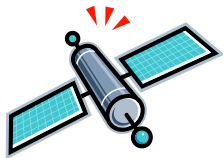
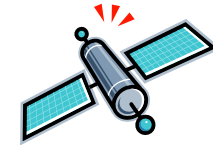
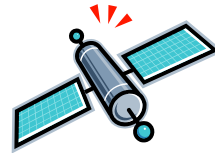




**IPNI**  
INTERNATIONAL  
PLANT NUTRITION  
INSTITUTE



# Precision Horticulture – some perspectives

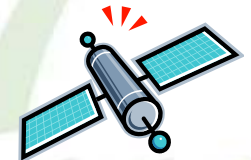
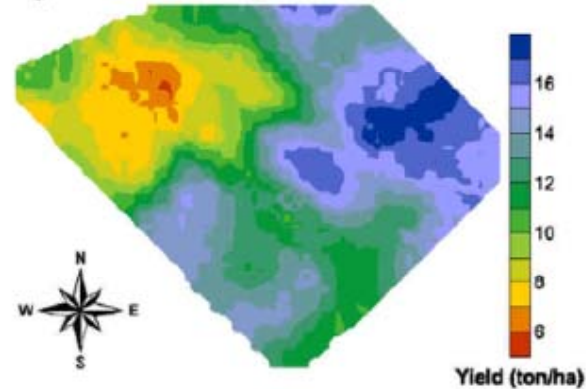


Figure 1a: Yield Map - Merlot, 2000



# What is Precision Horticulture

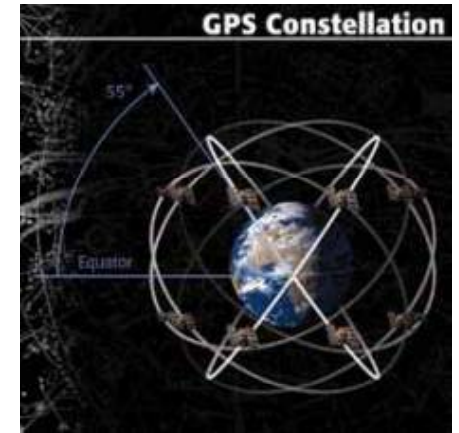
(or agriculture)

- *an integrated information and production based farming system*
  - *designed to increase long term, site-specific and whole farm production efficiency, productivity and profitability while minimizing unintended impacts on wildlife and the environment.*
- *Site-Specific Crop Management (SSCM)*
  - *PA whereby decisions on resource application and agronomic practices are improved to better match soil and crop requirements as they Vary in the field*
- farming by the foot, farming by satellite, site specific management, etc.

# Technologies behind PH/PA

- Global Positioning System (GPS)

- 24 satellites, base station, receivers, time signal delay.
- Allows precise locations to be identified (sub 5 cm).



- Data layers linked by GPS = GIS

- Mapping (DEM/GIS)
- Soil data (eg EM38 maps)
- Landscape features (eg cover, colour)
- Crop performance (eg yield maps)



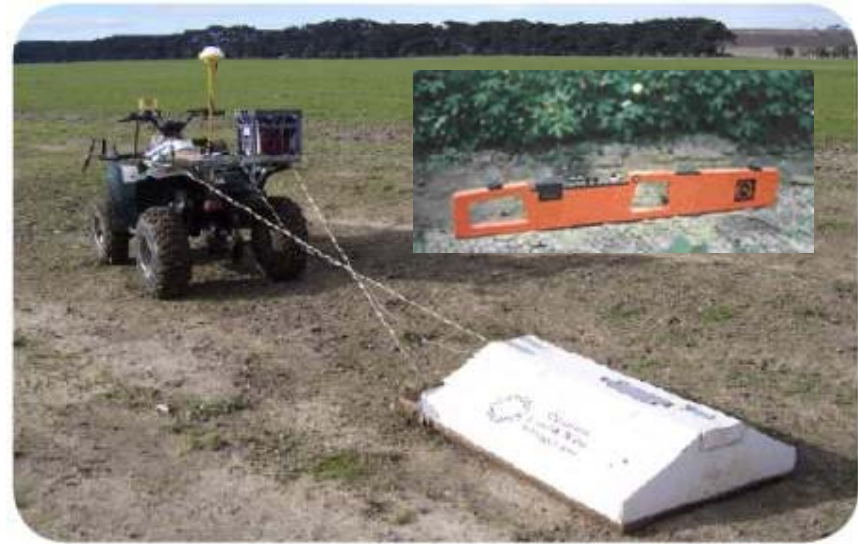
# Yield mapping – data layers

- Monitor to map grain flow through a header.
- Grain flow data linked to a GPS co-ordinate and mapped

