FLOW-AID, an Assistant for Deficit Irrigation

International Workshop on

"Innovative irrigation technologies for container-grown ornamentals"

Centro Sperimentale Vivaismo
Pistoia (Italy), 10 July 2009

Jos Balendonck

WAGENINGEN UR
For quality of life

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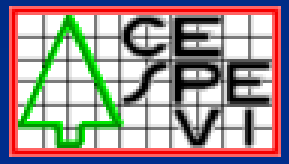
European Project

- 7 universities + 3 companies from 8 countries
- NL, UK, ES, IT, GR, TR, LB, JO
- Italy:



2006 - 2009

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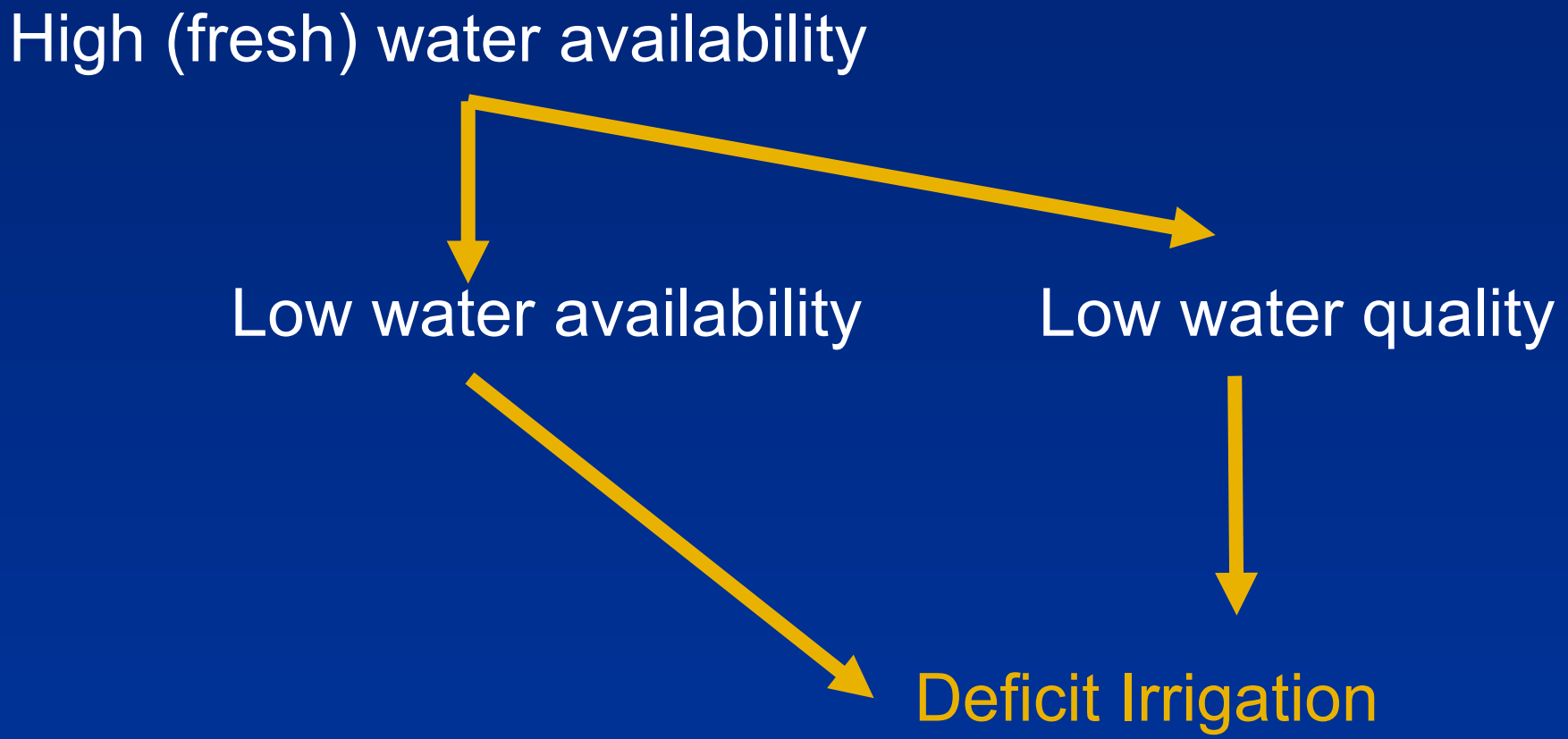
Outline

- Introduction
- Technology “building blocks”
- Case study results
- Conclusions

Trends in Water Management



No restrictions on water use

- Farmer practices
  - Irrigation amounts depend on availability
  - Give enough water and fertilizer to maximize crop yield
  - Give more, to be sure that all plants get enough (variability)
- result in …
  - Good crop yield and income
  - Leaching or run-off of water and fertilizers
  - Higher costs due to over use of water and fertilizers

