

# Prediction of Water Content & C7 Sugars using NIR Spectroscopy

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## Introduction

- Maturity measured using water content/dry matter
- C7 sugars major non-structural carbohydrates in avos
- NIRS able to non-destructively predict organic compounds
  - Water, proteins, carbohydrates, lipids

## Need for Prediction

- Highly variable fruit
- Variable ripening is a major problem
  - "In any box of avocados the fruits will vary in the time they take to ripen. This is because the fruits on the tree 'set' over a long period." [www.avocado.co.za](http://www.avocado.co.za)
- Poor quality fruit exported
- Need to prolong storage potential



## Objectives

- Develop equations to quickly and accurately predict:
  1. Water content
  2. Sugars
  3. Lipids
  4. Protein
  5. Physiological disorders
  6. Storage potential
  7. Days to ripen

## Ultimate Aim

- Development of postharvest model for avocados
  - Every avocado can be quantified
    - Storage potential
    - Physiological disorders
    - Days to ripen
    - Eating quality
  - Export fruit are of consistent high quality

## Materials & Method

- Fruit from Tzaneen, Howick
- Water Content
  - Freeze dry
- Sugars
  - HPLC
- NIRS
  - FOSS "NIRS6500" →
  - Reflectance mode
  - Vision<sup>®</sup> software



# Southern Africa



Tzaneen

Howick

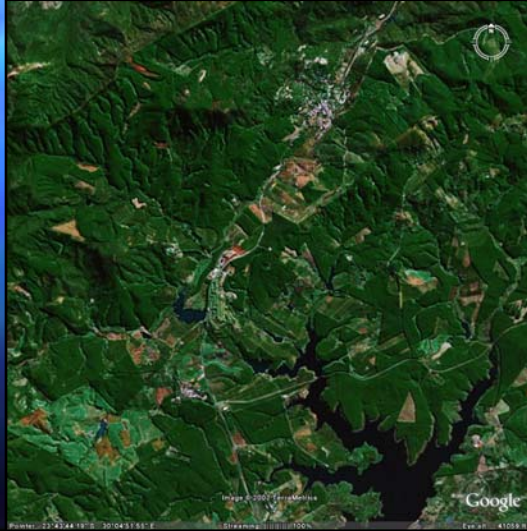
Visuals: Google Earth™

# Howick: Everdon Estate



Visuals: Google Earth™

# Tzaneen: Westfalia Estate



Visuals: Google Earth™

## What is NIR?

Waveband  
700-2500nm

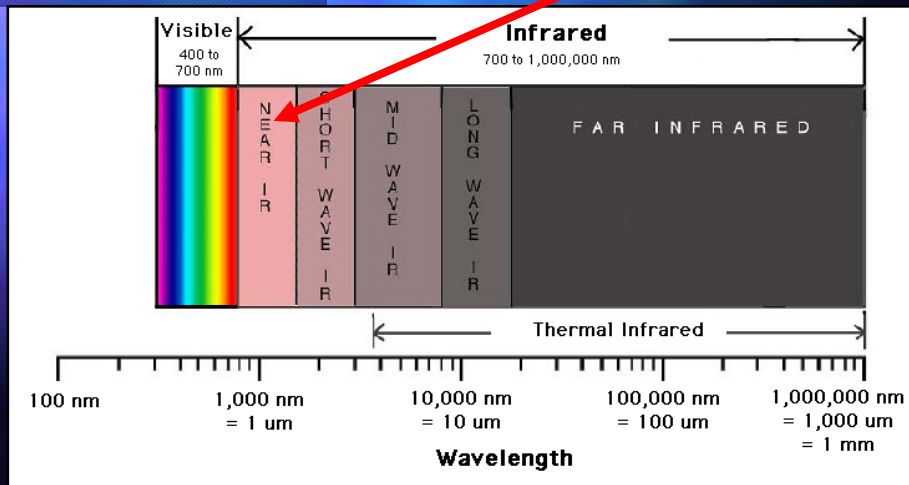


Figure: Portion of electromagnetic spectrum (100nm - 1mm)

