Progress in ‘mango-tech’

for forecast of harvest timing and load… and harvest

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Data Acquisition System

SensorHost

F750 device

Temperature Sensor

MV Imaging rig

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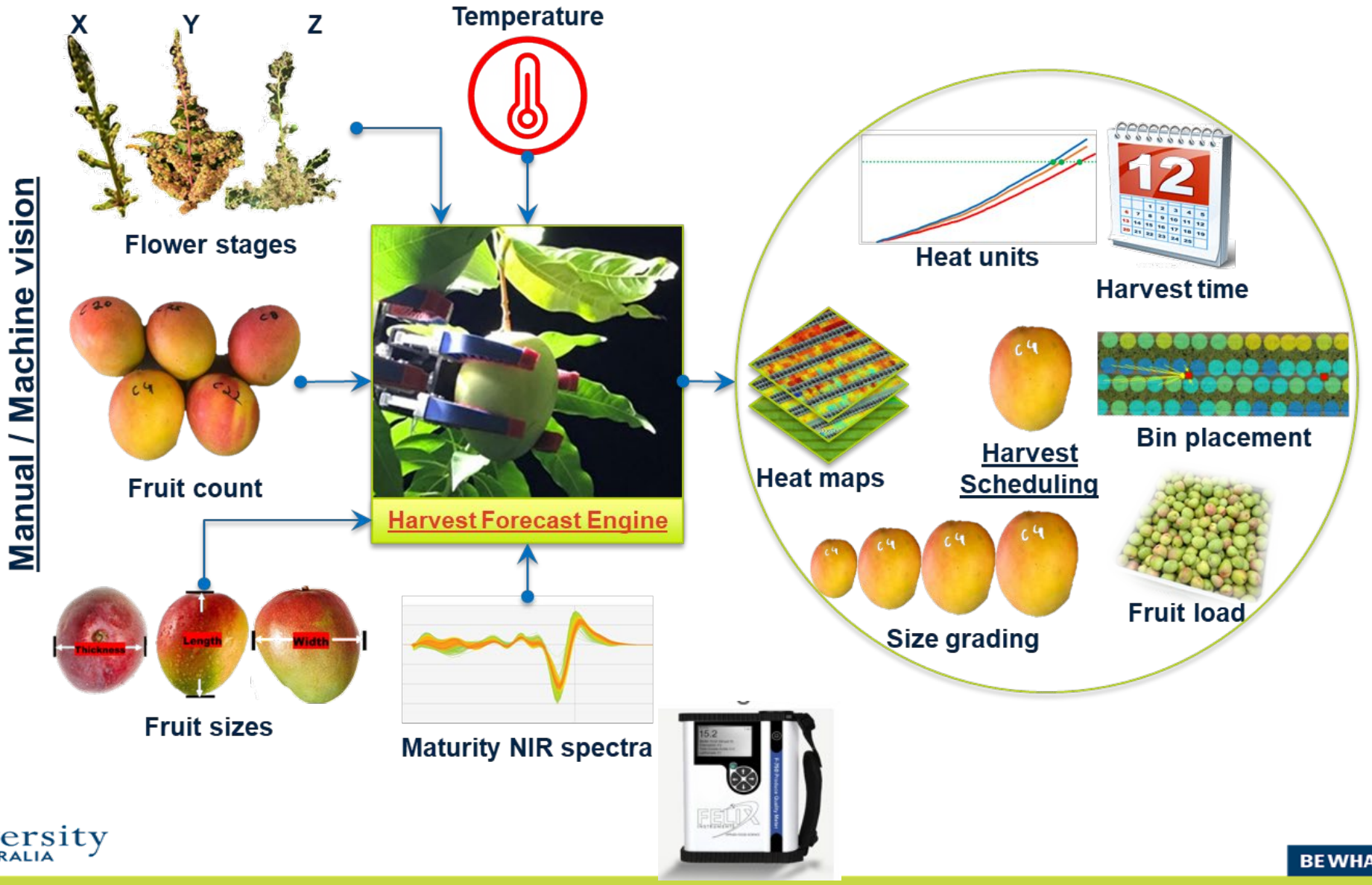
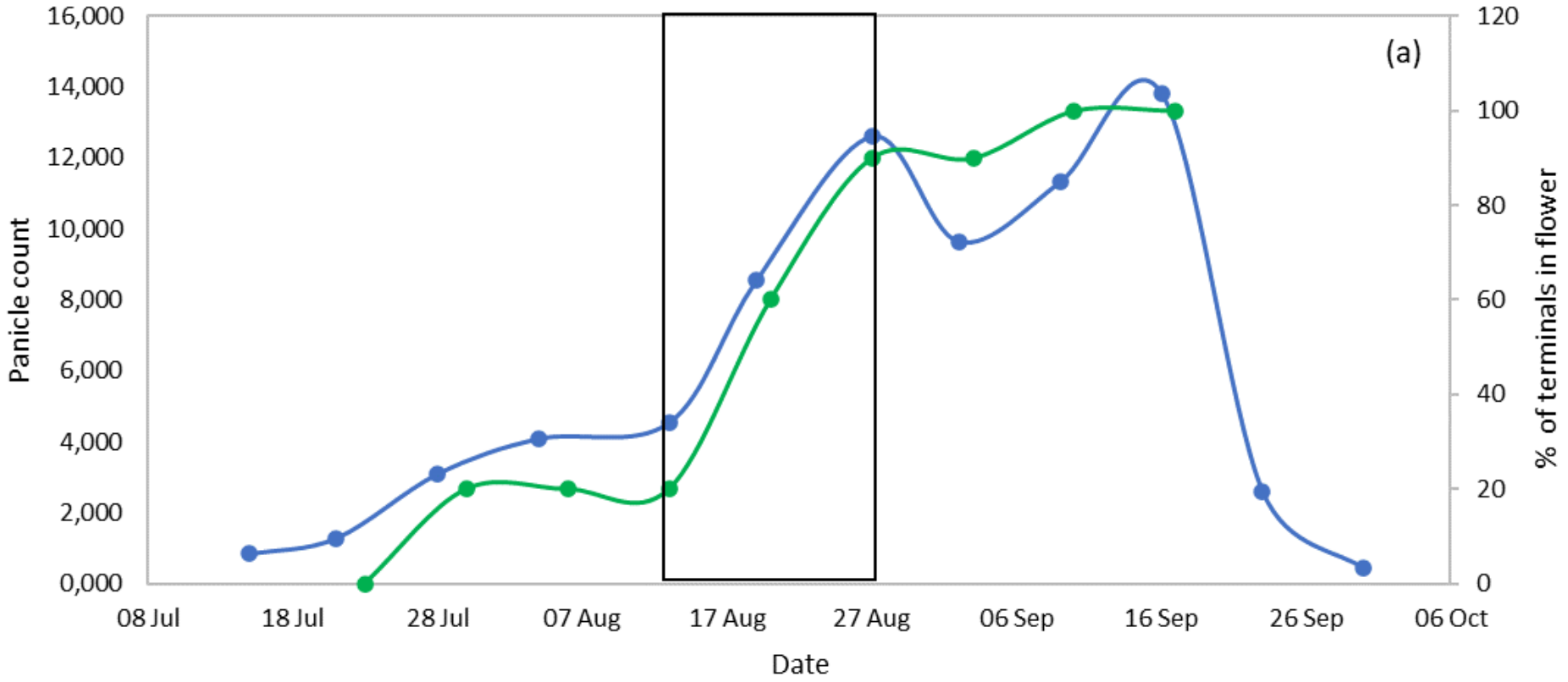
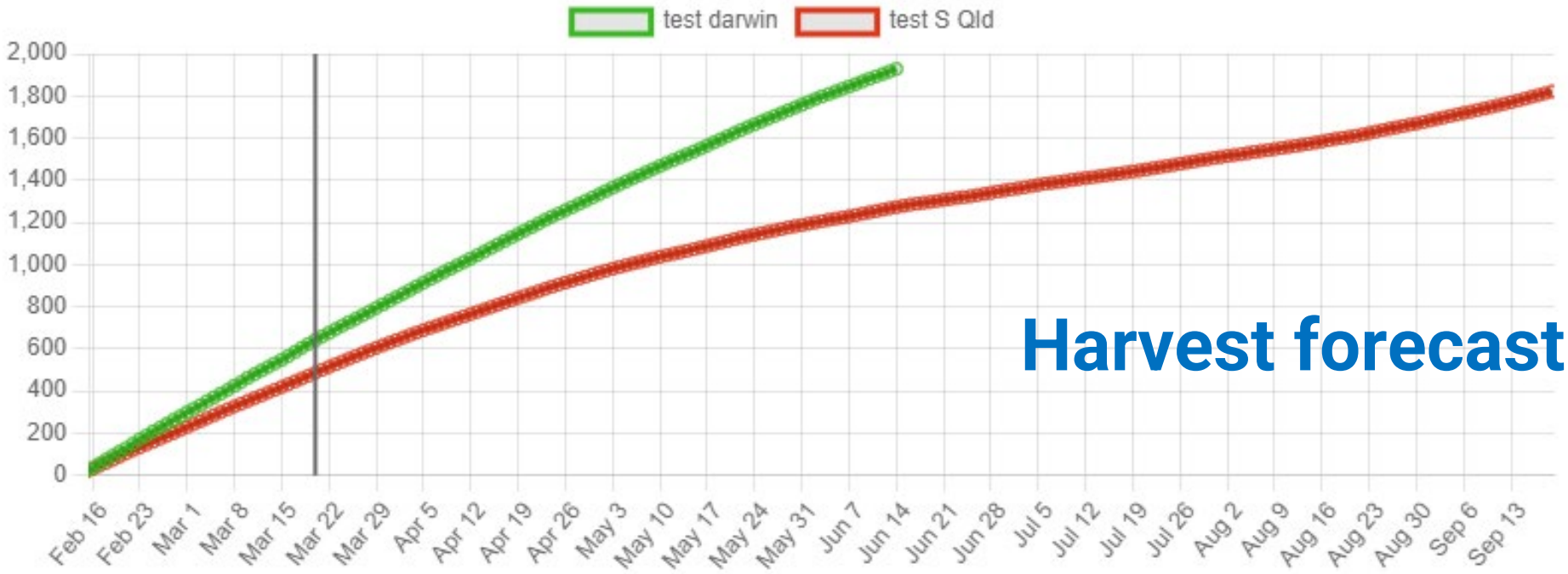
Harvest forecast engine: concept

