

Horticultural Crop Value

Crop	Acres	Farm Gate Value
Grapes	1,000,000	6 Billion
Nuts	1,300,000	6 Billion
Citrus	800,000	3.5 Billion
Tree fruit	250,000	1.0 Billion



Horticulture Research Roadmap

Drive research to maximize productivity, sustainability and competitiveness of US horticultural crops

Genomics

Gene identification
and function
Gene regulation
Traditional breeding
Molecular breeding

Resources & Environment

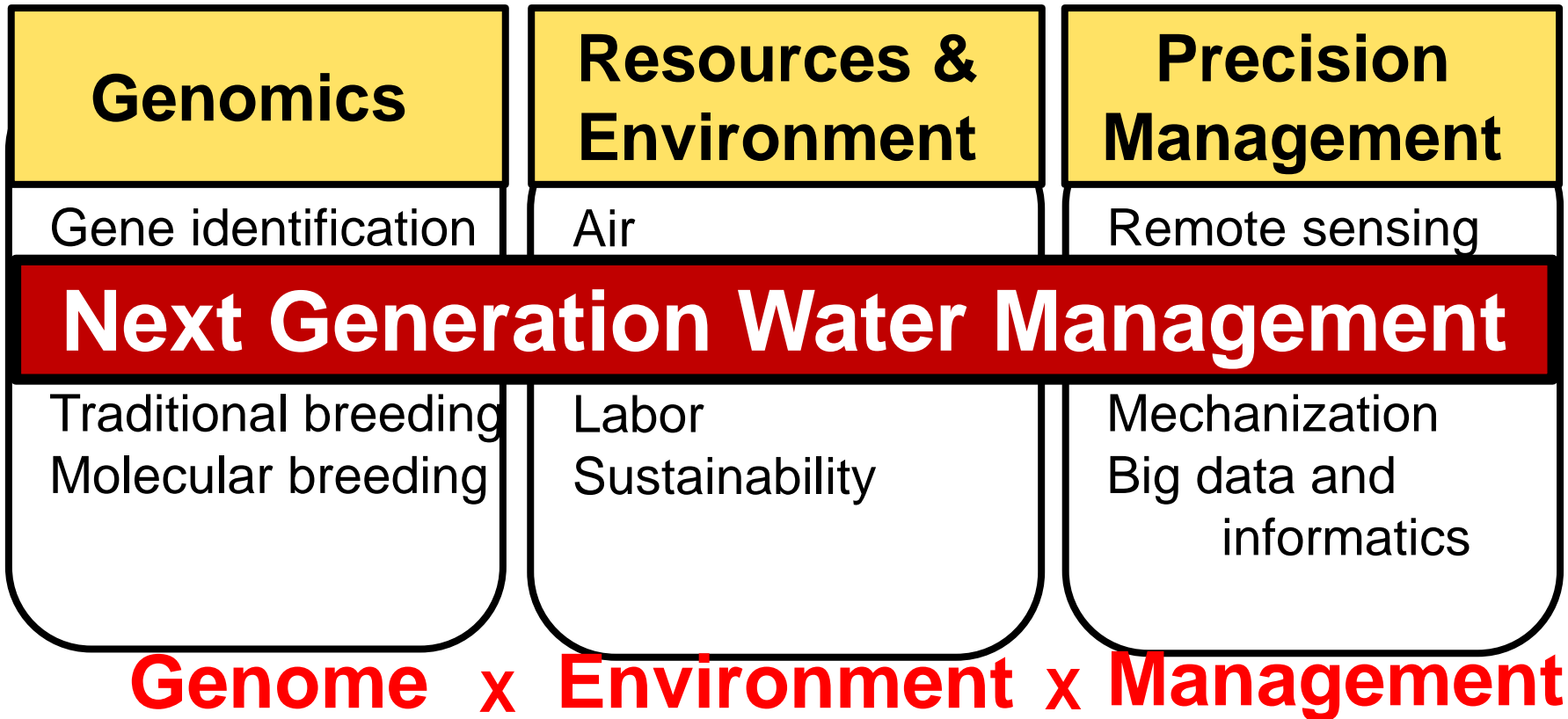
Air
Water
Land
Labor
Sustainability

Precision Management

Remote sensing
Proximal sensing
Automation
Mechanization
Big data and
informatics