Fresh Water or Leaching Restrictions

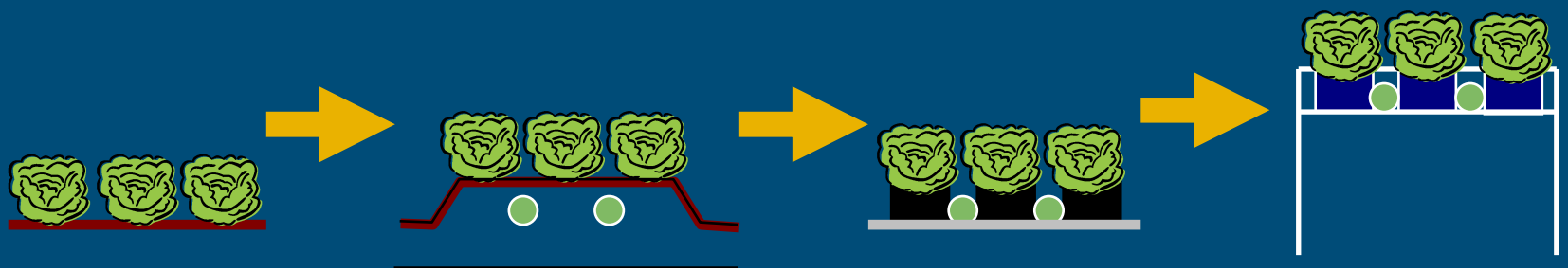
- Use of less water and fertilizer, as well as
- Use of marginal water resources may result in:
  - Crop damage
  - Diseases
  - Yield loss
  - Lower income
- Adapt growers practice to:
  - avoid or minimize crop losses by
  - optimal water and fertilizer management

Objectives of FLOW-AID

- SAVE WATER
  - Efficient use of available water
- SAVE NUTRIENTS
  - Rational use of nutrients and marginal water resources
- SAVE THE ENVIRONMENT
  - Prevent leaching of chemicals
- SAVE FARMER INCOME
  - Maintain crop yields at affordable investments

Solutions

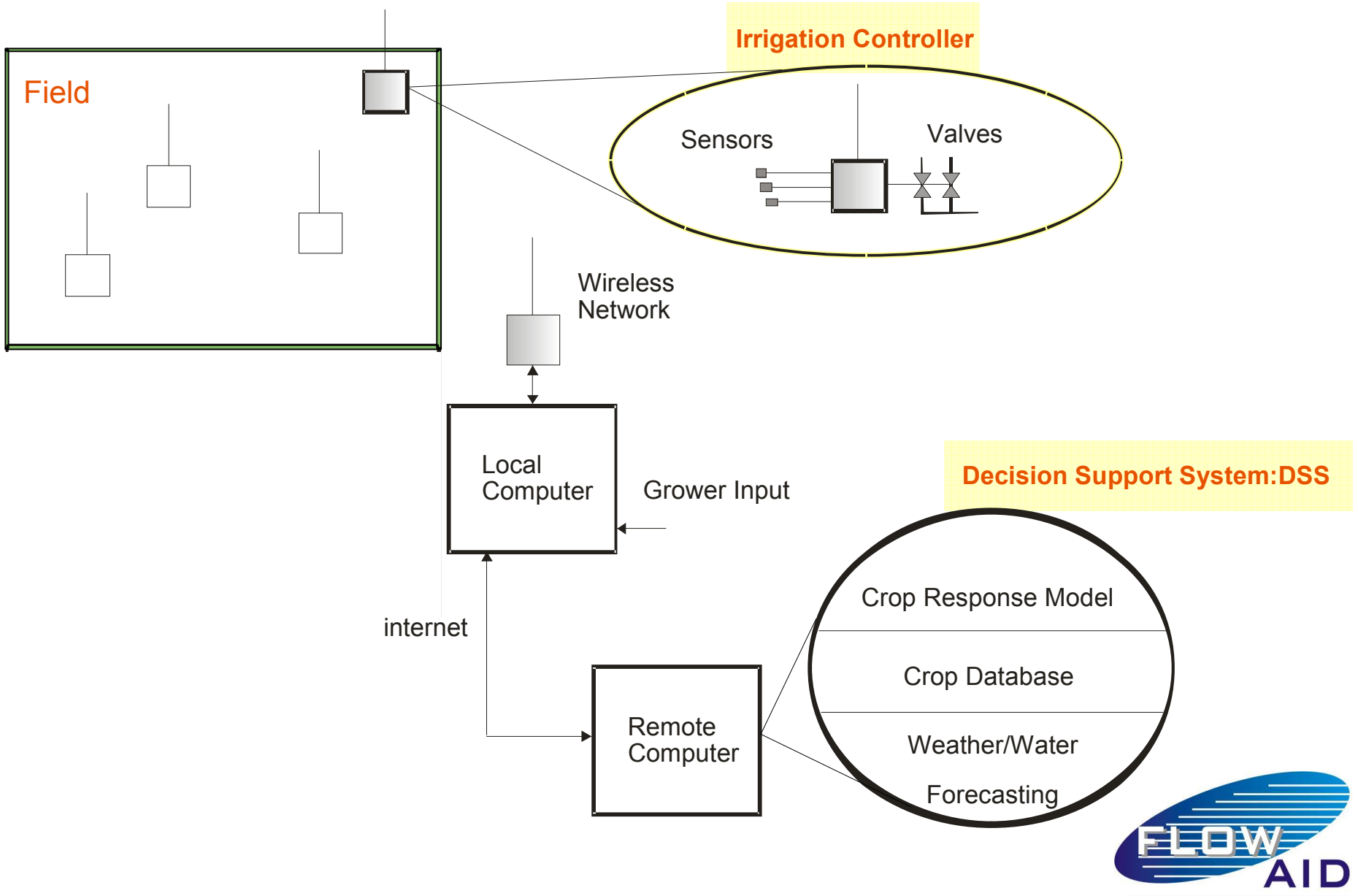
- Grow detached from soil
- Reuse your water and nutrients
- Use drip irrigation with fertigation
- Automate the irrigation process



How to support growers?

