VRDI

Variable Rate Drip Irrigation

The next generation of drip irrigation

Almond board of Australia, Nov. 2016

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NETAFIM™

ITAMAR NADAV

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Itamar gained his Ph.D. studying at the Soil & Water Sciences Department, Faculty of Agriculture in Rehovot, Hebrew University of Jerusalem. He published several papers on soil water distribution under water repellent conditions. For the last nine years, he has been project manager and chief agronomist at the R&D department of NETAFIM. Itamar's main responsibilities include soil sensors implementation, testing and development and precision agriculture implementation. His work includes experimentations in advanced drip irrigation technology involving remote sensing and precision agriculture as well as advanced modelling for irrigation scheduling.

Uniform application

- Applying the same rate (amount) across the field
- Over/under applications
- Low application efficiency (high costs)

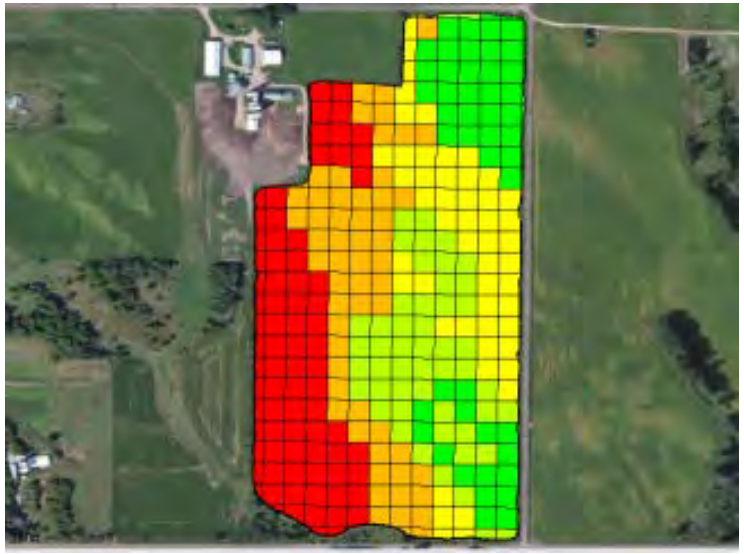
Variable rate application

- Applying different rates (amounts) across the field
- Adequate application for each zone
- high application efficiency (lower costs)

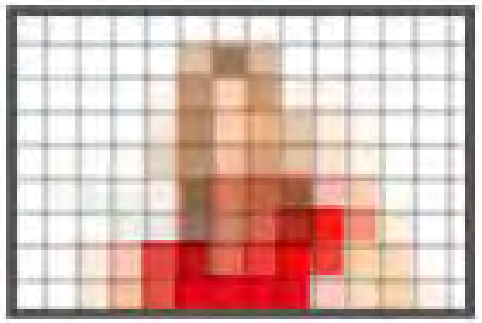
VARIABLE RATE APPLICATIONS

- Fertilizers
- Pesticides
- Herbicides
- Tillage
- Seedling
- Irrigation

Management zones



WHAT'S IN THE PICTURE?



Lesson of the day: **higher resolution is better!**

OBJECTIVES

- VRDI aims to eliminate/reduce spatial variability
- Variability in yield
- Variability in quality

Causes for variability:

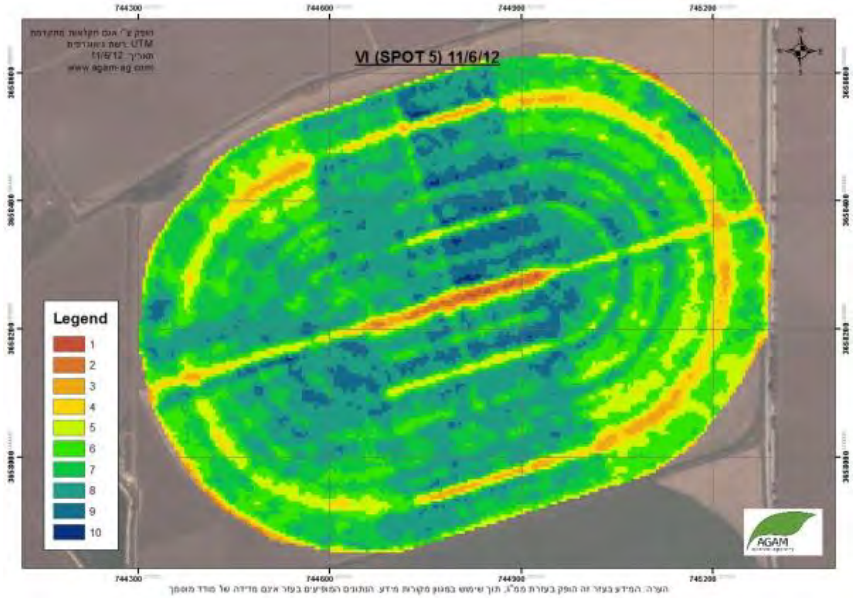
- Sloped plots
- Different types of soils
- Soil depth
- other

TARGET CROPS

- Perennial crops
- Vineyards
- Citrus
- Almonds
- Avocado
- ……

MEASURING VARIABILITY

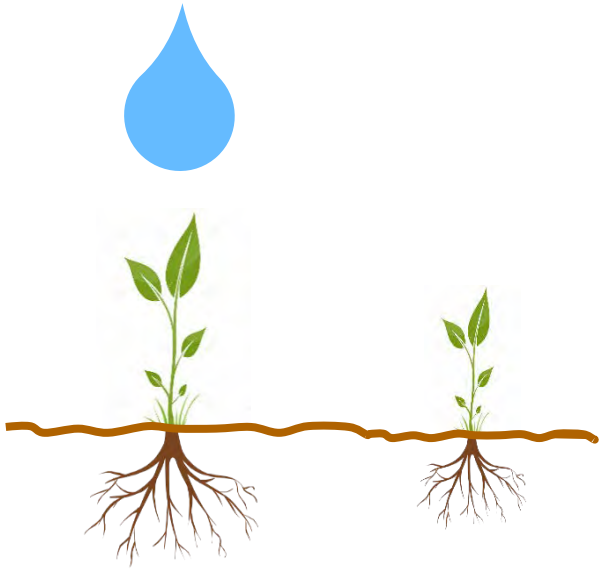
- Yield map
- Remote sensing (NDVI)
- Soil texture (VERIS)
- Proxy sensors



DIFFERENT APPROACHES FOR VRI

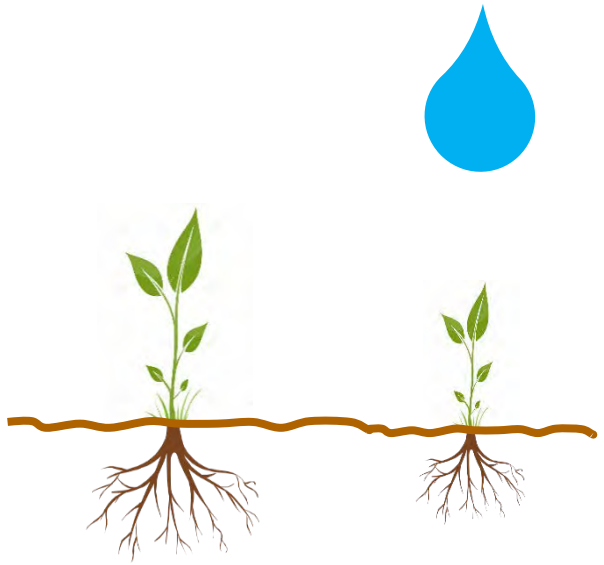
The capitalistic approach

(increase variability)



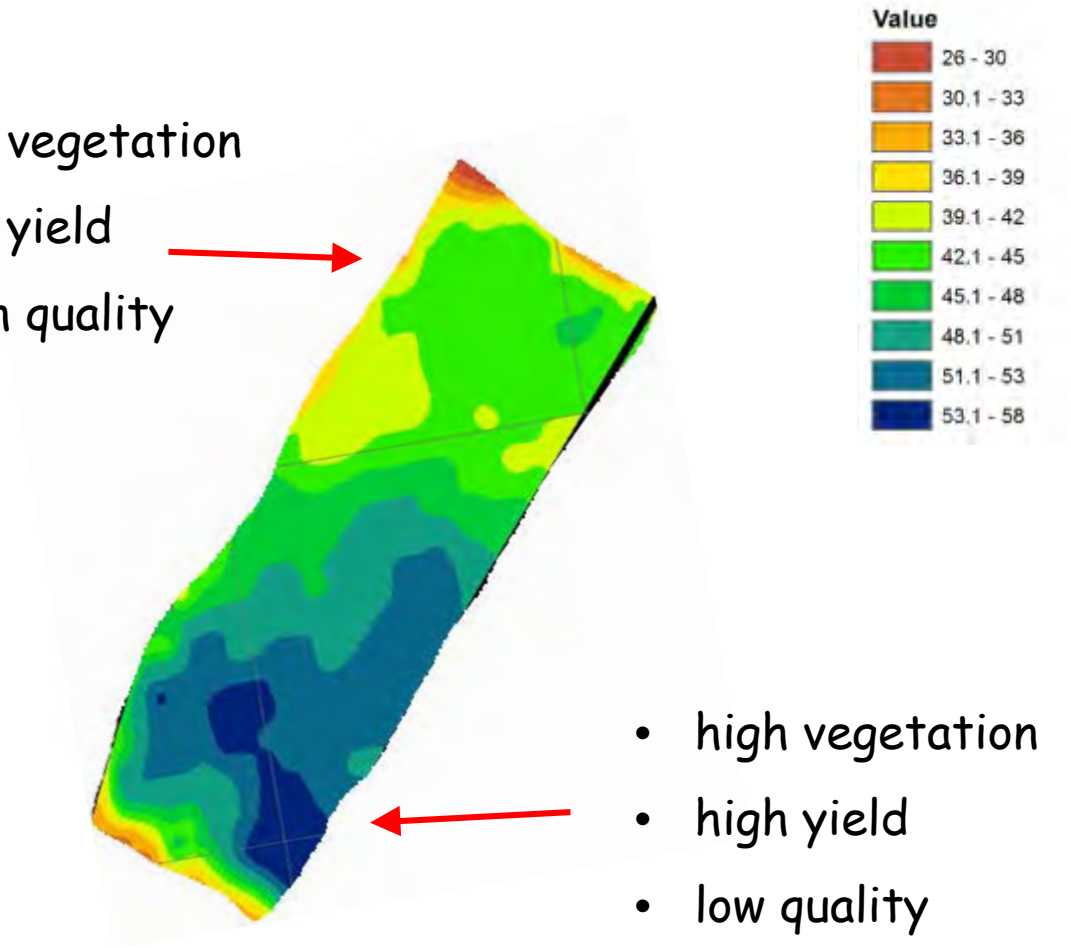
The socialistic approach

(reduce variability)



