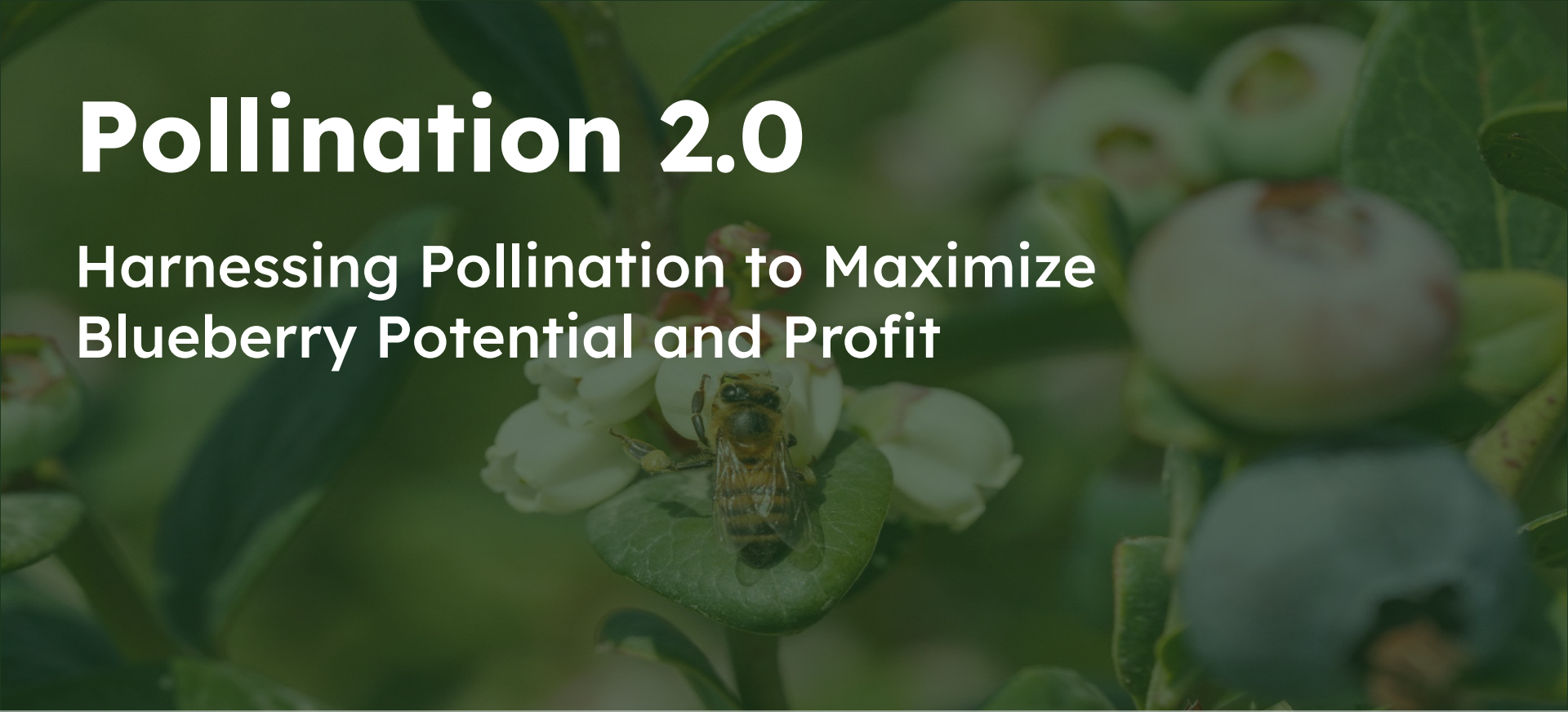
Pollination 2.0

Harnessing Pollination to Maximize Blueberry Potential and Profit



Beeflow

IBO Summit SOUTH AFRICA 2025

Matias Viel - Founder & CEO at Beeflow

- From Buenos Aires, Argentina
- Based in Los Angeles, California, USA since 2018
- Founded Beeflow 9 years ago (2016) with a **mission to put bees and pollination in the center of agriculture**
- +15 blueberry pollination seasons, many learnings and still many more things to learn!

Let's talk!

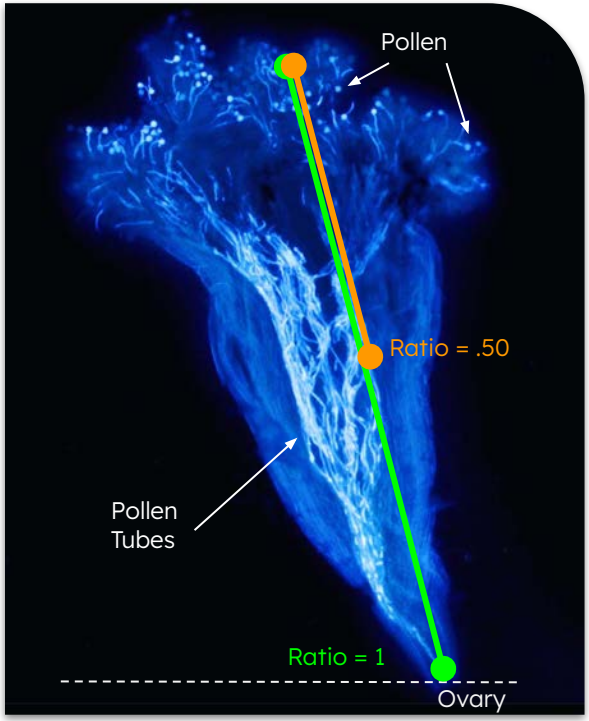
Agenda

1. **Rethinking Pollination: Insights and Challenges**
2. **From Research to Practice: Applying Knowledge in the Field**
3. **Measuring the Economic Impact of Pollination**