Horticulture Research Roadmap

Drive research to maximize productivity, sustainability and competitiveness of US horticultural crops



Current Methods for Water Management

- Standard, discrete methods for monitoring plant water and soil moisture status have significant limitations for production
 - Subjective
 - Location specific
 - Labor intensive and expensive
 - Too few measurements are collected

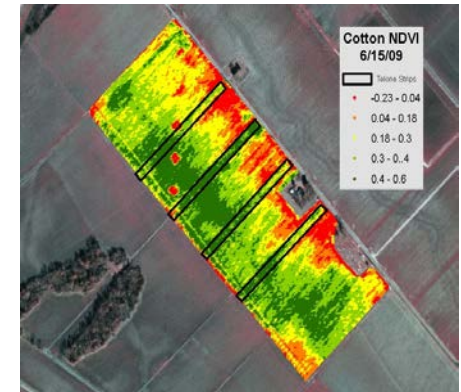
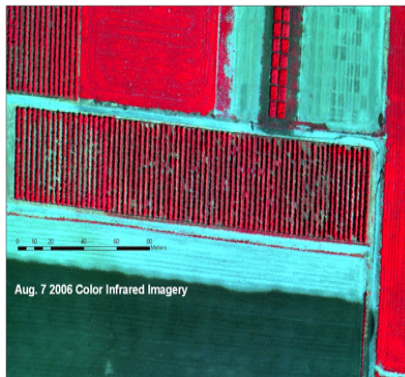


Next Generation Water Management

Remote sensing allows an integrated look at the vineyard

Remote sensing

- Multispectral, hyperspectral, thermal provide measures of plant water use and status
- Vegetation indices provide measures of canopy development and size
- Integration of remote sensing provides our most accurate assessment of whole-block water use and crop irrigation requirements



Next Generation Water Management

Models based on remote sensing data
will replace current methods for irrigation management

METRIC (Mapping evapotranspiration at high resolution and internalized calibration)

- ET residual of surface energy balance

$$R_n + LE + G + H = 0$$

- Inputs

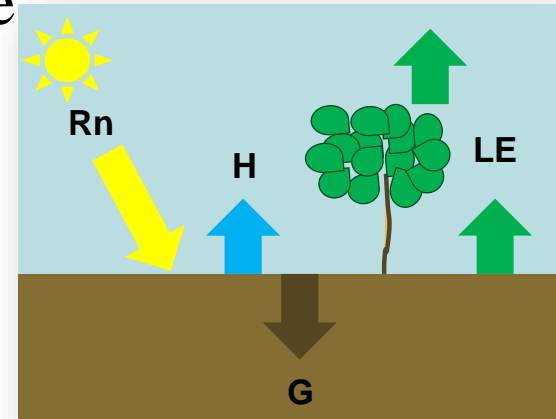
- Landsat (visible & infrared)
- CIMIS weather data

- Outputs

- ET_c
- K_c (f/NDVI)

- Watering of each zone:

