College of Food, Agricultural, and Environmental Sciences

2022 Annual Research Conference

CFAES

THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

2022 Annual Research Conference

- Directors Welcome and Remarks
- Recap of Faculty Research Awards
- Undergraduate Student Poster Awards
- Graduate and Professional Poster Awards

CFAES Strategic Alignment: Goals

- Student-First Philosophy
- Innovative Scholarship to Sustain Life
- Capacity Building of Our People and Communities
- Partner of Choice
- Resource Stewardship in a One College Model

CFAES Strategic Alignment: Grand Challenges

- **Sustainability** – simultaneously ensuring viable ag production, food security and safety, and environmental and ecosystem sustainability
- **One health** – Studying the intersections or interactions among human, animal, and environmental health
- **Rural-urban interface** – exploring the tensions and opportunities created in the communities, industries, policies, economies, and communications among urban and rural residents
- **Leadership** – preparing the next generation of scientists and leaders

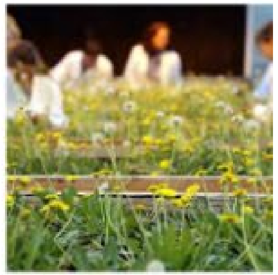
CFAES

CFAES MASTER PLAN

AUGUST 2021











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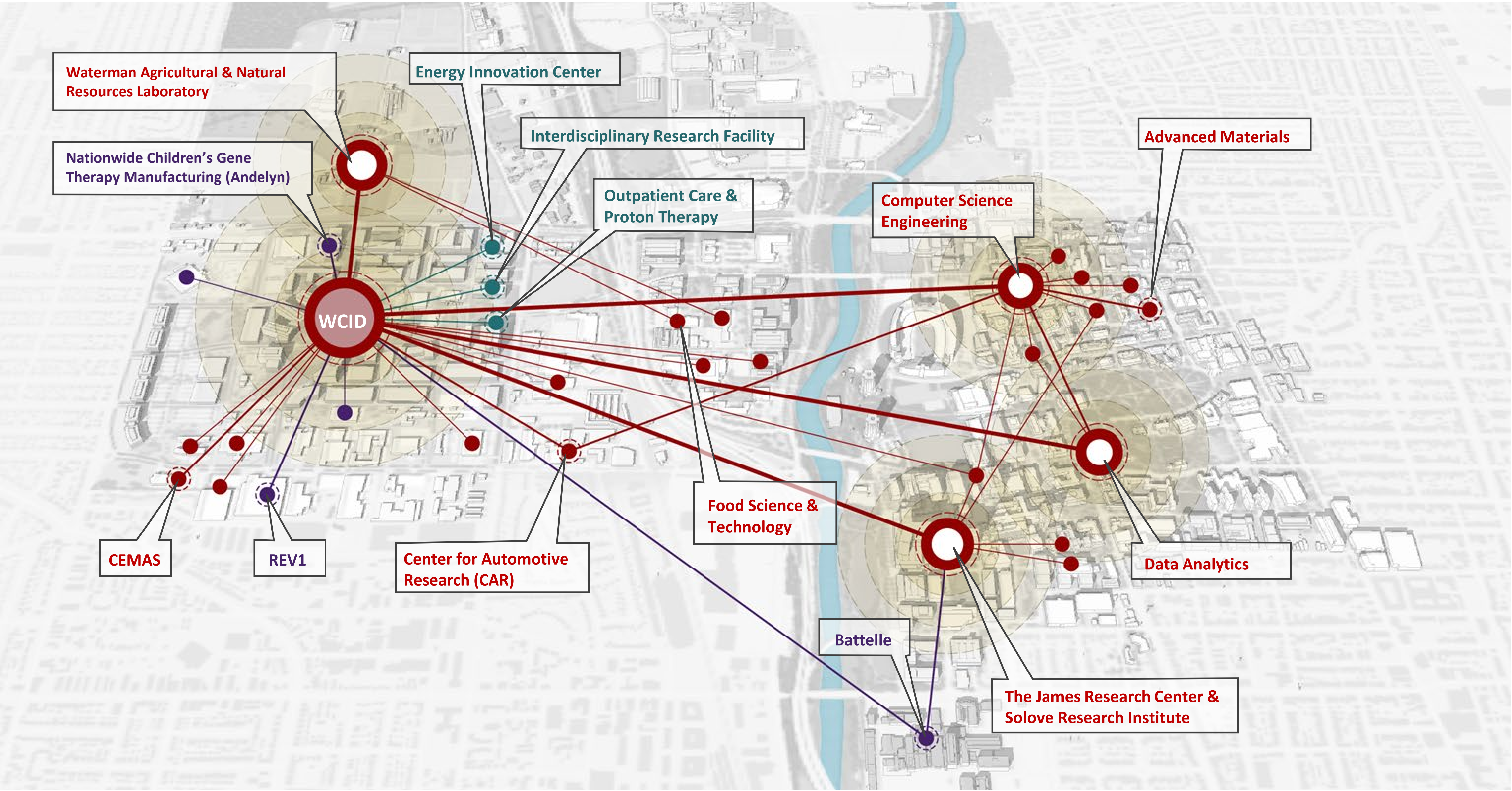
WCID | THE MOMENTUM



West Campus Innovation District
Interdisciplinary Research Facility

The Interdisciplinary Research Facility will catalyze convergence research in life sciences and biotechnology while providing new opportunities for the community and industry to engage Ohio State researchers.

Controlled Environment Food Production Research Complex (CEFPRC) – 50,000-SF

Location
- Waterman

Scope
- Production Greenhouse
- Research Greenhouse
- Indoor/Outdoor Learning
- Headhouse & Offices
- Sustainable Features

Budget: $35.8M
- Philanthropy
- CFAES

Completion
- Fall 2022

CEFPRC March 2022

Open Fall 2022

George Washington Carver Science Park

Nanoracks: $140 M from NASA

OSU: Projected $14 M

CFAES and COE

HCS, FABE, PP

GWC Science Park Founding Partners

VOYAGER SPACE

Voyager Space
Strategy Lead

Advisory Board

Nanoracks
Owner and Operator

Management Team

Lockheed Martin
Spacecraft Integration Lead

Nanoracks

DreamUp
STEM Education Advisor

- Coordinate youth and college STEM education efforts

Ohio State University
University Consortium

- Coordinate university research
- Manage terrestrial research analog facilities
- Provide inputs into lab development efforts.

Universities Space Research Association
Director, GWC Park

- Manage the GWC Science Park
- Oversee the scientific operations of the lab

International Association of Science Parks
Global Engagement

- Foster a global network of academic and commercial researchers
- Build research pipeline to grow GWCSP utilization

ZIN Technologies
Component Development

- Overall lab design, component upgrades, and overall architecture
- Develops key lab subcomponents

Industry expertise spanning decades of NASA projects, commercial development, and worldwide academic research

We do controlled environment!

CFAES

RESEARCH IN REVIEW

FISCAL YEAR 2021

AWARDS & SUBMISSIONS

$50 M

637 Proposals Submitted
344 Total Awards

RESEARCH EXPENDITURES

$44 M

Sponsored Programs
>1,000 Active Projects

FEDERAL CAPACITY FUNDING

$8.7 M

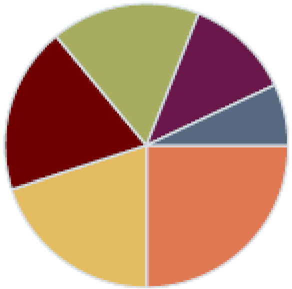
Federal support allocated to each state as a land-grant institution.

INTELLECTUAL PROPERTY

25 New Innovators
18 Patent Filings
7 Active Startups
38 Invention Disclosures

SPONSORED PROGRAM FUNDING SOURCES

Federal	25%
Industry	20%
Colleges/Universities	19%
Private Agency	17%
State	12%
Other Non-Federal	7%



ACTIVE PROTOCOLS

IACUC 170

IBC 119

IRB Exempt 1130

IRB Approved 160

NEW INVENTION DISCLOSURES BY TYPE

18 Plant Variety
4 Research Tools
16 Technology

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CONTACT US
Phone: (330)462-6157
Email: gdsu@osu.edu
Website: research.cfaes.ohio-state.edu

Additional Research Highlights

- Number of proposals submitted increasing
- 10 proposals requesting $5 M+
  - 2 funded, some still pending
  - 2 funded @ $1 M+, 18 @ $500k - $1 M
- Graduate enrollment increasing
- Inaugural The Ohio Program Fellowship

Additional Research Highlights

- CFAES only college to maintain SROP summer 2021
- Embedded mental health counselor CFAES Wooster
- Stone Lab under CFAES umbrella
- Inaugural cohort: STARS

Looking Ahead

- Continued emphasis on faculty development
- Energy Advancement and Innovation Center
- Emerging topics: AI, microbiome science, controlled environment food production, etc.
- New faculty hires
- Kellogg Chair & AMP

We Sustain Life™

Research Summary

- Strategic Alignment and Master Plan provide path forward
- Graduate programs and funding in good standing
- IRF and CEFPRC will add much needed capacity
- Research enterprise continues to evolve

William E. Krauss Director's Award
for Excellence in Graduate Research

Yusheng Guo

Graduate Research Associate in the Department of Animal Sciences and Center for Food Animal Health

Advised by Anastasia Vlasova

Assistant Professor in the Department of Animal Sciences and Center for Food Animal Health

2022 CFAES Faculty Awards

Graduate Mentor Award

Monica Giusti

Professor and Graduate Studies Chair in the Department of Food Science and Technology

