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Features . . . . . . The Rest

Crocus – an early Spring bloomer. Good for bees, great for beekeepers. photo by Zachary Huang.

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Correction To CAP

Thank you for publishing our article *From the Front Lines-The War Against Varroa*. Directly under the title and list of authors the line "Chemicals are not the Answer. Here's Why" was added without our knowledge or consent and making it look like the opinion of the authors. Based on the data, we do have serious concerns about the build-up of chemicals in bee hives, especially those used to control mites and diseases. However, it is our intention to report our research results and findings in a fair and objective manner. We are not supporting an agenda for or against the use of chemicals. We request that you relate to your readership that the line "Chemicals are not the Answer. Here's Why" was an addition made by *Bee Culture* and not the authors.

Maryann Frazier
(for Sara Ashcraft, Chris Mullin and Jim Frazier)

Do I Need All This?

I've been keeping bees for 27 years and have at least an average level of knowledge about ordering equipment from a beekeeping catalog. I'm currently receiving copies of the new 2013 catalogs and have been reviewing the contents. Is it just me, or have these things become complicated. Just look at the catalog contents and try to select the type of frame or foundation you want. This is not easy. For instance, consider ordering frames and try selecting the one(s) you want and need. No longer do we merely order small, medium or large frames. No, now we must consider wood, plastic, groove top bar, wedge top, end bar holes, split bottom and do you want them assembled! Hey, that's just thinking frames, now you need foundation like size, color, wired with hooks, without hooks, thin surplus, small cell or standard, and don't forget brood drone foundation. Folks, this is confusing, to say the least.

Just for kicks, I reviewed and compared the contents of two catalogs from the same prominent beekeeping company. One was dated 1988 (25 years ago) and a current 2013 catalog. The older one was much smaller in length and width and contained 63 pages. The latest one was much larger in cover size and contained 139 pages. That's a gain in number of pages only, by 83%, not to mention the increased size of pages. Do beekeepers really need the plethora of gadgets and gizmos offered for sale? No wonder some of us (me) are having trouble thumbing through pages and ordering correctly.

Maybe my beekeeping colleagues have solved a way to easily order desired beekeeping equipment. I haven't, and my honey house is cluttered. What is this JZ-BZ queen rearing kit sitting on my work bench? (Don't remember ordering that?) Well, I don't need all this stuff I bought mistakenly and unintentionally the past few years. Who out there would like to buy a few frames or sheets of foundation? Will sell all . . . cheap!

Dean Burroughs
Salisbury, MD

Package Bee Producers

I would like to remark that I especially enjoyed your new column, "Ask Dr. Phil." I also notice that every journal issue has a personal-interest column about some apiary, or queen producer, or mead maker. But I notice something is missing.

It seems to me that the package bee producers are the heroes of the beekeeping industry, yet also the black sheep. No one mentions them. No one thanks them. But still, no one can do without them.

Possibly the large-scale commercial beekeepers are able to replace their losses on their own, but they don't talk about doing it. Judging by my state association here in Wisconsin, even the "big" apiaries of 50 to 100 hives end up buying 25 to 100 packages each on a regular basis. James Tew, a long-time, experienced beekeeper bought 10 packages last year, and is getting 10 this year. I bought three last year and will buy three this year. Where will we get them? From the package producers. Why don't we hear anything about them??

Would you be able to find some author to write about the production of package bees?

Jeanne Hansen
Madison, WI

Roof Top Beekeeping

The *Bee Culture* 2013 calendar has just arrived; titled "Bees in the Hood." No less than 10 pictures on that calendar show bees residing atop buildings.

My small rural apiary (eight to 10 colonies) is strictly a hobby. We're located near Oklahoma City on 30 acres of woods.

Ok, so why am I writing this letter? If you are a commercial building owner, a home owner, or locate your colonies on the ground, you are exempt from the purpose of this letter. My target is beekeepers who locate their colonies on roofs which they don't actually own.

Modern commercial roofing systems very often carry long term warranties from the manufacturer of that system. Warranties of 20 years are quite common. Using a roof for any other purpose other than intended, without permission from *that manufacturer*, can easily lead to that building owners warranty being terminated. At least four calendar pictures could fit the profile just described. Please be a responsible, courteous beekeeper and get WRITTEN permission before you locate bees on any roof that you don't own.

I make my living as an independent manufacturer's representative for several manufacturers of warranted commercial roofing systems.

Chris Sennott

Good Wishes

Read your story last night in *BC*. WOW! All good wishes for a speedy and complete return to full time editor and other normal endeavors. Read Kathy's page too and always like to hear chicken stories.

We had two old hens (their names were Grey Lady and Red Girl) who were afraid to sleep in the coop because of raccoons so they would come up on the porch and we would let them into the mud room for the night. If we weren't there to let them in, they would peck on the door. If nobody answered, they would walk around to the front door and peck there.

In gratitude, I think, they always waited until they were outside to poop. They lived to be about 14 years. That was years ago and we still talk about them.

Good luck, get well soon and Happy New Year!

Judy Pendergast

Boy Scout Merit Badge

Thank you for the positive in put on the beekeeping merit badge you e-mailed to Euvonne Harrison of NEOBA. I am Christopher Stowell the Boy Scout/Beekeeper who campaigned a couple years back to get the BSA to reinstate the merit badge. While they did not reinstate the Bee keeping merit badge as it had once been, they did revamp the merit badge program to include Beekeeping in eight merit badges. One of those merit badges are a requirement for a boy to make Eagle.The adjustments to these eight merit badges will be complete by the year 2015. So I feel very positive about the results of the campaign.

Thank you, Mr. Flottum, for your part in updating the beekeeping information and requirements in the Gardening Merit Badge section on beekeeping, and supporting this endeavor to bring back beekeeping to Boy Scouts. Some of the merit badges are still in the works for the change. This is why I am encouraging all beekeepers to get involved as becoming mentors to their local troops as a merit badge councilor for teaching and assisting the boys as they work on these merit badges. There is no cost involved in becoming a merit badge councilor and it is very rewarding. So this has been a slow path but one that is worth the efforts.

Christopher Stowell
Boy Scout/Beekeeper

Multiple Frame Jig

In the Jan. 2013 issue, Winter Projects, Build a Multiple Frame Jig: are the thickness and width measurements for Parts #4 correct?

Charles Ballard

Author's Response: *The correct part listing for #4. should be: 3/4" x 4½" x 15" -Pressure plate (2). In Bee Culture it shows "1½" x 9¼" x 15"-Pressure Plate (2). 9¼"? Sorry, for the confusion.*

Read Up & Get Ready For Spring -

The History Of American Beekeeping. By Frank C. Pellet. First published 1938, republished by Wicwas Press. 6" x 9.5", black and white, 212 pgs., Hard cover. ISBN 978-1-878075-30-7. $35 **www.wicwaspress.com**

Frank Pellet did it all in his day, and he wrote books telling folks about how he did what he did. He raised queens, wrote about honey plants, wrote kid's book on bees and flowers, wrote on how to be a commercial beekeeper, and he wrote on the history of the industry from our founding fathers to the beginning of The Great War. In his words, the end of the war was the end of the Golden Age Of Beekeeping, because size became important, science and business and skill suddenly out distanced the beekeeper of old, for which bees were a diversion, not a business. If you want grounding in who we are, why we do things the way we do, and who's responsible for what in this industry this is the book you should have. And then, read it. From Langstroth to new races of bees to migratory beekeeping to the bee journals, to improving bee pasture to the Pure Food Act... it's all here. The rise in commercial queen production, commercial scale honey production, and dealing with diseases...it's all here. Do yourself a favor this spring. Find your history, no matter one colony on a rooftop, or 1000 in the almonds.

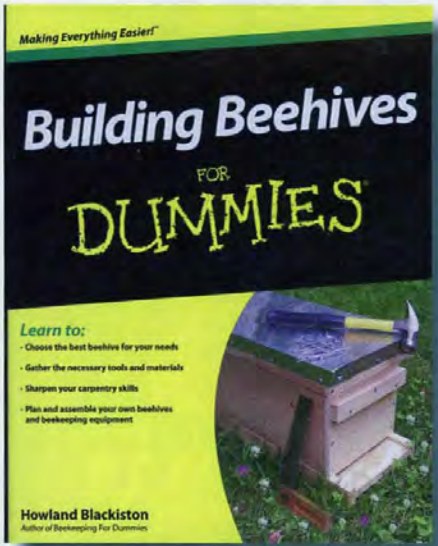
Bees and Wasps. By James Maclaine. 6" x 8.5 inches. Published by Usborne Begginers. ISBN 978-0-7945-3360-1. Color throughout, 32 pgs. $4.99.

A well done beginner's book on what tends to be a touchy subject with small children. Bees sting, and that's almost always an issue, because kids learn it from their parents, and other kids. This well illustrated and informative book takes the scary out of bees and wasps, but doesn't ignore the word sting. It's still there. But the differences in bees and wasps is shown, nests, pollination, honey and beautiful bees by the score. It's a great place to start when talking to small children about this subject. And affordable.

Natural Beekeeping With Ross Conrad. (DVD). Three hours, 13 minutes. Published by Chelsea Green Publishing. $24.95. www. Chelseagreen.com. 800.639.4099.

In this filmed workshop Ross Conrad flips the script on traditional approaches by proposing a program of selective breeding and natural hive management. The video presents a comprehensive survey of natural beekeeping methods and challenges, including segments filmed in the field. It offers practical information that every aspiring beekeeper needs to know—everything from basic hive equipment to working with your bees to harvesting and processing honey.

More Reading -



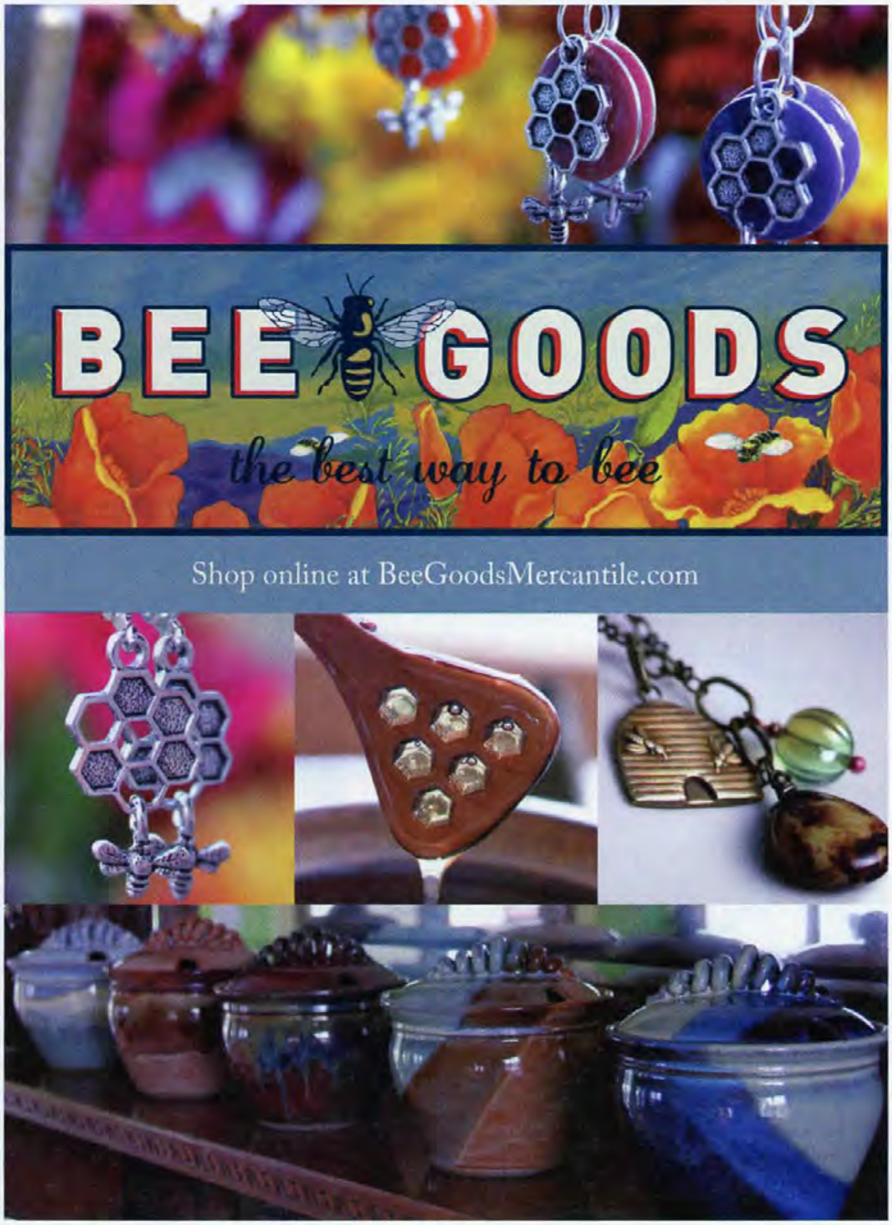
Building Beehives for Dummies. By Howland Blackiston. Published by John Wiley & Sons, Inc. 10" x 8", 268 pgs., black and white. ISBN978-1-118-31294-0. Available everywhere books are sold. $19.99.

Who would have thought. In one year three good books on how to build beekeeping equipment get published. If you are a builder, these are all different, all well done, all worth the money, and all worth having. This is the third.

Howland did the Beekeeping For Dummies book several years ago and it remains one of the leading beginner's books on the market. The Dummies publishers are a marketing machine and they've made his book available, inexpensive and popular. I suspect they will do the same with this one.

He starts with a bit on colony biology, tool and carpentry skills, then moves into the many kinds of hives you can make . . . topbar, four, five, eight and 10 frames hives, the Warre hive, the British National and the traditional Langstroth. He builds jigs, inner covers, hive stands, hive-top feeders, a solar wax melter and even frames. And finishes with tips on extending life of hives, and fun facts. Well illustrated, easy to follow instruction, with the typical Dummies format. Anybody can do it.

Kim Flottum



INNER COVER

While at the Federation meeting in January I got a piece of advice from a California queen producer that bears repeating, and doing if possible. It was one of those blinding flashes of common sense you have once in awhile, usually from someone else. Simply, don't order only a single queen, or even a couple, that will travel through the mail system for two days at the very least, not uncommonly a week or more and are just as likely to arrive dead as they are not to arrive at all. And then try and get insurance to cover it. No, single queens don't do well in that Priority prison. There's just too much stress on those too-few bees in the queen cage in an envelope to do what they need to do best, and that's take care of that queen. Hot. Cold. No ventilation. Stuffed in a bag. Sitting on a shelf in a sorting room. And worst – stuck in a rural mailbox for who knows how many hours in 80 degree weather because nobody called you to come and get her. Death would probably be a welcome relief for these bees.

So . . . the local supplier doesn't have the queens you want and nobody has those local queens you'd prefer, and you only want two or three? What to do? What to do?

Get on the phone and email and let people know you're ordering queens from a supplier you know and like. That they aren't available anywhere else and that you'll have them here on a certain date. If you want one, let me know, and get me the $20 I need to pay for them a date you set so you have the money up front, (or you really trust the guy who called back), and we can make this work.

How many to order? 40 is good because the box holds that many, but maybe not doable locally, and dealing with individuals in another club is . . . Ummmmm . . . tricky. But, you could contact one of that club's leaders and see if he or she can gather up orders for 20 or so queens, get the money from them just like you did locally, and they'll pick them up when they arrive. Order 40 or so queens that have a whole hive full of care-takers with them for a couple days and you end up with a well ventilated box full of unstressed queens in better shape than you've ever had ready to go. Your other buyer shows up, you get paid and they have 20 or so unstressed queens in better shape than they've ever had, ready to go.

This'll take some coordination the first time, and it definitely requires some trust, but it can work. And what about those four folks who for whatever reason bailed and you've got more queens than you need? That's always the hard part, but if you know going in that two or three will bail because they always do, you'll already have a couple of nucs ready or a colony set up to bank them for a bit. Before you start, make sure everybody knows upfront what's to be done if they don't show, and this is livestock folks, so no guarantees after the first day they arrive if you have to take care of them, and there's that taillight guarantee once they leave, and no refunds. The second time they'll be on time. These are adults, right?

It's a gamble, and an investment, but if you don't raise your own queens or want new blood in the system or just need queens fast, it's worth a try. Tell the producer what you're doing and if it works you'll be back. For the most part they'll help out because they want both the business, and they want you to get the best product they can produce so you do come back. Try it this year, be a queen broker. Let me know when and I'll take two.

Right now many hundreds of beekeepers are packing up a million plus colonies in almond orchards stretching from Bakersfield to Sacramento California. Early reports were not wonderfully optimistic about there being enough colonies to satisfy the demand and in all likelihood some blossoms were left wanting because of the compressed season due to the cold Spring and not quite enough bees to do the job needing done. It's a certainty that every year there are more and more blossoms to visit, too, because every year more and more trees are planted. Money grows on almond trees in case you haven't heard and almond-friendly land is selling for $15,000 or more per acre. When you can find it.

And this year even more money grows on those trees. Last year these rich brown nuts brought in about $2/lb, a buck more than the year before. But because of water issues that richest-yet crop came in short. Smaller by far than anticipated.

So now, those even richer brown nuts are worth half-again as much as last year – $3/lb.

Well, how many of those almond blossoms do you supose the growers want pollinated? Every one? Most of them? And there's only one way to get that job done. Pray for good weather, and have enough bees. The price of doing business follows closely the profit gained. So large colonies are very expensive, average colonies expensive, and couldn't-find-a-home-last-year colonies are expensive too.

Buying Queens. Pollination Thoughts.

And like last year, some newbies will take that very attractive pollination fee promise - hook, line and sinker - for the first time and head west just to see. I hope it worked for them, or for you.

Still, there were reasons some beekeepers this year didn't heed the call to go west, young man, go west. The most obvious is that it costs about $200 to keep a colony going all year when you have to pump them up early, replace queens a few times for each colony, feed, feed and feed some more to have them ready in time for that very attractive pollination fee that still doesn't cover those costs. This year the lure of high honey prices at home was for some stronger than the yet stronger temptation of not quite enough fast cash far away. The world honey market is stretched this year and prices are attractive. Honey is up 13% from a year ago – $2/lb and the promise to go higher. But dead bees, unhealthy bees, or bees that aren't at home don't make honey. No, it takes lots of bees to make lots of honey, and heading west to the Stress Capital of the honey bee world most times isn't a good way to get lots of bees, or to keep lots of bees if you started with lots of bees.

But how many went? And how many are now tainted with that California Dream gone bad? Maybe so many that Florida oranges went short of bees, and the market short of orange honey?

Staying home and taking care of business is what some did, beginning last July and all Winter long. Well cared for, well fed, healthy, away from the killing fields of agriculture, these bees are now lots of bees, ready to make even more bees and lots of honey. And $2.00 a pound or more in the barrel is a far more attractive lure for some than stopping by California for a month on the way to honey bee heaven.

So we'll see. Honey or almonds. Any bets?

•

And in a somewhat related story . . .

Several years ago at an EAS meeting I listened to a small scale commercial operator tell about his business. He had been, I think, a school teacher and keeping bees is what kept him busy during his off time in the Summer. It kind of got out of hand after awhile and he had to choose – bees or bureaucracy. Bees won.

Early on he was making honey to sell at farm markets and local stores. Then to more stores. And more stores. Then to other beekeepers. But when he went full time he had to wring more out of those hives and he investigated the pollination business.

But wait a minute. Let's talk about shipping costs. This past week I had to buy a piece of electronic hardware for my department – a headset for one of our telephones. I went to the web page, picked out the part, filled out the order and paid with a credit card. The order confirmation came back almost instantly showing the price of the unit, the $2.03 shipping charge, the total and the approximate delivery date.

Did you catch that? The $2.03 shipping charge? Rather than roll that charge into the overall cost and charge me a sort of generic cost that absorbs that fee, say an extra $3.50 to cover freight to almost anywhere, they charged me the exact fee. Nothing hidden or unknown.

Back to our beekeeper. When he started his pollination business he figured that out right away. OK, he thought, it costs me $X a year to maintain this colony, to keep it healthy and productive, and in return it makes me on average Y pounds of honey. At the end of the year there is a dollar figure of profit or loss for that colony. I can figure that out, every year, he thought.

So when it came to pollination, he figured out the opportunity cost of the honey crop he would lose while his bees weren't at home making honey (about a box, he figured), the extra work of feeding and replacing queens, travel time and such, and came up with a cost to maintain a colony, factoring in the lost crop and extra expense, and derived a figure for his pollination fee that would net him more per colony to pollinate a crop some distance away. And then he added the freight to get them there, a trip to check on them, and to get them home *above* the cost of his pollination fee. He thought this was a fair way to do business. I supply the product, you buy the product and have it shipped to you, just like that head set. And of course, the further away the orchard, the higher the freight cost.

His farmers were astounded. And upset. At first.

That's OK, he thought. I'm making money either way. You want my colonies, here's the deal. But the deal was better than the farmers thought – it costs about the same to drive a one ton truck 50 miles with 10 colonies as it does with 50, so the freight cost per unit went down.

WOW.

Now, my question to the pollinators of those almond trees that money grows on – why don't you do the same. Cost plus freight. What if, next year, everybody did that? California colonies would be the cheapest because they live there. Florida colonies would be much more expensive because they travel the furthest. But all the colonies in the world can't live in California, and some of the best live in Florida, or New York, or lots of places east of California.

I've asked some migratory guys about this and the stock answer is – this is the way it's done. The growers do it only one way. So what if the beekeepers did it only one way – cost, plus freight. In fact, what if transportation was the responsibility of the grower, not the beekeeper. You want my bees, tell me when the truck will be here. The grower makes the arrangements, pays the freight and with bulk purchases probably gets a better deal from the truckers. Plus, they get there just in time, or on time, or in time to get ready while they sit in a holding yard somewhere, waiting.

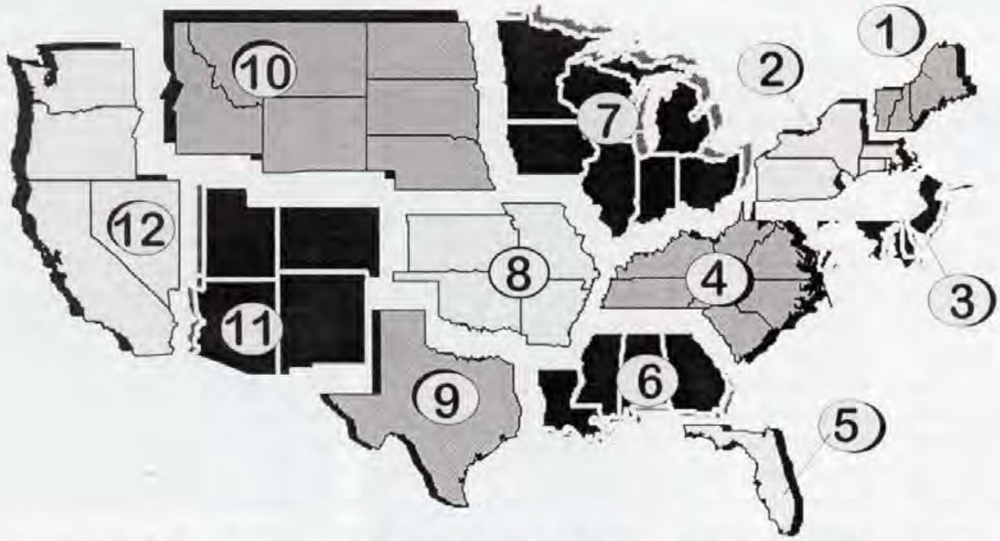
So what am I missing?

•

It's been a tough Winter most places. Lots of bees aren't here that were here last Fall. Most of us have a lot to do, so keep your veil tight, your hive tool handy and your smoker lit and get to work. But still, isn't Spring grand?

Kim Flottum

MARCH – REGIONAL HONEY PRICE REPORT



The "Market" is a force to contend with, but the variables are so diverse, and numerous, that often we don't take them all in. For instance.

The price for bulk honey produced in the U. S. has slowly risen from about $1.60 to $1.75 a pound a year ago this month to now $1.56 to $2.55 a pound, with an average price right about $2.00. The USDA report gives similar ranges and price advances over the same time period, so in a year, the price of honey, on average has climbed a quarter a pound in the barrel. And the price of imported honey, averaging about $1.40 a pound has been stable. Somewhat less bulky, the 60 pound pail, has risen on average from $2.55 to $2.65 a pound. The current and future honey market in the U.S. appears to be promising.

"Market" forces play a role in this certainly. Honey production last year in the U. S. was abysmal, so there isn't as much of last year's crop instantly available, and the carry over from the almost as bad crop the year before didn't help the supply very much at all. Overall, the world crop last year was not spectacular, so there simply isn't as much honey this year as last. The crop in the southern hemisphere seems to be average or less – inconclusive reports so far – so the promise of more than enough from there this season seems weak at best. The price should remain high.

The pull of the almond crop was strong though. As the bloom got closer even the high price of honey lost some of its magic and steadfast east coast producers wavered, and left for different pastures. As I write this, the how many is an unknown…it may be only a few, or it may be many, but even a few will affect the orange crop…the orange honey crop, and the orange crop itself, which needs bees. As far as I can tell, there's never been a shortage of bees for Florida oranges so there's never been a pollination shortage…If you're looking for an investment this year, you might consider orange juice. It might be as scarce as orange honey.

REPORTING REGIONS	1	2	3	4	5	6	7	8	9	10	11	12	SUMMARY Range	Avg.	History Last Month	Last Year
EXTRACTED HONEY PRICES SOLD BULK TO PACKERS OR PROCESSORS																
55 Gal. Drum, Light	2.00	2.10	2.00	1.72	1.95	1.88	2.15	2.00	2.00	2.00	1.93	2.25	1.56-2.55	1.95	1.95	1.72
55 Gal. Drum, Ambr	1.94	2.03	1.94	1.67	1.90	1.73	2.10	2.00	1.94	1.94	1.73	2.13	1.54-2.49	1.86	1.87	1.64
60# Light (retail)	160.00	182.00	157.50	158.50	160.00	163.75	149.17	132.50	166.73	162.00	130.67	215.00	105.00-240.00	160.97	164.50	155.04
60# Amber (retail)	192.50	170.00	157.50	163.20	160.00	158.33	136.50	145.00	150.00	167.63	145.00	197.50	120.00-225.00	162.75	159.31	147.96
WHOLESALE PRICES SOLD TO STORES OR DISTRIBUTORS IN CASE LOTS																
1/2# 24/case	69.32	82.82	48.00	64.90	68.05	54.75	60.04	68.05	68.05	49.20	75.84	92.00	43.20-96.00	66.50	66.66	68.87
1# 24/case	106.72	102.93	114.00	84.90	84.00	106.13	93.00	90.00	72.00	100.80	105.92	123.73	72.00-156.00	101.34	103.67	98.01
2# 12/case	103.40	86.01	78.60	74.00	84.00	83.16	79.03	95.95	63.00	91.92	144.00	100.27	63.00-144.00	88.41	89.11	84.38
12.oz. Plas. 24/cs	97.31	94.42	63.10	73.33	72.00	78.40	70.90	72.00	66.00	70.08	88.08	82.10	60.00-125.00	79.70	79.80	79.00
5# 6/case	119.55	101.49	93.00	83.43	101.40	93.00	95.22	101.40	72.00	95.40	140.00	115.00	66.00-140.00	99.81	99.64	93.68
Quarts 12/case	143.00	163.44	127.98	113.60	96.00	104.10	129.75	102.00	127.98	117.36	114.20	138.67	72.00-198.00	120.95	125.70	118.30
Pints 12/case	87.73	79.65	96.00	77.80	72.00	63.00	83.87	60.00	78.58	78.58	73.20	80.67	45.00-117.60	75.87	80.36	70.87
RETAIL SHELF PRICES																
1/2#	4.25	4.58	3.30	3.62	2.49	4.00	3.32	2.99	4.12	3.25	4.00	5.00	2.49 -6.50	3.75	4.01	3.46
12 oz. Plastic	5.67	4.91	4.22	4.13	4.13	4.80	3.89	3.96	3.99	4.69	4.88	5.10	2.99-7.50	4.54	4.51	4.26
1# Glass/Plastic	6.39	5.85	6.31	5.46	5.62	6.55	4.80	5.09	4.99	5.67	5.70	4.75	3.00-8.50	5.77	5.95	5.67
2# Glass/Plastic	10.76	8.95	12.22	8.40	10.00	9.77	8.62	10.00	8.99	9.92	9.80	12.33	6.00-15.00	9.84	9.82	9.04
Pint	8.63	8.24	9.05	7.20	6.25	7.48	8.80	6.84	10.55	7.80	8.05	13.15	4.00-21.99	8.11	8.12	8.33
Quart	15.00	14.49	9.99	12.15	11.10	12.05	12.33	10.88	14.36	14.25	12.13	15.00	8.00-24.00	12.72	13.27	13.24
5# Glass/Plastic	23.88	18.99	19.46	21.38	21.75	25.48	20.70	20.00	15.99	20.26	20.41	25.00	10.19-35.00	20.90	21.17	21.67
1# Cream	9.00	7.44	8.10	6.68	5.49	5.25	5.95	7.59	7.59	6.94	9.10	7.75	3.99-12.00	7.18	7.40	7.29
1# Cut Comb	9.17	8.32	8.60	6.68	8.95	7.33	6.34	8.95	8.95	9.00	9.25	13.66	4.00-15.00	8.40	9.01	7.70
Ross Round	7.83	5.98	8.19	6.42	7.69	7.00	7.00	7.69	7.69	7.69	10.33	7.20	3.50-12.00	7.63	7.96	7.69
Wholesale Wax (Lt)	4.69	6.74	4.38	3.95	3.25	5.62	5.08	5.79	5.00	8.00	3.56	4.50	2.25-11.00	4.95	4.80	4.68
Wholesale Wax (Dk)	3.50	4.65	4.38	3.71	3.15	5.67	4.80	4.38	4.38	4.38	2.87	4.00	2.10-7.00	4.20	4.26	3.91
Pollination Fee/Col.	91.25	112.50	85.00	55.00	80.00	63.33	58.83	88.98	88.98	60.00	120.00	103.33	35.00-165.00	77.96	78.77	80.72

It's Summers Time –

Still Winter, And What About Those Chickens!

As I write it is still very much Winter in Northeast Ohio, but the hope of Spring is in the air. It's not pitch dark until after 6:00 p.m. – one of the first signs. The seed and bee catalogs have started arriving, a different one every day. And we're gearing up for the beginner's beekeeping class that Kim teaches each year. Between a five Wednesday night session or a two Saturday session, there are over 100 people signed up already.

