

Pollination Insights - Improving Pollination in Blueberry



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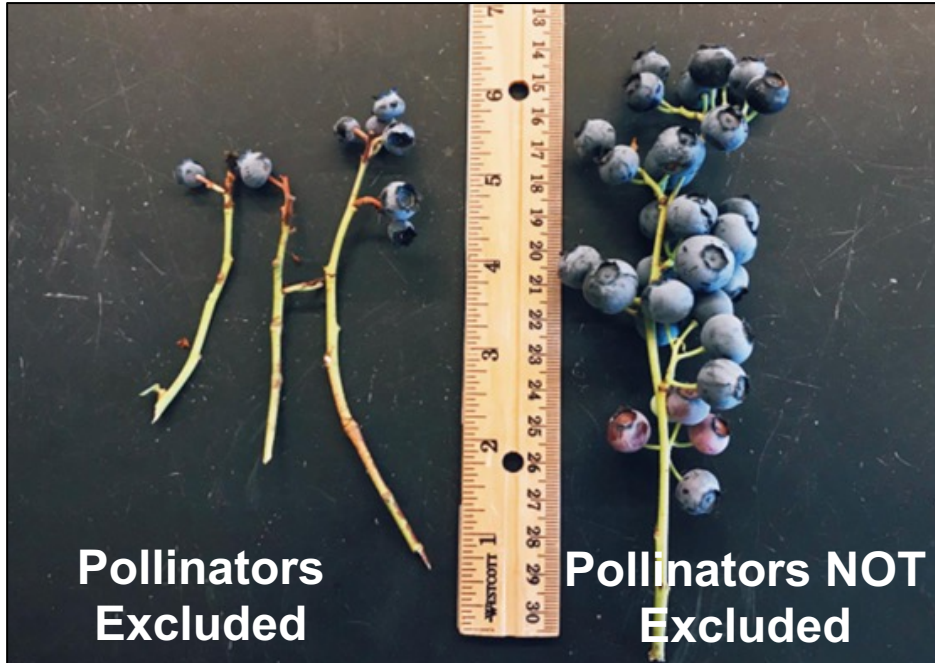


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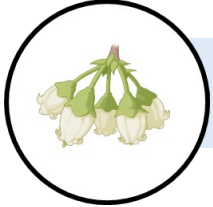
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Blueberry Pollination



- Most cultivars require or benefit from insect-mediated pollination
- Honey bees are the primary pollinator
- Pollination often variable and insufficient
- Growers need evidence-based strategies to improve blueberry pollination

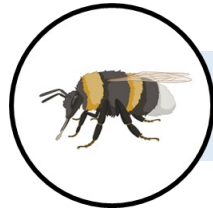
Topics Highlighted Today



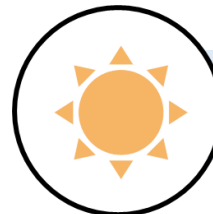
Pollination requirements



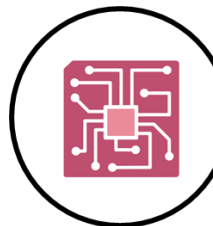
Honey bee pollination



Bumble bee pollination

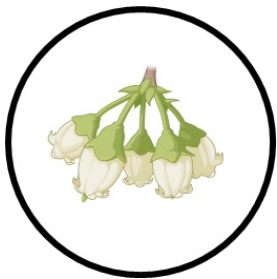


Mitigating extreme heat



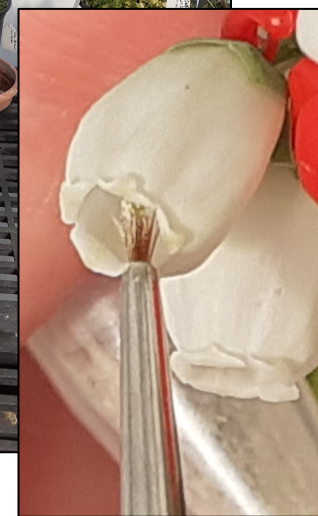
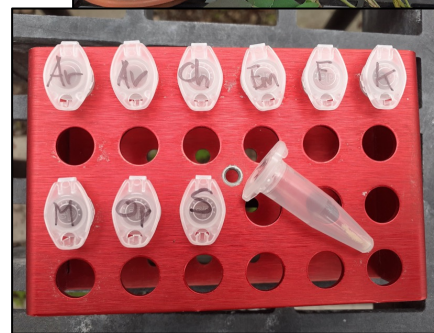
New technology (just a few words)

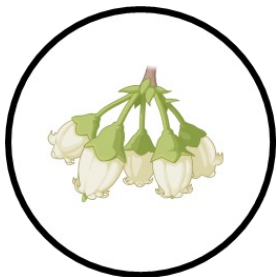




Pollination Requirements

- Highbush blueberry has a high degree of self-compatibility
- Yet, *Vaccinium* is partially self-sterile with an early-acting inbreeding depression
- Self-pollination causes some embryo abortion, which can limit fruit set and berry development
- **Cross-pollination improves pollination outcomes across most blueberry cultivars**

