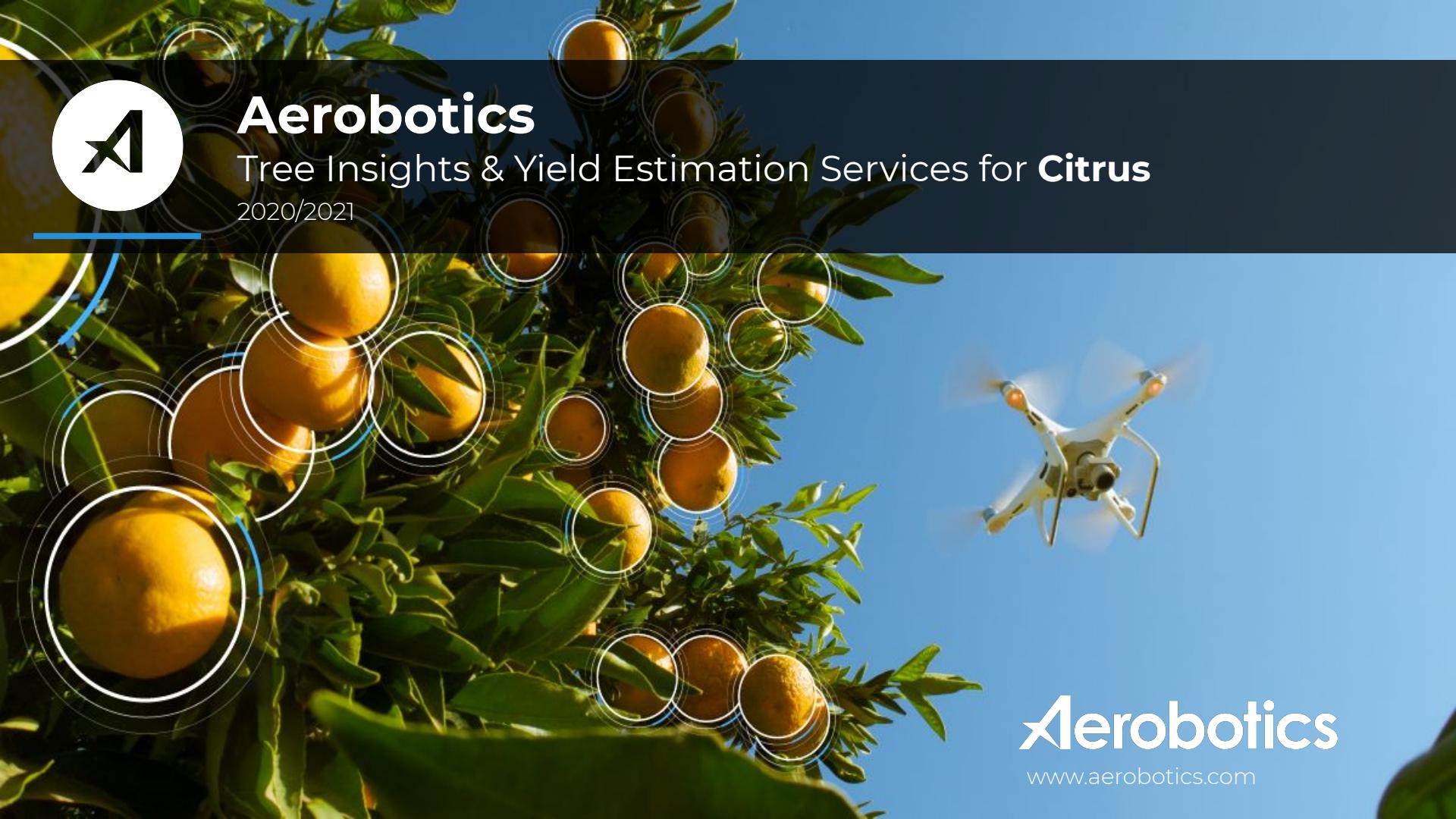




Aerobotics

Tree Insights & Yield Estimation Services for **Citrus**

2020/2021



Aerobotics
www.aerobotics.com

Data Volumes & Geographies

Aerobotics is an agriculture technology company, focussed on citrus, fruit and nuts. We collect high resolution imagery at large scale, then use Artificial Intelligence to extract tree counts, sizes, health, and count fruit. Driven by our customers' needs, we have developed a yield estimation product for citrus, which has been well received from some of the top citrus producers in the world.

- 170 000 Acres of Citrus Flown & Processed worldwide
- More than 200 Growers, Packers & Marketers
- 38 Million Citrus Trees Scanned
- More than 1 000 000 Fruit Detected
- Operational in 18 countries
- More than 18 Citrus Varietal data collected

"Aerobotics has become an incredibly important tool for us for both tree management & yield estimations. The tree stats are accurate and insightful and their new Citrus Yield Estimation service has proven very accurate, particularly around fruit sizing. I'd recommend them any day of the week!"