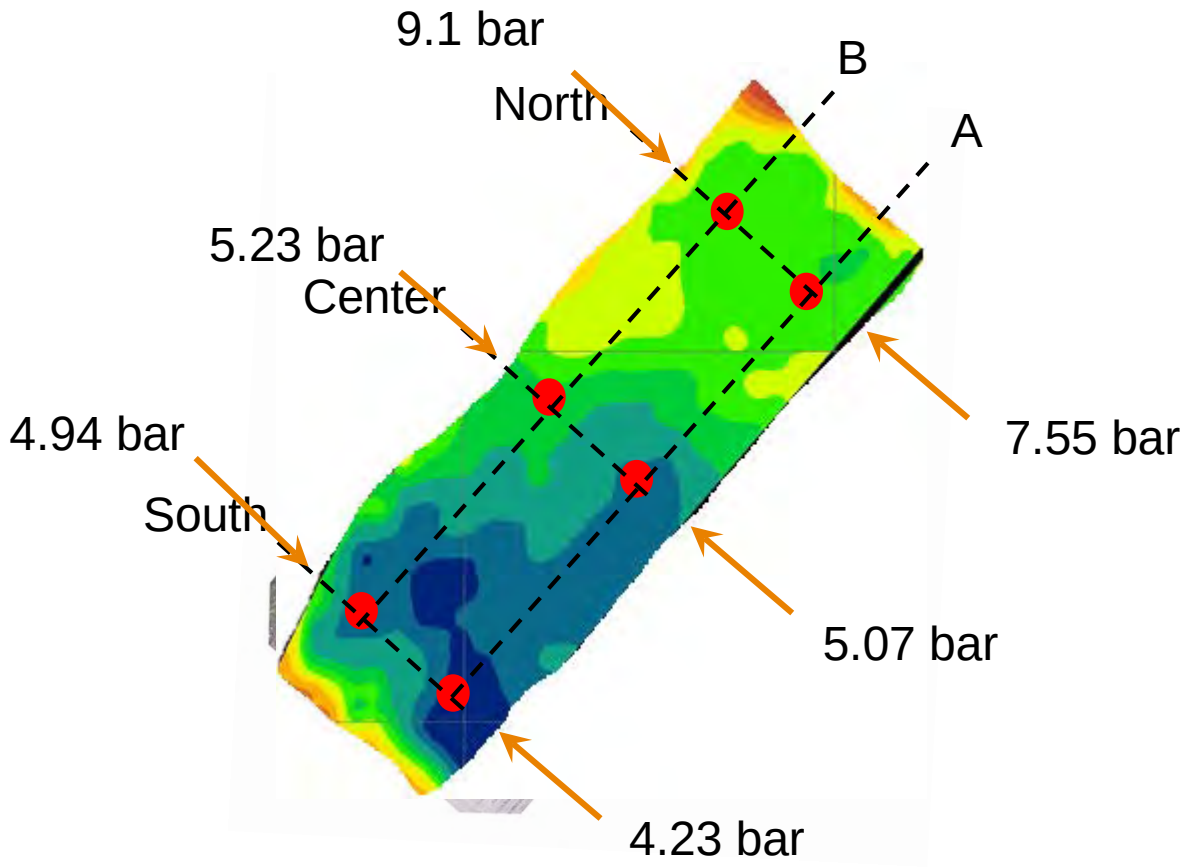
CASE STUDY: VINEYARD

- 2006 Syrah variety vineyard.
- 1.2 hectare.
- Variable vegetation, yield and quality in the same plot.

