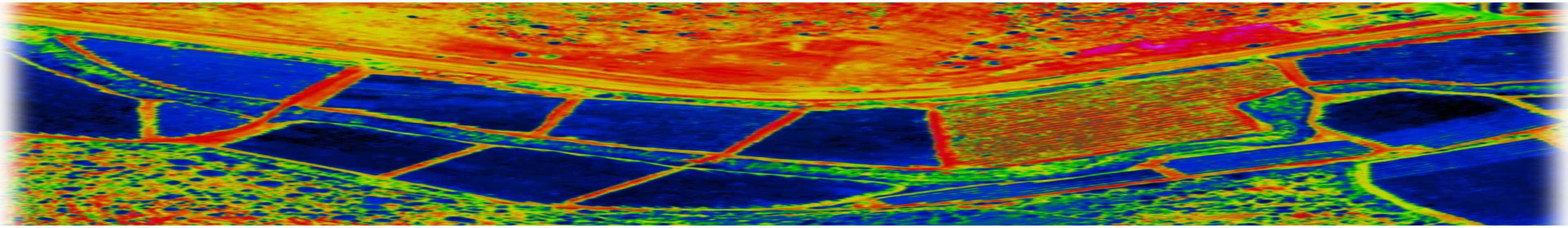


Adding precision to precise irrigation

Yafit Cohen, PhD

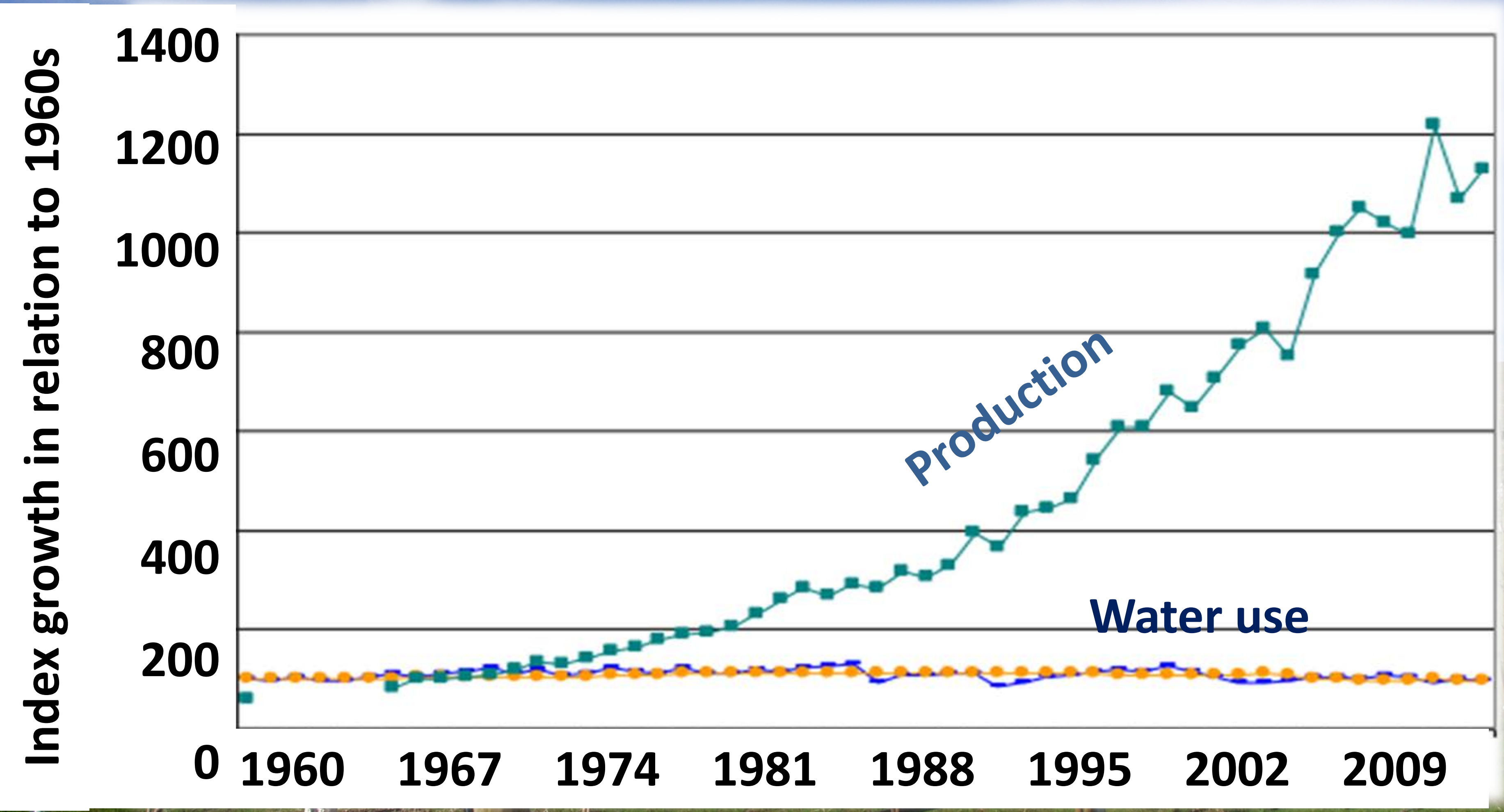
Institute of Agricultural Engineering
Agricultural Research Organization,
Volcani Center, Israel

Methods and technologies to improve efficiency of water use (yield per irrigation unit)

