

A photograph of a mango tree with many green, unripe mangoes hanging from the branches. The image is overlaid with a semi-transparent green filter. The text is centered over the image.

# TECHNOLOGY FOR ESTIMATION OF FRUIT SIZING ON TREE

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# OVERVIEW

## Importance of fruit sizing



### Why?

Early fruit load forecast (number and size) is useful for labour and packing house planning, transportation and marketing strategies.

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### How?

Estimating fruit weight depends on a size-weight relationship known as Allometry.

# ALLOMETRY

Relating size to weight



## Apple

$$F_w = a - (b * FD_1) + (c * FD_2)$$

Marini et al. 2019

## Kiwifruit

$$F_w = a * FD_1 * FD_2$$

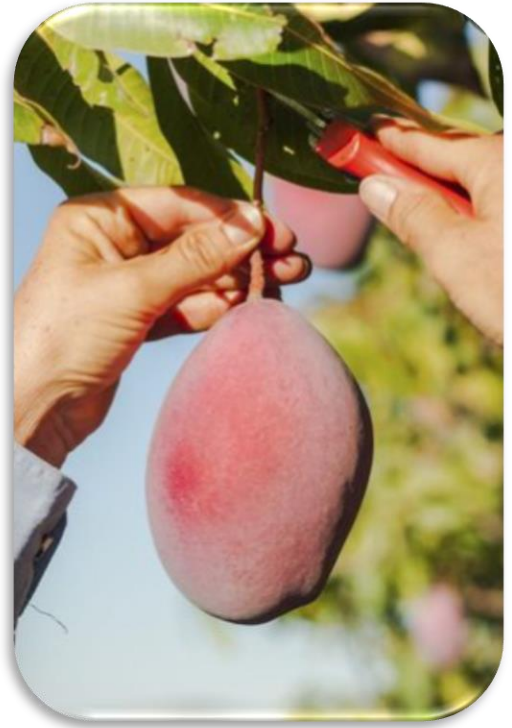
Snelgar et al. 1992



## Mango

$$F_w = a * L * W * T$$

Spreer & Muller, 2011



Where  $F_w$  = fruit weight;  $FD$  = fruit diameter;  $L$  = length,  $W$  = width,  $T$  = thickness,  $a$ ,  $b$  and  $c$  are constants.