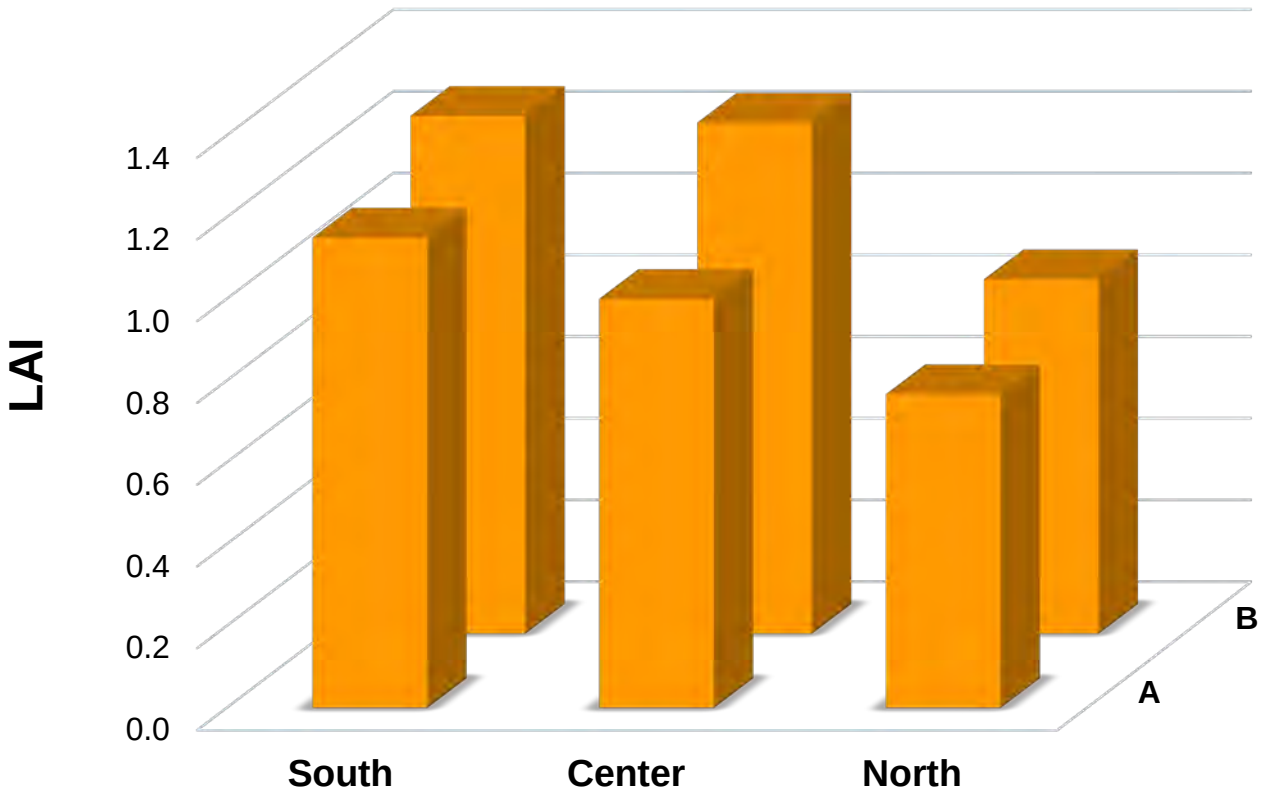


PRE-VDRI RESULTS

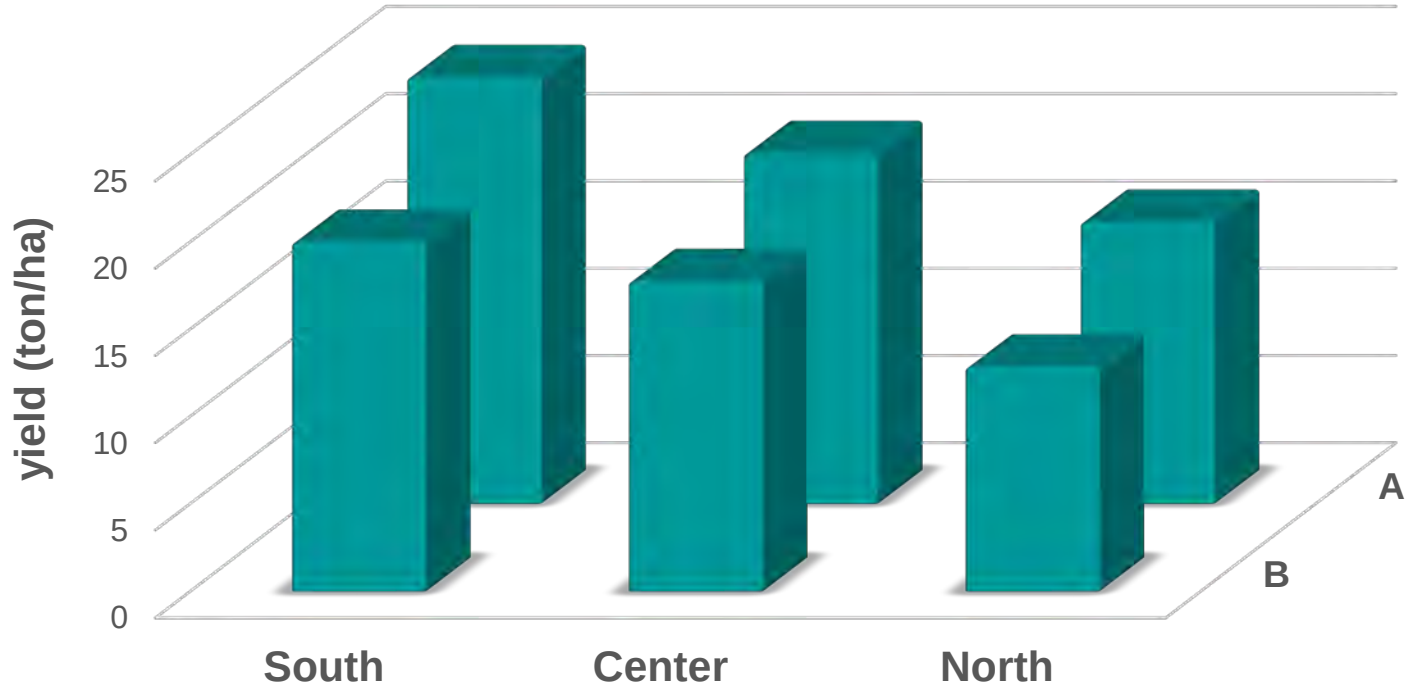
SWP- mid season



PRE-VDRI RESULTS

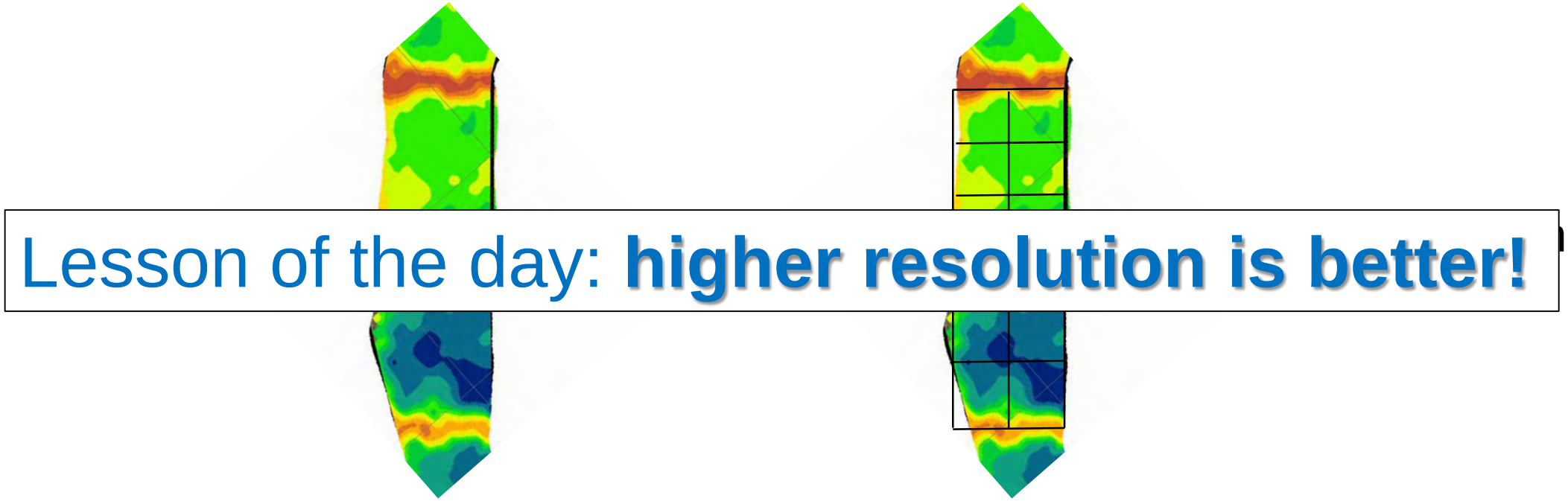


PRE-VDRI RESULTS



THE PROBLEM: VARIABILITY

The solution: VRDI



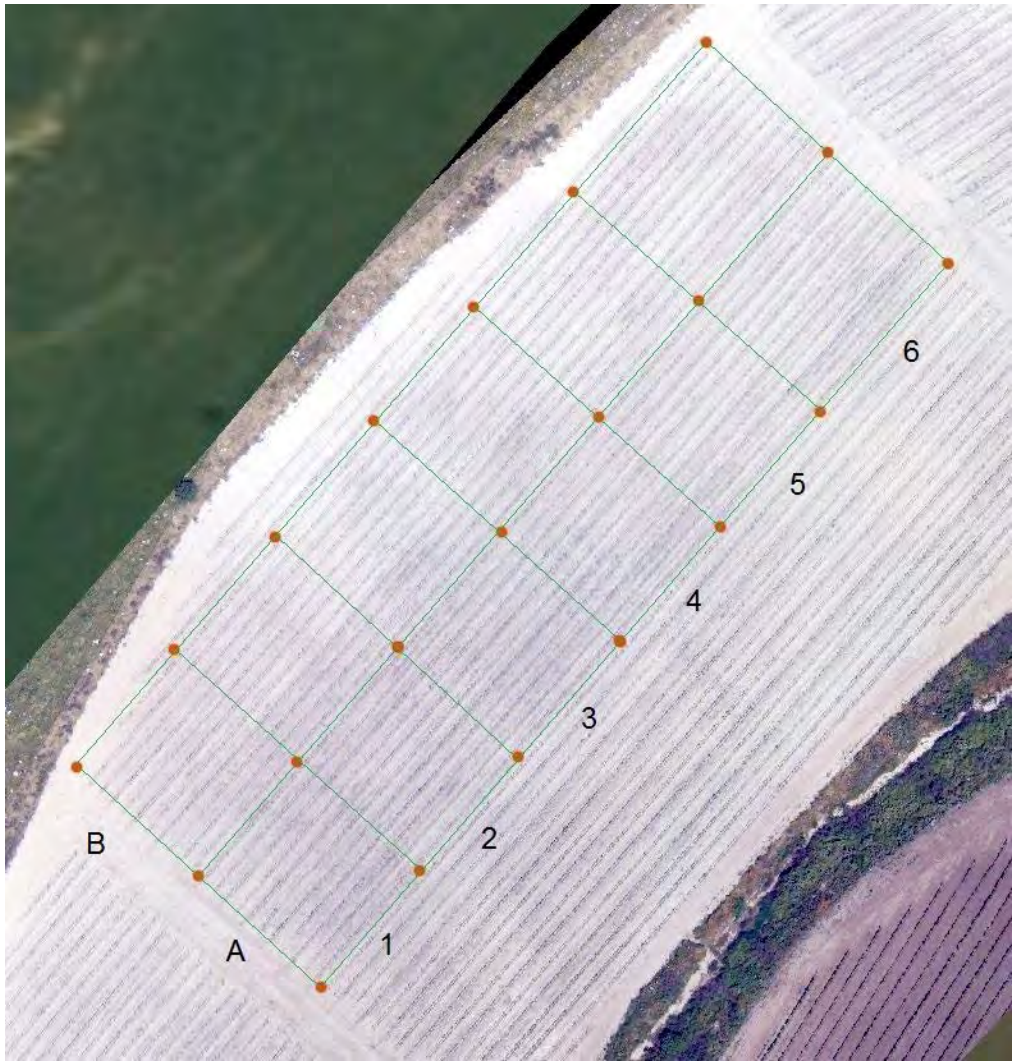
Lesson of the day: **higher resolution is better!**