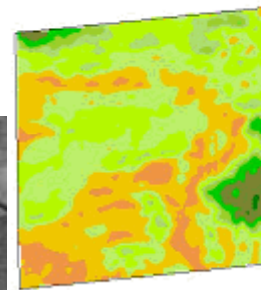


# Soil data layers

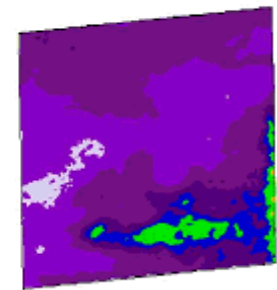
- EM38 (electromagnetic)
- Veris (direct EC)
- Aerial photography
- Airborne images
- On-the-go soil tests



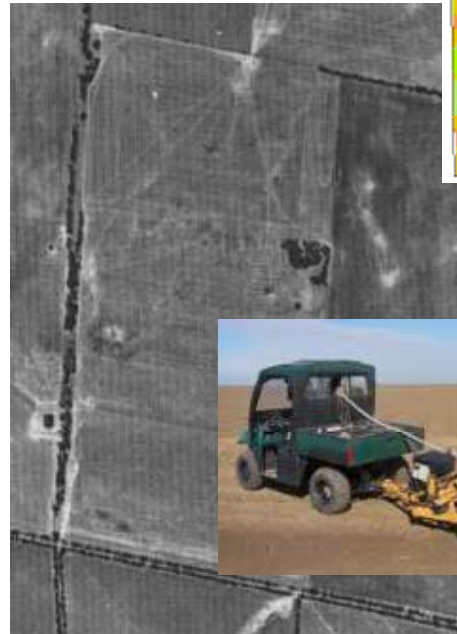
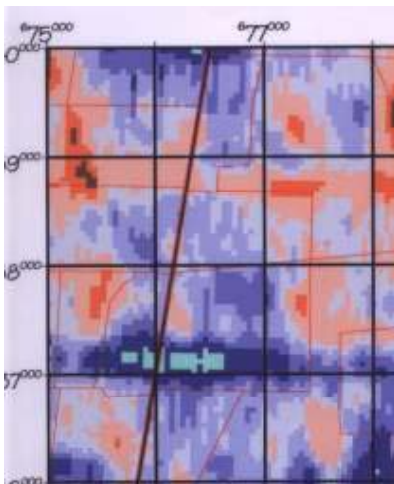
2001 Wheat