2022 CFAES Faculty Awards

Distinguished International Research and Engagement Award

Clay Sneller

Professor in the Department of Horticulture and Crop Science

2022 CFAES Faculty Awards

Distinguished Junior Faculty Research Award

Laura Lindsey

Associate Professor in the Department of Horticulture and Crop Sciences

2022 CFAES Faculty Awards
Distinguished Senior Faculty Research Award

Gireesh Rajashekara

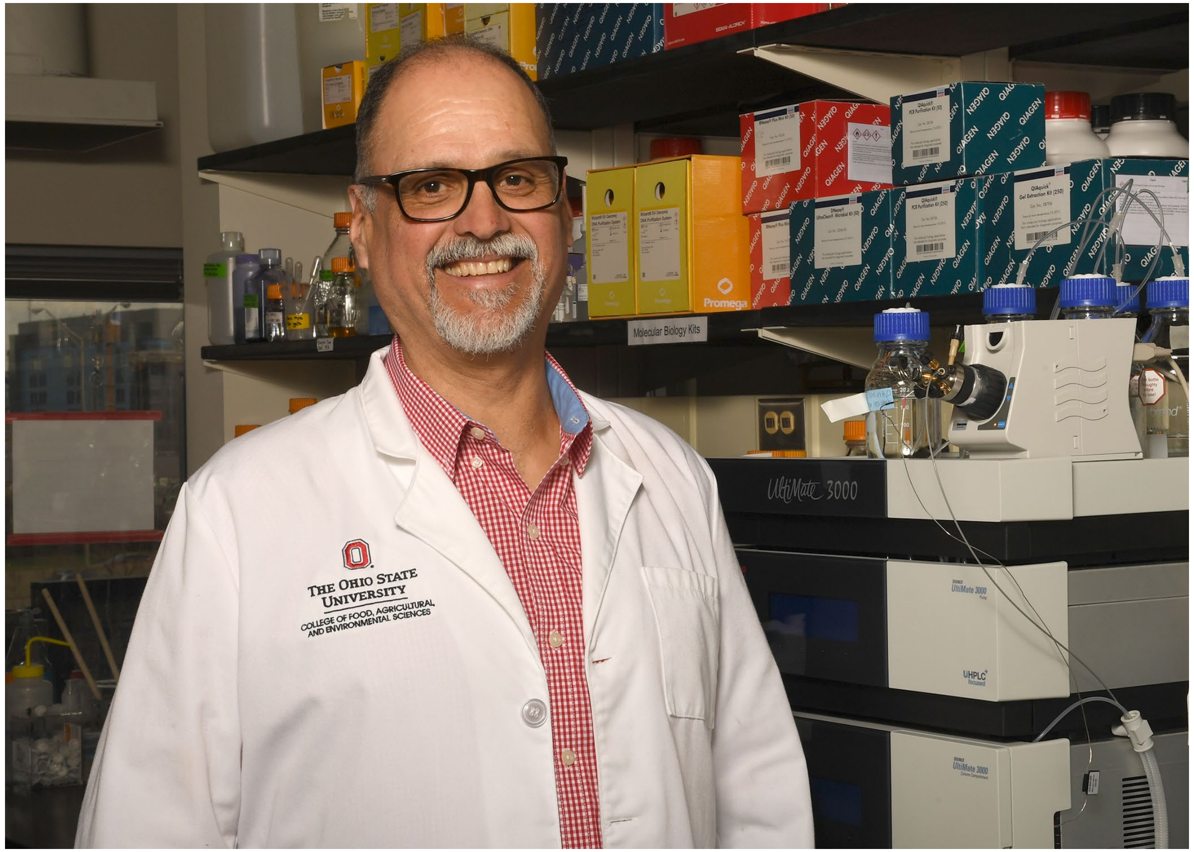
Professor in the Department of Animal Sciences and Interim Head of the Center for Food Animal Health

2022 CFAES Faculty Awards

Innovator of the Year Award

Rafael Jimenez-Flores

Professor in the Department of Food Science and Technology



Congratulations Faculty & Krauss Award Winners!

Graduate School Awards

Leadership Award (GALA)

Ellia La, Ph.D. Candidate
Department of Food Science & Technology

Adrian Pekarcik, Ph.D. Candidate
Department of Entomology
CFAES - Wooster Campus

Teaching Award (GATA)

Jai Tiarks, M.S.
School of Environmental and Natural Resources

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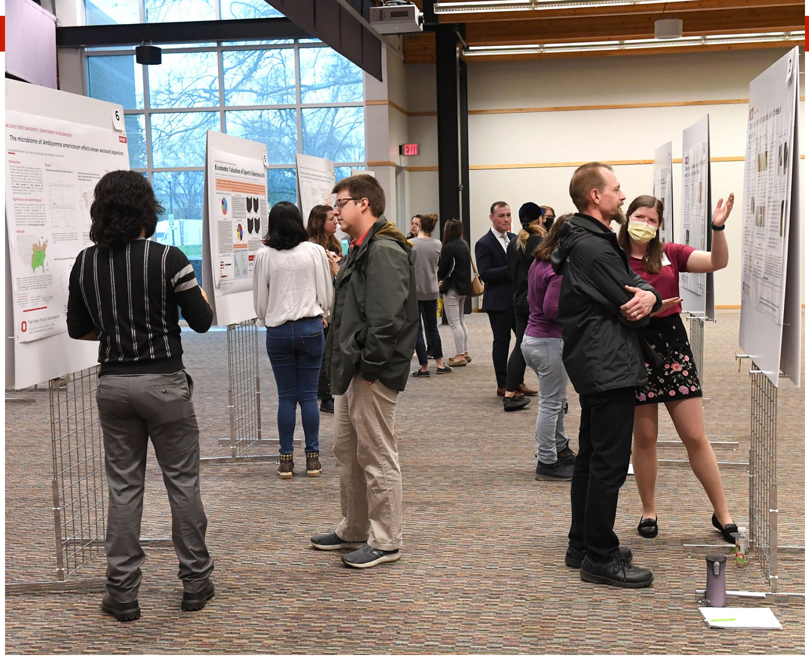
CFAES Presidential Fellows 2022

Rafael Quijada Landaverde
Agricultural Communication, Education, and Leadership
Advisor: Mary Rodriguez

Taylor Klass
Plant Pathology
Advisor: Jonathan Jacobs

Congratulations Graduate Award Winners!




CFAES
Department of Animal Sciences, Center for Food and Animal Health
The Effects of Vitamin A Deficiency and Supplementation on Innate and Passive Lactogenic Immune Responses against Rotavirus in Sows
INTRODUCTION
MATERIAL AND METHODS
RESULTS
OBJECTIVES
EXPERIMENTAL DESIGN
CONCLUSIONS
REFERENCES
ACKNOWLEDGEMENTS
THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