- Kobus van Staaden | Director for Soleil Citrus Group, South Africa



Common Industry Challenges

Orchard Health and Tree Insights

Fruit size distribution measurements during fruit development

Early season 'fruit size at harvest' estimates

Labor: Efficient use during harvesting

Early season total yield estimation per block / per variety

- 1
- 2
- 3
- 4
- 5

Aerobotics Solutions

Multispectral Imagery

By using our health metric tool, our growers identify lower chlorophyll levels in their trees at an early stage. Lower chlorophyll is usually related to deficiency or stress in the trees. Growers have seen significantly better performing and more homogenous orchard's after they picked up lower health areas and made corrections.

Drone fruit image & AI measurement software

Using state of the art machine learning models & algorithms, our software will collect fruit images and then measure their respective sizes for a representative sample of each orchard and variety. We will then report size distributions for growers & packers to save on current manual collection methods, quicker, with a greater sample and more accurately.

Early & Late Harvest Fruit Size Estimate Tool

Using the fruit images and size distribution data during the collection stage, we use varietal & regional growth curves, harvest dates and tree information to report on fruit size estimates at either an early or a late harvest date.

Fruit Image & Color feature

With the ideal fruit size in mind, we offer a harvest planning report by variety and orchard level. Knowing the perfect harvest date and orchard/varietal order of harvest, growers can save both time and money in terms of labor allocation and correct ripening & size stage picking.

Yield Estimation feature

Although in BETA PHASE for the 2020 season, at no additional cost we will offer our BETA Yield Estimation Tool. Using tree statistics, fruit sizes, historical data and varietal & regional base data, this tool will offer total weight/cartons per block or variety at a particular harvest date.

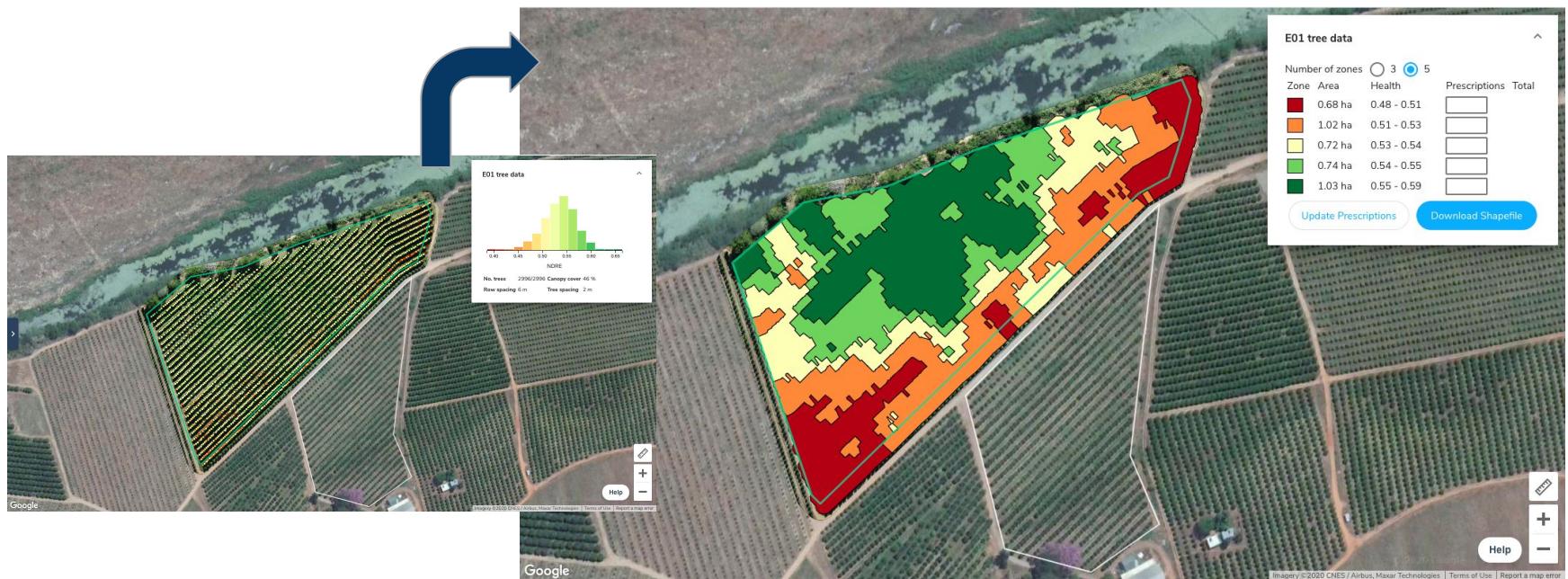
Tree Insights and Orchard Health

- **Monitor Every Tree**
 - Monitor your orchards at scale
 - Per tree metrics offered for: census, health, size and NDVI
 - GPS coordinates per tree