We travelled to Hershey, PA in January for the American Beekeeping Federation meeting. I had not been in several years so it was a treat for me. We saw many of you there. And many folks we hadn't seen in years. I'm not sure how many were there. You tend to get a different answer from everyone you ask. But it was big. Lots of people, all of the well known vendors and some I didn't know. We spent hours in the vendor area. The scientists were there meeting at the same time. You'll see most of their abstracts in the *Science of Bee Culture*, included in this issue. I always enjoy being at a meeting that is at the hotel where you're staying. It just makes life easier. We got there on Tuesday evening and didn't go outside until our jaunt to Chocolate World on Friday. The hotel had everything we needed. Lots of talks going on all of the time – too many to choose from, four or five different restaurants, a gift shop featuring all of the Hershey's chocolate you could want and we actually managed a quick dip in the hot tub one night. And there were lots of nooks with comfy chairs to just sit and visit if you had the time.

I hadn't been to Hershey since my children were very small. It's an interesting place. We stayed at the "Hershey" Lodge which was quite comfortable. And everywhere you go you are handed chocolate. You get Hershey bars when you check in at the front desk. And every morning when your room is cleaned they leave several Hershey kisses on the table for you. Peggy and I took a short break on Friday afternoon to visit – you guessed it – Chocolate World! What a wonderful place. We had lunch there – I had chili made with Hershey's Cocoa. Not bad. We did a short survey and they gave us another Hershey bar. And of course we bought chocolate for everyone at home.

We've had a cold snap here in Ohio the last week or two. It has been down in the single digits most every night. Because of this we've been keeping a close eye on those chickens. They seem to be weathering fine. We left the warming lights on during the really cold nights and that sort of threw them off a bit. They are used to having total darkness for sleeping. The warming lights are red and don't put off very much light but it still disrupted their routine. In the morning when Kim goes out to check on them instead of all being up on the perch, they are all huddled underneath the warming lights. Now is it because they got cold or just because it's something different. It's hard to tell with this bunch. When they all squeeze together on the perch they generate quite a bit of body heat. You can stick your hand between two birds and it's pretty warm.

This past weekend Kim had all the outside duties because I had one of those colds (maybe the flu, I'm never quite sure what the difference is) that makes you stay in bed for three days. You're pretty sure you won't die from this, but doing anything other than lying in bed is out of the question. By Sunday I had recovered enough to sit at the dining room table and answer a few emails. As I was sitting there Kim came in and said I think we have a problem.

As you know the chicken coop is nicely attached to the garage with a door going between the two. Well the girls have become so tame that they often wonder out into the garage with us if one forgets to close the door tightly. Well they had been out there with him while he was changing the water and puttering around. He got them all back into the coop but one and she proceeded to hide herself very well somewhere in the garage. She's one that is still a little skittish and if she gets spooked she hides. So I got my barn jacket and barn shoes and went out to help him.

I called and whistled and coaxed and finally heard her, but couldn't see her anywhere. We pulled out a cart that has bee equipment stacked on it and now you could hear her clearly, but still couldn't see her. Finally I located her so tightly wedged in between two supers that I could hardly drag her out.

All is well again in the coop.

And to all who continue to ask about Kim, thank you. He is doing a little better everyday.

Kathy Summers

Nosema apis And *Nosema ceranae*

Wei-Fone **Huang** and Leellen F. **Solter**

A Comparative Study In The Honey Bee Host.

Introduction

Nosema apis and *Nosema ceranae* are genetically related microsporidian pathogens that infect the western honey bee. Both species cause chronic disease that that can shorten the adult lifespan and impact hive health and productivity, and when infections reach high levels in apiaries, honey production and pollination services can be severely impacted (Bailey and Ball, 1991; Fries, 1993). In recent years, *N. ceranae* appears to have become the dominant species in the western honey bees around the globe but the mechanisms of replacement are not fully understood (Huang *et al.*, 2008; Klee *et al.*, 2007).

N. apis infects only the adult stage of honey bees and only reproduces in the cells of the host's midgut where food is absorbed (Bailey and Ball, 1991; De Graaf and Jacobs, 1991; Fries, 1993). Most other *Nosema* species, including the bumble bee pathogen, *Nosema bombi*, develop in most body tissues, causing systemic infections rather than being restricted to one tissue. Many *Nosema* species infect the ovaries of reproductive female hosts and are transmitted from the infected females to their offspring (Becnel and Andreadis, 1999) but, although *N. apis* infection in honey bee queens may affect the development of eggs and even stop reproduction (Liu, 1992), the pathogen is not transmitted through the eggs to the offspring (Webster et al. 2008).

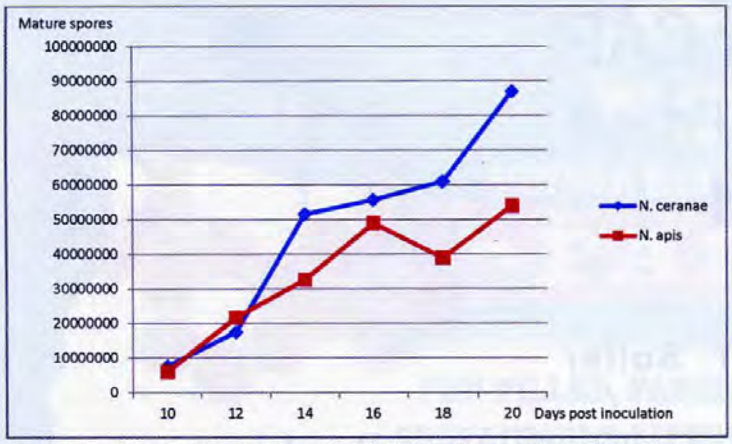
Restraint system for bees reared individually. (photo by W-F Huang)

Like *N. apis*, *N. ceranae* was described as a midgut pathogen of adult bees (Fries, 1996; Fries, 2010), but researchers have observed microsporidian DNA signals in tissues of the head and in other body tissues when using PCR diagnosis, a very sensitive molecular technique (Chen et al., 2009; Copley and Jabaji, 2012; Gisder et al., 2010). With the exception of the midgut, however, neither infective spores nor developmental forms of *N. ceranae* have been microscopically observed in these tissues (Gisder *et al.*, 2010).

We compared the development of *N. apis* and *N. ceranae* in honey bees because the possibility that *N. ceranae* infects tissues like the hypopharyngeal glands and salivary glands in the head capsule could have implications for how *N. ceranae* is impacting bee health and how it is transmitted between individual bees. We are also attempting to understand why *N. ceranae* appears to have replaced or competed with *N. apis* in most honey bee populations in the US (Chen et al., 2009). We were particularly interested in clarifying which body tissues are infected, as well as comparing the number of infective spores each microsporidian species produces. We used genetic tools, PCR and quantitative PCR (qPCR, a method for determining the number of pathogens in a host by measuring DNA), to detect *N. ceranae* and *N. apis* in the tissues, but we redesigned the methods used to rear the bees and methods for removal of body tissues to perform the evaluations.

Methods

We collected *Nosema ceranae* from honey bees in campus apiaries at the University of Illinois, Urbana-Champaign, and Dr. Tom Webster at Kentucky State University provided *N. apis* spores. Honey bees were reared in small groups in plastic cages. We fed an infective dosage of either *N. apis* or *N. ceranae* spores to groups of 30 honey bees and reared them on sugar water for approximately two weeks. The bees were then killed and surface sterilized with diluted bleach and all major body tissues were examined at 400x with a compound microscope. We also extracted the contents of the hindgut where spores are contained in fecal material. Because we can distinguish spore stages based on light refraction using specialized microscope lenses and condenser called "phase contrast," we were able count mature infective spores that appear brightly shining; immature spores and "primary" spores that have a grayish cast; and primary spores that have already germinated and that appear empty and gray with dark cell walls. Primary spores are formed in the early stages



Accumulation of mature spores in hindgut of bees infected with Nosema apis *or* Nosema ceranae.

of infection and germinate inside the cells in which they develop, ensuring transmission of the infection from cell to cell inside the host.

We noted that numerous mature spores were always found in the mouthparts of caged infected bees. These spores could contaminate the tissues of the head during dissection. We therefore designed a restraint system that was used isolate individual bees from colony members and eliminate grooming and other hygienic behaviors (Fig. 1a); a method intended to determine whether spores in the oral cavities were due to grooming or were due to infection of the foregut and/or regurgitation. The restrained bees were fed *N. ceranae* spores in sugar water (Fig. 1b) and fresh sugar water was provided every two days. The infected bees were held for 14 days to evaluate infections in the midgut and to determine whether other body tissues were involved. We tested all major body and head tissues with microscopic observations and conducted PCR to detect *Nosema* DNA.

Results and Discussion

Most bees we used in our experiments did not defecate inside their cages, so the different spore types that accumulated in the hindgut contents indicated the progress of infection in midgut tissues. *N. ceranae*-infected bees produced more mature infective spores (80-95%) than *N. apis*-infected bees (57-83% mature spores). The ratio of *N. apis* mature spores to immature/primary spores did, however, increase during the infection period. Because immature spores are not yet infective, and primary spores are only infective to other cells within a bee's midgut tissues and are not transmissible among hosts, *N. ceranae* may have a competitive advantage with its higher ratio of mature infective spores.

N. ceranae produced approximately eight million spores per day, and *N. apis* produced approximately four million spores per day in the fully developed infections. Spore accumulation per day in the hindgut was somewhat higher for *N. ceranae* than *N. apis* after 12 days of infection and was consistently higher overall (to 20 days).

In previous studies, DNA was detected in head tissues of *N. ceranae* infected bees, but researchers had not observed any early microsporidian stages or spores in these tissues in either *N. apis* or *N. ceranae* infected bees. By restraining the bees and rearing them individually so they could not groom their sisters, the mouthparts remained uncontaminated and no *N. apis* or *N. ceranae* DNA was detected in these samples of head tissues, nor was *N. ceranae* DNA detected in hemolymph (blood) samples collected from the head or abdomen. This suggests that *N. ceranae* cannot exit the midgut to infect the blood or other tissues, nor are spores regurgitated; and, indeed, spores and DNA of *N. apis* and *N. ceranae* were detected only in the midgut cells of the restrained bees.

We determined that, although *N. ceranae* infects the same tissue as *N. apis* and, in our studies, was not more virulent, the timing of the life cycle and production of more infective spores may be factors that allowed *N. ceranae* to successfully compete with *N. apis* and become the dominant microsporidian species in honey bees. BC

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Feeding system for restrained bees.

A Closer Look

COMMUNICATIVE DANCES

Clarence **Collison**
Audrey **Sheridan**

Recruiting nest mates to profitable food sources through dance communication is critical to a colony's foraging success and long-term fitness.

Honey bees famously use their "dance language" to communicate with one another about resources such as food, water and nest sites. A forager returning from a flower rich with pollen or nectar may choose to advertise it to her nestmates by dancing (Donaldson-Matasci and Dornhaus 2012). Karl von Frisch, throughout his writings about how honey bees communicate with dances, described two types of recruitment dance: the round dance and the waggle dance. The round dance is the simplest dance and does not communicate precise distance or direction information. This type of dance is done by bees that have flown to locations near the hive. In performing this dance, an incoming worker which has discovered a nearby food source first exchanges nectar with workers inside the nest (Winston 1987). Then she performs the round dance, being closely followed and antennated by attending bees. In this dance the dancer repeatedly makes small circles, reversing and going the opposite direction after every one or two revolutions and sometimes more frequently. Up to 20 of these reversals can occur, with dances lasting for only seconds or up to minutes. Often food is then exchanged again between the dancer and the nest bees, and then dancing may resume. The dancer may then leave the nest on another foraging trip, while the recruits clean themselves, take some honey for energy on their flight and then exit the colony.

While the round dance is believed to indicate the presence of a food source somewhere near the hive, the waggle dance indicates the distance, direction and profitability of a food source more than 100 meters from the hive (von Frisch 1967). To produce the waggle dance, a bee walks in a straight line at a certain angle on the vertical surface of a comb while waggling her body vigorously from side to side at a rate of about 13-15 times/second. At the end of each straight run, the bee turns in one direction and makes a semicircular turn back to the starting point, followed by another straight run and a semicircular turn in the opposite direction and so on in regular alternation (Winston 1987; Griffin et al. 2012). The abdomen is given the most emphasis during this wagging behavior during the straight part of the dance, and a buzzing sound is given off by muscular and skeletal vibrations. As in the round dance, the waggle dance is punctuated by the dancer stopping and distributing food from its honey stomach to nearby workers and the dance is closely attended by a retinue of workers with extended antennae. The dance followers may produce a squeaking sound of short duration, lasting 0.1-0.2 seconds, which has been called a "begging signal" and causes the dancer to stop and exchange food with the bee that squeaked (Michelsen et al. 1986). Both nectar and pollen collectors dance in the same manner.

Von Frisch emphasized an important role for odors in the recruitment process. Specifically, he suggested that floral odors and other environmental chemicals cling to the body of the foragers and are detected by the dance followers. The spatial information in the dance allows recruits to get only to the general vicinity of the food; odors allow them to pinpoint the resources indicated by the dancer (von Frisch 1967). A powerful source of odors can even lead recruits to ignore the spatial information in the dance and find food locations other than the one being signaled (Dyer 2002). This effect of odors on recruitment is strong for nearby sources of food but weakens considerably as the distance to the food increases (Kirchner and Grasser 1998), which makes sense given the inherent imprecision of odors as a cue for food location.

The round dance is similar to the waggle dance, but differs in that waggle phases are extremely short and at first glance appear to be randomly oriented. The view that round dances and waggle dances are distinct recruitment signals has been revised in recent times in light of the finding that distance and direction information are encoded (albeit imprecisely) in round dances (Griffin et al. 2012). Many round dances actually contain directional information (Kirchner et al. 1998). Dancers produce sounds during round dances, when their bodies are aligned in the direction corresponding to that of the food. Thus, round dances may best

be interpreted as waggle dances with short-distance signals (Dyer 2002).

Recruits that have followed round dances search in all directions near the nest (von Frisch 1967), thus they may have difficulty obtaining directional information from such dances. Griffin et al. (2012) investigated whether dance followers actually use the location information in round dances. They looked at recruitment to nearby food sources and found that dance followers can use the directional information in the dances advertising these food sources. Directional bias in recruitment was found for food sources as close as 5 m from the hive. Controls for effects of assembly pheromone (Nasonov pheromone) and bee presence at the advertised food sources indicate that these factors play a minimal role, relative to dance information, in producing the directional recruitment.

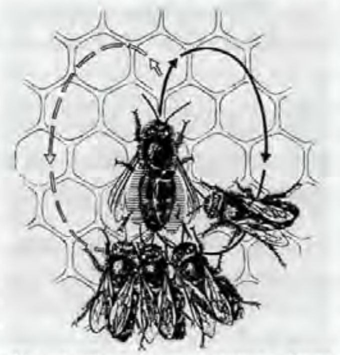
The round dance enables foragers to transfer information to nestmates concerning a nearby food source, including its profitability. The number of the direction reversals in a round dance, dance duration and rate of reversals correlate with food profitability (von Frisch 1967; Waddington 1982; Seeley et al. 2000) and affect the number of new recruits (Seeley and Towne 1992). Honey bees also engage in trophallaxis (mutual feeding), during which information about food source value is communicated by the number of contacts with surrounding nest mates, and duration and rate of unloading (Farina and Nunez 1991; De Marco and Farina 2001). Profitability of nectar, which consists mainly of sugars, is usually defined by the energetic value (caloric value). Nectars, however, also contain a wide range of trace components, some of which affect their attractiveness. Afik et al. (2008) compared the round dance and trophallaxis behaviors of bees foraging on avocado and citrus honey solutions, as a substitute for nectars. These sources differ in their trace-elements composition, with avocado nectar and honey containing higher concentrations of minerals than citrus nectar and honey. They compared the behavior of bees foraging on sucrose solution and sucrose solution enriched with four major mineral components of avocado nectar. Workers foraging on avocado honey had a significantly lower probability of dancing than those foraging on citrus honey, a rate of direction reversals that was almost one half lower than total number of reversals, shorter dance duration and longer trophallaxis time. When avocado honey was supplied to bees that previously fed on citrus honey, most of them avoided it, indicating a strong content effect. When foraging on mineral-enriched sugar solution, dance variables tended to be lower compared with sucrose solution without minerals, but differences were smaller than the differences between the honey solutions. These results show that nectar trace components negatively affect the estimation of nectar profitability by bees and consequently recruitment of new foragers to nectar sources.

Floral scents learned during the waggle dance are an important component of recruitment. Forager bees can be reactivated to go to previously exploited food sources by perceiving scents they learned at the flowers within the dance context. Balbuena et al. (2012) tested whether floral scents experienced not at the foraging site, but via scented nectar inside the hive, can influence subsequent recruitment. Bees that were exposed to scented food while in the hive tended to follow dances in which the recruiting bee presented the same odor experienced eight days earlier. Moreover, a higher proportion of bees with in-hive experience were successfully recruited to the feeding sites scented with the experienced odors than to the feeding sites scented with novel odors. This bias in recruitment was independent of the time that the bees spent following dances. These findings suggest that associative memories acquired even as early as the first week of adult life were responsible for a variation in recruitment.

Honey bees possess a suite of anti-predatory adaptations used to defend their colony against intruders and to avoid flowers associated with predation risk. Abbott and Dukas (2009) showed that honey bees returning from foraging on dangerous flowers are less likely to perform the waggle dance and engage in fewer waggle runs than foragers returning from equally rewarding, safe flowers. Their results indicated that experienced foragers effectively steer naïve recruits away from dangerous flowers and raise interesting questions as to how information about the reward and risk properties of flower patches are integrated into the waggle dance.

The thorax surface temperature of dancing honey bees recruiting nestmates to natural sources of nectar and pollen around Graz (Austria) was measured by real-time infrared thermography without touching them or disturbing social interactions (Stabentheiner 2001). Thorax temperature during dancing was quite variable (31.4-43°C). In the course of a foraging season it varied considerably and was always lower than in bees foraging from a highly profitable food source (2 molar sucrose 120 m from the hive). It averaged 38.0°C in nectar foragers and 37.4°C in the pollen foragers, resembling that of dancers foraging on 0.5 molar sucrose from feeders with unlimited flow. Hive air temperature accounted only for about 3-8% of total variation. Foraging distance modulated dancing temperature in a way that, according to the decrease of the profitability of foraging with distance, maximum temperatures decreased and, in accordance with the increase of the dancing threshold with distance, minimum temperatures increased with distance. These results provide new support for the hypothesis that the ⇨

The round dance. The dancer is followed by three bees who trip along after her and receive the information.



The tail-wagging dance. Four followers are receiving the message.

Illustrations taken from The Dance Language, *by Karl von Frisch.*

Three examples of the indication of direction on a vertica surface. St. beehive. I. II. III. feeding stations in three diffe rections; I'. II', III', the corresponding tail-wagging dances vertical comb.

dancing temperature is modulated by the profitability of foraging and the dancing and foraging motivation of the bees.

Dancing temperature of both nectar and pollen dancers correlated with several parameters of the hive status, increasing with the amount of brood and decreasing with the amount of honey and pollen.

Honey bee queens who mate with multiple drones produce colonies that are filled with numerous genetically distinct patrilines or subfamilies of workers. A genetically diverse colony benefits from an enhanced foraging effort, fuelled in part by an increase in the number of recruitment signals that are produced by foragers. However, the influence of patriline diversity on the attention paid to these signals by audiences of potentially receptive workers remains unexplored. To determine whether recruitment dances performed by foragers in multiple-patriline colonies attract a greater number of dance followers than dances in colonies that lack patriline diversity, workers were trained from multiple- and single-patriline colonies to forage in a greenhouse and their dance-following activity back in the hives were monitored. On average, more workers followed a dance if it was performed in a multiple-patriline colony rather than in a single-patriline colony (33% increase), and for a greater number of dance circuits per follower. Furthermore, dance-following workers in multiple-patriline colonies were more likely to exit their hive after following a dance, although this did not translate to a difference in colony-level exit rates between treatment types. Recruiting nest mates to profitable food sources through dance communication is critical to a colony's foraging success and long-term fitness; polyandrous queens (mated with multiple drones) produce colonies that benefit not only from increased recruitment signaling, but also from the generation of larger and more attentive audiences of signal receivers (Girard et al. 2011).

Four colonies of honey bees, each composed of two subfamilies were separately placed in a screen cage. Bees of each subfamily were found at different frequencies on a pollen feeder, a sucrose feeder and on the roof of the cage, indicating sub-familial genetic variance for foraging preferences (Oldroyd et al. 1991). The colonies were then placed in observation hives, and communication dances were observed. The type (pollen or no pollen) and subfamily of dancers and the subfamily recruits were recorded. Sub-familial variance for nectar or pollen preference and propensity to dance were observed. There was a strong tendency for recruits to follow dances performed by a member of their own subfamily (super-sisters), indicating subfamily recognition. However, at least some of this positive assortment was due to a complex interaction of genotypic differences among subfamilies in their foraging preferences and tendencies to dance.

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Dr. Eric Mussen, UC Davis getting stung.
(photo by Kathy Keatley Garvey)

Honey Bee Allergy

Nancy **Wade, MD**
Board Certified in Allergy, Immunology and Pediatrics

Jack M. has been a beekeeper in Keene, NH for over 10 years. Like most beekeepers he has suffered uneventfully through many beestings. He considers it a hazard of the job. In October 2011, however, he had a sting that was different from the rest. Almost immediately after the sting, he began to feel itchy all over, turned bright red and developed hives over his chest and abdomen. He went to the emergency room.

Jack had a generalized reaction to the honey bee venom, a rare but potentially life-threatening reaction. Approximately 3% of the adult population develops a systemic or severe allergy to beestings and 40 persons die each year from bee sting reactions. Symptoms following a bee sting are usually mild with pain and irritation at the site. Some people experience large local reactions where redness and swelling extend a distance from the site of the sting. A much smaller percentage experience systemic reactions like Jack did. In a systemic reaction, symptoms occur away from the site of the sting. Symptoms may include shortness of breath, wheezing, itchiness over the body, redness of the face and extremities, loss of consciousness, hives and trouble swallowing. Having a sting on the hand and developing hives on the chest and abdomen would be symptoms of a systemic reaction while having a sting on the right hand with swelling to the right elbow would qualify as a large local reaction. Systemic or generalized reactions are an emergency and should be treated immediately.

Beekeepers have frequent exposure to huge numbers of bees and therefore are at higher risk than the general population of frequent beestings. Beekeepers average about 58 beestings a year. The average person has far less exposure to beestings and much lower risk.

So what can be done? In the emergency room Jack was treated and fortunately did not have further progression of his symptoms. He was referred to a local allergist, advised to avoid getting stung again, and to carry an emergency EpiPen with him to use if he should have another sting.

Five types of bees are responsible for most allergic bee sting reactions. Yellow jackets are the most aggressive bees and are responsible for many beestings and reactions. They frequently build their nests in the ground and are disturbed by gardeners and landscapers. Wasps are also responsible for many stings. Honey bees tend to be docile unless disturbed. They are one of the few bees that leave their venom sac behind with their barbed stinger left in the skin.

Allergic reactions to honey bees tend to be more severe than those from other bee varieties, and honey bee allergy is more difficult to desensitize successfully. Venom allergy injections are approximately 95% successful in preventing systemic or severe reactions on subsequent stings. With honey bee injections, success is closer to only 80%. This is still far superior to the potential of 25-70% chance of a repeat severe reaction without allergy injections. Similarly while most people who have had three to five years of venom desensitization may discontinue their venom allergy injections, with honey bee allergy injections, treatment sometimes needs to be continued indefinitely to provide adequate ongoing protection.

An interesting finding among beekeepers is that with their frequent beestings, many actually desensitize themselves. Frequent stings act almost as allergy injections in providing a stimulus to the beekeeper's immune system to make protective antibodies. But not always! With Jack and countless other beekeepers the careful symbiosis sometimes breaks down, the bees feel threatened and sting. Whether or not a severe reaction will result can't be predicted.

At the allergist Jack was tested for five venoms including yellow jacket, yellow hornet, white face hornet, wasp and honey bee. He had an immediate reaction to honey bee venom. His doctor advised rapid desensitization since his risk of a repeat sting from a honey bee was high.

Jack is very happy to continue tending his bees. He receives a honey bee allergy injection once every month. He carries an EpiPen to use only if he were to develop another systemic reaction, unlikely on allergy injections. He wears a full protective suit when he tends his bees. The risk of a severe reaction is relatively low as long as he completes his treatment.

Beekeepers and the general public should be aware of the warning signs of a serious bee sting reaction. The reaction develops quickly and can rapidly progress to a life-threatening situation. If a person is having a serious reaction, call 911 immediately. If they have an EpiPen, encourage them to use it. BC

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Diseases and Pests In A Beehive

Larry **Connor**

Tenth In A Series . . . Examine How These Materials Are Used In The Hive

In this session, we will look at the nature of the beehive and how it supports a wide range of diseases, parasites and pests. The instructor's emphasis is on recognition of healthy bees and brood, and being able to detect that something is not right in the hive.

Classroom discussion

The social nature and nest of the bee colony provides a remarkable opportunity for disease, parasites and pests to develop and thrive. The treasure trove of resources bees collect – honey and pollen – combine with the tremendous riches of developing bee brood to attract creatures of a diverse nature that eagerly exploit these items as food. From the large powerful bear to the odoriferous skunk to a tiny pollen mite, various creatures stand ready to enjoy a meal at the colony's expense.

Nest habitats – in a tree trunk, a rock outcropping or the side of a building – provide a dark, humid and temperature controlled environment where both parasites and diseases flourish. The darkness allow insects like the **small hive beetle** and the **wax moth** to enter and hide in crevices in the comb so bees are unable to detect or physically remove them. Adult moths enter the hive at night, soon after dark, when they are harder for the bees to detect. Hive beetles enter hives that are weak, diseased, undergoing queen change, or are released from propolis prisons after being visited by a beekeeper, taking advantage of the disruption of ordinary colony control and entrance protection.

Integrating adaptions to bee behavior with a unique body shape allows ***Varroa* mites** to feed on the bee in the late larval and pupal stage within the darkness of the cell, at first hiding in the royal jelly and brood food deposited at the cell bottom as food for the developing bee. Once the bee emerges the adult mite crawls between the abdominal plates of the bee to feed on the haemolymph, or blood, of the bee. When worker bees are able to make contact with the mite they may attack it and damage its body, but the mite is only exposed to the adult bees during a short period of its life cycle.

Natural hives are unique combinations of architecture and bee modification. When we review the features of the bee nest, its volume, entrance size, and orientation to the sun, we realize that the bee colony has rather specific needs to occupy a space that is not too large or too small. New swarms begin comb construction from the top of the empty chamber, attaching beeswax to the wood or rock of the site. As the colony grows in size the bees build a large percentage of the comb they will ever need, doing so in about three months time. The wood or rock are cleared of debris and coated with plant resins called **propolis** that can be quite thick. The propolis serves to waterproof the nest while its remarkable properties reduce the development or rate of growth of numerous fungi, bacteria and viruses. The exception is the bottom of the nest, which seems to serve as a natural recycling area for the debris of the colony – dropped pollen, bits of wax, comb pieces and wood trimmings. The bees do not coat these materials with propolis, but seem to invite organisms to degrade this waste. Mites, small beetles, and other insects are found inside a hive feeding on the debris of the colony but pose no concern to the bees themselves.

This unique ecological habitat is complex and we continue to learn more about the relationship between various other organisms and the bee colony. It is remarkable that some beekeepers will place a hive over a nest of fire ants in the southern states as a means of controlling wax moths and other pests, without harm to the bees or their valuable resources. Newer beekeepers must learn to approach each non-bee occupant of a hive with the query – is this creature a threat to the colony, or is it actually beneficial to the social nest? Many hive occupants are undoubtedly benign, causing no harm to the bees but simply exploiting the cast-off riches of the hive.

Various pathogens from several disease categories are indirect benefits of the community feeding and stomach bee colonies use to share food and queen pheromones. Bacteria, fungi and viruses are easily spread throughout a colony by the mouthparts of contaminated bees to those that have not had contact with the pathogen. These diseases have exploited this unique bee behavior as a method of spread and growth within the hive, sometimes leading to colony death.

Laboratory activities

Examine bee free-nests of the bee colony for evidence of other organisms. These may be colonies that have died in the field, perhaps overwinter. Set all hive materials on heavy paper or layers of newspaper to allow for sanitary removal in case of disease contamination.

Look for evidence of wax moths for start, searching for the **trail of**

silk in the comb to the **chewed wood** where pupal cocoons were formed by the metamorphosing larvae. Look at the deposits of propolis in the hive, where the propolis is thickest, and consider how this has protected the bees. In natural nests examine the bottom of the nest for debris of pollen, wax, wood and other material found there. Then look at the wide range of mites, beetles and other organisms that thrive in this energy-rich environment.

Now examine the cells of wax. Find the cells where the bees raised brood. Look for remains of materials in the bottom of these structures. You need to carefully determine if there are dried dead bees, called scale, in these cells, as this may be due to one of the most dangerous bee diseases, called **American foulbrood**. The scale, formed from the diseased larval or pupa in the cell that has been killed by the ABF bacteria, will be tightly attached to the bottom of the cell. Submit a sample of the comb to a recognized government laboratory that will examine the material and determine that is or is not AFB. Once you finish the examination of material, treat the samples as if they are diseased, and seal up the hive bodies and sanitize all equipment that contacted the sample.

Another common cause of colony death is **starvation**. The bees crawl into the cell as part of the winter cluster and generate heat with the last of the honey available to them. Should the cold persist while they are unable to reach additional honey, the bees will die of starvation. Because the colony shares food, they will all die at nearly the same time. There may be stored honey in the hive located in comb some distance from the cluster. This honey is safe to use in other colonies or to harvest in most situations.

Bees that have died of starvation usually come out of the cell with ease when removed by a pair of laboratory forceps. Since the inside of a winter colony is moist due to colony respiration burning honey for heat, this promotes growth of fungi on the dead bees, and this can present as a pretty disgusting mess. Removal is more difficult, but not necessary. A frame with moldy, starved out bees poses no clear risk to a strong colony. Add a frame or box to a strong colony and return in a few days and you will find that much of the dead bees and fungal growth has been removed, the cells polished, and perhaps some new food stored in the cells.

Bees transfer the fungal spores with their mouthparts, making disease removal a challenge. Many beekeepers change the queen, looking for a more resistant stock as well as creating a break in the brood cycle, so the re-infection process if broken.

Colony debris should also be examined. Look for white and dark mottled cadavers of dead bees in brood cells as well as at the entrance. These are the dead bodies of a fungus-infested larvae form a disease called **chalkbrood**. This is often observed when the season has been cool and damp, although some strains of bees seem to be more susceptible than others. Chalkbrood spores are airborne and probably found in all bee yards – it is the environmental conditions that determine susceptibility. Drone brood seems to be more susceptible than worker brood.

