

Wolfpack's Waggle



October 2014 Newsletter

NC State Apiculture Program

Dedicated to the dissemination of information and understanding of honey bee biology and management

Issue 4, October 2014



More inside

- Page 2 BEES network update
Lab spotlight: Hongmei Li-Byarlay
- Page 3 The developmental biology of queen honey bees
- Page 4 Donate to the NC State Apiculture Program
- Page 5 Random notes
- Page 6 Teacher's Corner
Tarpy's back page

What have we been up to?

It was a long and productive research season, although not nearly as crazy as last year! Mike Simone-Finstrom got our new project on the genomics of *in vitro* reared queens off the ground with his usual high productivity. Carl Giuffre and his small team of BioMath undergrads made significant headway on automating a grooming assay of bees, and more recently made video recordings of varroa-mite movement to see what might motivate them. Margarita Lopez-Urbe has really hit the ground running on testing the effects of urbanization on native bee health and disease. Holden Appler graduated this summer with his MS on the same topic, and we're very happy to have been joined by James Withrow who will be doing his graduate work on the conflict and cooperation during queen rearing. And of course, we've been busy processing samples for the Bee Informed Partnership (BIP) and Queen & Disease Clinic, delivering talks and webinars to beekeeping groups, and writing up our findings!

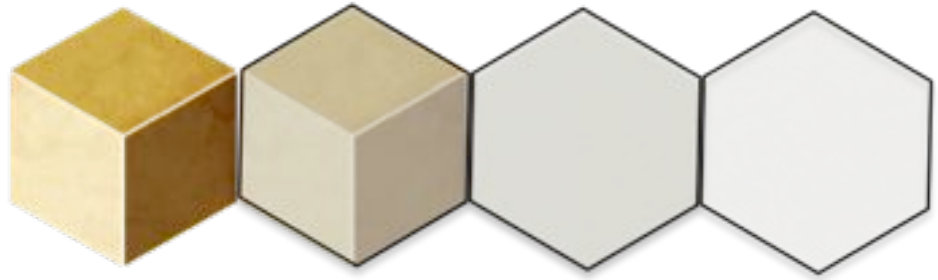


The developmental biology of queens

These past few months, we hosted Dr. Daiana De Souza from the University of Sao Paulo, Brazil, who is investigating ways to improve queen rearing and make high-quality queens.

More on Page 3

Beekeeper Education & Engagement System



New developments in the BEES network

The extension server for the college is discontinuing. However, these online beekeeping mini-courses will now be offered through DELTA!

The **BEES** network is moving! What was once hosted on the Extension server of the College of Agriculture and Life Sciences (CALs) is now migrating to the Distance Education server. While it is a pity that budget cutbacks continue to impact extension delivery, it is comforting that this system appears not to be going away anytime soon!

Beginner level

BEES 1.01: Basic honey bee biology and life history (1.66 hours)

BEES 1.02: Introduction to beekeeping and hive management (1.95 hours)

BEES 1.03: Importance of bees and beekeeping to society (1.71 hours)

Advanced level

BEES 2.01.02: Honey bee anatomy

BEES 2.01.05: Queens and mating

BEES 2.01.07: Foraging biology

BEES 2.02.03: Pathogens, parasites, pests, and problems

BEES 2.02.04: Varroa mite IPM

BEES 2.02.05: Queen rearing and bee breeding

BEES 2.03.01: Africanized bees

BEES 2.03.07: History of beekeeping

Sign up today @:

<http://go.ncsu.edu/BEES>

Lab spotlight: Hongmei Li-Byarlay

Dr. Hongmei Li-Byarlay has only recently joined our collaborative group, but she comes having already gained a strong reputation in the fields of honey bee genetics and genomics. She is at the leading edge of research on how methylation can regulate gene expression and using

bioinformatic approaches to large genomic datasets. Her background speaks for itself, and I believe we are fortunate to have attracted her to North Carolina.

Hongmei's current project is to elucidate the genetic architecture of oxidative stress and aging in honey



bees. She was brought on board because of her different skill sets and intellectual independence, and she has already begun to take the science in a direction we had not originally anticipated. We look forward to great things!

The developmental biology of queens



The quality of a honey bee queen is reflected in her colony

We have several projects investigating honey bee physiology. Specifically, we are trying to understand the optimal development of queens in an effort to maximize their reproductive potential. Increasing “queen quality” may help us make “super queens” that are reproductively superior in the ways that count.

Artificial queen rearing is a very labor intensive process, not only the larval transfer (“grafting”) itself but also the preparation and control of the hives that receive the grafts. Thus, any additional resources that can promote the production of high-quality queens shall be welcome by the practitioner. Moreover, recent evidence from our lab suggests that queens of higher reproductive potential are more likely to produce colonies of greater productivity. Furthermore, built on a sound scientific background, they can also provide deeper insights into the mechanisms of the developmental processes.