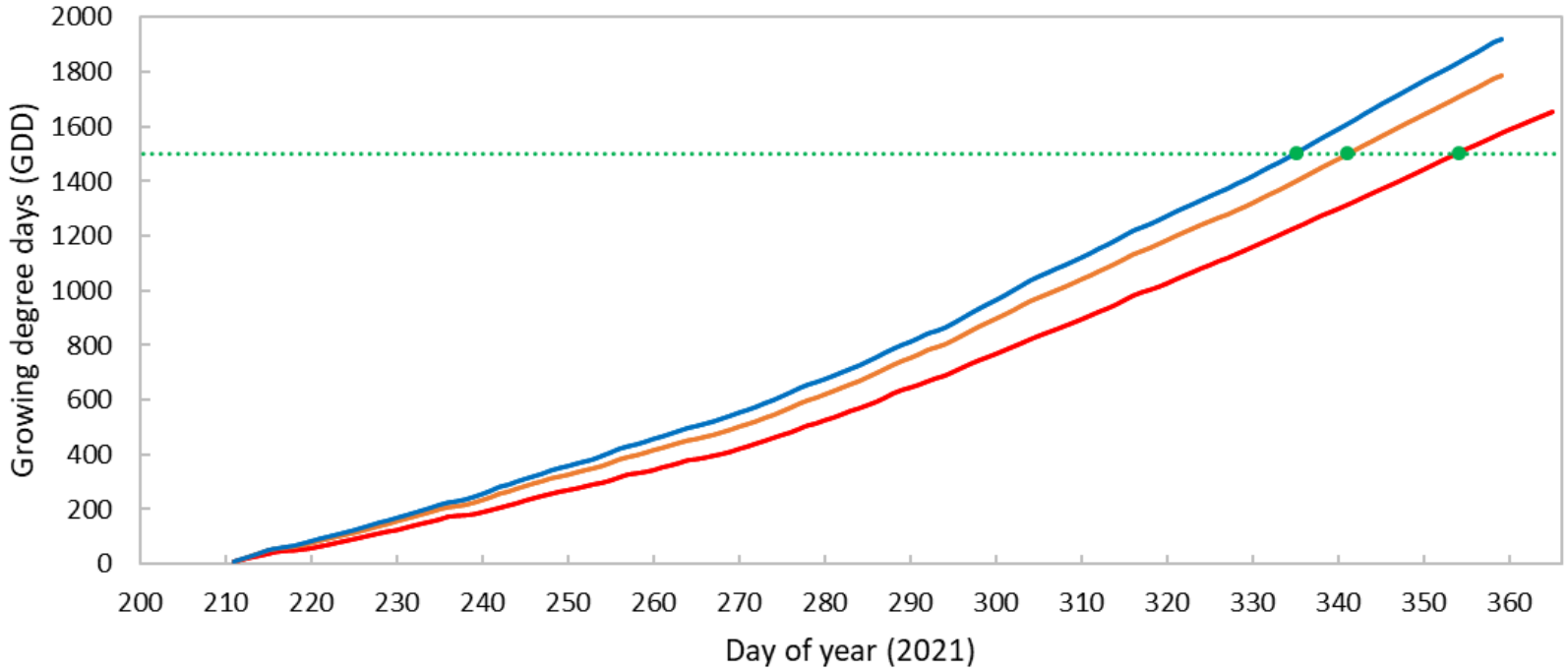


It all begins with flowering





Harvest forecast based on GDD



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