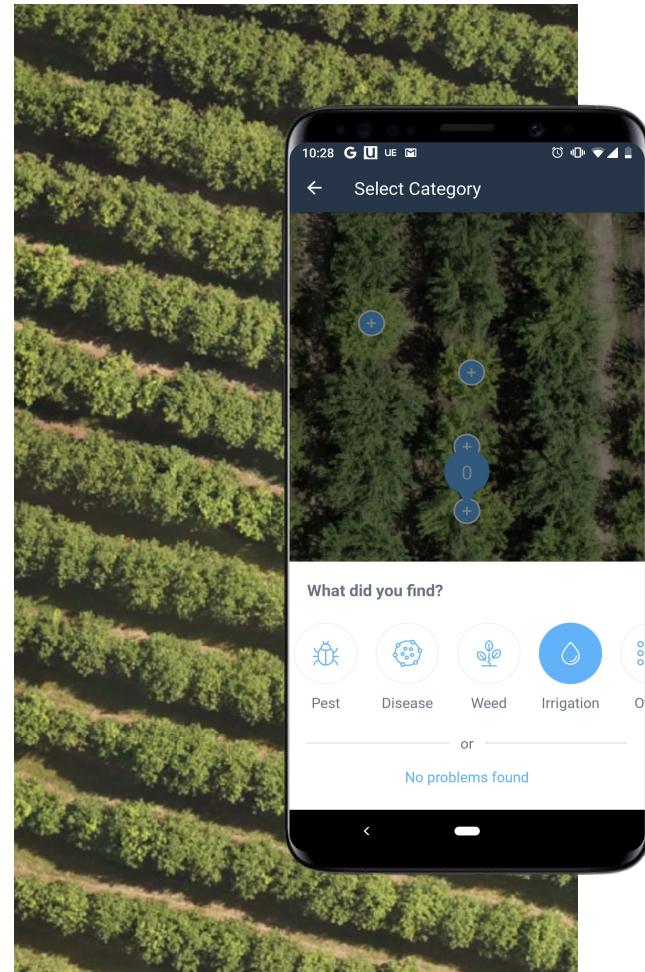
Tree Insights and Orchard Health

- **Farm Management Tool**
 - Zonal Mapping
 - Soil or leaf sample site identification
 - Variable rate application, prescriptions



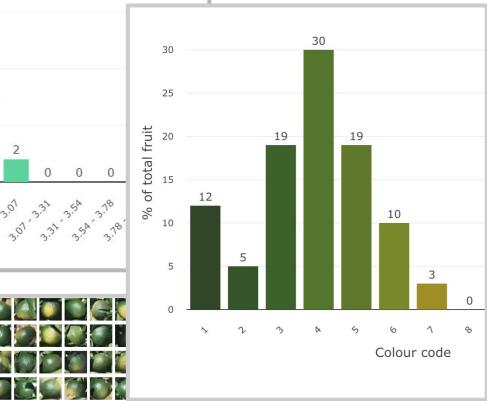
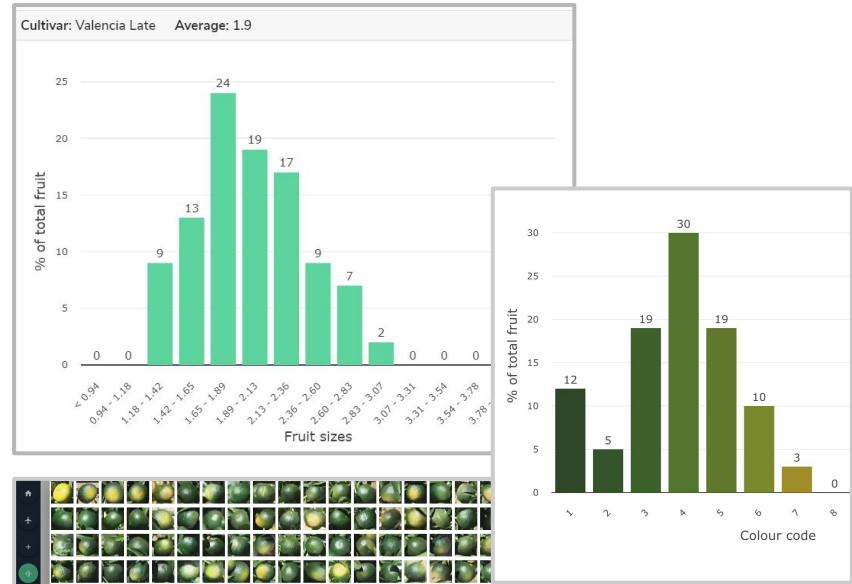
Tree Insights and Orchard Health

- **Orchard Monitoring**
 - In-house mobile scouting application (AeroView In Field)
 - Manage scouts and dedicate scout routes
 - Review information remotely