We are currently collaborating with several researchers to focus on two questions. First, we wish to determine whether and how JH and/or its mimics (e.g., methoprene or pyriproxifen) can be used to promote queen development in the queen rearing praxis. This question builds on the already well documented role of JH as an agent promoting queen development when topically applied to a critical stage in larval development, which coincides with a stage of marked difference in

the hemolymph JH titer. A major effect of JH is on the larval ovary, where it protects the ovariole primordia from undergoing autophagic cell death. Importantly, what has never been shown is whether the emerging bee, with her full suite of morphological queen characters, will actually exhibit the full behavioral repertoire of a high-quality queen (i.e., whether a queen developmentally induced by JH treatment will actually mate and lay eggs).

Our second question is to find molecular markers that can reveal the effects of the experimental treatments already in the larval stages. For understanding JH effects, we will assess the expression of two early effector genes: the putative JH receptor methoprene tolerant/germ-cell expressed (*met/gce*) and the JH response gene *krüppel* homolog 1 (*kr-h1*), both now being established indicators of JH action. Other markers clearly associated with caste development are the expression levels of the hypoxia response genes, which are much higher in workers than in queens, and a long noncoding RNA

differentially expressed in the larval ovary. The analysis of the expression levels of these markers should be indicators of the degree of queen/worker differentiation of the experimentally treated and reared queens.

This line of research was first initiated by Dr. Ming Huang, a postdoctoral researcher in our lab a couple of years ago before he took a job in local industry testing the effects of new pesticides on honey bees. It was his insights into queen



Dr. Daiana De Souza, a visiting postdoctoral researcher from the University of Sao Paulo, Brazil, is helping to conduct our collaborative research with Dr. Klaus Hartfelder

NCSU Swarm Collective (Continued)

development that spawned our continuing collaborations with Dr. Miguel Corona (USDA Beltsville) and Dr. Klaus Hartfelder (University of Sao Paulo, Brazil).

For the past 3 months, a postdoctoral research from the Hartfelder lab, Dr. Daiana De Souza, was visiting to conduct several tests within this research paradigm. In doing so, she not only raised queens *in vivo* (i.e., in the hive), but she also reared queens *in vitro* (i.e., in the incubator) in order to have very accurate control over larval age, diet, and rearing conditions. In doing so, she was able to uncouple the social rearing environment in the hive from the developmental physiology of queens.

Daiana reared both high- and low-quality queens by grafting young and older worker larvae. She then subjected them to different diets

according to the objectives above, specifically by adding JH and/or different sugar supplements to the royal jelly. She then measured the morphological characteristics of the queens, and she preserved their RNA and took them back to Brazil in order to measure the various molecular markers that may be associated with high queen quality.

We hope to bring Daiana back next year to follow up on this work.



We can manipulate the grafting age of larvae, their diet, food additives (notably different sugars and hormones), and other factors to significantly vary the reproductive potential or “quality” of queen bees, ranging from workers, to intercastes, to very high-quality queens.

NC State Apiculture Program

David Tarpy, Professor and Extension Apiculturist
919-515-1660
david_tarpy@ncsu.edu

Jennifer Keller, Apiculture Technician
919-513-7703
jjkeller@ncsu.edu

Margie Gurganus, Genetics Technician
919-513-6732
mcgurgan@ncsu.edu

Mark Jandricic, Queen & Disease Clinic Technician
919-513-6732
mjandricic@ncsu.edu

Michael Simone-Finstrom, USDA Postdoctoral Fellow
Hongmei Li-Byarlay, NRC Postdoctoral Fellow
Margarita Lopez-Urbe, Postdoctoral researcher

Carl Giuffre, PhD Student (Biomathematics)
James Withrow, MS Student

Undergraduate Researchers
Sam Freeze, Jennifer Fulp, Ravi Dixit, Jason Brannock, Paulina Spencer, Brinkley Raynor, Gabriela Quinlan, Cheyenne Lashmit, Donna Albright, Cameron Johnson

Support the NC State Apiculture Program!

The Apiculture Science fund-raising efforts operate under the auspices of the North Carolina Agricultural Foundation, Inc. a 501(c)3 organization. You will receive an official receipt for your donation.

Make a gift toward emerging needs – Consider supporting the program with a gift that would go toward the current area of greatest importance. Flexible funding enables the Apiculture Program to address critical needs as they emerge, often enhancing the program beyond what would be possible through restricted grant funding. Funding of any amount, from \$10 to \$10,000, will be extremely helpful.