DESPITE BEING ONE OF THE MOST IMPORTANTS ASPECTS OF PLANT BIOLOGY,

Pollination Innovation has been neglected in Agriculture

Confidential & Proprietary – © Beeflow 2025 – Do Not Distribute



Microscope image of In-vivo pollen

Pollination happens **inside flowers' ovary**

- Agriculture has optimized most plant-science topics, **except pollination**
- Bees turn flowers into fruits for 70% of crops globally ($15bn); **but growers do it informally**
- Bees decline and climate stress impact pollination performance, developing a **major risk to crop yields**
- *"Pollination is where irrigation was 20 years ago. There is an urgent need to develop Pollination 2.0 in Agriculture"* ***- top 3 largest blueberry grower globally***

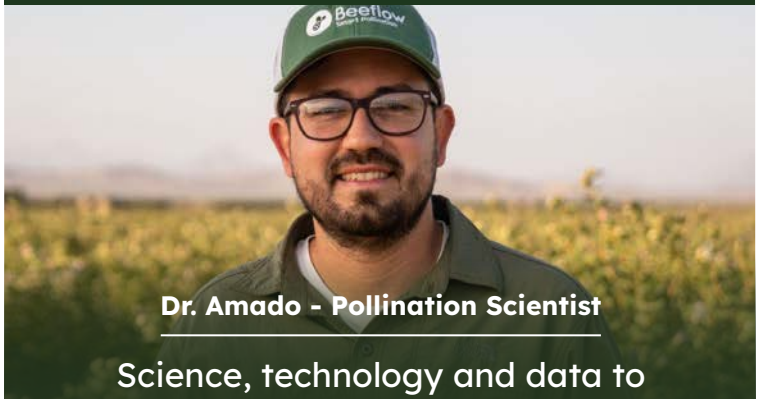
Confidential & Proprietary – © Beeflow 2025 – Do Not Distribute

Developing a **new paradigm of crop pollination**

Pollination **1.0**

Renting beehives …
then hoping for the best.

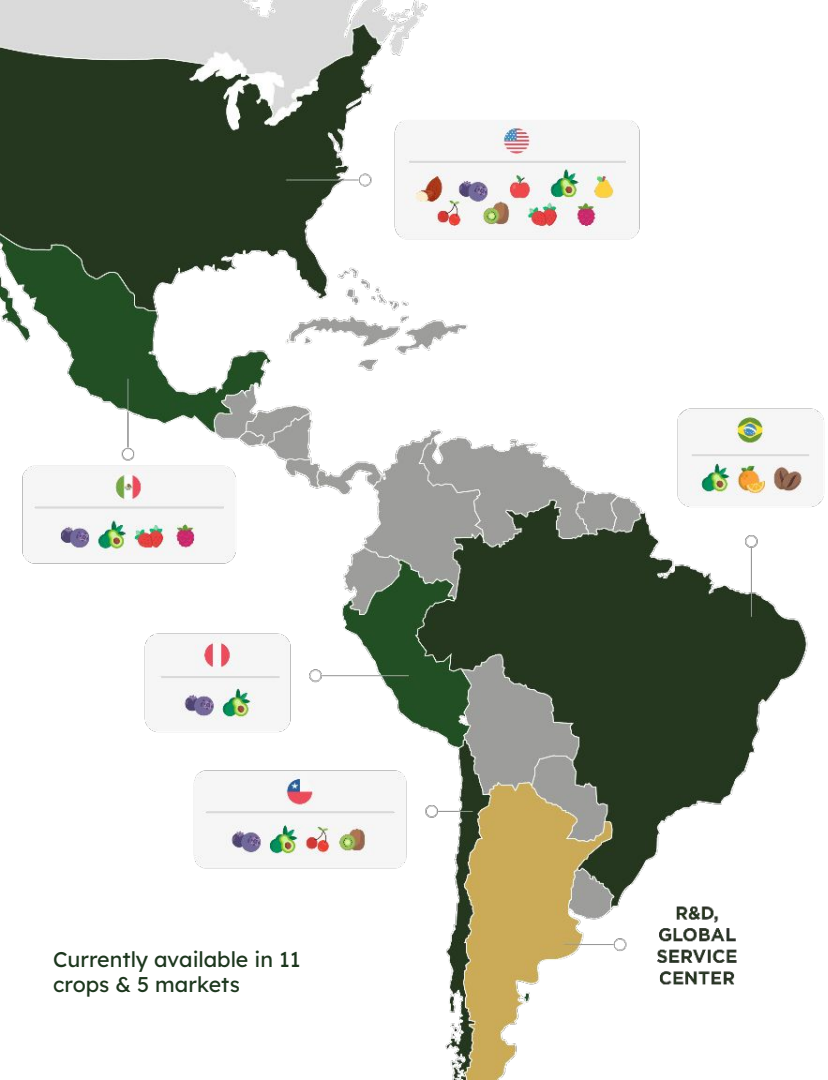
Pollination **2.0**



Dr. Amado - Pollination Scientist

Science, technology and data to **manage and maximize** the pollination variable that impact crop productivity

Confidential & Proprietary – © Beeflow 2025 – Do Not Distribute



Currently available in 11 crops & 5 markets

Beeflow: World's 1st Pollination Science Company

- **Headquarters** in Somis, California, USA
- **+15 Blueberry pollination seasons**
- Manage pollination for growers on **+60 blueberry varieties** (high, mid, low chill) in 4 countries
- **Proprietary** pollination technologies - MaxPoll™ & ToBEE™ that solve pollination challenges.
- Reduced bee mortality from 40 to <5%
- **World-class team of Pollination Scientists**
- Soon in **Europe/Africa (2026)** and **Asia (2027)**

Pollination impacts profitability

Efficient pollination throughout the blooming season **improves the consistency of fruit quality** throughout the harvest.