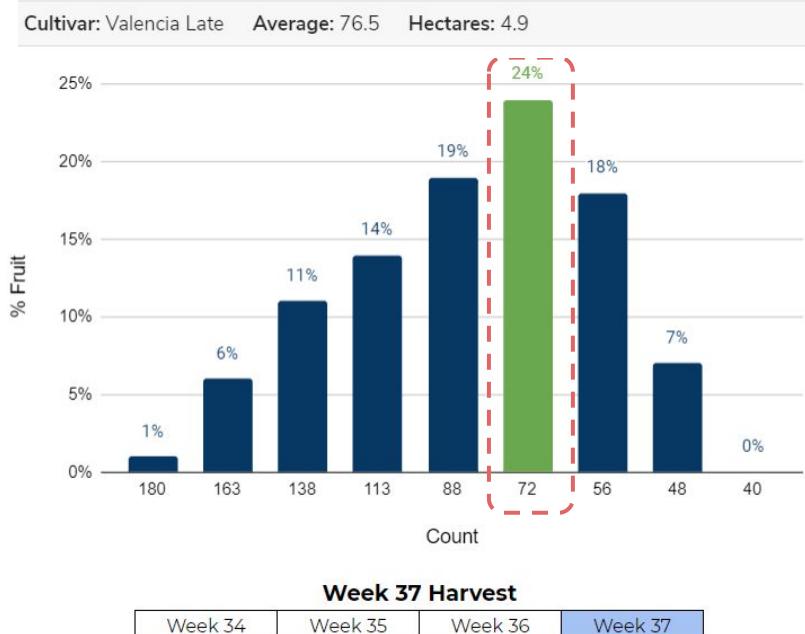
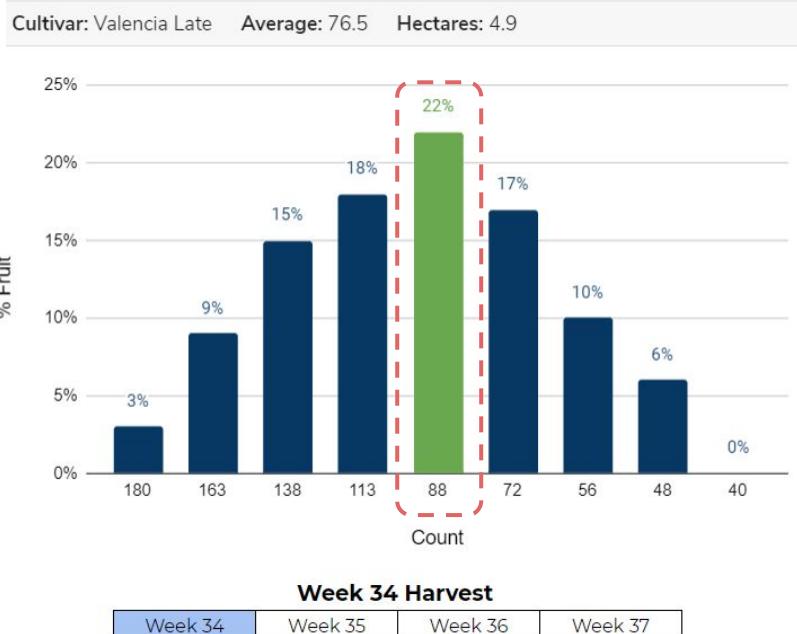
Real Time Data - Flight Reports

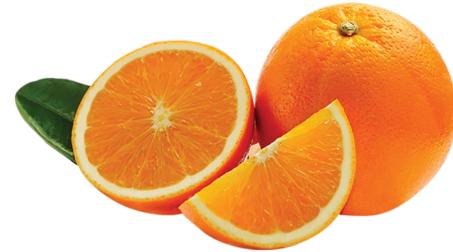
- **Fruit Size Distribution Report**
 - Tailor-Made reports
 - % Fruit per size category (counts / inches)
 - Fruit Peak graphs
- **Fruit Color Graphs**
 - % Fruit per color category
- **Fruit Images & Videos**
 - Sample fruit images
 - Sample tree videos



Early Season Size Estimations

- Early & Late Harvest Fruit Size Estimations**
 - Adjustable harvest dates (below)
 - Customizable size aggregations
 - Millimeter or Count Peak graphs (below)





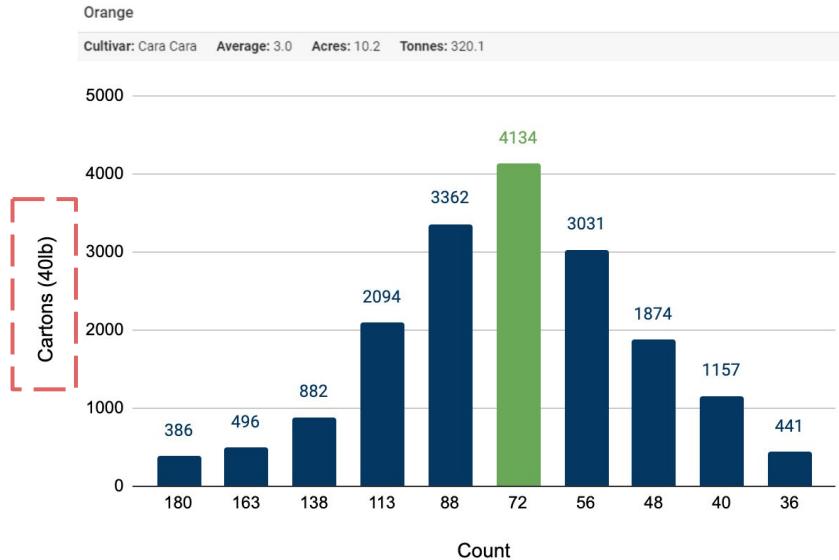
- Orchard Harvest Schedules
 - Varietal level scheduling
 - Suggested orchard level picking ranks

		Orchard	Harvest Dates	Peak Size (Flight 2)	Peak Color (Flight 2)	Pick Order	Peak Size (Flight 3)	Peak Color (Flight 3)	Pick Order
Orange	Navels	1A	41 - 44	72	4	4	88	6	4
Orange	Navels	1B	41 - 44	88	5	1	113	7	1
Orange	Navels	1C	41 - 44	72	4	3	72	7	2
Orange	Navels	1D	41 - 44	138	4	2	138	6	3