Hive Inspections

Key to healthy hives is the beekeeper's ability to look at a colony and determine, accurately, that there are no problems in the hive. This is strangely difficult for some people to do. They see diseases in healthy bees and brood, but fail to recognize disease or infested bees.

Healthy bee recognition – Healthy bees will be fully developed, their wings will be crossed over their bodies and they will be at rest or actively working in the hive. Diseased or malnourished bees may be reduced in size, or their wings unhooked, creating a condition called **K-wing**. Don't confuse newly emerged worker bees with those that are deformed. Bees being removed by other bees at the entrance should be examined for deformities. They may also be old or pesticide-exposed.

Healthy brood recognition – Eggs, larvae and pupae are pearly while and shiny. Any discoloration, yellowing, browning, or lack of shine should command a second look. Bees removed in the sealed pupal stage

A disturbed wax moth larvae moving rapidly over a brood comb. Even the smallest larvae move quickly, and are usually hidden in silk in the midline of brood combs, or along edges until the colony is overtaken. Wax moths are Lepidoptera, and lack the spines on the body that are found on the small hive beetle, order Coleoptera. Most beekeepers keep there colonies strong and healthy to avoid both beasties!

should show normal pigmentation and be free of *Varroa* mites. Drone brood is about nine times more attractive to *Varroa* than worker brood, so look there first. *Varroa* mites move quickly and are sometimes missed on inspection.

Screened bottom board droppings – I recommend the use of screened bottom boards as a means of increasing hive ventilation as well as providing a means of detecting problems inside the hive. The obvious use is to insert the tray that is part of the screened bottom board, apply cooking spray or another sticky material, and return in two or three days and count the number of *Varroa* mites found on the board. Small hive beetles and wax moth larvae will also fall through the screen and be detected there. Wax moth caterpillar droppings are easily recognized as symmetrical cylinders of dark material (not round mites). Other secondary pests are found there including other beetles and pollen mites, so examine with care and get help or submit a sample if suspicious of something that does not appear right. BC

Once wax moths take over a weak or dead colony their population explodes. The larvae feed on the pollen, broodcomb and beeswax. They produce silk cocoons that are the larvae chew into the wood and fasten the silk to, making removal difficult. Freezing kills the wax moth, so outside storage is better then heated storage. The black fecal pellets are one of the things a sharp-eyed beekeeper looks for on a tray in a screened bottom board.

Vocabulary

Colony social nature, nest habitat, wax moths, small hive beetles, role of darkness inside the hive, bee blood, nest architecture, nest volume and characteristics, new swarm comb construction, material at the bottom of a hive, debris feeding insects and mites, bacteria, fungi, viruses, contaminated mouthparts, trail of silk, chewed wood, propolis deposits, American foulbrood, scale, disease sanitation, starvation, reusing comb after dead-out, chalk brood, hive inspections, disease cadavers, characteristics of healthy bees, characteristics of healthy brood, screened bottom board evaluation.

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The Voice Of The South Should Be Used To Teach Children

Remember When You Got Hooked?

One of my hobbies is birding or bird watching. I came to the activity rather late in life, but when not keeping bees, I can usually be found searching for the feathered gems wherever they can be found. I frequent saltwater marshes, swamps, bottomland hardwoods, pine and deciduous forests and open fields identifying all bird species encountered. I even enjoy identifying birds from their songs while working in the apiary. The challenge of species identification is the game, and the activity is an excuse to get outside and enjoy nature. Most of my birding friends and I realize that we are all probably addicts – doing way too much of the activity and getting way too much enjoyment from it. But there are worse things to which one could be addicted.

Often in my conversations with other birders we discuss the spark bird – that memorable first interaction with a bird that made each of us want to learn more about birds. For some the spark bird was a beautifully gaudy bird seen for the first time. For others, the spark was seeing or hearing a common bird doing unusual things (e.g. a Red-bellied Woodpecker, banging on a metal utility pool to announce his territory). For me, the spark was seeing a Rufous Hummingbird in south Louisiana during the Winter. I had no idea that up to nine species of western hummingbirds regularly visit the southern U.S. during the Winter. Inquiring about the Rufous hummer opened a whole new world to me, and I will always fondly remember that moment of surprise on a cold January day.


Rufous Hummingbird

It recently occurred to me that my introduction to beekeeping was also sparked by a first memorable interaction. My uncle kept bees in log gums in southern Appalachia, and he took me to see the bees up close and personal during a family visit to his farm. I will always remember the taste of honey from the small sliver of comb that he cut directly from one of the hives. We stood there without veils, protected by the gentle puff of cigarette smoke that he had blown into the hive entrance, and the buzz of intense foraging activity filled the air from about 20 hives. Although naturally afraid of being stung, as a five-year old boy I trusted my uncle to protect me as he explained the basics of bee biology. His stature grew in my young mind as I watched him casually scrape a stinger out of his hand after a worker had stung him when taking my honey sample from the hive. My uncle was an instant hero to me, and I was hooked on beekeeping for life.

During the last few years many of us who keep bees have felt a palpable concern about declines of honey bees and other pollinators from the non-beekeeping public. The caring attitude always seems genuine when a person asks me, "So, how are the honey bees doing these days?", and probably reflects an understanding of the importance of honey bees as pollinators that many people at least partially understood even before "CCD" became a household term. Although not at the level of reverence held for the honey hunters in some tribal cultures of Nepal, I have always sensed something beyond curiosity when someone discovers that I am a beekeeper. Overt fascination as indicated by a barrage of questions about bees and beekeeping is a common response. I even remember a woman who declared almost with pride, "Wow, I have never met a beekeeper before!" It was almost as if she could finally scratch that one off her bucket list. Part of the fascination


Red-bellied Woodpecker.

Exposing kids to insects at Bug Camp held at Mississippi State University.

probably stems from the intrigue that non-beekeepers have for people that deliberately interact with an animal that can inflict intense pain. They may think that, "Gosh, I could never do that; or could I?"

It is this spark of curiosity that we as beekeepers can leverage to recruit newbies to our ranks. Although I found it comical at the time, I once worked many years with a commercial beekeeper who knew full well of his unique social status as a beekeeper in the southern city where he lived. He loved being the beekeeper that everybody knew, and folks were magnetically drawn to him whenever the opportunity arose. Perhaps it had more to do with his personal charisma than anything else, but I suspect that a more general social phenomenon was also at play.

Many mornings I would meet my boss in a local café for breakfast. Often I would arrive a little before he did, and I could watch the spectacle of his grand entry. A chorus of "Joe" would ring out from the locals when he walked in the door – just like "Norm" rang out in the bar room of the television sitcom "Cheers." Old Joe would then shake their hands and converse with farmers and old friends as he slowly made it to our table. As he mingled I could hear questions about bees, the state of the current honey crop, how the recent weather might affect the beekeeping business, and so on. Old Joe had a booming, jovial voice, and he could probably be heard blocks away as he answered the clamoring crowd. I would often begin sipping my second cup of coffee before he would finally reach the table.

Although he surely enjoyed his stature, Old Joe was often very quick to use his unique position to correct misunderstandings that non-beekeepers had about honey bees. He would reclassify scientific facts as some knew them to be mere folklore, and he did his best to counter the hyperbole surrounding the threat from Africanized honey bees. He also recruited and energized younger folks like myself to stay in beekeeping. He loved teaching his skill set to younger beekeepers, and I loved learning from him. I suspect that he was more than a little disappointed when I chose to be a scientist rather than a commercial beekeeper, but he was happy that I kept working with honey bees. When I reflect on those days, I know that Old Joe understood his important roles as ambassador for beekeeping to the non-beekeeping public and as mentor to new beekeepers.

I was more recently reminded of the power that an individual can have in sparking an interest in honey bees to others. I was returning to Starkville, MS from Great Britain where I had attended a meeting with other bee scientists. It was about 18 hours after beginning my return trip that I stood in line at the Immigration and Customs re-entry at the airport in Atlanta. It was the typical scene of hundreds to thousands of people standing in lines that inched along through multiple gates. There were the obviously anxious folks that surely were going to miss connecting flights, the sleep-deprived and weary, and some that expressed a rather bovine stupor as they stood in yet another long line. I probably fit into the latter group.

Finally, it was my turn to step up to the booth to seek clearance from the immigration officer. He was a gray-haired man of mid-sixties, and he began the standard questioning with a nearly bored monotonous manner. He asked my origin, reason for visiting England, and my final destination, and periodically he clicked the mouse of his computer in response to my answers. I explained that I was a scientist participating in a meeting of like-minded scientists and that I was returning home to Starkville.

More activities at Bug Camp.

He paused and asked what kind of scientist. My response completely changed him; the lifeless automaton instantaneously transformed into a smiling and excited chatterbox about honey bees.

He had been a student at Mississippi State University some 30-40 years ago, and he had taken a course in apiculture from entomology Professor Henry Green. He told me a couple of stories about catching his first swarms with the help of Dr. Green, and how much fun he had in learning about bees in that course. It seemed like we talked for 15 minutes; enough time that groans of displeasure emanated from the folks waiting in line behind me. The immigration officer (I never got his name) was beginning yet another story about Dr. Green when I decided that I had better interrupt him and move along before those angry folks behind me rioted. He was about to relay a now legendary tale on the MSU campus; one that I had heard from four or five different folks in my first months on campus. Dr. Green apparently kept his pipe tobacco in the carrying bag in which he carried ammunition for his 0.22 caliber rifle. The practice stopped when his pipe literally exploded while he was walking through the MSU student union. Amazingly, no one was hurt, and the stray bullet was never found.

I apologized for interrupting, but pointed out that a mutiny was about to take place if I did not move along. The officer looked behind me and begrudgingly agreed. I gave him my contact information and invited him to visit me whenever he was on campus, and we would surely visit my apiaries and talk bees. He boomed a big smile and agreed to look me up. As I walked away, a burst of applause erupted from the impatient mass. I heard the officer explain to the next in line that we were talking about bees, and that man walking away is a bee scientist! Unimpressed, I heard the sarcastic retort, "Well, at least the conversation was important. Cheeez!" I raised my coat collar to conceal my face as I slinked to the next line.

I smiled to myself when I finally sat down in the jet plane that was the last portion of my journey home. I could tell that Dr. Green's effect on the immigration officer was akin to the influence that Old Joe had in my life. So, maybe a big part of the explanation was based on charisma after all. Although I have never met Dr. Green, I have heard from several that he was indeed a true "character." However, I also felt that honey bees themselves were important to the immigration officer. He spoke fondly not just about the instructor but also about the bees. I could tell that the entire experience of working bees – the sounds, smells, tastes and textural components – were very important to the man's memories. There was an almost primal quality to his allure to honey bees; something similar to cave men and fire. I drifted off to near sleep wondering if I had ever had such an impact on another person.

Although folks of any age can be brought to beekeeping, it is especially satisfying to watch children as they tackle and engulf new knowledge about nature. A great venue for exposing kids to insects has been the Bug Camp held at Mississippi State University every Summer. It is

Bug Camp.

a Summer camp where kids stay in dorm rooms on campus for a week, and they participate in many hands-on activities that teach them about insects and entomology. Beekeeping is featured for several hours during one of the days. Other activities include some classroom lessons about insects and plants, but the highlights are always the pure joy of getting outdoors to collect and observe insects in wild places. The overriding goal of Bug Camp is to stimulate an interest in insects when kids still remain open to learning just about anything, and the hope is that some of the kids become professional entomologists later in life. If nothing else, many participants develop a deep appreciation for the important role of insects in our natural and agricultural worlds.

MSU's Bug Camp, now Bug and Plant Camp, is entering its 19th year of operation and throughout that time has steadily produced entomologists. Children like bugs, and for some this fascination does not wane as they age. Campers return year after year. For around a dozen, the effect was influential enough that they remained interested in entomology through an undergraduate biology or biochemistry degree and entered master's entomology degree programs. Several have now entered doctoral programs and there are a lot more in the pipeline. Of interest is that children begin making

important contributions along the way – finding and naming insects that are new to science or their state, discovering potential threats to crops and becoming active in entomology education programs at BugFest (an annual festival that celebrates insects and is held at the Crosby Arboretum in southern Mississippi) and other venues. They also become the entomological resource persons in their families, schools and communities.

I cannot wait to participate in the MSU Bug Camp this upcoming Summer. It will be my first chance to help stimulate kids in Starkville, and I genuinely want to excite them about honey bees. Even if I can snag only one into the ranks of beekeepers, I will feel a great success. I want the experience to be that spark that opens our unique beekeeping culture to a kid. I would be excited if an attendee took up beekeeping as a hobby, but it would be pure joy to see one become either a commercial beekeeper or a scientist studying bees. Perhaps this is day dreaming from someone who already does not have enough time to do what his job requires, but it would be cool to develop a Young Beekeepers Camp, not to compete with Bug Camp, but to more intently promote beekeeping to children? There is never enough time. BC

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HOW I DO IT –

Importantly – Do I even *want* to clean up and recover Winter-killed colonies?

James E. **Tew**

In my article last month...

In my article last month, *"How do I recover from an unexpected Varroa attack?"* I had a bit of a controlled tantrum. In fact, several months later, I still am not totally over the disappointing loss of some of my colonies to an unexpected *Varroa* assault. For me, it was a personal beekeeping moment that I frustratingly made public. Though I have written about events like my surgery and the birth of my grandkids, writing about my bees dying really had an odd taste about it. All the personal events that I have written about were beyond my control. Surely there was something I could have done to forestall my bees dying. After all, I am the beekeeper.

Some of you wrote offering advice, while some of you wrote offering sympathy. The majority of you didn't communicate with me. No doubt many of you just wanted to avoid me in case I and my bees were contagious.

Regardless of my personal situation, winterkilled colonies are a beekeeping fact. It seems that no matter how dedicated an effort one makes, there are always colonies that are annoyingly insistent on dying.

Some Traditional Colony Suggestions for Successful Wintering.

1. *A young, productive queen.*
2. *Honey stores that are correctly positioned. (Amount varies with location but generally 40-65 pounds of honey.)*
3. *Four – five frames of pollen near the brood nest.*
4. *Strong population of healthy bees (50,000+).*
5. *Basic hive manipulations performed (e.g. entrance reducer installed, inner cover reversed, and upper ventilation and upper entrance provided.)*
6. *Protected Location.*

In general, the colonies I am discussing have no business dying, but die they do. During late Winter and Spring, winterkills are a common beekeeper discussion at meetings. *"What did I do wrong?"* Most of the time, it was something routine, like starvation or a queen dying, but sometimes good colonies just die, and we will never know why. In my case, *Varroa* played a major role. Poor wintering genetics can also be important. Colonies can look good in late Summer and Fall, but turn up dead in the Winter. Sometimes you lose. (In my case, that should read, *"Sometimes I lose."*)

My colonies dying so dramatically remind me of a nightmarish runaway football score where a perfectly good team shows up and does horribly during the game. While that score goes in the stats forever, the team continues to practice and play. Life goes on. In my bee life, I will never forget this past season, but there will be honey bees in my life this Spring and I will try again. While I am disappointed and annoyed, I still love beekeeping. I will carry on. Right now, I have a mess to clean up.

But it will not always be *Varroa* and *Varroa*-related issues. Several other common reasons can result in colonies dying in Fall and Winter.

The Dead Colony's Autopsy. Varroa, Wax Moths, American Foulbrood and Nosema.

Depending on the location of the beekeeper, various procedures are required to recoup Winter losses. In warm climates, the wax moth is a relentless taskmaster. The combs are often destroyed before the colony is completely dead. Warm climate beekeepers must be doubly alert or their problem is compounds – they can lose bees and comb. In cooler climates, the situation is still bad, but not so urgent. The first thing a beekeeper should do with winterkilled equipment is to determine what caused the colony to die. One obvious concern is that spore-forming American Foulbrood (AFB) may have been the problem. If foulbrood has been a problem in the past, the beekeeper should contact the state apiary inspector and have a competent assessment made. At times, Nosema is a problem. Unfortunately, Nosema is difficult to diagnosis and the remedy is somewhat expensive. Excessive defecation spotting is an indication of dysentery. While my *Varroa* deaths were frustrating, at least the equipment is readily reusable. *(Sorry, I must find something positive wherever I can.)*

Starvation.

Starvation has distinct characteristics. The cluster will be in a tight (and dead) group, probably near the center of the colony with single dead bees scattered about. Upon removing frames from the colony, many bees will be seen in cells with their heads toward the center of the comb. Meager amounts of any honey will be in the colony. Occasionally, patches of honey will be found scattered throughout the colony, but bees were unable to get to it before chilling.

Once the reason for the winterkill has been determined, the beekeeper must then decide what to do with the equipment. Diseased equipment should be destroyed or sterilized depending on the disease pathogen. Colonies that starved should have dead bees shaken from the equipment and comb as much as possible. True, new bees will remove all the dead bees from the equipment, but critical time can be saved by assisting the bees with this task.

Re-Establishing Hives. Spring Colony Splits.

Logically, most beekeepers want to restock their winterkill equipment. Several techniques are possible. Unless the beekeeper has had extremely bad luck, some hives probably survived the Winter. Depending on the strength of the surviving colonies and the subsequent season, bees and brood can be taken from surviving colonies, along with a new queen, and put in refurbished winterkill equipment. The strength of the split is an arbitrary decision the beekeeper must make. The stronger the split, the more likely the colony will survive the Winter. However, the stronger the split, the more likely the beekeeper will not get a honey crop from the original colony.

Provide Mated Queens.

I would strongly suggest placing a mated queen in the re-established colony as opposed to letting the bees produce their own. If winterkills have been a problem, one should do everything possible to improve management techniques for the next Winter. If bees are required to produce their queens, too much time is lost during the nectar flow. Brood and bees from several colonies can be mixed to form a new colony. Smoke or some other disruptive agent (air freshener or newspaper barriers) should be used to mix the bees from different colonies to minimize fighting.

I need to admit that finding a high-quality mated queen when she is needed has become a challenge. Bees and queens are in high demand. Producing your own queens is certainly an option but much has been written and writing more at this point is beyond the subject of this piece--but consider producing your own queens.

Buying Package Bees.

Another common technique for restocking hives is to purchase package bees. This is a simple and proven procedure for getting colonies back into operation. In order to book the arrival date most convenient for the beekeeper, package producers, listed in the bee journals, should be contacted as early as possible. If bees are all that's needed, queenless packages can be purchased. Colonies that survived the winter in a weakened condition, but alive, can be boosted with the addition of a few pounds of healthy adult bees. Contact individual package producers for the details on queenright or queenless package purchases.

A small winter-killed cluster. Note the queen on the left hand side

As I admitted in my previous article, I will be purchasing some packages this spring, but for the first time in my life, I will provide *Varroa* treatments to them until I am sure that my recent scourge has passed.

Buying Colony Splits.

Colony splits have the advantage of not having the *"Post Package Population Slump."* After a package of bees is installed, the adult population declines until new bees are produced by the colony. Since brood is included in a colony split, adult population decline is not as great. Subsequently, the colony builds up faster and is better prepared to withstand the upcoming Winter.

To the best of my knowledge, there is not a "standard" split. The beekeeper must contact other beekeepers who are selling splits to determine how many frames, how many adult bees, and how many developing bees will be in the split. The buyer should also determine if frame replacements are required. It would probably be a good idea to check with the state inspector to be sure the individual has a good record of disease control. Occasionally, special deals may be worked out with another beekeeper for the purchaser to provide the manual labor required to make the splits. It makes sense that on-site pickup of the splits will considerably reduce the cost of shipping (assuming there's no long drive involved).

Swarms.

I seriously doubt that there's a beekeeper anywhere in the world who doesn't have a slight rise in blood pressure at the mention of a big swarm. In fact, swarms are an excellent way to restock winter killed hives. The only problem is that they are so unpredictable and, due to mite predation, they have become somewhat uncommon. They are also inaccessible at times – requiring great feats of strength, bravery, and agility (maybe other descriptive terms would have been more appropriate here).

The "Dead-Outs"

"Dead-Outs" are simply colonies that died during the Winter – whatever the reason. There are few reasons to wish for colony winterkills, but if it happens, the beekeeper has a window

Checking old combs.

to perform routine hive maintenance and late Winter busy work.

Fix and Repair. Old or Busted Frames.

Increasingly, I am agreeing with those people, who years ago, were recommending the disposal of old, dark combs. Use common sense here. If the frame is still perfectly useable, then use it, but if it needs extensive repair, is distorted, or has a lot of drone brood, toss it. (Actually, they make great kindling for a fire to keep you warm while working.) The reason for my change-of-heart is the possibility that pesticides are accumulating in old wax and the increased concerns about old combs harboring viral and bacterial pathogens. My general recommendation...use old comb, but don't become attached to it.

Scrape Propolis and Burr Comb.

Bees busily apply propolis in the Spring; you busily remove it during the Winter. While the frames are out, scrape propolis and burr comb so the frame fits more cleanly in the hive body. I'm not sure why, but I always save the propolis scrapings. I've never sold any, but I confess that I do like the smell of fresh propolis.

Various tools are available for removing propolis. I use an industrial heat gun to heat the hardened propolis. Once softened, it is easily scraped from the equipment – plus the shop smells good.

Repair and Paint.

There will never be a better time to scrap, repair, and paint the hive equipment. It's cathartic. From a dead hive, you remodel, restore, and reinstall a new colony. I feel frugal, but a radio and a warm fire help with potential boredom during this Winter task. If you mark or brand your equipment, do it now, just before repainting.

Sisyphean beekeeping

I know that most of you have read, or heard, the story of Sisyphus. In the underworld of the dead, as his penalty for sly and evil deeds, he is forced to roll a stone up a steep hill. As he nears the top, the stone tumbles back down. Sisyphus must then begin again – and again – and again -- forever. In a bit of a similar way, I share Sisyphus's penance. Each spring, I will start beekeeping again or I will continue to pursue beekeeping until all my colonies are healthy and productive. For me it is not a penalty. *I want to continue rolling that rock up that hill.*

From the bleak disappointing death of a colony arises the birth of a new, refurbished colony in a clean hive – but too many deaths are indicative of management procedures that need to be improved. I have discussed some of my changes at length in my previous article. But all beekeepers should be prepared for some colony deaths each year. Take it in stride and prepare the equipment for the re-establishment of a new colony the next Spring. Thoughts of Spring can make the coldest Winter day more tolerable. *(More than for you, those last comments are for my benefit. Thanks to all who corresponded with me on this subject.)* BC

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USING A SMOKER?

Ross **Conrad**

If you do, do it correctly. If you don't there's alternatives.

The modern day smoker – The use of smoke to work with bees has a history that is recorded in ancient Egyptian hieroglyphics and cave paintings that are thousands of years old.

One of the primary tools that beekeepers use when working with honey bees is the time-honored practice of using smoke to confuse and distract the residents of the hive. According to some of our most ancient historical records, smoke has always played an integral part in working with honey bees. Although the types of materials used to create smoke and the various forms of applying smoke to hives have varied throughout the centuries and from culture to culture, the basic concept has remained the same: to distract the bees and disrupt their communication. Because smoke by definition contains pollutants and toxic gases, the type of fuel used in the smoker is extremely important. Recognizing the necessity of using smoke when working with bees, modern-day organic regulations allow the use of only those smoker fuels that are derived from natural sources. In this context, the definition of natural means "in its original form, without added chemicals or ingredients." Hence, materials such as newspaper, cardboard, and treated burlap – as well as any other material that contains petroleum-based or synthetic substances – are prohibited, whereas wood shavings, pine needles, leaves, dried grasses, and sawdust are all considered acceptable.

Of all creatures in the wild, the moth is the only one famous for not having a healthy fear of fire. Most animals and insects – the honey bee included – will head the other way when they smell smoke. The beekeeper capitalizes on the honey bee's natural fear of fire by sending smoke on a mission to spread alarm deep within the dark recesses of the colony. After sensing smoke within their chambers, the worker bees can often be seen gorging on honey stored within the cells of the honeycomb in preparation for a hasty retreat, because they have been misled to believe that their hive may soon be consumed by fire. When the bees are distracted by the message of imminent hive destruction, the colony's inhabitants are much less likely to worry about any intrusion into their midst. At the same time, the warning alarm pheromone given off by the agitated bees guarding the entrances to the hive – that serves to warn the rest of the colony in an effort to rally the troops to their common defense – are masked by the scent of the smoke. This temporarily shuts down the hive's primary form of communication and organization.

When it comes to such an integral part of beekeeping as the use of smoke, the proper and effective use of the gaseous products of combustion cannot be overestimated. It is certainly true that through trial and error even a novice is able to learn many of the basics of what works and what doesn't when using these tools of the trade. Teaching yourself about beekeeping through the school of hard knocks, while not necessarily easy, can provide an excellent education – though the tuition is high, because the bees are quick to let you know when you're not making the grade.

I have found the following approach works best for me. Keeping in mind that heat rises so you want your fire located on the bottom of the smoker and unburnt fuel above, clean out all the ashes and partially burned fuel in your smoker and place a little fresh, well-dried fuel in the bottom of the smoker cavity. Light the fuel and work the bellows with short, quick squeezes until the fuel is burning well. I look for flames shooting up out of the top of the smoker as a sure sign that there is "fire in the hole." It is important to be conscious of the direction of the wind and how close you, your clothing, and your equipment come to the exposed flame. You don't want to melt the screening on your veil or singe any hair, if it can be helped.

Once you have a good fire going, add another handful of fuel to the smoker, and again work the bellows with rapid, short blasts of air until this additional fuel is well lit. Now that you have a good hot fire burning in the bottom of the smoker, fill the rest of the fire chamber with more fuel, close the top, and you're ready for action. Care must be taken not to pack this final addition of fuel too tightly into the fire chamber or you run the risk of smothering the fire. Should you find that, after setting the smoker down for a period of time, the amount of smoke produced is reduced to a mere wisp, then making short, rapid squeezes of the bellows for 30 to 60 seconds should be enough to rekindle the burning embers within the smoker's fire chamber, unless the fire has gone out completely.

Once you have the smoker lit and the fire chamber full, making the most effective use of the smoker requires some practice. A smoker can be used not only to distract and calm the bees but also to push the bees in a certain direction, either toward or away from an area. A typical mistake that many beginners make is to use too much smoke, perhaps in the mistaken notion that if a little smoke is good, then a lot must be better. It takes just the right amount of smoke, at just the right time and from just the right direction, to prod the bees into going where you want them to go. Use too much smoke and the bees will just run around in circles, confused as to where to find a breath of fresh air. Use too little smoke and the bees will act as if there were no smoke at all and place their focus on things that we would prefer they would ignore, like the tip of our nose. For the bees to move, they need to be able to identify where the smoky areas are (places they will move away from) and where the areas clear of smoke exist (toward which they will naturally gravitate). The beekeeper can use this behavior to "herd" bees in the desired direction. Again, noting the direction and speed of the wind can play a critical role in either helping or hindering your efforts, and care should be taken to position oneself advantageously.

It is also important to pay attention to the quality of the smoke that issues from the smoker. The smoke should exit in thick white clouds and feel cool to the touch. A sure sign that the fire within the smoker has made its way to the top of the fuel pile and that your fuel needs replenishing is the appearance of hot, thin, gray smoke. Miss this telltale sign and you will likely end up with sparks, or perhaps flames shooting out of the smoker and singeing your bees. Trust me, blowing hot gray smoke, flames, and red-hot cinders onto your bees is a great way to make them upset with you really fast. If the fire is approaching the top of the fire chamber and you don't have enough fresh fuel to refill the smoker, one trick is to place a wad of green grass on top of the burning fuel. This will serve to cool the fire and will help prevent flames and sparks from exiting the smoker and overexciting the bees. When all the work is completed and you're ready to put away the smoker, it is a good idea to plug the smoke hole with a wad of green grass or a cork to limit the amount of fresh air available to the burning material inside and help smother any hot embers that remain. To be extra safe, it is wise to store your smoker in a metal can that has a lid. It can be very disconcerting to be driving down the road, look in your rearview mirror, and see flames shooting up from your bee equipment, all because a smoker was not fully extinguished before being stowed in the back of your vehicle. Keep a fully charged fire extinguisher handy in any vehicle or building that is used for beekeeping purposes on a regular basis. When properly used, the smoker becomes one of the best pieces of protective beekeeping gear you can own. Just make sure you don't run out of good-quality fuel that is dry and ready to burn!

An alternative to the use of smoke as a means to make the bees manageable is the use of a one-to-one dilution of sugar in water. This solution, applied in the form of a fine spray, not only distracts the bees as they lick the sweet syrup off one another's bodies, but also serves to wet down their wings – in effect grounding them so they can't fly after you. Although not a viable option in cold weather (it is unwise to allow the bees to become cold and wet, because they too can die from a form of hypothermia), the use of a sugar spray can come in handy when no matches or dry fuel are to be found, so long as you are a beekeeper who doesn't mind providing support to the sugar industry.

There are beekeepers who promote the idea of not using smoke at all. Their reasoning is that smoke is toxic and that the bees don't like having smoke blown in their faces, and thus smoking the hive is too disruptive and not good for the bees. However, any beekeeper who has smoked a hive and then continued to work there for 10 to 15 minutes can attest that the bees ventilate the smoke out of the hive and reorganize themselves relatively quickly. Nevertheless, some folks continue to claim that not using smoke is not only better for the bees, but also better for the beekeeper, who won't be exposed to second-hand smoke. Some beginner beekeepers even assume that the increase in pitch and volume of the sound emanating from a hive when smoke is applied is evidence that smoke makes the bees angry. This is a misconception; the sound is simply the result of increased wing fanning by the bees to blow the smoke out of the hive.

By wedging the nose of a smoker between supers that have been separated, the beekeeper has time to reach around and grab the handhold while the smoker prevents the upper super from dropping back down and crushing bees.

I concede that smoke is toxic, bees don't really like it, and it would be better if beekeepers didn't have to use it. However, in most cases, the potential for harm from not using smoke outweighs the harm caused by using smoke. The exception to this is when a beekeeper is so gentle and respectful working a hive without smoke or sugar water spray, that they do not need to wear any protective clothing at all.