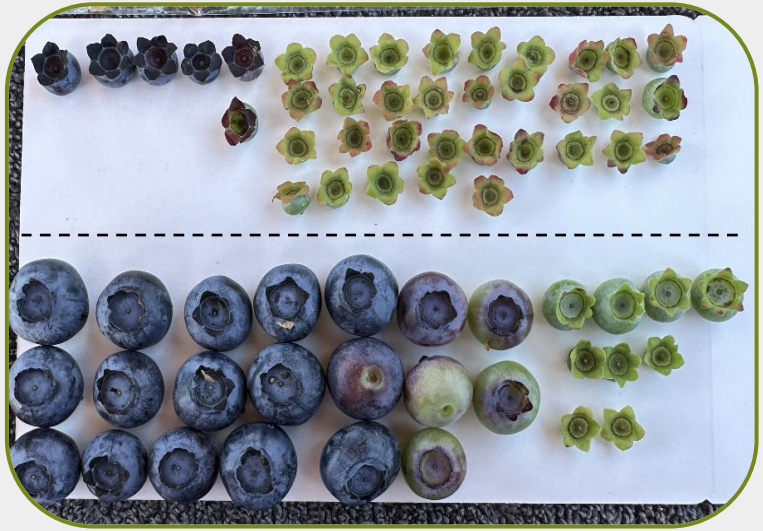


Image. Impact of pollination in fruit quality. Duke variety: fruits harvested from isolated plants during the blooming season (no insect pollination) and from open pollination plants. PNW 2023.

Confidential & Proprietary – © Beeflow 2025 – Do Not Distribute

Pollination 2.0 is already happening within +30 innovative growers

Some of the largest blueberry growers in the world are starting to think about pollination in a new way. These are some of the companies already working with Beeflow:

unifrutti, HORTIFRUT, ALPINE FRESH, Mission, Driscoll's Only the Finest Berries, FALL CREEK, beta complejo agroindustrial, SILVER VALLEY FARMS, NORTH BAY PRODUCE, Prize SUPERFRUITS, acp AGRÍCOLA CERRO PRIETO, AGROVISION, AC Foods, OREGON BERRY PACKING, INC., GRUPO GLORIA, LARAMA BERRIES, SAKUMA BROS., REITER AFFILIATED COMPANIES

YIELD INCREASE BY **10-40%**

Welcome to Pollination 2.0

Science, technology and data to maximize crop productivity with better pollination

Blueberry Pollination and genetics

Plant–pollinator interactions are shaped by multiple parameters that influence attraction, recognition, and pollination efficiency.

Visual
Flower color, shape, symmetry and size.
Visual patterns (e.g., nectar guides).
Contrast against the background foliage.

Chemical
Floral volatile compounds (scent).
Nectar and pollen content (sugar, amino acids).
Species-specific chemical cues.

Physical
Flower structure and accessibility.
Texture and temperature of floral parts.
Landing platforms or mechanical barriers,

Behavioral
Pollinator foraging patterns and preferences.
Learning and memory.
Floral constancy and handling behavior.

Confidential & Proprietary – © Beeflow 2025 – Do Not Distribute

Blueberry Pollination and genetics

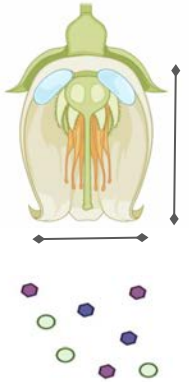
Within a particular crop, varieties can have different floral morphologies, volatile compositions, and nectar rewards among other traits. Understanding the differences and similarities between varieties is critical in order to build a comprehensive and effective pollination management strategy.

Flower Morphology/Accessibility

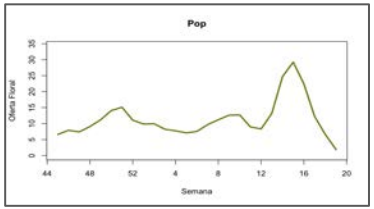
Bloom curves

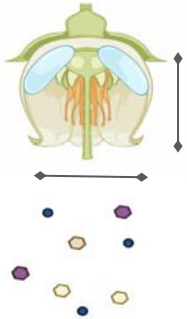
Floral volatiles profile

Nectar/Pollen Reward

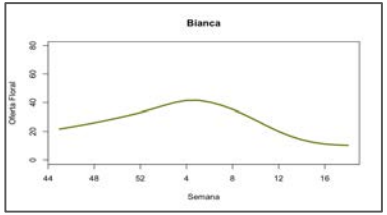


Var. Pop

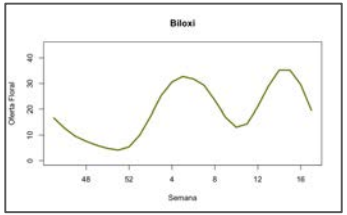




Var. Bianca



Var. Biloxi



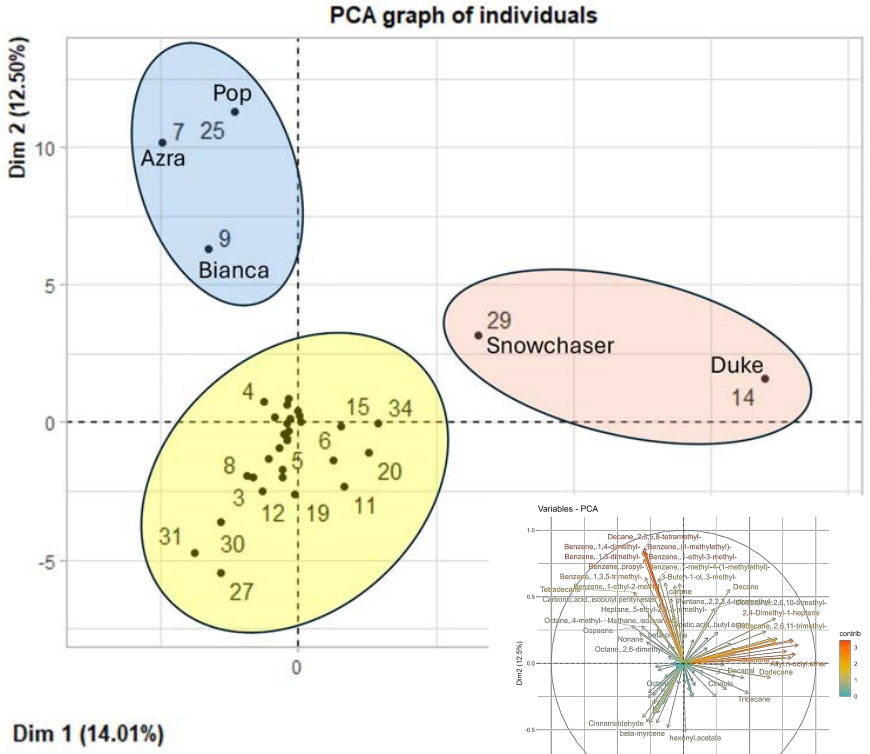
Confidential & Proprietary – © Beeflow 2025 – Do Not Distribute