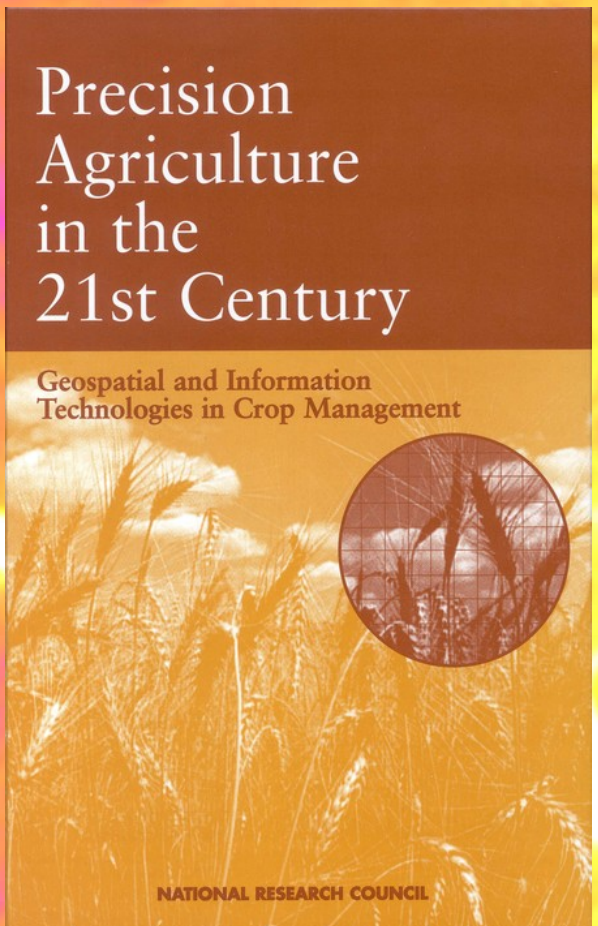
Robert G. Evans, E. John Sadler, 2008

- Agricultural advances will include:
  - Conversion to crops with higher productivity per unit of water consumed,
  - Development of precision irrigation technologies for sprinklers and micro-irrigation systems

