Farm Level Optimal Water Management Assistant for Irrigation under Deficit

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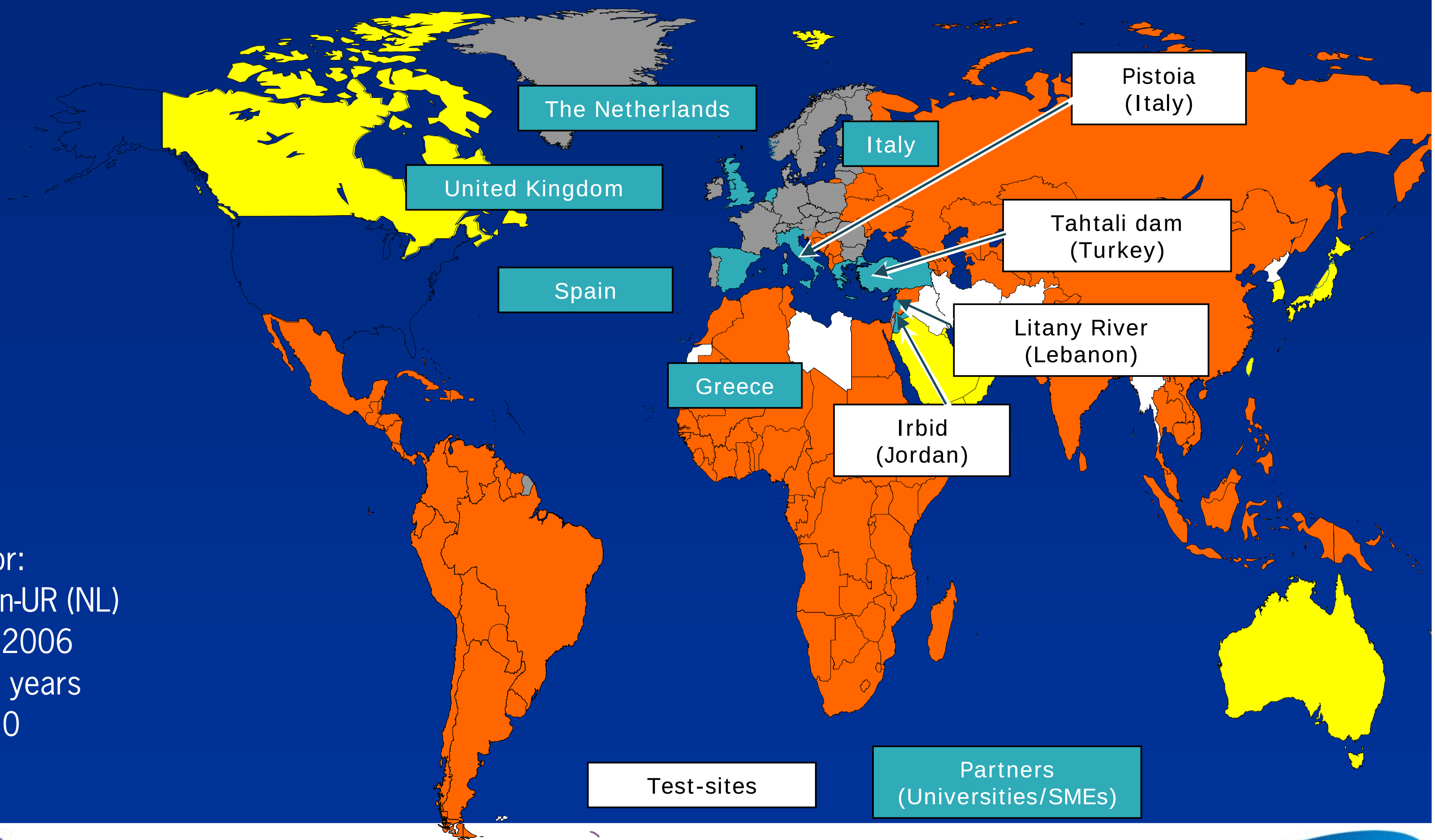
Int. Symp. on Strategies Towards Sustainability of Protected Cultivation in Mild Winter Climate

