

Wolfpack's Waggle

NC State Apiculture Program Newsletter

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

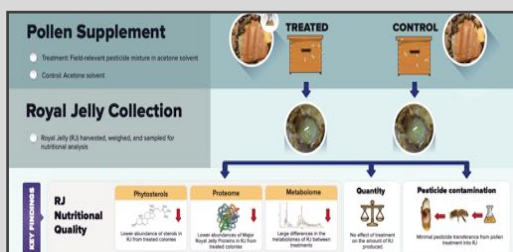
Issue 4 | Oct 2020

Table of Contents

- 2 | Queen & Disease Clinic; Lab
Spotlight: Sharon Munger
- 3 | New research papers
provide important insights
- 4 | (main story continued);
Donate to the NC State
Apiculture Program
- 5 | Random Notes
- 6 | Teacher's Corner; Tarp's
Back Page

What have we been up to?

We have been slowly adjusting to our "new normal" as best we can, and for the most part we have been incredibly fortunate by not being significantly impacted by COVID. Both Jennifer and Erin were granted exempt status very early on so that they could continue to work at the bee farm and on-campus genetics lab, respectively. We were even able to secure a new qPCR machine for the lab so that we are not reliant on a communal facility, which has further increased our productivity in pathogen screenings for our research and the Queen & Disease Clinic. Our Apiculture Online webinars have been going very well with ~650 people on alternate weeks, and Brad, Hannah, and I have mostly been working remotely analyzing data and catching up on a huge backlog of manuscript writing. Sharon has been busy updating and coordinating new offerings in our Beekeeper Education & Engagement System. Ali and Esmaeil have had remarkable years in getting their publications out, with 5+ published this year so far for each. The undergraduate researchers (Gaven, April, Rachael, and Danyelle) have set up their projects so that they can do them either remotely or with sparing trips into the lab, so they've been able to juggle their online classes with continued research. Thus while we all yearn to get back to firing on all cylinders, we're certainly staying busy and productive!



New publications reveal importance of pesticides and the environment on honey bees

Two pairs of recent papers, one set by Joe Milone and the other by Ali McAfee, provide important insights into how pesticides affect colonies and how environmental stressors affect queen failure, respectively.





HONEY BEE QUEEN AND DISEASE CLINIC | BETTER DATA BETTER BEES

Quality Assurance

Morphometric Analyses: multiple measures of queen or drone, body and reproductive tract (rearing quality)

Semen Quality: total sperm count, and sperm viability in queens (mating success), or drones (mating potential)

Quality Report: a "grade" report of a queen or drone's reproductive quality for your quick interpretation



Strong Research Foundations

Established as a natural extension service leveraging basic and field honey bee research at NC State, the clinic has worked to improve colony health for over 10 years.

Troubleshooting

Mitotyping for Africanization: genetic analyses of maternal ancestry as African or European using population genetic techniques and markers

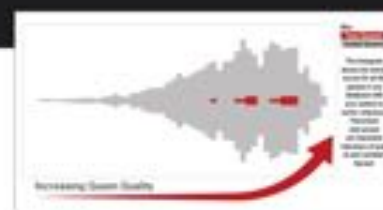
Pathogen Screening: identification of presence and relative levels of ABPV, BQCV, DWV(A&B), IAPV, LSV, Trypanosomes, and both Nosema species. Additional and custom pathogen targets available upon request.

Genotyping Analyses: full assessment of paternity for up to 48 workers and an estimate of queen mating frequency

Custom Collaboration

This highly-tailored collaboration involves custom experimental design, analyses, and interpretation. This unique partnership between science and industry has been utilized to:

- Test the impact of various agrochemicals
- Assess the effects of banking on queen quality measures
- Evaluate novel management practices' improvements in queen mating quality
- Observe the effects of shipping on queen health and sperm quality



Queen and Disease Clinic Pricing

Five Sample Minimum • Bulk Pricing Available

ANALYSIS	PRICING (per sample)	SAMPLES TESTED		
		QUEEN	DRONE	COLONY
Reproductive Quality	\$24.00	✓	✓	
Standard Pathogen Screen	\$55.00	✓	✓	✓
Aplary Pathogen Screen	*\$220.00	N/A TO IN-COUNTRY PRODUCE		
Mitotyping (Africanization)	\$35.00	✓	✓	✓
Genotyping (Mating Number)	\$220.00			✓

Custom Disease Screening

Additional and custom pathogen targets available upon request.