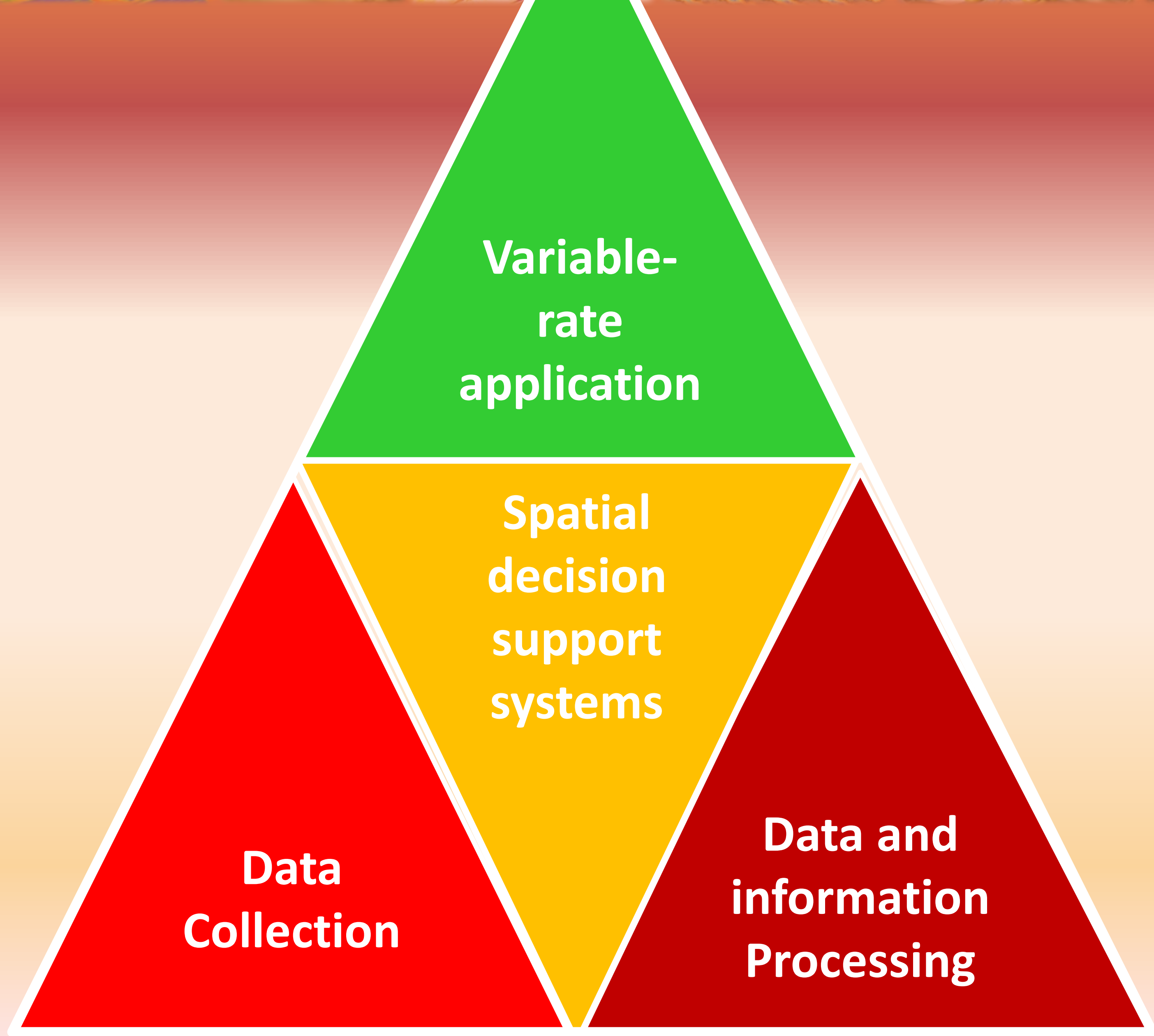
Water use efficiency in Israel



Precision agriculture

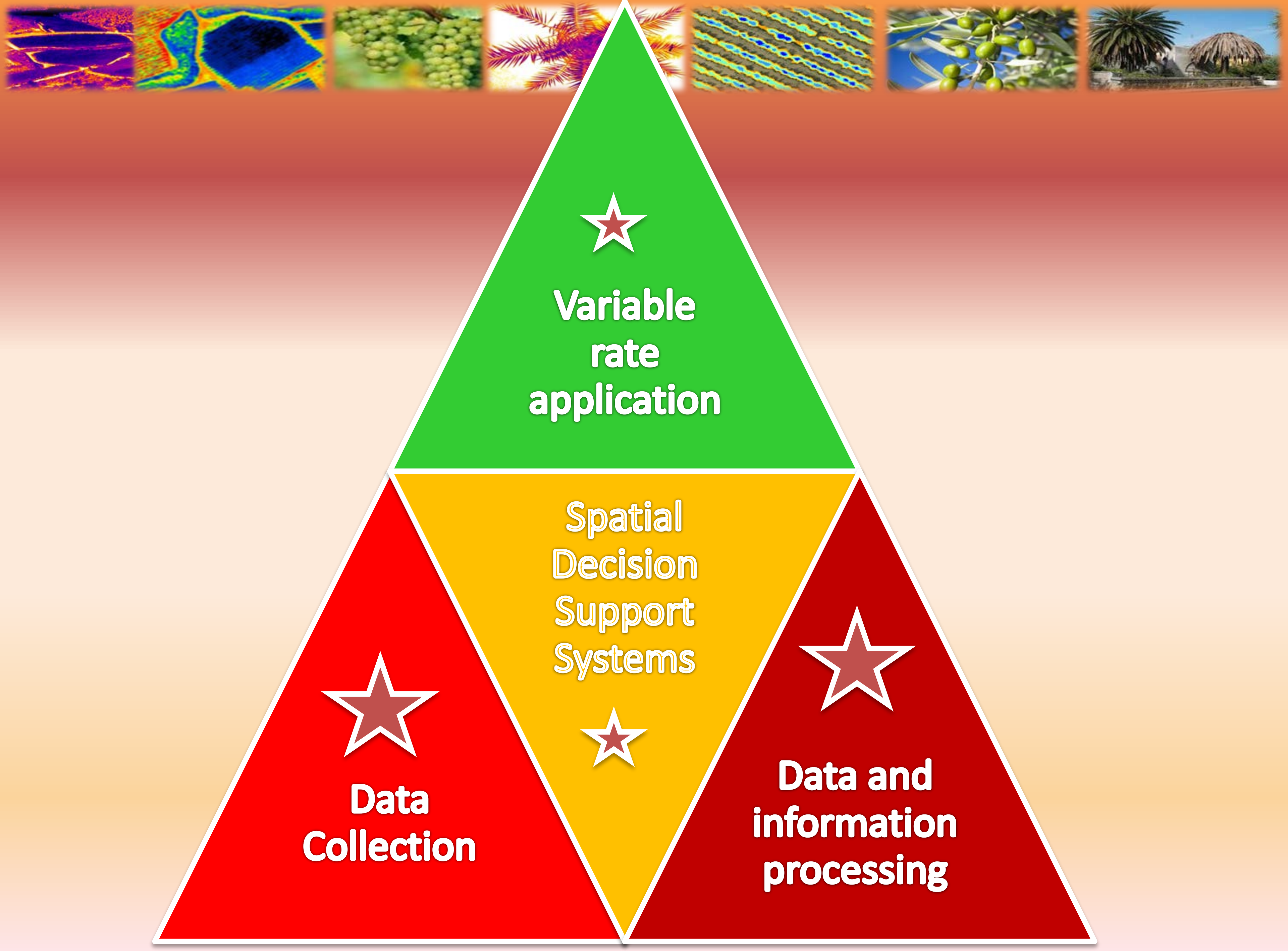


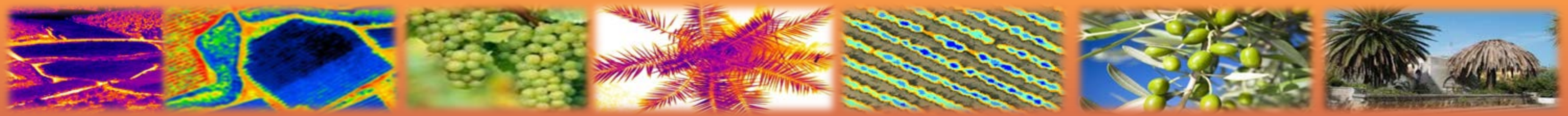
A management strategy that uses ***information technologies*** to bring data from multiple sources to bear on decisions associated with crop production (1997)


Variable-rate application
Spatial decision support systems
Data Collection
Data and information Processing

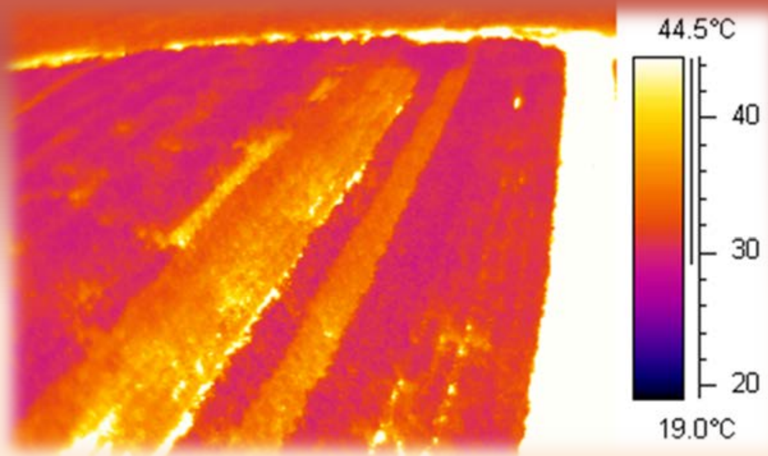
From data collection to VRI

1. Data collection to map the in-field variability
   – Mostly indirect measurements like NDVI and plant temperature
2. Data processing
   – Transformation into meaningful measures
3. Spatial DSS
   – Strategies for variable rate irrigation
4. Variable rate application technologies