Flowers' chemistry impacts productivity

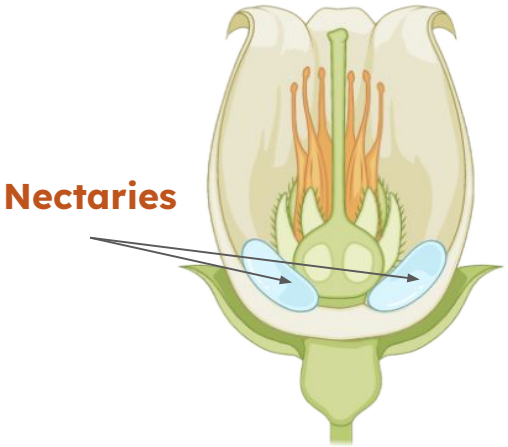
Beeflow has built the largest proprietary blueberry floral scent library globally.

One of the first **cues of attraction** for bees towards blueberry flowers are the **volatiles** they **emit.**

We intend to understand the different profile and **tailor our technology** for the different groups of varieties

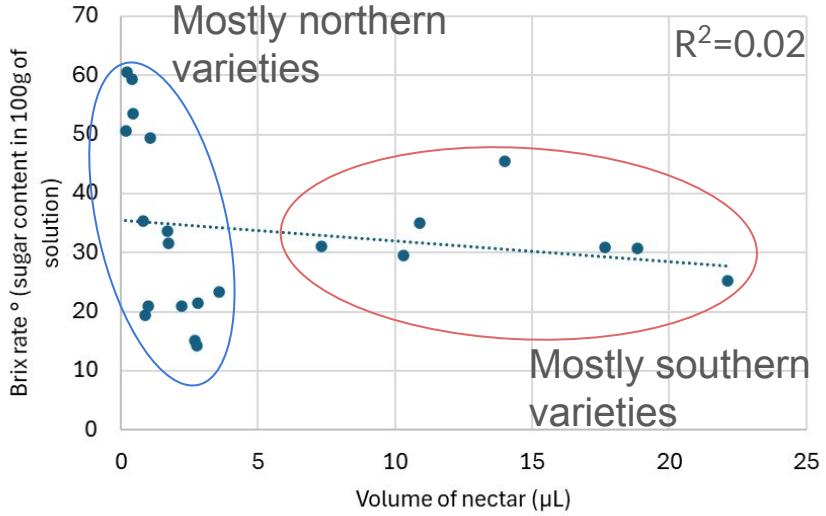


Flowers' resources and quality



Beeflow has been collecting nectar data globally

Another **cue of attraction** for bees towards blueberry flowers is **resource quality** (nectar).



By understanding the **pattern of nectar production and sugar content** of different varieties we can **adjust decisions about hive stocking rates** and generate valuable information for yield projections.

Confidential & Proprietary – © Beeflow 2025 – Do Not Distribute

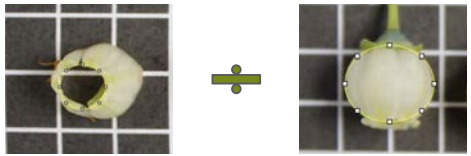
USA

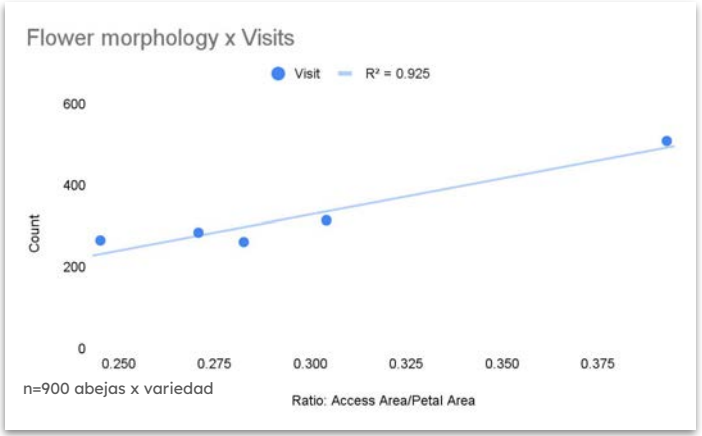
Pollination Challenges & Key Learnings

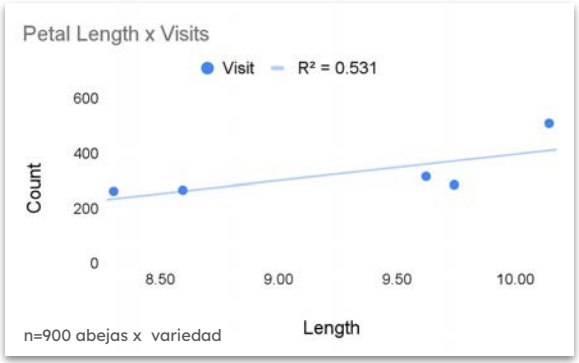
© 2025 Beeflow | Smart Pollination | www.beeflow.com | Confidential, for internal purposes only, not for distribution

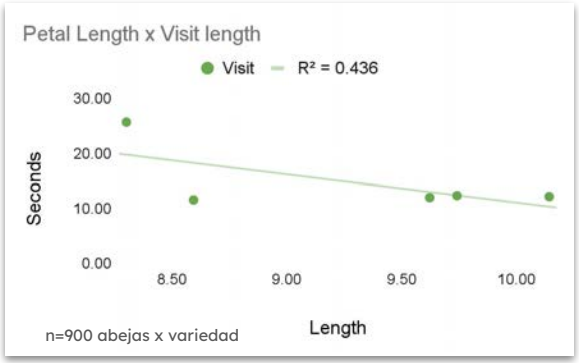
Morphology and bee behaviour

The ratio between corolla and flower size (area) is **highly predictive** of visitation success for a given variety (R^2=0.93).









