on the pollen parent was 2.5 times greater than on the male-sterile plants. Similar results were obtained by Carlson [2]. In the two male-sterile varieties tested against a single pollen parent, one male-sterile variety attracted 90% *more* bees than the pollen parent, while the other male-sterile variety attracted *only* 85% the number of bees as the pollen parent. These results were also reflected in the seed yields. The results of Nye and Carlson seem to indicate that the greater attractiveness of male-fertile lines is not inextricably linked to the male-fertile line.

Gary et al.[7] used a magnetic retrieval system *similar* to the one described above to study movement of foraging bees in an onion field where 12 row blocks of both male-fertile and male-sterile onions were alternated in the field. Small numbered iron discs were lightly glued to the body of bees that were foraging one of the two onion varieties. The chips glued to bees that carried pollen in their pollen baskets were marked with a spot of paint. A total of 2043 strong magnets used to collect the discs were suspended above the umbels of both varieties throughout the field in a 4 meter grid pattern. They found that bees tagged while foraging male-sterile plants had a slight tendency to leave their tags on male-sterile plants (54.5 %), while those initially foraging on male-fertile plants tended to leave their tags on male-fertile plants (57.6%). 71% of the discs from the bees *with pollen packed in the corbiculae* during the initial tagging were left on male-fertile lines. While the differences were statistically significant, they indicate a good potential for cross-pollination. Most bees tended to forage near the initial capture and tagging location, but many foragers also foraged fairly long distances from the point of their initial capture and tagging. Significantly more bees foraged male-fertile lines than male-sterile lines, which the researchers felt to some extent could be accounted for by the fact that at the time of the study, the male-fertile plants were more floriferous than the male-sterile line. No differences were found in nectar volume or concentration in the nectar loads of bees foraging the two lines. In this study, foraging seemed to be more concentrated near prominent landmarks (corners of the field) than in areas without such features. Small fields might, therefore, give different results than larger fields. The researchers speculated that landmarks such as field corners, buildings etc. might be used by bees to return to the same location in the field on subsequent foraging trips.

Recommended proportion of male-sterile plants to male-fertile plants

When creating hybrid onions, pollen must be transferred from the male-fertile plants to the male-sterile plants and the relative numbers of male-sterile to male-fertile plants is of great importance. Research in this area, however, suggests that this varies greatly depending on the *total situation*. Given the variations in flowering biology, the differential attractiveness of the various lines, as well as the effect of the environment on these characteristics, it is not surprising that recommendations for the ratio of male-sterile to male-fertile lines, and how they should be spaced in the field, would vary considerably. Below I have chosen just a few examples of research to emphasize this variation.

Franklin[6], working with plantings of 24 rows of male-sterile plants set between two rows of male-fertile plants, found that the seed set of the central eight rows was lower than that of the remaining rows, but considered the difference to not be sufficiently large to warrant planting another male-fertile row in the center of the 24 rows of male-sterile plants. When the male-sterile plants were planted in blocks of 16 male-sterile rows between single rows of male-fertile plants, seed production did not vary with distance from the male-fertile rows. Franklin pointed out, however, that his experiments were conducted in commercial fields where the remainder of the fields were planted in a pattern of 8 male-sterile rows between two male-fertile rows and also that the male-fertile plants were excellent pollen producers that bloomed very synchronously with the male-sterile plants. For these reasons he cautioned that seed producers should not jump to the conclusion that in other situations the results would be the same, but only that they should consider the possibility of using male-sterile to male-fertile ratios that were larger than those commonly used at the time. Nye et al.[21], on the other hand, found that during a year with an unfavorable foraging season, in a field with blocks of 24 rows of male-sterile plants set between blocks of four male-fertile rows, seed yield decreased significantly with increased distances from the male-fertile plants.

Williams and Free[30] in their review of the literature, state that the recommendations for North America have generally varied between 4 rows male parent to 4 rows of female parent; 1 row male parent to 2 rows of female parent; 1 row of male parent to 3 rows of female parent; and 2 rows of male parent to 6 rows female parent. These researchers themselves found no difference between plantings of four or eight rows of female parents between single rows of male parents.

[13] **I think mean as used by Gary et al. can interpreted as average.**

Recommended bee populations for pollination

McGregor[18] references several works that indicate that honey bees greatly increase seed production. Recommendations that he cites range between 2 colonies per acre to 5 to 15 colonies per acre. He also mentions suggestions that the bee population could be built up over the flowering season to take advantage of the "naïve" bee behavior of the newly arriving bee colonies. The sequence described was two colonies per acre at the start of flowering followed by an additional two colonies per acre at 3 to 4 day intervals. Delaplane and Mayer[4] report that when the procedure was tried by one of the authors (Mayer), no increase was found in the honey bee populations working the onions.

Delaplane and Mayer[4] provide the estimate that growers generally place 5-15 colonies per acre, either within or beside the onion seed fields at the time of flowering. They estimate that the literature average is 6.7 colonies per acre.

Scott-Dupree et al.[26] provide a recommendation of 5 to 15 colonies per acre.

Recommended isolation of onion fields

Because onions come in different colors (red, white and yellow) as well as different bulb types (flat to roundish). cross pollination from neighboring onion fields of plants grown for seed is of concern. This is of particular concern in the production of hybrid seed because of the premium price paid for hybrid seed in order to benefit from the promised exceptional bulb uniformity. Franklin[5] developed a set of recommendations for both open pollinated cultivars as well as for plantings intended for hybrid seed production. In general the recommended distances for open pollinated varieties were less than for hybrid seed production, and within each system the distances recommended increased as the differences in bulb type and/or color increased. The recommended distances for open pollinated varieties ranged from 1 mile down to ¼ mile while those for hybrid seed production ranged from, 3 miles down to ¼ mile. Based on a decline in complaints about productions of nonuniform onion crops, Franklin felt these recommendations were working well.

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