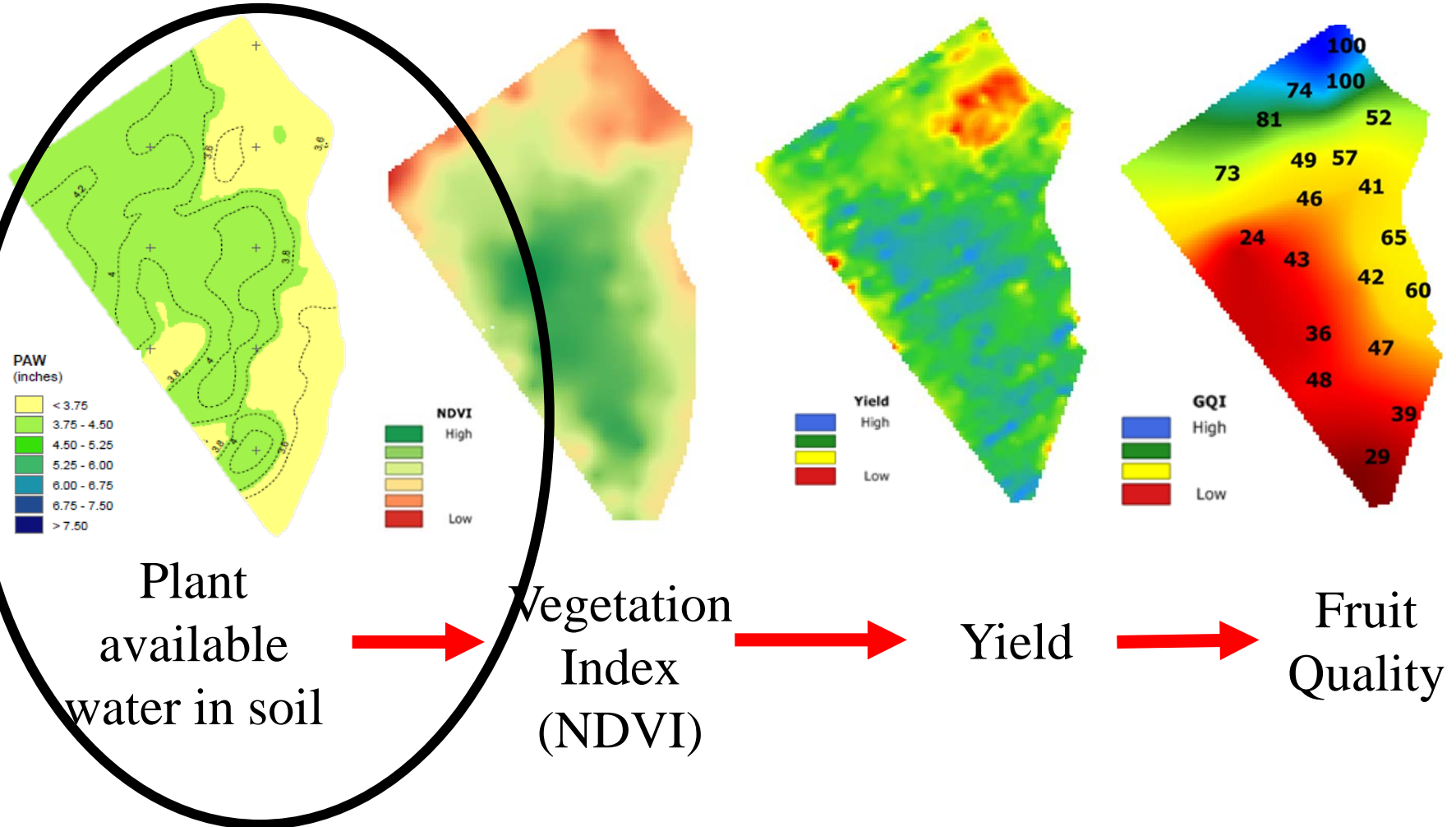
$$ET_c = ET_{ref} * K_c * K_m$$



Building robust models based on remote sensing requires ground truthing

