

Blueberry Pollination Research Update

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1. Pollination requirements (cross-pollination vs. self-pollination)
2. Optimal planting designs for pollination
3. Optimal honey bee and bumble bee stocking densities
4. Optimal honey bee placement
5. Honey bee colony assessments and honey bee health
6. Contributions of wild insects, management to enhance wild insects
7. Effects of pesticides on bees and pollination



1. Pollination requirements (cross-pollination vs. self-pollination)
2. Optimal planting designs for pollination





Self pollination = within same plant
or between plants of same cultivar

Cross-pollination = across
different cultivars

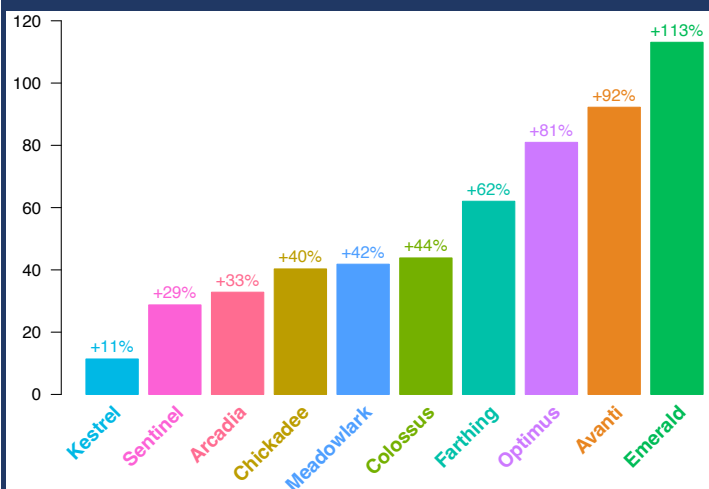


Hand pollinate flowers with self and cross pollen

- Arcadia
- Colossus
- Farthing
- Kestrel
- Sentinel
- Meadowlark
- Chickadee
- Emerald
- Avanti
- Optimus

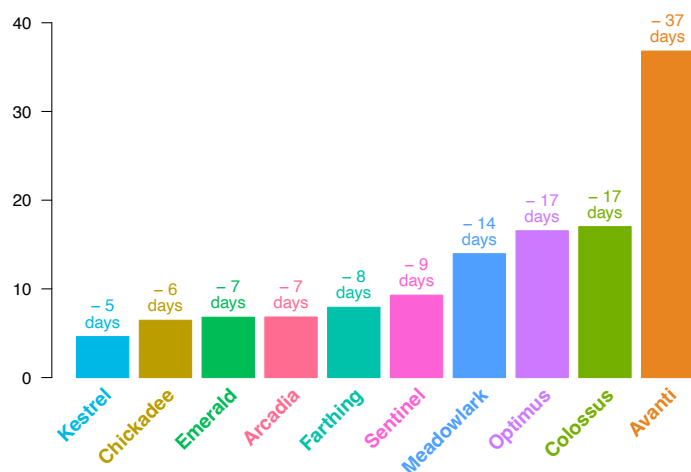
Cross pollination increases fruit weight and quality for all cultivars

Increase in berry weight/size due to cross pollination



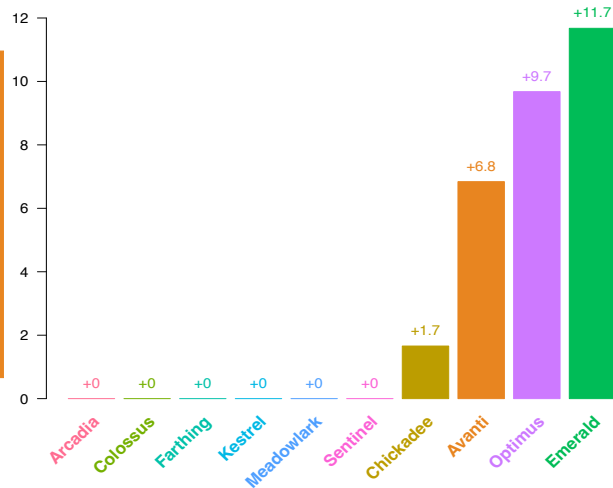
Cross-pollination increased berry weight in all cultivars, from +11% to +113%

Decrease of time to ripen (days) due to cross pollination



Cross-pollination decreased time to ripen in all cultivars, from 5 days to 37 days