Antalya (TURKEY), April 6-11, 2008

Albacete, October 2007

Contributing countries and target areas



Co-ordinator:
Wageningen-UR (NL)
Start: Oct. 2006
Duration: 3 years
Partners: 10

Water management trends

- Over irrigation in cases of high (fresh) water availability
  - Irrigation amounts depend on availability
  - Leaching or run-off of water and nutrients
- Deficit irrigation if water availability and irrigation water quality is low
  - Use of marginal water resources
  - Yield losses and crop damages

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Objectives

- Sustainable irrigated agriculture
  - Efficient use of available water
  - Rational use of nutrients and marginal water resources
  - Economically and socially accepted farming

- Improve irrigation practices by introducing new tools
  - Decision Support System for optimal irrigation
  - Sensitive, simple and affordable tools to determine optimal amount and source of water
  - Generally applicable in Mediterranean countries for protected and non-protected cultivation

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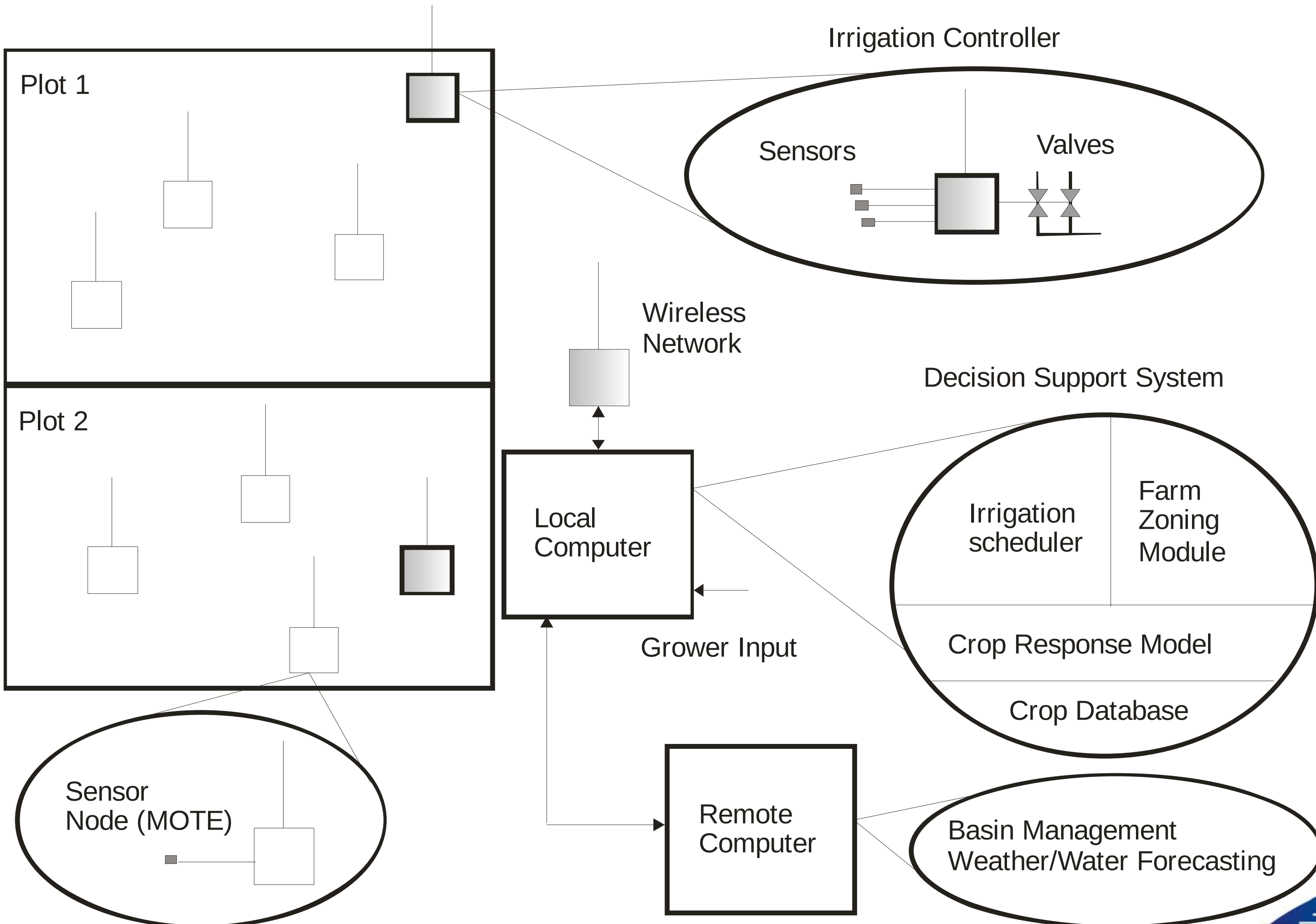
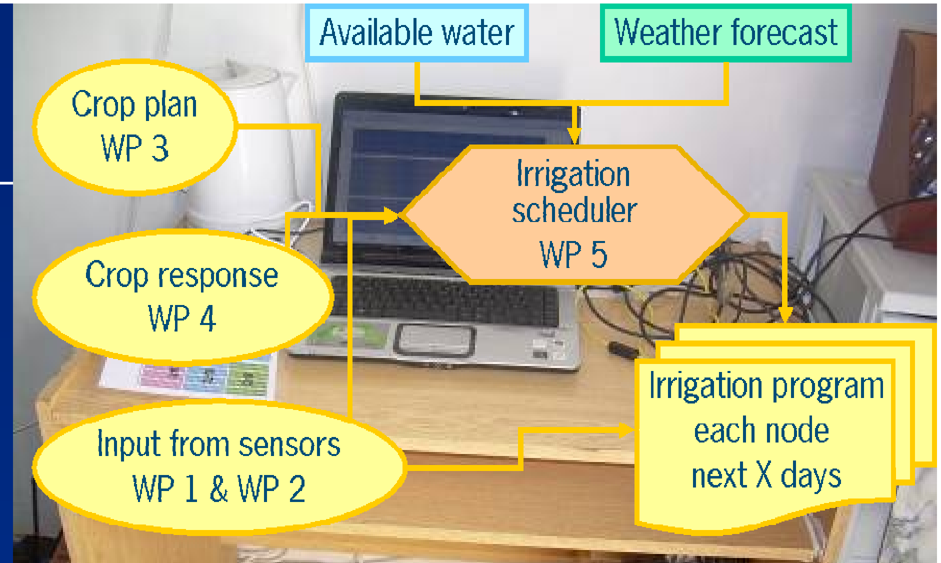
System Components