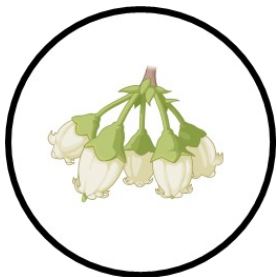




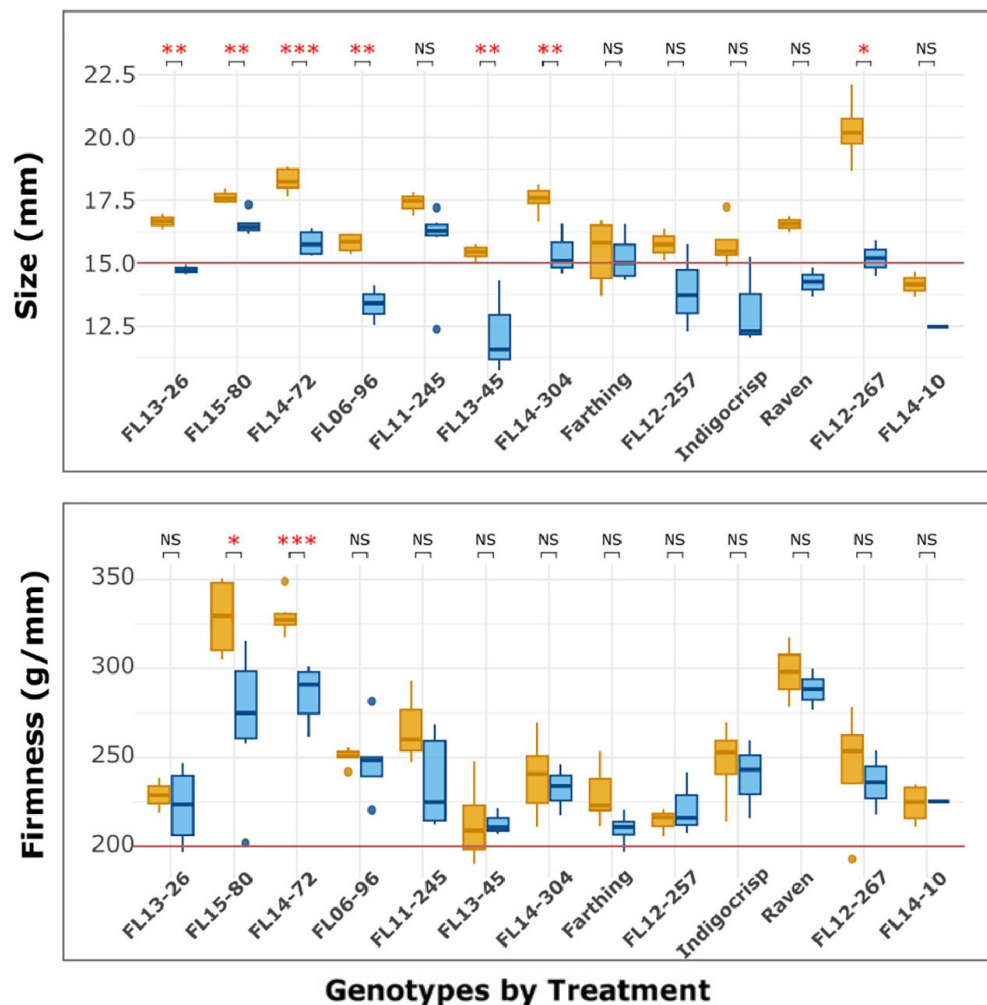
Cultivar Responses to Cross Pollination

Cultivar	Crossed with	Fruit mass	Firmness	Sugar:acid ratio	Ripening time
Arcadia	Arcadia Emerald Farthing	+	+	=	Up to 1 week faster
Colossus	Arcadia Emerald Farthing	+	+	=	Over 2 weeks faster
Farthing	Arcadia Emerald Farthing	+	=	=	Up to 8 days faster
Sentinel	Arcadia Emerald Farthing	+	+	=	Up to 9 days faster
Emerald	Arcadia Emerald Farthing	+	+	+	Up to a week faster
Optimus	Arcadia Emerald Farthing	+	+	+	Over 2 weeks faster

Data from Chabert and Mallinger at the University of Florida. Data based on greenhouse experiments and may not be transferrable to the field.