Your Bees • Your Data

Any results or interpretations from our work is held in the strictest confidentiality and anonymity

Lab Spotlight: Sharon Munger

For the last several years, we have been fortunate to have Sharon Munger as an integral part of our team. Sharon is Project Manager for the lab group, doing everything from coordinating our online BEES courses and last year's BEES Academies, managing the logistics of our USDA research, and streamlining the inner workings of the lab. Sharon is no stranger to field work too! As an experienced landscaper, she is more than happy to help out at the bee lab from time to time. The day to day function of the program has been infinitely better since Sharon joined the lab, and we are appreciative of her many contribution to our extension and research missions.

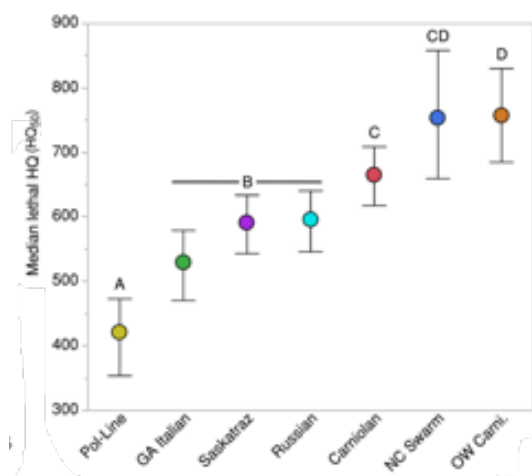


New research papers provide important insights into honey bees

We've had a flurry of new publications based on the past few years of hard work. **Joe Milone**, a recent PhD graduate in our program, published two recent papers from his thesis investigating how pesticide exposure affects colony health in different ways. **Ali McAfee**, a postdoc in our program located at the University of British Columbia in Canada, was also first author on two recent papers that provides important insights into the underlying factors that can result in queen failure.

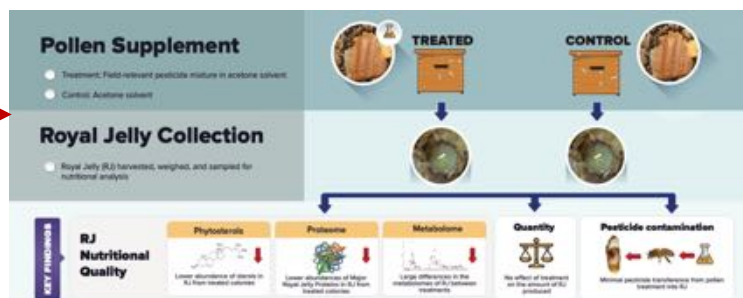
While **Joe Milone** has graduated with his PhD degree and moved on to his "dream job" at the EPA, the fruits of his labor during his time in the program are only now just coming to light. One of his recent papers, in collaboration with colleagues at Oregon State University (co-first author Priya Chakrabarti and Ramesh Sagili), tested how pesticide exposure from contaminated pollen can affect queens through the royal jelly. We fed multiple colonies with pollen patties, some with and some without a mixture of common pesticides, and then harvested the RJ from newly grafted queen cells (see figure below). We then measured the pesticide levels in the pollen patties and RJ, the amount of RJ produced in each cell, and the nutritional quality of the RJ using state-of-the-art chemical analyses. What we found was very interesting and perhaps counter-intuitive: while there were very low levels of pesticides in the RJ compared to the pollen patties (<100x less), both the quantity and quality of the RJ was significantly lower in the colonies fed contaminated pollen. Therefore, pesticides may affect the quality of queens indirectly (by the workers not making sufficient quality RJ) rather than directly (from the pesticides themselves).

In a second study, Joe took a completely different approach to determine how bees cope with a toxic environment. His recent paper published in *Ecotoxicology and Environmental Safety* compared different honey bee stocks for their responses to the same pesticide exposures. Here, he raised larvae in the laboratory to maintain very careful control over the environment, and he grafted thousands of larvae from seven different genetic stocks that are commercially available in brood food with increasing levels of pesticides (largely the same toxic brew from his first paper). What he found was again very insightful but perhaps logical: not all honey bees are the same. Some of the commercial stocks