Variable rate application
Spatial Decision Support Systems
Data Collection
Data and information processing



Thermal imagery for irrigation

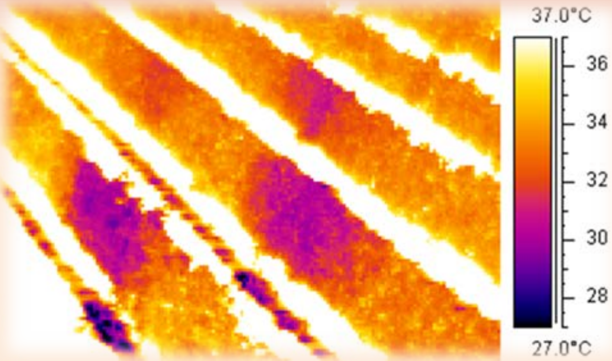


- Detection of irrigation malfunctions

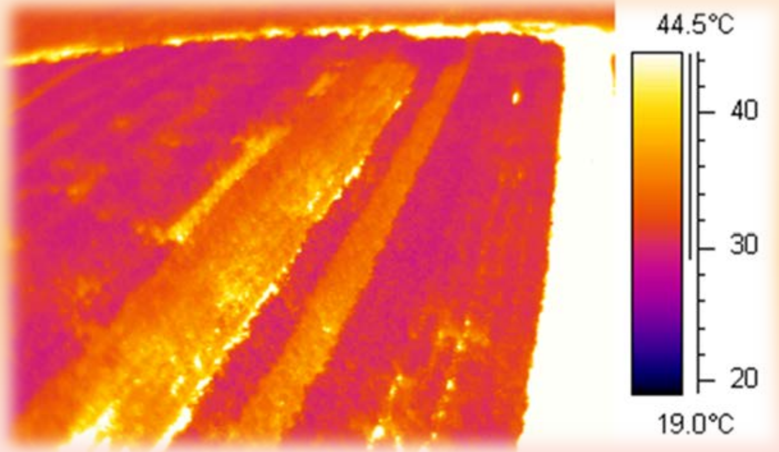
- Water status mapping and Irrigation management

Thermal imagery for irrigation

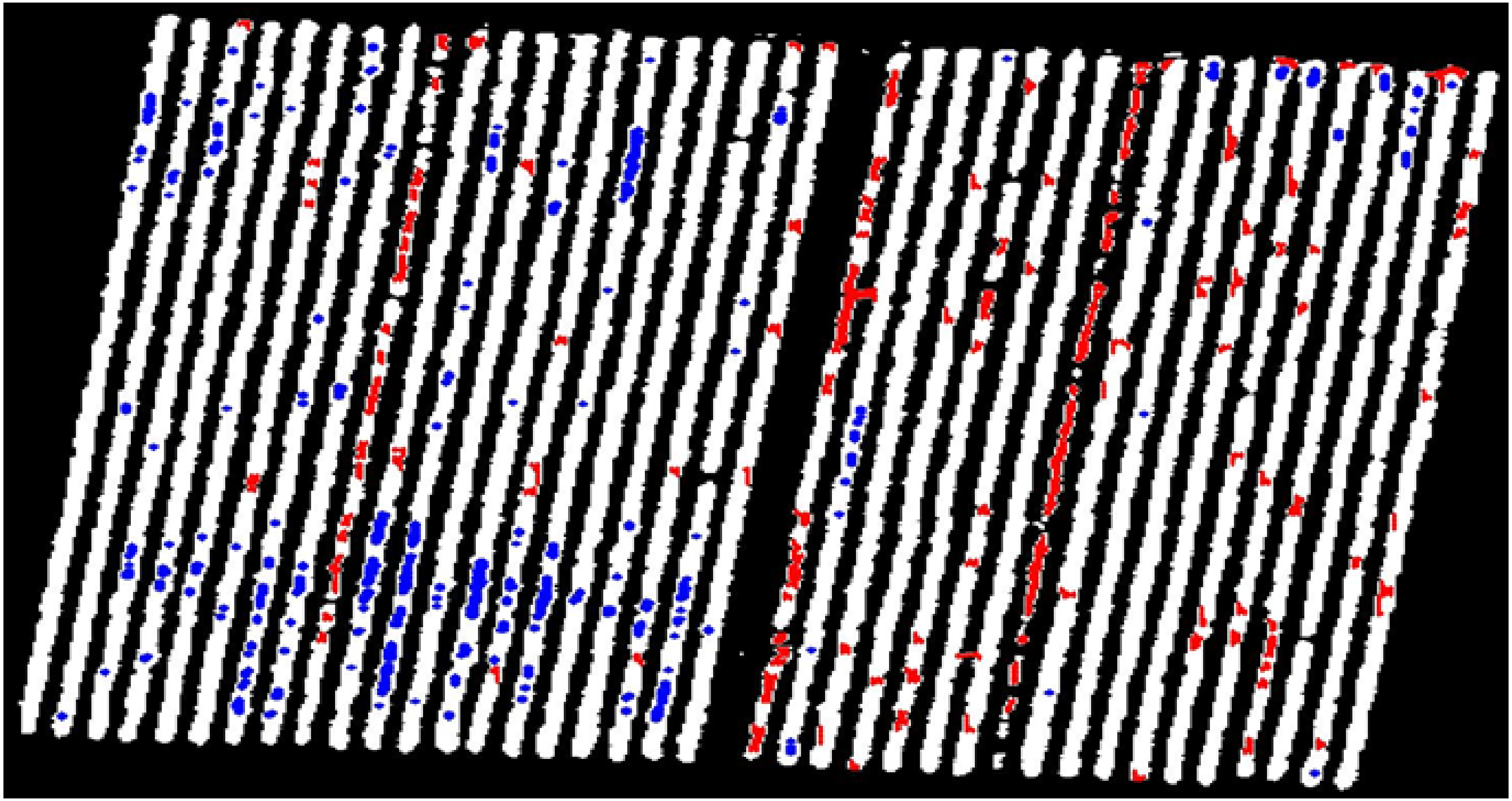
- **Detection of irrigation malfunctions**