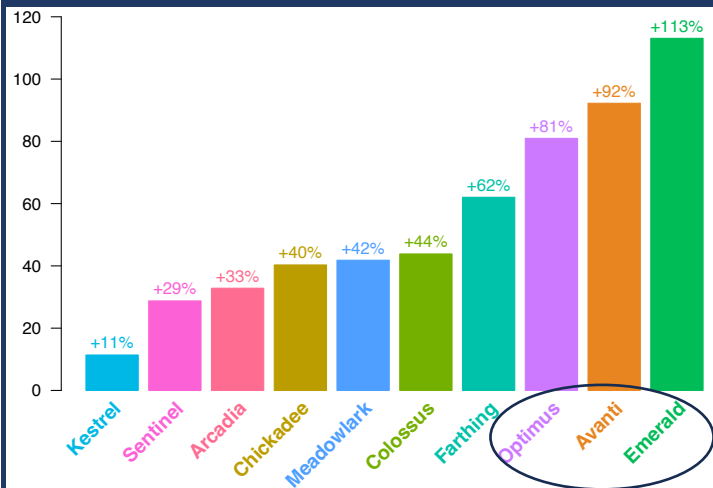
Increase in sugar:acid ratio due to cross pollination



Cross-pollination increased sugar:acid ratio in 4 cultivars, From +2 to +12

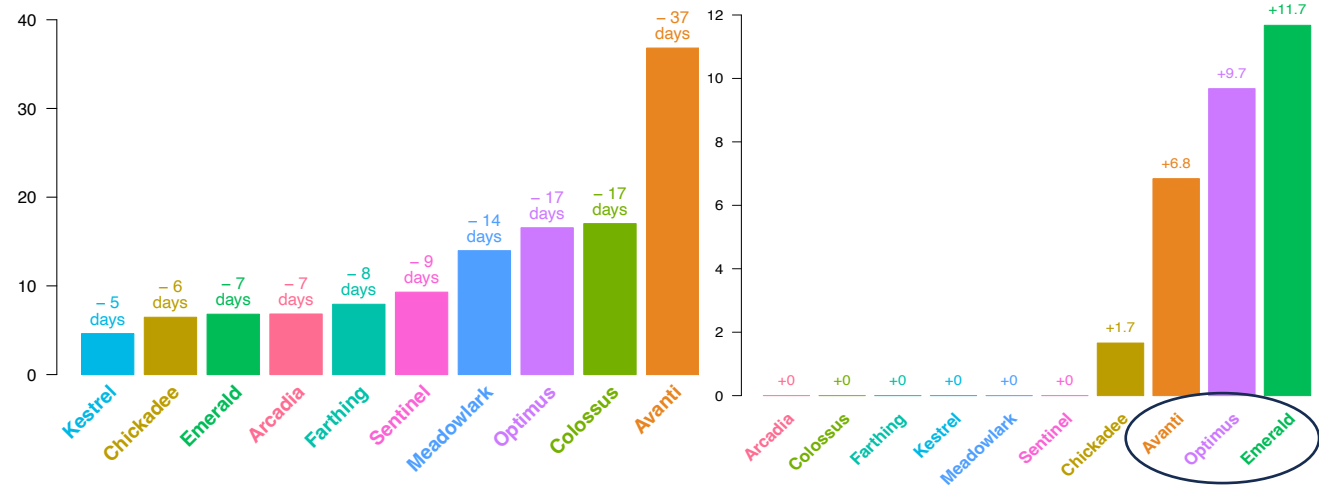
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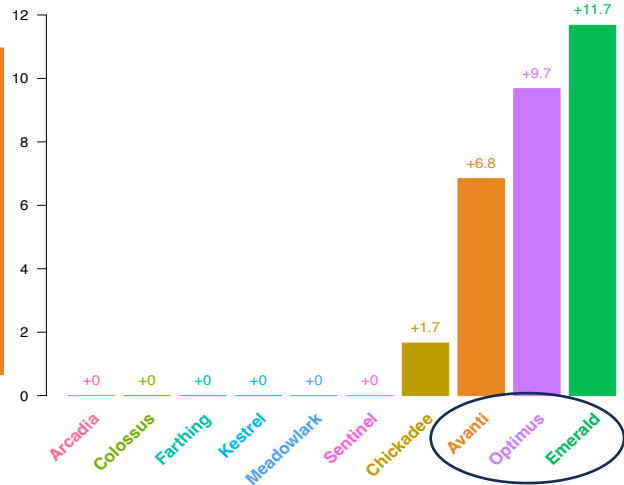
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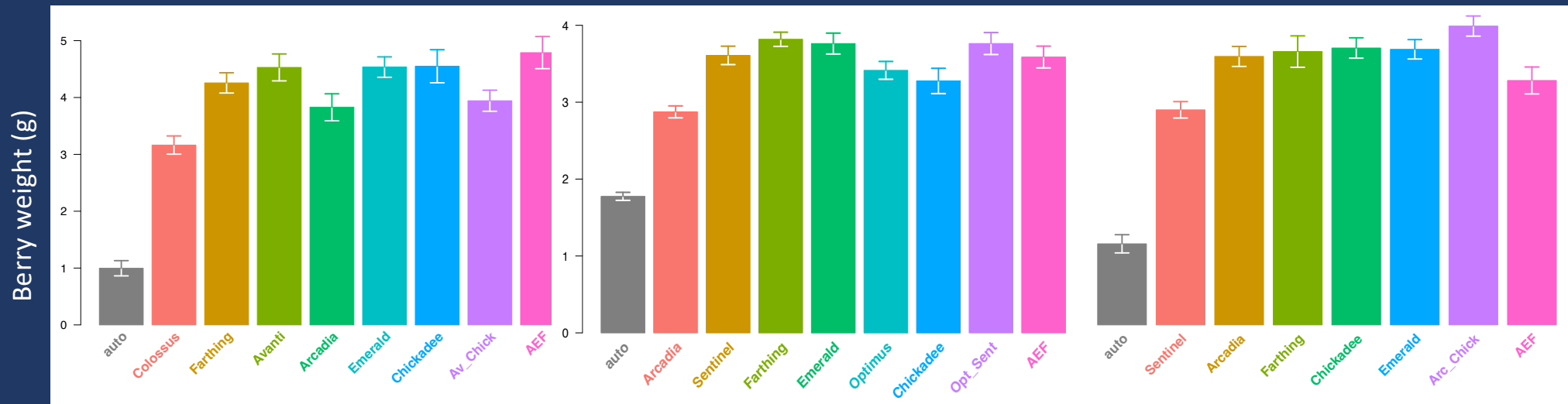
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All cross pollen donors better than self pollen