Breeding for Parthenocarpy



Legend: ■ Open ■ Netted

- Parthenocarpy = fruit development without fertilization (and pollination)
- Non-pollinated parthenocarpic fruits were smaller, sweeter, less firm, and took longer to develop but still met market standards
- **Breeding for parthenocarpy possible**



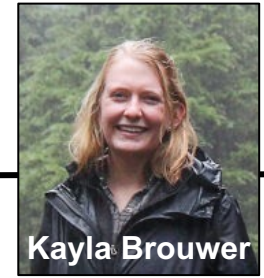
Honey Bee Pollination

- Individual blueberry flower requires 5-15 visits by a honey bee
- 25-274 pollen tetrads per flower to maximize fruit set and mass
- Low attraction to blueberry flowers, but they can get the job done!
- **Hive placement and colony strength impacts foraging and pollination outcomes**





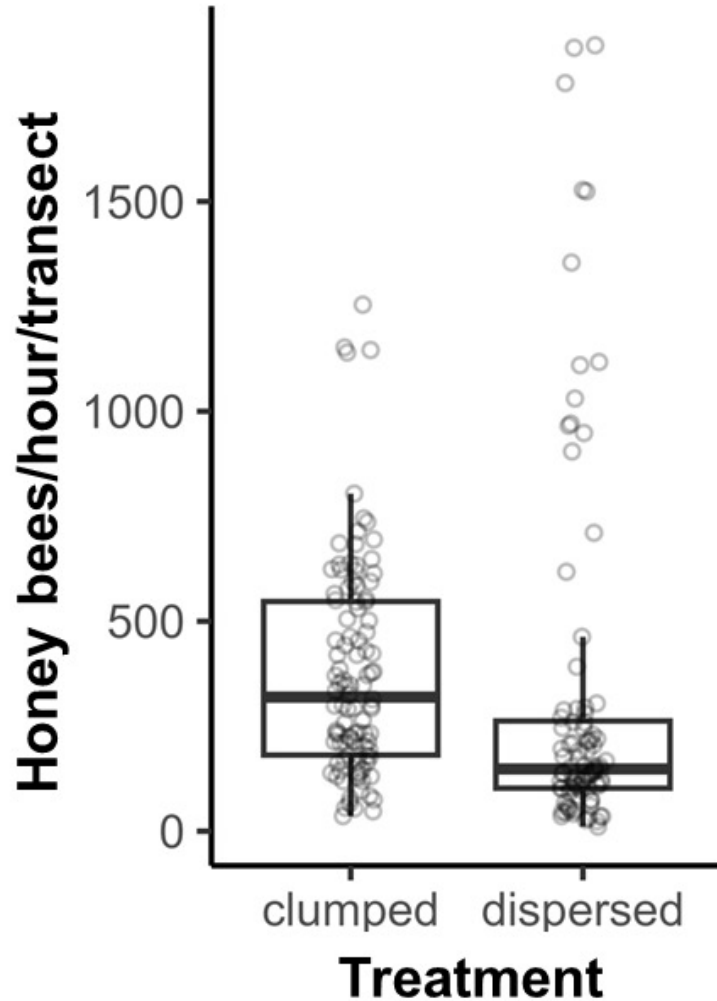
Hive Placement Matters



Kayla Brouwer



Maxime Eeraerts



Clumped



Dispersed

- Clumping hives led to a 2.6- and 1.3-fold increase in honey bee visitation in the Midwest and PNW, respectively, with no effect of stocking density
- No effects on fruit set, berry weight, nor seed set



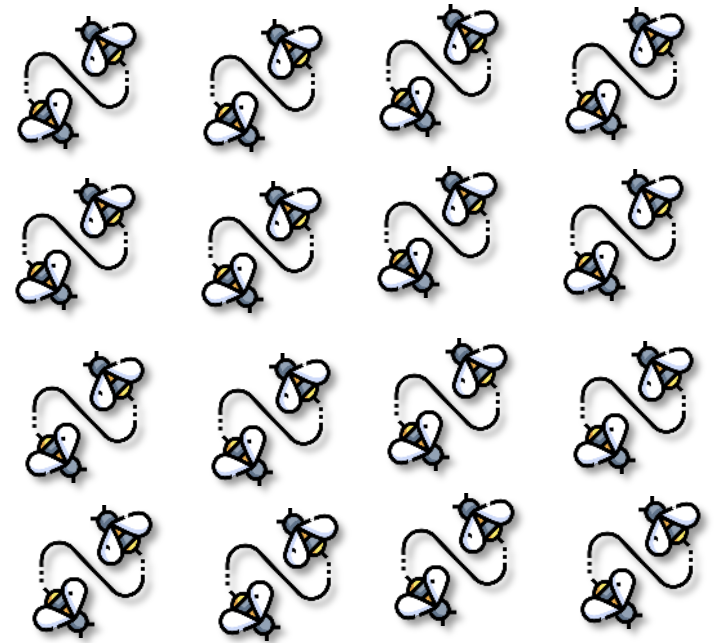
Colony Strength (Worker Population Size) Varies