- Water status mapping and Irrigation management

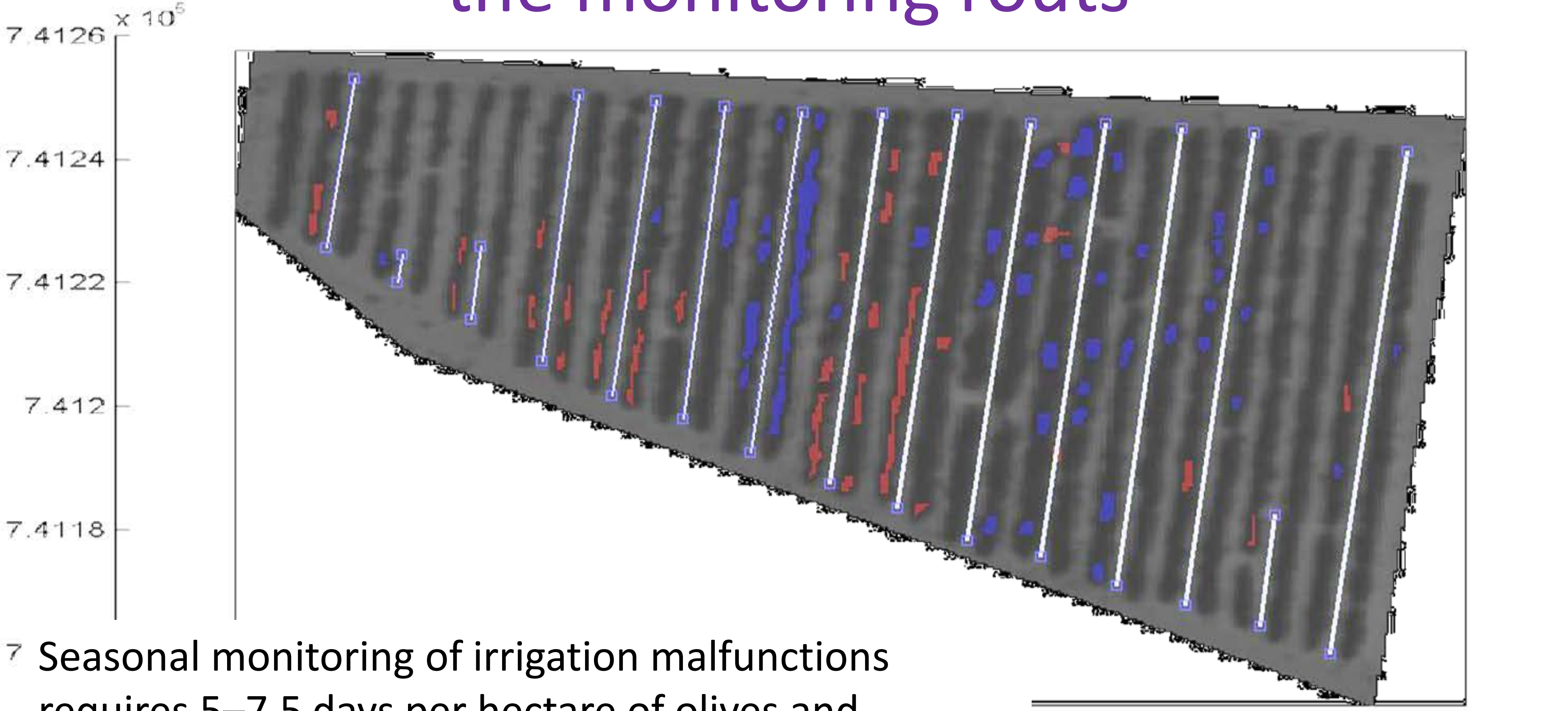


Map of irrigation malfunctions

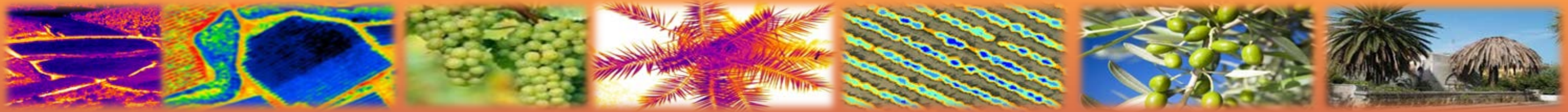


Red – clogs; Blue- leaks

'Waze' for the farmers: the monitoring routs



- Seasonal monitoring of irrigation malfunctions requires 5–7.5 days per hectare of olives and grapevines. The thermal-based detection system can reduce this to 3–4 days.



Thermal imagery for irrigation

- Detection of irrigation malfunctions

- Water status mapping and Irrigation management

CWSI – Crop Water Stress Index

- The index based on canopy temperature (Tcanopy) and extreme reference temperatures:

$$CWSI = \frac{(T_{canopy} - T_{min})}{(T_{max} - T_{min})}$$

(Idso *et al.*, 1981)

  - T_{max} – Heavy Water Stress, Closed Stomata, low transpiration.
  - T_{min} – Full Transpiration, Open Stomata, high transpiration.