# FORECAST

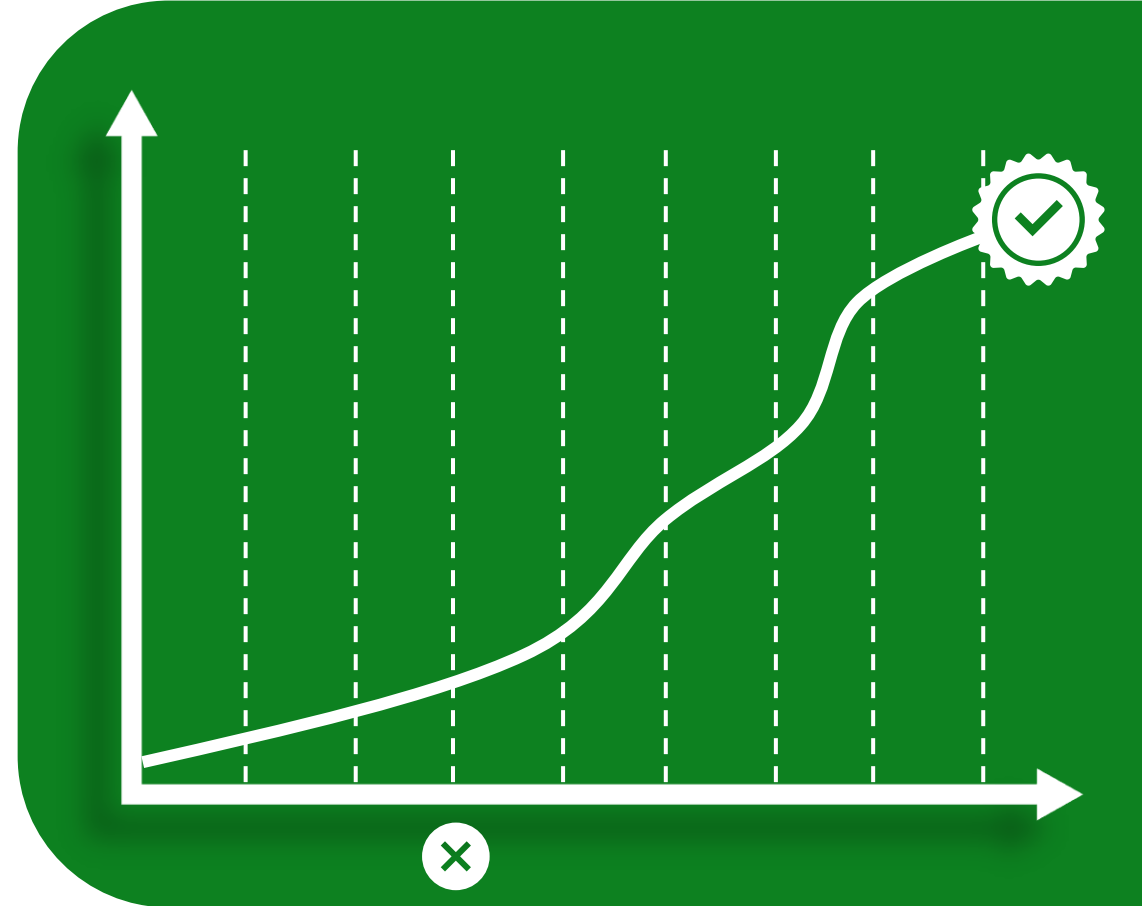
## Predicting final fruit size



Various modelling approaches exist to predict fruit weight and growth patterns.



Effectiveness of these models can be affected by meteorological conditions and specific cultivar characteristics.



# TRADITIONAL METHODS



**Calliper**

## Sizing Rings



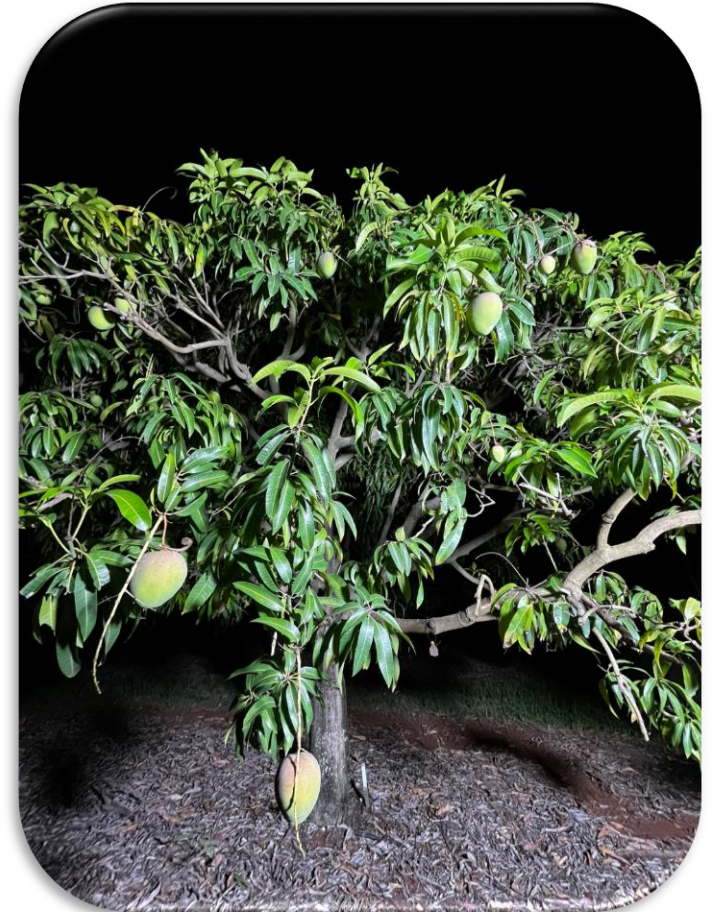
**Dendrometer**

# TECHNOLOGIES

## Measurement of fruit

### IMAGING SYSTEM

- Vehicle mounted
- Nocturnal imaging
- Constant light
- RGB camera
- Depth perception



# TECHNOLOGIES

## Measurement of fruit

### IMAGING SYSTEM

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Daytime imaging faces challenges like variable light conditions, shadows and sun flares.