- Decision Support System
  - Farm Zoning and Crop Planning
  - Irrigation Scheduling
    - Allocate water and schedule irrigation
    - Individual farm zones
    - In view of expected water availability (amount and quality)
  - Economic Optimizer for Water Allocation
  - Crop Response Model for Deficit Regimes
- Irrigation System
  - Remote Irrigation Controller
  - Wireless Sensor Network

System Layout



DSS-Irrigation Scheduler



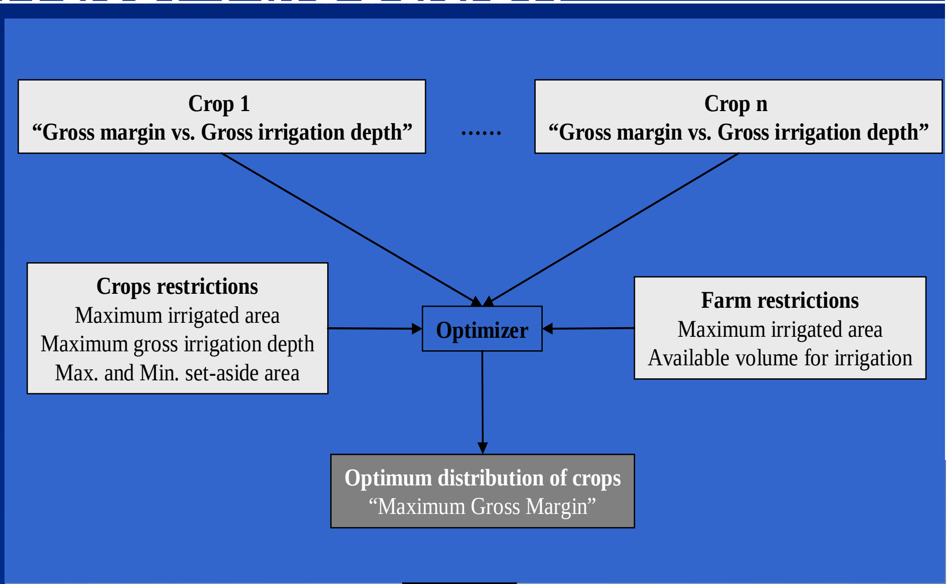
- Farm-level tool
- Day to day planning
- Short-term Water Availability
- Weather Forecasts
- Plant Status (Crop model)
- Set Irrigation Controllers