Undergraduate Competition Winners

Animal Sciences - Health

First

Madison Pinkerton *advised by Dr. Jessica Pempek*

Second

Elizabeth Ohl *advised by Dr. Alvaro Garcia Guerra*

Third

Hailey Main *advised by Dr. Christopher Hadad and Dr. Christopher Callam*

Animal Sciences - Nutrition

First

Sophia Kienzle *advised by Dr. Jeffrey Firkins*

Second

Elizabeth Due *advised by Dr. Sheila Jacobi*

Entomology/Environmental Sciences

First

Aleacia Laird *advised by Dr. Francesca Hand*

Second

Isabel Nazarian *advised by Dr. Reed Johnson*

Third

Nicole Sammons *advised by Dr. Reed Johnson*

Food Science & Technology

First

Talia Katz *advised by Aishwarya Badiger*

Second

Cameron McCurdy *advised by Dr. Kichoon Lee*

Third

Thania Ortiz Santiago *advised by Dr. Monica Giusti*

Social Science

First

Shanvanth Arnipalli *advised by Dr. Feng*

Second

Maddie Allman *advised by Dr. Ken Martin & Dr. Joe Campbell*

Third

Kiley Holbrook, Callee Aviles, Haley Schmersal *advised by Erica Summerfield*

Master’s Competition Winners

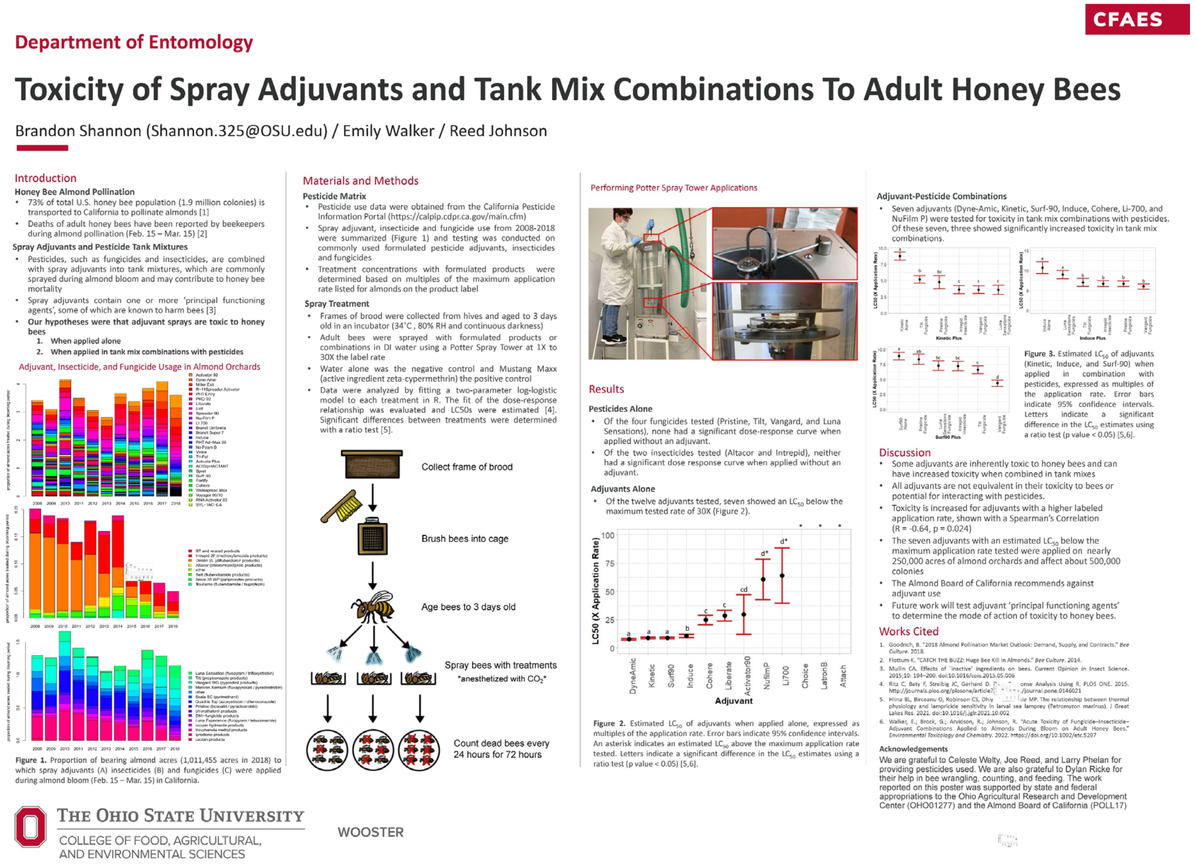
2022 CFAES Poster Competition

Master's Category, Third Place

Brandon Shannon

Entomology & Environmental Sciences

Advisor: Dr. Reed Johnson



CFAES

Department of Entomology

Toxicity of Spray Adjuvants and Tank Mix Combinations To Adult Honey Bees

Brandon Shannon (Shannon.325@OSU.edu) / Emily Walker / Reed Johnson

Introduction

Honey Bee Almond Pollination

- 73% of total U.S. honey bee population (1.9 million colonies) is transported to California to pollinate almonds [1]
- Deaths of adult honey bees have been reported by beekeepers during almond pollination (Feb. 15 – Mar. 15) [2]

Spray Adjuvants and Pesticide Tank Mixtures

- Pesticides, such as fungicides and insecticides, are combined with spray adjuvants into tank mixtures, which are commonly sprayed during almond bloom and may contribute to honey bee mortality
- Spray adjuvants contain one or more 'principal functioning agents', some of which are known to harm bees [3]
- **Our hypotheses were that adjuvant sprays are toxic to honey bees**
  1. **When applied alone**
  2. **When applied in tank mix combinations with pesticides**

Adjuvant, Insecticide, and Fungicide Usage in Almond Orchards

Figure 1. Proportion of bearing almond acres (1,011,455 acres in 2018) to which spray adjuvants (A) insecticides (B) and fungicides (C) were applied during almond bloom (Feb. 15 – Mar. 15) in California.

Materials and Methods

Pesticide Matrix

- Pesticide use data were obtained from the California Pesticide Information Portal (https://calpip.cdpr.ca.gov/main.cfm)
- Spray adjuvant, insecticide and fungicide use from 2008-2018 were summarized (Figure 1) and testing was conducted on commonly used formulated pesticide adjuvants, insecticides and fungicides
- Treatment concentrations with formulated products were determined based on multiples of the maximum application rate listed for almonds on the product label

Spray Treatment

- Frames of brood were collected from hives and aged to 3 days old in an incubator (34˚C , 80% RH and continuous darkness)
- Adult bees were sprayed with formulated products or combinations in DI water using a Potter Spray Tower at 1X to 30X the label rate
- Water alone was the negative control and Mustang Maxx (active ingredient zeta-cypermethrin) the positive control
- Data were analyzed by fitting a two-parameter log-logistic model to each treatment in R. The fit of the dose-response relationship was evaluated and LC50s were estimated [4]. Significant differences between treatments were determined with a ratio test [5].

Collect frame of brood

Brush bees into cage

Age bees to 3 days old

Spray bees with treatments
anesthetized with CO_2

Count dead bees every 24 hours for 72 hours

Performing Potter Spray Tower Applications

Results

Pesticides Alone

- Of the four fungicides tested (Pristine, Tilt, Vangard, and Luna Sensations), none had a significant dose-response curve when applied without an adjuvant.
- Of the two insecticides tested (Altacor and Intrepid), neither had a significant dose response curve when applied without an adjuvant.

Adjuvants Alone

- Of the twelve adjuvants tested, seven showed an LC_{50} below the maximum tested rate of 30X (Figure 2).

Figure 2. Estimated LC_{50} of adjuvants when applied alone, expressed as multiples of the application rate. Error bars indicate 95% confidence intervals. An asterisk indicates an estimated LC_{50} above the maximum application rate tested. Letters indicate a significant difference in the LC_{50} estimates using a ratio test (p value < 0.05) [5,6].

Adjuvant-Pesticide Combinations

- Seven adjuvants (Dyne-Amic, Kinetic, Surf-90, Induce, Cohere, Li-700, and NuFilm P) were tested for toxicity in tank mix combinations with pesticides. Of these seven, three showed significantly increased toxicity in tank mix combinations.

Figure 3. Estimated LC_{50} of adjuvants (Kinetic, Induce, and Surf-90) when applied in combination with pesticides, expressed as multiples of the application rate. Error bars indicate 95% confidence intervals. Letters indicate a significant difference in the LC_{50} estimates using a ratio test (p value < 0.05) [5,6].

Discussion

- Some adjuvants are inherently toxic to honey bees and can have increased toxicity when combined in tank mixes
- All adjuvants are not equivalent in their toxicity to bees or potential for interacting with pesticides.
- Toxicity is increased for adjuvants with a higher labeled application rate, shown with a Spearman's Correlation ($R = -0.64$, $p = 0.024$)
- The seven adjuvants with an estimated LC_{50} below the maximum application rate tested were applied on nearly 250,000 acres of almond orchards and affect about 500,000 colonies
- The Almond Board of California recommends against adjuvant use
- Future work will test adjuvant 'principal functioning agents' to determine the mode of action of toxicity to honey bees.

Works Cited

1. Goodrich, B. "2018 Almond Pollination Market Outlook: Demand, Supply, and Contracts." *Bee Culture*. 2018.
2. Flottum K. "CATCH THE BUZZ: Huge Bee Kill in Almonds." *Bee Culture*. 2014.
3. Mullin CA. Effects of 'inactive' ingredients on bees. Current Opinion in Insect Science. 2015;10: 194–200. doi:10.1016/cois.2015.05.006
4. Ritz C, Baty F, Streibig JC, Gerhard D. [illegible]onse Analysis Using R. PLOS ONE. 2015. http://journals.plos.org/plosone/article?[illegible]/journal.pone.0146021
5. Hlina BL, Birceanu O, Robinson CS, Dhiy[illegible]ie MP. The relationship between thermal physiology and lampricide sensitivity in larval sea lamprey (Petromyzon marinus). J Great Lakes Res. 2021. doi:10.1016/j.jglr.2021.10.002
6. Walker, E.; Brock, G.; Arvidson, R.; Johnson, R. "Acute Toxicity of Fungicide–Insecticide–Adjuvant Combinations Applied to Almonds During Bloom on Adult Honey Bees." *Environmental Toxicology and Chemistry*. 2022. https://doi.org/10.1002/etc.5297

Acknowledgements

We are grateful to Celeste Welty, Joe Reed, and Larry Phelan for providing pesticides used. We are also grateful to Dylan Ricke for their help in bee wrangling, counting, and feeding. The work reported on this poster was supported by state and federal appropriations to the Ohio Agricultural Research and Development Center (OHO01277) and the Almond Board of California (POLL17)