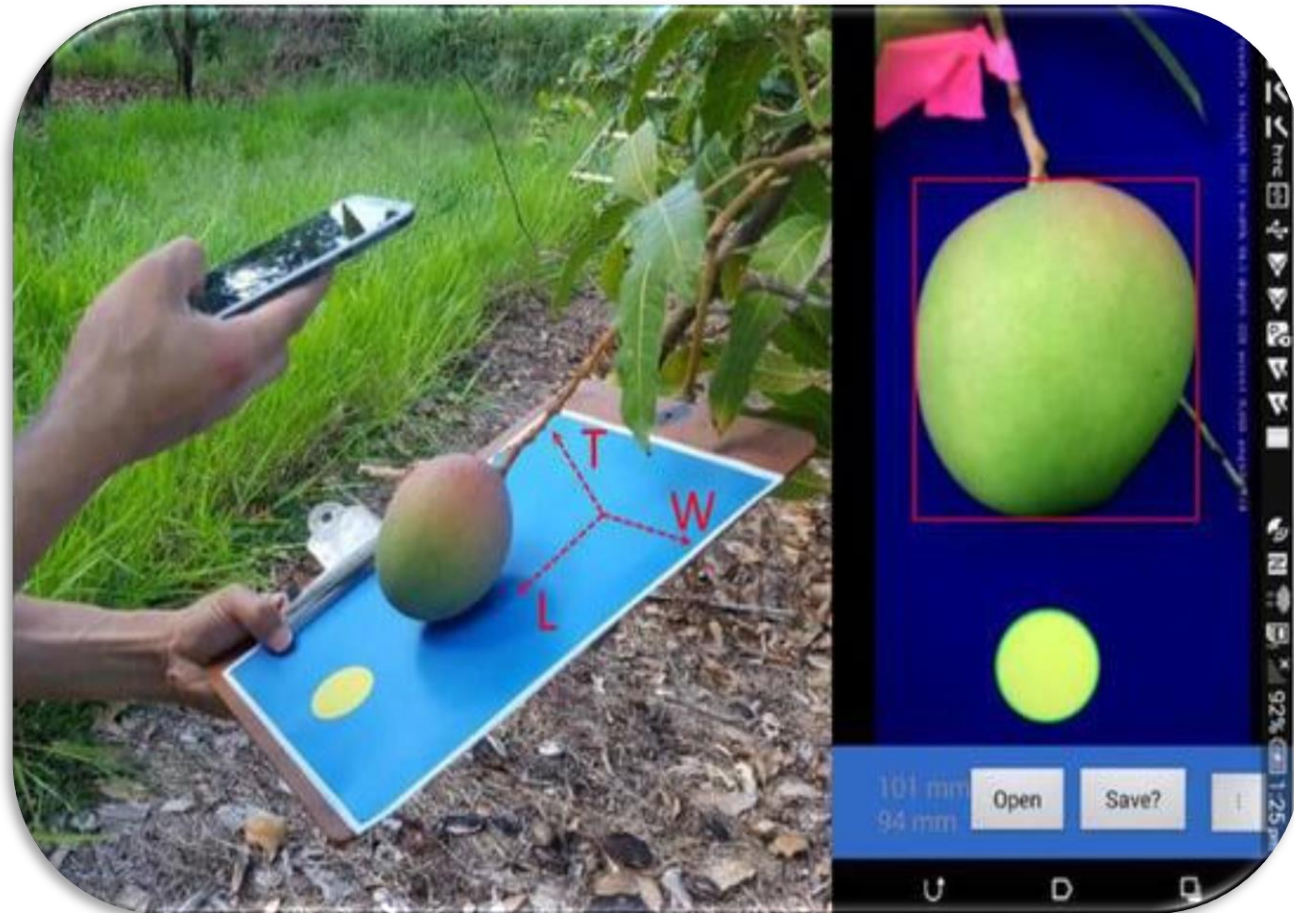


# TECHNOLOGIES

## Measurement of fruit

### FRUIT SIZE MOBILE APP

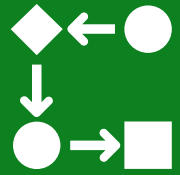
- Fruit orientation controlled through a standard background
- 2D images using phone camera