Varieties with the longest petals received more visits, but those visits were shorter.

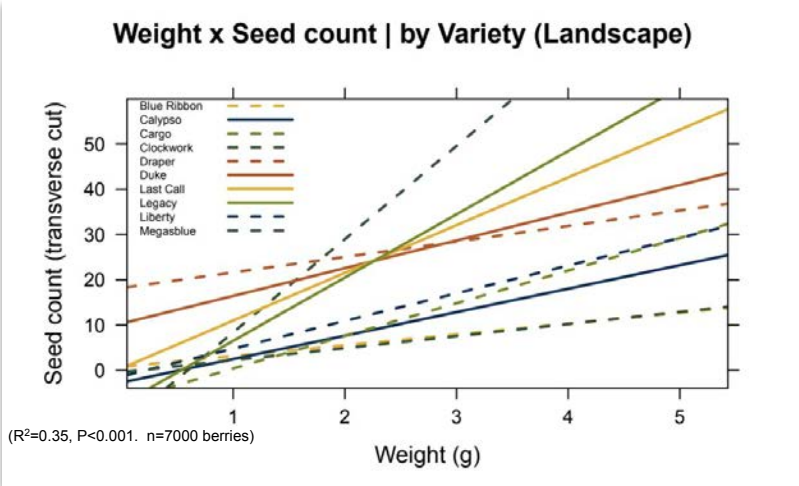
Variety	Petal (mm)
Duke	10.14
Legacy	9.74
Draper	9.62
Liberty	8.59
Calypso	8.30

**Data from 1 year 21 field sites in Oregon, USA*

Pollination sensitivity by variety

- Overall **positive relationship between berry weight and seed count.**
- Important differences between varieties: **3 distinct pollination dependency groupings***
- This information may help guide pollination management decisions for these varieties in the future.

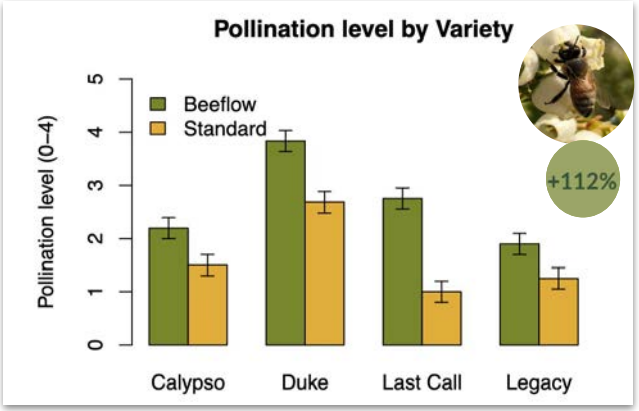
*Data from 1 year 21 field sites in Oregon, USA

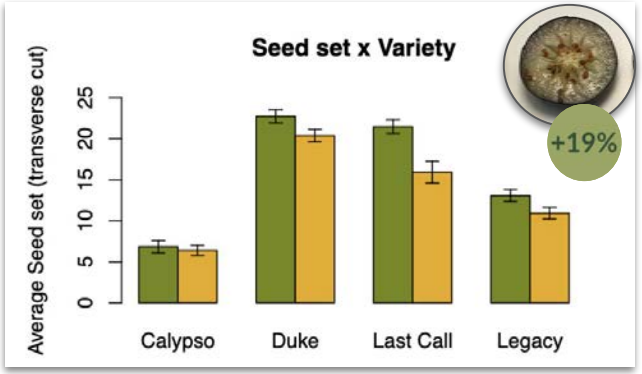


Group	Varieties	Pollination Dependency Level
1	Clockwork, Last call*, Legacy*	High
2	Cargo, Duke*,Liberty	Medium
3	Draper*, Calypso*, Blue Ribbon, Megasblue	Low

*Varieties that were also part of the paired comparison trial with similar results.
*Groupings are not all inclusive and only consider varieties included in our study. More research is needed to capture this information for the full suite of varieties available to blueberry growers.

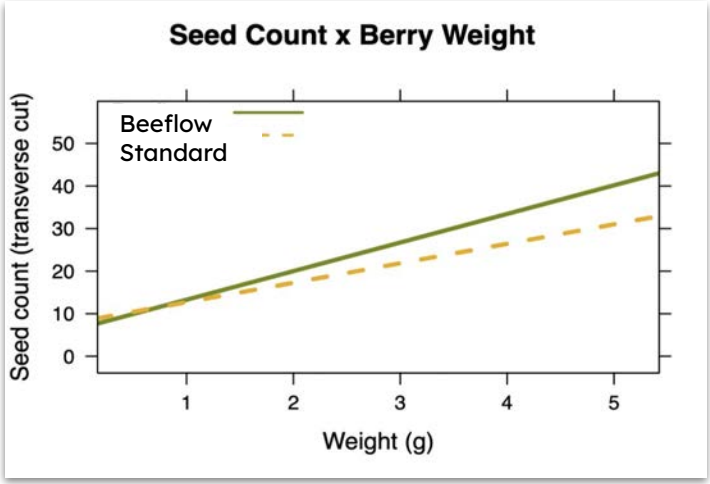
Seed set and berry weight





**Third-party validation of Beeflow results available upon request*

- **Pollination levels were 112% higher in Beeflow pollinated fields** compared to grower standard fields (n=21 field sites)
- **Beeflow pollinated berries had +19% more seeds** on average compared to grower standard.