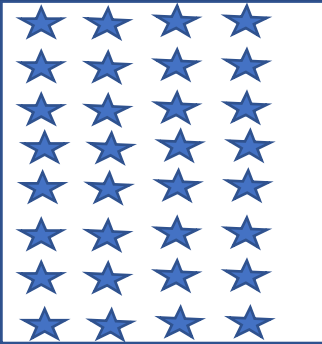
Pollen donors for Colossus

Pollen donors for Arcadia

Pollen donors for Sentinel



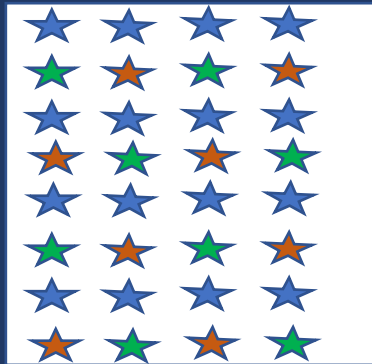
How to arrange cultivars for optimal cross-pollination?



Single cultivar (Arcadia)

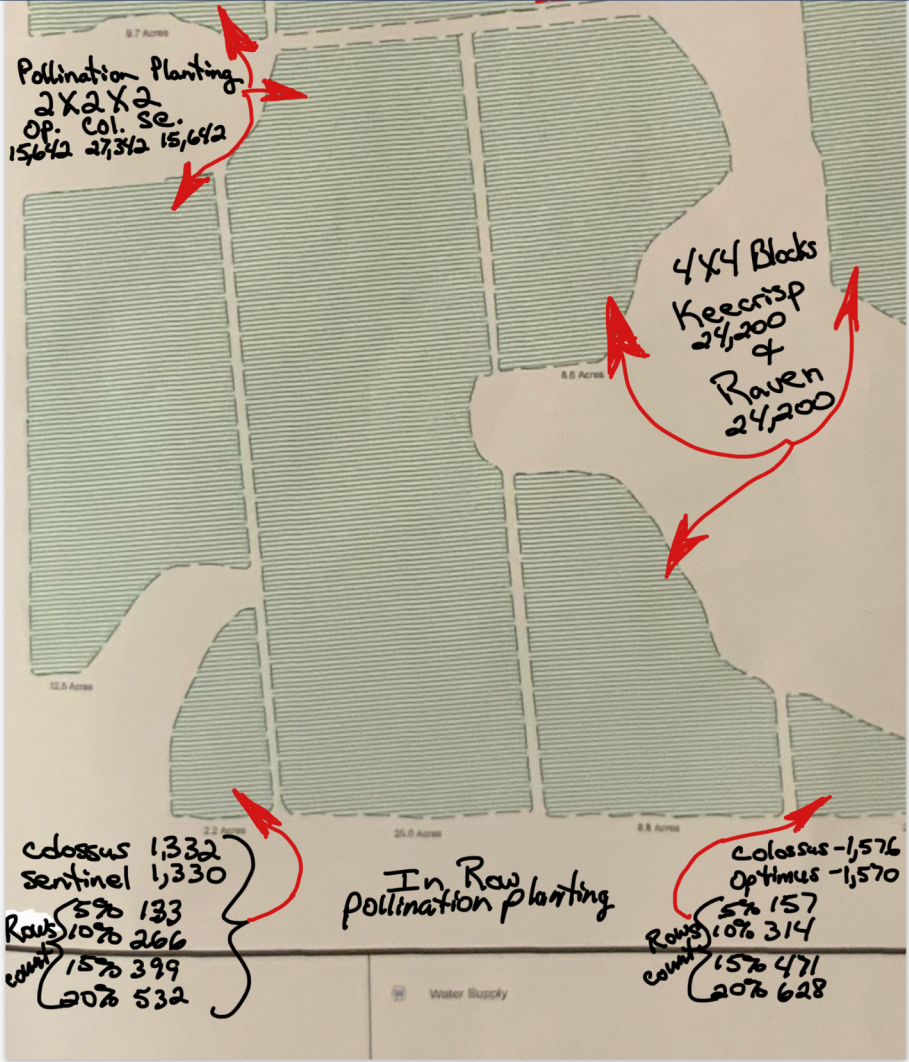


Mixed cultivar across rows
(Arcadia, Avanti, Kestrel)