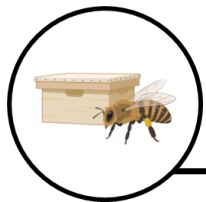
15,000 workers



30,000 workers



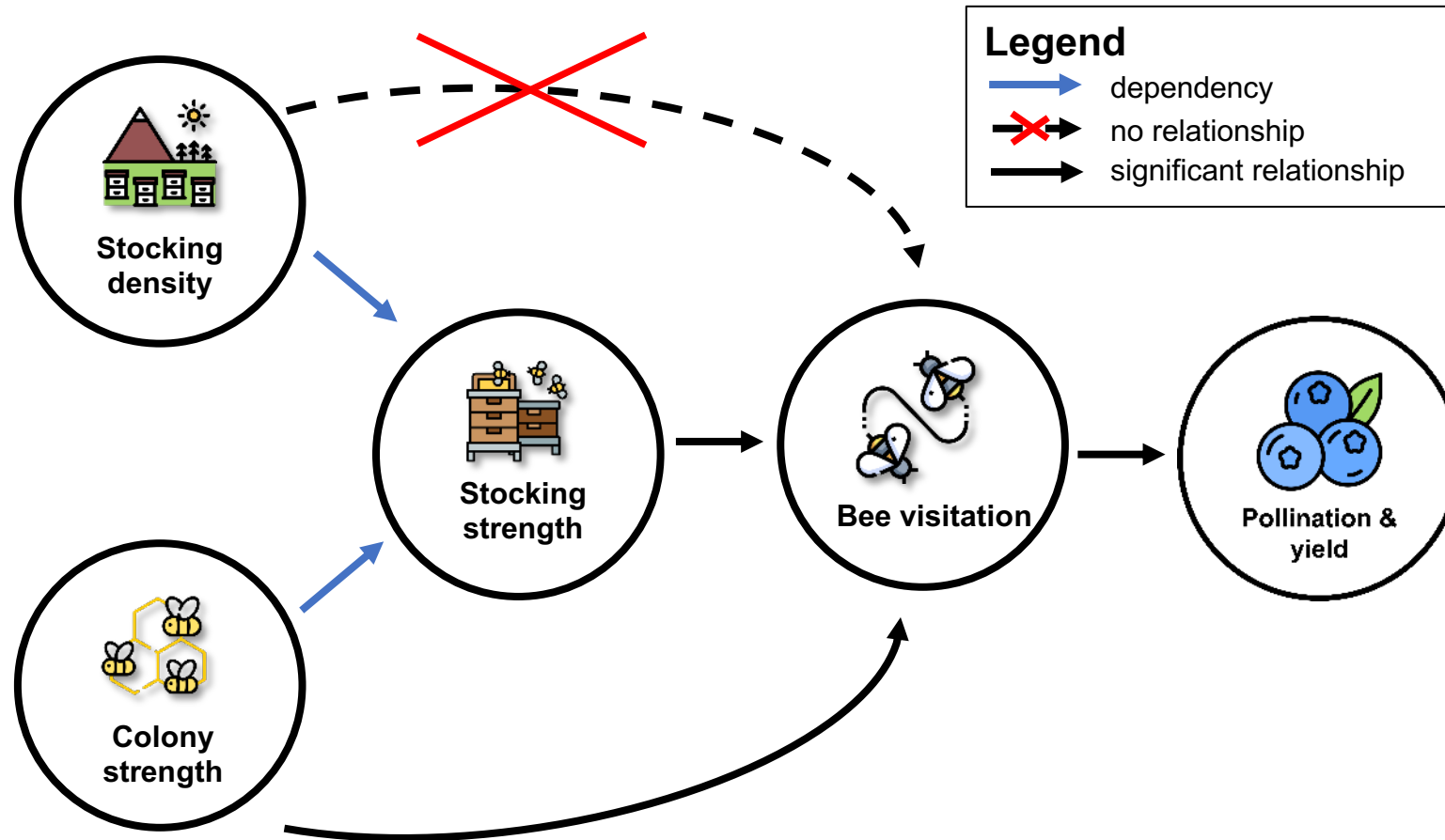
60,000 workers



It's Not Just Density – Colony Strength Counts!



Lauren Goldstein



Legend

- dependency
- no relationship
- significant relationship

- Increasing honey bee visitation improves pollination and yield outcomes (to a point)
- Visitation is best predicted by *stocking strength* (not field-level stocking density), underscoring the importance of stocking fields with strong colonies**