Make a gift-in-kind – The Apiculture program is always seeking creative solutions to its material needs. If you have surplus equipment or other non-monetary assets to give (e.g., gently used honey extractors, microscopes, even vehicles), please consider donating them to the program. You will receive credit for the monetary value of the gift and the gratitude of our faculty and students.

MAKE A DONATION

Make an estate gift – If you are interested in planning an estate gift to benefit Apiculture, please let us know! We can provide you with the tools you and your attorney will need to ensure that your wishes are fulfilled. Please click the link above for more information.

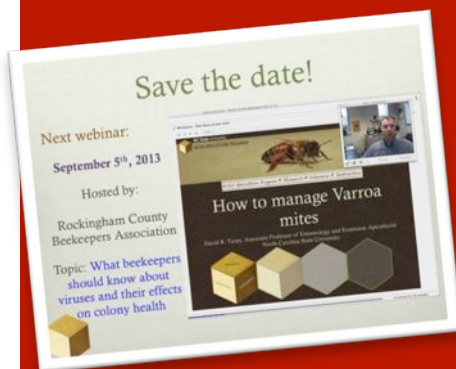


Photo by Alex Wild

Queen & Disease Clinic now open!

We're extremely excited to offer a new fee-based service to the beekeeping community. Send us your queens—good or bad—and we will be able to accurately quantify their sperm viability and sperm counts within a matter of days. We can also analyze entire colonies for virus levels, Nosema, and Africanization using genetic techniques.

[LINK](#)



Next Apiculture webinar January 15th, 2015

We are delighted to be hosted by the Chatham County Beekeepers Association for our next live online webinar about bees and beekeeping. Just let us know if you wish to join as a club or as an individual!

[LINK](#)

Random notes

New publications

Tarpy, D. R. and R. Oliverez, Jr. (2014). Measuring sperm viability over time in honey bee queens to determine patterns in stored-sperm and queen longevity. *Journal of Apicultural Research*, **53**: 493-495.

Presentations

David Tarpy presented his work with Mike Simone-Finstrom at the International Congress of Behavioral Ecology (ICBE) in Manhattan at Hunter College this past August. The title was “Unruly mates: no evidence for behavioral control or effort assessment in honey bee queen mating.”

We also had many different presentations and posters by the undergrads in our lab, particularly the BioMath REU interns. Those include Ravi Dixit's poster “Selection variation of oxidative stress in drone honey bees” with Hongmei Li-Byarlay, and Ben Hamm and Brinkley Raynor's poster “Evaluating queen quality of in vitro reared queen bees via digital image processing.”

BIP update

For the past three years, we have been working with several tech-transfer teams who have been busy working with beekeepers on various aspects

of bee health. In doing so, they have sent us over **1,800 colony samples for which we analyzed the workers for seven important honey bee viruses** using quantitative PCR.

We also process Emergency Response Kits (ERKs) directly from beekeepers who are experiencing particular difficulty. In doing so, they sample adult workers from 8 “problem” hives into one box, then do the same from another 8 “healthy” hives in another. The bees are then shipped to our lab while still alive to test for viruses. Other samples are simultaneously shipped to other BIP labs to measure varroa, nosema, and pesticides.



Teacher's corner: Courses at NC State

Another fall semester, another offering of one of the most popular courses in the Entomology Department. We have a really great set of 131 students who are very inquisitive and interactive. Many have already volunteered at BugFest and soon at the State Fair for extra credit, which reinforced what they have learned by interfacing with the general public.

Next semester:

ENT 401, "Honey bee biology and management"

ENT 601/801, "Social behavior of insects"

<http://go.ncsu.edu/honeybees>



Tarpy's back page

Last month, I was supremely fortunately to be invited to Belfast to speak to the Institute of Northern Ireland Beekeepers. What gracious and wonderful hosts! I am particularly grateful to my host, Michael Young, world-renown beekeeper, chef, honey judge, and mead-maker who is a regular speaker at the Eastern Apicultural Society conferences and recent guest at the NCSBA July meeting.



My timing was impeccable, as the Small Hive Beetle was just found for the first time in an EU country (Italy). To my surprise, there is a lot of shipping of queens and packages from the Mediterranean countries, so the potential importation of the SHB was a genuine concern for the beekeepers in the UK. Thus at the last minute, I changed one of my planned talks from "beekeeping in the mid-Atlantic US" to how to co-exist with the SHB.

My experience in Northern Ireland was delightful, and it also opened my eyes as to just how similar beekeepers are throughout the world—friendly, curious, inquisitive, kind, and intensely passionate about their craft. They are also facing a lot of the same challenges that beekeepers in the US and NC are facing: different visions of the future, how to best educate new and experienced beekeepers, and diminishing resources. In that way, it is comforting to have strength in numbers, even across the pond.

Sincerely, David