We found a 38% stronger relationship between seed count and berry weight for Beeflow pollinated berries, compared to grower standard.

México

Pollination Challenges & Key Learnings

© 2025 Beeflow | Smart Pollination | www.beeflow.com | Confidential, for internal purposes only, not for distribution

Challenges pollinating under tunnels

Beehives placed alongside the blueberry block which is covered with black plastic along the bottom and white plastic along the top. In addition, bird netting (arrow) closes off any access points between the plastics and roadway entrances.

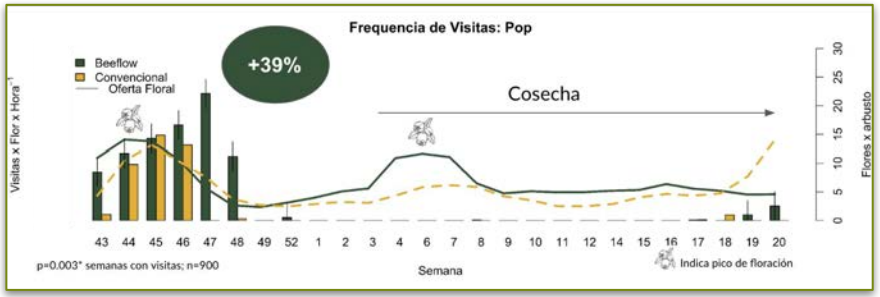
Honey bees in these conditions will have trouble accessing the crop for pollination.

Tunnel edges where the plastic overhangs the tunnel roof (arrow) are a common place for bees to get trapped and die. Sometimes in addition to the overhang, mesh is added and tucked back which further compounds the issue.

Honey bee colony populations will decline over time if not addressed either by removing the plastic/mesh from the edge or by replacing hives when quality declines.

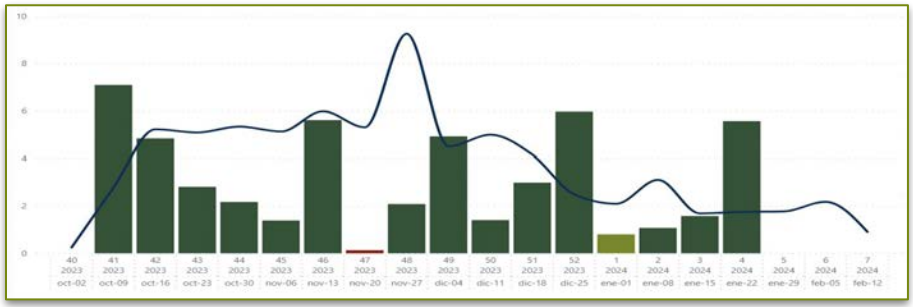
Pollination and Pest Management

2022-23 Season

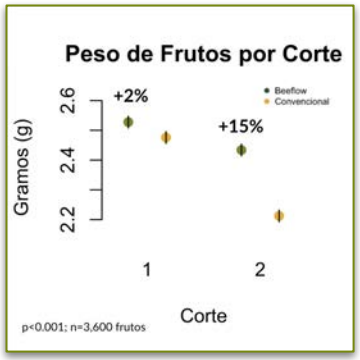


Visitation frequency was impacted by use of repellents (pest management)

2023-24 Season



Improved Pollination and Pest Management led to larger berries



Fruit weight per harvest period

2022/23:
9% more visits *Beeflow vs.* control.
Higher fruit weight vs. control.

2023/24:
Consistency on flower visitation frequency
Higher fruit weight compared to 2022 season (3.1 gr vs. 2.5 gr.)

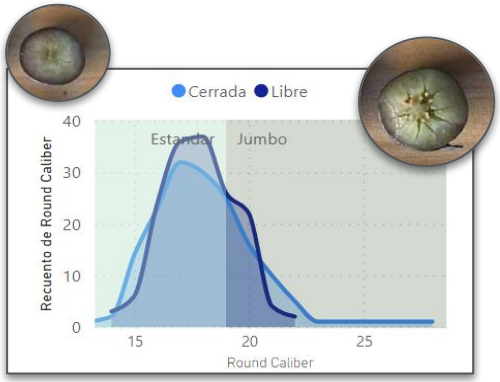


Image. Fruit caliber distribution Harvest between open and excluded flowers: 4 weeks

Beeflow's average blueberry weight
3.1 grams

Perú

Pollination Challenges & Key Learnings

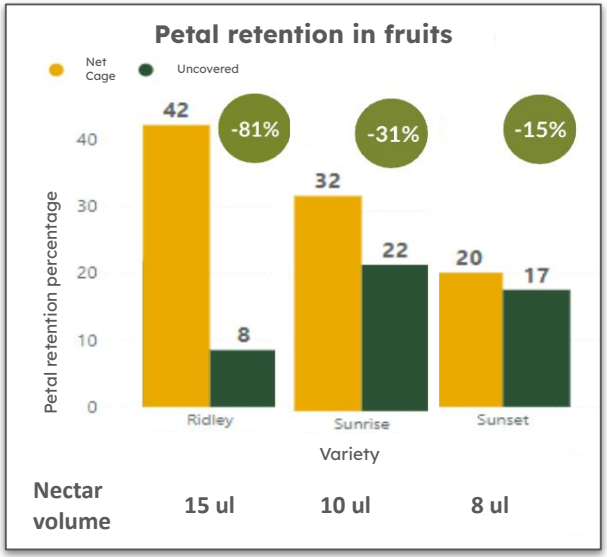
© 2025 Beeflow | Smart Pollination | www.beeflow.com | Confidential, for internal purposes only, not for distribution