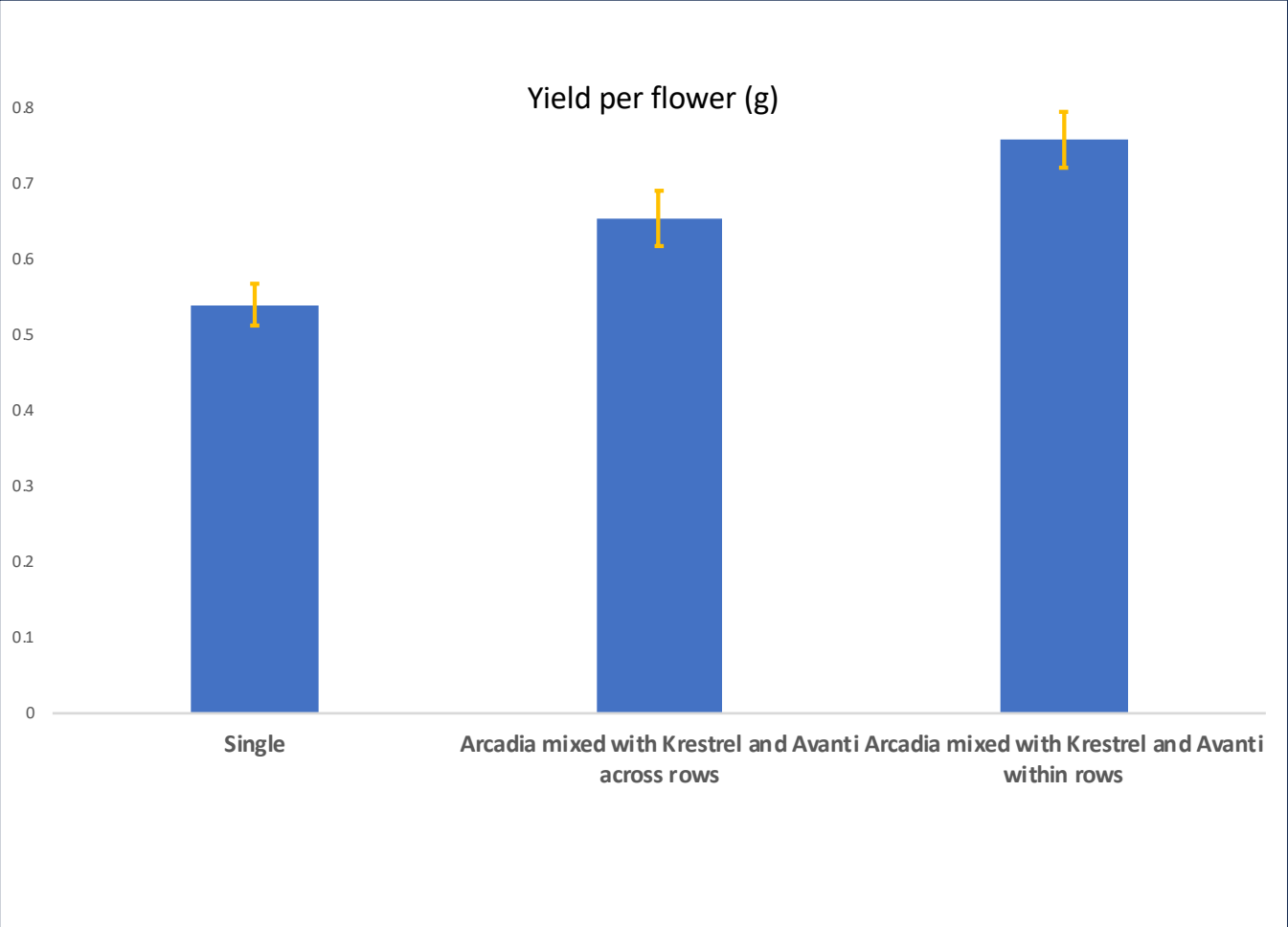


Mixed cultivar within row
(Arcadia, Avanti, Kestrel)