- Decision Support System:
  - Advice when and how much to irrigate
  - Advice when and how much to fertigate
- Tools to determine amount and source of water
  - Continuous feed-back about crop status: Sensors
  - Process Automation: controllers, computer software

System Layout



Irrigation (Fertigation) Controller

- Stand-alone operation
  - Programmed by grower
  - Advised by DSS
  - Wired or Wireless
- START/STOP
  - Timed
  - Sensor based
  - Multiple valves
  - Multiple water sources

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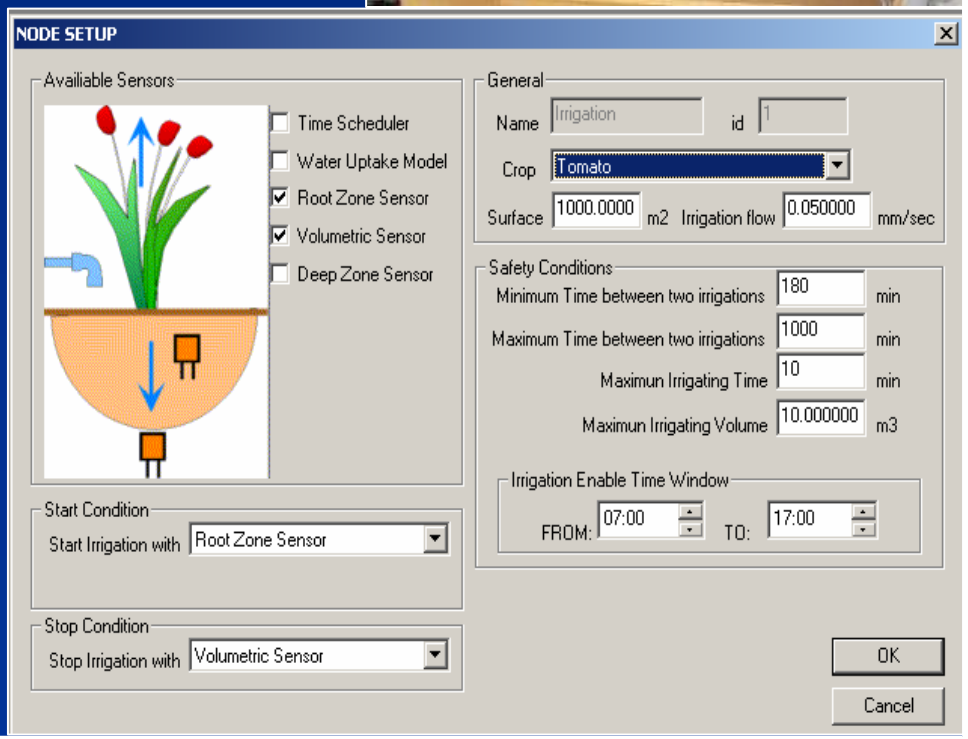
DSS-Irrigation Scheduler

- Day to day planning
- Upload local data
- Water availability
- Weather Forecasts
- Plant Status (monitoring)
- Crop Stress Model
- ET-model
- Set Irrigation Controllers
- Safety (warnings)
- Receive e-mails from DSS