## What is NIRS?

- Organic compounds absorb NIR radiation at **specific** wavebands for specific bond types
  - N-H, O-H & C-H bonds
  - Samples high in moisture: higher absorptions in regions associated with hydroxyl (O-H) bonds
- Able to discern & quantify individual compounds in a sample

## An Avo in NIRS

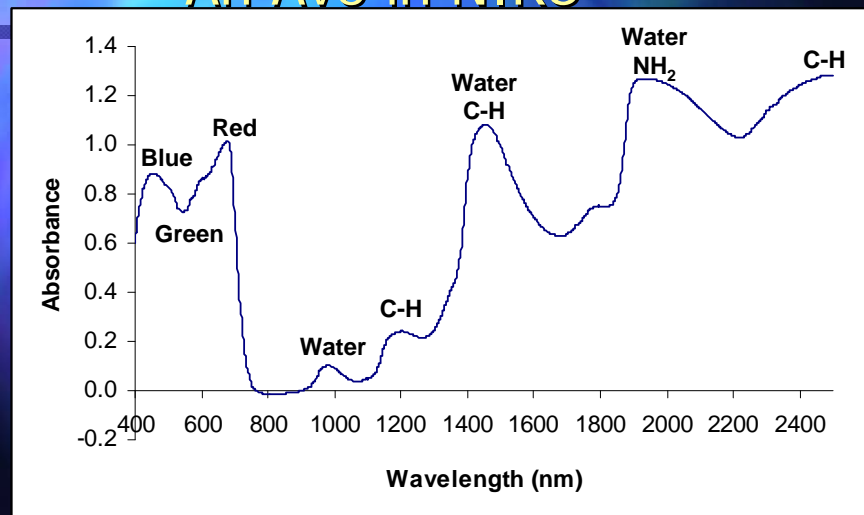
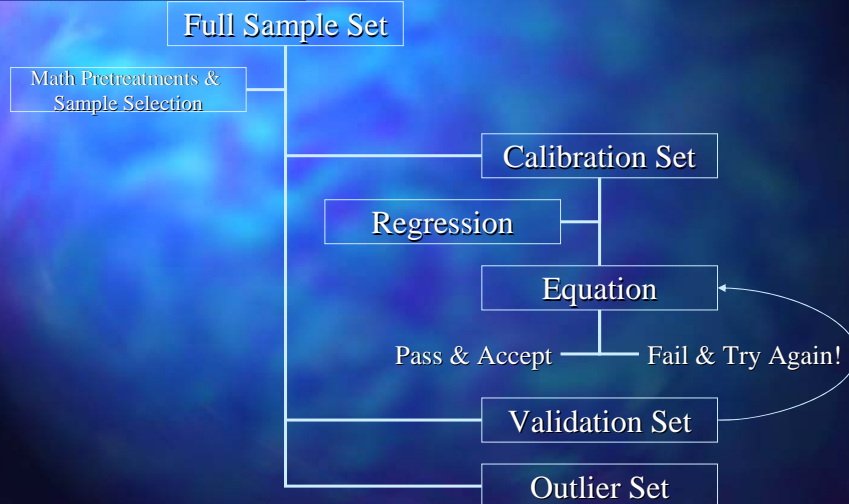