1 irrigation zone

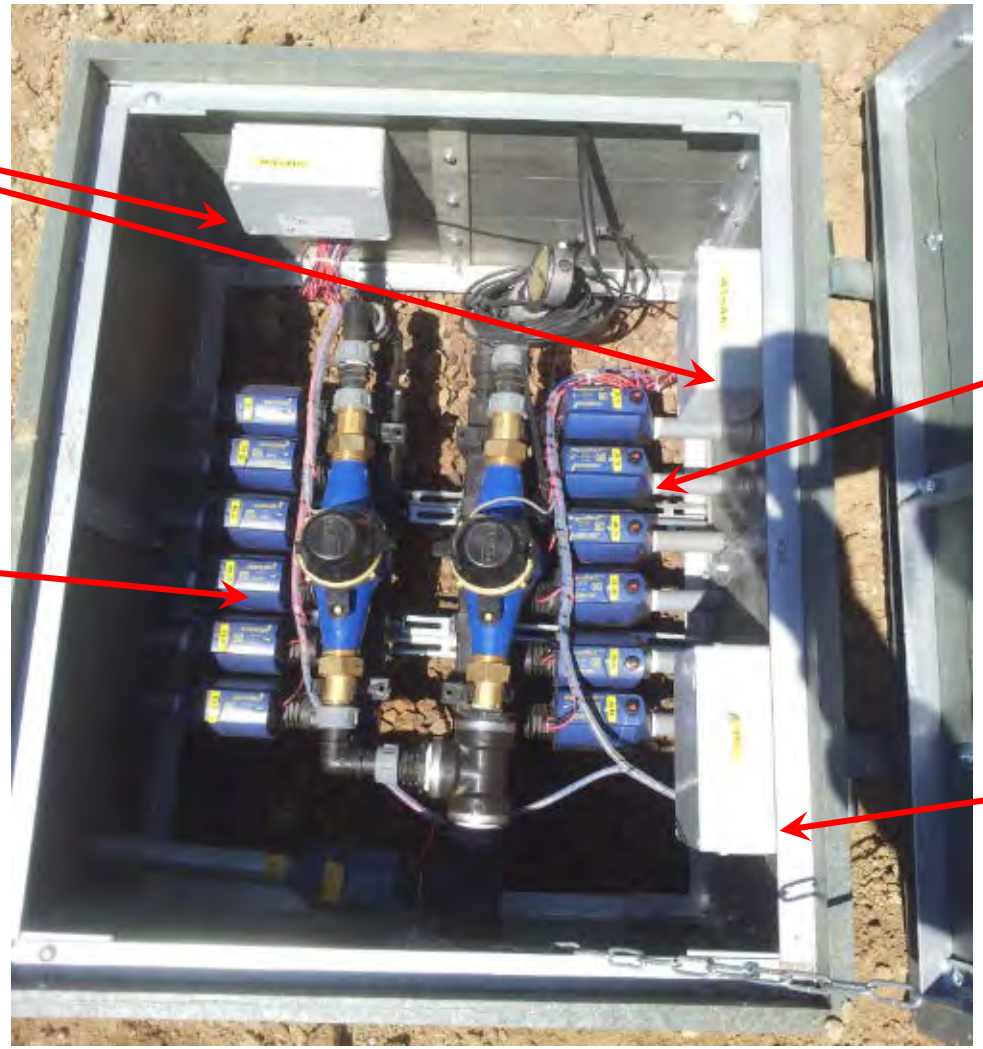
12 irrigation zones

VRDI SUB PLOTS

- Dividing the plot into 12 sub irrigation zones (A1…A6; B1…B6).
- Each subplot can be irrigated separately.
- Each irrigation subplots is irrigated to achieve goal yield and quality.



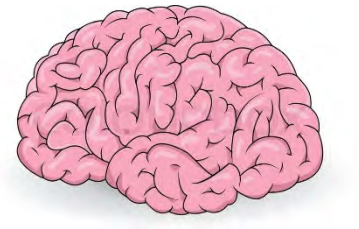
SYSTEM HEAD


Controllers
A1-A6 valves and water meter
B1-B6 valves and water meter
Solar panel charged battery

SYSTEM INSTALLATION

- Left: system head is levels with ground surface
- Right: no sign for the installation…