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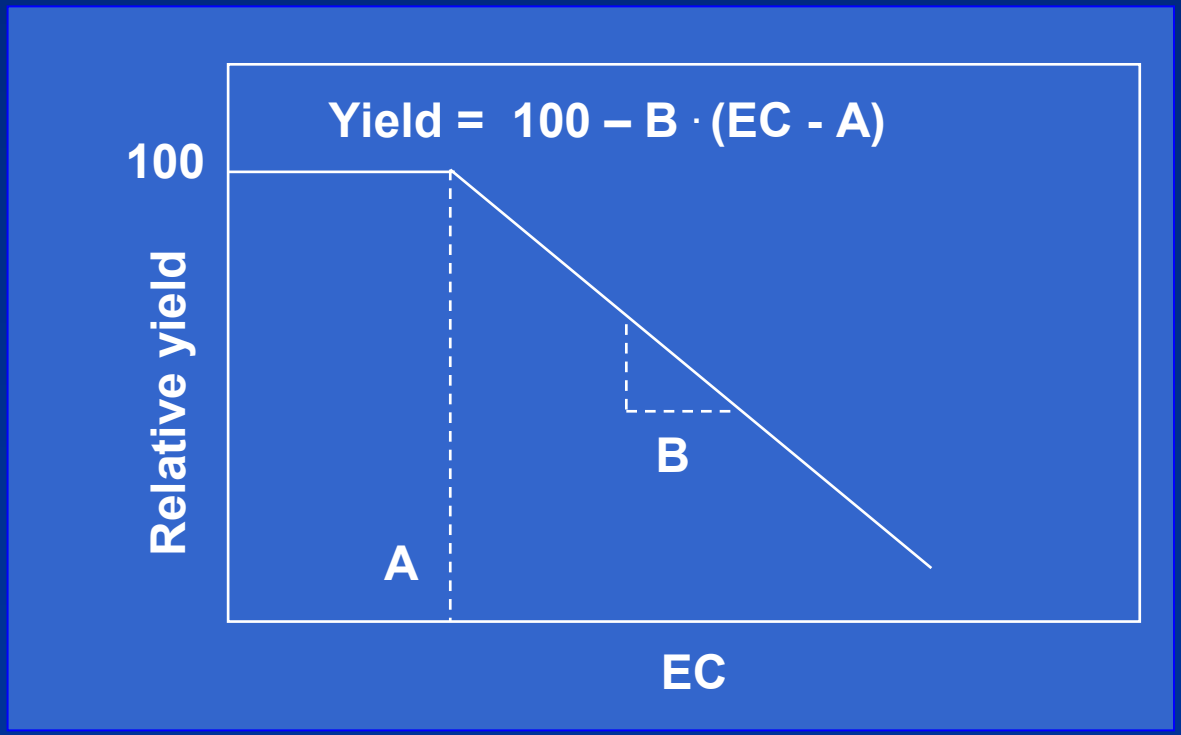
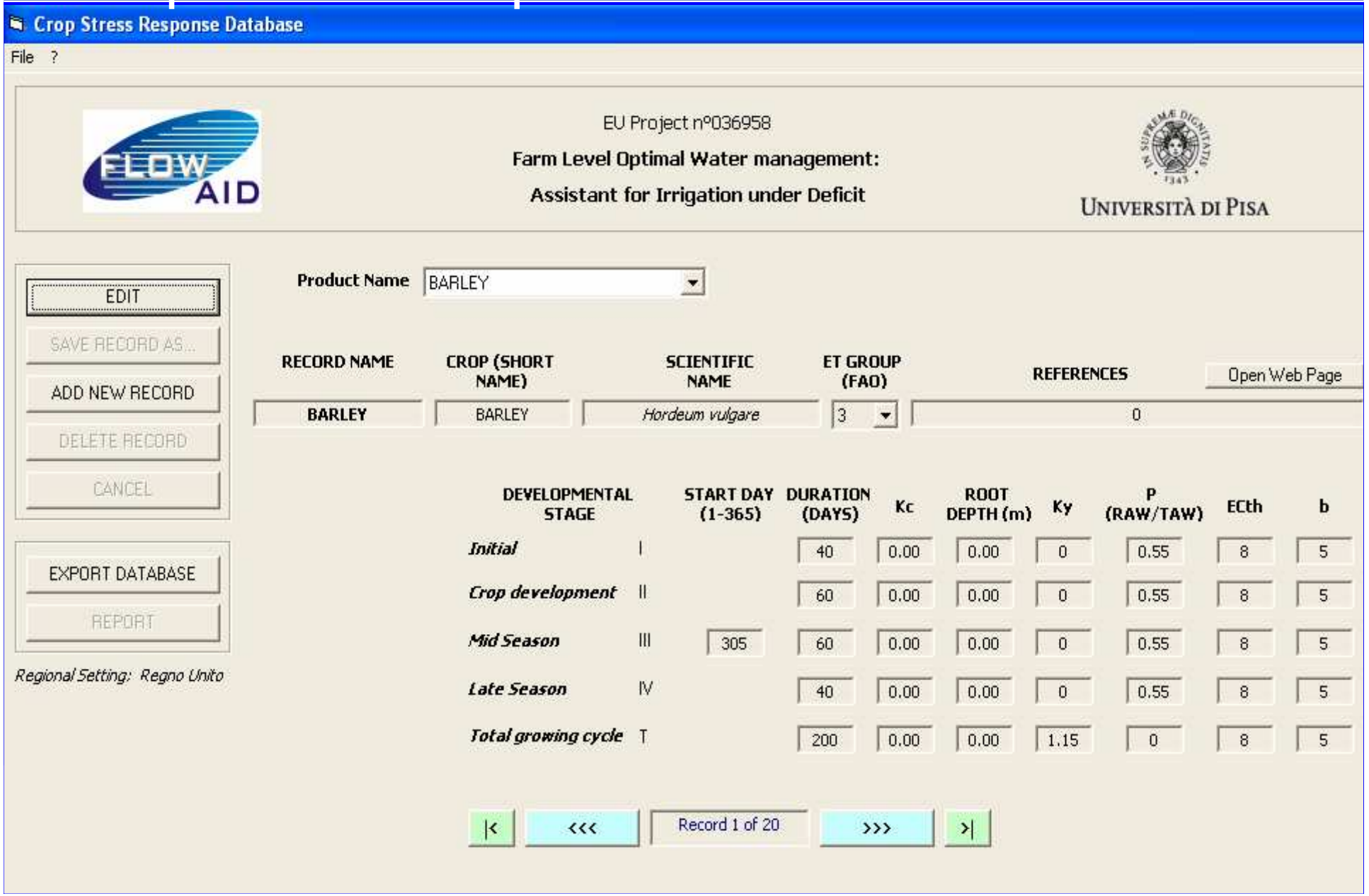
Crop Yield Model for Deficit Irrigation

- Yield to Water Quantity (A: ET-model)
- Yield to Water Quality (B: Salinity model)