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WOOSTER

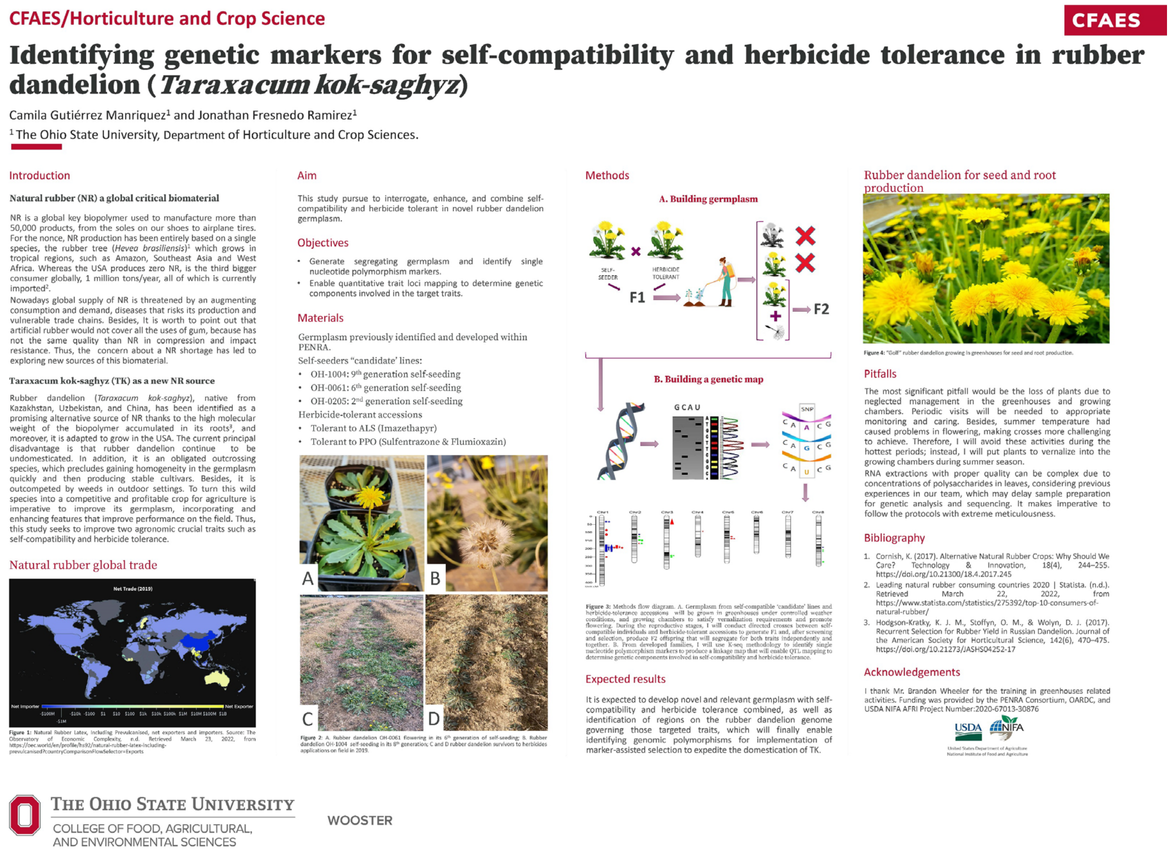
2022 CFAES Poster Competition

Master's Category, Second Place

Camila Gutierrez Manriquez

Department of Horticulture and Crop Sciences

Advisor: Dr. Jonathan Fresnedo Ramirez



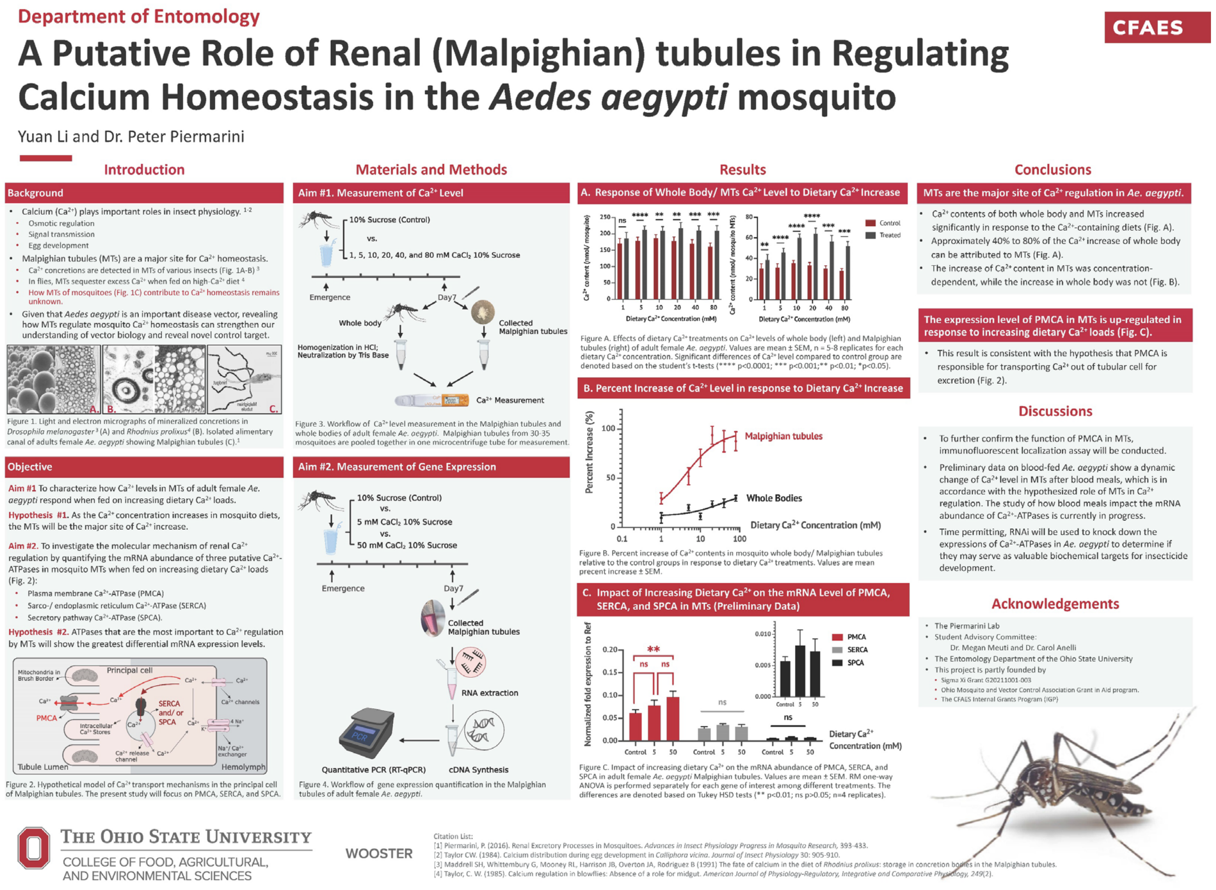
2022 CFAES Poster Competition

Master's Category, First Place

Yuan Li

Entomology

Advisor: Dr. Peter Piermarini



Ph.D. Competition Winners

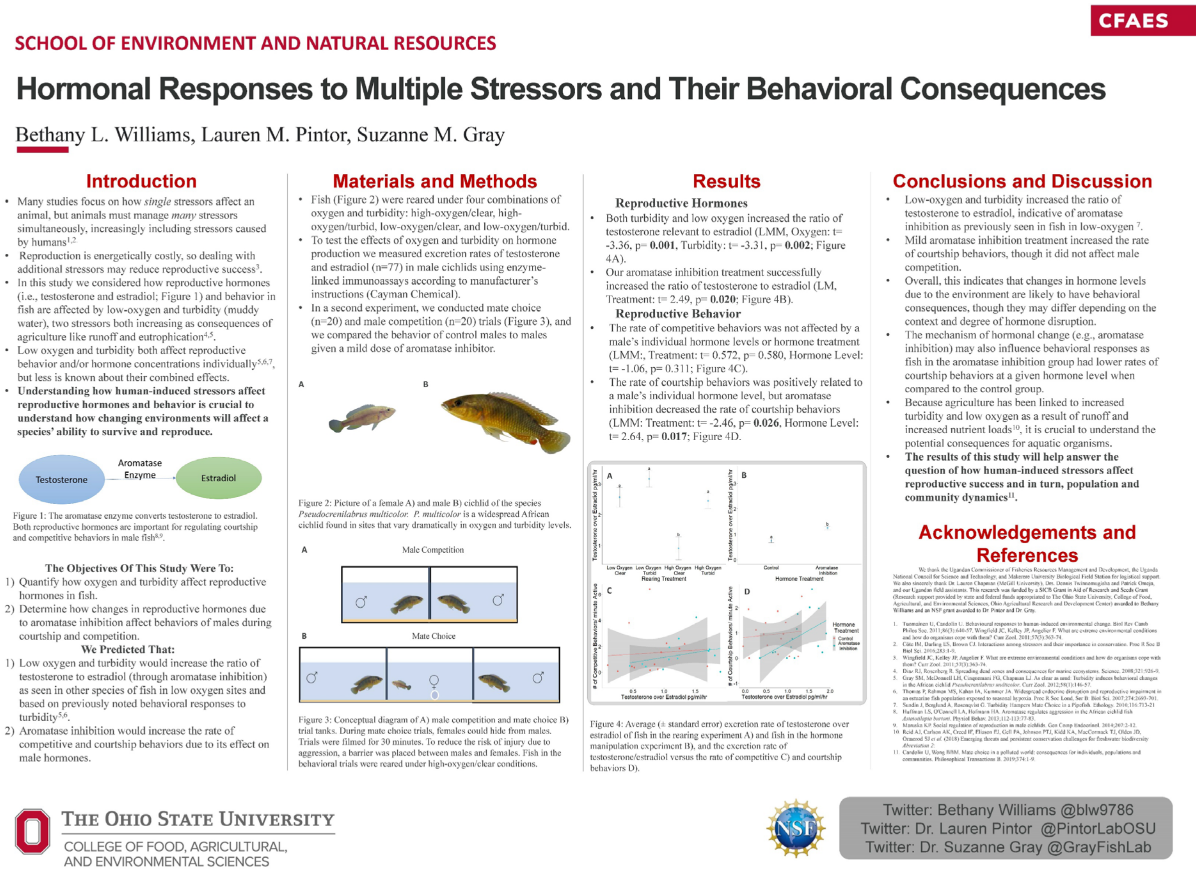
2022 CFAES Poster Competition

Ph.D. Category, Third Place

Bethany Williams

School of Environment & Natural Resources

Advisors: Dr. Suzanne Gray and Dr. Lauren Pintor



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SCHOOL OF ENVIRONMENT AND NATURAL RESOURCES

Hormonal Responses to Multiple Stressors and Their Behavioral Consequences

Bethany L. Williams, Lauren M. Pintor, Suzanne M. Gray

Introduction

- Many studies focus on how *single* stressors affect an animal, but animals must manage *many* stressors simultaneously, increasingly including stressors caused by humans[1,2].
- Reproduction is energetically costly, so dealing with additional stressors may reduce reproductive success[3].
- In this study we considered how reproductive hormones (i.e., testosterone and estradiol; Figure 1) and behavior in fish are affected by low-oxygen and turbidity (muddy water), two stressors both increasing as consequences of agriculture like runoff and eutrophication[4,5].
- Low oxygen and turbidity both affect reproductive behavior and/or hormone concentrations individually[5,6,7], but less is known about their combined effects.
- **Understanding how human-induced stressors affect reproductive hormones and behavior is crucial to understand how changing environments will affect a species' ability to survive and reproduce.**

Testosterone → Aromatase Enzyme → Estradiol

Figure 1: The aromatase enzyme converts testosterone to estradiol. Both reproductive hormones are important for regulating courtship and competitive behaviors in male fish[8,9].