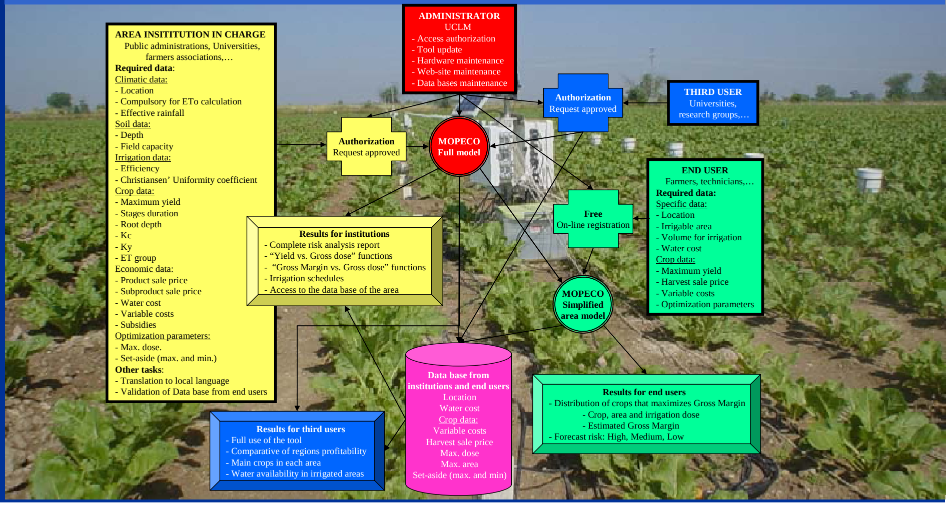
DECISION SUPPORT FOR OPTIMISED IRRIGATION SCHEDULING

Sigrimis, N. , Anastasiou A. et al.

Economic Optimizer for Water Allocation

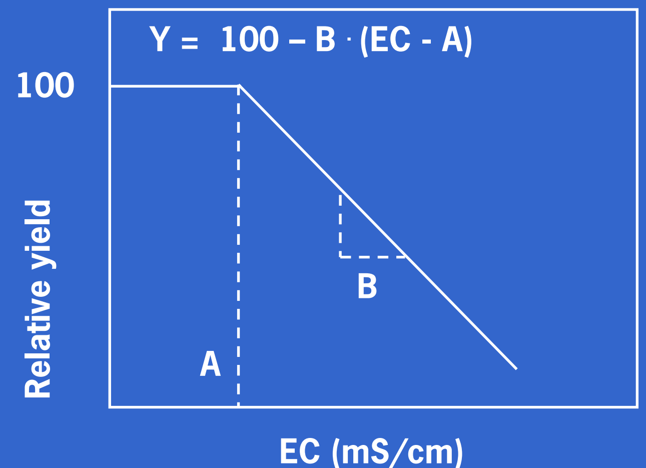
- Web-based Advising Tool
  - Used every season for Farm Zoning and Crop Planning
  - Regularly used for Optimal Economic Water Use Efficiency
  - Multiple crops/plots
  - MOPECO (Ortega)
  - Crop response model for deficit
- Inputs of farm related data
  - Long-term water availability
  - Local constraints:
    - Economics, crops, sizes, machines, water constraints …
- Outputs
  - Maximum Gross Margin
  - Optimum Distribution of Crops
  - Scheduling tasks, water allocation and sources