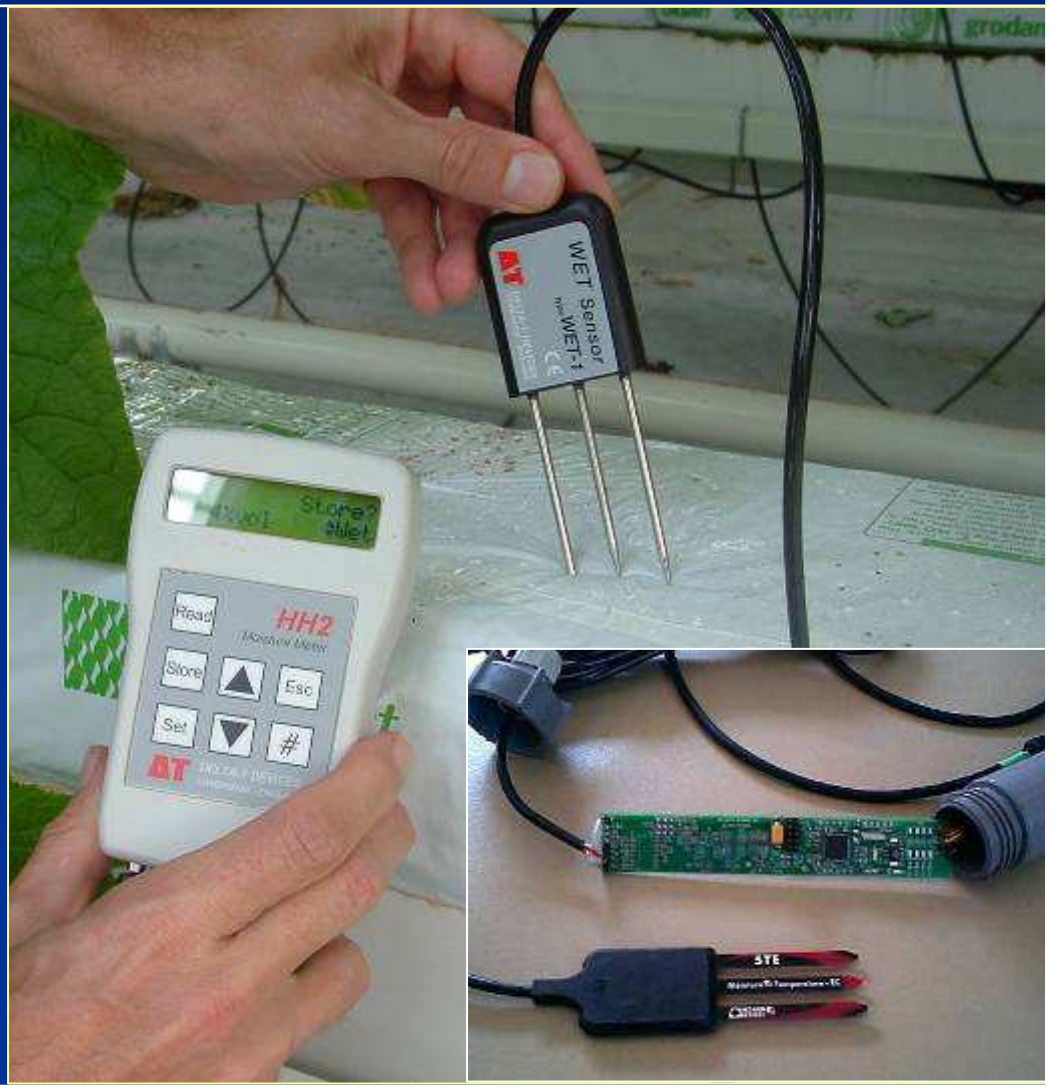


Crop Stress Response Database

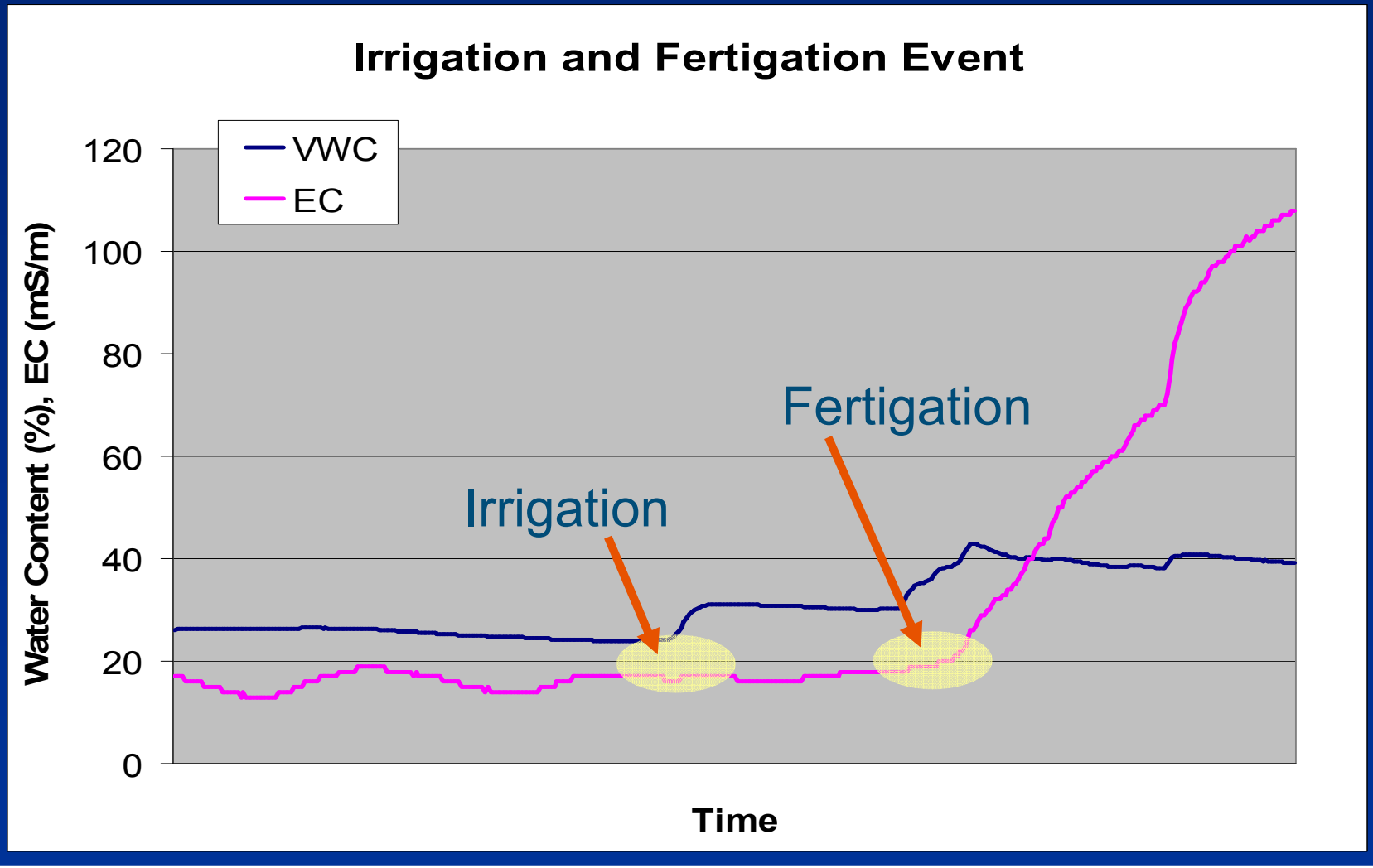


Root Zone Sensors

- Water Content
  - Indicates “Available Water”
  - Soil calibrations
  - For medium wet to saturation
- Electrical Conductivity (EC)
  - Total Nutrient Concentration
  - WET-sensor, ECHO-probe
  - Pore Water EC calibration
- Temperature



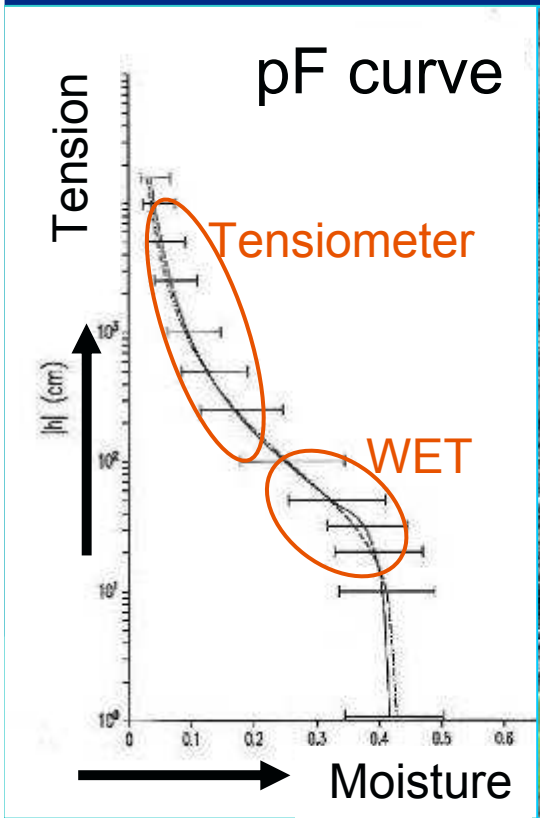
Example of WET-sensor readings



Electronic Tensiometers: indicate soil suction

- Water filled tensiometer
- Limited range
- Installation and maintenance
- For dry soils

- Porous Matric Sensor (prototype)
- Larger range
- Easy installation - Low maintenance
- For wet to very dry soils



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Wireless Sensor Network

- No cabling, easy installation
- Multiple nodes and sensors
- Robustness in field