When a beekeeper does wear protective clothing but does not use smoke or a smoke substitute (or does not use the smoker properly), the bees may become defensive and start to sting. In the process of stinging, many bees die, because their stingers lodge in the protective clothing and tear loose from the bees' bodies. When smoke is used properly to distract the bees and disrupt their communication, far fewer bees are incited to sting, and thus to die, in defense of their hive. I believe that whatever harm may be done by exposing a colony to smoke for a brief period during a hive inspection is far less damaging than having bees die during hive manipulations because no smoke is used. BC

Ross Conrad will be teaching an advanced organic beekeeping course in Lincoln, Vermont at the end of March. For more information visit ***www.dancingbeegardens.com***

Protecting Pollinators & Beneficials

Jennifer **Berry**

UGA Is Reaching Out This Year

Last October, staff from the UGA bee lab traveled south to Moultrie, Georgia to participate in the Sunbelt Ag Expo Show, which, for 35 years, has showcased the newest innovations in agriculture. The annual Expo is housed on a 100-acre site and features over 1,200 exhibitors. One of those exhibitors was Rossman Apiaries. Fred and Ann Rossman have been attending the Sunbelt Expo for over a decade now. Fred explained that they had decided to exhibit because it was an excellent opportunity to educate the public about honey bees; plus, they only had to travel a few miles from their business location. Every year, they display beekeeping equipment and observation hives for the public to see. They also offer educational materials about the importance of honey bees and the role they play in agriculture – not only in Georgia, but world-wide.

While walking around Expo, it was amazing to see every kind of agricultural equipment imaginable: big tractors, small tractors, red tractors, blue tractors, bush hogs, sprayers, diggers, and harvesters. Everything you could possibly need in the agriculture business was on demonstration. Alongside all this machinery were research specialists from the College of Agriculture and Environmental Sciences (CAES) offering helpful, educational information to the public. The college's theme this year was "Pollinators and Peanuts," which provided the perfect opportunity to launch our "Protecting Pollinators and Beneficials" program.

Here at the UGA Bee Lab, one of our most important goals is to disseminate information about all aspects of beekeeping to the public. We accomplish this through direct consultations, our website (*http://www.ent.uga.edu/bees*), the Young Harris Beekeeping Institute (May 9-11), exhibits, publications, classes, workshops and lectures to local, state, national and international audiences. It is also our goal to educate the general public on the importance of honey bees, other pollinators (bumble bees, mason bees, sweat bees, digger bees, butterflies, moths, flies, bats, hummingbirds, and flying squirrels) and beneficials, along with how to protect and encourage their presence. By "the general public," I'm referring to non-beekeepers, since most beekeepers already have an understanding of the importance of honey bees. For instance, the average American usually doesn't realize that honey bees are responsible for the pollination of about 1/3 of the food that we consume. Most folks, and I was one of them years ago, have no clue where their food comes from or how it even becomes food to begin with. So, it is important that the public be informed not only about pollinators, but beneficial species as well.

We all know the definition of pollinators. When we speak of beneficials, we are talking about any organism that feeds upon or parasitizes unwanted pests in the farm, orchard, garden, landscape setting or turf grass. They benefit the growing process by reducing the extent of botanical injury by pests. These "good" insects, such as praying mantises, ladybugs, green & brown lacewings, dragonflies, tiger beetles and spiders (e.g., garden, jumping and wolf spiders), are some of the most common beneficials around. They eat agriculturally destructive insects such as whiteflies, aphids, plant bugs, and potato beetles, but, since they're not particularly discriminate eaters, they also sometimes eat each other. Notably, most parasitoid wasps are species-specific, only attacking one species of insect. For instance, the braconid wasp, *Aphidius ervi*, parasitizes exclusively the pea aphid. While parasitoids can act externally or internally, the ones most important to agriculture parasitize internally (endoparasitoid). Another parasitoid wasp, *Encarsia formosa* is used commercially for the control of the greenhouse whitefly, *Trialeurodes vaporariorum*, on greenhouse-grown vegetable crops and to a lesser extent ornamental crops. Some parasitoid wasps are tiny, measuring less than 0.6mm. Endoparasitoids pierce the integument of the host-insect of choice with their ovipositors and deposit their eggs. These eggs hatch into larvae and begin to feed on internal tissues; this eventually kills the host, which is a good thing, since now the destructive pest is no longer dining in your garden or yard.

Rossman Apiaries set up at the Sunbelt Ag Expo.

Praying mantis eating grasshopper.

Unfortunately, homeowners are some of the worst abusers of pesticides. Panic-stricken after having seen a **bug** ("Oh, my!"), too many rush off to the nearest big box store and grab the bottle that promises instant, devastating and the longest-lasting results. Then they race home, haphazardly toss a "feels good" amount of the concentrate into a pump sprayer without reference to written instructions, and proceed to douse the garden or yard indiscriminately until saturated. Unfortunately, the "menacing intruder" that initially gave rise to this environmental tragedy was quite possibly not even a true pest. It may have just been an inconsequential passerby or, even worse, a pollinator or beneficial! The problem with using broad-spectrum pesticides is they eliminate all bugs in the system, the good along with the bad. This is why it is important to first know the beneficials from the pests. I'm not suggesting that everyone becomes an entomologist, but at least have some appreciation of the environment as a whole and be open to strategies to target specific pests. This year, our lab will be focusing on this very objective: to raise the public's awareness of the good verses the bad bugs.

Parasitized caterpillar. (photo by David Cappaert)

The orders which include most of the bad bugs are Orthoptera (grasshoppers, crickets and katydids), Hemiptera (true bugs, which include, aphids, lacebugs, scales, spider mites, and spittlebugs), Coleoptera (beetles, Japanese beetles, and flea beetles), and Lepidoptera (butterflies and moths, with the caterpillars doing the damage).

Once identified as a pest, the next step is to determine if a bug is actually causing enough damage to be harmful to the plant as a whole. Direct injury is physically eating the leaves, sucking sap or burrowing into stems, fruit, or roots. This is usually apparent upon inspection of the plant; some examples are holes in leaves, necrotic spots on fruit or stippling on leaves and stems. Indirect injury is the secondary bacterial, viral, or fungal infection transmitted to a plant by a pest via direct injury. A few examples of this are chlorosis (change in leaf color), growth malformations, loss of vigor, and leaf wilt.

Now, most plants can tolerate some infestation and infection. Problems arise when that infection or infestation goes beyond the threshold of what the plant can handle. A few aphids or whiteflies on your tomatoes are usually not going to cause the plant to die or reduce yield. However, a few thousand is another story; this is when we may need to take incursive action if we want any tomatoes.

But, before reaching for that can with the skull and crossbones, first try one of several less-toxic approaches such as physical controls. For example, soft-bodied insects, such as aphids, are no match against a strong, steady blast from a water hose. Or, better yet, a pair of fingers can work wonders, squashing, picking and flicking off these guys while inspecting stems and leaves. This is a regular practice of mine in my veggie and flower garden. "Hasta la vista, Baby!!!"

When there are no other physical control options and pesticides are necessary, there are still several simple "tricks" to reduce undesired side effects. Try the softer chemicals first. For instance, insecticidal soaps or oils are excellent alternatives to use in place of the harsher chemicals, and are sometimes much cheaper. Again, they work great against the smaller, soft-bodied arthropods such as aphids, mealybugs, psyllids and spider mites. Bt, *Bacillus thuringiensis*, another great alternative, is a soil dwelling bacterium used to control susceptible Lepidopteron larvae. Another biological pesticide is *Paenibacillus popilliae*, the bacterium responsible for causing a disease called milky spore, which helps to control Japanese beetle larvae in the ground.

When applying pesticides, two of the best usage suggestions are to apply at night and to avoid blooms. The first of these strategies helps since most pollinators are back home or out of the area after the sun has set. The second is important, obviously, because pollinators carry out their work by visiting the flowers, whereas most pests suck from stems or chew leaves. Another quick suggestion is to not apply any pesticide during windy conditions.

UGA Lab technicians Nicholas Weaver and Ben Rouse.

Pesticide contaminants can drift onto areas you want to avoid such as flowers, nesting sites, hives, waterways, and your body!

When choosing pesticides, you will have more control over environmental impact with those that break down (lose their effectiveness) rapidly. Also, avoid dusts, such as Sevin™ Dust, since the particulate size is similar to pollen and can be collected by bees and then fed to brood. Incorporating just these few measures will dramatically reduce the effects chemicals will have on the beneficials you want to keep around your yard and garden plus the impact on the environment as a whole.

Several years ago I took an IPM biological control class and just loved it. At one point during a lecture, the professor stated that it was unrealistic to assume that we could feed the population on this planet without the use of common, harsher pesticides. Our monocultured approach to agriculture was one of his reasons for this belief. He lamented that organic and sustainable agriculture were wonderful ideals, but they could only feed a small portion of the world. To this day, I question that statement. BC

Jennifer Berry is the research director at the University of Georgia Honey Bee Research Lab.

Got A Question?

Ask "Dr. Phil"

Phil **Craft**

He Knows!

Send your questions to Dr. Phil at
phil@philcrafthivecraft.com
www.philcrafthivecraft.com

A beekeeper from Kentucky writes:

I have overwintered hives with three hive bodies and three supers, completely full of bees, brood & honey.

To split this hive can I move a hive body and super without a queen but with brood, bees & freshly laid eggs to a new foundation & let them make a queen? Or do the same thing if it has a queen cell?

What would you do? These hives are extremely active.

Phil replies:

I would not advise allowing the bees to make their own queen from eggs or larvae, largely because of the loss of time. Sixteen days will elapse between the time an egg hatches and the emergence of a queen. Another week or more will pass while she matures, conducts her mating flight(s), and mates, before she can begin laying eggs. That means that the new hive will experience, at minimum, a gap of more than three weeks with no eggs being laid, and then an equal period before any new bees emerge. During this time when it should be building in numbers and strength, the colony will not grow; it will, in fact, lose population as some bees die of old age. Once the hive does begin to produce young bees again, this period of decline will still have to be overcome. In the meantime, a significant part of the spring nectar flow will have been missed.

Queen cell. (photo by Mary Parnell Carney)

If you find a queen cell in any of the brood boxes, moving it to the new hive to be the source of a new queen is a better approach. However, there will still be a gap in egg laying, albeit a shorter one. In both cases – a queen reared from an egg and one from an existing queen cell - you will need to check diligently for eggs in order to be assured that she has successfully emerged, mated and begun laying. It is not unusual for a colony to fail in its attempt to produce a new queen, or for the queen to fail to mate well, or for her to be injured or lost on one of her mating flights. The result is a queenless hive. Then, instead of a new hive with a young queen, you have a queenless hive which continues to lose population each day - a serious problem.

I think that your best option would be to purchase a new queen and split your hive. The gap in egg laying would only be a few days. Since your existing hives have three brood boxes, you could easily make the new hive with one existing brood box and a honey super. I would suggest, though, adding another hive body with foundation after the new queen starts laying eggs. This strategy will give the new colony the best opportunity to build up quickly, and both old new hives should produce honey this year if you have a good nectar flow in your area.

A beekeeper in Indiana writes:

I am a beginning beekeeper. This was my first year. Recently, somewhere on-line, I had seen a "temperature guide for beekeepers" which gave temps recommended for various tasks. Unfortunately, I did not make notes that day, and have not been able to find it since. It seemed helpful to a newbie. Do you have a guide or suggestions?

Phil replies:

Bees may fly on sunny days at temperatures as low as the 40s°F. However, if brood is present (and that is possible even in Winter), opening hives in temperatures below 50 can interfere with the cluster's ability to keep the brood warm enough to prevent harm. Here in Kentucky, we have occasional days with temperatures in the 60s during the Winter, but I never open hives on those days. I don't open them until early Spring when temperatures climb into the 60s for several consecutive days. Even then, caution must be exercised. I suggest the following guidelines for opening hives early in the spring or on cool days. Consider 50 to 60 degrees as a minimal outside temperature. If it is cloudy and/or windy, I would wait until it is close to 60. On sunny, windless days, I might settle for closer to


Take care in opening your hive in cool weather. (photo by Mary Parnell Carney)

50. I also recommend not removing brood frames from a hive until temperatures are consistently getting up into the 60s in the Spring. Little is to be gained earlier in the season from examining brood frames, so removing them prior to the onset of warm Spring weather will not aid you in managing the colony.

A beekeeper writes:

I'm getting started as a beekeeper this year and need advice as to where to locate my hives. I live in the suburbs, have a fairly large lot, and neighbors all around me. I read your answer about shade versus sun in the recent Bee Culture, but wonder about other considerations, my neighbors being one. I've spoken with some of my neighbors and they seem okay with me having bees here.

Phil replies:

You're right. Your neighbors are an important – perhaps the most important – consideration in deciding where to locate your hives. Even though they are comfortable with the idea of your keeping bees, you want to place your hives where there is the least chance of unpleasant interactions (meaning stinging incidents or fear of them.) Fortunately, it sounds as though you have a large yard; for those with smaller lots, placement of hives is even more important. Of course, situating them as far as possible from neighbors' yards goes a long way


Hive with nearby neighbor.

towards reducing or alleviating concerns, but there are other factors to keep in mind as well. Consider which parts of your neighbors' yards have the most activity (such as entrances, driveways, patios, swimming pools, etc.), and try to keep a maximum distance from those areas. Don't forget places with occasional heavy use, like an apparently open space where volleyball is played during parties. It is especially important, if the neighbors have small children (or grandchildren who visit), to avoid placing hives near where they play.

Even on a small lot, there are measures which can minimize potential problems. If hives must be located nearer than 30 feet or so from property boundaries, avoid facing the entrances toward the neighbor's yard. Try to position the hives where bushes, trees, or out buildings will separate them from adjacent lots, or create an artificial barrier with solid fencing. When bees fly in and out of the hive, they move in a horizontal line (the proverbial bee line), much like a plane lining up to land or takeoff. When a barrier is placed a short distance in front of the hive, bees will begin their departure and approach flights at a height above the obstacle. The higher trajectory makes them less likely to be noticed or to disturb people living near the hive. I've known of beekeepers, with nearby neighbors, who completely enclosed their hives in fencing. Shielding the hives from view will also reduce any nervousness your neighbors may feel about having bees nearby. Even though they know the hives are there, not seeing them (out of sight, out of mind) may reduce anxiety for those with even a little bee phobia. My hives sit across the road and a good distance from my nearest neighbor, but last Spring I started a hedge of American holly bushes to shield them completely from view. As a bonus, the hollies will provide a good nectar source for my bees.

Of course some hive location criteria are related to good, basic beekeeping practices. These include locating hives where they receive direct sunlight on the entrances as early in the morning as possible. Honey bees do not fly in the morning until the hive warms up, especially in Spring and Fall. I consider it preferable for reasons I discussed in my January column, to try to place hives in a location that is in the sun all day. You should also keep in mind your own access to the hives. Since, in your case, they will be near your house, try to place them where you can keep an eye on them. When they become established and start swarming, this can become very important. Keeping your neighbors comfortable, however, may supersede other considerations. In trying to keep hives and be a good neighbor at the same time, compromises sometimes have to be made. Remember, a jar of honey after your harvest always helps to sweeten those relationships. BC

Phil served as the KY Dept. of Agriculture's State Apiarist from 1999 through 2011. He is a graduate of Oberlin College in OH and the University of KY. A native of the mountains of Eastern KY, he now lives out in the sticks in the Bluegrass Region of KY near Lexington with his family, a very old dog, and some beehives.

Rooftop Bees Part 1

DOWNTOWN

Rooftop apiaries are probably the signature image of urban beekeeping. Downtown, we are often short on personal space, and long on neighbors, but the sky is wide open. City rooftops have surprising benefits for both bees and their minders, though like every other hive site, local features will have a lot to do with both upside and downside of skyside beekeeping.

There is one major advantage to urban roofs that needs to be mentioned right away: despite any concerns we may cover here, the presence of large, increasingly green city rooftops means that almost any urban dweller should be able to find a safe and healthy place to partner up with *Apis mellifera!*

In fact, I am a beekeeper because of the rooftop paradise we encountered when we moved here. Our roof has a flat deck, and you reach it via a spiral staircase to a level where the bees are looking straight at trees and not at frightened humans. My roof practically demanded that I take up beekeeping. To be fair, you may have to convince yours.

Looking at the upside of rooftop beekeeping, many rooftops greatly reduce neighbor and vandalism concerns, and there are some pests which don't seem to do as well a story or so above ground. On the downside, beekeeper access can be difficult or even dangerous, hive moves achieve new dimensions in complexity, and wind has a whole new role to play. Luckily, others have come before us to tackle some of these problems, and we can look at a few cases here.

And a disclaimer: Nature being the way she is, you are likely to encounter variables not covered in this article, but here's my "Top Ten List" of issues which potential urban rooftop beekeepers should consider up front.

The Rooftop Beekeeping Top Ten:

1) Access
2) Beekeeper Safety
3) Honey bee Health and Safety
4) Structural Safety
5) Neighbors, Vandals and Other Third Parties
6) Honey Harvests On High
7) Moving a Rooftop Hive
8) Pest Management Issues
9) High Altitude Habitats
10) Wintering on the Roof

Number One: Access

As important as the bees are, your beekeeping plans have to start out with how you are going to get all the pieces into place, and how are you are going to manage to take care of them and yourself over the long haul. History shows that stairs, hatches, and ladders can quickly turn into a very long haul. Also, many rooftop beekeepers share their roof with other tenants, or may even have an out apiary on a roof that does not belong to them. In many cities, beekeepers have hives on publicly owned buildings like community and recreation centers, and it is not unusual for a business (especially a hotel or restaurant) to solicit a beekeeper to place colonies on their premises. These hive hosts, however, may impose access rules or restrictions that you have to take into account in your management plans.

Getting Established

You can set up a rooftop hive several ways, fortunately. And don't be foolish: never attempt heavy maneuvers at altitude alone.

If you have access via a wide opening like a doorway or a bulkhead, you can move a nuc or split relatively easily, and can bring fully constructed hive components via additional trips. Many of us are lucky enough to have stairs leading up to a roof door or hatch, but it is possible to lift complete components up a sturdy enough ladder (preferably angled and with good treads to avoid slippage).

At the Trinidad Rec Center, we used a high quality hand truck with good thick rubber tires to set up the apiary there. We lashed a three-medium hive (secured with staples) to the body of the cart and lift/rolled it up a ladder, rung by rung, from above and below through a hatch used by the HVAC people when they move components. Remember, if your roof has large equipment on it that someone repairs, it is worth your while to get to know the maintenance team and learn how he or she gets the job done.

After this adventure, my co-conspirator Del Voss used his ex-Iowa farm boy expertise to build a Hive Crane from parts in farm implement catalogs. His crane can be secured on a roof with cement blocks and can lift a small hive a couple of stories. (He also uses the thing to lift mature hives off of rickety stands so the latter can be reinforced or replaced – my hero!)

When the hatch is small

Most of the townhomes in this city do not have full sized doors or hatches for roof access. In these cases, beekeepers often carry up unassembled hive parts up and hammer them together on site, Packages are easy to carry up and install, nucs a little more tricky. Just remember, for harvests, splits and hive moving purposes, what goes up must come down! We have hints about this later.

Tools and feeding

Most beekeepers end up carrying loads of stuff around with them as

Toni Burnham

they tend their hives, and running to get a missing tool, or making separate trips for sacks of sugar or buckets of water have a whole new meaning when a hatch and a ladder and several flights of stairs lie between you and your kit.

Beekeepers need all that stuff. One of my favorite early beekeeping stories comes from the Montgomery County Beekeepers 2005 Field Day. Several experienced beeks were taking a few dozen newbees through our first hive inspections when a swarm landed 40 feet up a tree in the same apiary. Before you know it, middle-aged beeks in veils were running to their cars, one grabbed a saw, another a hundred feet of rope, someone had bed sheets, one an empty nuc box, and another was up that tree before the car folks got back. They got the swarm, but I got the impression that they were absolutely nuts.

However, today my car contains, among other things, just about everything you need to take down a bee tree. Beekeeping is like that. How are you going to guarantee access to all the stuff you need when you are a couple (or more) stories up?

At most of our rooftop apiaries, we either request storage space in a nearby stairwell or place a waterproof plastic container (secured with bricks, bungee cords, or both) with a minimum set of two hive tools of different types, a bee brush, entrance reducers, note pad, pen, smoker, fuel, lighters, hat veil, gloves, and a sealed white plastic HDPE bucket with a bag of dry cane sugar inside. Some sites keep complete jacket veils on site, but if the public has access, those can be expensive to lose. We also post a "Warning: Apiary" type of sign within 20 feet of the hives.

We are lucky in that many of our roof sites have working hose nozzles, and that some folks have rigged a hose up the back of the house. If not, you will have to haul your own H_2O up there. Use the plastic bucket for mixing food on site (if robbing is not an issue at the time). And keep in mind a water source for your bees!

Case Study One: The Less-Than-Perfect Roof

Matt Braun started his third year as a rooftop beekeeper in 2012, and his hives are on the roof of a row house on Capitol Hill. They're about 2.5 stories up, though his neighbor's house is one story taller and provides a decent windbreak.

Matt has a slightly slanted, antique tin roof with ridges and a small wooden hatch in the ceiling of his spare bedroom, similar to the photo here. Matt finds that being on the roof adds a bunch of complications that terrestrial beekeepers don't have to worry about. In no particular order, here are some things that he's spent a lot of time thinking about:

1. As his wife likes to point out, the roof structure and the surface are designed to keep weather and water out, and not to hold hundreds of pounds of bee hives, and more importantly, to hold up to foot traffic. Some roofs are certainly sturdier than others: his is 86 years old. Matt occasionally lies awake at night in bed staring up at the ceiling, wondering if the roof is about to give way, and 60,000 startled honey bees are going to come pouring through the roof. Realistically this probably isn't too much of a worry, but leaks are. Water damage from even a small leak could cost a small fortune and ruin your relationship with fellow residents (or the landlord). So, you have to be confident that the roof is going to hold up, and you should be vigilant about inspecting for damage, recoating more often than is the norm, and minimizing the number of extra people you take up there for show and tell.
2. On a similar note, I recommend a hive stand that spreads the load out, preferably perpendicular to the direction of the joists. This could be a pain with the metal ridges, and if the roof isn't flat. Matt cut 2x8s on an angle and ran them parallel for ~8 feet. You're probably planning on one hive, but spend a lot of time thinking about your stand, and make it from day one with space for at least three hives. When you're standing on the roof with a recently collected swarm in a burlap sack and need a place to dump them you'll be glad you planned ahead.
3. Invent a system where by the screen bottom board isn't dumping directly onto the roof coating. Lots of wax/propolis/crap builds up down there and it makes it harder to keep on eye on the roof itself underneath.
4. Matt's hives originally were not strapped down in any way – the telescoping covers had two bricks on top, and that was it. For about 24 months, that was fine. Since then, he recommends building a strapping system into your hive stand, especially it you're higher up and more exposed. If a heavily laden hive fell in strong winds, it could easily punch a hole in the metal roof. Also, if something goes wrong, you'll likely only figure it out on your next inspection since you don't see the hive every day like you would in your yard: the stakes are a bit higher. The rational engineer in Matt didn't think he needed straps at the beginning, but his emotional human side concluded that he'd sleep better through Super storm Sandy with them, so he added them this Summer. And the hives did fine!
5. Carrying things up and down through the hatch is a pain. When you forget something and have to run back down it's a hassle. If you can leave tools on the roof in

a plastic tub (also strapped down so it doesn't fly away), it'll save you a lot of suffering. Similarly, maneuvering through the hatch and down a ladder carrying a 10 frame medium super full of capped honey is really difficult/dangerous (31 year old male in reasonably good shape here). I won't be doing that again. I'm building some boxes to carry four or five frames at a time.

Matt's bees haven't had any problems from the hottest summer days or the windiest winter nights. He says that all new beekeepers seem to worry about those things, but in practice they are rarely problems.

Matt's advice basically comes down to *plan really well before you bring a colony home*. Everything is more logistically challenging on the roof. He promises that you won't regret spending extra time working out as many details ahead of time as possible. Do whatever it takes to ensure your peace of mind on the windiest stormy night.

Case Study Two: Out Apiaries, or "What if it's not your roof?"

If your bees are not located on a roof which you own, you have special responsibilities and potential liabilities to other, non-beekeepers, as well as the chance to keep bees in locations that may be healthier than the limiting hive site options in tiny ground level yards.

For many urban beekeepers, their first hive is not going to be located in the same place they are living, especially for those in apartments or condos, or in rented accommodations. Many beekeepers are able to find public beekeeping programs at gardens or recreations centers, or are invited to place their hives at businesses such as hotels or restaurants, or even at their employers.

In many cities, building LEED-certified green buildings (with green roofs!) is the norm, and beekeepers are finding it relatively easy to pitch beekeeping to organizations that are already making these investments.

The opportunity is there, but it is always wise to weigh it against risks and responsibilities. And it is a good idea to get them spelled out in advance – key contacts, access times and means, on site storage, core responsibilities, what happens in case of damage, and what arrangements are necessary for exiting or expanding the apiary, among others. Look online for sample agreements related to public beekeeping, and consider adapting them for your apiary's needs!

In 2009, Izzy Hill, Chloe Wardropper, Rebecca Davis, and Gretchen Anderson launched an apiary that has since grown to three thriving hives on the roof of a community center in the most densely populated part of their city. They got help from, and volunteer for, a beekeeping education project sponsored by the Parks Department and Whole Foods.

There were strings attached with the offer of this apiary. The new beekeepers were expected to help care for publicly owned hives in the same apiary, and to participate in education and outreach programs involving both of the sponsors. Located above playing fields and fountains, they were also expected to keep an eye on swarms, robbing, and the need for water. Finally, they had no access to the apiary on Sunday at all, and could only get nighttime or early morning access with special assistance, arranged for in advance, from official staff members.

Sundays have developed into nail biters. Several major windstorms and blizzards have pelted DC on Saturday nights over the past three years, with hives located five stories up and wind barriers only on one side. The beekeepers made it through the first storm with no damage, and quickly ferried large cement blocks up to the roof and placed them on tele covers. Thus far, snow loads have not blocked lower entrances, but the beekeepers maintain upper entries just in case.

The Spring of 2012 was also a rare one for swarms in Washington, DC, and Izzy and Rebecca's hive popped out a monster, which attached itself to a tree trunk next to a very popular basketball court. Luckily, a history of close communication with not only the key staff member but also the front desk and the maintenance staff (and just about anyone in the building who showed the least curiosity) resulted in a quick phone call to an available beekeeper, as well as an invitation to bystanders to watch the swarm get hived from a safe distance and learn more about honey bee behavior and the environmental strength of their neighborhood.

Because everyone knew about the bees, knew who to call, and saw what a quick and informative response they could get, the program only got stronger.

When key collaborating staff left the Park department, it became important to seek out and develop a new relationship with her successor, who might not share the same interest in public beekeeping! Thus far, that request has come in the form of a greatly ramped up public education schedule, which is a challenge for such a small team of beekeepers. The next stage is to sit down and negotiate a clearly spelled out set of responsibilities and guarantees by both parties – something missing before now – including emergency contact plans as well as some scenarios for current participants exiting and others entering the project as needs change.

Just recently, the beekeepers harvested three supers of honey from this apiary, with several bottles designated for the public hearing on the broader legalization of beekeeping now just passed. Their efforts have been a key component in making these steps forward possible, in part because keeping bees on someone else's roof inevitably leads to talking about bees with people who would never have encountered them any other way!

Number Two: Beekeeper Safety

While it's a shame if an apiary does not work out for the bees, it's a tragedy if it causes harm to the beekeeper. Call it common sense, but look after yourself first when you are running around a story or more above grade.

Factoring in everything we said about access, remember that a fall or a back injury from hefting yourself or your tools and hive parts onto roofs ups the ante considerably. Take it slow. Take several trips, rather than rushing it all into one or two. Bring a buddy with you as often as you can when tending a rooftop apiary, and failing that, bring a well-charged cell phone. Keep it within reach.

Your bees are not the only ones who need water up there: during the Summer, you will, too. I put a weather station up next to my hives the same year they were installed, and discovered that Summer temperatures were routinely five to 10°F higher on the roof than on the ground, with less shade. Too many beekeepers let themselves get dehydrated in the average Summer beeyard: dizziness brings an additional hazard at elevation.

Throughout the year, we've recorded roof wind speeds that were not as high as the airport, but much higher than at ground level. Don't leave a lot of loose stuff (buckets, feeders, bottom board inserts, dead frames, etc.) laying around for you to trip on or to blow into your or a neighboring yard.

Finally, site your hives well away from roof edges, and let the bees fend for themselves during thunderstorms, hurricanes, and tornados. Even if they get toppled, they have handled worse, but you probably haven't. BC

Toni Burnham keeps bees, goes to schools, Summer camps and makes friends all over her city.

BIGGER PICTURE

You Don't Have To Be A Social Bee

Jessica **Lawrence**

It's probably not an unusual thing for most people to like to eat. When I think of tasty food, I normally think of fruits, vegetables, and a cow that would be named "Mr. Steak" (in the future, that is going to be my cow's name). Then I think of how honey bees are awesome because they pollinate all the things that make good pies. In my love of peach pie, I sometimes forget that there are other pollinating insects out there besides my honey bees. Since it's almost Spring, now is a good time to pay homage to and plan for happy habitat of the "unloved" insects.

Let's start with Alfalfa Leafcutter Bees (*Megachile rotundata*). They are really only useful for pollinating alfalfa, but dairy and meat cows eat alfalfa hay, and pigs. I like milk, beef and pork, so I like alfalfa. This particular plant has a tiny flower, similar to clover, but it has a "dark side." When a bee goes in, the disturbance causes the keel petal (the odd petal at the bottom of a bean flower) to "trip" and it slams the bee in the face. Honey bees do not like to collect pollen from alfalfa, as they don't like being hit in the head. The major pollinators are the leafcutter bees (ALB), who don't seem to mind the brutality. Instead of pollen baskets, they have stiff hairs on their abdomens called "scopa" that hold the pollen. I have learned from experience that if you try to catch them (say, for photographic reasons) and startle them, their immediate reaction is to fling off all the pollen so they can get away.

ALBs are solitary bees. The alfalfa growers have predrilled boxes with painted designs on the front, ready to go on big trailers that are moved into the alfalfa fields. The year before, these were in the fields, and are full of pupae ready to emerge. Male leafcutter bees emerge first, so that they are ready for action when the females hatch. The males are similar to drones in that they are worthless outside of reproduction. The females do the leaf chewing, pollen collecting, nest building and egg laying. The designs on the front of the boxes let the ladies know which hole is their "front door" so they can find their nests. They lay the all-important female eggs first, at the back of the hole, then fill the rest with male eggs. Since the males come out first, they will clear the path for the later debut of their sisters, and also if a predator or parasitoid comes along, the males will be the ones attacked, not the females at the back.

Something neat about ALBs is that they only forage for about 300 meters around their nesting site, so they can easily be confined in one area. This is a lot easier than honey bees, who can travel for miles to find favored flowers.