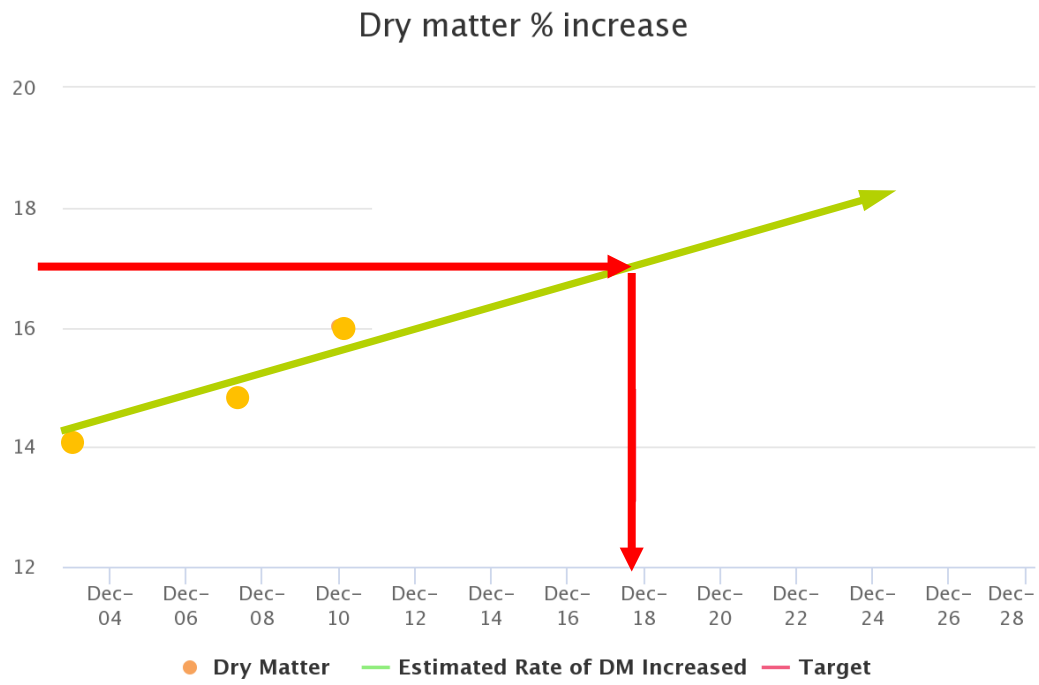
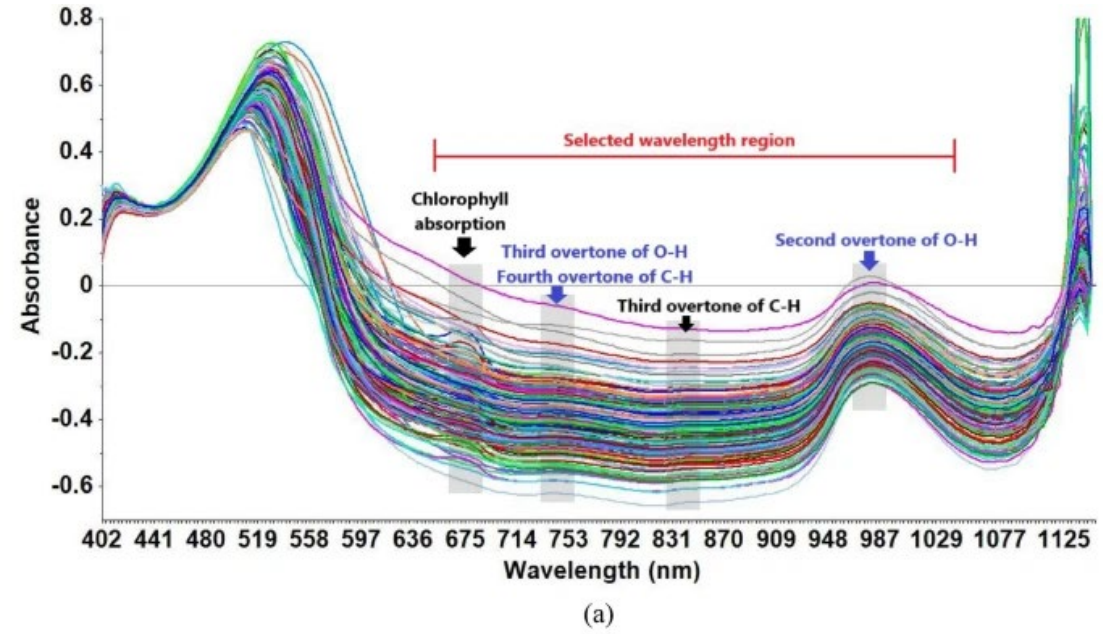
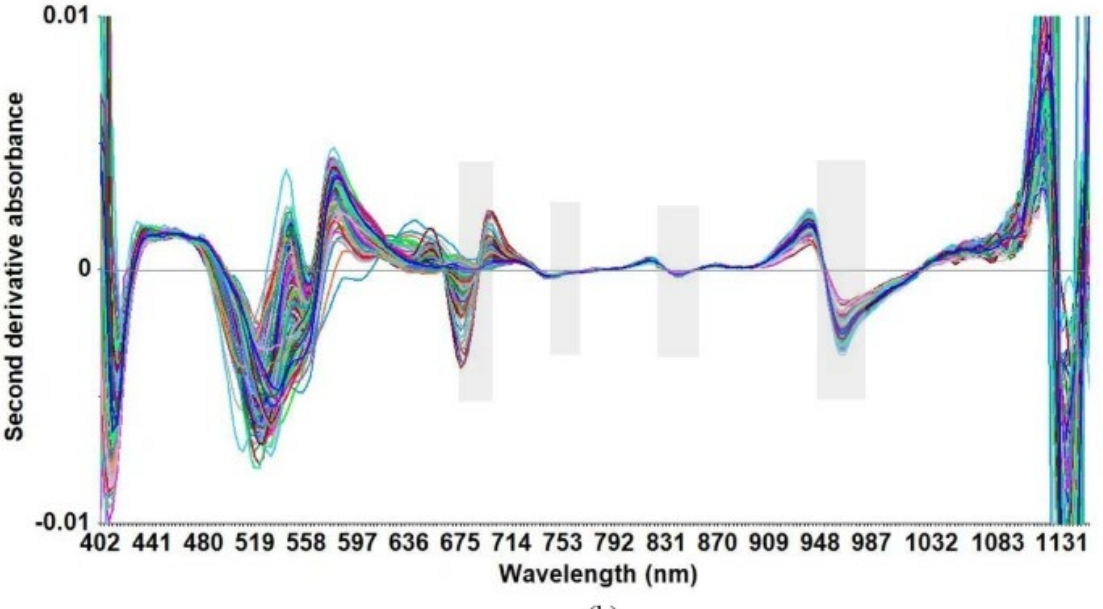
Fruit maturity (DM) model