Optional extra flight

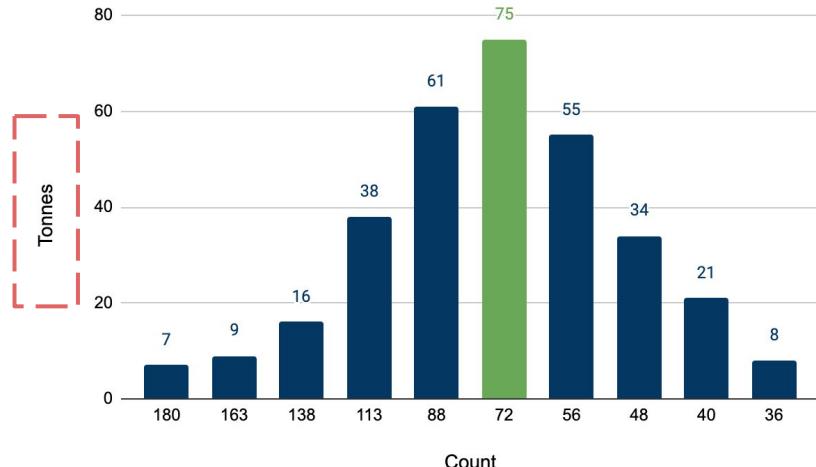
Total Yield Estimation | *BETA

- Early & Late Season Yield Estimation
 - As early as 1 inch fruit size harvest estimates
 - Total yield estimation by;



Week 12 Harvest

Week 10	Week 11	Week 12	Week 13
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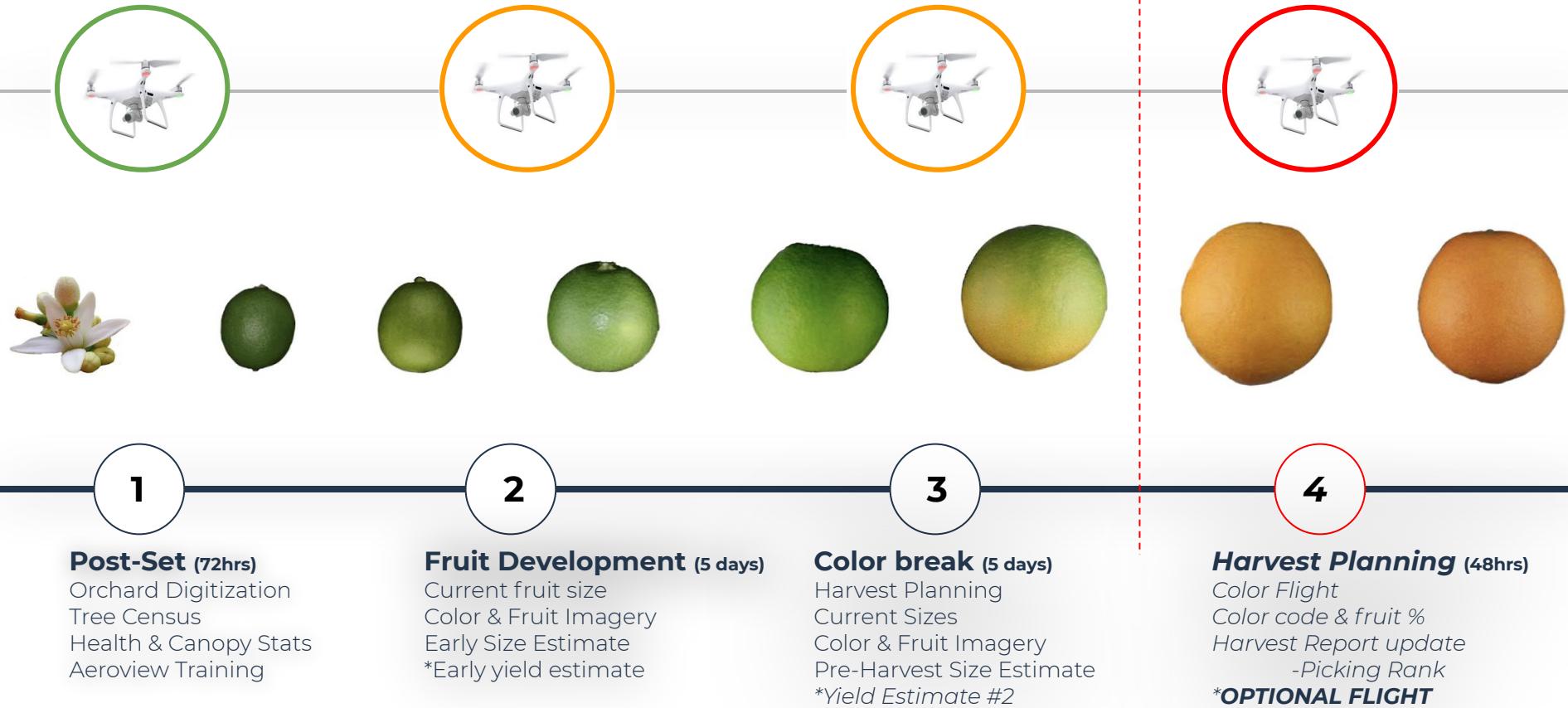