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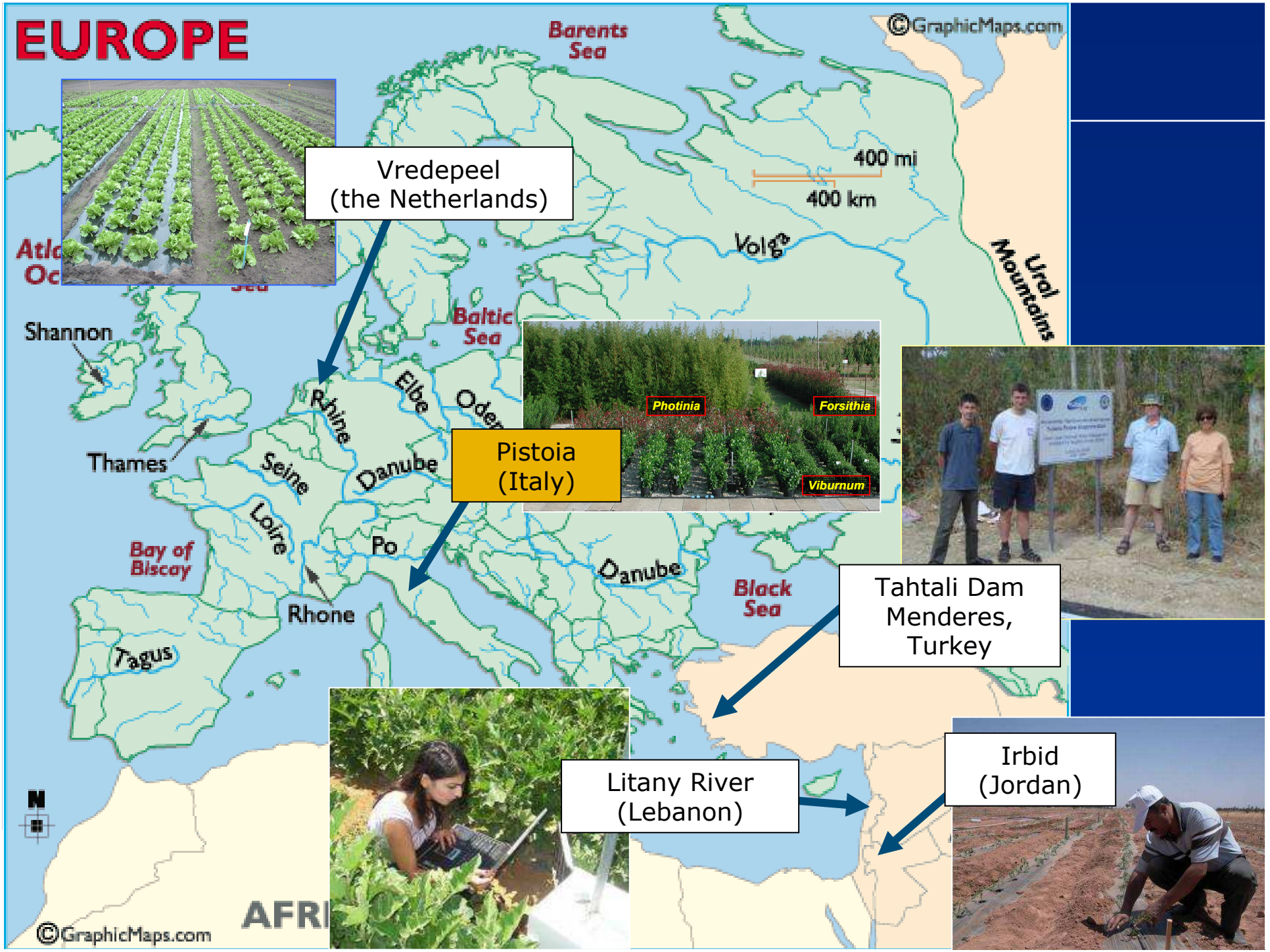
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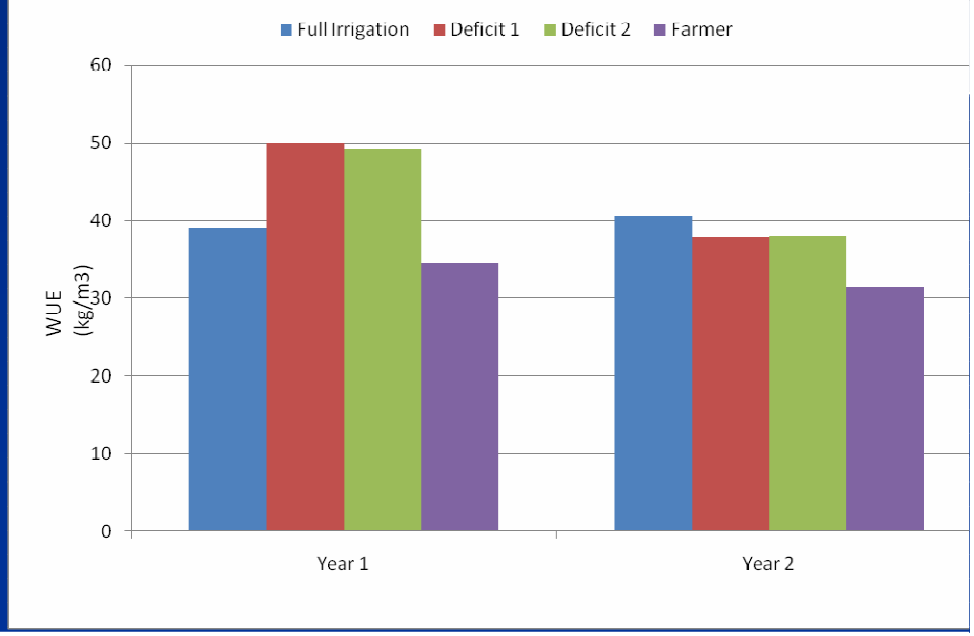
(Lebanon)
Irbid
(Jordan)

Italy

- Pistoia, Tuscany
  - Nursery stock production
  - Farm sizes: 10 - 100 ha
  - Container plants (drip/sprinkler)
  - Many crop types + sizes/plot
  - Need to use saline water
- Objectives
  - Dual water irrigation: Cleaned Waste Water and Fresh Water
  - Prevent Plant Stress
- Results
  - See Incrocci