- min DMC recommendations for ripe Brix
- associate DMC to maturity (flesh colour) for growing condition
- forward predict harvest maturity



Evolution of chemometrics





MLR

PLSR

SVM

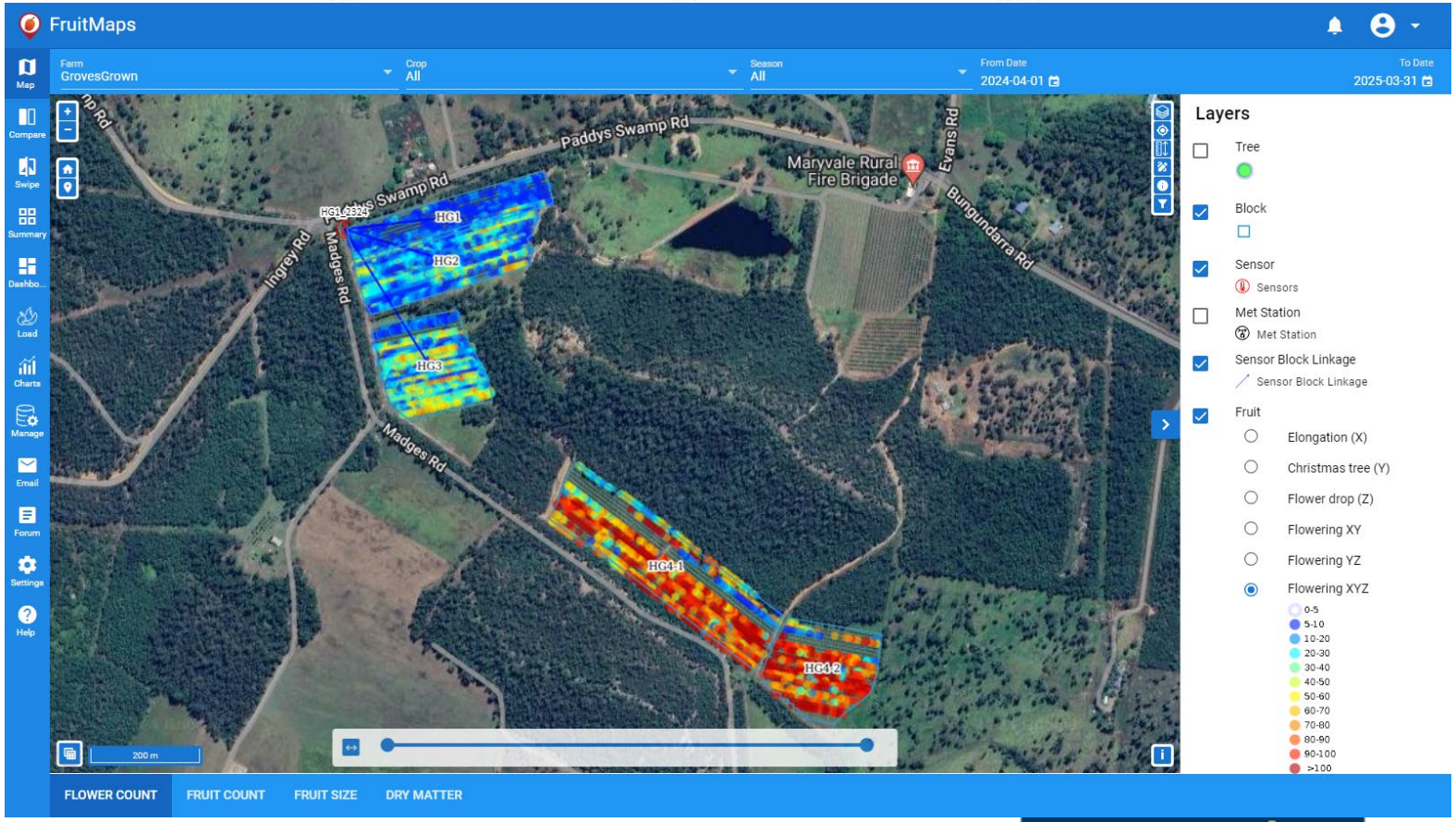
ANN

1D-CNN

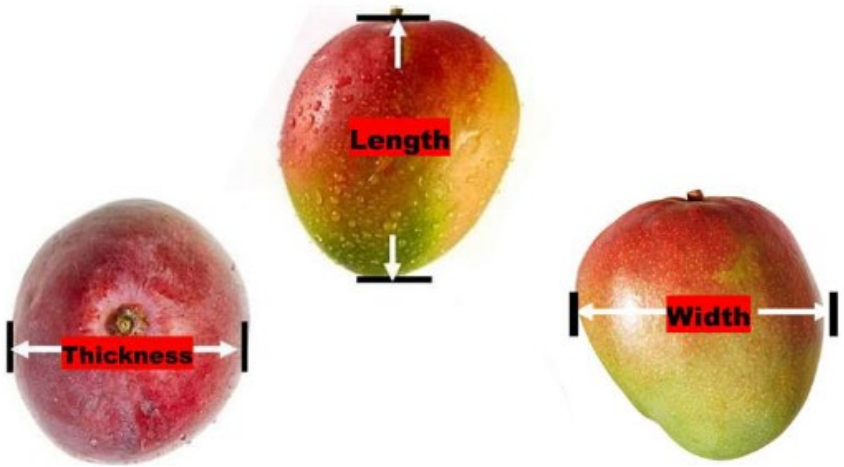
https://doi.org/10.1038/s41598-022-27297-2