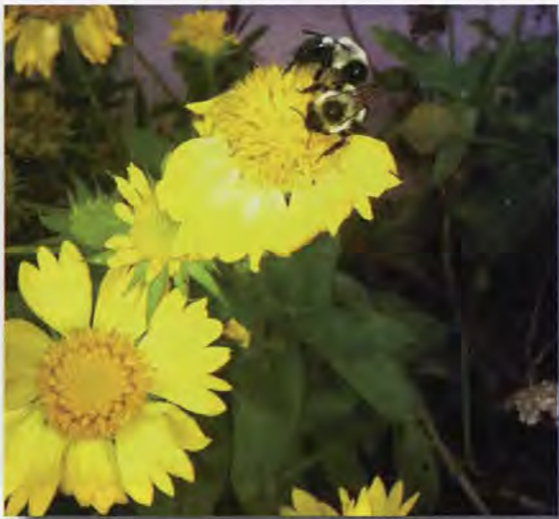
Next, we have the Blue Orchard Bee (*Osmia lignaria*). These solitary bees look more like blow flies because they are shiny blue and about the size of a large fly. Blue Orchard Bees (BOB) are similar to ALBs in that they have scopa on their abdomens to collect pollen, and lay their eggs in tubes. To attract this type of bee, bamboo is often used to make nests.

BOBs are useful for pollination because they prefer stone fruits or pome fruits (all in the rose family). What you won't get from these little gals is someone paying you to pollinate a strawberry field and they skip it to go to the cotton field nearby, like honey bees. They also move back and forth between trees more frequently than a honey bee, choosing one or two flowers from a tree, then moving across the path. Almonds are planted with a row of one variety, with the next row a different variety, because they need cross-pollination for fruit set. They also simultaneously collect their pollen and nectar from a flower, so

An Alpha Leafcutter, on alfalfa.

Growers use trailers to transport the nesting boxes to the fields.

A Blue Orchard bee nest.



Bumblebees.

they are excellent pollinators. Similar to the ALBs, they usually stay close to their nest when they forage, but they will travel up to three miles away if they decide the food source is worth the effort. Having both BOBs and honey bees in the same orchard can increase almond production by a substantial amount. However, BOBs seem to be more susceptible to pesticides than honey bees, so care is needed to keep them healthy.

Getting a little closer to what I expect is more familiar territory for most people – let's discuss the Bumble Bees (*Bombus impatiens*). It seems that you don't see the Impatient Bumble Bee often after you cross to west Texas, but the East Coasters will be used to seeing these little ladies buzzing around the gardens. Bumble bees are social insects and set up shop similar to honey bees, but more in a way that is comparable to wasps. The queen overwinters by herself, and builds the nest in the Spring. She mates and lays her eggs, and takes care of the children on her own. After the larvae pass through 4 instars, her new adult children will help with the next batch of brood by going out to forage, leaving the queen home to nurse the brood. Like the honey bee queen, she emits pheromones to suppress the ovary growth of the other females in the household. She will lay the first batch of males, but as she gets older, some of the other females in the colony will begin to lay males as well. Bumble bees are a little bit less supportive of the drones than a honey bee colony – they will forcibly remove the males after they reach adulthood. At the end of the season, the queen will start to raise new queens for the next year.

Bumble bees are my favorites from this list because they pollinate a lot of things that I like to eat. They are renowned for their tomato pollinating abilities (not a honey bee specialty), as well as other solanaceous plants such as eggplants and peppers. They also like blueberries, cucumbers, squash and strawberries. They are effective pollinators because they vibrate the flowers, releasing a lot of pollen for the taking. They also will go to most asters or other "pretty" flowers that are raised for non-food purposes.

Honey bees have this "depression" effect when they are enclosed in a small space for a long time, such as a greenhouse. Many growers have tried to pollinate their greenhouse-grown vegetables, all to no avail. However, bumble bees are great for this because it takes only a small colony (less than 100 bees) to pollinate a large greenhouse. You have to give them extra sugar water though, because greenhouse plants are not going to produce the same nectar amount as an outdoor plant. Speaking of greenhouse pollinations . . .

It's time to add a few non-bee pollinators to the list. Blue Bottle Flies (*Calliphora vomitoria*) are awesome because you can use the maggots for fishing, or the adults for pollination! I like multi-purpose things. This is another greenhouse pollinator. They are successful in pollinating tomatoes, canola, garlic, peppers, sunflowers and onions, and I'm sure other things as well. They can work in small spaces and they can work in cooler temperatures than a honey bee. On the days that a honey bee might curl back up in bed for a few more hours (or an entire day), the blue bottle flies are out and about slurping up nectar from the local plant population. The only caveat I have for these guys is that if you ever take it upon yourself to order them . . . they're going to smell nasty. Just don't ask how you would grow the maggots.

My last favorite is kind of a pollinator, but it is another of those multi-purpose creatures. The entire Hover fly family (Syrphidae) was named because they hover around flowers. You may have mistaken them for bees when you see them. They are usually yellowish with stripes, but they have big eyes. Since they usually look like a stinging

A Calliphorid fly.

This syrphid fly is a bee mimic.

Aphids, or what I call plant cows.

insect, most other creatures leave them alone. The adults feed on pollen and nectar, and are generally harmless. If you ever happen to be in the business of attracting them to your house, they seem to like buckwheat and yarrow a lot, and parsley if you let it bloom. I like to have them around because their maggots are predators on some of my not-favorite insects, including thrips, leafhoppers, and aphids (I also refer to aphids as "plant cows"). I used to see them a lot in the tobacco field if you don't treat for aphids – usually slumming with the lady beetle larvae in the back alleys eating the aphids on the undersides of the leaves. I think flies get a pretty bad reputation, what with all the nasty things you can contract from mosquitoes, but everyone has a few unsavory relatives, right?

It's hard for people to imagine "back in the day" before we were here, but honey bees are not native to the U.S., and neither are plants that require their pollination. There are lots of little native friendlies out there begging for attention and a little recognition. So, whatever your plan is for the Spring and Summer, whether you're a city dweller, a suburbanite, or country folk, take some time to grow a few tasty treats for everybody to thank all of the pollinators who feed you. BC

Jessica Lawrence is a Research Entomologist for Eurofins Scientific, an avid gardener, beekeeper and tattoo collector.

THE BEES OF NYUNGWE

Marcel **Durieux**

All It Takes Is A Dedicated Beekeeper


A traditional hive.

You might not think of beekeeping as an activity that would seriously endanger a protected rain forest. But it can: Nyungwe National Park in Rwanda was not only threatened, but partially destroyed by beekeepers. This is the story of the bees of Nyungwe, and of the role of one dedicated beekeeper in saving the rainforest – and the bees.

I recently had the opportunity to spend some time in Rwanda, and learn a little about beekeeping in this tiny country in central Africa. There are an estimated 15,000 beekeepers in Rwanda. The craft is usually passed from father to son to grandson (traditionally, this is very much men's work). As a result, beekeeping is very traditional: techniques don't get altered much, and there is little influx of new information.

Colonies are started by catching swarms: empty hives are placed high up in trees, and then you just wait . . . The traditional hive is a hollow cylinder, about three feet long and one foot in diameter, made out of logs or sticks. Getting it down at harvest time, when it's full of bees and honey, is difficult! A couple of determined people climb up, carrying burning brushwood to provide lots of smoke. Using a rope, the hive is then brought down, but not, I was told, without the beekeepers usually receiving a good number of stings (these are, after all, the African bees *Apis scutellata* and *monticola*).

Obviously, these traditional hives don't use frames. They just provide a space for the bees to build their own nest. This makes harvesting tricky. Using even more smoke, the hive is opened, and then the segments of comb containing honey are cut out, leaving as much as possible of the brood nest intact. But as careful as one may be, the colony is often left severely damaged, and the excessive smoke and fire also harm the quality of the honey. And the rain forest.

Nyungwe National Park in south Rwanda consists of almost 400 square miles of well-preserved tropical rain forest. It forms the watershed between the Nile and Congo catchment areas, and is home to a huge variety of wildlife: 14 species of primates (including chimpanzees), 280 bird species, and more than 1100 species of plants. Because of this abundance of plants, Nyungwe is also home to lots of wild bees, and it's a prime spot to place traditional hives. This may sound as a good, natural way to collect honey, but in reality, beekeeping in the park has been disastrous to the forest. The reason: the aggressive smoking when honey is taken from wild bees, or when traditional hives are brought down from trees at harvest time. The surrounding brush may simply be put on fire, but even if smoke generation is contained, burning grass and brushwood usually is tossed when the work is done. And every once in a while, smoking a hive of bees causes a forest fire. Multiply this by thousands of hives typically in operation in the area, and it becomes a lot of forest fires! In 1997 alone, almost 15% of the forest was destroyed by fires related to beekeeping. This problem, by the way, isn't limited to Nyungwe: in 2009, a beekeeper extracting honey burned down 300 hectares of protected gorilla habitat in the north of Rwanda.

Clearly, this amount of habitat destruction in Nyungwe was not sustainable. Something had to be done: beekeeping had to be moved out of the forest. But that's easier said than done: the 2000 or so beekeepers depending on Nyungwe honey for at least part of their livelihood could not simply be told to stay away – not to mention that enforcing such a decree would be almost impossible. The beekeepers needed to retain their livelihood, and if possible, even have it improved. Something had to be offered as an incentive for them to stay out of the protected areas. This is indeed what was done, and the result is a success story of conservation and bee culture in the developing world.

In a collaborative effort of the Wildlife Conservation Society and the Rwanda Development Board, cooperative apiaries were created around the periphery of the forest. These are areas where beekeepers can set up their hives, outside the park boundary, yet close enough to it that the bees can forage inside the rain forest. The apiaries


Removing honey from a traditional hive.

A co-op apiary.

Vincent Hakizimana.

have storage space, and are fenced against theft. At the same time, to induce beekeepers to join these apiaries, an educational program was created that taught them how to profit more from their trade.

And this is where a special role was played by Vincent Hakizimana, nicknamed *kayuki* ("bee" in Kinyarwanda, the local language). Vincent is an unassuming man, with a very kind smile. He learned the craft of beekeeping from his father, but went to university to become a psychologist. Then, one day, he saw a swarm of bees destroyed because they had taken up lodging in someone's house. And he contemplated the waste: destroying a colony that could provide food and income to someone. If people only knew how to handle bees! And since he knew, he decided to teach beekeeping instead of practicing psychology.

Now, years later, he is the key person behind the Huye Apiculture Training and Resource Center, located not far from Nyungwe. Through the Center, Vincent provides training in beekeeping techniques, both to novices and to experienced beekeepers. Many of the novices are youths who dropped out of school. They would not have much future, but learning the craft of beekeeping allows them to make a decent living. He trains people in the use of modern hive systems, which greatly increases honey yield. These hives are made locally: he has provided furniture makers with plans, and they are able, even with very simple tools, to construct all woodenware to the correct specifications and at modest cost. He trains people to use extractors to harvest the honey, to save the wax (which in traditional beekeeping goes unused), to process it and use it to make candles, and he teaches them the basic financial and business skills necessary to run a successful cooperative. By being organized, beekeepers can bargain for significantly higher honey prices as well.

Vincent has a very inclusive view of beekeeping. Not only those who work with the bees are beekeepers, but so are people who process honey, melt wax, or make and sell candles. This means that all members of the family are now part of the beekeeping business. It's no longer a job just for men. When asked if one could still be a beekeeper if one were allergic to bee stings, he thought for a while. "Sure," he then answered, "you can be a beekeeper. You just won't work with the bees."

I met Vincent in *Inzozi Nziza* ("Sweet Dreams"), Rwanda's only – and excellent – ice cream shop. After enjoying our pineapple ice cream, we drove to his training apiary on the university property, a small field with about 20 hives. Traditional hives of various designs stood next to locally built modern boxes, most of which consisted of a single brood box and a single super. He explained that since modern hives are not practical for mounting in trees, traditional hives are still used to catch swarms to start colonies. Once a swarm is caught, the hive is brought down, and then the colony is transferred to a modern box, by tying pieces of comb cut from the traditional hive into the modern frames. Harvesting honey is not easy, because of the defensive nature of the bees, and is usually done at night. A fire is lit, to keep away animals and inform any police personnel in the area that these are not thieves at work. Then, the honey is extracted right on the spot.

I congratulated Vincent on his work. He has done a marvelous job helping people to become beekeepers or become better beekeepers, which in turn made it feasible for them to keep their bees outside the Nyungwe rainforest. It worked. At this time, more than 1300 beekeepers, together managing more than 4000 hives, participate in the relocation program. He has helped integrate women and youths into the "inclusive" model of beekeeping, and has helped organize the local beekeepers into economically successful cooperatives. Nyungwe forest is protected from fires, and the beekeepers are doing better than before. It has been a win-win.

But there are challenges, he said. He needs more space at the university for his training apiary. There is a problem with thieves stealing honey from the hives at night. Honey prices are still low, and there's not always a market for the organic honey and the candles. Modern equipment is still expensive by local standards. And because of these issues, many beekeepers still feel there is insufficient incentive to join the cooperatives.

Nonetheless, the bees of Nyungwe make a great success story. By and large, the sensitive rain forest has been effectively protected from fires. And, thanks in large part to Vincent's exertions, it has been done in a way that has made the local beekeepers more self-sufficient, more financially secure, and more up-to-date in their techniques. The goal of the Center is "sustainable livelihood and poverty alleviation of beekeepers through increased income from commercial apiculture." Vincent has succeeded in reaching that goal.

During the drive back, he pointed out another apiary, with about 15 hives. For a moment I thought it might be his own – but no, he told me, it belonged to someone whom he had taught the craft. He looked at it proudly. BC

Marcel Durieux is a backyard beekeeper from Charlottsville, VA.

Why Treat For Var

Why Treat for *Varroa*?

Well, there *are* good reasons, but they might not be what you think. If you thought:

"because if I don't I will lose all my bees," or

"so I can have 100 % overwinter survival," or

"the *Varroa* mites are worse than the treatment effects on the colony," then

Think again.

Varroa mites *are* a serious threat to our honey bees and treatments *do* increase a colony's chance of survival, but not as much as you might think. And treatments certainly neither guarantee your colony's survival nor prevent overwinter loss. Furthermore, treatments *do* come at a serious cost to both your colony's health and your budget. And it is my belief that many beekeepers treat out of fear, which is *not* a good reason.

Be a Good Doctor

You may know that I'm a doctor when I'm not beekeeping. When you treat your honey bee colony with *anything*, **YOU** are your bees' doctor (or perhaps Veterinarian). So imagine for me if you will, what it would be like to go to your doctor with a lethal illness like cancer (not too very different from *Varroa* mites in a colony of bees). Do you expect 100 % cure from chemotherapy? Do you expect *no* side effects? What *does* your doctor tell you? Probably something about marginal benefit *and* risk. So what's that, you say? Marginal benefit is the amount of benefit you receive over doing nothing. In other words, if you have a 70 % chance of survival with *no* treatment, and an 80 % chance of survival *with* chemotherapy, the marginal benefit (of chemotherapy) is 10 %. And then there are the risks of treatment. Let's not ignore those. We'll take those up first:

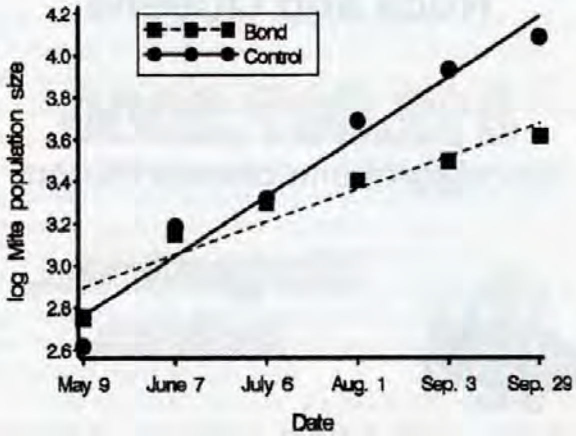
ALL *Varroa* treatments are bad for honey bees

All miticides used inside bee hives, whether natural or what is commonly called "soft" treatments (organic acids and essential oils) *and* hard chemical treatments (like coumaphos and fluvalinate), are lipophilic. That means they like fats – not water. So they are incorporated into beeswax. And this beeswax is where your honey bees rear their brood! How many of you would put no-pest strips in your baby's or grandbaby's bassinette? Would you spray a selected group of your toddler's cribs with pesticides? Or all of them? As crazy as that seems, a human baby will do a lot better with insecticide-exposure than an insect (bee) will do with miticide-exposure. Because mites and insects are a lot more alike than mammals and insects.

Of course you've heard that the hard chemicals are bad and that many *Varroa* mite populations have become resistant to them [1-6], but even natural or soft treatments have deleterious effects on a honey bee colony. Formic acid has been shown to reduce adult drone survival, worker longevity, and brood survival [7-9]. Thymol induces brood removal and decreases sperm viability [10,11]. Organic acids and essential oils also have strong odors and really disrupt honey bee colonies during (and probably after) treatments.

Treatments select for weaker, less-resistant bees, *and* for meaner, more-virulent mites

You've probably heard about the first part of that statement so in the interest of time and space I'll skip it. But what about the second part? Do treatments really select for meaner mites? Yes they do. As seen in the following graph, Fries et al showed that no chemical treatment facilitates the development of less-virulent (nicer) mites, or at least mites whose population growth was much slower than those mites that were exposed to treatments [8]:



Average mite population size (log 10 transformed) over the season, in Bond ($N = 12$) and Control queen colonies ($N = 15$).

They compared control colonies (which received treatments) to what they called Bond colonies (literally named after the James Bond movie "Live and Let Die"), but rather than look at the bees, they looked at the mites. And the scale on the Y-axis in the diagram (of mite population growth) is logarithmic. That means the population expansion is not actually a straight line; it's exponential! As you can see, Bond colony's mite populations went up much slower than the control colony's.

In another study, *Varroa* mites have been shown to be more virulent (meaner) in managed colonies (experiencing treatments) than in feral survivor colonies that live in trees (with no treatments, obviously) [12]. Also, within a population of mites in a colony (which is what you have – a *population* of mites), individual mites that are resistant to treatments are selected by those treatments because drug exposure favors their survival (and subsequent egg laying) over the non-resistant ones (which die and can't reproduce).

The only way we're going to help establish a biological equilibrium between our host honey bees and this new foreign parasite, is to let the bees do the fighting! Now, on to how well the treatments work:

Treatments don't work near as well as you might think

First I will quote my own cumulative overwinter survivals over the last nine years (I freely admit that this is all non-randomized anecdotal data). When based on whether I had the philosophy of selectively treating (my first four years) or intending *not* to treat any colony (my last five years), I had 73% overall survival, 89% survival *with intention to selectively treat* (14/27 colonies were actually treated), and 79% survival *with an intention not to treat* (no treatments, but pollen or a pollen substitute was used in the Fall). My raw data (across 9 winters) shows that 12 of the 14 colonies that I treated survived (86 %), whereas 55/77 (71%) untreated colonies survived, regardless of my intent. My experience mirrors the Bee Informed Partnership respondents (which accounts for approximately 20% of the beekeepers in America). They self-reported a 21% mortality last (2011-2012) winter, and the previous five winter's mortalities ranging from 29% - 36%. Thus overwinter survival seems to be about 70 %.

The full Bee Informed reports are available for the 2010-2011 Winter [13]. I strongly suggest you look at them. And based on actual *Varroa* treatment, mortality was 29.5% when *any Varroa* product was used and 36.7% when *no* product was used. When based on treatment philosophy: 3,590 colonies were managed with a no treatment philosophy and had a 33.6% mortality, whereas 92,919 were managed with either only or mostly natural product treatments and had a 33.4% mortality, and in 171,594 when *any* treatment was used a 35.7% mortality was experienced.

Thus, at best, there is a 7 – 15% marginal benefit to either treating or intending to selectively treat, and at worst, there is no benefit at all! Remember, the marginal benefit is the percentage of improved survival – so a survival improvement from 70% to 80% would equal a 10% marginal benefit. And that's all you get when you treat for *Varroa*.

The other thing the Bee Informed data tells me is that *the vast majority of beekeepers in this country are treating.* But I'll bet they don't know why . . . BC

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American Beekeeping Federation – Then & Now

Ann **Harman**

Beekeepers, like the bees themselves, tend to gather together but we humans have clubs, sometimes called associations. Today as we look across the United States we will find national, regional, state and local beekeeper associations. Some of these are newly formed; others have celebrated a span of 100 years or so.

This year, 2013, the American Beekeeping Federation, as such, celebrates its 70th birthday. However, in a way the Federation's origins date before 1943. We can go back as far as 1906 (and perhaps further) and find two associations – the National Bee-Keepers' Association [sic] and The Honey Producers' League. State associations could join the League by paying an annual affiliation fee.

One of the objects of the National Bee-Keepers' Association was "to enforce laws against the adulteration of honey." The Honey Producers' League had a similar objective – "to publish facts about honey and counteract misrepresentations of the same." These two themes are still with beekeepers today.

However, as with many associations, there are ups and downs. If we jump forward to 1920 we find the formation of The American Honey Producers League. The League was certainly quite active during the 1920s. A rather impressive book was published in 1924: *A Treatise on the Law Pertaining to the Honeybees* [sic]. This book covered all the laws, current at that time, involving honey bees from the entire English-speaking world. Yes, it included New Zealand and Australia.

In the Second World War year of 1942 the League was dissolved because of lack of members and insufficient treasury followed by the cancellation of the annual convention. Although travel was restricted during the war years, in January of 1943 a "War Time Conference" was held in Chicago. The honey producers of the U.S. were still determined to have an organization. This time the name was to be the National Federation of State Beekeepers' Associations, again with state association affiliation. 1943 was a time of organization when the new constitution was drawn up and submitted to the state associations for acceptance. The state associations were also asked to elect their delegates who would attend the next meeting.

If the pace of organization seems slow we must remember that communication was limited to telephones and the mail, with mail being the cheapest form of communication. Travel, in the war years, was very limited.

In January 1944 the "Second Bee and Honey Conference" was held in Chicago with 19 affiliated states sending delegates. This new organization represented not only honey but also the honey bees themselves. We see this from some of the Resolutions adopted at this conference: a request for Federal funds to study nosema disease as well as provide benefit payments for pollination services, and that the USDA consider a support price program for honey. One resolution seems curious today. It was a request that the U.S. Government Bureau of Standards designate a standard cap size for the 60-pound metal cans used for bulk honey.

The next year, 1945, the conference was again held in Chicago with attendance of 200, an excellent wartime representation of the membership of 438. The states had responded with 36 affiliated out of 48. In addition six countries were members. Individuals could join by paying annual dues of $5.00. The end of the war seemed to bring the largest gain in membership – 854 in 1946. After so many conferences in the Midwest, the 1947 one was held in Tampa, Florida with 600 attending from 42 states.

The American Beekeeping Federation (ABF) acquired its present name at the December 1949 conference. It was felt that this name would show representation of the entire industry. The Mission of ABF is stated: "The American Beekeeping Federation (ABF) will act on behalf of the beekeeping industry on issues affecting the interests and the economic viability of the various sectors of the industry."

The conference moved west to Salt Lake City in January of 1948. There an interesting resolution was passed: it was requested that the Federal Trade Commission require all imported honey to be so labeled. Another resolution from the conference of 1950 asked the FDA to make an official standard for honey. Although today imported honey must be labeled as such with the source, beekeepers were urged at the 2011 conference to help monitor the labeling. The hope for an official standard of honey is still with us today.

Looking at various resolutions over the years we can find repeating themes. In 1963 we see a resolution asking for adequate staffing and facilities for beekeeping research laboratories. In 1964 a resolution asked for sufficient funding for the new USDA lab in Tucson, AZ. During recent years of budget cutting, requests for adequate funding for the USDA labs remains today.

In the 1960s interest in protecting honey bees from pesticides first appeared. In view of the losses of bees from pesticides, the Federation sought research into protecting honey bees with subsequent specific labeling of pesticides and a request for a federal program of compensating beekeepers for their losses. The micro-encapsulated pesticides entered into resolutions in the late 1970s. Pesticides, now joined by CCD problems, remain an important current topic with the Federation.

The American Honey Queen program began in 1959. A Honey Princess was added in 1960. States that have a Honey Queen can send her to participate in the annual contest. Although the number of contestants is smaller today than previously, the Honey Queen program is active with the Queen and Princess traveling throughout the U.S. to promote honey and honey bees. The ABF Auxiliary is involved with the Honey Queen Program and is active in encouraging the use of honey in the home. Yearly Queen and Princess recipe folders are available through the Auxiliary.

In order to attract hobby (small-scale) beekeepers to the conference, in 1958 and 1959 a special program for them was held. Attendance was reported to be good. The next mention of a program for hobby (small-scale) beekeepers occurred in 1981, also with good attendance. However small-scale beekeepers have consistently been members of ABF and have attended conferences in significant numbers. A mistaken view held by some is that the Federation is for commercial beekeepers. How strange. A look through programs of conferences shows topics that affect all beekeepers, even those with two hives in the backyard. Diseases, parasites, bee nutrition and queen problems are part of every bee colony. Up-to-date information helps all beekeepers and thus benefits their bees.

Small-scale beekeepers also need to realize that to keep colonies healthy, and even alive, that research is necessary and must be funded. Money for the five USDA bee research laboratories comes from the decisions of Congress on funding for the Department of Agriculture. Congress members are not beekeepers so bees may mean only "honey" and "sting." Here is where the American Beekeeping Federation's efforts are important to every beekeeper, large or small, in the United States.

Members, particularly Board members, have been quick to arrive in Washington, DC, to meet with members of Congress whenever an issue arises that will impact beekeepers. Over the years topics such as pesticide damage, honey imports, adulterated honey, CCD, bee importation and, of course, funding for research. In order to help with expenses for such trips, beekeepers are asked to contribute to the Legislative Fund.

Since bees are perceived to be "dangerous" any form of insurance for beekeepers and their operations has been difficult to obtain. The Federation was able to work with an insurance company to develop insurance for beekeepers that fits with both large and small beekeeping activities.

The years 1968 and 1969 brought a division within ABF. At that time controversy over a 1968 resolution requesting mandatory funding for a national research program resulted in the establishment of the American Honey Producers Association (AHPA). In 2008 ABF and AHPA hosted their first joint meeting with attendance of about 1000. The second joint meeting, held in 2011, brought 1100 enthusiastic beekeepers.

The ABF conferences have expanded over the years. Workshops, held on Saturday morning, are an important and well-attended part of the conferences today. In 1998 programs for Shared Interest Groups (SIGs) were introduced with the presentations open to all although the topics are specific to a group. The segments of the beekeeping industry are covered with the four groups: Commercial Beekeepers, Small-Scale/Sideliners, Honey Producer-Packers, and Package Bees and Queens.

In 2006 the Serious Sideliner Symposium, developed and coordinated by Dr. Lawrence Connor, became a part of the ABF conference program. It runs concurrently with the main ABF program, on Thursday and Friday of the ABF conference.

With all the problems facing bees and beekeepers today, the ABF now offers beekeeper education in two ways. Members can receive a Webinar, "ABF Conversation with a Beekeeper," given on different topics and on different levels. Members receive information on the date and time and are invited to sign up for it. In addition ABF members can subscribe to the BEES (Beekeeper Education & Engagement System) program, developed by Dr. David Tarpy of North Carolina State University. Another aspect of education is the awarding of grants to students of apiculture. These grants are funded by the Foundation for the Preservation of Honey Bees, a non-profit corporation. In addition to grants to students, money is also given to beekeeping research.

The ABF conference is held each year during early January, a quiet time in the beekeeping industry. The trade show is enormous and provides beekeepers with a look at equipment, large and small, new items for the beekeeper and also products of the hive. However, beekeepers should visit the website (Google either abfnet.org or American Beekeeping Federation) to obtain a comprehensive look at all the activities including the conference programs. Membership information, categories and forms are available. Beekeepers, new and old, large and small, should use the advantages of membership and also plan on conference attendance. BC

Ann Harman can be found most years at the American Beekeeping Federation and keeping her bees in Flint Hill, Virginia.

Teasels

Connie **Krochmal**

Nearly indestructable, invasive and loved by bees.

The various teasels are known to be excellent bee plants. Historically, beekeepers reaped good honey harvests when these were widely grown as an agricultural crop in the U.S.

Around 15 species are found worldwide, most of which are native to Europe. These occur in Asia and North Africa as well. Although most are generally biennials, some can be short-lived perennials. The genus name, *Dipsacus,* is Greek for thirst. This refers to the cup-like cavity formed by the leaves. The dried flower heads of all teasels have been used by fullers in the manufacture of woolen fabrics.

Three species have naturalized in the U.S. Each is distributed in one or more states. The only states or regions where teasels are largely absent are the Dakotas, Alaska, Maine, and the Southeast.

General Description of Teasel

These rough, coarse, stout, stiff plants have spines or prickles on the stems and leaves. During the first year, the teasels typically develop a flat basal rosette of foliage. These produce erect, upright, branched flower stems with spiny-tipped leaves the second year. The opposite foliage is generally lobed and toothed.

The blooms form dense, cone-shaped or egg-like flower heads. The individual blossoms open unevenly within each head. Leafy-tipped bracts, which surround the heads, are one of the most distinctive identifying features of these plants.

The Most Common Teasels

Of all the teasel species, the most common teasel species in America are the following.

Cut-leaf teasel *(Dipsacus lacinatus)*

This is hardy to zone four. Very similar to fuller's teasel, it is named for the deeply slashed foliage. Four to eight feet tall, cut-leaf teasel has prickly stems.

The hairy, bristly leaves often have coarse lobes. The foliage found on the flower stems is linear to lance-shaped. Mostly white, the blossoms can also be pale lilac. They have showy red stamens. The egg-shaped to oval flower heads open from July through September. The heads are surrounded by spiny bracts.

Introduced to the U.S. during the 1700s, this species has naturalized in waste places in 20 states or so. It occurs mainly in the Northeast southward to Virginia, westward to Colorado, and northward to Wisconsin. It is also found in Oregon. Cut-leaf teasel is listed as a regulated weed in Missouri, Oregon, and Colorado.

This was originally native to Central and Southern Europe. Of all the teasels, this species is the most likely to escape. It is found in meadows, prairies, savannahs, damp ditches, and along roadsides.

Common teasel *(Dipsacus sativus)*

Also known as Indian teasel, this prickly plant is hardy to zone three. It can reach six to eight feet in height. Common teasel has large flower heads that are lighter colored than those of fuller's teasel. With stiff spines on the ends, the bracts spread horizontally.

This species has naturalized on a localized basis in six states or so. The western states include California and Oregon. It also occurs in parts of New York, Pennsylvania, and Virginia. Common teasel is considered a noxious weed in New Mexico, Iowa, and Colorado.

Fuller's teasel *(Dipsacus fullonum* or *sylvestris)*

By far the best known of the teasels, it has historically been an important honey plant for beekeepers. One of the Latin names for the species, *sylvestris,* means 'of the woods'. This strong, sturdy plant has been characterized as "unkillable" by some gardeners. A tough species, it is a perfect choice for adverse situations. Quite adaptable, fuller's teasel grows in a range of conditions, including dry and wet spots, stony soils and heavy clay.