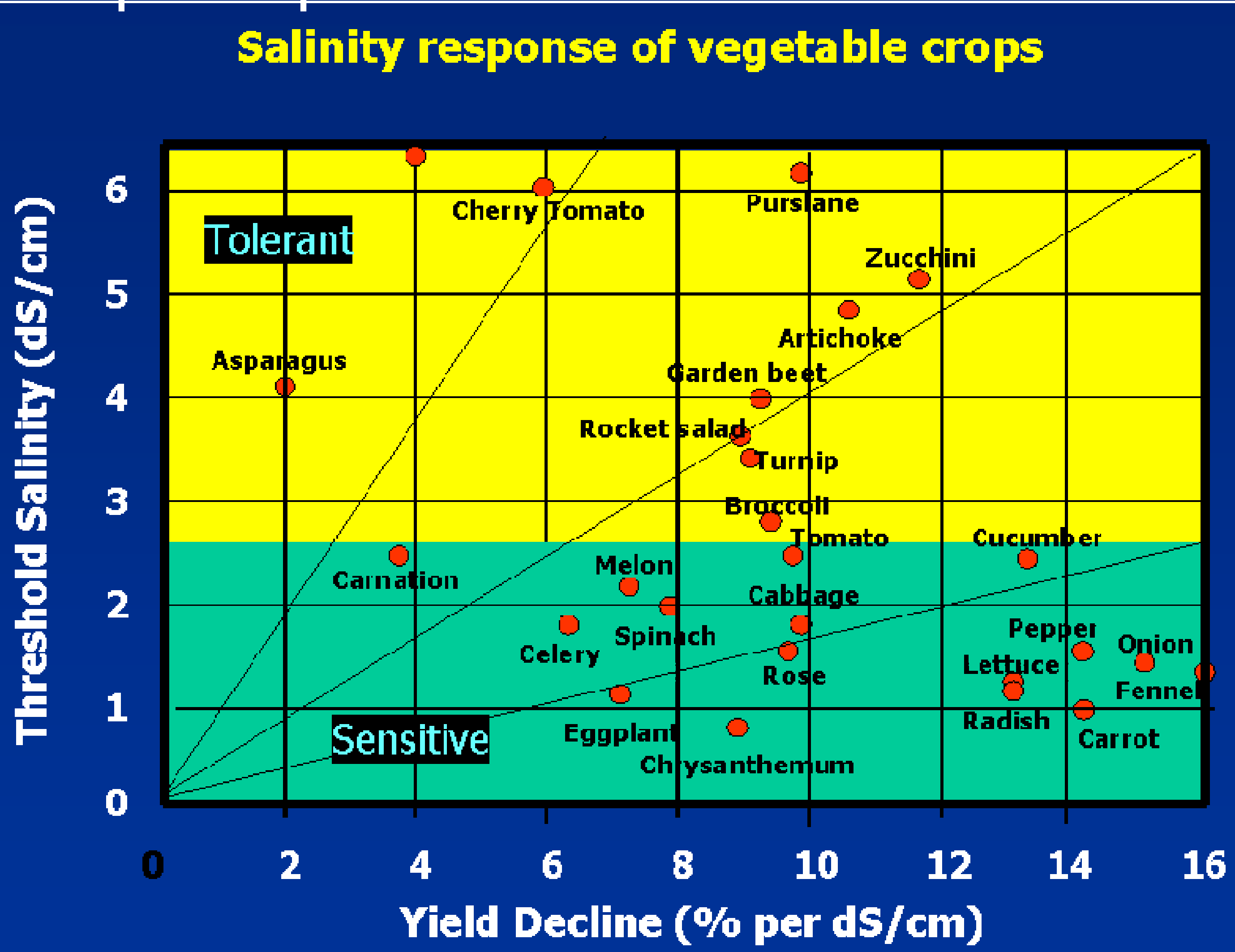


Crop Response Model for Deficit

- Yield response to
  - Water Quantity (ET-based)
  - Water Quality (Salinity model)