Petal Retention issues

“We have two harvests, one for fruit and the other for petals”
Less petal retention makes harvest more efficient

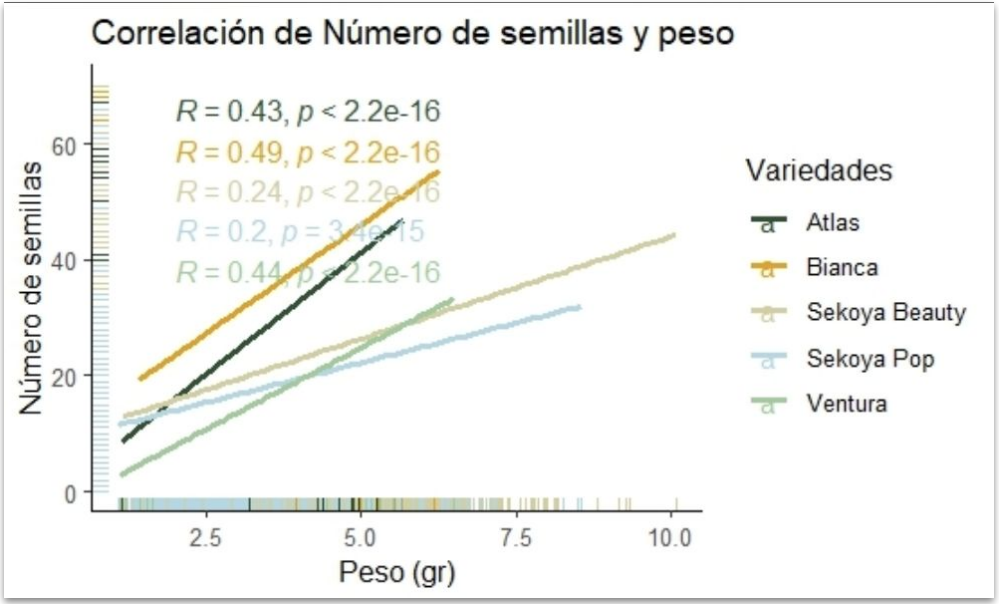
Beeflow Pollination helped reduce petal retention by between -15% and -80%, depending on the variety.

- Petal retention is greatly reduced in Ridley followed by Sunrise with Sunset being the least impacted.
- Nectar production in each variety is has a positive relationship with petal retention in the absence of pollination (yellow bars)
- Suggests that more nectar removal via pollination can effectively reduce petal retention, particularly in high nectar producing varieties.



Confidential & Proprietary – © Beeflow 2025 – Do Not Distribute

Pollination sensitivity by variety



**Field specific data (n=1). Individual results may vary*

Low chill varieties grown in Peru show an overall positive relationship between berry weight and seed count.

In this case, **Atlas, Bianca, and Ventura had similar, higher dependencies** on pollination (average r^2 of 0.45).

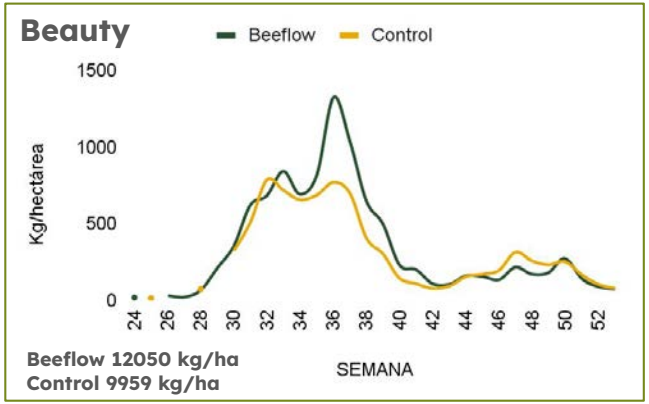
Sekoya Beauty and Sekoya Pop were less dependant on pollination (average r^2 of 0.23).

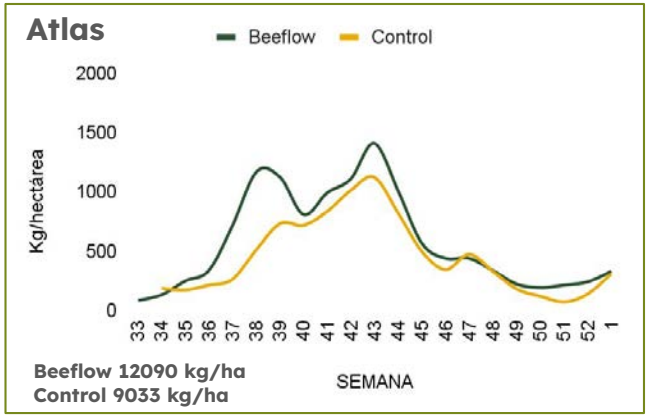
Confidential & Proprietary – © Beeflow 2025 – Do Not Distribute

Pollination & Yields

We compared Beeflow pollinated plots to those pollinated via grower standard methods for 4 varieties over two years in Peru:

- Varieties: Atlas, Beauty, Pop, Ventura
- Visitation Frequency was consistently rated “Excellent” in all Beeflow plots and with less variation compared to grower standard plots.
- Consistent pollination management during this trial led to an average **14.5% higher yields** over 2 seasons.





Figures. Weekly yields (data provided by grower) for Beeflow and control plots for Atlas variety. This is one of four varieties we worked with between 2022-2023 with this client.