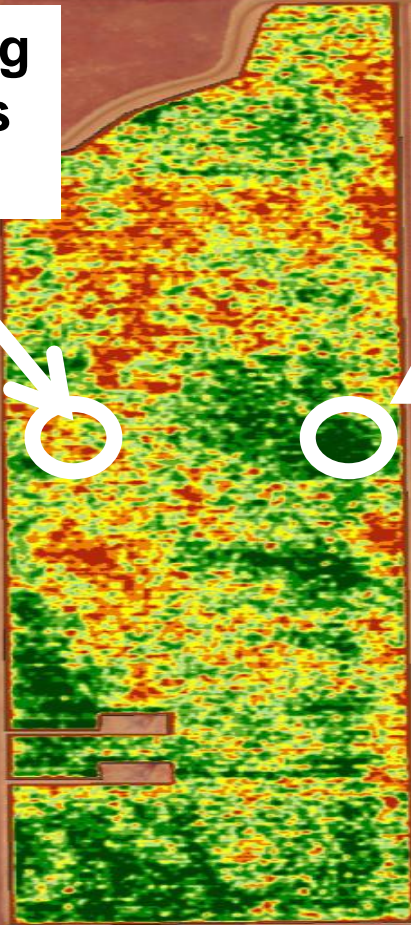


Integrated data analytics



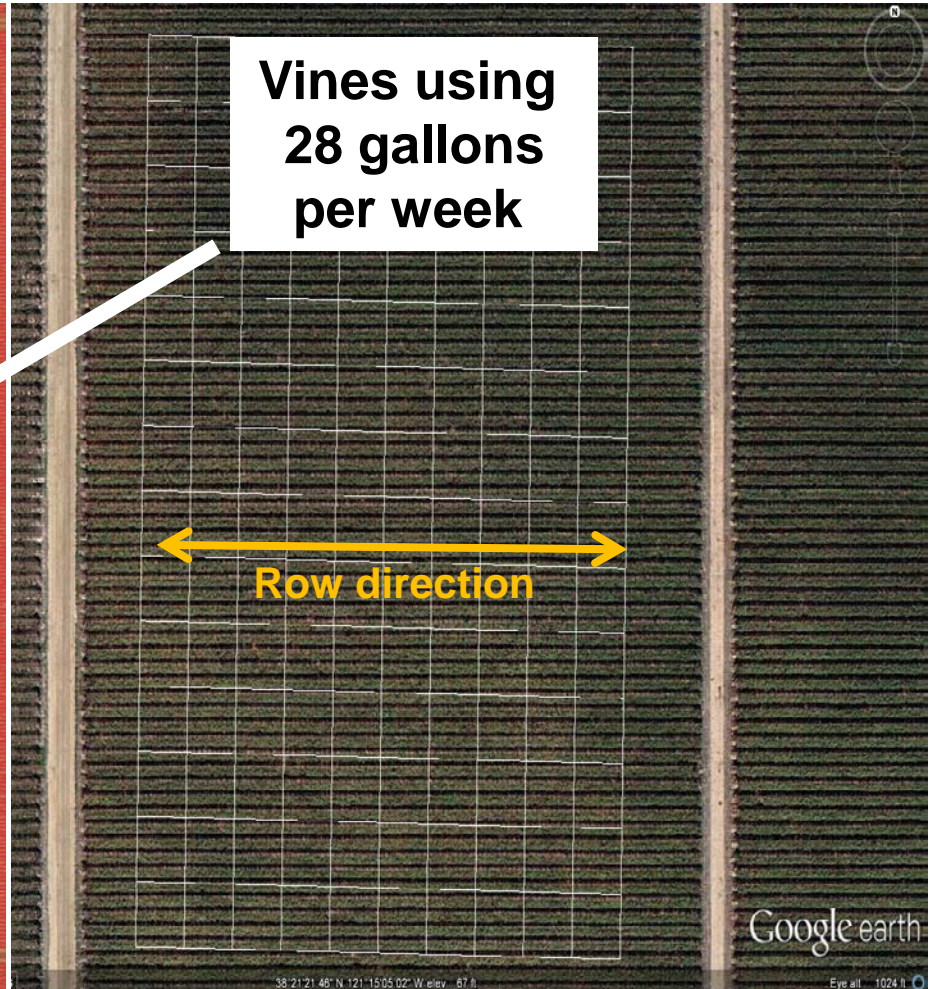