THE VRDI SYSTEM COMPONENTS

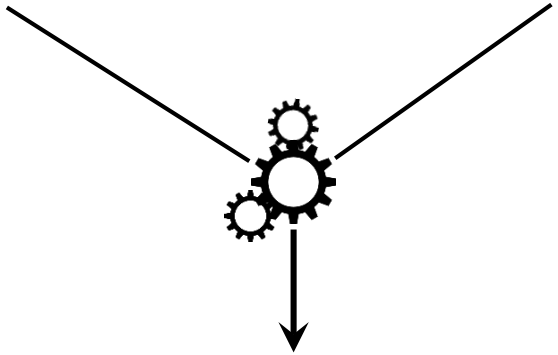


Software

- Remote sensing
- Algorithm
- DSS

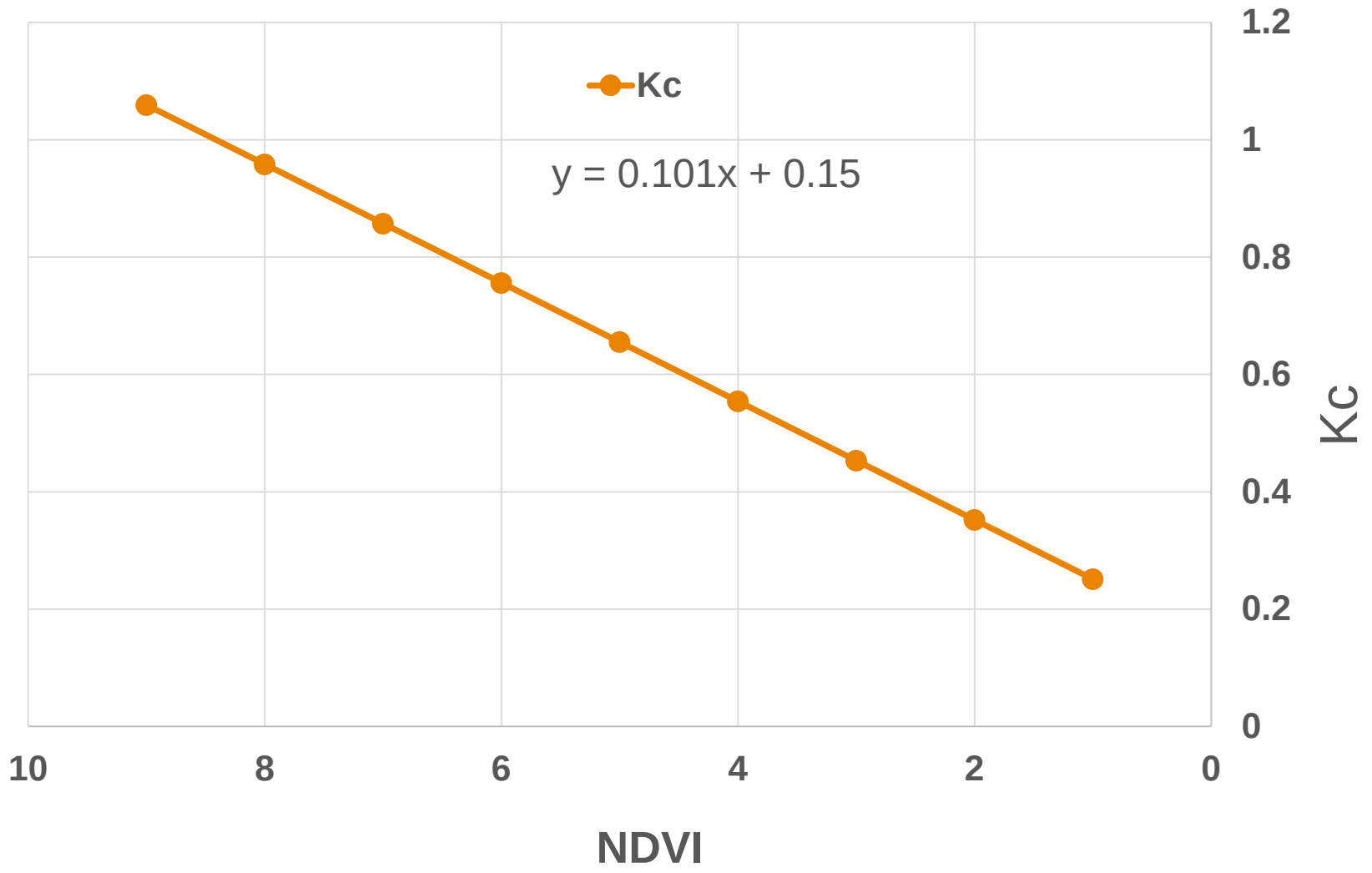
Hardware

- Driplines
- Valves
- Controllers



Variable rate irrigation according to the spatial variability in the field

KC-NDVI MODELS



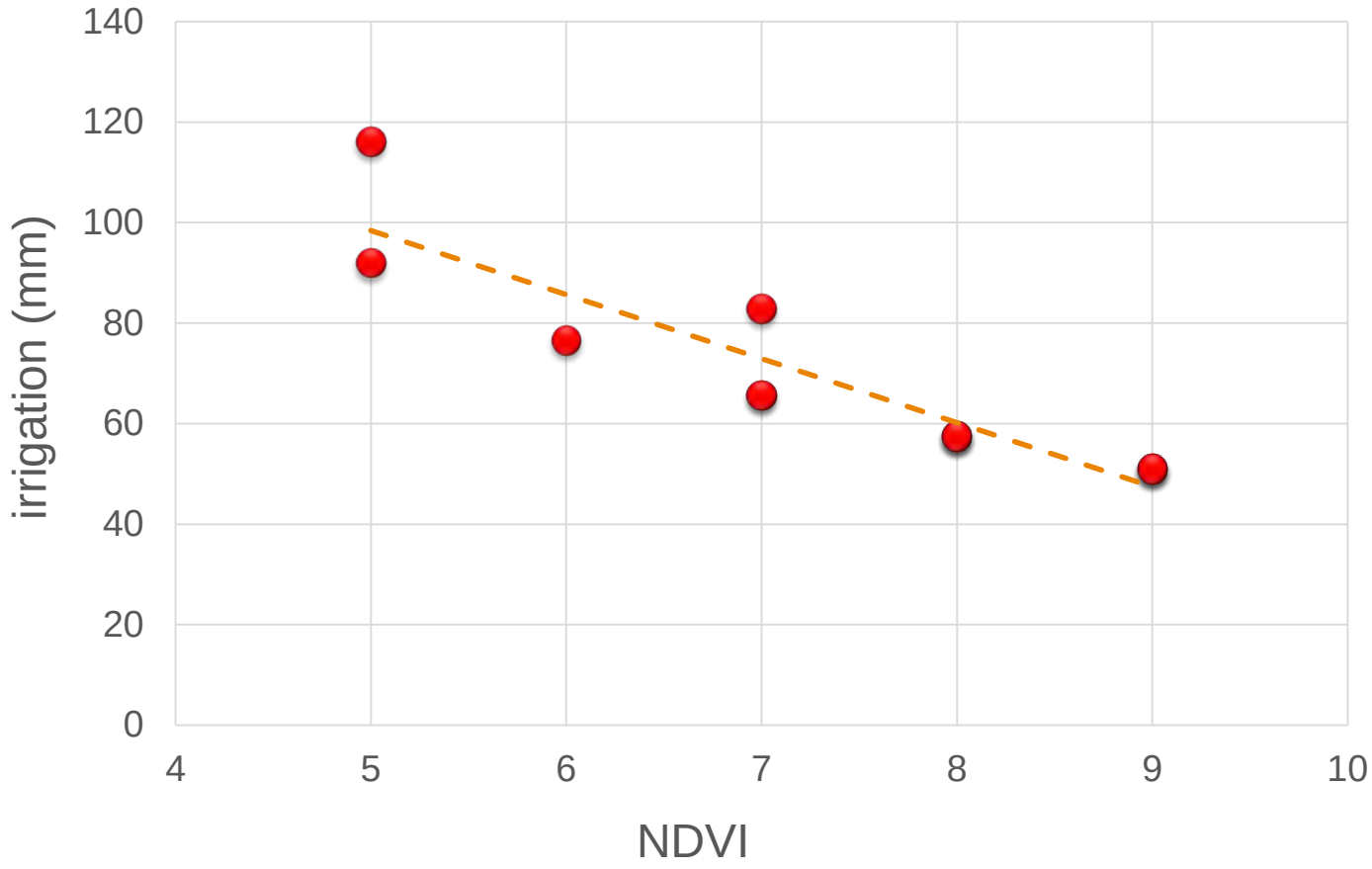
PIXELS IRRIGATION MODEL

- Kc=0.15+(NDVI*1.01*0.1)
- ETc = ETo x Kc
- Irrigation per pixel: ETc x Stress factor (0.2-0.5)

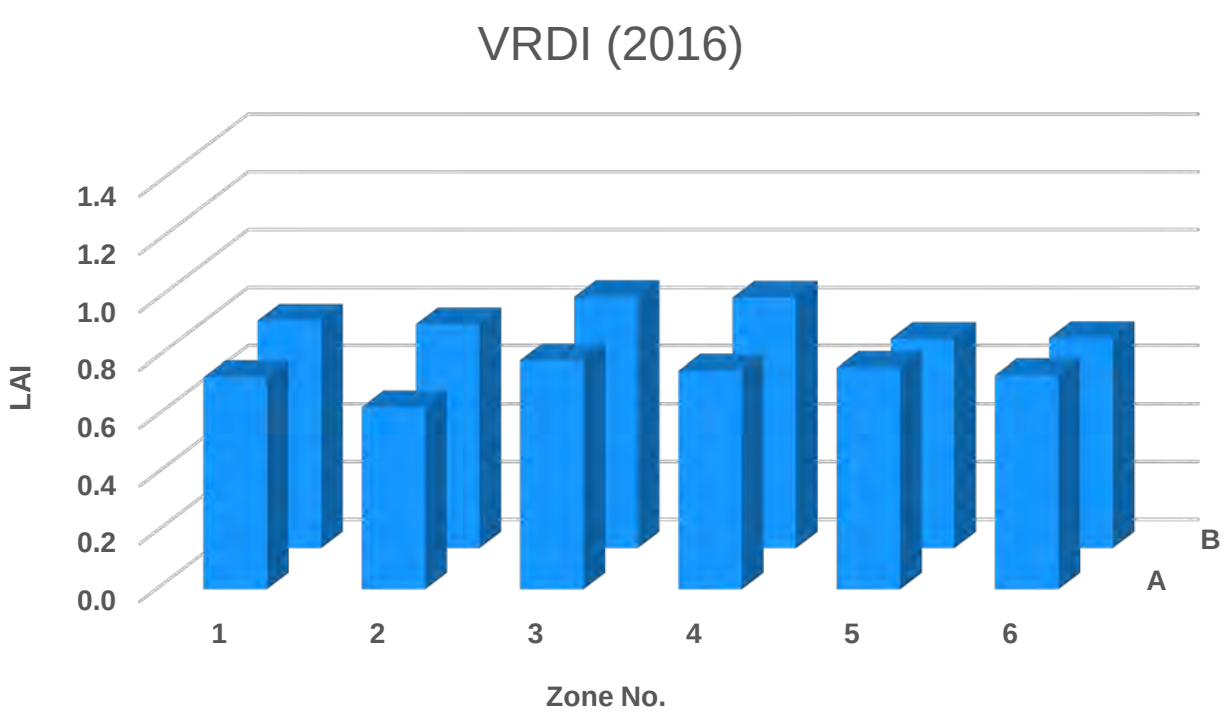
- Compensated irrigation: ETc x Stress factor (0.2-0.5) x $\frac{Ref.\ NDVI}{Pixcel_i\ NDVI}$ $\left[\frac{5}{2}\right]\times 1$
- Early irrigation at low NDVI zones

NDVI VS. IRRIGATION (2015)

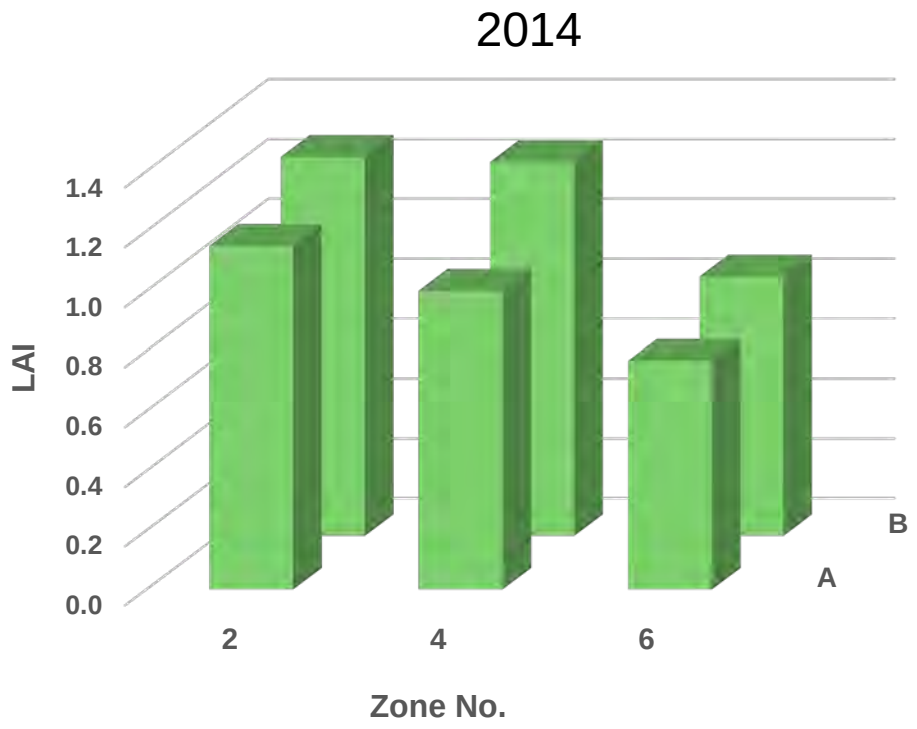
Larger plants (high NDVI) get less water than smaller plants (low NDVI)