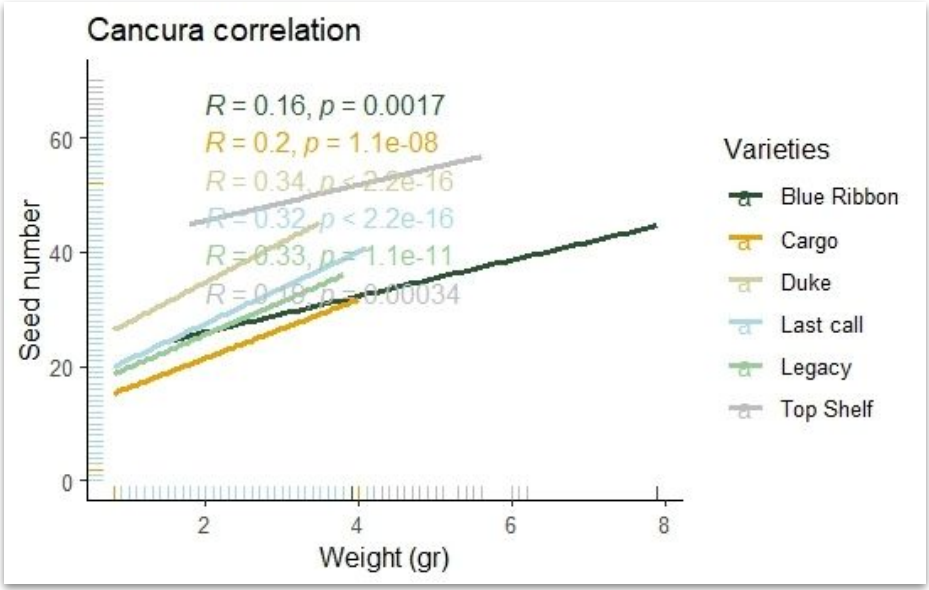
Confidential & Proprietary – © Beeflow 2025 – Do Not Distribute

Chile

Pollination Challenges & Key Learnings

© 2025 Beeflow | Smart Pollination | www.beeflow.com | Confidential, for internal purposes only, not for distribution

Pollination sensitivity by variety



We notice **a positive relationship between berry weight and seed count in all varieties.**

In this field, **Last Call, Legacy, and Duke** showed the highest sensitivity to pollination (average r^2 of 0.33). **Top Shelf and Blue Ribbon** (r^2 = 0.18) were the least sensitive to pollination.

This information helps us **refine our pollination management strategy** for upcoming seasons.

**Field specific data (n=1). Individual results may vary*

Confidential & Proprietary – © Beeflow 2025 – Do Not Distribute

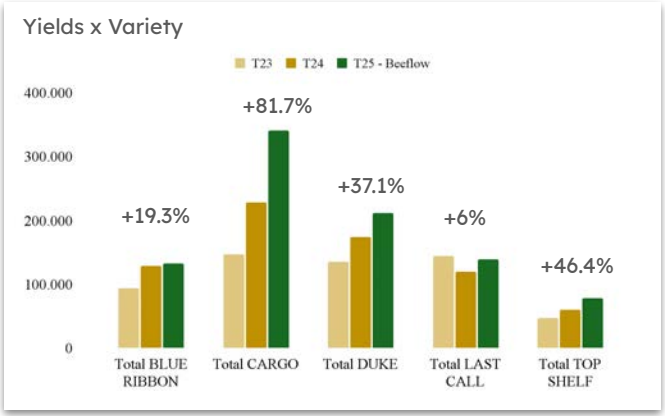
Poor fruit-set can be overcomed

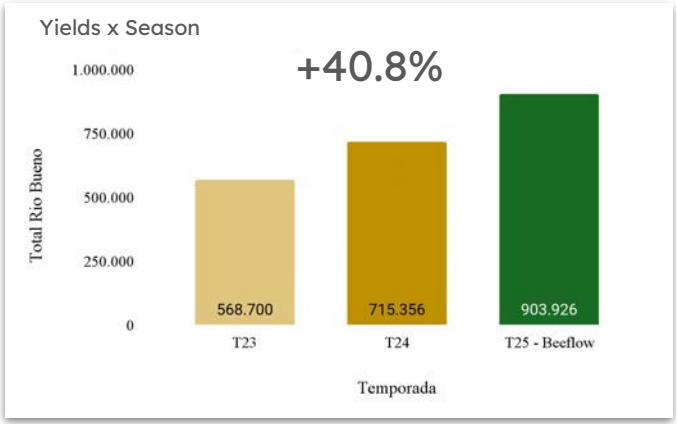
During the 2024-2025 season, we observed **impressive results in blueberry fruit set**, with values above 80% in all cases.

Variety	Ha	Initial fruit set	Pollination level
Cargo	33,42	86,60%	**Excellent**
Blue Ribbon	16,22	80,68%	**Excellent**
Duke	23,91	86,92%	**Excellent**
Top Shelf	19,25	83,35%	**Excellent**
Crunch	0,8	82,14%	**Excellent**
Last Call	19,57	92,39%	**Excellent**
Legacy	5	91,10%	**Excellent**

Confidential & Proprietary – © Beeflow 2025 – Do Not Distribute

Pollination impacts crop profitability





In Osorno, Chile avg. temperature during bloom was <10 C. **With Beeflow Pollination Program and technologies crop yields increased by 40.8%** this season compared to the average of the last two seasons (yellow bars). And by 26% compared to 2024.

Final Thoughts

Pollination Challenges & Key Learnings

© 2025 Beeflow | Smart Pollination | www.beeflow.com | Confidential, for internal purposes only, not for distribution

Pollination 2.0: Key Takeaways

- **Pollination is a critical aspect of blueberry production.**
- **Blueberry varieties can have distinct floral scents**, nectar content, and flower shapes which impact how attractive they are to honey bees.
- **Pollination sensitivity, or the relation between seed set and berry size differs across blueberry varieties.** This provides an opportunity to refine pollination management.
- **Pollination challenges are manageable** by building a Pollination Program that includes technologies to solve challenges and scientific knowledge.
- **Successful pollination management can help reduce harvest costs**, disease (botrytis) and petal retention via nectar removal.
- **Plastic tunnels can severely limit pollination** via light obstruction, high temperatures, and colony stress. Pollination management is required

Confidential & Proprietary – © Beeflow 2025 – Do Not Distribute

Thank you!

Harnessing Pollination to Maximize Blueberry Potential and Profit

Let’s talk!