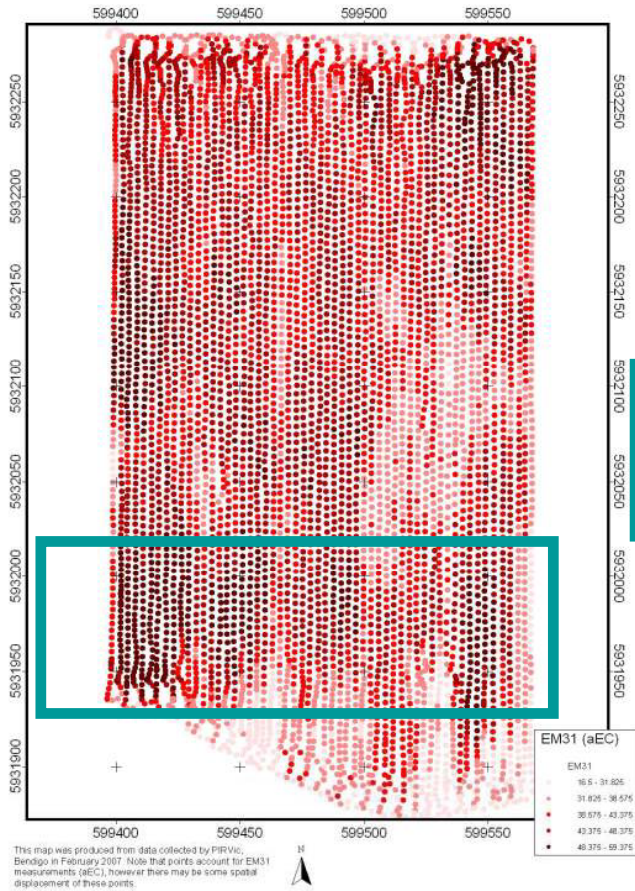
2001 EM38



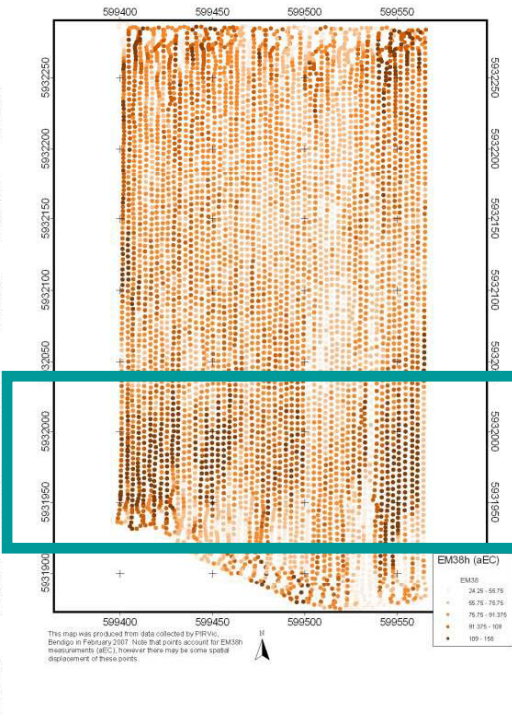
EMV (dS/m)



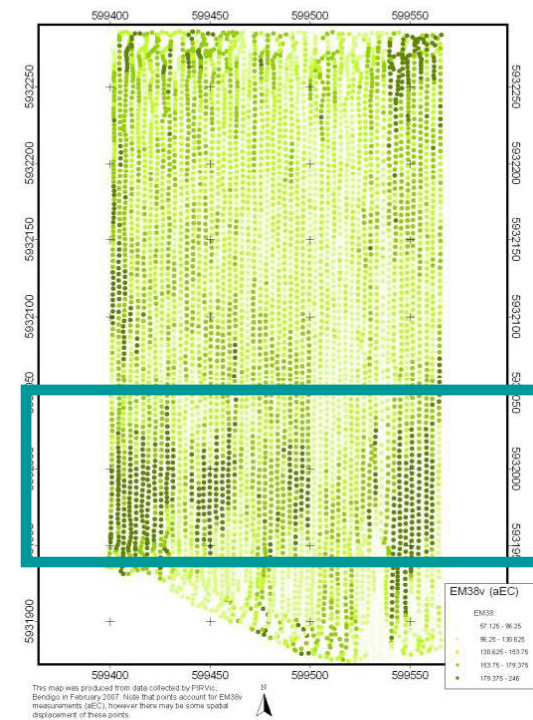
VIDA Research site - EM31



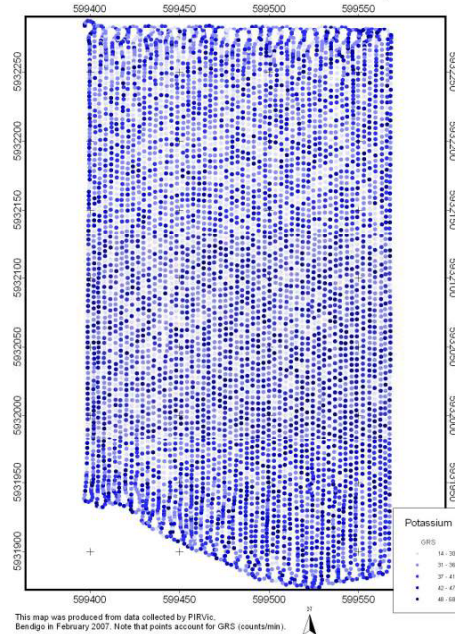
VIDA Research site - EM38h



VIDA Research site - EM38v



VIDA Research site - GRS (Potassium)