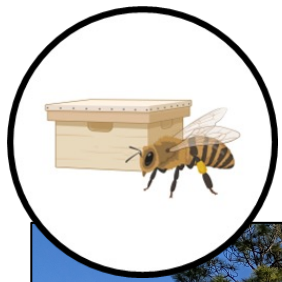
Returning
forager count

X

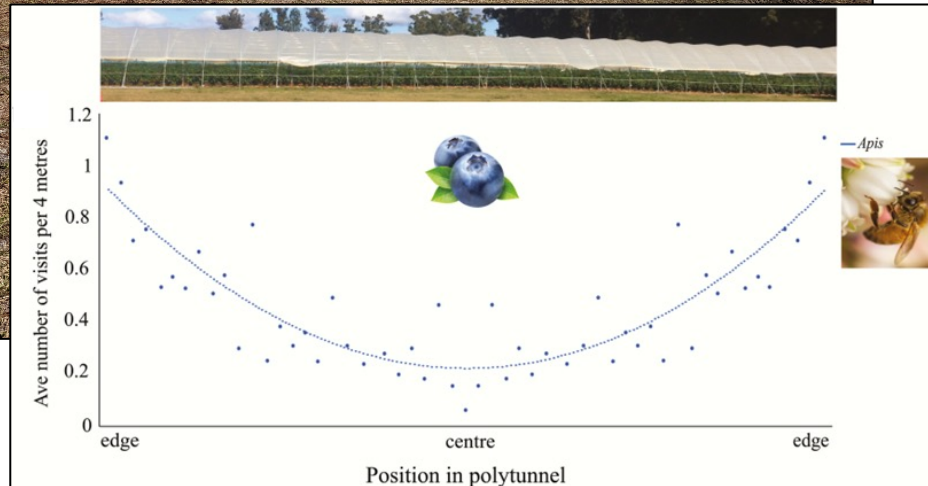
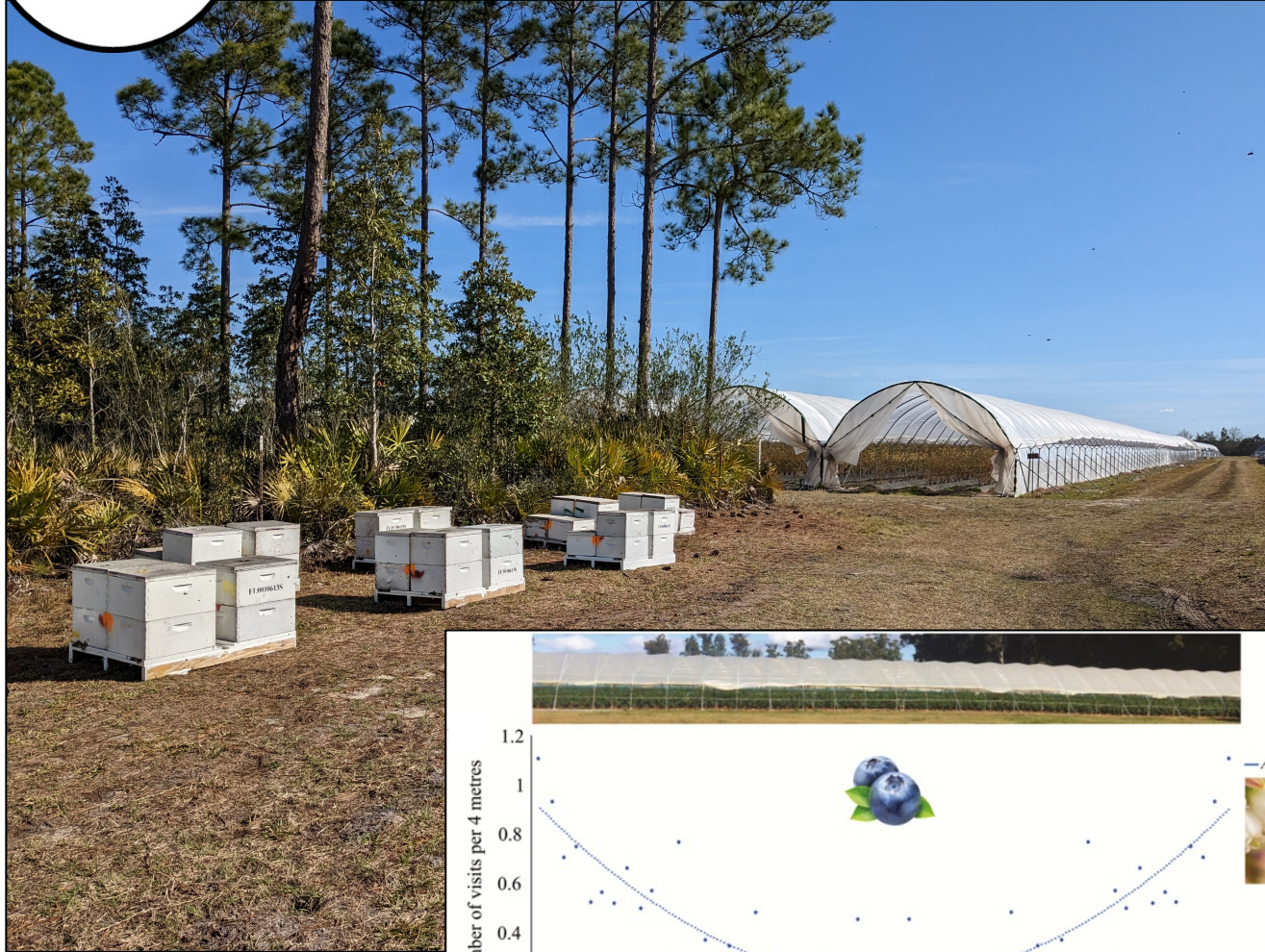
Stocking
density

=

***Stocking
strength***



Honey Bee Pollination in Protected Culture



- Honey bees are highly dependent on the sun for navigation
- Polytunnels reduce foraging and deplete hives when they fail to return to their colonies
- Middle sections of tunnels experience greater pollination deficits