Variable rate drip irrigation

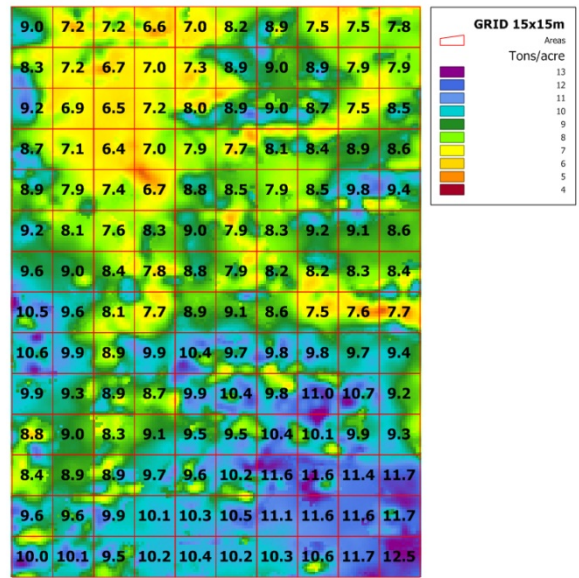
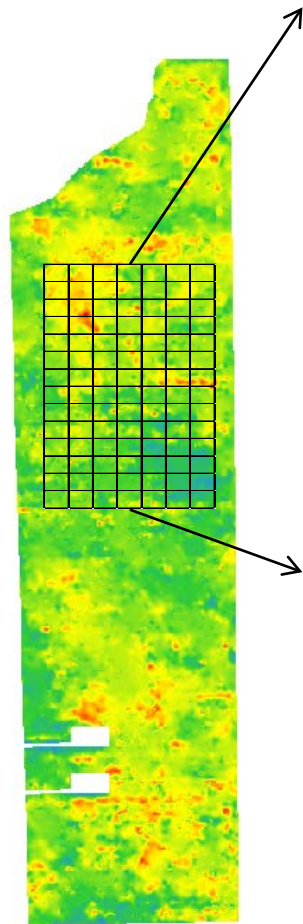
Vines using
17 gallons
per week