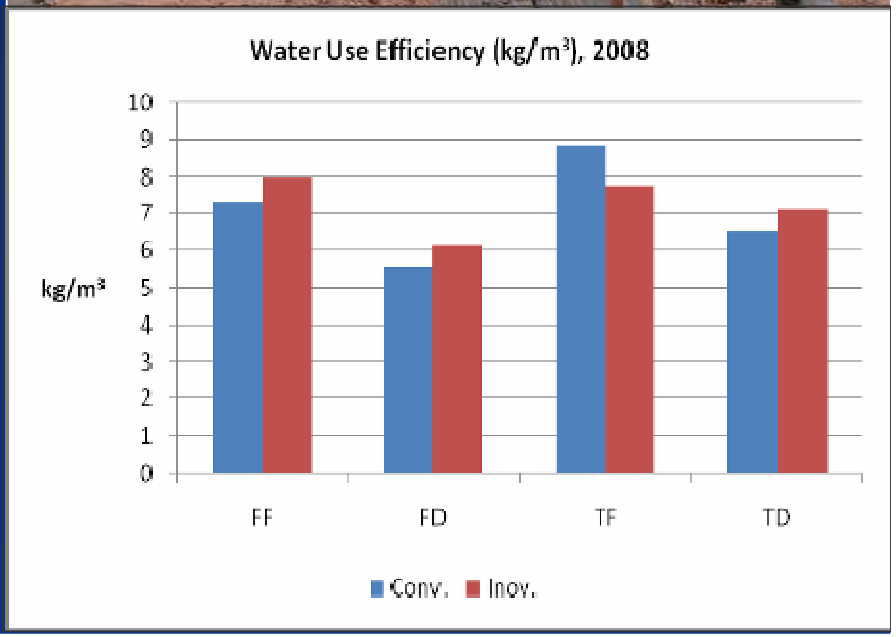
Turkey

- Izmir (Tahtalı Dam)
  - Preservation area
  - Greenhouses (Cucumber)
  - Water from wells
  - No leaching allowed
- Objectives
  - Reduce water use
  - Maintain Marketable Yield
  - Sensor activated control
- Results
  - Water Use Efficiency higher in Deficit and Full Irrigation compared to Farmers' treatment
  - Slightly lower Yield



Jordan

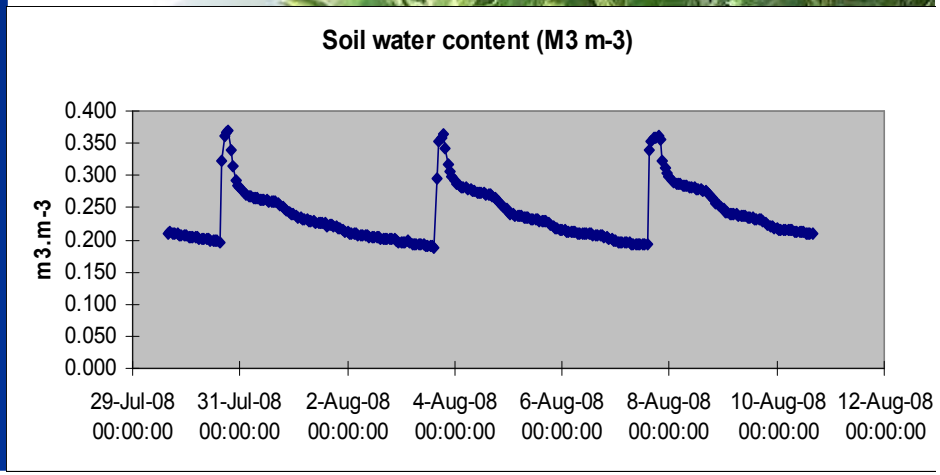
- Irbid, Jordan Valley
  - Fruit and oriental trees, vegetables
  - Limited water resources
  - Poor water management at farm level
  - Low water use efficiency
- Objectives
  - Maximize Water Use Efficiency
  - Soil grown tomatoes
  - Dual water quality irrigation: Treated Waste Water (T) and Fresh Water (F)
  - Sensor Activated Irrigation
  - FULL (F) and DEFICIT irrigation (D)
- Results
  - 5-10% Higher WUE with Innovative Irrigation Strategies



Lebanon

- South Bekaa Valley, Litany River
  - Tal Amara Research Station
  - Vegetables (potato, eggplant)
  - Water sources:
    - Surface irrigation
    - Sprinkler and drippers
  - Poor water management

- Objectives
  - Deficit irrigation performance
  - Enhance Water Use efficiency
  - Evaluate New Technologies
  - Knowledge transfer to farmers



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The Netherlands

- Vredepeel
  - Slight loamy-sandy soils
  - Rain-fed agriculture
  - High water tables
  - Leaching
- Objectives
  - Prevent leaching of Nitrate (WFD)
  - Iceberg lettuce crop
  - Plastic cover to block rain
  - Root zone sensor (Start)
  - DSS adapt irrigation dose by monitoring deep sensor (Stop)
- Preliminary Results
  - Lower water use (plastic)
  - Prevent leaching (sensor control)
  - 10% more yield (fertigation)

Technology can offer farmers, under sub-optimal growing conditions, more possibilities to:

- Efficiently use water and nutrients
- Minimize run-off, percolation losses
- Prevent crop damage
- Reduce labour costs

Technology can be used for a wide range of growing practices

- Soil or substrates
- Protected or non-protected
- Arid or non-arid zones
- Multiple quality water sources

Technology comes within reach for farmers

- Availability from suppliers
- Knowledge
- Costs

Thanks for your attention, and …

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