Machine vision

- object detection
- object tracking
- polygon boundaries
- cumulative count

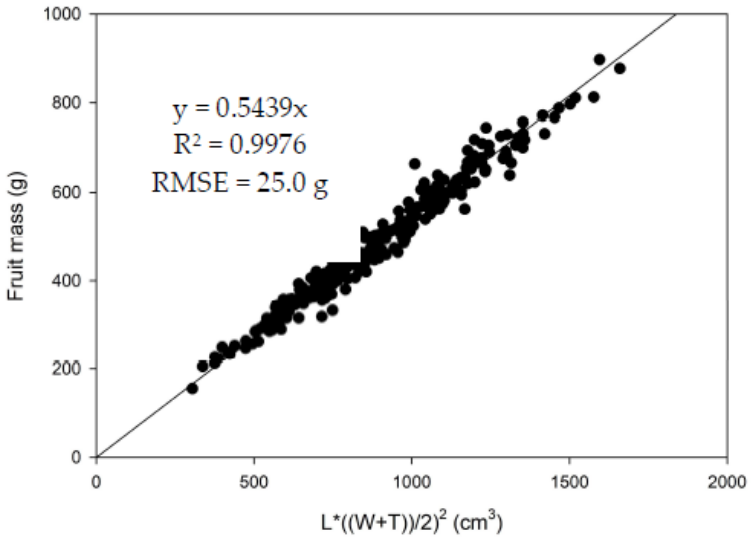


Fruit size estimation model

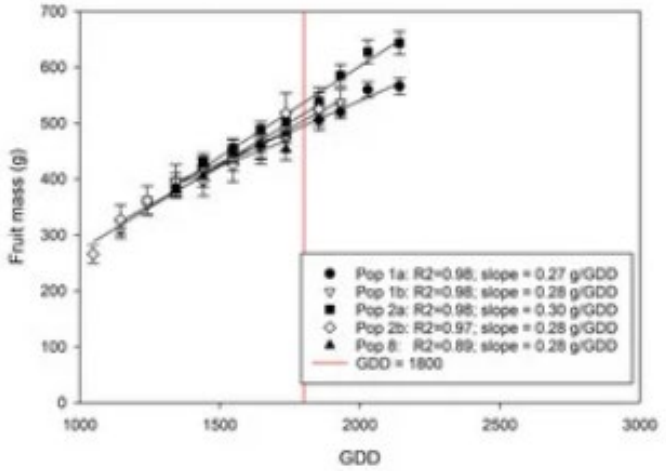


*For **manual**, fruit mass (m) = $kL((W+T)/2)^2$*

*For **machine vision**, fruit mass (m) = $kLW^2/4$*



Fruit weight increases linearly in the last weeks before harvest



(Amaral et al. 2023b)

Harvest load calculator

FruitMaps

Map | Compare | Swipe | Summary | Dashbo... | Load | Charts | Up/Down | Email | Forum | Settings | Help

Farm: GrovesGrown | Crop: Mango - HoneyGold | Season: 2021 - 2022 | From Date: 2021-04-01 | To Date: 2022-03-31

Harvest Load Calculation

Method *: Manual

Fruit Weight: 0.47 **Harvest Capacity/Week:** 200000 ± 10% Search EXPORT