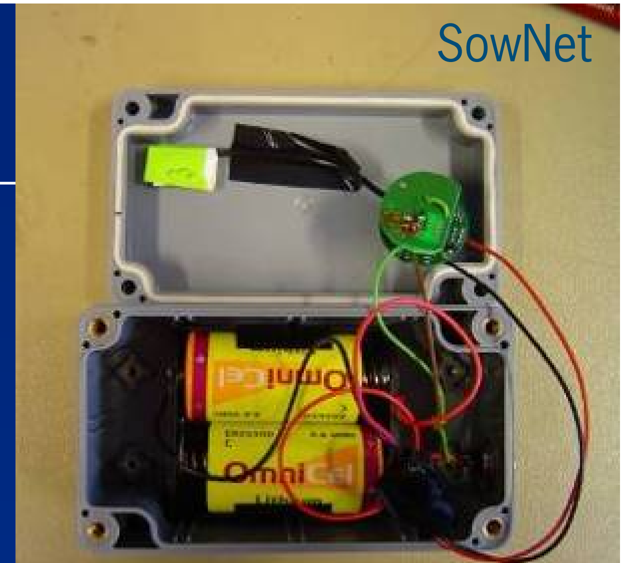


Crop Response Database



Wireless Network

- High spatial and temporal density
  - Multiple nodes
  - Multiple sensors
- Wireless Advantages
  - No cabling
  - Easy installation and handling
- Robustness in field
  - Weather
  - Data Reliability
  - Long Range
  - Solar powered or long battery life time