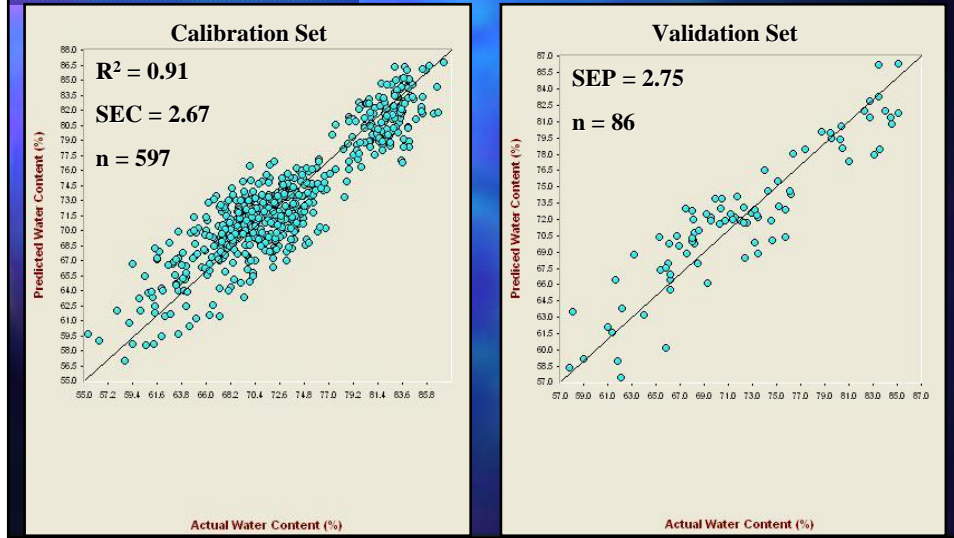
Figure: Typical NIR spectrum of a whole avocado with compounds