Promoting Pollination in Protected Culture



- Stock with strong honey bee colonies (e.g., 6-10 hives/ha)
- Avoid UV-absorbing plastics and long tunnels (≥ 100 m)
- Place hives near tunnel ends
- Lift tunnel edges and leave ends open during bloom

- *Possibly* place hives in tunnels → rotate out with new hives every 2 weeks to maintain strong foraging populations
- Supplement honey bee nutrition
- Use additional pollinators (e.g., bumble bees)





Bumble Bee Pollination

- Buff-tailed bumble bee (*Bombus terrestris*)
- Good option for protected culture → less dependent on sunlight for navigation
- “Buzz pollination”
- More effective pollinator compared to honey bees (1 flower visit can lead to full pollination)
- Can be combined with honey bees
- Several commercial suppliers (Biobest, Koppert, Agrobio, etc.)

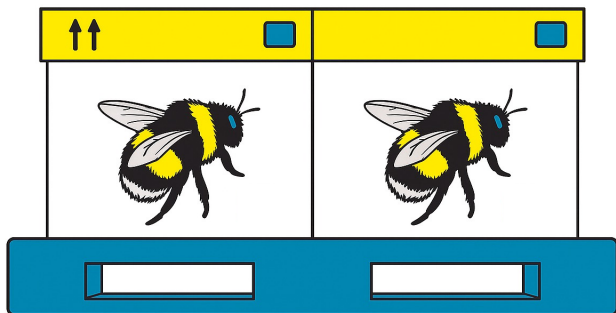




Optimizing Bumble Bee Pollination



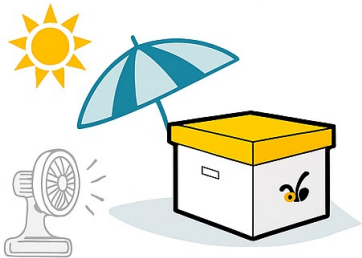
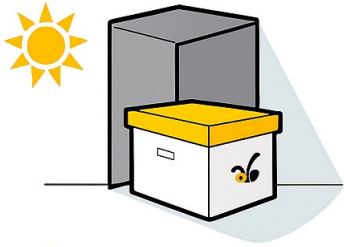
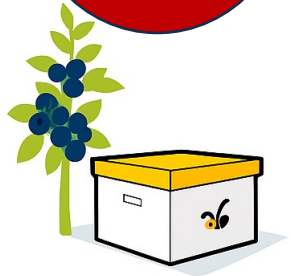
● = Pollination check points



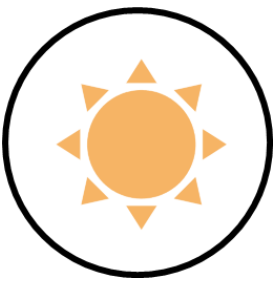
- Order hives 8 weeks in advance
- Hives should arrive at ~5-10% bloom
- Single colony lasts 6-8 weeks before shifting into queen production
- Optimal hive density depends on colony size, flower density, and whether other pollinators are being used:
 - Start conservatively with a low density (9-10 hives/ha) and increase over time
 - Watch for over pollination
 - Work with your supplier



Bumble Bee Deployment



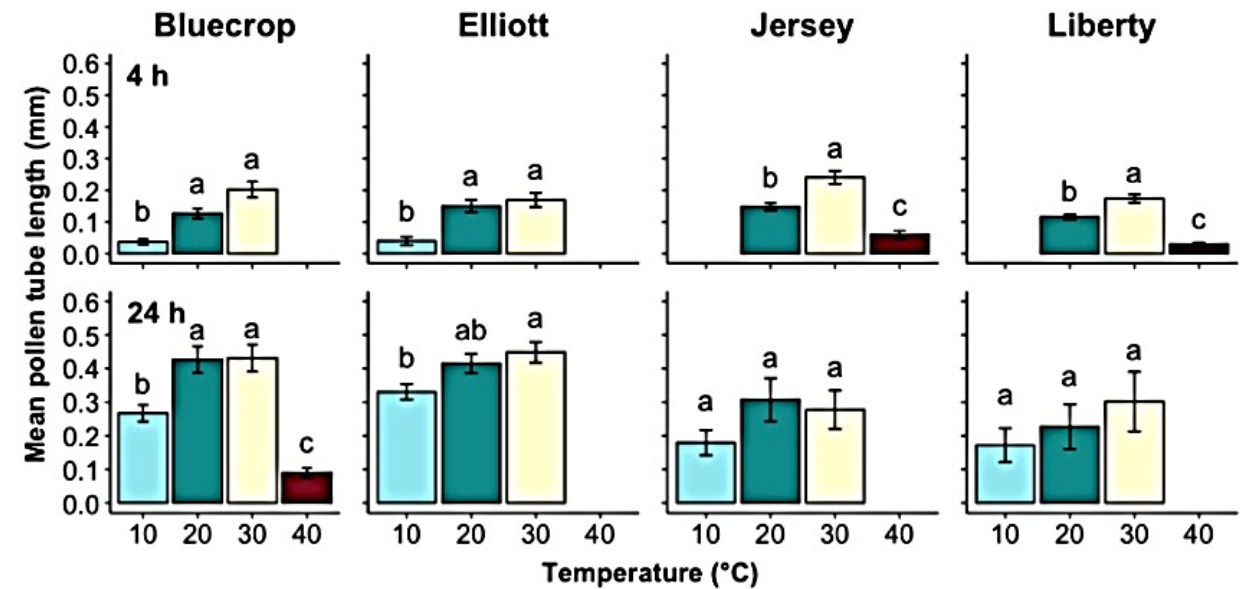
- Deploy the day of arrival
- Uncap sugar water (e.g., Biogluc[®])
- Do not place in direct light
- Keep in a ventilated area (below 80% RH)
- Place near pathways and distribute
- Entrance/exit should be visible
- Elevate 30-60 cm off the ground
- Do not cluster more than 2 hives together
- Protect from moisture
- Use petroleum jelly if ants become problematic
- Open hive after 15 minutes and monitor regularly
- Dispose of hives after pollination is complete