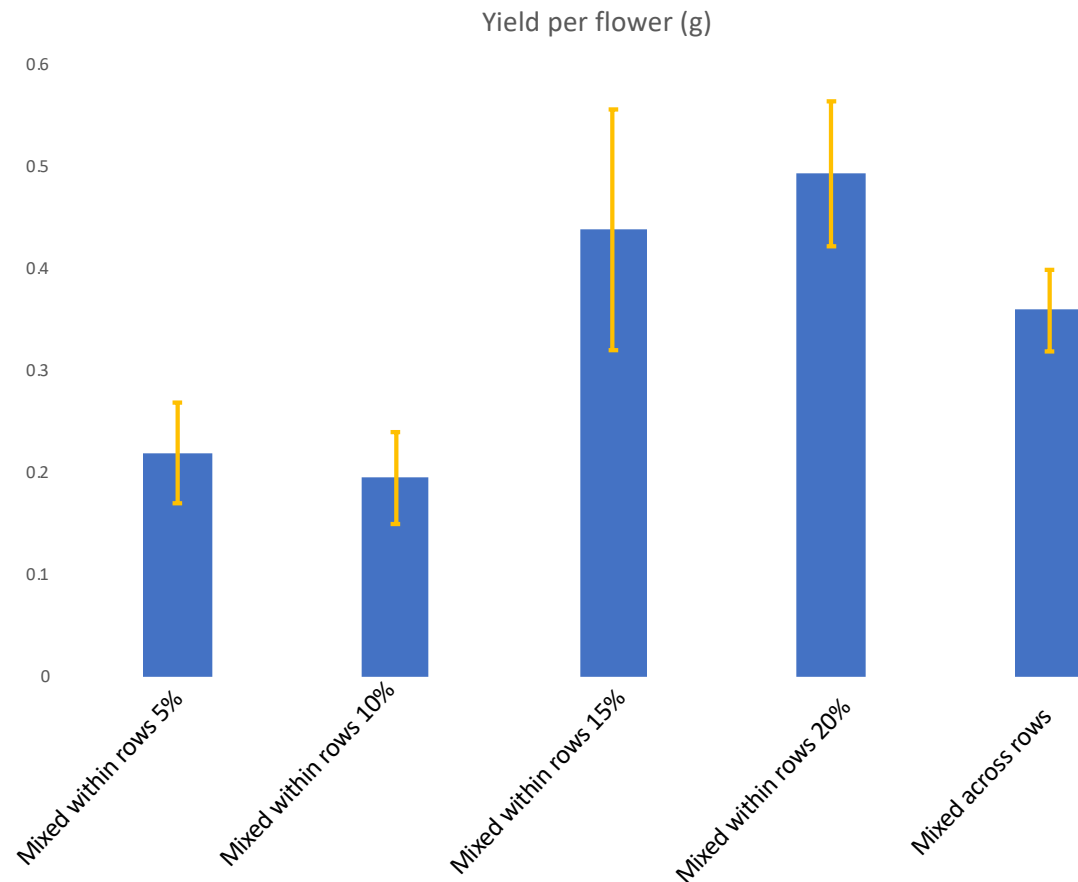
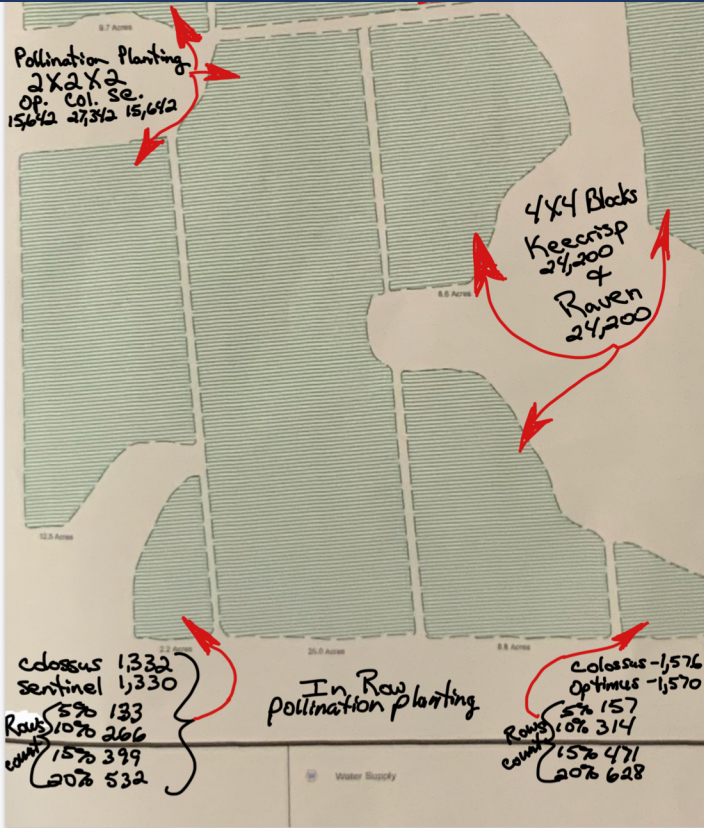