FLOWERING DATA (% terminals flowered) EDIT

↑ Date	07-23	07-30	08-06	08-13	08-20	08-27
Harvest	12-24	12-27	12-30	01-01	01-04	01-07
Block	W29	W30	W31	W32	W33	W34
HG1	10	50	70			100
HG2	0	20			60	90
HG3	0	20		40		
HG4-1	20	20			50	
HG4-2	50	50			100	

FLOWERING CONDENSED TO FLOWERING EVENTS (FE) (MATURITY ZONES) EDIT

↑ Flower Event	07-23	07-30	08-06	08-13	08-20	08-27
Harvest	12-24	12-27	12-30	01-01	01-04	01-07
Block	W29	W30	W31	W32	W33	W34
HG1		60				40
HG2		20				70
HG3			20	20		
HG4-1						
HG4-2						

FRUIT COUNT AND WEIGHT

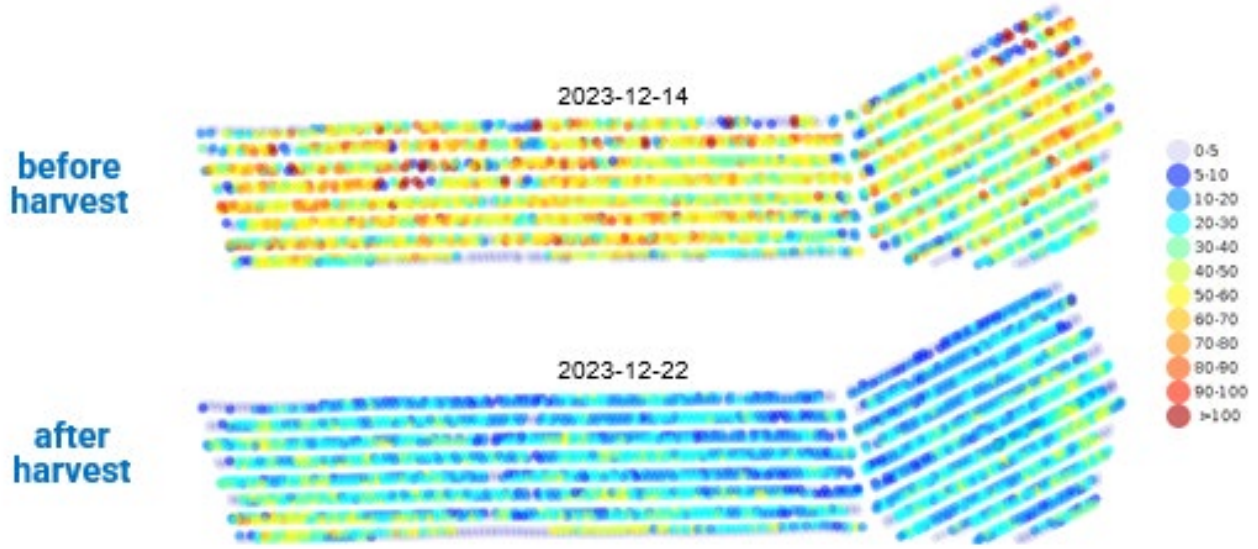
↑ Block	Count	Weight	Y_{POT}
Total	1854935	871819	36395
HG1	464675	218397	7275
HG2	444808	209060	9112.5
HG3	424841	199675	3620
HG4-1	349205	164126	7662.5
HG4-2	171406	80561	8725