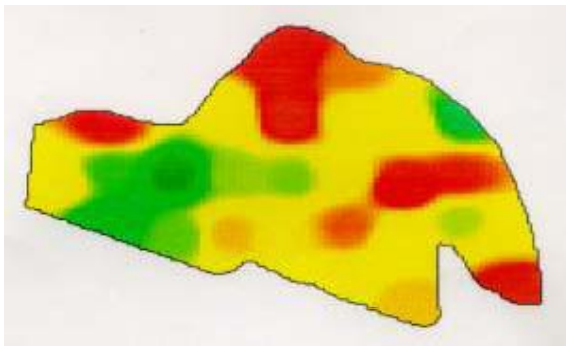
No significant variation appears in the Gamma Ray Spectrometry (GRS) for the potassium band (at right)

Examples of soil data layers EM38 horizontal has overall less variation than EM31 and is relatively consistent in northern 2/3 or survey. Note the section highlighted in south of survey, this is also clearly evident in EM38v data

# Applications - Zoning

- Paddock zoning

- pH maps – for strategic liming
- Veris maps for soil texture
  - Specific water management (wireless network water sensors)
- Weed mapping for herbicide application
- Fertility maps
  - Variable rate fertilizer application



# Applications – Guidance

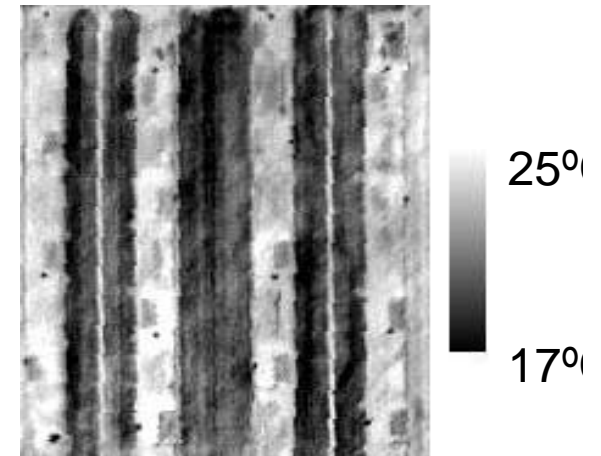
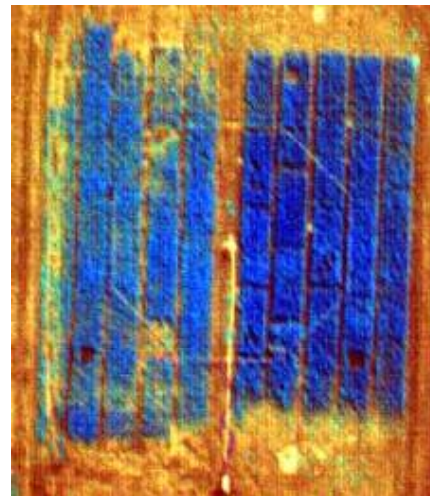
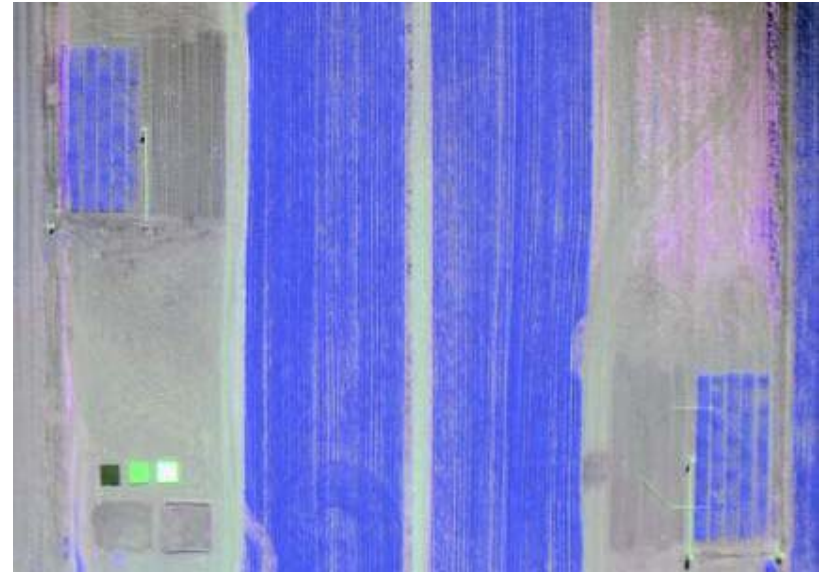


- Guidance systems (eg light bars)
  - Spraying, planting, fertilizer application
  - Perennial planting
  - Harvesting paths
  - Anywhere precise placement is needed
- Autosteer (removes operator)