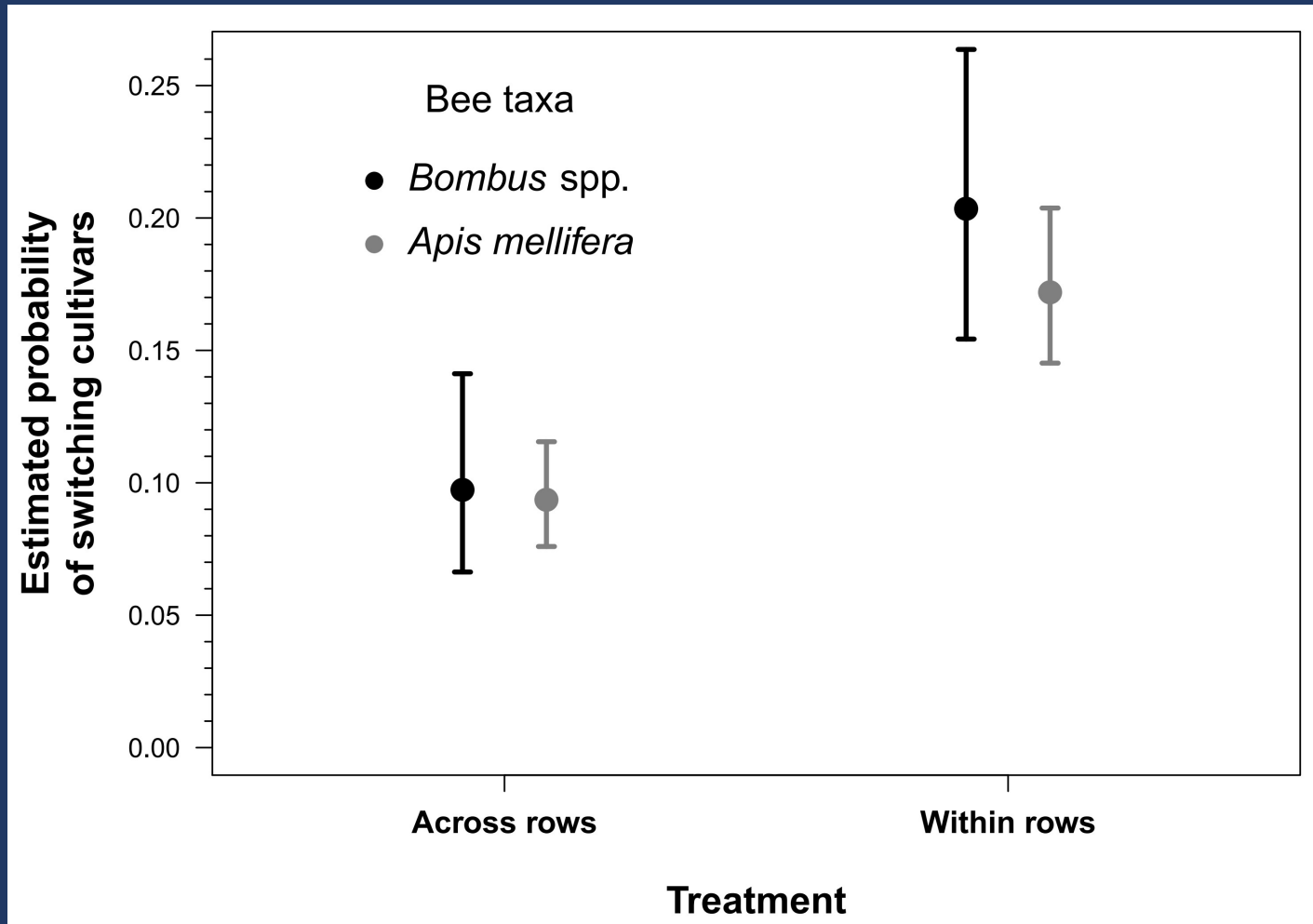
Yield higher by 39% when mixing within rows and by 21% mixing across rows