Extreme Heat Disrupts Pollination



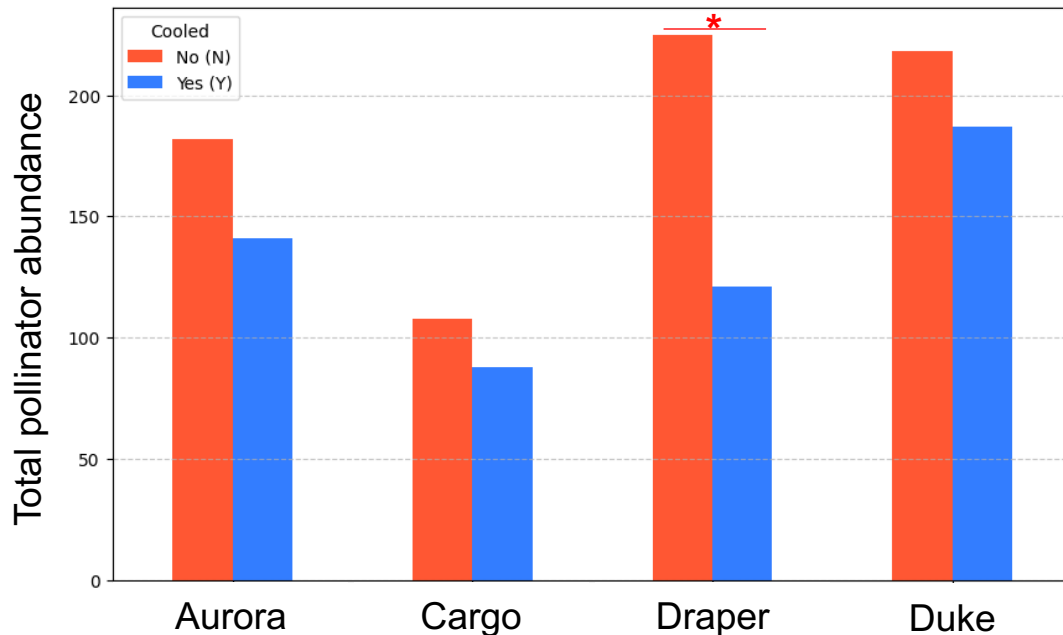
- *In vitro* studies show pollen performance declines and is nonrecoverable as temperatures increase from 30-40°C
- Extreme heat events reduce pollen viability and functioning and can have nutritional effects that impact bee survival



Mean pollen tube length of four cultivars after 4 and 24 h of exposure to 10, 20, 30, or 40 °C.



Mitigating Extreme Heat



- Overhead cooling using micro-sprinklers in open fields reduced flower temperatures by 4 °C
- Honey bee activity reduced in 'Draper' only (yield data being analyzed)
- Current recommendation is to cool flowers when air temperatures are ≥ 29 °C and to automate cooling cycles
- Also investigating biostimulants derived from kelp (*Ascophyllum nodosum*) and glycine betaine
- Research ongoing



Pollination Technology



- Pollination tech field is buzzing, but what is worth the investment?
- Partnership with universities – objective data to inform decisions
- Encouraging results with Beeflow
- Ongoing trials with BloomX



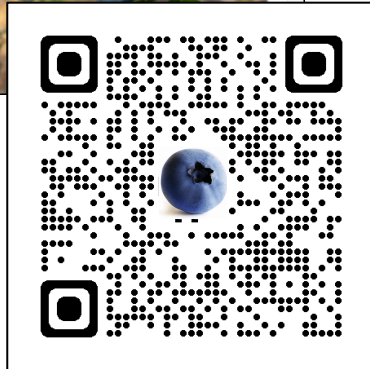
Pollination Resources

Blueberry Pollination Project
A project supported by the USDA-NIFA Specialty Crop Research Initiative

About Our Team News Resources for Growers Videos Twitter Bees and Berries Blog

Blueberry Pollination Planner

We are a multi-state research and extension team working to develop modern pollination decision tools to help blueberry growers optimize pollination of their fields.