The Objectives Of This Study Were To:

1) Quantify how oxygen and turbidity affect reproductive hormones in fish.
2) Determine how changes in reproductive hormones due to aromatase inhibition affect behaviors of males during courtship and competition.

We Predicted That:

1) Low oxygen and turbidity would increase the ratio of testosterone to estradiol (through aromatase inhibition) as seen in other species of fish in low oxygen sites and based on previously noted behavioral responses to turbidity[5,6].
2) Aromatase inhibition would increase the rate of competitive and courtship behaviors due to its effect on male hormones.

Materials and Methods

- Fish (Figure 2) were reared under four combinations of oxygen and turbidity: high-oxygen/clear, high-oxygen/turbid, low-oxygen/clear, and low-oxygen/turbid.
- To test the effects of oxygen and turbidity on hormone production we measured excretion rates of testosterone and estradiol (n=77) in male cichlids using enzyme-linked immunoassays according to manufacturer's instructions (Cayman Chemical).
- In a second experiment, we conducted mate choice (n=20) and male competition (n=20) trials (Figure 3), and we compared the behavior of control males to males given a mild dose of aromatase inhibitor.

Figure 2: Picture of a female A) and male B) cichlid of the species *Pseudocrenilabrus multicolor*. *P. multicolor* is a widespread African cichlid found in sites that vary dramatically in oxygen and turbidity levels.

A Male Competition

B Mate Choice

Figure 3: Conceptual diagram of A) male competition and mate choice B) trial tanks. During mate choice trials, females could hide from males. Trials were filmed for 30 minutes. To reduce the risk of injury due to aggression, a barrier was placed between males and females. Fish in the behavioral trials were reared under high-oxygen/clear conditions.

Results

Reproductive Hormones

- Both turbidity and low oxygen increased the ratio of testosterone relevant to estradiol (LMM, Oxygen: t= -3.36, p= **0.001**, Turbidity: t= -3.31, p= **0.002**; Figure 4A).
- Our aromatase inhibition treatment successfully increased the ratio of testosterone to estradiol (LM, Treatment: t= 2.49, p= **0.020**; Figure 4B).

Reproductive Behavior

- The rate of competitive behaviors was not affected by a male's individual hormone levels or hormone treatment (LMM:, Treatment: t= 0.572, p= 0.580, Hormone Level: t= -1.06, p= 0.311; Figure 4C).
- The rate of courtship behaviors was positively related to a male's individual hormone level, but aromatase inhibition decreased the rate of courtship behaviors (LMM: Treatment: t= -2.46, p= **0.026**, Hormone Level: t= 2.64, p= **0.017**; Figure 4D.

Figure 4: Average (± standard error) excretion rate of testosterone over estradiol of fish in the rearing experiment A) and fish in the hormone manipulation experiment B), and the excretion rate of testosterone/estradiol versus the rate of competitive C) and courtship behaviors D).

Conclusions and Discussion

- Low-oxygen and turbidity increased the ratio of testosterone to estradiol, indicative of aromatase inhibition as previously seen in fish in low-oxygen [7].
- Mild aromatase inhibition treatment increased the rate of courtship behaviors, though it did not affect male competition.
- Overall, this indicates that changes in hormone levels due to the environment are likely to have behavioral consequences, though they may differ depending on the context and degree of hormone disruption.
- The mechanism of hormonal change (e.g., aromatase inhibition) may also influence behavioral responses as fish in the aromatase inhibition group had lower rates of courtship behaviors at a given hormone level when compared to the control group.
- Because agriculture has been linked to increased turbidity and low oxygen as a result of runoff and increased nutrient loads[10], it is crucial to understand the potential consequences for aquatic organisms.
- **The results of this study will help answer the question of how human-induced stressors affect reproductive success and in turn, population and community dynamics[11].**

Acknowledgements and References

We thank the Ugandan Commissioner of Fisheries Resources Management and Development, the Uganda National Council for Science and Technology, and Makerere University Biological Field Station for logistical support. We also sincerely thank Dr. Lauren Chapman (McGill University), Drs. Dennis Twinomugisha and Patrick Omeja,

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Twitter: Bethany Williams @blw9786
Twitter: Dr. Lauren Pintor @PintorLabOSU
Twitter: Dr. Suzanne Gray @GrayFishLab

2022 CFAES Poster Competition

Ph.D. Category, Second Place

Caralee Shepard

Entomology

Advisor: Dr. Mary Gardiner

CFAES

Department of Entomology

Urbanization as a filter for the regional bee species pool

Caralee Shepard,[1] Sarah Scott,[1] Kayla Perry,[2] Katherine Turo,[3] Frances Sivakoff,[4] Mary Gardiner[1]

Introduction

- Vacant land is common in legacy cities where substantial population declines have occurred.[1]
- Over 20% of Ohio's bee species use vacant land as habitat.[2,3]
- A bee's ability to access and benefit from vacant land is likely-influenced by its functional traits, such as body size and nesting behavior.[4,5]
- Our goal was to determine what functional traits limit a bee species from utilizing urban vacant lots. **This information can inform future management plans to address these limitations posed by the urban environment.**

Objective:
Determine how urbanization filters the urban species pool of bees utilizing vacant land.

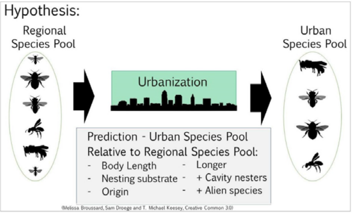

Figure 1. Hypothesis that urbanization will filter the urban specie pool relative to the region species pool based on the functional traits of body length, nesting substrate and origin.

Materials and Methods

- The regional species pool was defined using updated source files shared by Ascher and Pickering. [6]
- Five years of published bee collection data was used in a presence absence matrix for all regional bee species.
- A functional trait database was created using data gathered from online and published resources.
- Statistics: Community-weighted-means (CWM), Null model communities, Standardized effect sizes (SES), Wilcox signed rank analysis.

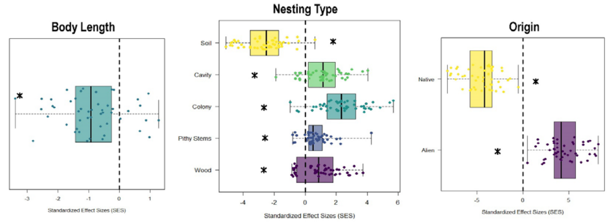

Figure 2. Graphs of results from tunning Standardized Effect Sizes (SES) for each functional category based on Null model communities The x axis shows the SES and asterisks show significant differences ($p < .05$). Colored points represent the SES of each site, while bar graphs show descriptive statistics for all sites.

Results

- Body length of urban species pool was smaller than expected ($p < .05$)
- Fewer soil nesting and a greater number of cavity, colony, pithy stem, and wood nesting species than expected ($p < .05$)
- A greater number of alien bee species and fewer native species than expected ($p < .05$)

Conclusion and Implications

Urban environments lack:

- Enough bare, stable soil to support soil nesting bees,
- Large resource habitats to support larger bees with greater nutrient needs

Conservation projects should provide nesting sites for soil nesting bees on larger patches of greenspace that could provide habitat for larger bee species.

References: [1] Perry et al., Urban Ecosyst, 2021, 24. [2] Sivakoff, Prajzner, and Gardiner. Sustainability, 2018, 10. [3] Turo et al., J Appl Ecol, 2021, 58:58– 69. [4] Ayers and Rehan, Insects, 2021, 12:128. [5] Fitch et al, Biol Lett, 2019, 15: 20190574. [6] Ascher and Pickering, DiscoverLife, 2020, 55.

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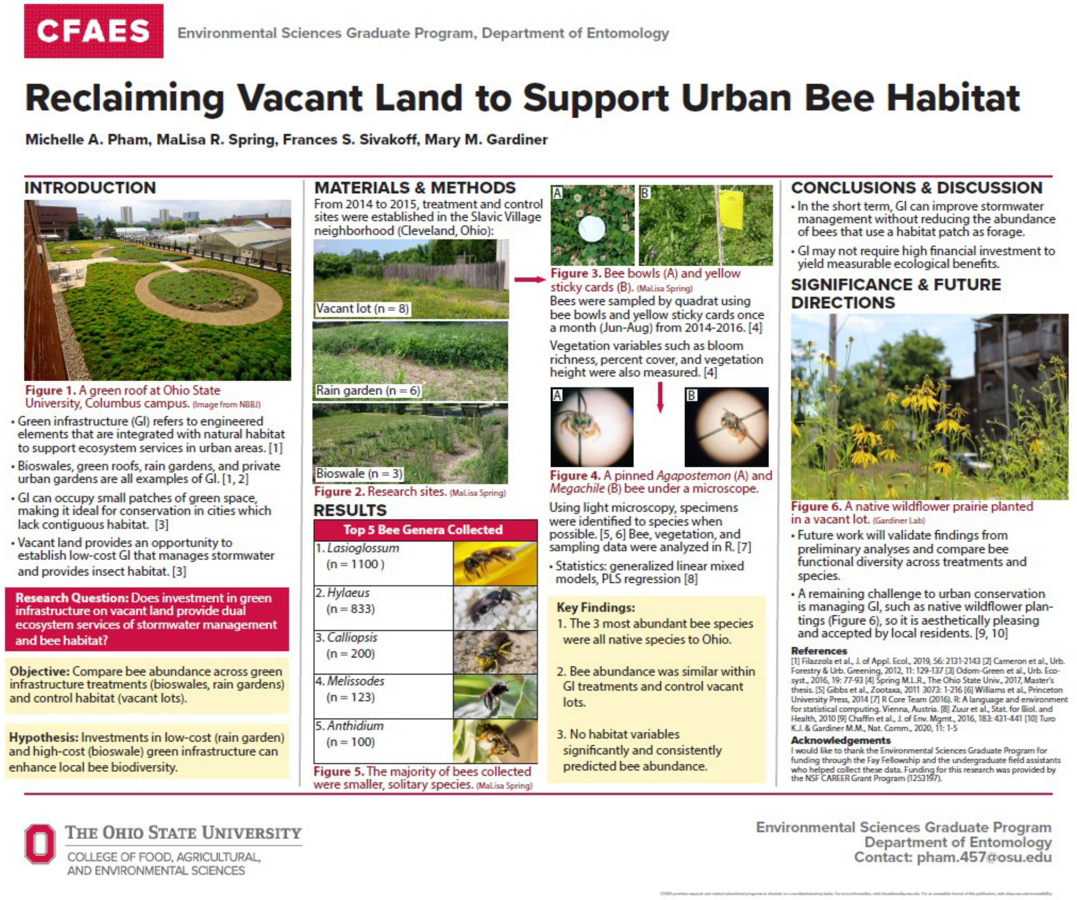
1. Department of Entomology, The Ohio State University, Columbus, OH.
2. Department of Biological Sciences, Kent State University, Kent, OH.
3. Department of Ecology, Evolution, and Natural Resources, Rutgers University, New Brunswick, NJ.
4. Department of Ecology, Evolution, and Organismal Biology, The Ohio State University, Columbus, OH.