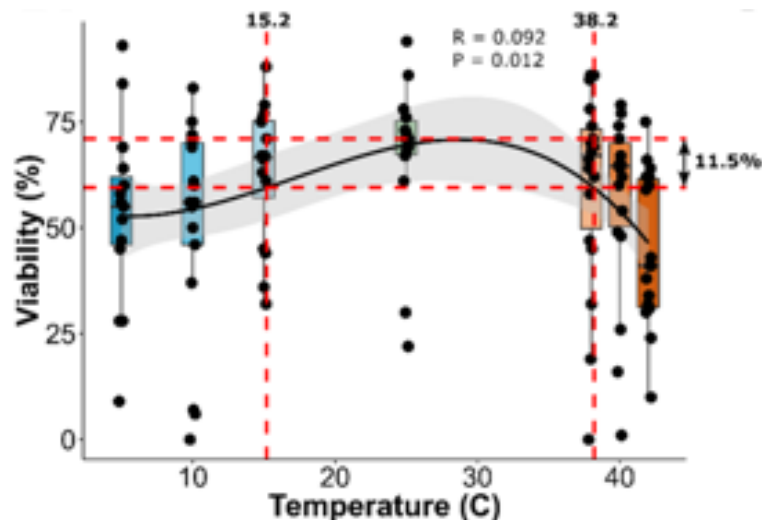


(e.g., POL-line and Italians) were very sensitive to pesticides and died more readily, whereas other stocks (e.g., old-world Carniolans and feral bees) were very tolerant of the same pesticide exposure (see figure above). This will have significant bearing on how pesticides are screened for their safety, since different types of bees may result in different conclusions of their effects. This paper was co-authored with Frank Rinkevich from the USDA-ARS, as well as our own Ali McAfee and her co-advisor Leonard Foster.

Alison McAfee, our NSERC postdoctoral fellow at UBC in Vancouver, Canada, has also been very busy these last few years investigating a different stressor of honey bees and their queens: temperature. At issue is how we transport, ship, and handle newly mated queens before we introduce them into our colonies. This is important since most beekeepers know that if you overheat bees that they can die, so we overcompensate by making sure the bees are cooled when we transport them. However, Ali's work underscores previous studies that while chilled bees may live, the stored sperm in queens may die and result in her premature failure. Her first ground-breaking paper published in *Nature Communications* took a very thorough approach to seeing how high- and low-temperature exposures affected the queen's sperm viability. Her results show that you really need to keep queens above 15.2 °C (59 °F) and below 38.2 °C (101 °F), otherwise she can't keep the sperm alive nearly as well (see figure below, Page 4). So if you're requeening next spring while needing to wear a winter jacket, just make sure to keep the queens incubated as close to brood-nest temperature as possible (we use an Igloo cooler with a jar of hot water next to the queen cages).



Apiculture Online (Continued)



Ali's second paper builds upon her first paper, where she investigated different queens that were exposed to similar temperature exposures. Ali is a leading authority on the proteomics of bees—that is, how different conditions change all of the thousands of proteins in bees by getting turned up or down like a dimmer switch. Ali's work has found certain proteins that are strongly associated with decreased sperm viability when they are overly chilled or heated. In a different experiment published in *BMC Genomics*, she attempted to see if those same heat-shock proteins were helpful predictors of temperature stress. Sure enough, in unknown queens that were blindly subject to different temperatures, those same proteins were significantly tuned-up just like those exposed to known temperature extremes. Therefore, these candidate proteins may be useful biomarkers that can be used to see if queens have had prior temperature.

Congratulations to both Joe and Ali for their excellent work!

Current Lab Members 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

Erin McDermott - Genetics Technician
919-513-3967
eemcderm@ncsu.edu

Sharon Munger - Project Manager
919-513-3967
swmunger@ncsu.edu

Kirsten Benson - Design Coordinator
kebenso2@ncsu.edu

Esmail Amiri - NRC Postdoctoral Fellow (UNCG)
Brad Metz – NC State Research Associate
Alison McAfee – NSERC Postdoctoral Fellow
(Univ. British Columbia)

Hannan Levenson - PhD Student
(Entomology and Evolution & Ecology)

Undergraduate Researchers
Gaven Bell, Danyelle Reiskind, April Sharp,
Rachel Laminack

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.

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.

Gift-In-Kind

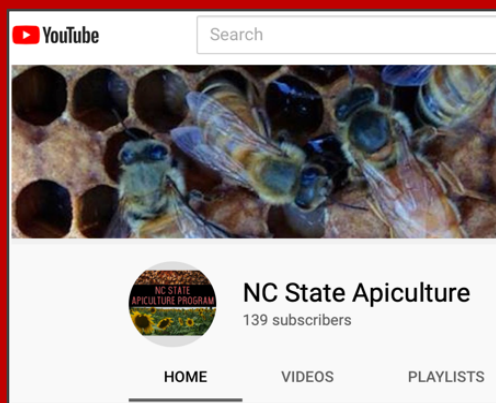
The Apiculture program is always seeking creative solutions to its material needs. If you have surplus equipment or other non-monetary assets to give (e.g., gently used honey extractors, microscopes, even vehicles), please consider donating them to the program. You will receive credit for the monetary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

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 go to our website for more information: www.ncsuapiculture.net

go.ncsu.edu/apiculture





Try us on YouTube!