Week 12 Harvest

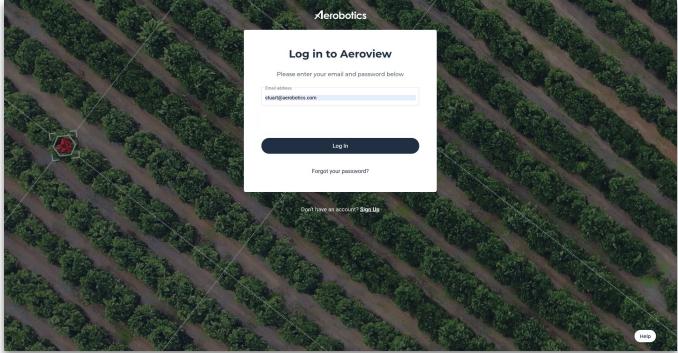
Week 10	Week 11	Week 12	Week 13
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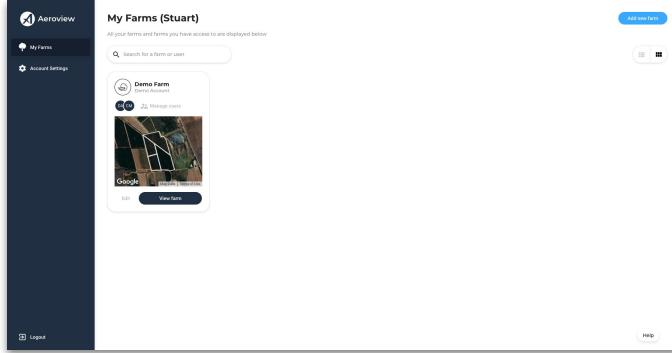
Varietal Delivery Timelines



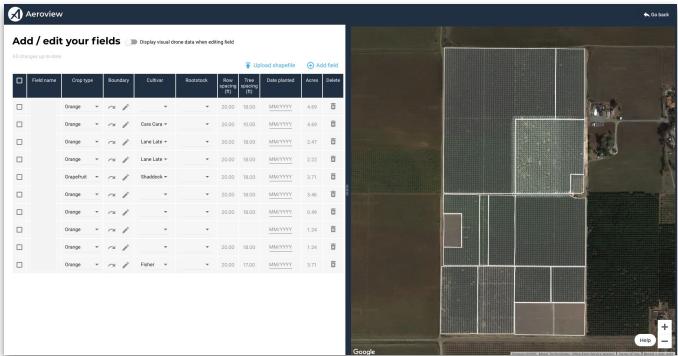
Step 1: Farm Digitization



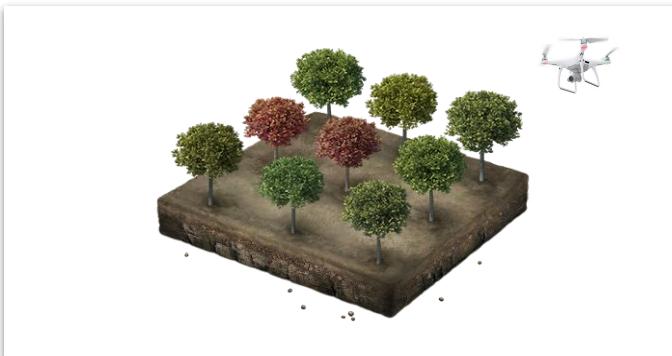
A. Aerobotics helps create Aeroview account