2022 CFAES Poster Competition

Ph.D. Category, First Place



Michelle Pham

Entomology & Environmental Sciences

Advisor: Dr. Mary Gardiner

Postdoctoral Competition Winners

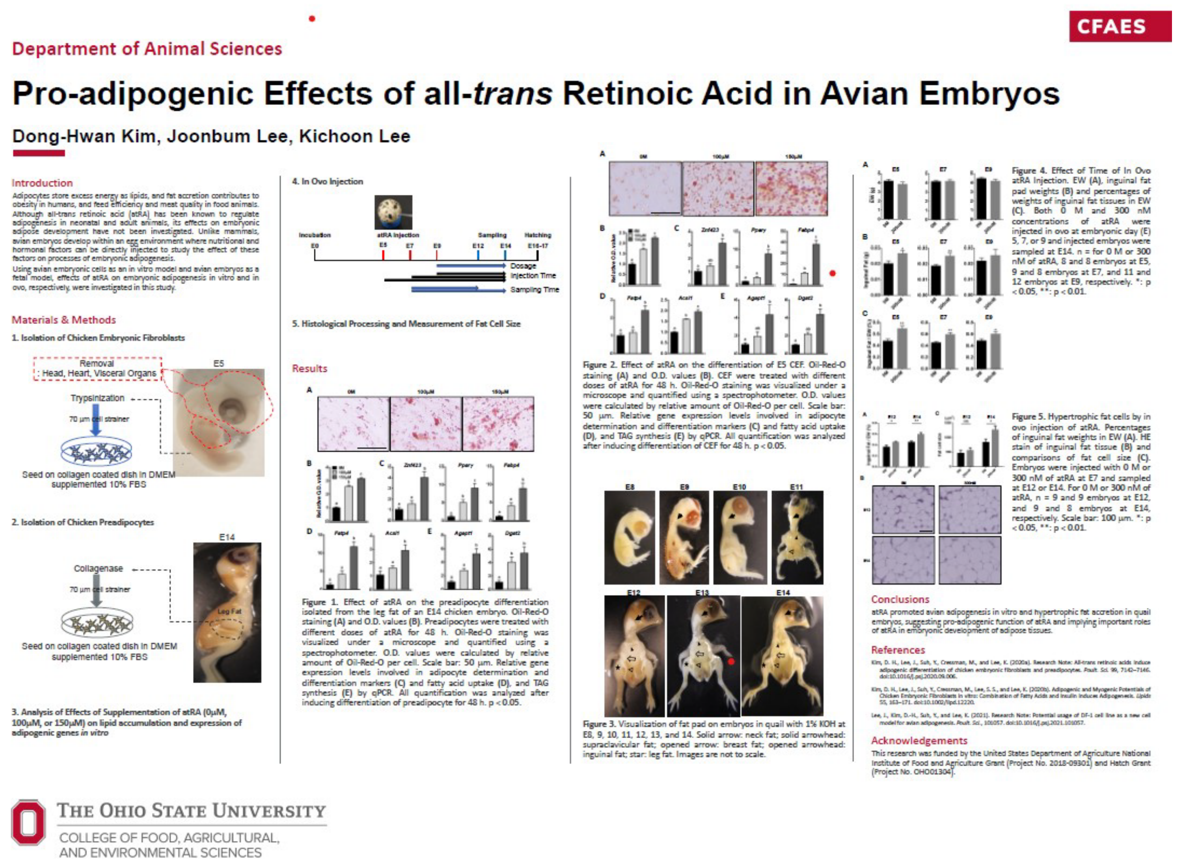
2022 CFAES Poster Competition

Post Doc Category, Third Place

Dong-Hwan Kim

Animal Sciences

Advisor: Dr. Kichoon Lee



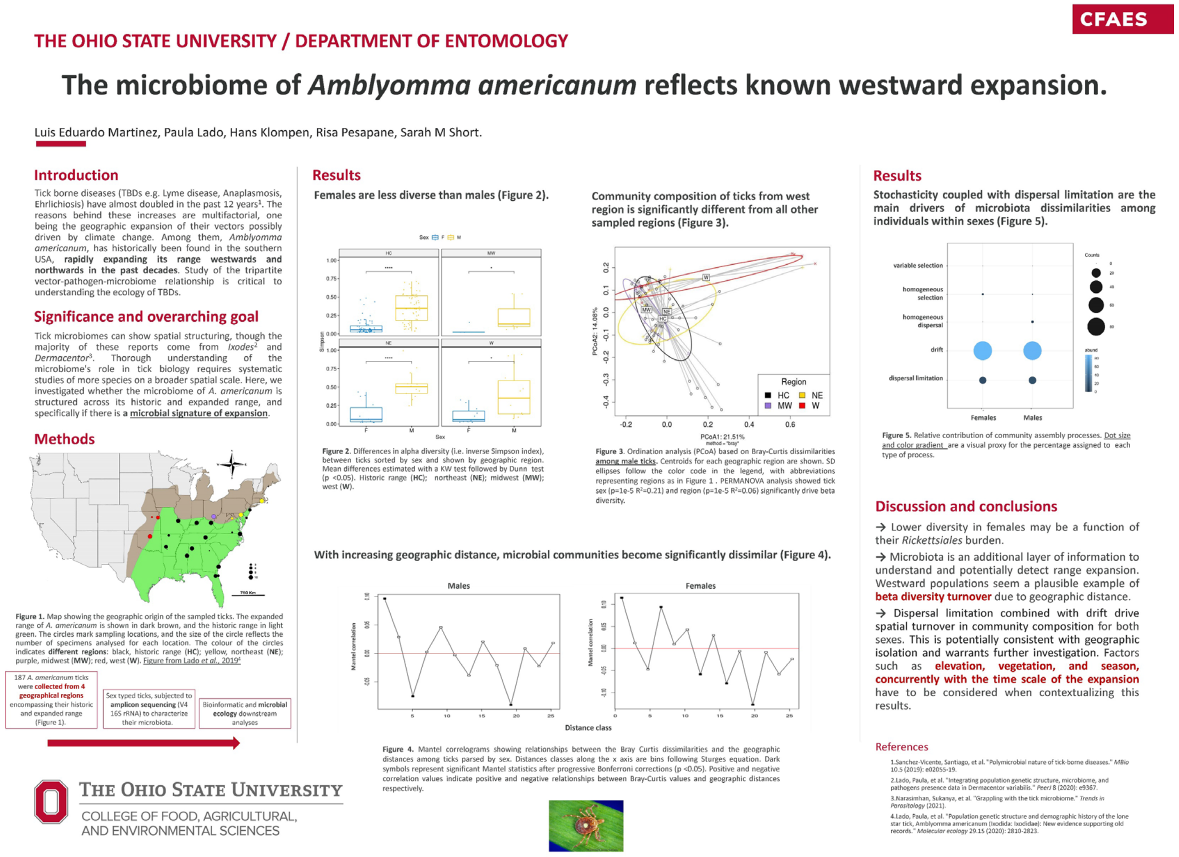
2022 CFAES Poster Competition

Post Doc Category, Second Place

Luis Martinez

Entomology

Advisor: Dr. Sarah Short



CFAES

THE OHIO STATE UNIVERSITY / DEPARTMENT OF ENTOMOLOGY

The microbiome of *Amblyomma americanum* reflects known westward expansion.

Luis Eduardo Martinez, Paula Lado, Hans Klompen, Risa Pesapane, Sarah M Short.

Introduction

Tick borne diseases (TBDs e.g. Lyme disease, Anaplasmosis, Ehrlichiosis) have almost doubled in the past 12 years[1]. The reasons behind these increases are multifactorial, one being the geographic expansion of their vectors possibly driven by climate change. Among them, *Amblyomma americanum*, has historically been found in the southern USA, **rapidly expanding its range westwards and northwards in the past decades**. Study of the tripartite vector-pathogen-microbiome relationship is critical to understanding the ecology of TBDs.

Significance and overarching goal

Tick microbiomes can show spatial structuring, though the majority of these reports come from *Ixodes*[2] and *Dermacentor*[3]. Thorough understanding of the microbiome's role in tick biology requires systematic studies of more species on a broader spatial scale. Here, we investigated whether the microbiome of *A. americanum* is structured across its historic and expanded range, and specifically if there is **a microbial signature of expansion**.