PHYSIOLOGICAL MEASUREMENTS- LAI

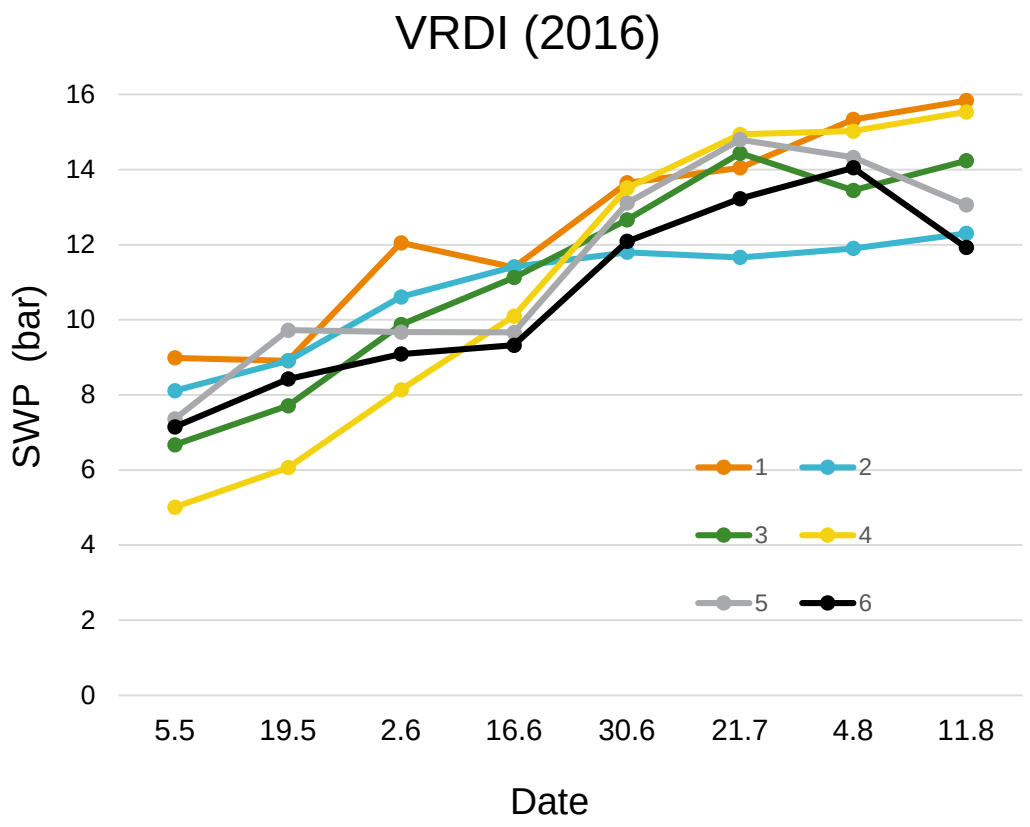


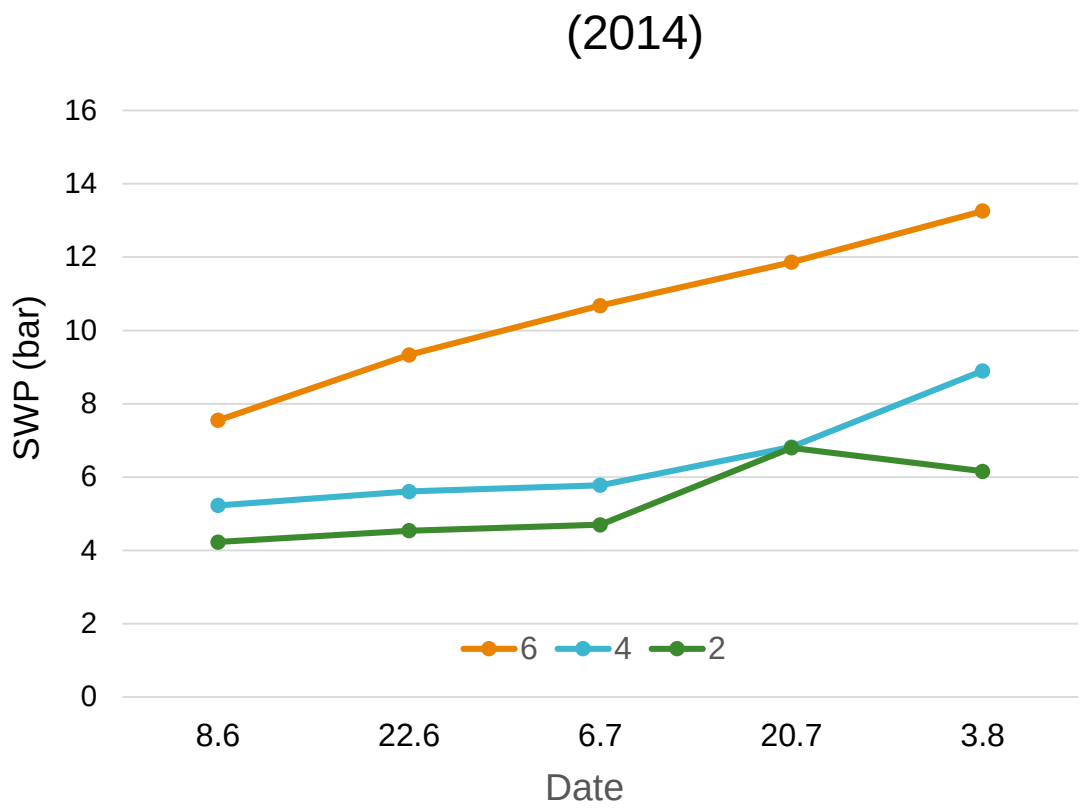
South → North



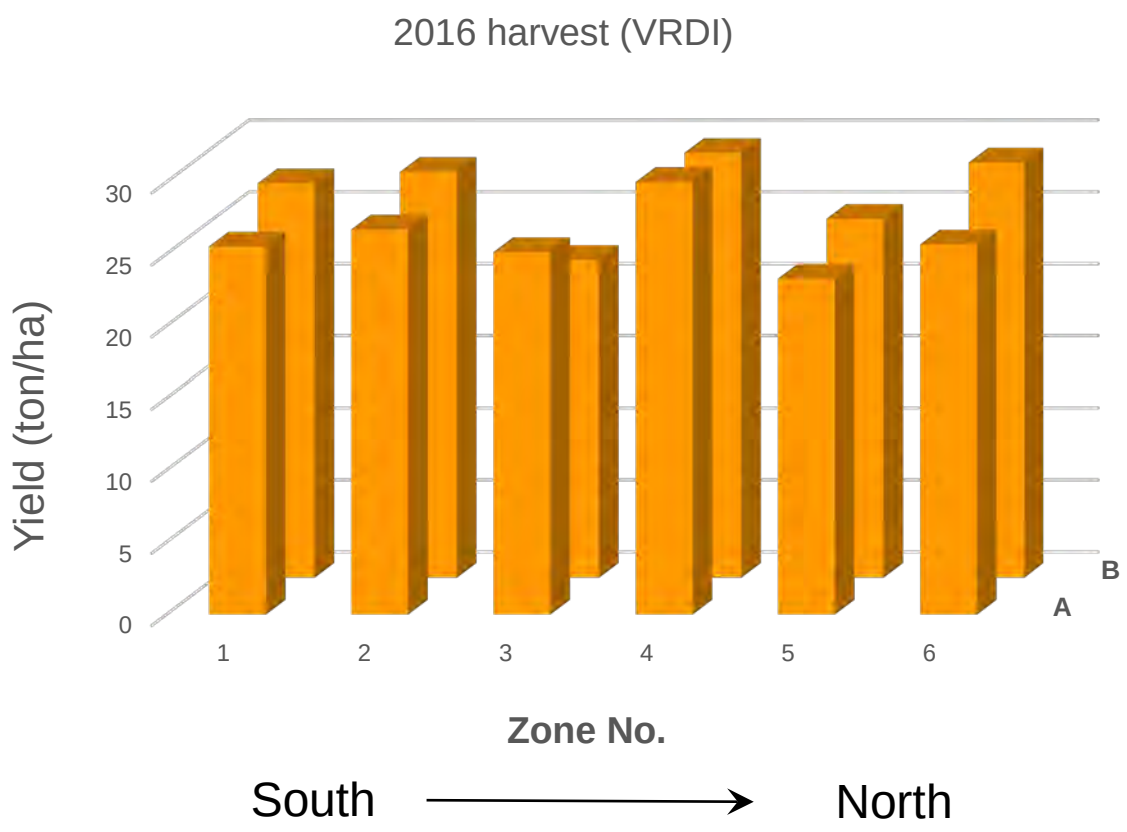
South → North

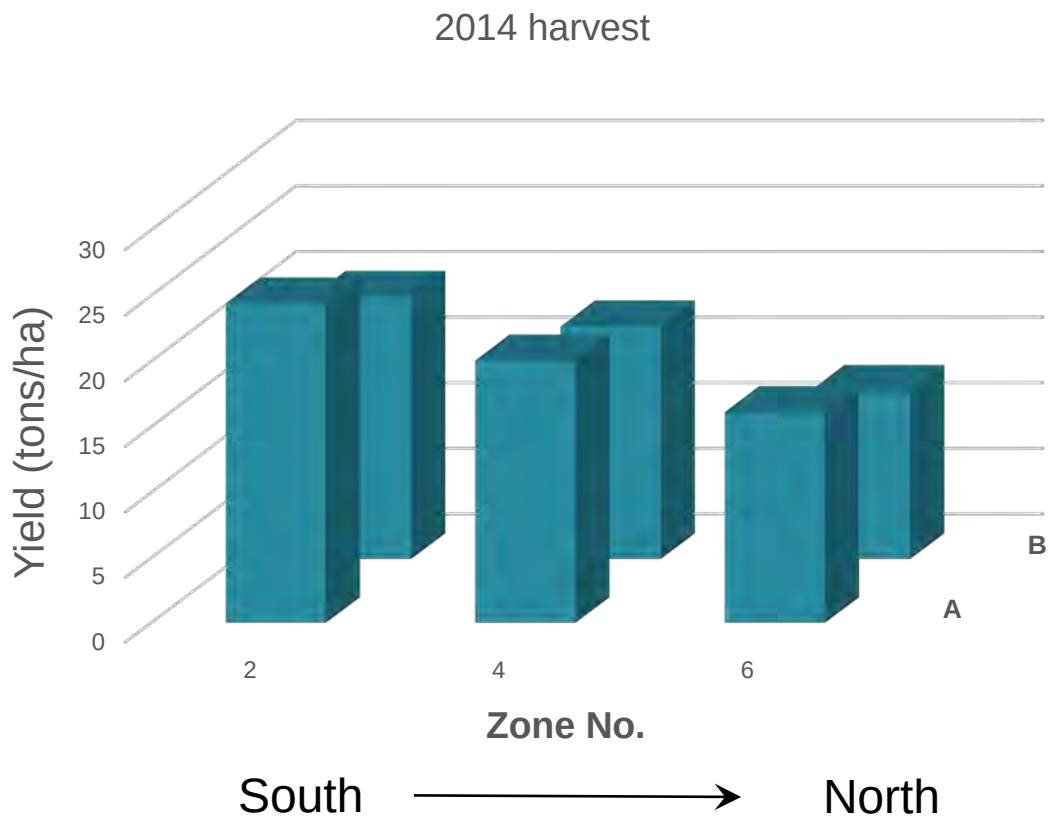
PHYSIOLOGICAL MEASUREMENTS- WATER POTENTIAL