B. Farms are added to the software platform

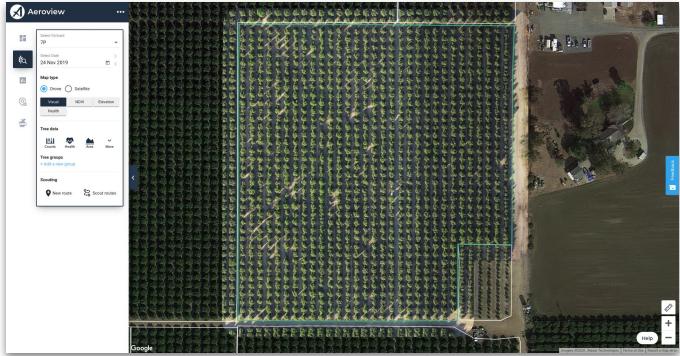


C. Blocks and varieties are set up

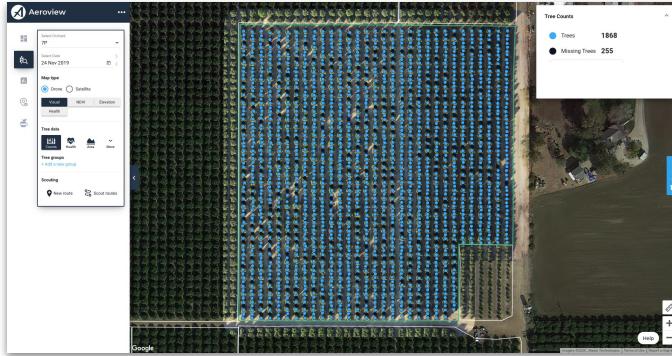


D. Flight schedule is set up

Step 2: Aeroview & Tree Insights



A. Aerobotics obtain sub-mm imagery



B. Tree counts & missing tree insights are generated

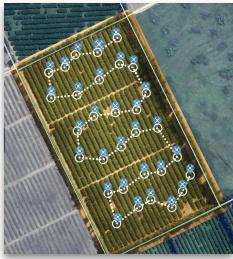


C. Per tree health & size insights



D. Flights for fruit insights are set up

3. Yield Flights



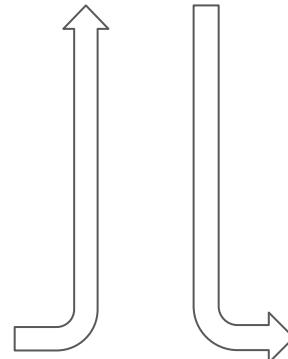
Aerobotics sets up flight paths using Flight #1 data



Flights are allocated to our pilot



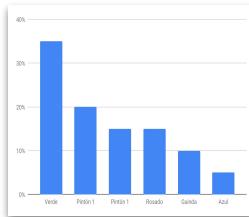
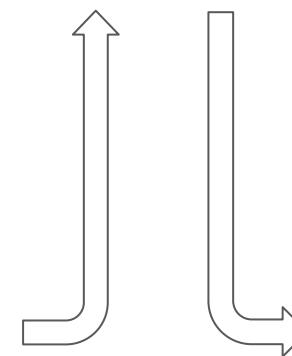
Automated drone operations & flights



Drone captures video for each tree sample



Aerobotics processes imagery with proprietary algorithms

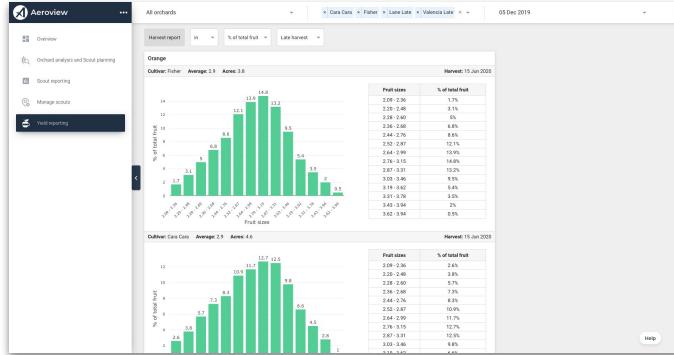


Fruit counts, size, color & yield are generated in Aeroview (ready for export)

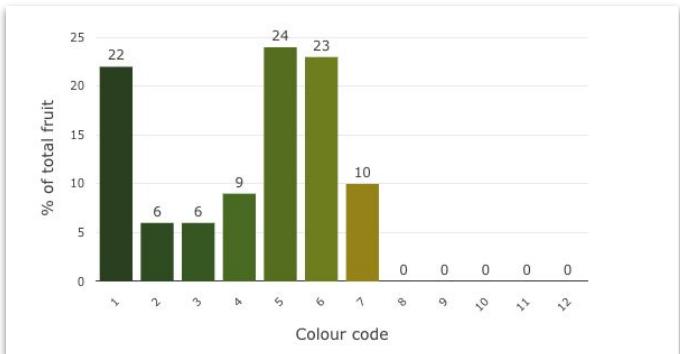
Step 3: Aeroview & Fruit Insights



A. Sub-mm video **imagery** of samples



B. **Fruit counts & size** insights



C. **Fruit color** insights for harvest planning



D. **Fruit images** available in platform

Tech updates since previous season

	Avg size (mm)
Drone Flight (Top)	73.18
Drone Flight (Side)	87.49
Aerobotics In-Field	88.96

Improved sizing using 'side-flights'

Developed 'side-flights' where the drone sampled imagery from the side of the tree rather than the top. This resulted in significantly more fruit detected (up to 4x) and improved results on crops like Grapefruit.



Removing non-fruit objects

We developed a model to identify and remove non-fruit objects such as leaves and rocks (called "Hamlet"). The top image shows the model detecting rocks, and the bottom image after Hamlet has run.



Improved tons/ha estimates

We are including additional data points into our tons/ha models including fruit density, fruit size, size-weight correlations, and tree volume. The models also include historical data and fruit growth models.

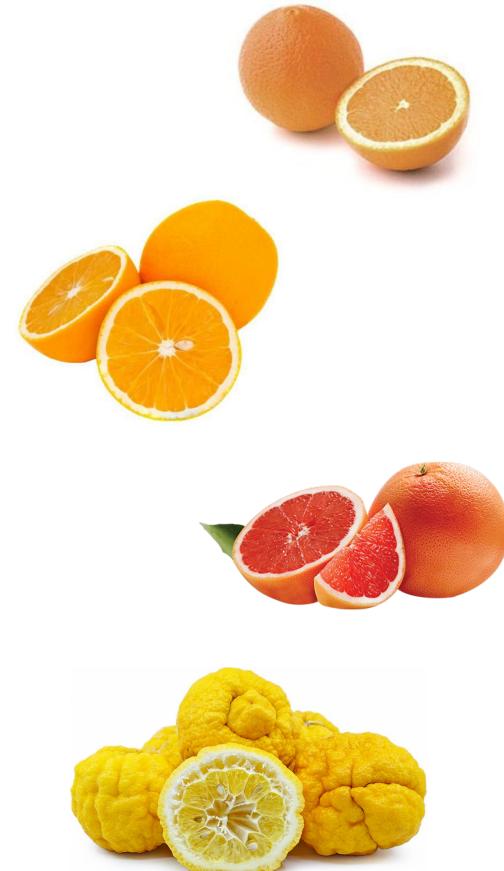
Recent results: Size estimates VS Ground Truths