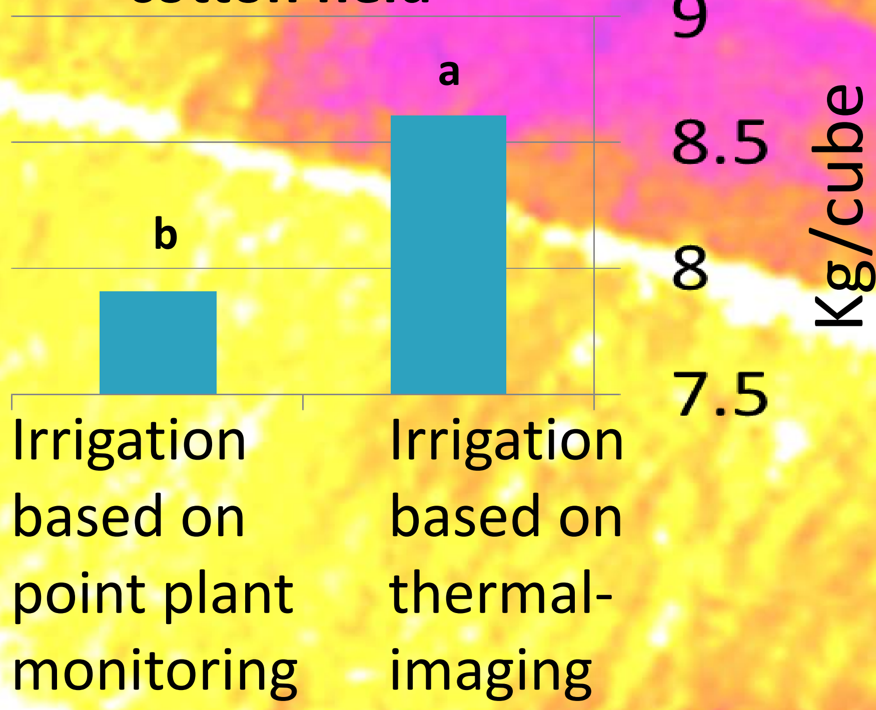
Min = 0 = well-irrigated

1 = Max = heavy water stress

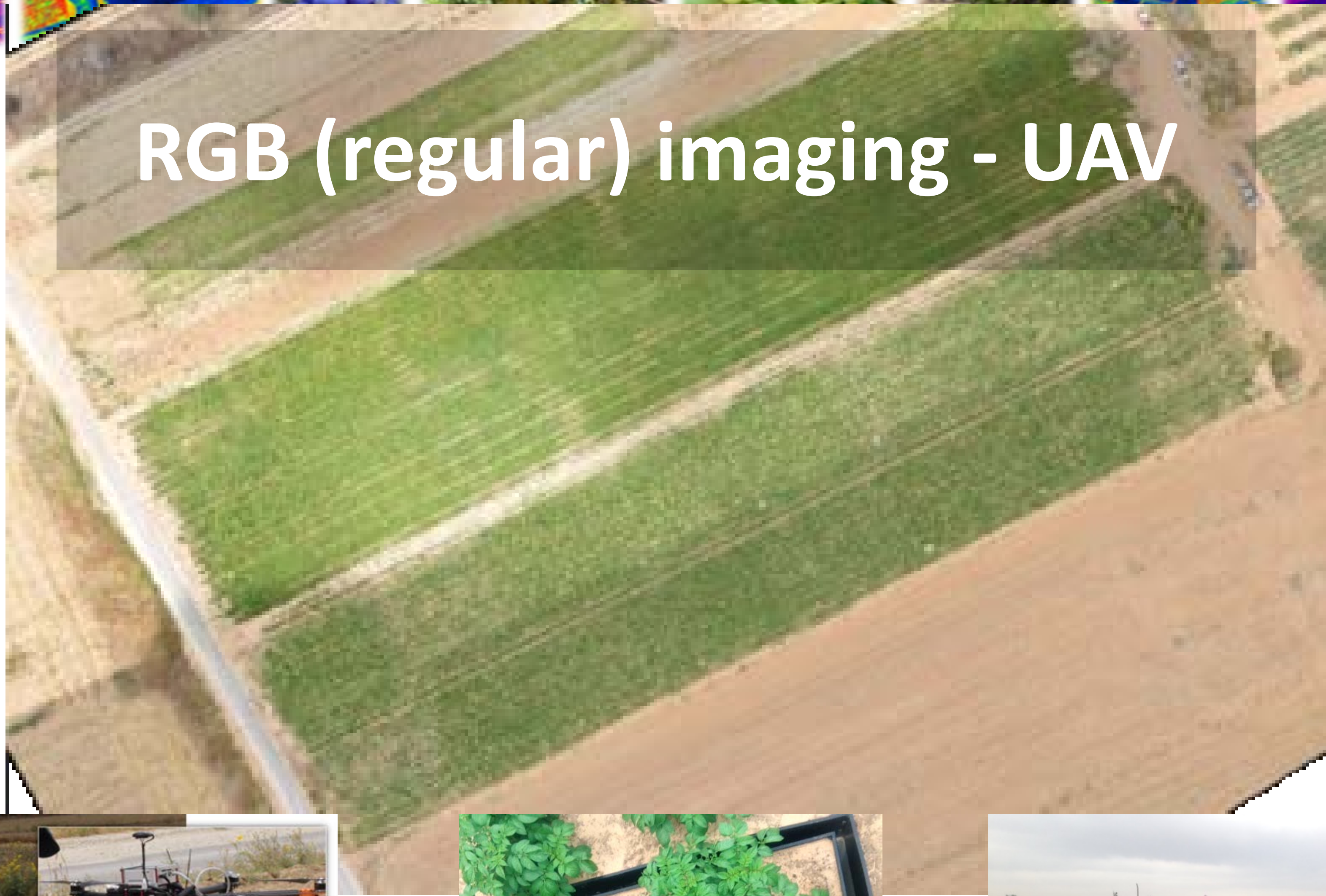
Precise and Precision Irrigation

- The use of thermal remote-sensing to map the in-field variability has the potential to increase WUE without decreasing yield
- Adding precision to precise irrigation systems