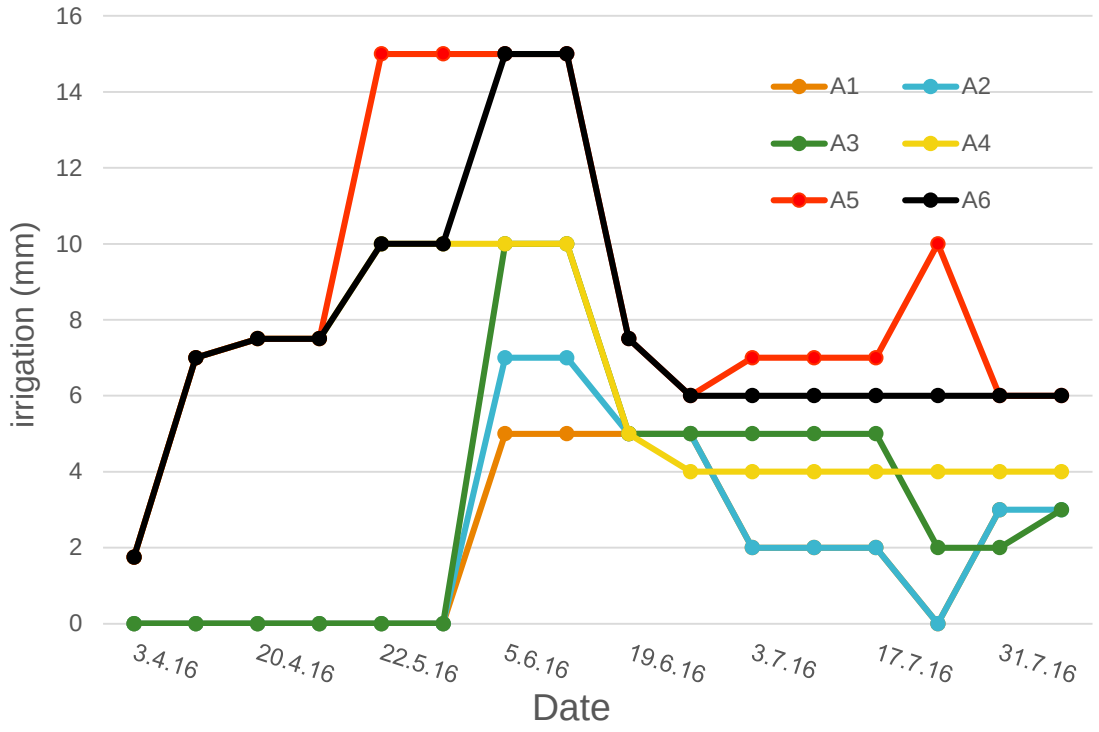


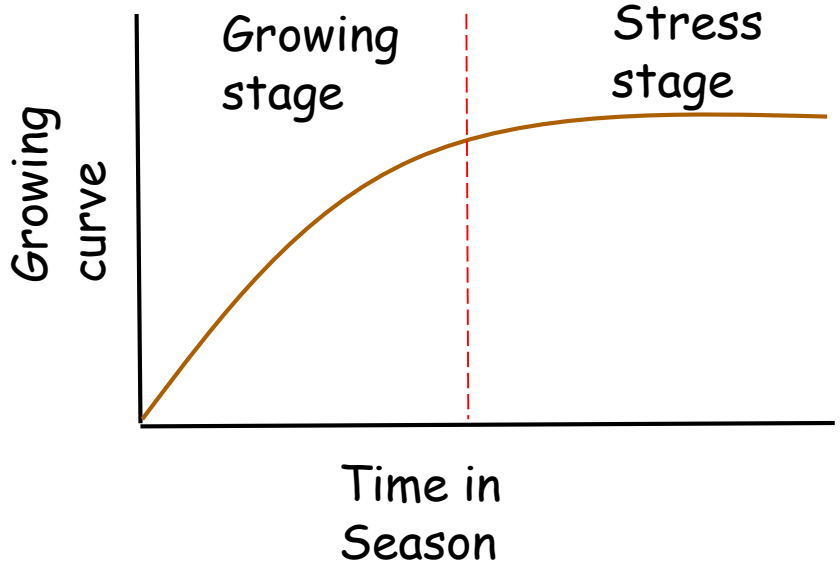
YIELD RESULTS

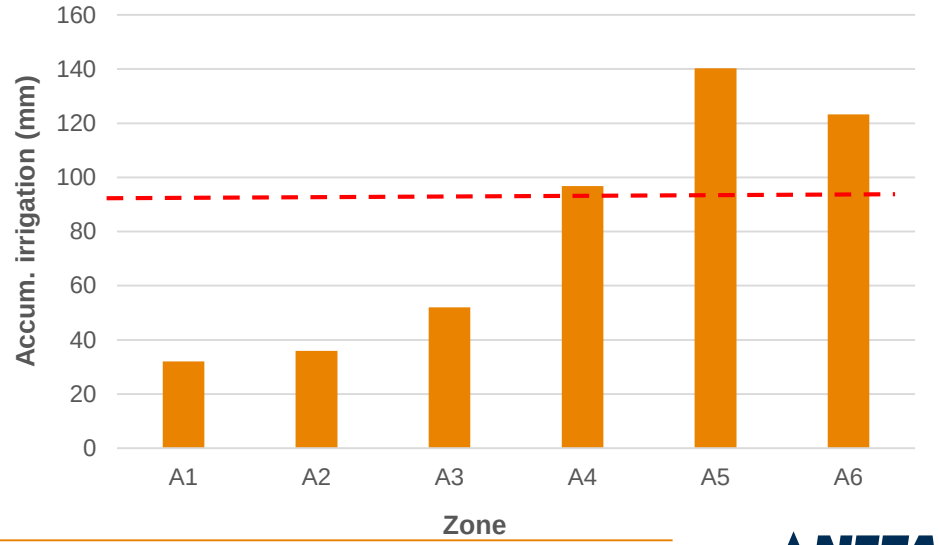




IRRIGATION SCHEDULING



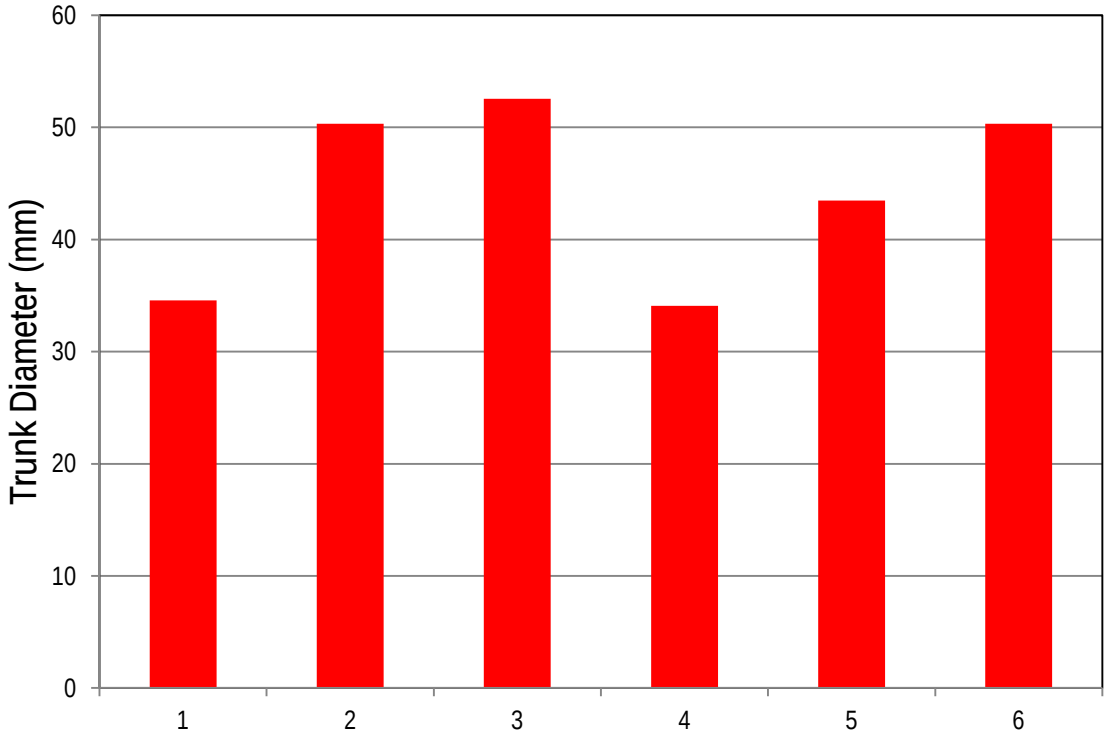




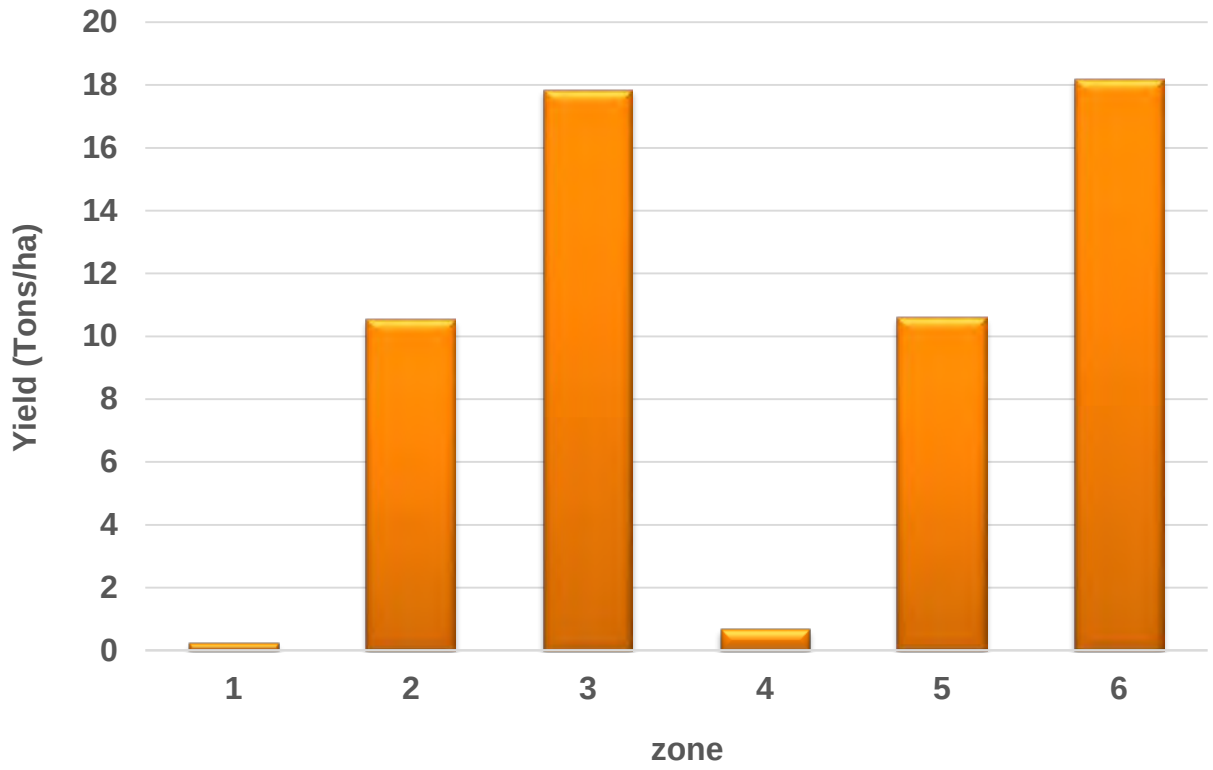
VARIABILITY IN A CITRUS PLANTATION

- 3 ha of clementine citrus plantation
- Sloped field with variable soil depth.
- Variable tree size and yield

VARIABILITY IN AN CITRUS



YIELD 2014

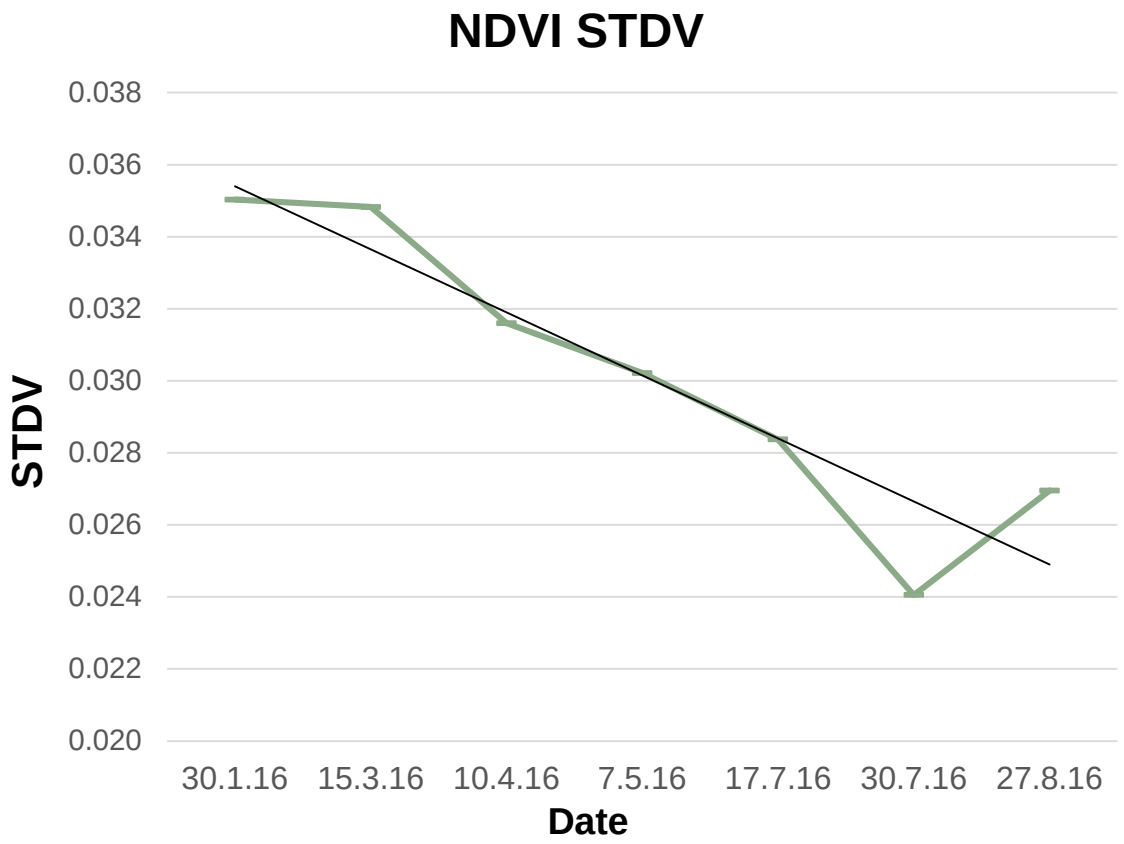


DIVIDING TO SUBPLOTS

- The plot was divided into 28 sub plots
- Each plot can be separately irrigated

1ST YEAR SUMMERY

- Increased number of fruits