Methods

Figure 1. Map showing the geographic origin of the sampled ticks. The expanded range of *A. americanum* is shown in dark brown, and the historic range in light green. The circles mark sampling locations, and the size of the circle reflects the number of specimens analysed for each location. The colour of the circles indicates **different regions**: black, historic range (**HC**); yellow, northeast (**NE**); purple, midwest (**MW**); red, west (**W**). Figure from Lado *et al.*, 2019[4]

187 *A. americanum* ticks were **collected from 4 geographical regions** encompassing their historic and expanded range (Figure 1).

Sex typed ticks, subjected to **amplicon sequencing** (V4 16S rRNA) to characterize their microbiota.

Bioinformatic and **microbial ecology** downstream analyses

Results

Females are less diverse than males (Figure 2).

Figure 2. Differences in alpha diversity (i.e. inverse Simpson index), between ticks sorted by sex and shown by geographic region. Mean differences estimated with a KW test followed by Dunn test ($p < 0.05$). Historic range (**HC**); northeast (**NE**); midwest (**MW**); west (**W**).

Community composition of ticks from west region is significantly different from all other sampled regions (Figure 3).

Figure 3. Ordination analysis (PCoA) based on Bray-Curtis dissimilarities **among male ticks**. Centroids for each geographic region are shown. SD ellipses follow the color code in the legend, with abbreviations representing regions as in Figure 1 . PERMANOVA analysis showed tick sex ($p=1e-5$ $R^2=0.21$) and region ($p=1e-5$ $R^2=0.06$) significantly drive beta diversity.

With increasing geographic distance, microbial communities become significantly dissimilar (Figure 4).

Figure 4. Mantel correlograms showing relationships between the Bray Curtis dissimilarities and the geographic distances among ticks parsed by sex. Distances classes along the x axis are bins following Sturges equation. Dark symbols represent significant Mantel statistics after progressive Bonferroni corrections ($p < 0.05$). Positive and negative correlation values indicate positive and negative relationships between Bray-Curtis values and geographic distances respectively.

Results

Stochasticity coupled with dispersal limitation are the main drivers of microbiota dissimilarities among individuals within sexes (Figure 5).

Figure 5. Relative contribution of community assembly processes. Dot size and color gradient are a visual proxy for the percentage assigned to each type of process.

Discussion and conclusions

→ Lower diversity in females may be a function of their *Rickettsiales* burden.

→ Microbiota is an additional layer of information to understand and potentially detect range expansion. Westward populations seem a plausible example of **beta diversity turnover** due to geographic distance.

→ Dispersal limitation combined with drift drive spatial turnover in community composition for both sexes. This is potentially consistent with geographic isolation and warrants further investigation. Factors such as **elevation, vegetation, and season, concurrently with the time scale of the expansion** have to be considered when contextualizing this results.

References

1.Sanchez-Vicente, Santiago, et al. "Polymicrobial nature of tick-borne diseases." *MBio* 10.5 (2019): e02055-19.

2.Lado, Paula, et al. "Integrating population genetic structure, microbiome, and pathogens presence data in Dermacentor variabilis." *PeerJ* 8 (2020): e9367.

3.Narasimhan, Sukanya, et al. "Grappling with the tick microbiome." *Trends in Parasitology* (2021).

4.Lado, Paula, et al. "Population genetic structure and demographic history of the lone star tick, Amblyomma americanum (Ixodida: Ixodidae): New evidence supporting old records." *Molecular ecology* 29.15 (2020): 2810-2823.

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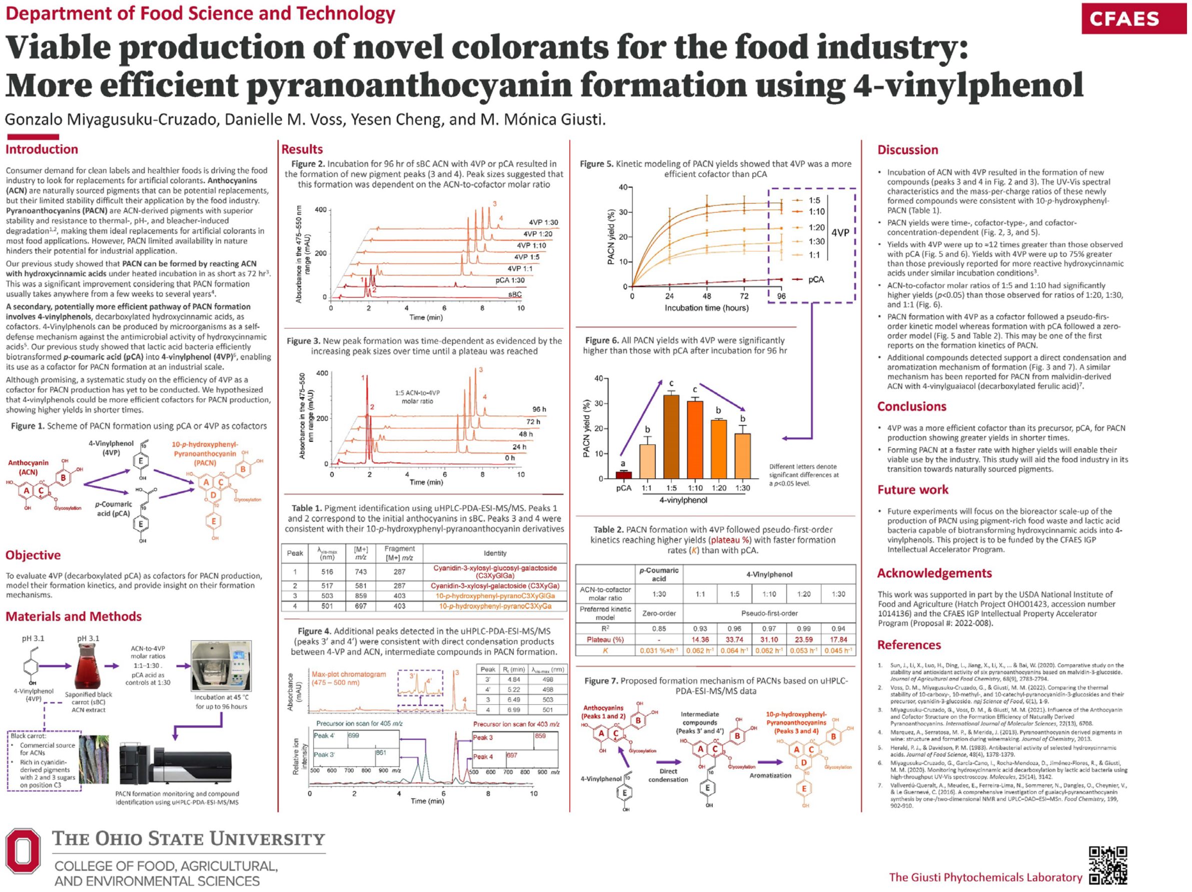

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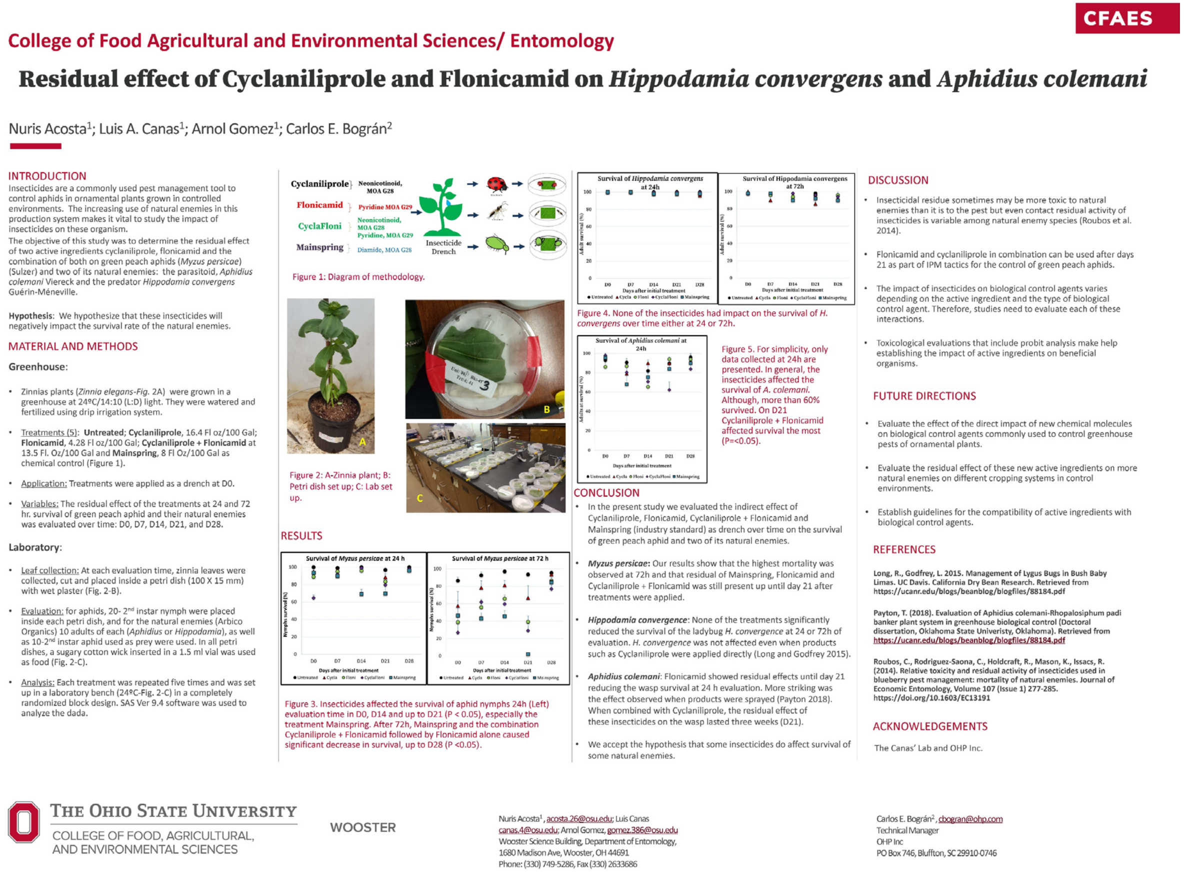

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Residual effect of Cyclaniliprole and Flonicamid on *Hippodamia convergens* and *Aphidius colemani*

Nuris Acosta[1]; Luis A. Canas[1]; Arnol Gomez[1]; Carlos E. Bográn[2]

INTRODUCTION

Insecticides are a commonly used pest management tool to control aphids in ornamental plants grown in controlled environments. The increasing use of natural enemies in this production system makes it vital to study the impact of insecticides on these organism.