This species has naturalized in a variety of different habitats. These include railroad embankments, meadows, along the banks of waterways, edges of woods, roadsides and ditches, in pastures, old fields, waysides, thickets, and waste ground. Originally native to much of Europe, fuller's teasel also occurs in Asia.

Of all the teasels, fuller's teasel is least likely to naturalize. When it does escape, its spread is generally localized. It is found in some states mostly in the Northeast and West.

This plant goes by an assortment of different common names. These include clothier's brush, bristly head

First year plant.

brushes, brushes and combs, clothes brush, and pin cushion.

Hardy to zone four, this prickly, upright plant reaches four to six feet in height, somewhat shorter than some other teasels. It has a spread of 2½ feet. The silvery green, branched, hollow stems have fine lengthwise streaks or markings. Prickles are found along these lines. The sturdy, erect, stiff flower stems are coarse and hairy with either prickles or spines.

The foliage has distinctive bristly pimples. The leaves, typically unlobed, feature prickly veins along the center. Bristles or prickles are present on the margins and on the undersides. The silvery green basal foliage ranges in shape from oblong to egg-shaped or lance-like. Often narrow and tapering, the stem leaves are opposite. The edges can be toothed, scalloped, or wavy.

The basal leaves, which form a flat rosette, are sharp pointed, reaching a foot in length. These will begin wilting once the plant starts blooming during the second year. This is normal since the plant is a biennial.

The individual blossoms are small and tubular. They're crowded together on the flower heads. These can bloom any time from June through August or so. In many cases, they open about the same time as basswood blossoms, but lasts about a week or so longer.

Cutleaf teasel.

The thistle-like flower heads, which are reminiscent of the composites or daisies, are egg-shaped or cone-like, up to four inches long. The dense heads literally contain hundreds of individual blossoms. These open terminally. Flowering on a different portion of a given flower head can occur unevenly. In some instances, these can start in the middle and go either direction. At other times, they first emerge at the bottom of the head and move upwards.

The flower color can vary widely. It is often within the purple range. The shades can include lavender, lilac, violet-white, purplish-pink, violet, and purplish-rose. It can even be mauve.

Each flower head has long, stiff, prickly, curving bracts that taper to a sharp point. These are longer than the flower head. The bracts or awns are flexible. The fact that they curve backwards makes it easy to distinguish this species from the others.

Growing Teasels

All of the teasels are very easy to grow. These have few insect or disease problems. Deer ignore these plants. Teasels thrive in a well drained, lime-rich soil. However, they aren't picky. Suited to most any reasonably rich soil, these even tolerate heavy clay. Although full sun is best, they're adapted to partial shade.

The teasels are grown from seeds, which are available from a number of seed catalogs. These are usually planted in the Spring or Fall. Seeds can be direct sown where they're to grow or started early indoors in pots.

Cover the seeds lightly. A temperature of about 68°F is considered ideal. These can take several weeks to germinate. If the seedlings become crowded, thinning will be necessary. In the garden, space the plants about two feet apart.

Once they're planted, the teasels often self-sow. If this is undesirable, simply remove the flower heads at the end of the season so the plants won't have a chance to spread.

Teasels as Bee Plants

These flowers provide bees with nectar and pollen. All of these species are sure to attract bees, which have been known to neglect basswood in order to work teasel blossoms. They will fly a long distance to seek out the plants.

The flowers yield lots of nectar. A few individual blossoms on a flower head are open at a given time, which allows the plants to serve as a nectar source over an extended period of several weeks. The bees work the teasel flowers throughout the day.

In earlier times when teasel was widely grown as an agricultural crop in some regions of the country, this brought a reliable, profitable honey crop. One New York beekeeper reported to the American Bee Journal on July 21, 1886 that he made over $1000 from his hives, which numbered less than a hundred. Much of his honey crop was from teasel.

At one time, teasel was an important crop for farmers, especially in New York. This was a leading farm product in the town of Skaneateles, according to Peter Henderson, author of *Henderson's Handbook of Plants and General Horticulture*, published in 1910. Frank C. Pellett, who wrote *American Bee Plants*, reported that at one time there were some 110 acres of teasel in the state of New York.

Over 50 farms in the area grew these. In 1919, American farmers harvested 75 acres.

Teasel honey tends to have a thin body. It is water white to transparent. The flavor can vary from excellent to fair. Some beekeepers have reported the flavor isn't as pleasant as that of clover and basswood.

History and Uses for

The main use for the teasels has always been by fullers. The plants have been widely cultivated for this purpose in England, once a major producer of wool fabric, and in Europe. Fullers use the dried flower heads to comb or raise the nap of newly woven wool fabric. This process is known as fullering or teazeling.

The comb-like flower heads raise the nap without damaging the fabric. The curving teasel bracts generally do a better job than most inventions made from metal and wire, according to Alice Morse Earle, author of *Home Life in Colonial Days*.

For this purpose, the flower heads are attached to a spindle. Although this isn't as commonly used as it once was, fuller's teasel is still popular among hand weavers. As interest in weaving continues to grow, this could possibly lead to small-scale production of teasel for this niche market.

Fuller's teasel has served fullers since Roman times. Historically, it was also used by the Anglo-Saxons. According to *Gerard's Herball* by renowned herbalist John Gerard, this was introduced to gardens "to serve the use of Fullers and Cothmakers." It isn't clear as to when or how the plants reached America. What is known is that it was widely grown around wool mills in Colonial times.

According to the best known and widely respected herbals, this was popular among herbalists. *Culpeper's Complete Herbal* by Nicholas Culpeper says the roots were used in home remedies. This book also recommends teasel for treating warts and worms in the ears. Gerard's herbal states that the plant was totally ineffective for treating fever although it was widely used for that purpose.

The water that collects in the trough or cavity where the leaves join the stems has a number of interesting uses. Historically, it was popular as an eye wash. This was used to treat various eye ailments. It could reputedly clear the sight, relieve tired eyes, and reduce redness. According to folklore, the water was also drunk by travelers to quench their thirst.

Women used the water as a complexion wash for it reportedly could enhance one's beauty. This belief might have been encouraged by the fact that Culpeper classified the plant as being under the dominion of Venus, the Roman goddess of beauty. This use also explains why this plant is sometimes called Venus' basin.

Gypsies reportedly used the dried flower heads as combs, which gave rise to another common name, gypsy comb. Before chemical-based dyes became available, teasel served as a dye source for wool.

The teasels have long been used and marketed as an everlasting. However, this use was always secondary. These stems remain one of the most popular dried flowers. Maintaining their shape very well, they're a potential source of income for beekeepers as there is a good market for them at produce stands and farmers' markets. Teasels are used year-round in dried flower arrangements, and are highly popular for Christmas. They're sometimes gilded with silver or gold. For an everlasting, harvest them promptly as soon as they've matured and begun to dry. Otherwise, goldfinches and other birds will likely consume the seeds. BC

Connie Krochmal is a writer and beekeeper in Black Mountain, North Carolina.

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A Gift From Heaven

Ed **Colby**

My gal Marilyn's stuff keeps piling up at the house, and she never really goes home, so I guess you could say she's moved in. She descended on me like a whirlwind. I never saw it coming. It isn't perfect. It never is. Neatness is not her strong suit. She flies around the kitchen trying to use every pot and pan. I clean up in her wake. On endless Winter nights when the alarm goes off hours before dawn, I serve her latte in her nightie. She helps me catch the early bus. I arrive home just in time for supper and bed. When I'm grumpy, she laughs at me. She takes care of the chickens, and I tend the geese. We never have any spare time.

My race is nearly over. You can't argue with the math. At least I have my health, for now. I can still work. I'd better. My savings largely vanished in a scorched-earth divorce six years ago. I still owe on the farm. None of this matters to Marilyn. I wonder why. I used to sleep in the ski patrol locker room in Aspen, because the commute's so horrendous. My bunk was above the boot dryers. Very fragrant! I called the locker room "my cozy Aspen bungalow," but it never really was. Now I hardly ever stay there. When my co-workers ask why I'd commute so far, I tell them "To get back to those lovin' arms!" They get it. Like dandelions in April, Marilyn's a gift from Heaven.

Of course she loves the bees. What's not to love? It's just that they don't always love her back.

At first, her response to stings was localized swelling. She seemed to be acquiring some immunity. Then, at a beeyard in Mexico a year ago, she got stung twice and suffered a systemic reaction with all-over itching and hives that scared us both. I have to tell you that Marilyn's Irish. She's prone to rashes, blushes, freckles and all the afflictions of those fair-haired, pale-skinned Celts. She's allergic to just about everything.

Marilyn didn't want to give up on the bees, so we decided to take action. She didn't have health insurance, so a series of treatments from an allergist seemed out of the question. But I have lots of bees. We agreed we'd start with a short dose of bee venom.

The first time, she was in the kitchen when I came inside with a bee held between my index finger and thumb. "Hold out your arm," I said. "You're really going to do this?" she gasped. Her eyes went wild as the reality sank in.

"Sure," I said. "Or you could stay home and live in fear of getting stung or even handling my bee suit and having a reaction. I have the EpiPen if this goes south on us."

"I don't think it will," she said. "You're right. I have to do this." I gently rubbed the bee against Marilyn's upper arm. At first she was uncooperative. (The bee, not Marilyn!) Then I squeezed her just a little, and she vented her fury. Marilyn gave a little cry, and before you could say, "Jack Robinson!" I scratched out the stinger.

"There," I said. "That wasn't so bad, was it?"

Marilyn was less sanguine. "I'd forgotten how much it hurts!" She swelled a little. The generalized itching and hives never came back.

There followed many more bee venom administrations. We left the barb in a little longer. Marilyn didn't mind so much now. She watched bemusedly as the stinger twitched and pumped its poison into her hand.

We moved on to multiple stings in the same or different locations. I suppose she got stung 50 times over several months. We didn't keep good records. We did this when it was convenient, and each time I gave Marilyn as many stings as she requested.

I don't recommend that you try this on anyone who suffers

generalized allergic reactions from bee venom. I never killed Marilyn, although I guess I could have. We talked about it in advance, and she made a decision based on her health care budget and perhaps her commitment to living her life with a beekeeper. We kept an EpiPen on hand in case her throat swelled and she struggled to breathe. I'm trained to use it. We live pretty close to two hospitals.

And now? I still surprise Marilyn occasionally with a bee in hand. In a weird way she seems to like it. She laughs and comes up with new locations where a sting might challenge her immunity. She's apparently as immune as any beekeeper. We'll see.

She's a huge help when I'm moving bees. Now I don't worry about bringing her along. I like having her along. Why wouldn't I? She's a gift from Heaven.

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INSIDE

Simple Method For Mounting Honey Bee Body Parts For Morphometric Analysis

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Abstract:

Measuring honey bee morphological characters is very important for systematic purposes and for measuring the degree of hybridization among populations. The traditional method for mounting honey bee body parts requires mounting on glass slides, sometimes with the use of permanent or temporary dyes. This is particularly tedious and time-consuming in investigations examining large numbers of individuals. Here we describe a simple method for mass mounting of honey bee body parts, including heads, wings and legs, to facilitate taking morphological measurements.

Keywords: *Apis mellifera*/ morphometric, honey bee, mass/ mounting.

Introduction:

The importance of measuring morphological characters is well known. There are different purposes for measuring honey bee morphological characters including classification and characterization (e.g. Ruttner 1975, Sheppard *et al.* 1997), identifying the degree of hybridization among populations (Radloff *et al.*, 2003), and indirectly identifying economic characteristics (Edriss *et al.* 2002). There are many methods for measuring morphological characters; the traditional method depends on using an ocular micrometer mounted on a stereomicroscope (Ruttner *et al.* 1978). Projectors have also been used in some morphometric work (Kandemir *et al.* 2000). Also, various computer programs such as AutoCAD (Miladenovic *et al.* 2011), Photoshop (Abou-Shaara *et al.* 2012) and other image programs (Jones *et al.* 2005, Andere *et al.* 2008) have been employed for taking morphological measurements. Preparing body parts for taking morphological measurements is a problem, especially in cases where thousands of parts must be mounted and measured. Here we describe a fast, simple, inexpensive method for mounting honey bee body parts. The mounted body parts can then be scanned and transferred as images for subsequent analysis.

Materials and Methods:

The collected samples of honey bee were killed and body parts were dissected using forceps. Then dissected parts were mounted by using the following method. The method requires simple materials: plastic transparent sheets, wide sticky tape, scissors and forceps. First, the plastic transparent sheet was cut into strips 8 cm wide and 20 cm long (Fig. 1). (Other dimensions could be used).The center was cut out of each strip using scissors, creating a plastic frame around a rectangular opening 4 cm wide and 18 cm long (Fig. 2). Precise dimensions are not critical, but the width of the opening should be less than the width of the sticky tape. By using these dimensions more than 100 body parts can be mounted on the single prepared sheet. Subsequently, the wide sticky tape was used as the bottom part of the evacuated plastic sheet piece (Fig. 3). After that the dissected parts were fixed on the sticky base using forceps (Fig. 4) then they were covered by the excised plastic rectangle to increase the stability of the dissected parts on the sticky bottom during the scanning process as well as to allow preserving the dissected parts. In case of mounting heads, there is no need for covering the mounting. The next step is to scan the mounted body parts using any available desk scanners with resolution of at least 1200 dpi to obtain appropriate images for measuring programs such as Photoshop, Image Tool or AutoCAD (Fig.6).

To test the accurateness of the new technique, especially for mounting wings, 29 Carniolan honey bee workers were collected from a colony at the apiary of the Bee Research Unit. After they

Figure 1. *Pieces of plastic transparent sheet.*

Figure 2. *Rectangular openings cut into transparent sheets.*

were killed in the freezer their right fore wings were separated by using forceps. The separated wings were arranged on the glass surface of a HP Scanjet scanner and were scanned at 4800 dpi to obtain clear images. Wings were removed from the scanner and were mounted again by using the new method and were scanned by using the same scanner at the same resolution. For all the obtained images; inner wing length and width were measured by using Photoshop program. These two characters were selected because these characters sufficiently reflect the flattened degree of the mounted wings. Means and standard errors were calculated for measured characters, ANOVA was performed and means were compared by using least significant difference (L.S.D.$_{(0.05)}$.

Means of inner wing length were 4.33 ± 0.012 mm and 4.33 ± 0.016 mm while means of inner wing width were 1.94 ± 0.015 and 1.96 ± 0.013 mm for scanned wings by using the scanner directly and the new method, respectively. No significant differences were found between the two methods and values of L.S.D.$_{0.05}$ were 0.0501 and 0.0397 for inner wing length and inner wing width, respectively. Therefore the described method has excellent accuracy. This new method is simple and does not require any costly materials. Specimens can be prepared for scanning quickly, and can be preserved for future use. Moreover, the described method can be used with any other insects and can be used successfully in mass mounting of dissected body parts.

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Figure 3. *Using sticky tape as the bottom of the evacuated part.*

Figure 4. *Mounted forewings.*

Figure 5. *Mounted legs and dissected heads for scanning.*

Evaluation of the Efficacy of Small Hive Beetle (*Aethina tumida* Murray) Baits and Lures

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Summary

Two experiments were conducted to evaluate the attractiveness of a lure being developed by the Food and Environment Research Agency (=UK lure) to adult small hive beetles (SHB). Experiment 1 compared the UK lure with: USDA fermented pollen dough, banana scent, apple cider vinegar and their combinations while Experiment 2 included: USDA fermented pollen dough, slow-released ethanol (SRE), SuperBoost (SBt), apple cider vinegar and combinations of these products. Overall, the USDA pollen dough inoculated with the yeast, *Kodamaea ohmeri*, was the most attractive bait for adult SHBs especially when used in combination with SBt (the brood pheromone), and SRE. It is possible that the volatiles associated with the yeast had a synergistic effect when combined with the several compounds that made up SBt. Also, the possible increase in the amount of alcohol from both SRE and fermenting pollen dough significantly improved trap catch. The unattractiveness of the UK lure to SHB may be due to an insufficient amount used per trap exacerbated by its rapid evaporation rate. Further development work to decrease the evaporation rate of the UK lure is recommended.

Keywords small hive beetle/lure/bait/trap/efficacy

Introduction

In the United States, the small hive beetle (SHB) has killed many colonies since its detection in 1998 in Florida (Elzen *et al.* 1999). The SHB has since expanded its distribution with problems being more evident in the southern-eastern region where beetles are more abundant (Neumann and Elzen 2004). This abundance is a consequence of hot weather which is known to shorten SHB developmental time, and hence more generations per year (de Guzman and Frake 2007). Nevertheless, honey bee stock is reported to influence the number of SHB in honey bee colonies (Frake *et al.* 2009, de Guzman *et al.* 2010).

In the USA coumaphos strips or CheckMite+® (stapled to corrugated board for use inside the colonies) and GardStar® (a permethrin soil drench for use in front of colonies) are currently recommended (by whom?) for managing SHB populations but neither is particularly effective. Further, the inappropriate use of insecticides can have negative consequences such as the development of resistant SHB populations, high toxicity to honey bees and contamination of honey and other hive products.

Traps baited with attractants are not only used for the detection and survey of insect populations, but in some cases are also used for controlling them. At present, several designs of in-hive SHB traps are commercially available. However, the efficiency of these traps relies significantly on the attractiveness of baits or lures. Different attractants have been tested in several trapping experiments. The combination of hive products such as honey, pollen, combs, brood and adult bees are very attractive to SHB (Elzen *et al.* 1999). Pollen dough inoculated with the yeast, *Kodamaea ohmeri*, was shown to be effective in attracting adult SHB (Arbogast *et al.* 2007), as was apple cider (Nolan and Hood 2008). Although attractive to SHB, traps containing fermented pollen dough were unable to lure a majority of SHB from inside colonies to traps located outside the hive (de Guzman *et al.* 2011). In order to maximize trap catch, a better bait or lure is needed. This study was conducted to evaluate the efficiency of a lure (referred to hereafter as UK lure) being developed by the Food and Environmental Research Agency (FERA) in the United Kingdom to monitor small hive beetle numbers.

Materials and Methods

To trap beetles inside the colonies, the Hood SHB traps Nolan and Hood (2008) were used. This trap consists of three compartments. The lures or baits were placed at the middle compartment, and the two side compartments received vegetable oil (about 30 ml) to prevent adult beetles from escaping. Each trap was attached to the bottom of a frame having no comb or foundation as described by Nolan and Hood (2008).

Experiment 1

We determined the attractiveness of the UK lure to adult SHB inside nucleus colonies. The following baits and lures were used: USDA pollen dough, USDA pollen dough + UK lure, banana scent (Nature's garden), USDA pollen dough + banana scent, UK lure + banana scent, and apple cider vinegar (White House). No "unbaited control check" colonies were monitored for this study. Instead, we used the USDA pollen dough and apple cider as reference standards since they known to be attractive to SHB adults (Arbogast *et al.* 2007, Nolan and Hood 2008). Corrugated plastic board stapled with coumaphos strip was also included because it is the recommended control measure for SHB in the U.S.

The UK lure which was an alcohol-based lure was prepared according to the instructions provided by FERA. About 1 ml of the UK lure was placed in an eppendorf vial, hung inside each trap and replaced every day. Similarly, 1 ml of the banana scent placed in an eppendorf vial was used per trap. For the pollen dough baits, pollen patties (4% pollen) were inoculated with the yeast *K. ohmeri* as described by Arbogast *et al.* (2007); about 1/4 cup placed in a mesh bag was used per trap. About 30 ml apple cider vinegar was used per trap.

For each treatment, three nucleus colonies with three medium frames were used for a total of 27 colonies. In addition, three nucleus colonies that did not receive any trap or treatment were also monitored for the presence of adult beetles to determine if the presence of baits encourages SHB invasion into honey bee colonies. Each colony was headed by a mated queen of mixed origin. All colonies were sitting on hive stands about 2½ ft (76 cm) above ground. This means that adult SHB (whether emerging from the soil or invading from other colonies or apiaries) would have to fly to invade any of the test colonies. In Louisiana, the population of SHBs in the colonies is known to increase in the fall months (de Guzman *et al.* 2010). Hence, the traps were installed in September 1, 2009 and were monitored everyday for one week. The initial and final infestations of SHB per colony were determined by examining individual frames, all walls of the hive box and hive cover for the presence of SHB (de Guzman *et al.* 2006).

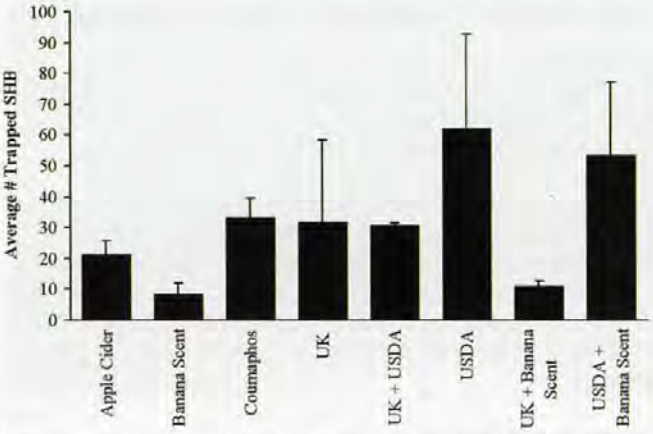

***Figure 1.** Number of adult beetles (Mean ± SE) caught in Hood beetle traps baited with different lures. Bars without letters are not significantly different (P > 0.05, Tukey test).*

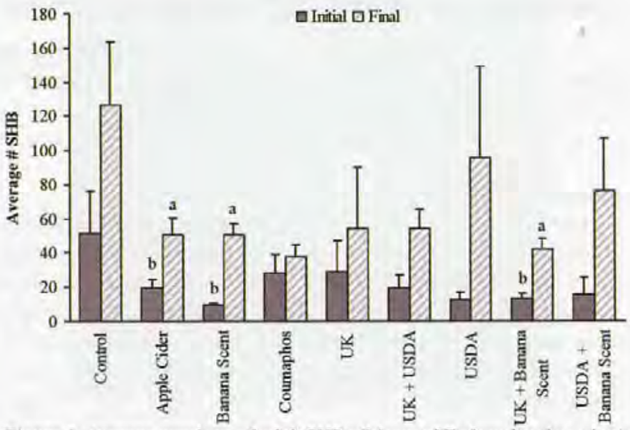

***Figure 2.** Average numbers of adult SHBs (Mean ± SE) found in the colonies before baited traps were installed and at the end of the experiment. For each lure or bait, bars without letters are not significantly different (P > 0.05, Tukey test).*

Experiment 2

Hood SHB traps were installed on October 15, 2009 using 55 three-frame nucleus colonies headed by mated queens of mixed origin. This experiment used similar methods as those of Experiment 1 however, a different array of potential lures was evaluated using five colonies per lure. The lures evaluated were: UK lure, USDA pollen dough, USDA pollen dough + UK lure, SuperBoost (SBt), USDA + SBt, UK lure + SBt, USDA + UK lure + SBt, Slow-release ethanol (SRE), USDA pollen dough + SRE, and USDA pollen dough + UK lure + SRE. SuperBoost (Contech), a honey bee brood pheromone which is made of several compounds (Pankiw *et al.* 2010), was included in this study to determine if brood pheromone will attract more beetles since brood is an important part of SHB's diet. Since infestation by SHB is always characterized by the fermentation of hive materials and since SHB were attracted to ethanol in the UK under laboratory conditions (Maureen Wakefield, Pers. Com.), the SRE was included in the experiment. Moreover, ethanol has been known to affect infestations of other beetles; induce infestation of spruce beetles (Moeck 1981), and attract scolytid beetles (Kelsey and Joseph 2001). As in Experiment 1, the USDA pollen dough bait served as the standard. In addition, five control colonies (without traps) were monitored to determine whether or not the presence of bait in the colonies will attract more beetles into the colonies. Traps and control hives were examined daily. At that time, UK lure was replaced because of its quick evaporation rate. Observations were made for two weeks. Weather data were obtained from the Louisiana Agriclimatic Information website (**http://www.lsuagcenter.com/weather**).

Data analyses

Data on the number of trapped beetles were analyzed by trial period using Proc Mixed in a one-way analysis of variance (ANOVA) with treatment as the variable to determine differences among the treatment groups. Before analysis, data were transformed using a square-root transformation to approximate normality. Data on the initial and final (final number of living SHB in the colonies plus the total number of trapped beetles) were analyzed by treatment using t-tests (SAS Institute 2008).

Results and Discussion

Number of adult small hive beetle trapped

For Experiment 1, a total of 752 adult beetles were trapped across all treatments during a week of trapping. This high number of trapped beetles may be influenced by warm temperature during this time. The average maximum and minimum air temperatures were about 32°C and 21°C, respectively. Overall, no significant differences in trap catches ($F=1.56$, $P = 0.216$) were detected among the different lures (Figure 1). This lack of difference may be due to a combination of the high variation in the number of trapped beetles that we observed among colonies within most of the treatment groups and a small sample size. There were only 30 colonies used in Experiment 1. Nevertheless, all traps caught beetles indicating that all lures were at least somewhat attractive to SHB.

In a comparison between the initial and final (number of live beetles in the colony plus total trapped SHBs) numbers of SHBs for each treatment, all treatment groups including the control colonies (without baited traps) had more beetles after the baited traps were installed (Figure 2). However, only the Apple cider ($t = 2.79$, $P = 0.05$), banana scent ($t = 7.03$, $P = 0.002$), and UK + banana scent ($t = 4.38$, $P = 0.012$) groups showed significant differences. This significant increase in the number of SHBs may suggest that the presence of Apple cider and banana scent lures in the colonies may have encouraged more beetles to invade the colonies. The Apple cider has been known to be attractive to SHB adults (Nolan and Hood 2008). The attraction of SHBs to colonies having banana scent-baited traps may be related to the association of isopentyl acetate with both the odor of bananas and honey bee alarm pheromone. The yeast, *K. ohmeri,* which was isolated from SHBs, is known to be associated (produced and released) with the alarm pheromone (Torto *et al.* 2007). In addition, the banana scent may have improved the attractiveness of the UK lure.

Number of adult small hive beetle trapped

For Experiment 2, a total of 369 beetles were trapped from nearly two weeks of trapping. Despite the longer trapping period, this number was lower than the number of beetles caught in Experiment 1. This disparity may be due to cooler temperature during Experiment 2 since the average maximum air temperature was about 23°C with a minimum average of about 11°C, about 10°C lower than that of Experiment 1.

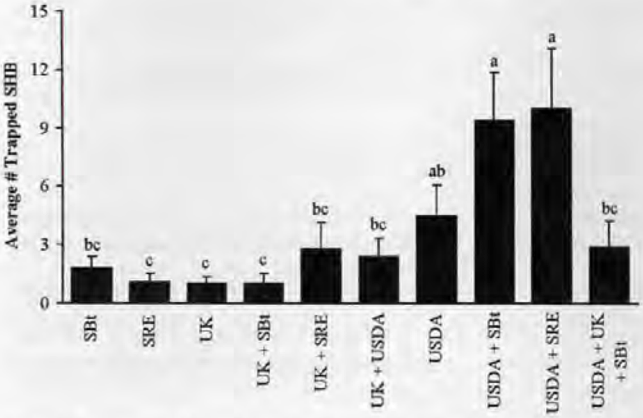

Figure 3. *Number of adult beetles (Mean ± SE) caught in Hood SHB traps baited with different lures. Bars with the same letters are not significantly different (P > 0.05, Tukey test).*

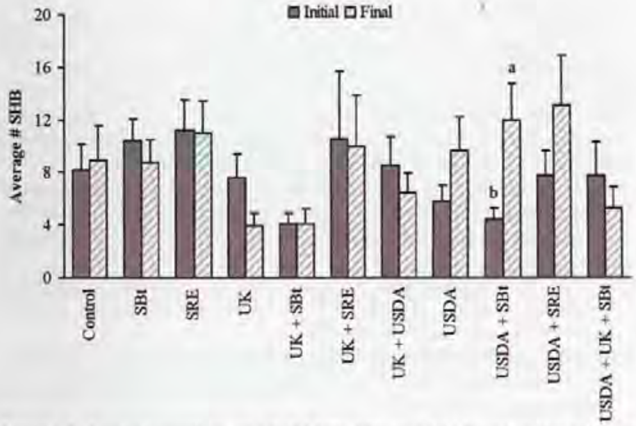

Figure 4. *Average numbers of adult SHBs (Mean ± SE) found in the colonies before baited traps were installed and at the end of the experiment. For each lure or bait, bars without letters are not significantly different (P > 0.05, Tukey test).*

Analysis of the number of beetles trapped showed a significant difference ($F = 4.57$, $P < 0.0001$) among the treatment groups (Figure 3). The traps baited with USDA + SRE and USDA + SBt produced the highest numbers of trapped adult beetles but the numbers captured were not significantly different from those captured in traps baited with fermented USDA pollen dough alone. The lowest numbers of trapped beetles were recorded in traps baited with SRE and UK but were not different from traps baited with SBt, UK + SRE, UK + USDA and USDA+ UK + SBt. This study showed that the addition of SRE or SBt increased the attractiveness of the USDA fermented pollen dough. It is possible that the alcohol, as a product of fermentation triggered by the yeast, in the USDA pollen dough was insufficient and that the addition of SRE improved its attractiveness. With SBt, it is possible that the different compounds that made the pheromone may have had a synergistic effect when combined with the volatiles produced by the yeast. *K. ohmeri* has been documented to be associated with several pheromones most notably the alarm pheromone of honey bees (Torto *et al.* 2007).

After the installation of baited traps, the number of beetles (final live beetles plus total trapped SHBs) was similar to the initial number in nearly all treatment groups (Figure 4). Hence, the presence of baits inside the colonies did not attract further invasion of beetles with the exception of the USDA + SBt groups. Most of these beetles were recovered from the trap. Again, this observation may indicate synergistic effect of USDA pollen dough when combined with SBt. Further, the discrepancy between our results in Trial 1 with that of Trial 2 may be due to the presence of the banana scent and apple cider in Trial 1 which may act as attractants with long-range volatility.

There were 10 colonies that were lost from either absconding or loss of queens during the experiment. However, there was no indication that colony loss was caused by the use of particular bait. The colonies were from the following groups: 2 unbaited control, 3 SBt, 1 UK, 3 UK + SRE, and 1 USDA + SBt. These small colonies may have been lost because of cool weather. The lowest temperature during the experiment was 5°C.