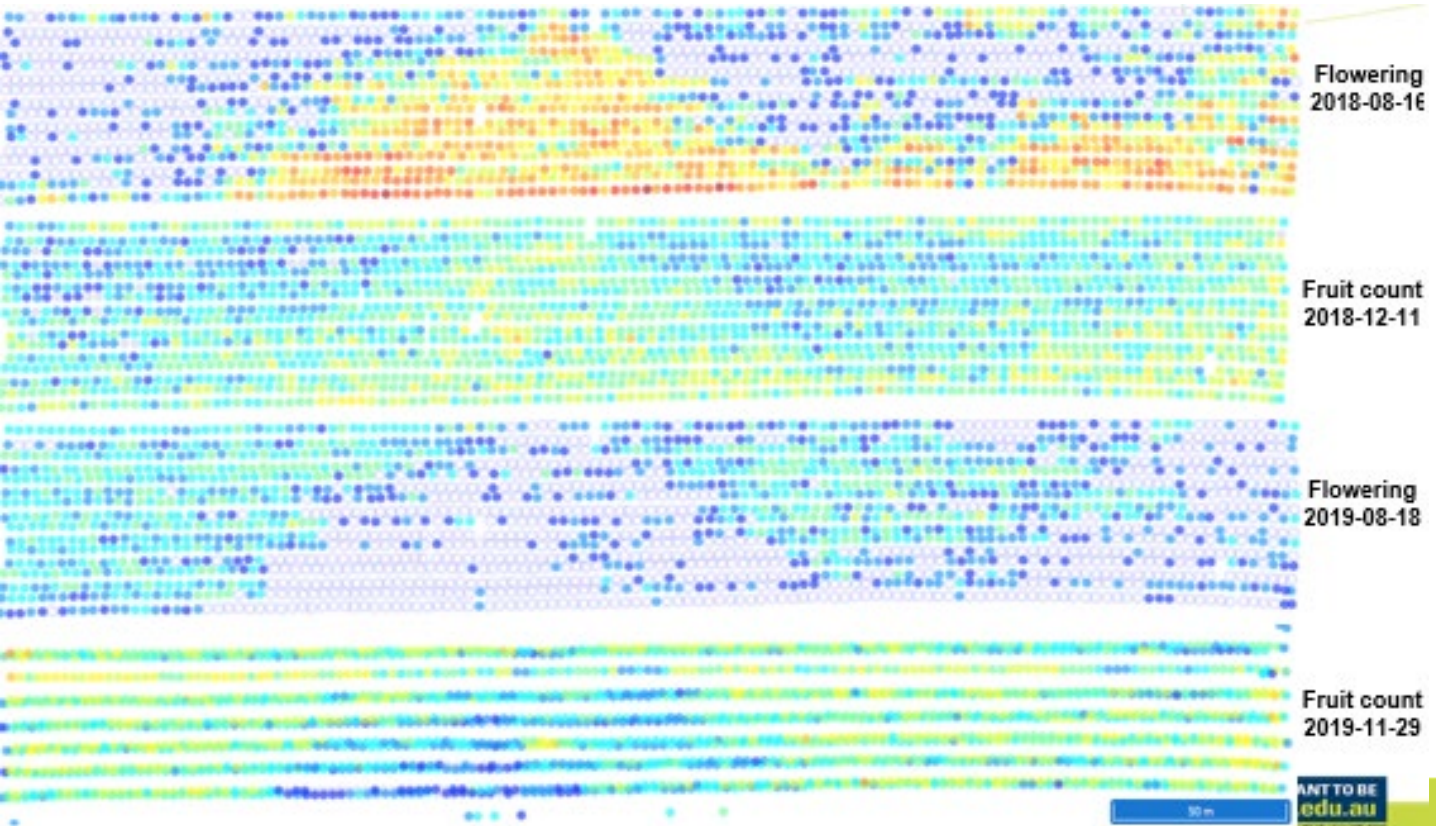
YIELD ESTI

↑ Harvest	12-24	12-27
Harvest Week	W51	W52
Total	0	377651
HG1		278805
HG2		98846
HG3		
HG4-1		
HG4-2		

1 2 3 4

Use cases:





Evaluation:

If you see it and know its 3D position….

- 70 to 12 c/kg - evolving the harvest aid
- Labour !!!!!!! consider wheat, sugar cane

- Cartesian vs higher DoF for speed and cost
- Fin-ray gripper

Recommendations

- Flower count – interpretation of MV
- Fruit count – improve tracking in MV
- Fruit sizing – phone depth camera
- Sample statistics
- NIRS – robust models and instrument QC

- Harvester – selective harvest
- Harvester – harvest aid integration c/kg