The objective of this study was to determine the residual effect of two active ingredients cyclaniliprole, flonicamid and the combination of both on green peach aphids (*Myzus persicae*) (Sulzer) and two of its natural enemies: the parasitoid, *Aphidius colemani* Viereck and the predator *Hippodamia convergens* Guérin-Méneville.

Hypothesis: We hypothesize that these insecticides will negatively impact the survival rate of the natural enemies.

MATERIAL AND METHODS

Greenhouse:

- Zinnias plants (*Zinnia elegans-Fig.* 2A) were grown in a greenhouse at 24ºC/14:10 (L:D) light. They were watered and fertilized using drip irrigation system.
- Treatments (5): **Untreated**; **Cyclaniliprole**, 16.4 Fl oz/100 Gal; **Flonicamid**, 4.28 Fl oz/100 Gal; **Cyclaniliprole + Flonicamid** at 13.5 Fl. Oz/100 Gal and **Mainspring**, 8 Fl Oz/100 Gal as chemical control (Figure 1).
- Application: Treatments were applied as a drench at D0.
- Variables: The residual effect of the treatments at 24 and 72 hr. survival of green peach aphid and their natural enemies was evaluated over time: D0, D7, D14, D21, and D28.

Laboratory:

- Leaf collection: At each evaluation time, zinnia leaves were collected, cut and placed inside a petri dish (100 X 15 mm) with wet plaster (Fig. 2-B).
- Evaluation: for aphids, 20- 2nd instar nymph were placed inside each petri dish, and for the natural enemies (Arbico Organics) 10 adults of each (*Aphidius* or *Hippodamia*), as well as 10-2nd instar aphid used as prey were used. In all petri dishes, a sugary cotton wick inserted in a 1.5 ml vial was used as food (Fig. 2-C).
- Analysis: Each treatment was repeated five times and was set up in a laboratory bench (24ºC-Fig. 2-C) in a completely randomized block design. SAS Ver 9.4 software was used to analyze the dada.

Figure 1: Diagram of methodology.

Figure 2: A-Zinnia plant; B: Petri dish set up; C: Lab set up.

RESULTS

Figure 3. Insecticides affected the survival of aphid nymphs 24h (Left) evaluation time in D0, D14 and up to D21 ($P < 0.05$), especially the treatment Mainspring. After 72h, Mainspring and the combination Cyclaniliprole + Flonicamid followed by Flonicamid alone caused significant decrease in survival, up to D28 ($P < 0.05$).

Figure 4. None of the insecticides had impact on the survival of *H. convergens* over time either at 24 or 72h.

Figure 5. For simplicity, only data collected at 24h are presented. In general, the insecticides affected the survival of *A. colemani*. Although, more than 60% survived. On D21 Cyclaniliprole + Flonicamid affected survival the most ($P=<0.05$).

CONCLUSION

- In the present study we evaluated the indirect effect of Cyclaniliprole, Flonicamid, Cyclaniliprole + Flonicamid and Mainspring (industry standard) as drench over time on the survival of green peach aphid and two of its natural enemies.
- ***Myzus persicae*:** Our results show that the highest mortality was observed at 72h and that residual of Mainspring, Flonicamid and Cyclaniliprole + Flonicamid was still present up until day 21 after treatments were applied.
- ***Hippodamia convergence***: None of the treatments significantly reduced the survival of the ladybug *H. convergence* at 24 or 72h of evaluation. *H. convergence* was not affected even when products such as Cyclaniliprole were applied directly (Long and Godfrey 2015).
- ***Aphidius colemani***: Flonicamid showed residual effects until day 21 reducing the wasp survival at 24 h evaluation. More striking was the effect observed when products were sprayed (Payton 2018). When combined with Cyclaniliprole, the residual effect of these insecticides on the wasp lasted three weeks (D21).
- We accept the hypothesis that some insecticides do affect survival of some natural enemies.

DISCUSSION

- Insecticidal residue sometimes may be more toxic to natural enemies than it is to the pest but even contact residual activity of insecticides is variable among natural enemy species (Roubos et al. 2014).
- Flonicamid and cyclaniliprole in combination can be used after days 21 as part of IPM tactics for the control of green peach aphids.
- The impact of insecticides on biological control agents varies depending on the active ingredient and the type of biological control agent. Therefore, studies need to evaluate each of these interactions.
- Toxicological evaluations that include probit analysis make help establishing the impact of active ingredients on beneficial organisms.

FUTURE DIRECTIONS

- Evaluate the effect of the direct impact of new chemical molecules on biological control agents commonly used to control greenhouse pests of ornamental plants.
- Evaluate the residual effect of these new active ingredients on more natural enemies on different cropping systems in control environments.
- Establish guidelines for the compatibility of active ingredients with biological control agents.

REFERENCES

Long, R., Godfrey, L. 2015. Management of Lygus Bugs in Bush Baby Limas. UC Davis. California Dry Bean Research. Retrieved from https://ucanr.edu/blogs/beanblog/blogfiles/88184.pdf

Payton, T. (2018). Evaluation of Aphidius colemani-Rhopalosiphum padi banker plant system in greenhouse biological control (Doctoral dissertation, Oklahoma State Univeristy, Oklahoma). Retrieved from https://ucanr.edu/blogs/beanblog/blogfiles/88184.pdf

Roubos, C., Rodriguez-Saona, C., Holdcraft, R., Mason, K., Issacs, R. (2014). Relative toxicity and residual activity of insecticides used in blueberry pest management: mortality of natural enemies. Journal of Economic Entomology, Volume 107 (Issue 1) 277-285. https://doi.org/10.1603/EC13191

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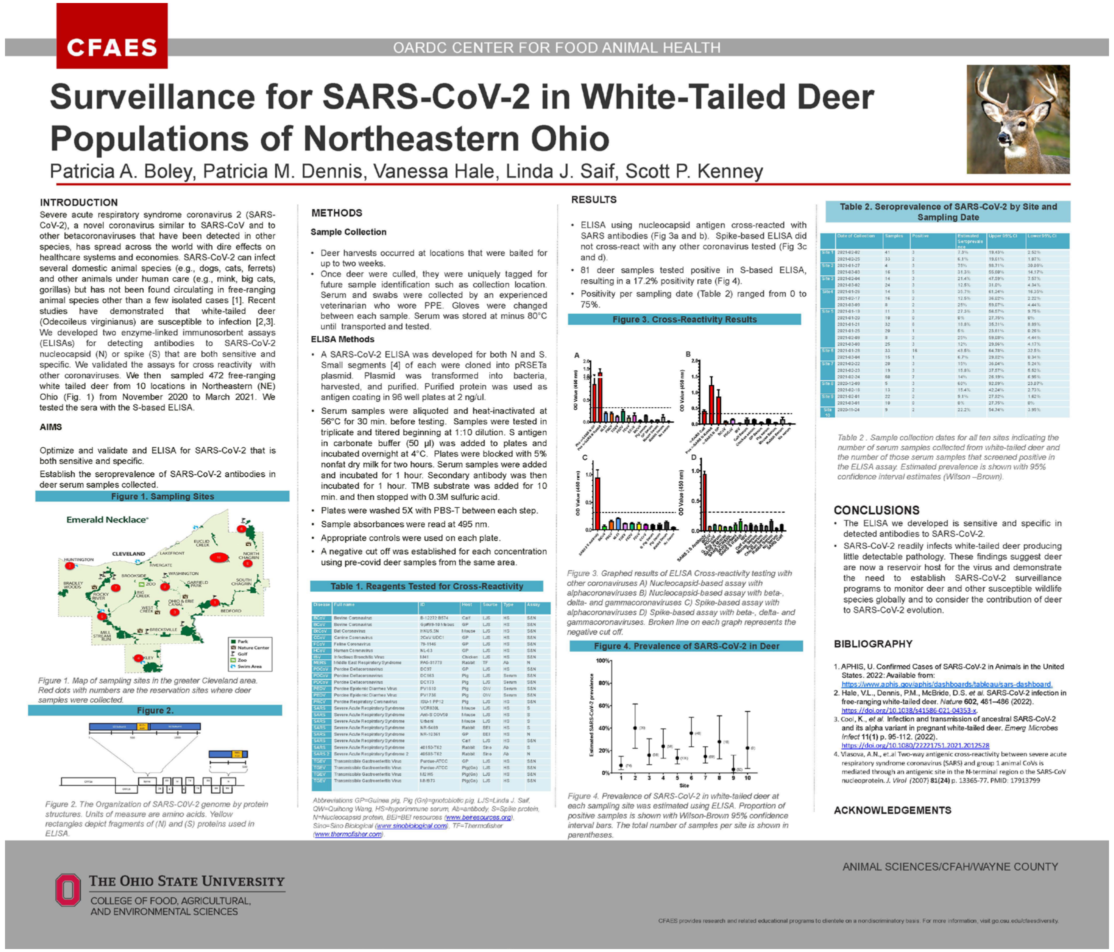

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