Although SHBs have a strong attraction to fermenting materials, the UK lure which is alcohol-based failed to consistently attract adult beetles. This observation was in agreement with the findings of Hood and Miller (2003) regarding the unattractiveness of alcohol (95% ethyl alcohol) to SHBs. This unattractiveness of the UK lure, however, may result in part from the recommended 1 ml of lure per trap being small and evaporating quickly. SHBs are excellent fliers and they are known to locate hosts or actively forage for food by smell. But the 1 ml lure may have already evaporated and thus, have lost effectiveness long before each trap was serviced the following day. Despite the cool weather, all vials were empty during each day of examination. Further development to decrease the evaporation rate of the UK lure may improve its attractiveness.

Conclusions and Recommendations

Lures and baits are used to increase capture rate of target insect pests. In this study, the USDA pollen dough inoculated with the yeast, *Kodamaea ohmeri*, was the most attractive bait for adult SHBs especially when used in combination with SBt, and SRE. The volatiles associated with the yeast may have a synergistic effect when combined with the compounds that made up the brood pheromone (SBt). It is also possible that the increase in the amount of alcohol from both SRE and fermenting pollen dough significantly improved trap catch. Inevitably, there are many problems associated with trapping SHBs. Capture rate depends on the abundance of beetles at the time of trapping, volatility and attractancy of the lures. In addition, temperature may not only alter the beetles' behavior but also the performance of the baits and lures. The unattractiveness of the UK lure to SHB may be due to an insufficient amount used per trap exacerbated by its rapid evaporation rate. Hence, further development work to decrease the evaporation rate of the UK lure is needed.

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Compiled/edited by Zachary Huang

Saraithong[a], P., Y. Li[b] & P. Chantawannakul[a,c] – BACTERIAL COMMUNITY STRUCTURE IN THE MIDGUT OF *APIS DORSATA* WORKERS IN THAILAND

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Asian giant honey bees are vital honey produces and pollinators of cultivated crops and wild plants. Relationships between gut microorganisms and honey bees are essential for maintaining proper nutrition and immunity. This study examined the bacterial community structures in the midgut of the Asian giant honey (*A. dorsata*) workers collected from two locations in Chiang Mai, Thailand. A total of 180 workers from six colonies were collected at different geographic sites in northern Thailand. Polymerase chain reaction-based denaturing gradient gel electrophoresis (PCR-DGGE) is a cultivation-independent molecular fingerprinting technique that allows the assessment of the predominant bacteria species present in bee midguts. The result showed the mean species richness and the Shannon index differed between colonies but nor by locations. Bacterial DNA profiles had similar patterns in individual colonies which differed amongst the replicate colonies, but was not affected by graphical location. Sequence analysis of DGGE products revealed evidence for core bacteria of the genera *Gammaproteobacteria* and *Firmicutes.* Although core bacteria existed in both populations, specific bacterial species were observed for each colony and site.

Milbrath, M.O.[a], X.B. Xie[a,b], & Z. Y. Huang[a] CARBON DIOXIDE ANESTHESIA AFFECTS MORTALITY OF *NOSEMA CERANAE* INFECTED HONEY BEES

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We have known for almost a century that the microsporidia *Nosema apis* is a serious parasite of the Western honey bee (*Apis mellifera*). Only recently, we have identified that a related microsporida, *Nosema ceranae,* has transferred from its original host, the Eastern honey bee, and is causing serious infection in *A. mellifera* as well. The full effects of *Nosema ceranae* infection in this new host remain unknown. Numerous studies have examined mortality after experimental infection with *N. ceranae*, but they have had highly variable results. One reason for this variation may be differences in experimental techniques. We examined one technique, CO_2 anesthesia, that may affect honey bee survival in the presence of nosema infection. We hypothesized that the use of CO_2 anesthesia when infecting bees would reduce survival. We used four treatments (Control, Nosema only, CO_2 anesthesia only, CO_2 anesthesia /Nosema), repeating the experiment with three colonies. We found that bees infected with Nosema spores alone had significantly lower survival than control bees (median survival = 21 days and 23 days, respectively), and that CO_2 anesthesia had a greater effect on survival than nosema infection alone. Bees infected using CO_2 anesthesia survived for significantly shorter times, regardless of their infection status (median survival = 18 days for both groups). Interestingly, bees infected using CO_2 had significantly fewer spores than bees infected without anesthesia. These results indicate differences in honey bee mortality experiments may be due in part to experimental technique. Overall, our survival rates were higher than these previous nosema mortality experiments, indicating that variation in honey bee resistance to nosema may be an important factor in determining survival after being infected with this parasite.

Xie, X.B.[a,b], G.W. Bian[b], Z. Xi[b], & Z.Y. Huang[b]-USING RNAi TO HUNT FOR GENES IMPORTANT FOR *VARROA* SURVIVAL AND REPRODUCTION.

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The varroa mite, *Varroa destructor,* is the worst pest of the Western honey bee (*Apis mellifera*) and responsible for declines in honey bee populations worldwide. In this study we used RNA interference (RNAi) technology to disrupt the life cycle of varroa mites by either causing death or causing a reduction in reproduction. We searched for gene orthologs in the newly established varroa mite genome (http://www.ncbi.nlm.nih.gov/genome/?term=varroa%20destructor). We tested the genes of Daughterless

(*Da*), Proteasome 26S subunit 4 (*Pros26.4*), Ribosomal protein L8 (*RpL8*), Ribosomal protein L11 (*RpL11*), Ribosomal protein P0 (*RpP0*), and Ribosomal protein S13 (*RpS13*), all of which have shown to play roles in survival or reproduction in other tick species.

Results showed that our method of microinjection worked well because the survival of 48-h post injection (p.i.) was 85.51 ± 1.98 % (mean ± SE) for GFP injected groups. Gene suppression efficiency at 48-h pi was 62~84% for four of the genes we tested. After microinjection, we assessed the effects on mite survival of 2 and reproduction of 4 candidate genes: Pts26.4 gene and Da gene caused a significantly reduction in mite survival compared to the GFP control. For the other four genes, no significant effect on survival was observed so we tested the effect of dsRNA on mite reproduction. The mean (± SE) number of female offspring of mites injected with dsRNA of *RPL8, RPL11, RPP0,* and *RPS13* were 1.51 ± 0.20 (N=146), 0.20 ± 0.10 (N=94) and 1.05 ± 0.09 (N=90) and 1.30 ± 0.18 (N= 129), respectively. All these were statistically significantly lower compared to their own GPF injected controls (T-test, $P < 0.001$ for each gene). RPL8, RPL11, RPP0 and RPS13 therefore seem to affect reproduction in *Varroa destructor*.

In conclusion, we have discovered four genes important for mite reproduction and two genes important for mite survival. Future goals are to find ways to introduce these genes into varroa mites so that their survival or reproduction can be suppressed.

Guzman-Novoa, E., G. Koleoglu, K. Reyes-Quintana & P.H. Goodwin – CELLULAR IMMUNE RESPONSE TO *VARROA* MITE INFESTATION IN EUROPEAN AND AFRICANIZED BEES

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Varroa destructor feeds on the haemolymph of the honey bee, leaving an open wound in its host. Wound healing would be a consequence of a cellular immune response by the infested bee. However, not much is known about how *Varroa* affects the haemocyte response of bees to its infestation over time, and even less if different genotypes of bees have similar responses to the parasite.

Newly emerged Africanized and European honey bees were artificially infested with varroa mites, were punctured with an entomological pin, were injected with a macerate of varroa mites or with the buffer used for the macerate, and were compared with control, untreated bees, for their cellular immune response. Haemocyte counts were obtained from bees sampled at different time points. Piercing resulted in a rapid (2 hour) increase in number of haemocytes in the haemolymph of bees of both types, indicating a response to heal the wound. However, when bees were infested with mites or injected with varroa macerate, the response in haemocyte numbers decreased significantly within 12 hours relative to the control or buffer injection treatments in both types of bees. These results suggest that *Varroa* inoculates components that inhibit the cellular response of Africanized and European honey bees, possible through saliva secretions.

Medrzycki, P.[a], S. Tosi[a,b], G. Bogo[a], & C. Porrini[b] - INFLUENCE OF TEMPERATURE ON HONEY BEE SUSCEPTIBILITY TO PESTICIDES [a]CRA-API

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EPPO (*2010 EPPO Bulletin 40(3): 313-319*) and OECD (*1998*) are the European official guidelines that describe how to conduct trials for the evaluation of side-effects of plant protection products on honey bees. According to these guidelines, acute oral toxicity tests on adult honey bees should be carried out at 25±2°C.

In nature, adult forager bees may be exposed to a wide range of temperatures: from about 15°C (when foragers fly in spring) to 35°C (brood nest temperature) or even more (outside in hot climates). Since forager bees may also be exposed to pesticides, the purpose of this work was to investigate the influence of temperature on the susceptibility of forager bees to these substances.

Exiting forager bees from healthy and queen-right colonies were collected. Subsequently, acute oral LD_{50} tests were carried out at three different temperatures: 25±0.5, 30±0.5 and 35±0.5°C. Three active ingredients (fipronil, clothianidin and thiamethoxam) were separately tested. Following the European official guidelines (EPPO and OECD), five different doses of each a.i. and a control were provided via bulk administration in 10iL 50% w/w of sucrose solution per bee. Three or four replicates in different seasons were carried out. Mortality at 24 hours was assessed and LD_{50} with confidence intervals were calculated (Probit analysis, Polo LeOra software).

The results show that the LD_{50} value depends on the test temperature. This relationship was confirmed statistically in all the replicates of fipronil and thiamethoxam and in 2 of 4 replicates of clothianidin. Furthermore, different substance groups have different LD_{50} trends in relation to the temperature. In fact, with the increase of the temperature A) the toxicity of fipronil (phenylpyrazole) increases, while B) the toxicities of clothianidin and thiamethoxam (neonicotinoids) decrease.

To conclude, the toxicity of pesticides to forager bees is influenced by the temperature which the bees are exposed to. Interestingly, the strength and sign of this correlation depend on the characteristics of the a.i./substance group.

The European official guidelines used in the pesticide registration process (EPPO, OECD) allow to perform toxicity tests at a single temperature within 23-27°C: this wide range gives the interested parts the opportunity to carry out the tests at the temperature that will cause the preferred effect. Thus, to carefully evaluate the effects of an a.i., toxicity tests should be carried out at least at two different temperatures distant by 10°C (e.g. 25°C and 35°C). Otherwise, the hazard which the bees are exposed to could be underestimated.

Tosi, S.[a,b], D. Bergamini[a], C. Porrini[a] & P. Medrzycki[b]- INFLUENCE OF POLLEN QUALITY ON HONEY BEE HEALTH

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It is commonly agreed that the phenomenon named CCD (Colony Collapse Disorder), related to the recent honey bee colony losses, is multi-factorial. One of the factors, suspected of playing an important role in these losses, is the nutritional status of the colonies (Oldroyd, *2007 PLoS Biol. 5(6):e168*; vanEngelsdorp & Meixner, *2010 J Invertebr. Pathol. 103:80-95*).

Honey bees need to eat pollen to ensure the proper development and growth. Indeed, pollen is their main source of proteins. Forager bees tend to collect pollen from different plant species (Dimou & Thrasyvoulou, *2009 Apidologie 40:124-133*) and this behavior helps to completely satisfy the nutritional requirements of the colony through a balanced and varied diet (Brodschneider & Crailsheim, *2010 Apidologie, 41(3):278-294*). In fact, the relative proportion of the nutrients in the pollen can vary widely according to its botanical origin. Nevertheless, commercial colonies are often placed in agricultural landscapes, where usually there are few pollen-producing plant species available for the bees. For this reason, forager bees can collect pollen from only few different plant species available, according to the flowering time.

The aim of this work was to investigate if the quality of the pollen available to a colony can influence the health of the bees.

Fresh pollen loads from apiaries situated either in natural (NAT) or intensive agriculture (AGR) ecosystems were collected. The AGR pollen was characterized by lower diversity of botanical origin and lower protein content than NAT pollen. No insecticide residues were found in the tested pollen.

Newly emerged bees from the same healthy and queen-right colony were collected. Then, the bees were incubated in laboratory at 30°C and fed with water, organic *Robinia* honey and fresh pollen (AGR or NAT) *ad libitum*. Mortality and food consumption during incubation were assessed.

After 2 weeks of incubation, acute oral LD_{50} tests were carried out. Two active ingredients (fipronil and thiamethoxam) were separately tested. Six test doses including control were administered to the bees, through bulk administration of an a.i. in 10iL 50% w/w sucrose solution per bee. Honey bee mortality was assessed at 24, 48, 72 hours. LD_{50} and its confidence intervals were calculated (Probit analysis, Polo LeOra software).

The results showed that bees fed with AGR pollen, compared to those fed with NAT pollen, were characterized by: 1) higher mortality during the 2 weeks of incubation and 2) lower resistance to the intoxication by fipronil. No significant effect of the pollen quality on the susceptibility of the bees to thiamethoxam was found. In addition, more NAT pollen than AGR pollen was consumed by the bees during the incubation period.

To conclude, the survival of the bees and their susceptibility to pesticides may be influenced by the pollen nourishment. In this case study, Italian pollen with low diversity of botanical origin and low protein content (AGR) reduced the longevity of the bees and their resistance to fipronil (phenylpyrazole) but not to thiamethoxam (neonicotinoid). Thus, intensive agricultural landscapes may have negative impact on honey bee colonies through both the widespread presence of pesticides and the low nutritional quality of the pollen available.

Finally, it is assumed that the same stressor (e.g. intoxication) can cause lower or greater consequences to the colony in relation to the pollen supply/location of the colony.

Mullin, C.A., J. Chen, W. Zhu, M.T. Frazier & J.L. Frazier - **THE FORMULATION MAKES THE BEE POISON**

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Modern pesticide formulations, particularly when multiple active ingredients are blended, require proprietary adjuvants and 'inerts' to achieve high efficacy for targeted pests. Although numerous pesticides have been found in beehive samples, no individual pesticide amount correlates with recent bee declines. Formulations usually contain inerts at higher amounts than active ingredients, and these penetrating enhancers, surfactants and adjuvants can be more toxic on non-targets than the active ingredients. For example, we found that the miticide formulation Taktic® was four time more orally toxic to adult honey bees than the respective active ingredient amitraz. Impacts of 'inerts' in pollen and nectar alone or in combination with coincident pesticide residues on honey bee survival and behavior are unknown. An improved, automated version of the proboscis extension reflex assay with a high degree of trial-to-trial reproducibility was used to measure the olfactory learning ability of honey bees treated orally with sublethal doses of the most widely used spray adjuvants on almonds in the Central Valley of California. Three different adjuvant classes (nonionic surfactants, crop oil concentrates, and organosilicone surfactants) were investigated. Learning was impaired after ingestion of 20 µg of any of the four tested organosilicone adjuvants, indicating harmful effects on honey bees caused by agrochemicals previously believed to be innocuous. Organosilicones were more active than the nonionic adjuvants, while the crop oil concentrates were inactive.

Monitoring methods are needed for major adjuvant residues so risks of formulation additives and their pesticide synergisms for pollinators can be assessed. Organosiloxane, nonyl- and octyl-phenol polyethoxylates are widely used as nonionic surfactants around honey bee hives or in their foraging areas as spray adjuvants or additives in agrochemical formulations. A method for analysis of organosiloxane, nonylphenol and octylphenol polyethoxylate surfactants in bee hive matrices was developed. A combined liquid-liquid extraction and solid phase extraction method was used. Less than 2 grams of honey, pollen or wax were extracted using the QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) approach. Identification and quantification were accomplished employing liquid chromatography coupled to electrospray ionization mass spectrometry (LC-ESI-MS). Nonylphenol more than organosiloxane and octylphenol polyethoxylates were found in wax samples, while pollen and particularly honey residues were lower. We will continue to focus on recent formulation technologies, including organosilicone surfactants and solvents like N-methylpyrrolidone (NMP), of unknown bee ecotoxicity, and to investigate the possibility of recent bee declines being associated with these 'inerts'.

A larval rearing method was adapted to assess the chronic oral toxicity to honey bee larvae of the four most common pesticides detected in pollen and wax - fluvalinate, coumaphos, chlorothalonil, and chloropyrifos - tested alone and in all combinations. All pesticides at hive-residue levels triggered a significant increase in larval mortality compared to untreated larvae by over two fold, with a strong increase after 3 days of exposure. Among these four pesticides, honey bee larvae were most sensitive to chlorothalonil compared to adults. Synergistic toxicity was observed in the binary mixture of chlorothalonil with fluvalinate at the concentrations of 34 mg/L and 3 mg/L, respectively; whereas, when diluted by 10 fold, the interaction switched to antagonism. Chlorothalonil at 34 mg/L was also found to synergize the miticide coumaphos at 8 mg/L. The addition of coumaphos significantly reduced the toxicity of the fluvalinate and chlorothalonil mixture, the only significant effect in all tested ternary mixtures. We also tested the common 'inert' ingredient N-methyl-2-pyrrolidone at seven concentrations, and documented its high toxicity to larval bees. NMP was more orally toxic to larvae than adult honey bees. We have shown that chronic dietary exposure to a fungicide, pesticide mixtures, and a formulation ingredient have the potential to impact honey bee populations, and warrants further investigation.

Johnson, R. & E. Percel. **The EFFECTS OF THE FUNGICIDE PRISTINE ON QUEEN REARING.**

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There have been reports by commercial queen producers of occasional unexplained loss of large numbers of developing queens in the larval or pupal stage. Many of the affected queen-rearing operations are situated among the almond orchards of California and report these losses in the weeks after almond trees bloom. Almond flowers are a rich foraging resource for bees, but are also commonly treated with fungicides, insecticides and spray adjuvants during bloom to control pests and pathogens. Queen producers have associated queen developmental problems with application of the fungicide Pristine, which contains the active incredients boscalid and pyraclostrobin, and the spray adjuvants containing organosilicone compounds. To test the effect of these pesticides queens were reared in closed swarm boxes for four days, until capping, with nurse bees fed pollen treated with four concentrations of Pristine (0.4, 4, 40 and 400 ppm), an organosilicone-containing spray adjuvant (Break-Thru, 200 ppm), the combination of Pristine and Break-Thru (400: 200 ppm), diflubenzuron (100 ppm) as a positive control or water as negative control. Low concentrations of pyraclostrobin (50 ppb), but no boscalid, was detectable in royal jelly fed to queens in the 400 ppm Pristine treatment. No significant difference in queen survival to capping or adult queen emergence was observed between any of the experimental treatments and the negative control. Only diflubenzuron, the positive control, caused a substantial reduction in queen cell capping. Interestingly, diflubenzuron use in almonds during bloom, at roughly the same time and scale as Pristine application, has been on a steady increase over the last decade. Future work should focus on the role of diflubenzuron, possibly in combination with other pesticides, on queen development, survival and success.

Villar, G., T. Baker, H. Patch, & C.M. Grozinger – EXAMINING THE CAUSES OF DIFFERENTIAL RESPONSES TO THE QUEEN BY DRONES AND WORKERS.

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In honey bees, the social interactions of workers and drones with the queen are primarily mediated by pheromones. Of these, a unique component of the queen mandibular gland pheromone, 9-ODA, has been found to function as both a social and sex pheromone. In workers, 9-ODA serves as an attractant, signaling the queen's presence in the hive and playing a role in the formation of the queen's retinue (Boch et al., 1975 *J Chem. Ecol.* 1:1:133-148). It also inhibits new queen rearing, slows worker maturation, and alters brain gene expression (Grozinger et al., 2003 *PNAS* 100:2). In drones, its effects are less well characterized, though we know it serves as a long range attractant, which allows drones to locate reproductively receptive queens at aerial congregation mating sites (Boch et al., 1975 *J Chem. Ecol.* 1:1:133-148).

The role that 9-ODA plays for the members of the hive is developmentally and spatially context dependent, however. Drones show no attraction to the queen while inside a hive, at any age. They also don't take mating flights outside of the hive before reaching maturity (Giray and Robinson, 1996 *PNAS* 93:21). Even after reaching sexual maturity, drones only attempt to find and mate with queens at specific times during the day. Workers, by contrast, are receptive to the queen soon after emerging; this is when they participate in queen tending and rearing and it is at this time that attraction to the queen and to 9-ODA is strongest. As workers age and transition from nurses to foragers, exposure and receptivity to the queen decrease. Though we have a good sense of the contextual dependency of the behavioral interactions with the queen in workers and drones, our understanding of the physiological and molecular mechanisms underlying these differential behaviors is not well understood.

Here I discuss several studies which look at physiological and molecular phenomena that may be modulating worker and drone behavioral receptivity to the queen pheromone component, 9-ODA, at the level of the peripheral nervous system. Gene expression studies looking at expression levels for the recently characterized 9-ODA receptor,OR11 (Wanner et al., 2007 *PNAS* 104:36), in antennae shows receptor expression levels to be significantly higher in older mature drones and in young nurse bees as compared to immature drones and foragers, a pattern which coincides with periods of interaction and receptivity to the queen by the former groups. Though not significant, preliminary qualitative electrophysiological studies on workers show a consistent trend of increased sensitivity to the queen in the antennae of nurses vs. foragers, and a possible function of juvenile hormone in modulating olfactory sensitivity to 9-ODA. These findings may indicate a role for the peripheral nervous system in mediating, in part, the differential behavioral responses to the queen in workers and drones.

Henderson, C.B.[a], J.J. Bromenshenk[a], & D.L. Fischer[b] -- Clothianidin exposure levels from bee-collected pollen and nectar in seed-treated corn and canola plantings.

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Field investigations of honey bee exposure to clothianidin from corn and canola grown from treated seed were conducted in 2010 and 2011. Fifty-three corn field sites, each consisting of 100+ acres of field corn grown from seeds treated clothianidin, were selected across three states, Illinois, Indiana and Nebraska. Pollen traps affixed to a single colony at each field were used to collect pollen gathered by foragers. A single bee-collected pollen sample was taken at each field, mid-tassel period in 2010. Three samples spanning the tasseling period were collected in 2011. Pollen for comparison was collected directly from tassels in 2010.

Seed treatment was at 0.5 mg clothianidin/seed in IL and IN; 1.25 mg /seed in NE. The former is the most common treatment rate in use in the U.S.; the latter is maximum allowed by the label. Measured clothianidin residues in bee-collected pollen did not vary across the tasseling period, and the magnitude of residues were approximately proportional to the seed application rate. Consequently, values from 2010 – treated at 0.5 mg/seed – were multiplied by 2.5 and pooled with those from 2011. For the pooled data set (N=53 field sites), the mean clothianidin concentration was 1.2 ppb with 95% of residue concentrations below 2.8 ppb. Thirty percent of bee-collected pollen samples were at or below LOD (0.44 ppb).

Corn pollen in bee-collected pollen averaged just 19 ± 22 percent whereas corn fields comprised 72 ± 14 percent of habitat within one mile of the study colonies. Clothianidin residue in tassel-collected pollen was higher than in bee-collected pollen averaging 4.4 ± 5.2 ppb with 95 percent below 11.9 ppb. There was a significant correlation between frequency of corn and clothianidin concentration in bee-collected pollen, r=0.69, but there was no relationship between frequency of corn in bee-collected pollen and clothianidin concentration in tassel pollen, r=0.29.

Residues in canola were assessed in 2011 from thirty fields in southern Alberta, Canada. Bee-collected pollen averaged 1.7 ± 1 ppb and nectar averaged 0.8 ± 0.1 ppb clothianidin. Clothianidin concentration did not vary across the pollination period. Bees made heavy use of canola pollen; it comprised 72 ± 26 percent of pollen samples. Forty-four percent of bee-collected pollen samples were 100 percent canola. Unlike corn, there was no correlation between the concentration of clothianidin in bee-collected pollen and percentage canola pollen in the sample.

We conclude from these findings that clothianidin residues in food items collected by bees are greater for bees placed at canola field sites than at corn field sites. Even so, mean concentrations in pollen and nectar were 2 ppb or less and 95%tile levels were 4 ppb or less in these crop situations, levels that are not expected to pose a significant risk the honey bee colonies. Although residues in corn pollen sampled directly from tassels may reach 10 ppb or greater, preference by foraging bees for other kinds of pollen dilute their exposure to the lower levels we observed.

Seccomb, R.A., C.B. Henderson,& J.J. Bromenshenk. **AUDIBLE CUES TO STRESS IN HONEY BEE COLONIES.**
Bee Alert Technology, Inc., 1620 Rogers Street Suite 1, Missoula, MT 59802

Investigation into honey bee response to sublethal exposure to airborne toxicants showed that honey bee colonies produce unique and characteristic sound profiles when exposed to different toxicants. Furthermore sonograms from different classes of toxicant were distinct and could be statistically differentiated at near 100% correct classification. Using these findings we explored whether other stressors of honey bee colonies induce similar identifiable sonographic profiles. We collected recordings of samples from free-flying colonies having verified conditions that included queenless and Africanized colonies as well as CCD, foul brood, small hive beetle, *Nosema*, and *Varroa* infections. Each of these conditions produced similar, unique sonographic profiles. We have developed an artificial neural network algorithm that uses these sonographic profiles to quickly assess the presence of these conditions. Using a microphone probe to make a 30 second recording, our instrument correctly identifies the presence of these conditions and the intensity of the infection with better than 85% reliability. Prototypes of our device are being tested in the field to further refine and improve the instrument's reliability in advance of its release for general use.

Pernal[a], S.F., A. Ibrahim[a], S.E. Hoover[b], R.W. Currie[c], H.A. Higo[d], E. Huxter[e], M.M. Guarna[f] & L.J. Foster[f] - **PROTEOMIC MARKER-ASSISTED SELECTION IN HONEY BEES: YEAR 2 UPDATE FROM THE BEEIPM PROJECT**
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The Next Generation Integrated Pest Management Tools for Beekeeping (BeeIPM) Project aims to evaluate the efficacy of using proteomic marker-assisted selection for enhancing disease and *Varroa destructor* resistance in honey bee populations. To evaluate the utility of this new tool for breeding, we embarked on a large-scale project. In 2011, 622 colonies were phenotyped across four Canadian provinces for hygienic behaviour (HB). A portion of these colonies was then randomly selected to establish an unselected benchmark population (n=83) while an F_0 population was established (n=110) from colonies most highly expressing HB. We successively tested, selected and propagated two generations from our F_0 during 2011 and 2012, in a parallel and direct comparison of proteomic-based marker-assisted selection (MAS) against traditional behaviorally-based phenotypic selection (FAS) on HB.

FAS-selected stock exhibited successive relative increases in hygienic behavior of 21.7 ± 2.4% and 45.7 ± 3.6% over benchmark populations in the F_1 and F_2 generations, respectively. Similar, though smaller, gains were observed for the MAS-selected stock where levels of HB increased 6.5 ± 2.8% and 29.2 ± 3.7 % over benchmark populations for the F_1 and F_2 generations. The F_0 and F_1 were also evaluated for *Varroa* Sensitive Hygiene (VSH) as described by Villa *et al., 2009* (*J. Apic. Res. 48: 162-167*). Though no significant differences were observed at one of two breeding sites in British Columbia, our Grand Forks F_1 FAS selected stock showed reductions in mite infestations of 40.9 ± 6.0% while MAS stock showed reductions of 50.8 ± 5.0%. F_0 performance was documented at 25.8 ± 3.0%.

Both FAS and MAS F_1 selected stocks were also evaluated via whole-colony challenge experiments with American foulbrood disease (AFB) (Pernal *et. al, 2008 J. Econ. Ent. 101:1095-1104*). Evidence of differences in colony-level resistance to AFB were observed for several parameters, including the numbers of clinical symptoms in colonies over time and the number of *P. larvae* spores in workers collected from the brood nest. At the end of the twelve week evaluation period, 100% of colonies of the unselected New Zealand stock and 83% of Western Canadian benchmark exhibited symptoms of AFB. In contrast, only 40% of MAS-selected and 15% of FAS-selected colonies exhibited symptoms.

V. destructor resistance was evaluated by examining changes in total colony mite populations after a ten week period, in September 2012, and again in November. Total mite levels in FAS and MAS selected colonies in the F_1 did not significantly differ in November (means ranging from 2004 ± 234 to 2680 ± 1240) however, differences in mean mite abundance (mites per 100 bees) and adult bee population sizes were found in September and November. Mean abundance of *V. destructor* was lower in FAS and MAS colonies than in New Zealand colonies for both sampling periods, though similar to Western Canadian benchmark colonies. Bee populations in FAS colonies were larger than in benchmark colonies in both time periods, and FAS colonies were also larger than New Zealand stock by November.

Based on results to date, we conclude that selection on proteomic markers as well as traditional phenotype has enriched HB over two generations and has demonstrated initial proof of concept for proteomic selection in general. Detailed evaluations of the F_3 will be made during the summer of 2013.

Ingram, E.M., M.D. Ellis & B.D. Siegfried. **TOXIC AND REPELLENT EFFECTS OF PYRETHROIDS USED IN ORCHARDS ON THE HONEY BEE, *APIS MELLIFERA* L. (HYMENOPTERA: APIDAE)**
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Managed honey bee colonies are rented by fruit orchards to provide pollination services that improve fruit quality and yield. Placement of colonies in this agricultural setting increases the possibility of exposure to pyrethroids used for broad-spectrum pest control in orchards. Pyrethroids are highly toxic to bees (Smart and Stevenson, *1982 Bee World 63(4):150-152*), and studies have correlated their use with decreases in honey bee foraging after application (Rev in Thompson, *2003 Ecotoxicology 12:317-330*).

The goal of this study was to quantify sublethal behavioral effects associated with orchard-applied pyrethroid exposure in laboratory and semi-field situations. Quantification of sublethal effects may lead to more informed management decisions by growers and beekeepers. Development of video-tracking protocols may provide regulatory agencies with a risk assessment tool for measuring sublethal pesticide effects on pollinators.

Following sublethal topical treatment of esfenvalerate, *lambda*-cyhalothrin, or permethrin, honey bee locomotion, time spent in a food zone and social interaction were quantified using video-tracking software, Ethovision XT® and methods from Teeters *et al.* (*2012, Environ. Toxicol. Chem. 31:1349-1354*). Separate analyses were performed on experimental colonies (A and B) and responses differed between colonies. Moderate (12.98 ng/bee) and high (25.96 ng/bee) sublethal doses of esfenvalerate significantly decreased total distance moved in colony A (moderate: $p<0.0001$; high: $p<0.0001$) and colony B (moderate: $p=0.0195$; high: $p=0.0041$). Social interaction time in colony A was significantly decreased at the highest dose of esfenvalerate ($p<.0001$). The highest dose of permethrin (52.29 ng/bee) significantly decreased both total distance moved and social interaction time in colony A ($p<.0001$; $p<.0001$). These results suggest that video-tracking can detect sublethal effects of esfenvalerate and permethrin on locomotion and social interaction at these doses.