For several years now, we've been adding video content onto our very own YouTube channel. From beekeeping advice to some of our latest research, this *free* resource is perfect to plug into your monthly beekeeper meetings or to watch during your downtime. Subscribe and view us today!



Congratulations Esmail!

Esmail Amiri, a postdoc in our program housed at UNC Greensboro in Dr. Olav Rueppell's lab, has had a truly remarkable year publishing six papers in 2020. So far, he's published in *Viruses*, *Frontiers in Microbiology*, *Insects*, *Journal of Evolutionary Biology*, and *Veterinary Sciences*. He's been very busy in the field and lab this summer too, so expect to see more in the near future!

Random Notes

New Publications

- Amiri, E., J. J. Herman, M. K. Strand, D. R. Tarpy, and O. Rueppell. (2020). Egg transcriptome profile responds to maternal virus infection in honey bees, *Apis mellifera*. *Infection, Genetics and Evolution*, **85**: 104558.
- Li-Byarlay, H., H. Boncristiani, G. Howell, M. K. Strand, D. R. Tarpy, and O. Rueppell. (2020). Transcriptome and epigenome dynamics of honey bees in response to lethal virus infection. *Frontiers in Genetics*, **11**: 566320.
- Milone, J. P.*, P. Chakrabarti Basu*, R. Sagili, and D. R. Tarpy. (2020). Honey bee (*Apis mellifera*) royal jelly is qualitatively and quantitatively affected by colony level pesticide exposure. *Chemosphere*, 128183.
- Milone, J. P., F. R. Rinkevich, A. McAfee, L. J. Foster, and D. R. Tarpy. (2020). The influence of breeding stock on honey bee (*Apis mellifera*) larval pesticide tolerance, esterase activity, and proteome. *Ecotoxicology and Environmental Safety*, **206**: 111213.
- McAfee, A., J. Milone, A. Chapman, L. J. Foster, J. S. Pettis, and D. R. Tarpy. (2020). Candidate stress biomarkers for queen failure diagnostics. *BMC Genomics*, **21**: 571.

Presentations

Because of COVID, we aren't holding any face-to-face extension events. Instead, we've been quick to move everything online through Zoom and other platforms. Importantly, we're holding bi-weekly webinars called Apiculture Online—Hive Chat with NC State and posting their recordings on our YouTube channel. Between the live-stream and recordings, we've been averaging ~650 people and over 1,000 in some weeks.

Erin McDermott has been really cutting up the airwaves! In the past few months, she has given webinars to the Mecklenburg, Gaston, Chatham, Moore, and New Hanover County beekeepers associations. **Ali McAfee** also gave two presentations to the Washington State Beekeepers in each October. In addition, David was featured on the podcast out of our counterparts at the University of Florida called "Two Bees in a Podcast." He also gave a presentation to the NC State Beekeeping Club, as well as two presentations each to the Georgia State Beekeepers and the Worcester Beekeepers of Massachusetts (both of which were well attended a lot of fun).



Teacher's Corner: Courses at NC State

NC State endeavored to go with face to face (F2F) courses this fall, but after ~2 weeks they moved everything fully online because of COVID safety. This didn't affect ENT 203, however, since we had planned since last semester to move this entirely to a Moodle-based platform. All lectures and material are asynchronous—that is, recorded rather than live—so that students can go at their own pace. The course has been going extremely well so far, thanks in large part to the two TAs (**Meredith Farve** and **Jingli Xuan**), and the students are doing very well given the novelty of the lecture delivery. We will see if the course will continue to offer a DE section going forward.

go.ncsu.edu/honeybees



Tarpy's Back Page

A bright light has dimmed in the starry sky that is the beekeeping universe. **Ann Harmann** recently passed away after a long and dedicated career within the beekeeping community. Ann was one of those people who make life enjoyable, interesting, and worthwhile. She dedicated her life to helping others in beekeeping, not just in her home state of Virginia but well beyond. She was an incredibly active member of the Eastern Apicultural Society, including serving as its Vice Chair among wearing many other hats, and she travelled the globe working for NGOs helping to train and educate beekeepers on five continents.

Ann also served as a liaison between the beekeeping and scientific world. Having received her degree in Chemistry from Virginia Tech, she was no stranger to the apicultural sciences and was a participating member of the American Association for Professional Apiculturists (AAPA). Importantly, she took an active role in the annual student award nominations, in which she reveled in getting to know the up-and-comers and future leaders in the field. I could go on, but it wouldn't do her justice. We have all lost a good friend and colleague, and she will be missed.