# Results & Discussion

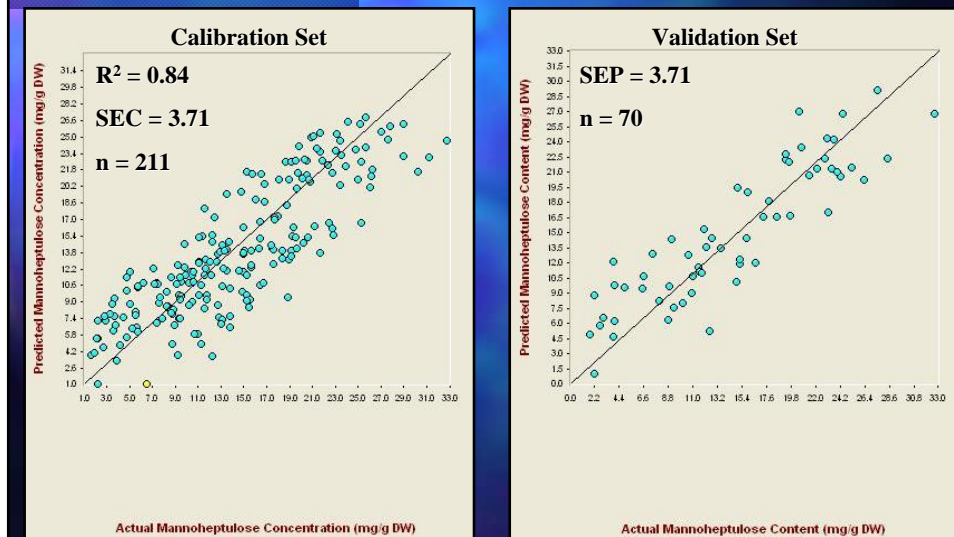
## Equation Development



# 1. Water Content

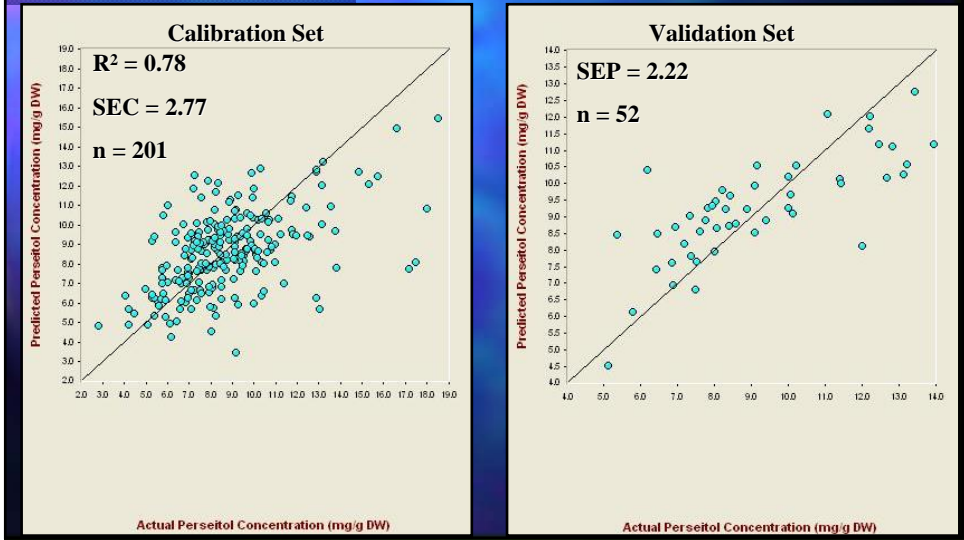


# 2. Mannoheptulose

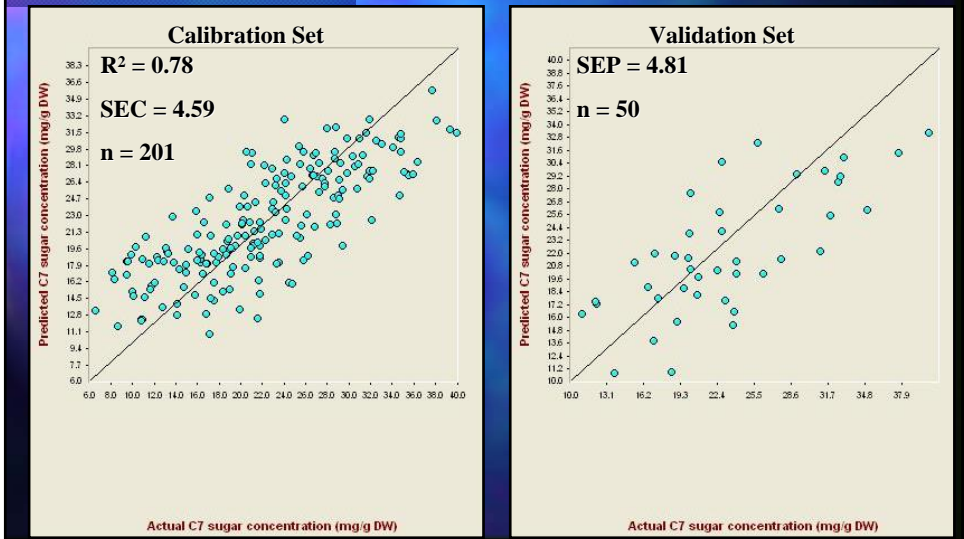




### 3. Perseitol



### 4. Total C7



## 5. Days to Ripen

- $R^2 = 0.69$
- $SEC = 1.35$
- $SEP = 1.76$
- 83% of fruit will ripen within  $\pm 2$  days of predicted date
- 50% of the fruit will ripen with  $\pm 1$  day of predicted date

## Practically...

- In a sorted Count 16 box:
- At least 13 of the fruit will ripen within  $\pm 2$  days of a set day
- At least 8 of the fruit will ripen with  $\pm 1$  day of the set day