Repellencies of technical-grade esfenvalerate, *lambda*-cyhalothrin, and permethrin were measured at artificial feeders using methods adapted from Rieth (*1986, Doctoral dissertation, University of Arizona*). Control or treated filter paper was attached to polystyrene floats and placed in artificial feeders stocked with 20% sucrose solution and 30 ppm peppermint oil as an attractant. Contact pesticide exposure was simulated as foraging honey bees landed on the floats and the edge of the feeder in order to consume the sucrose syrup. Digital photos of the floats were taken every 10 minutes for 1.5 hours at each feeder. Using ImageJ software, digital images were examined to manually determine forager counts. Mean comparisons of forager counts over 10 time points were analyzed to assess repellency. Significantly fewer foragers were observed on permethrin-treated floats compared to control-treated floats at time points 3-10 (time point 3: $p=0.0019$; time point 4: $p=0.0037$; time point 5: $p=0.0050$; time point 6: $p=0.0009$; time point 7: $p=0.0029$; time point 8: $p=0.0031$; time point 9: $p=0.0468$; time point 10: $p=0.0476$)

Traver, B.E., N.G. Johnson, T.D. Anderson & R.D. Fell - EFFECTS OF PESTICIDE TREATMENTS ON PATHOGENS AND IMMUNITY IN HONEY BEE COLONIES

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Honey bee colony losses are still occurring. While initially thought to be due to one factor, it is now probable that losses are influenced by multiple factors. The goal of this project is to examine the effects of pesticide treatments on pathogen levels and immunity of honey bees. Here we report the effect of 1) chlorothalonil, a commonly used fungicide, 2) fumagillin, the antibiotic used for *Nosema* control, and 3) *tau*-fluvalinate, an acaricide used for varroa mite control on *Nosema ceranae* and phenoloxidase levels. In the summer of 2012, colonies were established in apiaries that have not been treated with pesticides for five years. In the fall of 2012, colonies were either untreated (control) or treated with chlorothalonil (10 µg/L in sucrose solution), fumagillin (5 g/gallon in sucrose solution), or *tau*-fluvalinate (acaricide-impregnated strips; 10% w/w active ingredient). We collected samples of bees pre-treatment and 2 and 4 weeks post-treatment. For fall treatments, our results suggest that there was not a significant change in *N. ceranae* levels at any time point for the fumagillin-treated colonies compared to the untreated colonies. For chlorothalonil-treated colonies, there was a significant decrease in *N. ceranae* levels when comparing the pre-treatment and 4 weeks post-treatment ($p = 0.03$) time periods. *Nosema ceranae* levels also significantly decreased between the 2 and 4 weeks post-treatment ($p < 0.01$) time periods in these colonies. For *tau*-fluvalinate-treated colonies, there was a significant decrease in *N. ceranae* levels when comparing the pre-treatment and 4 weeks post-treatment ($p < 0.01$) time periods. *Nosema ceranae* levels also significantly decreased between the 2 and 4 weeks post-treatment ($p < 0.01$) time periods. Preliminary data for phenoloxidase activity suggest similar trends as *N. ceranae* levels for bees collected from the same pesticide-treated colonies.

Steinkampf, M.P[a], J. Hurst[b] & J. Tew[c] – EFFECTS OF OPTIMIZING HIVE SOLAR ABSORPTION ON HONEY BEE HEALTH AND PRODUCTIVITY.

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Ensuring that honey bee colonies maintain an optimal temperature remains one of the most debated and controversial topics of beekeeping. Although uncertainty about the benefit of conserving bee colony heat loss persists, wrapping hives in winter with tarpaper or insulation is still done by some beekeepers in colder climates. One potential reason for the inability to consistently document the benefit of hive insulation may be due to the fact that while insulation slows down the rate of energy exchange between the hive and the environment, it also limits penetration of heat generated via solar radiation. Preliminary experiments by our group indicated that honey bee hive temperature could be modulated using a hive coating that contained a *thermochromic* pigment, which appears black at low temperatures, facilitating solar absorption, but becomes white when temperature exceeds a threshold value. The purpose of our study was to determine the effects of hive coatings that modulate solar radiation absorption on honey bee health and productivity.

Hive boxes and covers were primed with white latex primer followed by two coats of TC coating (black/colorless, transition temperature 86F [31C], LCR Hallcrest Corporation, Streamwood, IL) and top-coated with four coats of transparent UV-protective spar varnish. Other hives coated with white (W) or black (B) latex paint to serve as controls. In April 2011, we installed 13 three-pound honey bee packages from our local supplier after installing hives (5 TC, 5 W, 3 B) on single-beam platform scales. Brood development was assessed after the colonies were established and in March of the following year, with honey harvest accomplished three months later. During the study period, colonies were reestablished as needed so that all hives were occupied at the start of winter, and TC boxes were recoated in November to minimize the effect of pigment fading. .

Packages initially established colonies in all TC and black hive boxes, but in only 2 of 5 white hives ($P=0.035$). Total colony brood area 3.5 weeks after package introduction among established colonies was similar among the study groups (TC 561 in^2, W 539 in^2, B 674 in^2; $P=0.819$). Weight loss between November and the following January was also comparable (TC -5.2 lb, W -4.9 lb, B -1.9 lb; $P=0.73$), as was spring brood development (TC 604 in^2, W 612 in^2, B 701.8 in^2; $P=0.85$) and honey yield (TC 40.5 lb, W 32.4 lb, B 21.3 lb; $P=0.95$).

We conclude that hive coatings which increase the absorption of solar radiation in cool weather facilitate honey bee package installation, but otherwise they have no demonstrable effect on honey bee health or productivity.

Yang, W.C.[a], H. Kuang[b], J. Wang[a], S.S. Wang[a], Z.H Wu[a], X.Q. Miao[a], & Z. Y. Huang[c] COMPARATIVE SUCROSE SENSITIVITY IN *APIS MELLIFERA* AND *A. CERANA* FORAGERS.

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Previous studies in the Western honey bee, *Apis mellifera*, have shown that pollen foragers have a lower sucrose threshold when tested using a proboscis extension response (PER) assay. Based on the biology of the Eastern honey bee, *A. cerana*, we hypothesized that *A. cerana* should have a lower threshold for sucrose. We compared the sucrose thresholds between pollen foragers and nonpollen foragers for *A. cerana* and *A. mellifera* in Fujian Province, China. Pollen foragers were more responsive to sucrose than nonpollen foragers in both species. Across the two species, *A. mellifera* was more sensitive than *A. cerana* in both types of foragers. In mixed species colonies where both species shared the same colony environment, *A. mellifera* also showed a higher PER score than *A. cerana*, so the higher sensitivity of *A. mellifera* was not due to a different colony environment. Based on these data, we predicted that nectar foragers in *A. mellifera* should bring in lower concentration nectar compared to that of *A. cerana*. We determined the nectar concentrations at each hour of seven-paired colonies of the two species of bees for seven days but found that the concentration of nectar foraged *A. mellifera* was not significantly higher than that of *A. cerana*. There might be other mechanisms to enable *A. cerana* to perform well in areas with sparse nectar resources.

Zhou, S.J., X.J. Xu, X.J. Zhu, J.L. Gao, & B.F. Zhou * - GENETIC DIVERSITY OF *APIS CERANA CERANA* IN HAINAN BASED ON MITOCHONDRIAL DNA

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Population genetics of island species can provide us important information for their evolutionary history, genetic diversity and conversation. Hainan is a large island in south of China, with different environment and has been separated from the mainland for 10 million years. *Apis cerana cerana* is an important endemic species in Hainan. Even though previous studies have found 3 haplotypes by sequencing 9 honey bee workers in Hainan island*(Jiang & ZHA., 2007 Sci. Agric. Sin. 40:7, Tan & Warrit, 2007 Apidologie 38:3)*, the sample size and number of collection sites were small. In this study, *Apis c. cerana* samples were collected from throughout Hainan island, and genetic diversity was determined by mitochondrial DNA fragments of $tRNA^{leu}$-COII sequence.

A total of 715 colonies were collected from Hainan Island, with 16 collection sites range from N 18°24.361′ to N 19°54.254′ and from E 108°50.359′ to E 110°52.689′. Workers were killed immediately by immersing them into absolute ethanol and kept at -80°C until processed in the laboratory. A single worker from each colony was examined by mitochondrial DNA. Mitochondrial analysis was carried out on a polymerase chain reaction produced from the intergenic $tRNA^{leu}$-COII region *(Garnery et al., 1993 Experientia 49:11)*, with the primers E2 located at the 5′-end of the $tRNA^{leu}$ gene, and H2 located at the 5′-end of the COII gene. An automated sequencer ABI3730 xl (Applied Biosystems, USA) was used to sequence the samples. Sequence data was aligned with the Clustal X1.83 program, and the haplotype diversity (*Hd*), average number of nucleotide differences (*K*) and nucleotide diversity (*Pi*) were calculated by DnaSP5.00.07.

A total of 48 haplotypes were found, 43 of which had not been previously published (Accession number: JQ323003-JQ3230045). There were 38 polymorphic sites, including 12 singleton variable sites, 23 parsimony informative sites, 1 insert site and 3 deletion sites. The average diversity of haplotypes was 0.742±0.017, the average nucleotide difference *K* and the nucleotide diversity of the honeybee samples *Pi* were 1.248 and 0.00354±0.00013 respectively, indicating the abundance of the haplotypes. The haplotype diversity (*Hd*) was unevenly distributed in all collections. The Wangning samples (WNLJ), from a southeast site in Hainan, were detected 3 haplotyes with the lowest haplotye diversity (1.171±0.066). Compared with the major haplotype (H02), the primary haplotype in Hainan island was H01, accounting for 46.15% of all samples in Hainan. But H02 was detected as the main haplotype in 3 collection sites (TCZJ, QZHM and QZJC), which were the primary places with introduced the mainland colonies. In addition, there were 74.27% honey bees in Hainan detected to have haplotypes which had the transition in 117^{th} site (G-A), such a greater percentage was never detected in Chinese mainland.

Mainland honeybee introduction and the rearing queen led to the obviously different genetic structure and lower abundance diversity in some places in Hainan, which was the reason of the unstable genetic structure in Hainan honeybee population. Results of this study will provide us the scientific basis for the conservation of *Apis c. cerana* in Hainan.

The full study was recently published (in Chinese) in 2012, J. Fujian Agric. For. Univ. 41:2.

Matisoff, M. A. & T. C. Webster AN INEXPENSIVE TEST FOR NOSEMA IN HONEY BEES.

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A simple and inexpensive test for the detection of *Nosema* spores in honey bee tissue is described. Currently, some beekeepers buy microscopes to observe spores in bee samples. But this is too expensive for many individuals. Apiary inspectors are available in some states to diagnose *Nosema* but this service may be time-consuming and it is not available in all states.

The test depends on (1) the high density of *Nosema* spores compared to honey bee midgut tissue, (2) the ability of a stain, Calcofluor white, to bind to the chitin on the surface of the spore, and (3) the vivid fluorescence of the stain under ultraviolet illumination. Bee midguts are removed from the bees and mashed in water. A drop of stain is added, the sample is mixed, and then it is passed through honey filter or similar material. The filtrate is allowed to settle in a small glass test tube for several hours. If the midguts are infected with Nosema, a pellet of spores will form at the bottom of the tube. The bottom of the tube is then illuminated with an ultraviolet-emitting diode powered by two flashlight batteries. Spores in the pellet will glow blue-white. The observations should be made in a very dark room.

Observations of 100,000 spores are possible by this method. This is equivalent to a low infection in a single bee. A sample may consist of more than one bee, to improve the efficacy of the test. The entire system including stain costs less than five dollars.

This test does not distinguish between *Nosema ceranae* and *Nosema apis*. However, *N. apis* is now relatively rare in the U.S. The test is roughly quantitative if the observer compares the observed spore pellet to prepared reference pellets with known numbers of spores. However this is not a research tool.

Webster, T. C., M. A. Matisoff & C. Butler. EARLY DEVELOPMENT OF *NOSEMA CERANAE* IN HONEY BEE MIDGUT TISSUE.

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An understanding of the early stages of *Nosema ceranae* infection are important for two reasons. First, accurate observations of these early forms will allow tests of *Nosema* treatments to proceed quickly. Similarly, efforts to breed bees resistant to *Nosema* will be facilitated if candidate bee stock may be inoculated and evaluated in short time periods. Second, the secretion and condition of the peritrophic matrix (PM) in the bee's midgut is affected by *N. ceranae* infection. PM condition may have other implications for bee colony health.

We inoculated individual worker bees each with 50,000 *N. ceranae* spores, and later caged them collectively at 32 C with 50% sucrose as feed. Bees were removed every two days and examined for spores. *N. ceranae* infections are first visible by light microscopy, with the appearance of 1-2 million primary spores per bee 6 days post-inoculation (dpi). These spores appear oval, slightly tapered, and dark at one end using phase contrast optics. These spores peak at 8-12 dpi with 2-10 million spores per bee (mspb). The mature form of *N. ceranae*, the environmental spores, are evident at 8 dpi (1-8 mspb). These are the spores that are shed in bee feces and are able to infect other bees. They steadily become more abundant, reaching 13-40 mspb by 22 dpi. From these observations we conclude that infections can be anticipated 6 dpi with primary spore counts.

The PM is secreted by specific midgut epithelial cells. This structure is produced as a series of continuous concentric sheets in healthy bees. After the midgut is infected with *N. ceranae* it degrades to shreds. Other studies have shown important roles for the PM in insects: a barrier to ingested pathogens, a substrate for digestive enzymes, and protection against abrasion. We suggest these roles be considered in examinations of honey bee pathogens and nutrition.

Bernert, A., R. Sagili, & K. Johnson - EVALUATING FUNGICIDE SENSITIVITY OF THE HONEY BEE (*APIS MELLIFERA* L.) MICROBIOME.

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Recent honey bee colony declines have brought significant attention to the need of improving honey bee health and nutrition. The importance of the microbiome of the honey bee and hive has gained significant attention in the last few years (Mattila et al. 2012 PLOS One 7(4) e35954, Anderson et al. 2011 Insectes Sociaux 58:431-444). Microorganisms associated with *A. mellifera* L. have been shown to inhibit the growth of *A. mellifera* L. pathogens (Evans and Armstrong 2006 BMC Ecol 6(4). However almost all microflora molecular work has been devoted to bacterial communities while the metagenomics of fungi has not garnered significant attention.

Some fungi have been found to be vital in the fermentation of pollen and making of the beebread. Recent research findings have shown that fungicides negatively impact the growth of symbiotic beebread microbes (Yoder et al 2002 CRC Press. p 193-214). The microbes tested were morphologically identified to the taxonomic genus level thus excluding any ascomycete anamorphs. Also, fungal microflora may differ between geographical locations, and specific strains of the same genus or species may have significantly different resistance levels. Currently, there is no regulation on fungicide treatment at full bloom when honey bees are foraging. Nectar and pollen contaminated with fungicides are carried back to the hive. Fungicide residues have been found in the wax, beebread, and pollen (Mullin et al. 2010 PLoS One 5(3): e9754). In this study we evaluated interactions between honey bee gut microbes (fungi) and their sensitivity to common fungicides found in honey bee hive matrices.

In this study we evaluated interactions between *Apis mellifera* L. gut microbes (fungi) and assessed their sensitivity to fungicides found in the hive matrices. Our results suggest that Chlorothalonil, Iprodione, and Boscalid inhibit growth of fungi associated with *A. mellifera* L. indicating the importance of further investigations into functional roles of these microbes and the effects of these fungicides in the hive. Fungicide concentrations used in this study were similar to residues found in wax and pollen. These concentrations inhibited growth of symbiotic fungi *in vitro* illustrating the need to know how they affect fungi in the hive and if those effects in turn would negatively impact colony health. Contrary to other studies, Chlorothalonil was detrimental to symbiotic fungal growth inhibiting nine of the ten isolates. Inconsistent trends of fungicide effects on fungal microbes, especially *Mucor hiemalis*, between this study and others highlights the need for further research into how exactly fungicides effect different strains of symbiotic fungi.

Li, Z.G.[a], Y.P. Chen[b], S.W. Zhang[a,c] & S.K. Su[a,d] - EFFECTS OF IAPV ON FORAGING BEHAVIOR OF HONEY BEES (*APIS MELLIFERA*)

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Israeli acute paralysis virus (IAPV) has been detected in many parts of the world. Like other common honey bee viruses, IAPV plays a detrimental role on colony health, especially in combination with Varroa mite. Effects of IAPV on foraging behavior and homing ability of pollen foragers were therefore investigated in this study using radio frequency identification (RFID) system.

Pollen foragers from colonies that weren't detected with any of the seven common honey bee viruses were used in the study. Each of the twenty pollen foragers was injected artificially with 1 ul IAPV. The IAPV was diluted 1:200 in sterilized phosphate-buffered saline (PBS: 137 mM NaCl; 3 mM KCl; 10 mM Na_2HPO_4; 2 mM KH_2PO_4, pH 7.2). Another group of twenty pollen foragers were injected with 1 ul PBS as a control. Each pollen forager was tagged with an RFID on the thorax and released 500 meters away from the hive. Data regarding foraging activity and homing ability of pollen foragers was collected by RFID readers placed in the hive entrance.

We found that homing ability of foragers infected with IAPV was depressed significantly in comparison with foragers injected with PBS as a control. There was no significant differences ($p > 0.05$) between the two groups in the number of foragers returning to the hive at days 0 and 1 post-injection. The number of foragers for PBS injected group returning to the hive at days 0 and 1 post-injection was around 16, which was nearly the same number for IAPV injected group. However, significant differences were found at 2 ($p < 0.01$), 3 ($p < 0.05$) and 4 ($p < 0.01$) days post-injection between the two groups. Two days post-injection, there were 14 foragers injected with PBS returning to the hive compared with only 1 forager injected with IAPV returning to the hive. There were 10 PBS treated foragers left and returned to the hive 3 and 4 days after the injection, however, there were no IAPV treated foragers foraged 3 and 4 days after the injection. The homing experiment was repeated and carried out in three different colonies and similar results were obtained from three independent experiments. The data provide evidence that viral infection in the heads may make honey bees lose their way back to the hive.

Wagoner[a], K., & O. Rueppell[b]. CONTRIBUTIONS OF BROOD COMMUNICATION AND MITE-EXPOSURE TO HYGIENIC BEHAVIOR IN *APIS MELLIFERA*.

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Honeybees (*Apis mellifera*) are important behavioral and molecular research models, and provide pollination services important to food security and maintenance of natural ecosystems worldwide. However the last six decades have seen significant honeybee declines, and the rate of these declines has only increased in the United States over the past five years. Honeybee declines are attributed largely to introduction and spread of novel parasites, specifically the recently introduced *Varroa destructor* mite, arguably the most important threat to apiculture today. Additionally, pesticides, including many of the miticides used to control *Varroa* infestations, are known to have lethal and sublethal effects on honeybee queens, workers, and drones. Though *Varroa* resistance through hygienic behavior has already been successfully selected for in honeybees, inefficiency and non mite-specificity of these selection processes leaves much room for improvement. Increased understanding and molecular markers of mechanisms underlying honeybee hygienic behavior are needed to improve existing selection processes. This research will study brood signals and the effects of mite pre-exposure on hygienic behavior to facilitate development of novel strategies for mite-specific selective breeding, which improve bee, human and environmental health by eliminating the need for chemical *Varroa* control. Experiments are being conducted to test the hypotheses that adult hygienic behavior is influenced by brood signals and by mite pre-exposure. Preliminary results support the hypothesis that adult hygienic behavior is influenced by brood signals, and suggest that these signals may be damage-dependent at least for certain honeybee genotypes.

Lichtenberg, E.M.[a], J.S. Pettis[b], M. Andree[c], J. Stitzinger[a], R. Rose[d] & D. vanEngelsdorp[a]. -- COLONY HEALTH IMPLICATIONS OF POLLEN AND PESTICIDE DIVERSITY IN COLONIES RENTED FOR CROP POLLINATION

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Recent declines in honey bee populations and increasing reliance on insect pollination of crops raise concerns about pollinator shortages. Research suggests that pesticide exposure and pathogens interact to have strong negative effects on managed honey bee colonies. For example, exposure to sub-lethal doses of several insecticides increases bees' susceptibility to or probability of death when infested with the gut parasite *Nosema* (Vidau *et al., 2011 PLoS ONE 6:e21550*; Pettis *et al., 2012 Naturwissenschaften 99:153-158*). Such findings are of great concern given the large numbers and high levels of pesticides found in honey bee colonies (Mullin *et al., 2010 PLoS ONE 5:e9754*). Thus it is crucial to determine how field-relevant combinations and loads of pesticides affect bee health.

We collected pollen via pollen traps from hives rented for pollination of seven crops to ask two questions. 1) What pesticides enter the nest via pollen when bees are rented for pollination of various crops? 2) How do field-relevant pollen and pesticide blends affect honey bee susceptibility to *Nosema* infection? Focal crops were almond, apple, blueberry, cranberry, cucumber, pumpkin, and watermelon. First we identified pollens collected from each crop. Each pollen sample contained multiple pollen types. In most crops, no or little of the trapped pollen was from the target crop. The second part of this study analyzed pollen samples for pesticide presence and quantity. We detected 35 different pesticides in the trapped pollen. Fungicide loads were higher than loads of all other pesticide categories. Finally, we tested whether source and pesticides in pollen fed to bees affected those bees' susceptibility to infection by the gut parasite *Nosema ceranae*. Several pesticides were associated with a higher risk of *Nosema* infection. In addition, probability of infection increased with the fungicide load in the pollen a bee was fed.

Our results indicate that more attention must be paid to how bees are exposed to pesticides outside of the field in which they are placed, and to the sub-lethal effects of fungicides on honey bees.

Khongphinitbunjong[a], K. L.I. de Guzman[b], M.R. Tarver[b], T.E. Rinderer[b], Y.P. Chen[c] & P. Chantawannakul[a,d] – PRELIMINARY RESULTS ON THE EVALUATION OF HONEY BEE STOCKS FOR SUSCEPTIBILITY TO DEFORMED WING VIRUS.

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We assessed the susceptibility of honey bee stocks to Deformed Wing Virus (DWV) infection. Three stocks ($n = 4$ colonies per stock) were evaluated: Italian (IHB), Pol-line (POL, hybrid Varroa Sensitive Hygienic bees) and Russian honey bees (RHB).

Each queen was caged to obtain uniformly-aged larvae. Rows of two-day old larvae were randomly fed 2µl of DWV lysate obtained by grinding 10 symptomatic bees in 10ml PBS. Several concentrations (DWV: PBS) were used: D1, D1:100, D1:1,000, D1:10,000, PBS alone and unfed larvae. Measurements were made of brood removal, DWV levels of newly emerged bees, weights at adult emergence and proportion of deformed bees.

Brood removal was universally about 30% ($P = 0.99$). For the levels of DWV, POL fed D1 had the highest while IHB and RHB had similarly low levels ($P < 0.0001$, Figure 1). Newly emerged IHB fed D1 (115.2 ± 0.7 mg) and D1:10,000 (115.0 ± 0.6 mg) were the lightest ($P < 0.0001$). Emergence weights of POL (117.6 ± 0.8 mg) and RHB (113.0 ± 0.6 mg) were higher and comparable. Larvae fed D1 ($5.84 \pm 1.64\%$) showed the highest proportion of deformed bees ($P = 0.005$). D1:10,000 ($1.26 \pm 0.52\%$) and control ($0.90 \pm 0.46\%$) groups had the lowest while D1:100 ($3.43 \pm 0.66\%$), D1:1,000 ($2.55 \pm 0.99\%$) and PBS ($1.70 \pm 0.63\%$) were intermediate. The proportion of deformed bees differed ($P = 0.049$): IHB ($3.57 \pm 0.68\%$) $\geq$ POL ($2.39 \pm 0.69\%$) $\geq$ RHB ($1.40 \pm 0.49\%$). Based on the low DWV levels and proportions of deformed bees, RHB may have some tolerance to DWV infection.

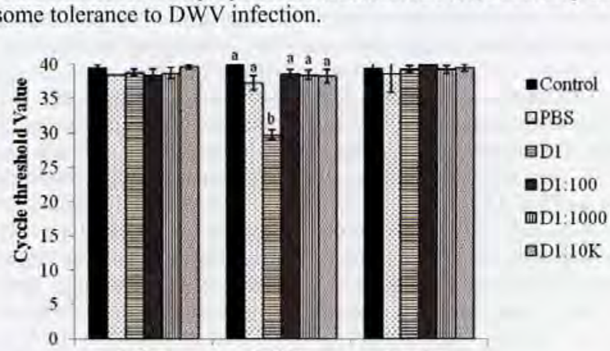

Figure 1. *Levels of DWV of three different honey bee stocks fed different concentrations of DWV.*

de Guzman, L.I., T.E. Rinderer & A.M. Frake – DOES THE REMOVAL OF MITE-INFESTED BROOD FACILITATE GROOMING?

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The relationship between the removal of mite-infested brood and mite drop was compared using Russian (RHB, $n = 9$) and Italian (IHB, $n = 9$) honey bee colonies. A cloake board was used to isolate test brood frame on the top hive body and the metal sheet served as a varroa trap. Inoculum mites were collected from newly sealed larvae and each was marked using correction fluid (Kirrane *et al.*, 2012 *J. Apic. Res.* 51: 212-213). Brood cells randomly received one of the following groups: 1) brood inoculated with one female varroa, 2) brood with capping opened and closed without mite inoculation (o/c), and 3) undisturbed brood cells as control. Brood removal and mite drop were determined every day for eight days.

Both stocks removed more mite-inoculated brood than o/c or control groups (P <0.0001). RHB (87.9 ± 2.0%) significantly removed more inoculated brood than IHB (61.9 ± 7.3%) (P = 0.0001). Increased removal of frozen brood by RHB has also been demonstrated (de Guzman *et al.*, 2002 *Am. Bee J.* 141: 58-60). Although both stocks removed brood every day, brood removal peaked during the first four days for IHB and during the first two days for RHB colonies. Overall, the RHB (2.5 ± 0.1 days) removed brood faster than the IHB (3.0 ± 0.1 days) colonies (P = 0.014).

Fallen marked mites were collected from traps every day with peaks observed during the first three days coinciding with the peak of brood removal. Overall, about 35% of the introduced mites dropped from the RHB compared to 24% for IHB. A similar observation was reported by Rinderer *et al.* (2001 *Apidologie* 32: 381-394). Regardless of stock, the number of dropped mites increased with an increase in brood removal (r = 0.089, P = 0.0001) (Figure 2). Brood removal may be one of the major causes of high mite drop in honey bee colonies.

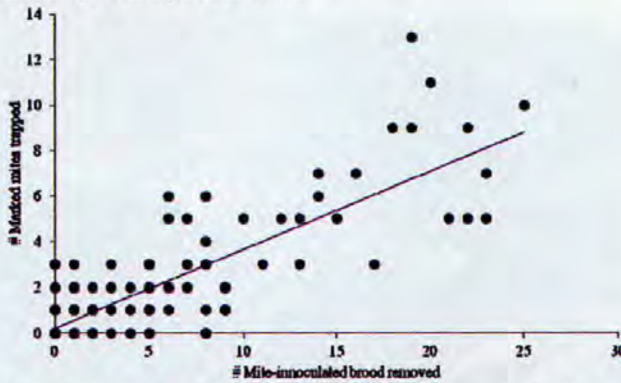

Figure 2. Correlation between the removal of brood inoculated with varroa mites and number of marked mites that dropped on traps.

Holloway, B[a]., J.W. Harris[b], J.Villa[a], R. Danka[a] – FINE MAPPING FOR SNP MARKERS ASSOCIATED WITH VSH BEHAVIOR

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Varroa Sensitive Hygiene (VSH) is a trait that effectively reduces varroa mite populations by removal of brood cells that contain primarily reproductive mites. Breeding for VSH has proven to be a successful control of mite populations in both pure VSH colonies as well as in out-crossed populations. Selection of queens that carry the hygienic trait requires colony-based phenotyping beyond the reach for most bee breeders. Marker assisted selection of VSH queens could substantially reduce the labor requirements of that for classical selection while increasing the overall VSH trait in the breeding stock.

Quantitative Trait Loci (QTL) mapping (Tsuruda *et al.,2012 PLoS ONE 7(11))* identified a genomic interval that associates with the VSH trait. The QTL contains several candidate genes that could be involved in the VSH trait in bees based on known functions in other model systems. We performed fine scale mapping to refine the QTL interval and identify additional molecular markers that could be used for marker assisted selection. Several markers located within two particularly interesting candidate genes associate strongly with the phenotype. mRNA sequencing suggests that a splice variant of one of the genes may result in the VSH trait. The strongest associating marker was used to genotype 28 colonies of either Italian or VSH stock in a single-blind study. Predictions for colony phenotype based on marker genotype proved to be accurate for 89% of the colonies when a strict set of prediction criteria were followed. This validation of a strong molecular marker associating with the VSH trait suggests that marker assisted selection may be highly effective for increasing VSH in breeding stocks at reduced costs and effort.

Dahlgren, L.[a], E. Siegfried[a], R.M. Johnson[b], B.D. Siegfried[a] & M.E. Ellis[a] - HONEY BEE CASTE-SPECIFIC ACETYLCHOLINESTERASE INHIBITION: INSIGHTS INTO COUMAPHOS TOLERANCE.

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Acetylcholinesterase functions in the central nervous system to regulate nerve impulse transmission and is the target for organophosphate insecticides such as coumaphos. Queens are 11 fold more tolerant of coumaphos than workers (Dahlgren *et al.* 2012 J. Econ. Entomol. 106:1895-1902). We evaluated whether differences in target site sensitivity could explain differences in worker and queen responses to coumaphos. Acetylcholinesterase activity can be measured with a simple spectrophotometric activity assay known as Ellman's assay. We compared honey bee worker and queen acetylcholinesterase inhibition by two organophosphate metabolites: coumaphos oxon and chlorpyrifos oxon. We also examined the response of a susceptible housefly (*Musca domestica* L.) population to establish whether honey bees respond differently than other insects. Acetylcholinesterase preparations were collected by homogenizing the heads of both honey bees and houseflies known to contain high concentrations of acetylcholinesterase. Inhibitors were diluted in ethanol and incubated with enzyme at 37°C for 5 time periods. Absorbance was measured at 21 second intervals for 5 minutes (at 412 nm), converted, and expressed as nmoles substrate hydrolyzed per minute per milligram protein (Siegfried and Scott, 1990 Pestic. Biocem. Physiol. 38:122-129). Results to date indicate that there is no apparent difference between queen, worker, and fly acetylcholinesterase inhibition for either coumaphos oxon or chlorpyrifos oxon. This indicates that queen tolerance of coumaphos is not due to target site insensitivity. Continued study of the mechanism of coumaphos tolerance in honey bees may lead to the design of acaricides with minimal adverse effects on colony health.