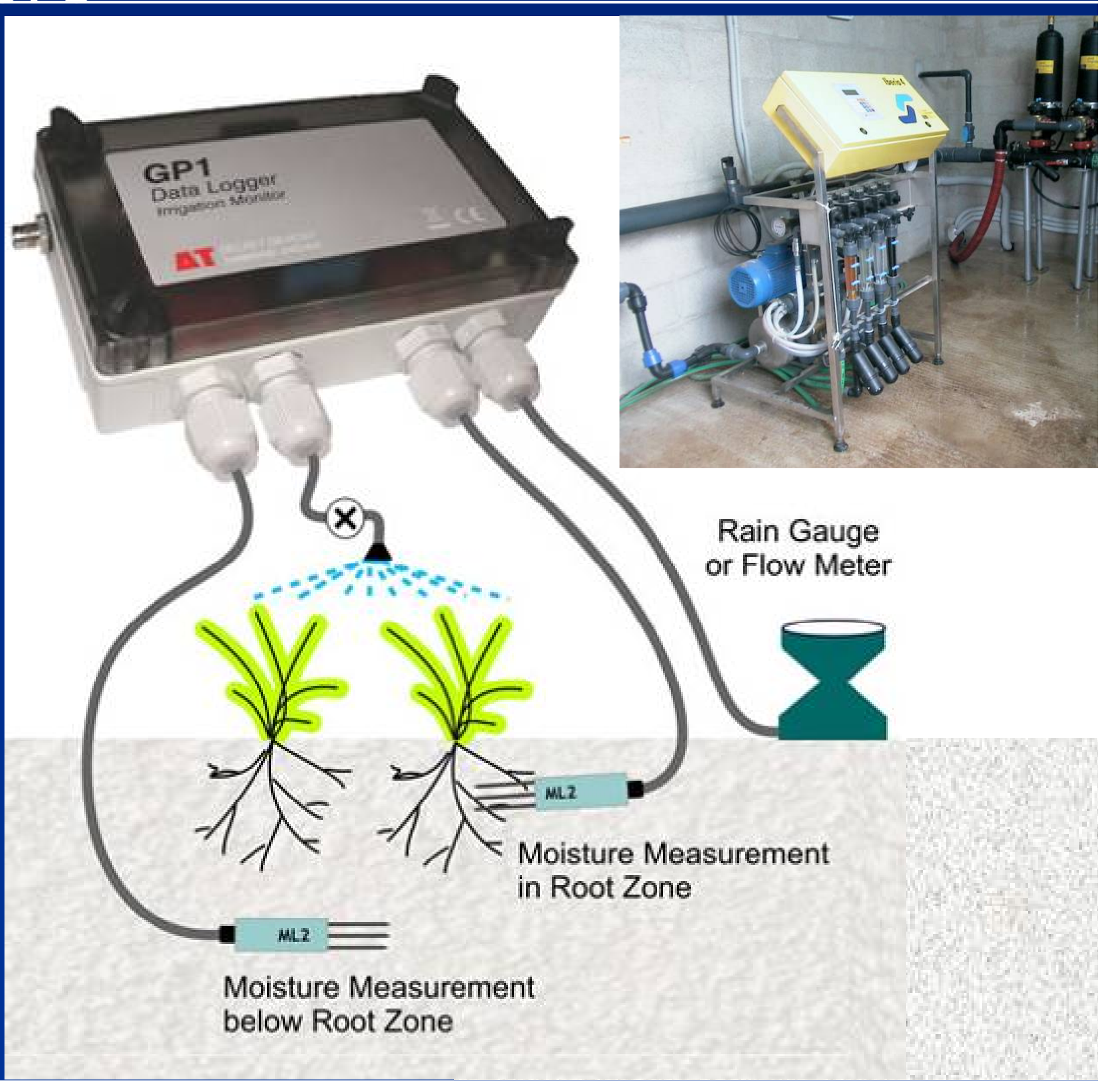
Improve Sensor Performance

- Volumetric Water Content
  - Soil/substrate calibrations
- EC
  - WET-sensor, ECHO-probe
  - Pore Water EC calibration
- Porous Matric Sensors
  - New Tensiometer
  - Large range (no air entry at dry end)

Calibration of WET-sensor for water content and pore water EC
in different horticultural substrates;
Pardossi, A., Incrocci L. et al.

Controller and Sensors

- Irrigation – Fertigation
  - Stand-alone operation
  - Parameterized
  - Wired or via GSM-link
- Activation On/Off
  - Timed
  - Sensor controlled
    - Water content, EC,
    - Tensiometer
    - Temperature, Rain gauge
    - Radiation …
  - Model based (f.i. ET)
  - Multiple valves
  - Multiple water sources



Field tests

- Targets
  - use deficit irrigation or prevent leaching
  - evaluate water use efficiency and yield
  - compare with common irrigation practise
- Constraints
  - crop production systems
  - system complexity
  - crop types
  - irrigation structures
  - availability of water
    - local/external water sources
    - amount and quality
  - goals and regulations



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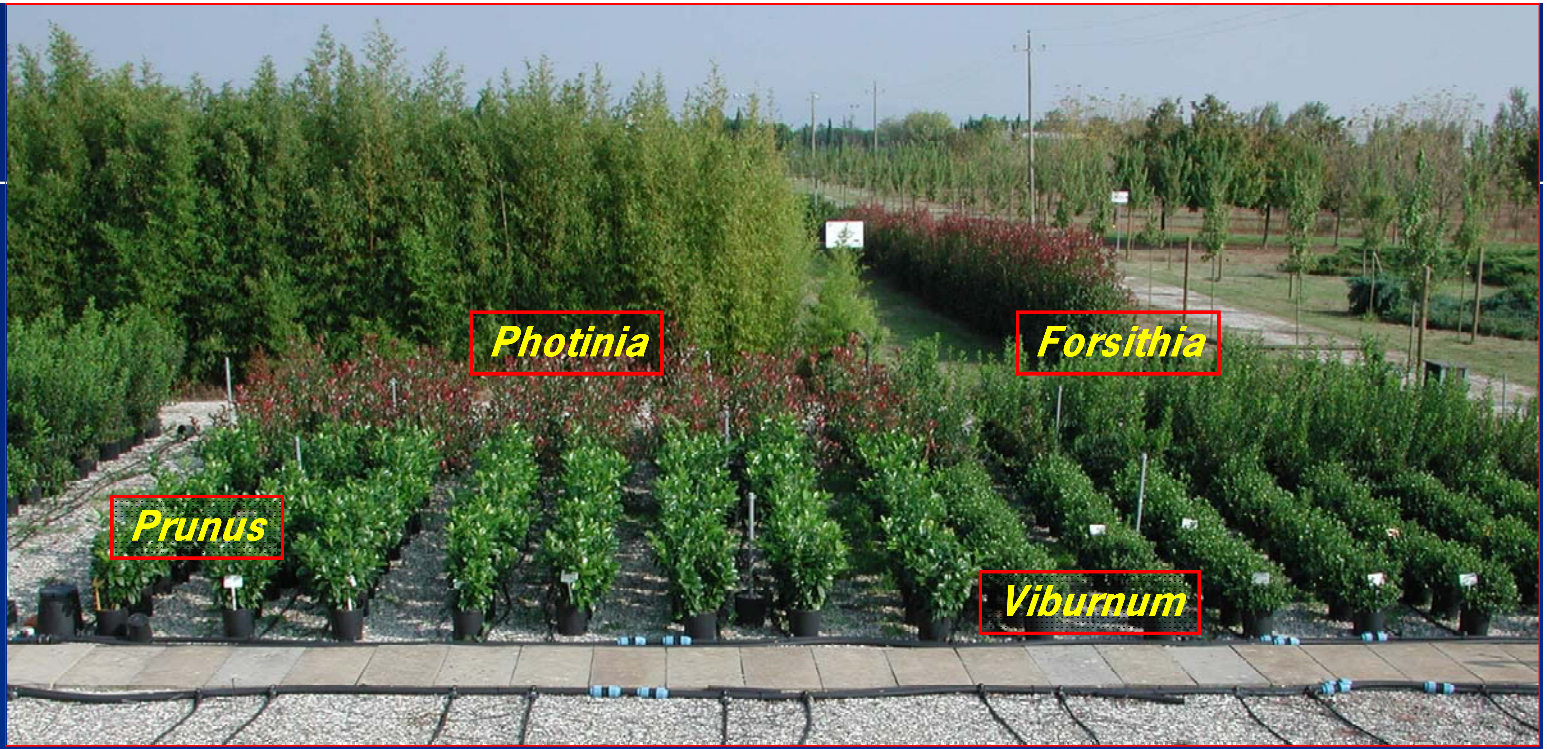
Italy