Yield highest when mixing within rows at high densities



Honey and bumble bees move between cultivars more when mixed within rows



Conclusions

- All cultivars show increased yield (fruit mass) and shorter time to ripen with cross-pollination
- Some cultivars show increased fruit quality (sugar to acid ratio, firmness) with cross-pollination
- Mixing cultivars within rows at high densities is optimal; mixing cultivars across rows beneficial
- Phenology and management should inform mixtures

Next steps

- Pollen movement within fields of varying arrangement
- How far do bees move pollen within fields?
 - Every other row, every 2 rows, every 4 rows
- Guide for optimizing cross-pollination



Honey bee density, placement, and assessment

Honey bee stocking density not a good predictor of bee activity

- Size and health of honey bee colonies is variable
- Honey bees can forage off farm depending on availability of other flowers



How to assess honey bee hive size or quality?



Figure and photo credit: Maxime Eraerts

1. Counting foragers returning to hive
 - Count for 1 min
 - Assess in good weather and full bloom

Small hive



Large hive



How to assess honey bee hive size or quality?



2. Cluster count:

- # of inter-frames covered with bees, to the nearest half, from above and below each hive box
- The spaces located at the two margins of the hive = $\frac{1}{2}$ inter-frame each
- From below is less sensitive to weather

How to assess honey bee hive size or quality?

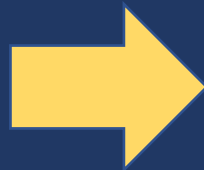


7 inter-frames covered with bees
from above the box



2 inter-frames covered with bees
from above the box

How to assess honey bee hive size or quality?