Region	South Africa	Aerobotics est. (mm)	Ground truth (mm)	Error %
Collection date	Variety			
February 2020	Washington's	60.96	63.25	3.71%
February 2020	Valencia's	60.45	57.40	5.04%
February 2020	Rough Lemons	51.31	55.63	7.76%
February 2020	Star Ruby PUM	87.38	87.63	0.29%

Region	Peru	Aerobotics est. (mm)	Ground truth (mm)	Error %
Collection date	Variety			
March 2020	Orri	44.20	42.36	4.34%
March 2020	W.Murcott	44.40	42.94	3.40%

Region	Peru	Aerobotics est. (mm)	Ground truth (mm)	Error %
Collection date	Variety			
April 2020	Orri	49.00	48.02	2.04%
April 2020	Orri	46.40	43.37	6.99%
April 2020	W. Murcott	43.30	44.76	3.26%
April 2020	W. Murcott	44.30	44.03	0.61%

Region	Uruguay	Aerobotics est. (mm)	Ground truth (mm)	Error %
Collection date	Variety			
February 2020	Clementine	46.82	47.05	0.49%
February 2020	Clementine	44.64	44.85	0.47%



Tree Insights Rates



Combination Package Includes

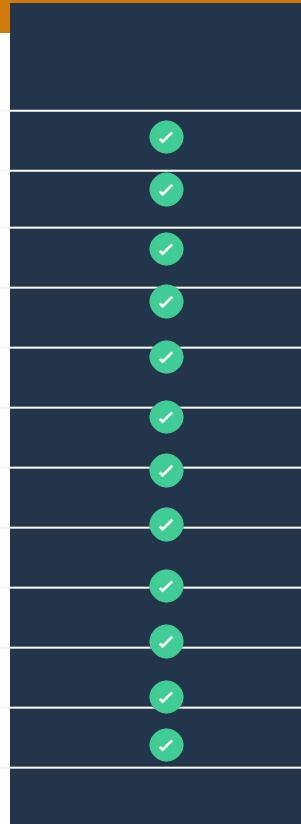
1x Orchard Mapping flight

- Tree counts & missing trees
 - Per-tree health, area, volume
 - Orchard Overview & Exports
 - Zonal Maps
 - Satellite Imagery

Mobile scouting app

- GPS-referenced data
 - Task assignment
 - Weekly satellite data
 - Pest & disease reporting

Premium training and support



***Minimum:** 50 hectares minimum flown per site.

***Site:** A site is a location where orchards of a particular variety are no further than 20 miles apart. Once a pilot has to travel further than this between orchards, it will be considered a second site and additional charges may apply.

BETA: Aerobotics BETA products are not complete yet and still in development, however we would like to offer our current version at no additional cost to customers. Importantly however, we cannot confidently commit any level of accuracy for these features at this stage.

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Citrus Yield Estimation Combo Rates



Combination Package Includes

1x Orchard Mapping flight

Tree counts & missing trees

Per-tree health, area, volume

2 x Yield Flights

Flight 1 at stage (1"+ Size)

Flight 2 at stage (Pre-Harvest)

Mobile scouting app

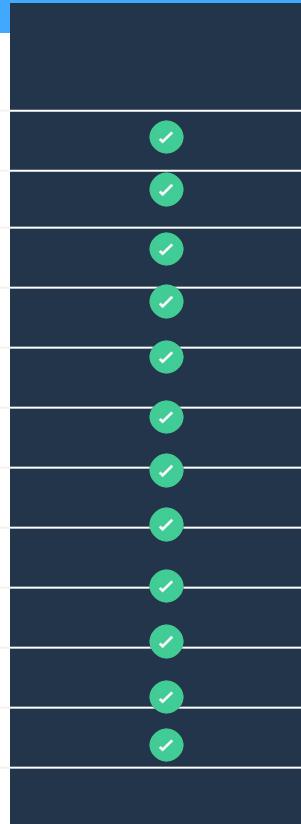
GPS-referenced data

Task assignment

Weekly satellite data

Best & disease reporting

Premium training and support



***Minimum:** 50 hectares minimum flown per site.

***Variety:** Each variety has unique fruit stages & therefore are treated independently.

***Site:** A site is a location where orchards of a particular variety are no further than 20 miles apart. Once a pilot has to travel further than this between orchards, it will be considered a second site and additional charges may apply.

BETA: Aerobotics BETA products are not complete yet and still in development, however we would like to offer our current version at no additional cost to customers. Importantly however, we cannot confidently commit any level of accuracy for these features at this stage.

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