BEES AND BERRIES **ROUGH GRADING OF COLONIES USING RETURNING FORAGER COUNTS**

The average returning rate of foragers to colonies you have rented is a rough predictor of the bees pollinating blueberry flowers. Watch our training video to learn how to grade your colonies.

Strong colony > 90 bees per minute
Medium 40-90 bees per minute
Weak < 40 bees per minute | Likely dead < 5 bees per minute




BEES AND BERRIES

Blossoming Success:

BEST PRACTICES FOR NORTHERN Highbush BLUEBERRY POLLINATION

Salena Helmreich¹, Andony Melathopoulos², Zoe Little³, Stan Chabert⁴, Meghan O. Milbrath⁵, Rachel E. Mallinger⁶, Jenna Walters⁷, Lauren Goldstein⁸, Rufus Isaacs⁹, Suzette P. Galinato⁹, Clark Kogan⁹, Emma Rogers⁹, Kayla Brouwer⁹, Maxime Eeraerts¹⁰, David Crowder¹¹, Lisa W. DeVetter¹²

Objective
This document describes northern highbush blueberry (*Vaccinium corymbosum*; hereafter referred to as "blueberry") pollination and factors that promote pollination success in open-field and protected culture (i.e., greenhouses, polytunnels, etc.). We will review how managed and wild pollinators contribute to pollination and how to aid their activity and health. Attention will also be given to future outlooks on pollination technologies and decision-support tools.

Defining pollination
Pollination is the movement of pollen between the reproductive parts of a flowering plant, which results in fertilization, production of seeds, and fruit development. In pollination-dependent crops, this pollen movement is facilitated by insects, mainly bees. In blueberry, insect visitation to flowers increases fruit set, berry size, and marketability. Bees, both managed and wild, are well known pollinators of blueberry; however flies and birds may also be minor contributors to the overall pollination success of blueberry. Most blueberry growers bring in managed hives of Western honey bees (*Apis mellifera*) to promote successful crop pollination. Some growers choose to supplement their honey bee pollination with other commercially available bumble bees (*Bombus* spp.), mason bees (*Osmia* spp.), or leafcutter bees (*Megachile* spp.). They may also promote wild bee populations locally in the landscape for increased pollination services.

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Conclusions

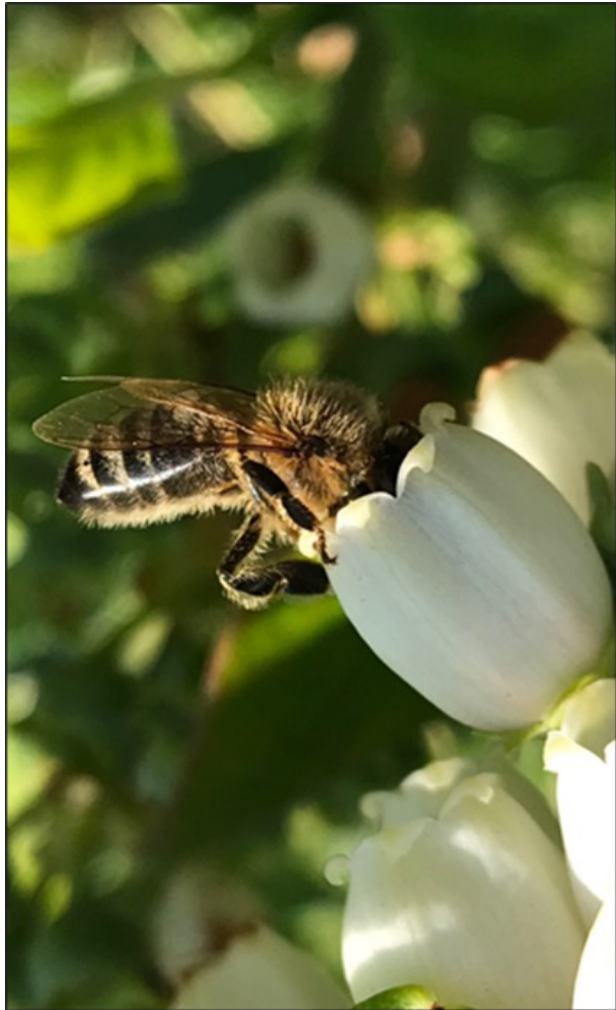
- Honey bees and bumble bees can be combined to improve pollination in protected culture, but further research is needed for optimization
- Important to establish good relationships with your bee supplier(s)
- Cross-pollination is beneficial for most cultivars
- Overhead cooling can reduce the negative effects of extreme heat
- Pollination tech is “buzzing,” but require validation
- Morocco has >930 bee species → future research should explore how to safely integrate wild pollinators for more resilient pollination and enhance conservation efforts



Thank you! Questions?



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