Vines using
28 gallons
per week

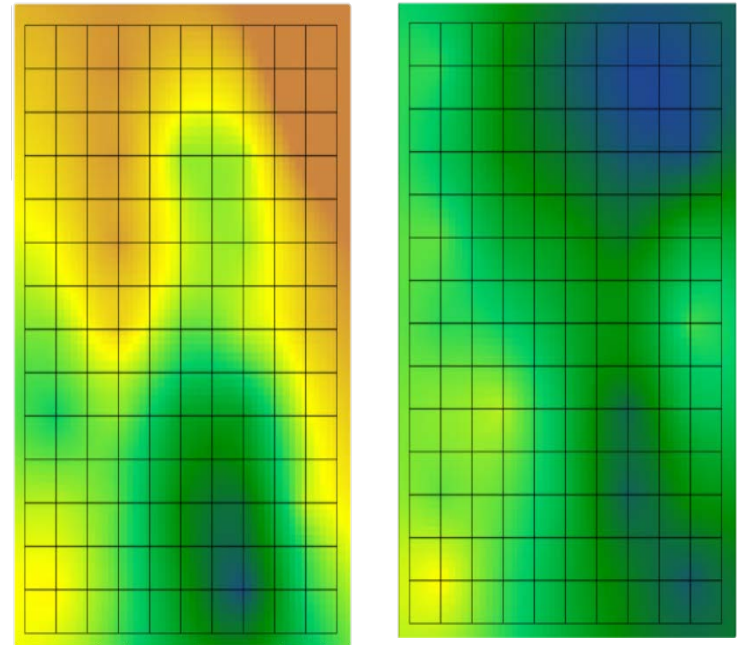
← Row direction →





Colony 2A
Cabernet Sauvignon

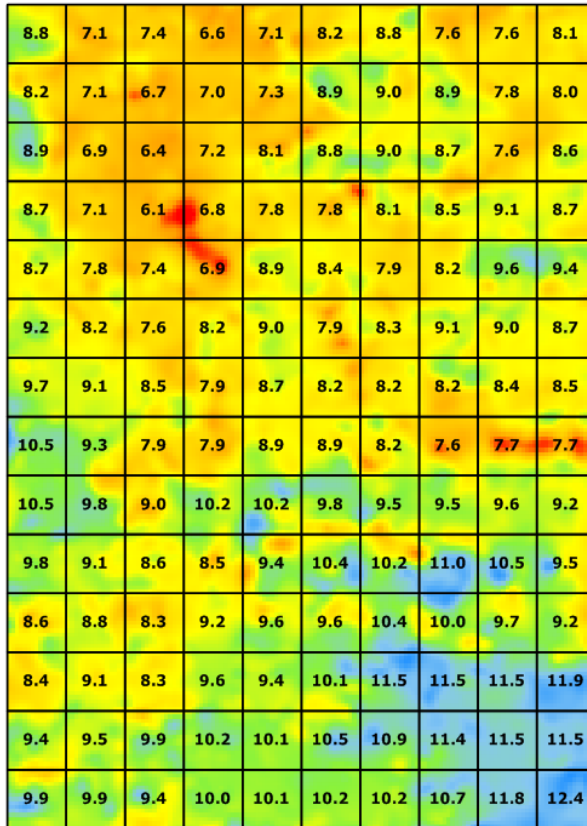
Changes in canopy vigor (NDVI)



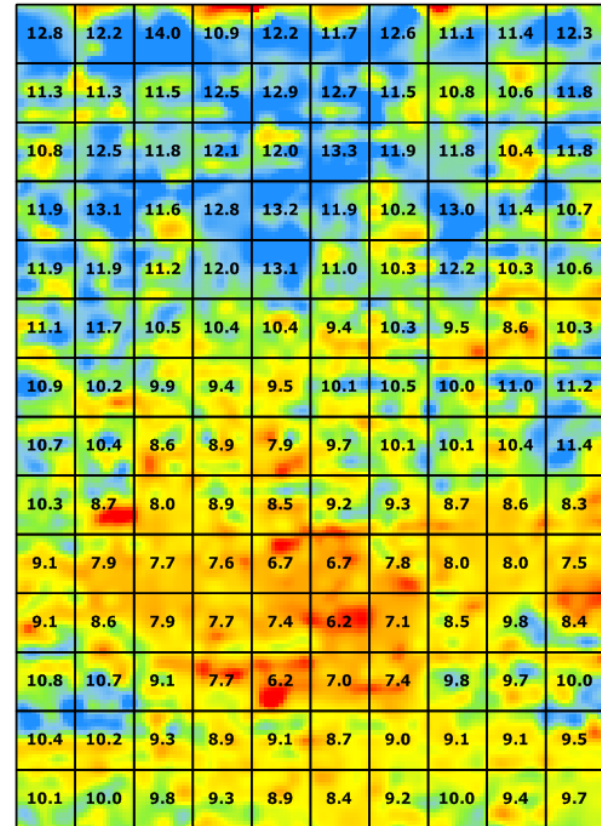
July 2012 → July 2013

Variable Rate Irrigation

Precision Irrigation



2012 Block Yield
8.9 t/ac



2013 Block Yield
10.2 t/ac
20% less water applied

Next Generation Water Management

MEASURE

soil and plant
water status

Develop integrated, block level measures to monitor plant water and soil moisture status

MODEL

remote and
proximal
sensor data

Correlate relationships among remote sensing, proximal sensing, traditional measures and other data sources and plant water and soil moisture status

MANAGE

Irrigation to
maximize
water use
efficiency

Develop precision irrigation systems for variable rate irrigation management, including Best Practices for irrigation amount, timing and frequency to optimize water use efficiency

Summary

- Increased focus on specialty crops
 - Modern tools to measure, model and manage water and improve water use efficiency
- Commodity group collaboration to extend ARS efforts
 - Potential source of funding
 - Link to extension of information to grower community
- Establish Grape LTAR in California
 - Focus on water agro-ecosystem and management