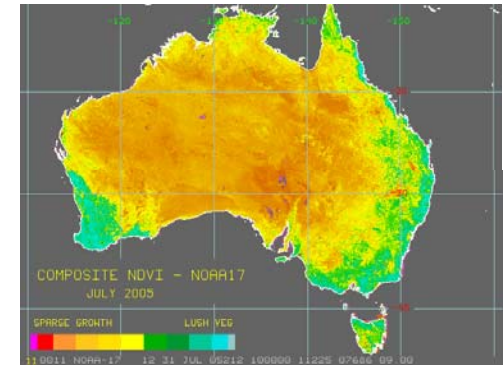
# Remote sensed data

- Visual – picture
- False imaging
- Alternate spectra
- Spectral Indices (eg NDVI)
- Thermal imaging



# Sensing platforms

- Remote data acquired by airborne imagery
  - Satellite images
    - Resolution, footprints, sensors available, accessibility, frequencies
    - Interferences, clouds, cost, interpretations
  - Aircraft platforms
    - Interference, timings, sensors
  - Aerial Sensors
    - Balloons
    - Radio controlled planes
    - RC “platforms”



Images courtesy of Reza Ehsani,  
University of Florida

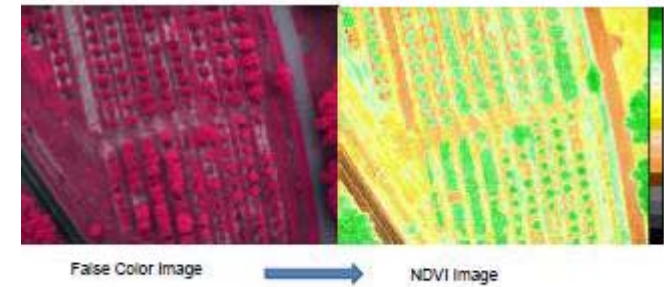


Images courtesy of  
Reza Ehsani,  
University of Florida



# Potential Applications

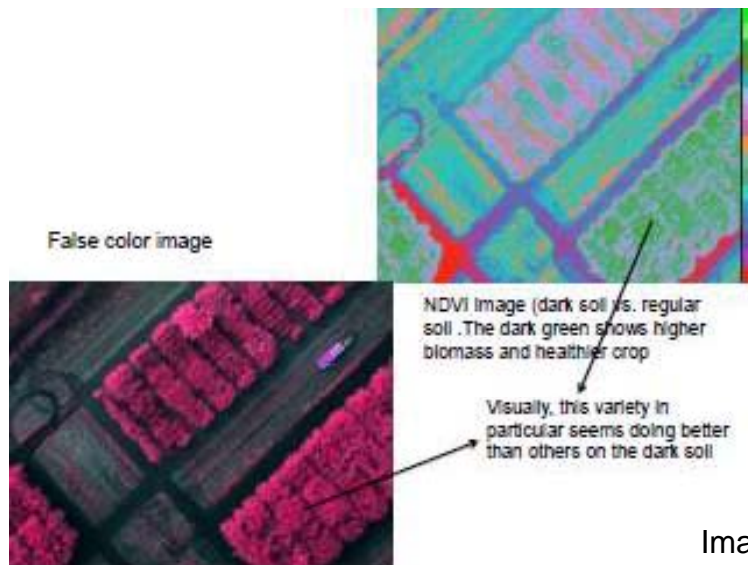
- Crop scouting
- Soil mapping
- Irrigation & drainage planning
- Yield estimation and crop load monitoring
- Inventory of trees and their condition



## Height Estimation



## Field Test Results: Diameter Estimation



Images courtesy of Reza Ehsani, University of Florida

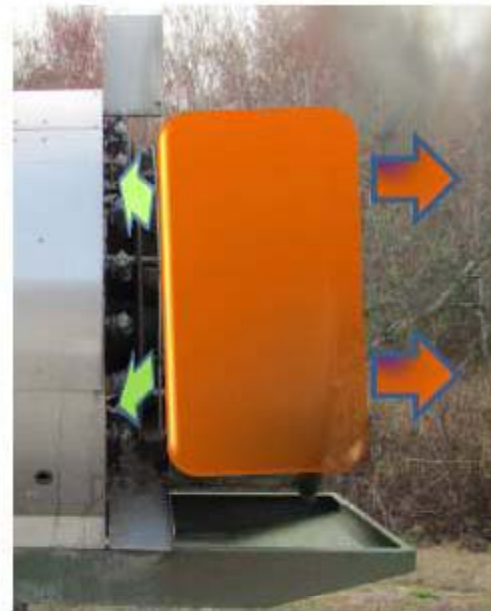
# Variable rate orchard sprayer

- Airflow adjustment as per the “tree height and density”