Wang et al. 2018

# FINDINGS

## Estimating model



### Methodology

- 50 fruit/week
- 16 weeks of assessment
- ‘Honey Gold’ cultivar
- LWT & Weight

# FINDINGS

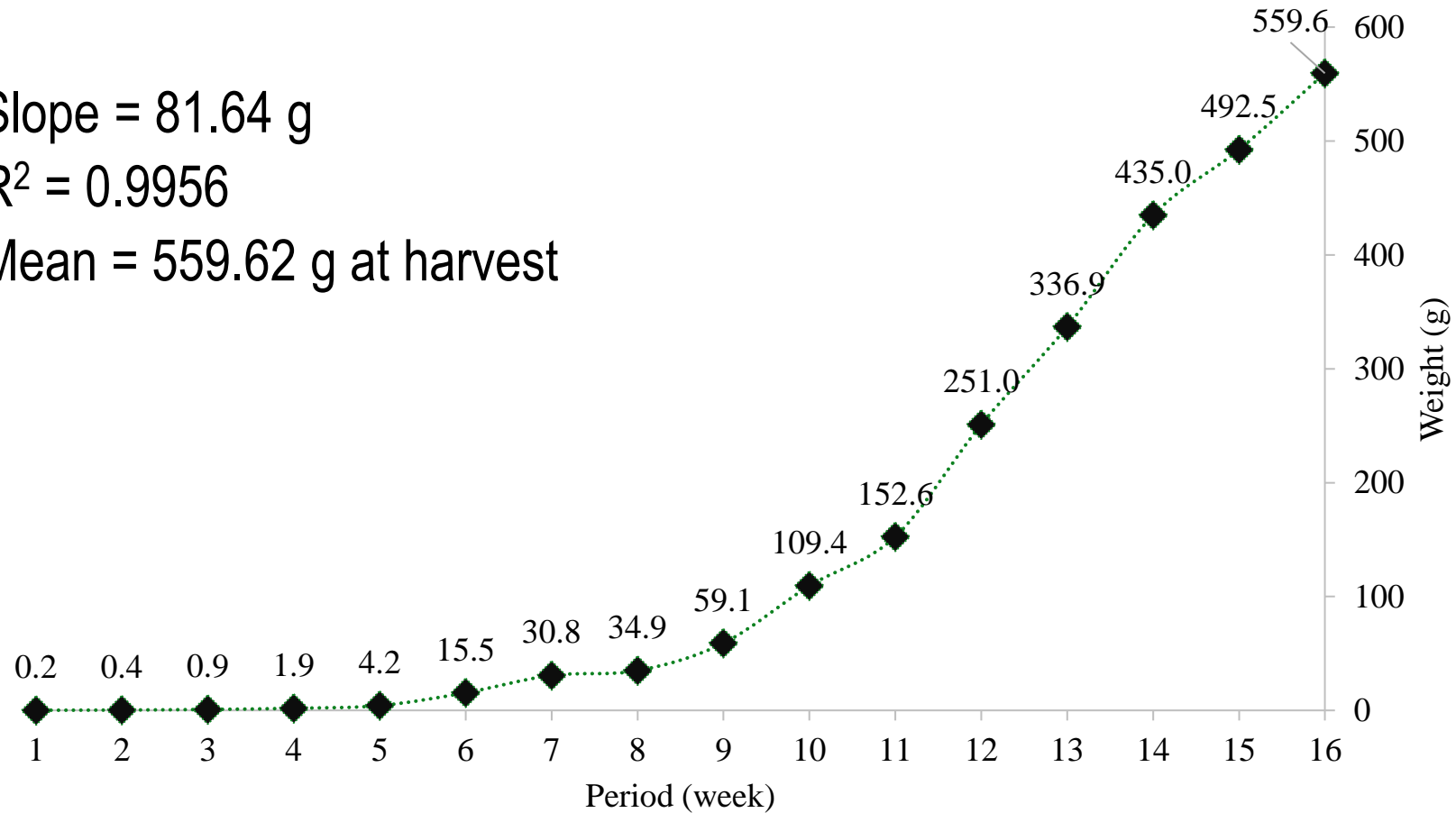
## Estimating model

Average weight of 50 random fruit across sixteen weeks.