- Nursery stock production
- Experimental Station CeSpeVi, Pistoia, Tuscany
- Container plants (drip/sprinkler)
- Farm sizes: 10 - 100 ha
- Irrigation unit size: approx. 1200 m2
- Deficit (zero-drain)
- Dual water irrigation: Cleaned Waste Water and Fresh Water

Turkey

- Region Izmir (Tahtalı Dam)
  - Preservation area
  - Greenhouses permitted
  - Water from wells, but no leaching allowed

- Test-site targets
  - Test-site at local farmer (Cucumber)
  - Irrigation: zero drainage
  - Sensor activated control
  - Monitoring crop yield and quality

REPONSE OF CUCUMBER TO DEFICIT IRRIGATION

Tuzel H. et al.

EC Project no. 036958 (FP6)

Thanks for your attention

Database Example

Crop (Short name)	Developmental stage (description)		K_C	*RD*	*P* *(RAW/TAW)*	K_Y	EC_{th}	*b*
Tomato	I	Initial	0.6	0.25	0.30	0.4	2.0	9.0
	II	Crop development	0.6	0.25	0.30	1.1	2.0	9.0
	III	Mid-season	1.15	1.0	0.40	0.8	2.0	9.0
	IV	Late season	0.7	1.0	0.50	0.4	2.0	9.0
	V	-	-	-		-	2.0	9.0
	Total growing cycle		-		0.30	1.05	2.0	9.0

THE INFLUENCE OF FERTIGATION STRATEGIES ON WATER AND NUTRIENT EFFECIENCY OF TOMATO GROWN IN CLOSED SOILLESS CULTURE WITH SALINE WATER

Jordan

- Irbid, Jordan Valley
  - Fruit trees, oriental trees, vegetables
  - Very limited water resources
  - Low water use efficiency
  - Poor water management at farm level
- Pilot Project Site
  - Treated Waste Water (2 types)
    - Extended Aeration (1000m^3/day)
    - Rotating biological contactors (600m^3/day)
- Objectives
  - Experiment with soil grown tomatoes
  - Dual water quality irrigation
  - Efficient irrigation scheduling
  - Use of soil moisture sensors (a.o. EC)
  - Technology transfer to farmers

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Lebanon

- Litany River, South Bekaa Valley
  - Fruit trees and vegetables
  - Water sources
    - 2000 ha, pressurized pipelines (sprinklers and tricklers)
    - 4700 ha, furrow irrigation and other traditional surface irrigation
- Evaluation of Technology
  - Pilot irrigation farms
  - Deficit irrigation performance (potato)
  - Pressurized versus surface irrigation
  - Water use efficiency, yield and growth
  - Socio-economic impact
  - Evaluation Farm Zoning and Crop Planning

DSS implementation