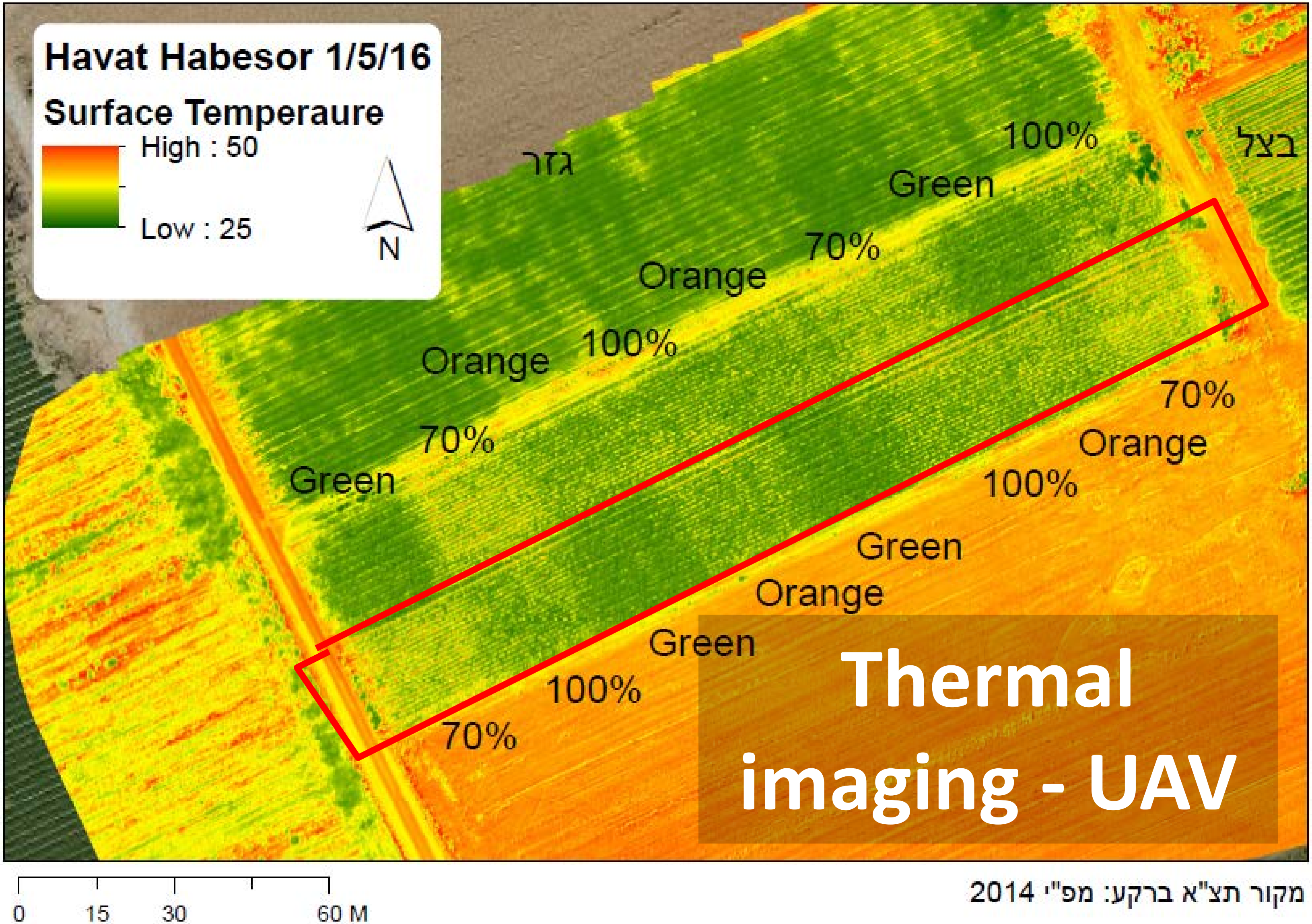
Water use efficiency in cotton field



RGB (regular) imaging - UAV

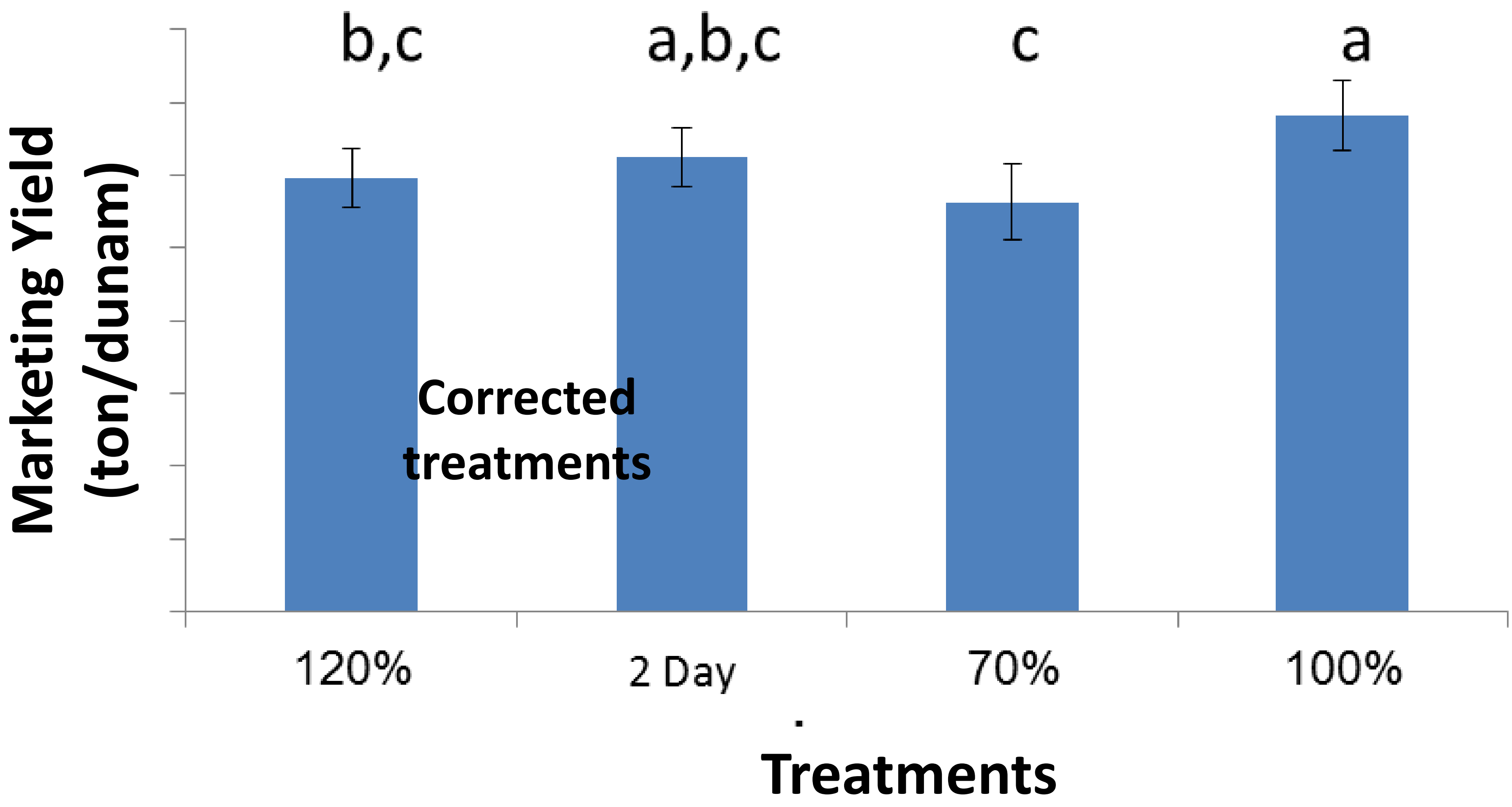


RGB (regular) imaging - UAV



מקור תצ"א ברקע: מפ"י 2014

Yield



b,c
a,b,c
c
a
Marketing Yield (ton/dunam)
Corrected treatments
120%
2 Day
70%
100%
Treatments

LWP Maps Givat Brener – 11/08/2013

Whole-field – 90%

Irrigation units– 95%

management zones – 100%

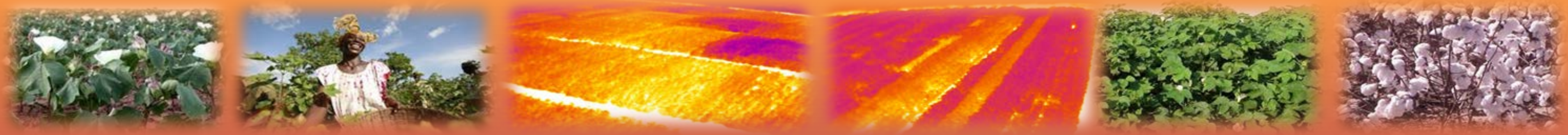
Over Irrigated

Well Irrigated

Low water stress

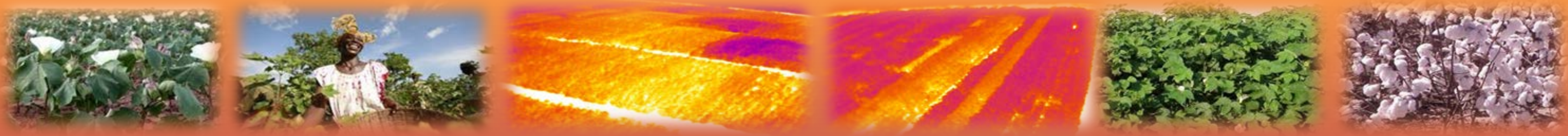
Medium water stress

Severe water stress



Summary

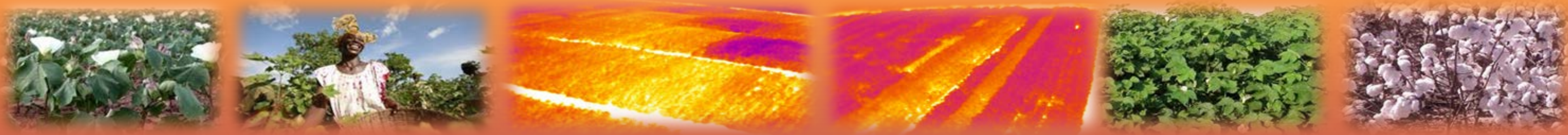
- VRI systems are already commercial for pivot and linear move irrigation systems
- Initial non-commercial systems were developed for drip irrigation
- These commercial systems are currently fed simply by static IMZ ignoring the in-season-change in their borders.
- To improve their performance these systems should be fed also by in-season prescription maps



Summary

- Methodologies are continuously developed to create high level irrigation prescription maps by including in-season thermal imaging.

- These technologies and methodologies have a great potential in increasing water use efficiency in the 21st century.



Summary

- Thermal images are becoming more available to the farmers yet, care should be taken to ensure using thermal cameras with high accuracy.

- The current challenge is to develop methodologies to decrease the costs involved in using thermal imaging in order to urge the adoption of thermal-based irrigation approach by the farmers.

Thank you for you attention

Questions?

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- Alchanatis et al., 2010. *Precision Agriculture,* 11:27-41.
- Rud et al., 2014. *Precision Agriculture,* 15 (3): 273-289.
- Cohen, et al. 2015. *Precision Agriculture*, 16 (3): 311.
- Cohen, et al. 2016. *Precision Agriculture*, doi:10.1007/s11119-016-9484-3.