- Increased tree size
- Reduced NDVI differences.



E. & J. GALLO

- Livingston Ranch, CA.
- 23 acres
- 96 irrigation pixels
- Highly variable

NEXT STEPS

- 40 acres of VRDI in almonds (wonderful, ABC)
- Additional 200 acres of VRDI in vineyard (E&J Gallo)
- 5 acre of VRDI in Greece
- VRDI in other crops and regions (Australia, South Africa)
- System improvements, optimization and cost reduction

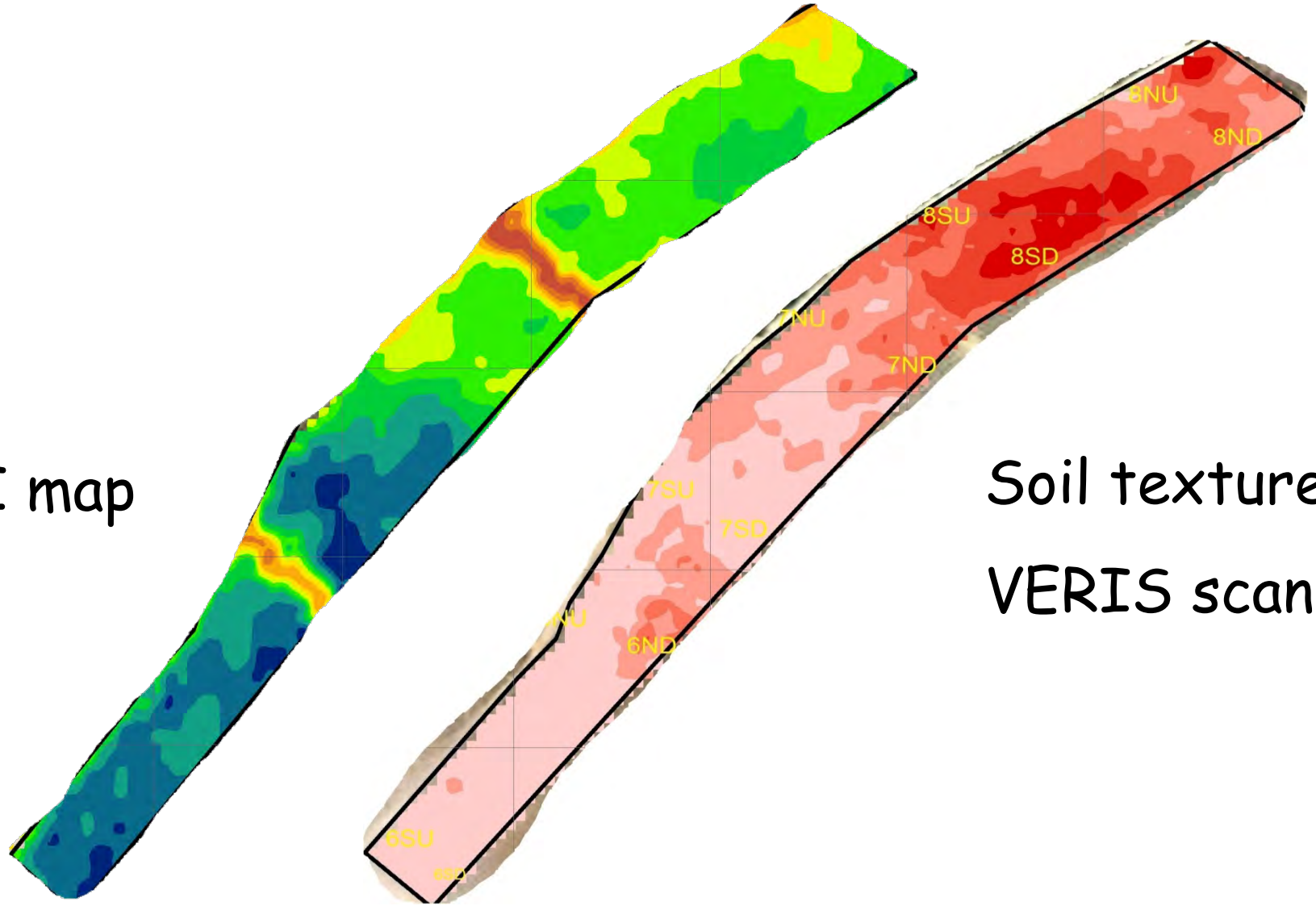

THANK
YOU
NETAFIM™

CASE STUDY: VINEYARD

- 2006 Syrah variety vineyard.
- 3.6 hectare.
- Variable vegetation, yield and quality in the same plot.

VINEYARD VARIABILITY

NDVI map



Soil texture by VERIS scanning