Slope = 81.64 g

$R^2 = 0.9956$

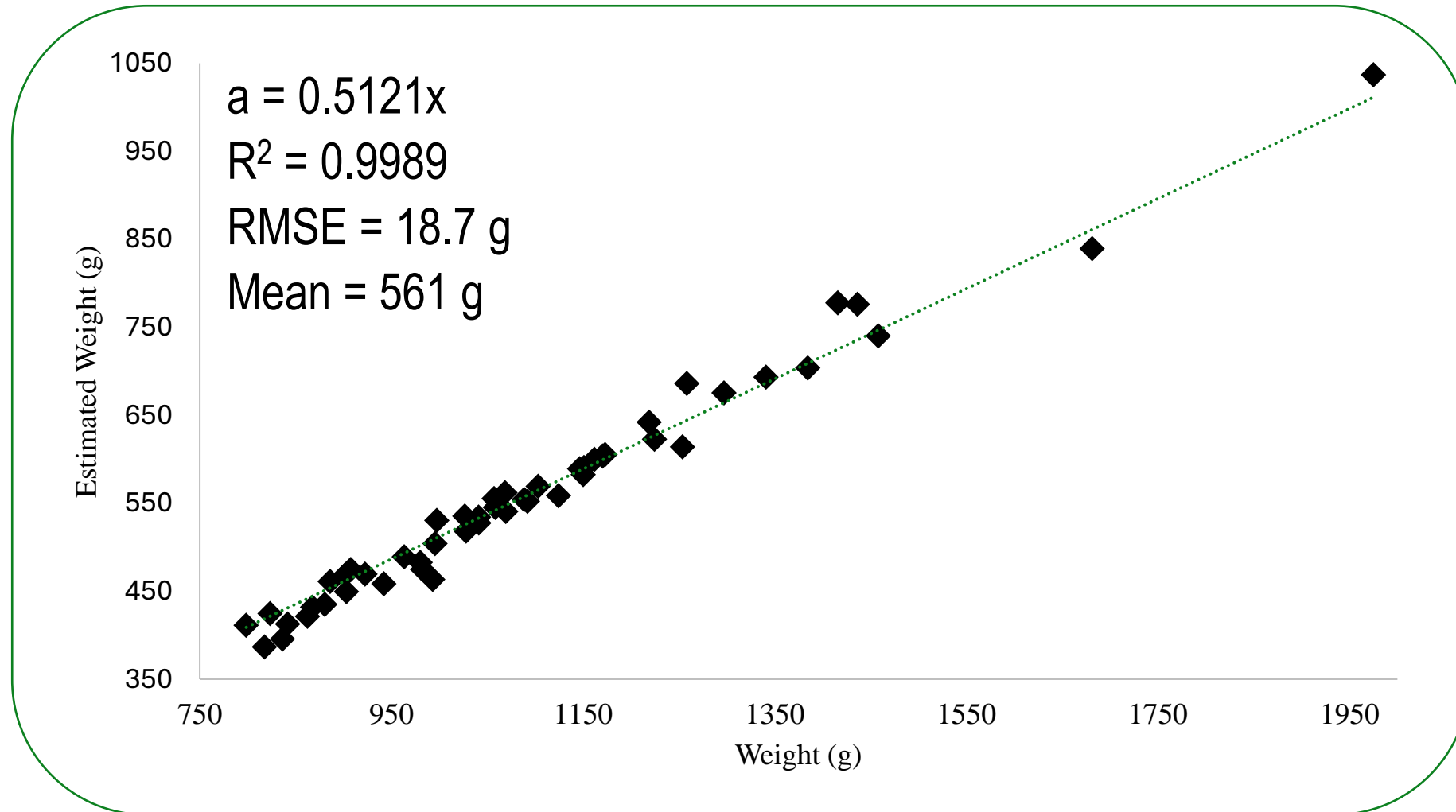
Mean = 559.62 g at harvest



# FINDINGS

## Estimating model

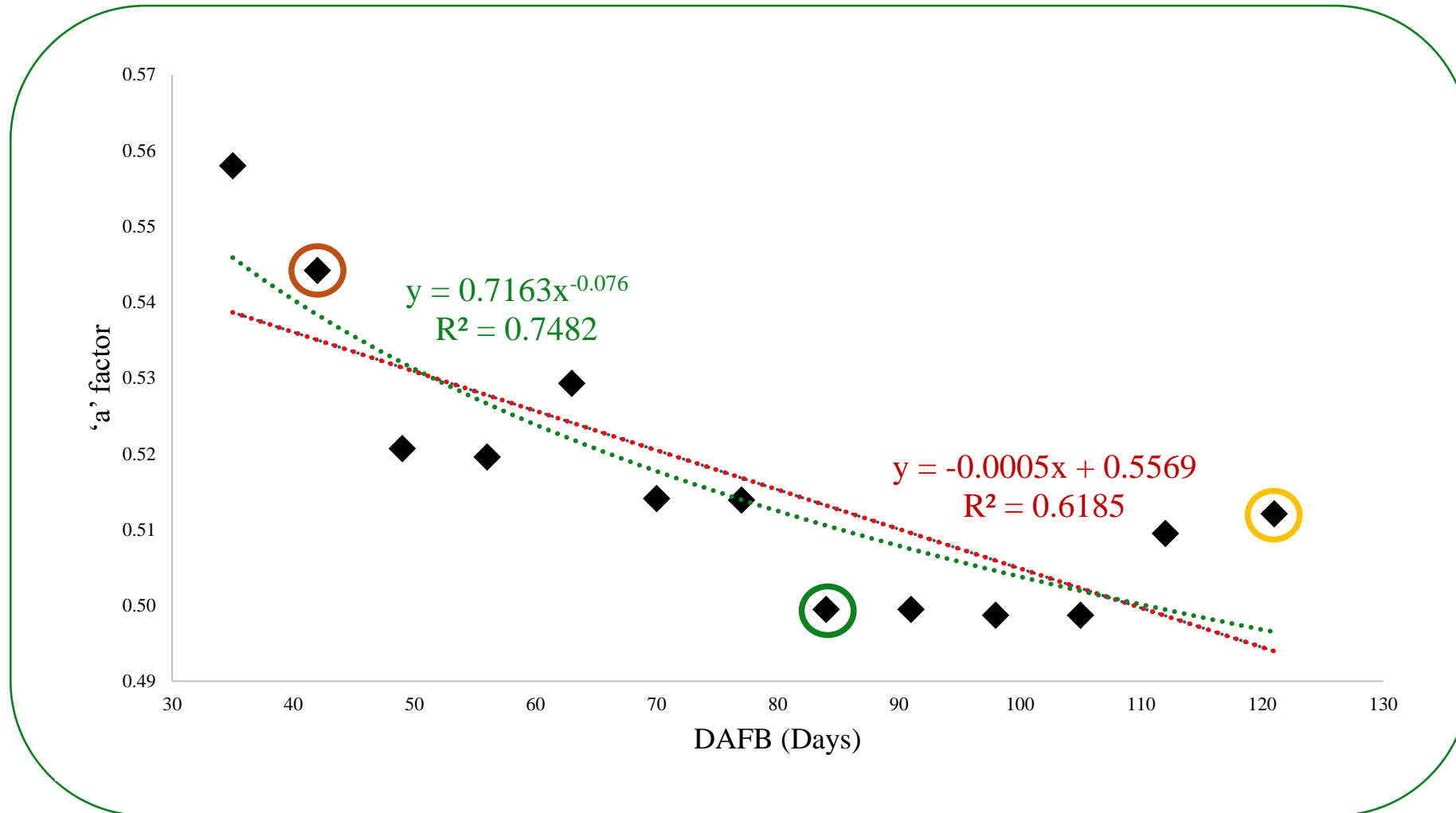
Relationship between estimated fruit weight (calliper) and fruit weight (scale).



# FINDINGS

## Estimating model

Relationship between coefficient 'a' and days after full bloom (DAFB). Each  $\blacklozenge$  represents the mean of 50 fruit.





IFFS – Sensors  
Group will continue  
working on  
enhancements

# Conclusions

## & future research

- Enhancing accuracy and precision of current frameworks is necessary.
- Research for more robust allometric relationships between fruit weight, volume, and linear dimensions.
- Growth models need to be fit to the unique characteristics of different cultivars.

# THANK YOU!



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