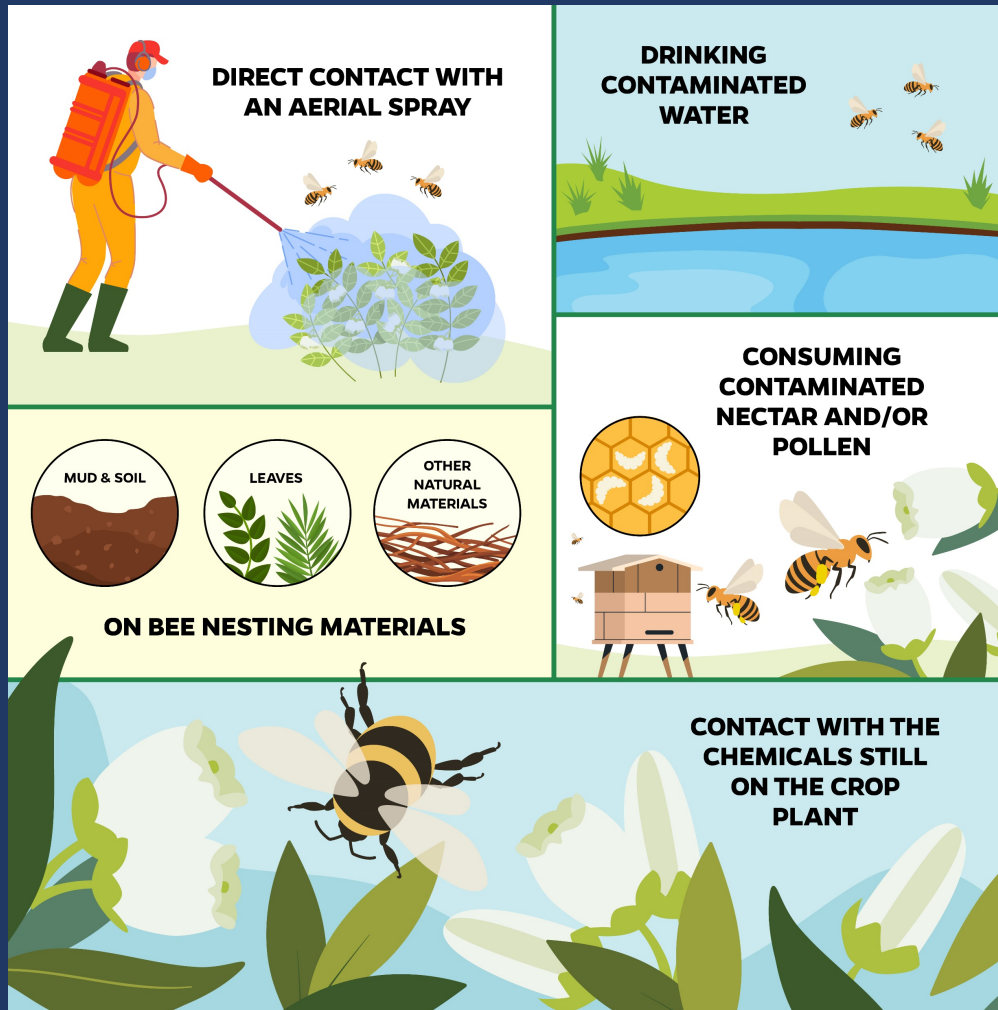
9 inter-frames covered with bees
from below the box

- White: 8 inter-frames fully covered
- Blue: 2 inter-frames fully covered at the two margins of the hive = $2 * \frac{1}{2} = 1$ inter-frame

Does honey bee placement matter?



Protecting bees during pollination



Protecting bees during pollination

A Guide to Selecting and Using Pesticides During the Blueberry Pollination Period: How Can We Reduce Risk to Pollinators?

<https://edis.ifas.ufl.edu/>

Chemical	General toxicity rating (high, moderate, low, practically non-toxic)	LC/LD 50 to honey bees (ug/bee)	Mode of action	Systemic/non-systemic	Residual activity (can be highly variable across studies)	Notes on use/special considerations
Azoxystrobin (ex. Abound): Source: US EPA 1997	Practically non-toxic	> 200 contact	Strobilurin, inhibition of electron transport	Systemic	Moderately persistent in soil; 5–12 day half-life on plants (Gajbhiye et al. 2011)	Number of hoverfly larvae produced was significantly and adversely affected at 0.22 lb/acre

Protecting bees during pollination

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Acetamiprid (ex. Assail): Source: US EPA 2002; Lewis et al. 2016	Moderate to low toxicity depending on exposure	8.09 contact and 15.43 oral	Neonicotinoid; nicotinic acetylcholine receptor (nAChR) competitive modulator	Systemic	Degrades rapidly in soil; relatively non-persistent in terrestrial environments	Moderate to low toxicity for bumble bees and mason bees (1.72 to >100 ug/bee)
Malathion Source: Lewis et al. 2016	Highly toxic	0.16 contact and 0.40 oral	Organophosphate insecticide; acetylcholinesterase inhibitor; contact, stomach, and respiratory action IRAC group 1B	Non-systemic	Non-persistent in soil; relatively short dissipation rate on plants	Highly toxic via contact exposure to other native bees

Questions?

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