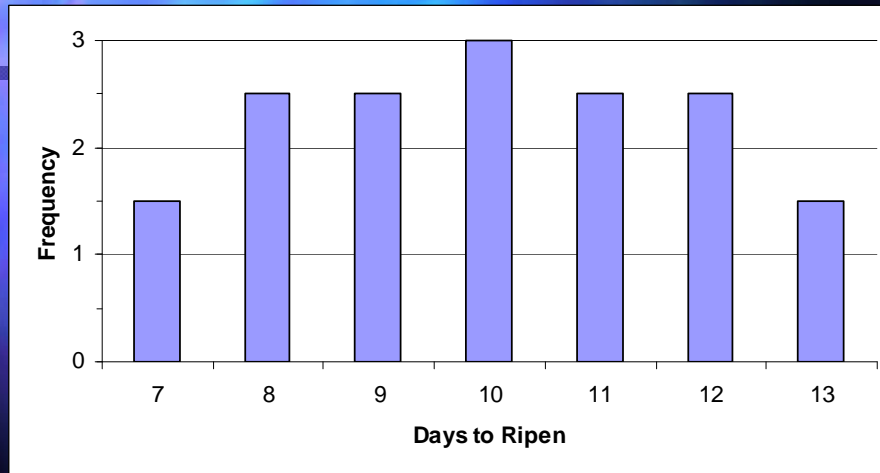
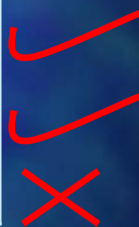


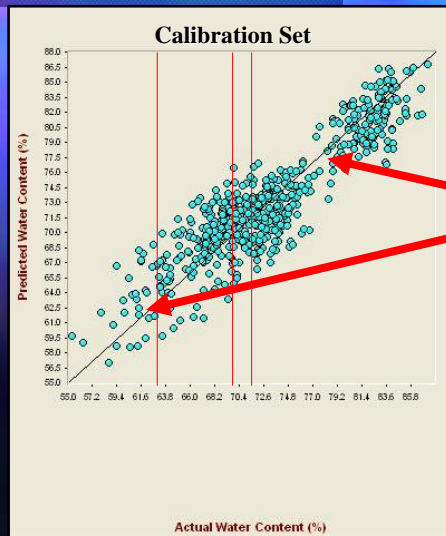
Figure: Frequency distribution of a 'count 16' box sorted to ripen 10 days after harvest

## Application

Harvest Date	Actual WC (%)	Predicted WC (%)
12/7/2007	71.5	71.1
7/8/2007	70.1	70.0
31/8/2007	63.3	68.1



## Explanation

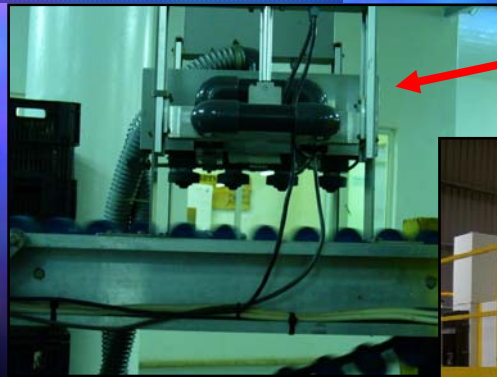


Inadequate number of samples

## Discussion

- 'Hass' is a difficult cultivar
  - Thick, rough skin
    - Reduced penetration of NIR radiation
  - Results still acceptable
    - Very large data set needed
- 'Days to ripen' depends on many endogenous factors

## Commercially



Potentially  
20 fruit/min/lane  
Firmness Tester



120-600 fruit/min/lane  
Commercial MIRS in  
New Zealand for kiwis  
4 measurements/fruit

## Other Parameters

### Whole Fruit

- Proteins
- Lipids
  - Fatty acids
  - Saturation
- Anti-oxidants

### Avocado Oil

- Moisture
- Purity
- Oxidative stability
- Authenticity
- Fatty acid composition

## Conclusion

- Water & C7 sugars in avocados can be predicted using NIRS
- Improvements and adjustments needed for commercial viability, but results are promising
- NIRS has fantastic potential in avocado industry

## Many Thanks To:

- Hans Merensky Holdings
- Westfalia Agribusiness
- South African Avocado Growers Association
- Staff & colleagues at UKZN