**Air Flow: MINIMUM**

**Tree Size: SMALL, SPARSE**



**INTERMEDIATE**

**MEDIUM**



**MAXIMUM**

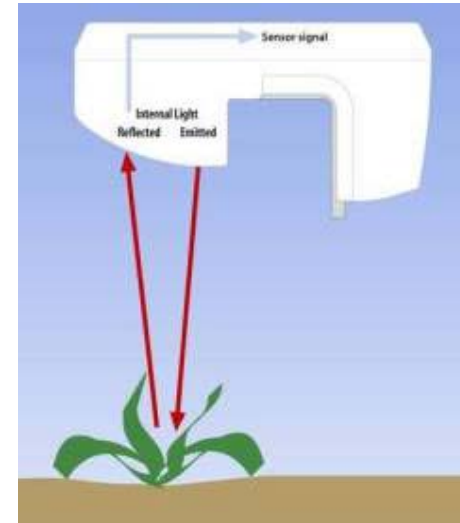
**LARGE  
DENSE**

Images courtesy of Reza Ehsani, University of Florida

# Real Time Sensing

- Active/Passive sensors
  - Nutrient status
  - Disease status
  - Vegetation density (NDVI)
  - Weed spraying

- ?Fruit maturity/colour?



# Current PA research in Horticulture

- Mapping soil water content and water stress to schedule irrigation
  - Localized sensors (eg TDR), linked to soil/water/plant model, localized water controllers (eg microsprays, drippers) – water part of field at a time.
- Vigour mapping vineyards to assist with segregation (*Rob Bramley, CSIRO, Ian Yule NZ*)
  - Vigour mapped using NDVI or using laser scanning , relates to important wine quality characteristics (Brix, pH, bunch number and weight, berry size) = possible to segregate zones into more uniform fruit into the winery.



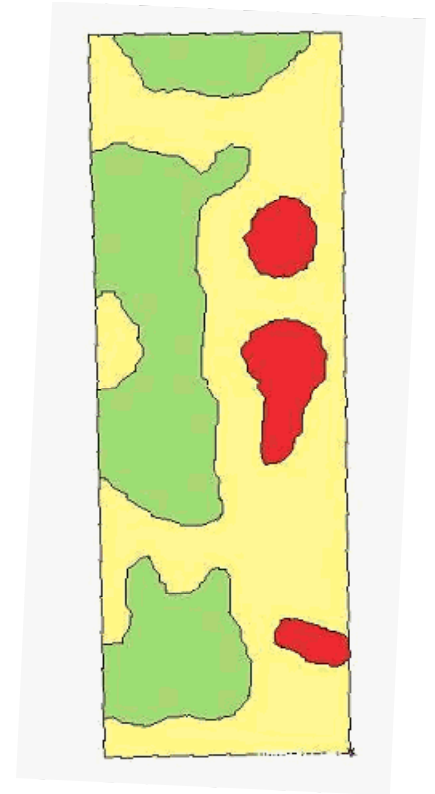
# Current research in Horticulture

- Orchard fruit yield maps

- Picking bins identified and grading mapped back to a few trees in the orchard (eg fruit colour mapped to orchard)
- Enable tracking through cool stores, fertility management of blocks, etc.

- Crop quality prediction

- Mild onions segregated for pungency based on sweetness ( $\text{Brix} > 7.5\%$ ) and pungency ( $\text{pyruvate} < 4 \text{ mg/kg}$ )
- Predict sugar & pyruvate from crop / soil features during growth, develop a harvesting pattern to segregate.
- Moonrocks P/L first batch, HAL, NOLA, I&I NSW



# Opportunities

- Precision horticulture offers:
  - Production efficiency – manage inputs to match targets.
  - Reduced environmental impact – by linking inputs to targets.
  - In-field quality prediction – develop and manage segregations
- Even in grain production, PA impact has yet to be maximized due to cost to collect the appropriate data layers – especially soil information.

Figure 2: Comparison of methods of describing production variability

