FLOWAID

Farm Level Optimal Water Management Assistant for Irrigation under Deficit

Wageningen (The Netherlands)
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EC project: **036958**

More Crop per Drop

Public Report

FLOWAID

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Consortium: 11 partners from 8 countries

Partners	**Country**
Wageningen University & Research Center, Plant Research International	NL
Rothamsted Research	UK
University of Castilla La Mancha, Regional Center of Water Research	ES
University of Pisa, Dipartimento di Biologia delle Piante Agrarie	IT
Ege University Faculty of Agriculture, Dept. of Agric. Structure and Irrigation	TR
Jordan University of Science and Technology, Faculty of Agriculture	JO
Lebanese Agricultural Research Institute, Department of Irrigation and Agro-Meteorology	LB
Delta-T Devices Ltd.	UK
Geomations S.A.	GR
Spagnol Srl	IT
Wageningen University & Research Center, Applied Plant Research BV	NL

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More Crop per Drop

Technology supports growers to cope with water shortage challenges as well as legislation like the Water Framework and the Nitrate Directive

Water shortage forces growers to adopt deficit irrigation practices. They tend to irrigate with less water at a lower quality. To avoid crop damages and income losses, they need to manage their water and nutrients more precisely. New technology based tools might help them by making the most optimal operational decisions. The extra income, due to slightly higher yields and use of less fertilizers, might help to invest in these new technologies.

The Problem

Agriculture is the largest user of water, making it a big competitor for domestic and industrial users. To secure our food production for future generations, the irrigation water use efficiency must be increased drastically, in other words: we need "more crop per drop".
Generally the way to go is to avoid spilling of water, and to ensure that all the irrigation water is being used by the crop. Over-irrigation invokes leaching of water and fertilizers affecting the environment. This can be ensured by optimizing irrigation equipment and irrigation management.

However, in many cases this step is not enough, and currently growers need to adopt a deficit irrigation strategy in which they supply water under the advised FAO amount or even use non-fresh water resources. Crop yield is closely related to water and fertilizer use. Limiting water supply or using marginal water resources might result in yield and quality losses. Working under deficit conditions means that the grower needs to operate his water management more precisely to prevent income losses. He cannot longer rely on his common sense, but needs help from technology.

Container grown ornamental plants grown under high saline conditions show crop damages: brown leaves (Italian case study)

Objectives

FLOW-AID contributes to sustainable irrigated agriculture by developing a deficit irrigation management system for farm-level crop production in cases with limited water supply and marginal water quality. It integrates innovative sensor technologies into a decision support system, taking into consideration boundary conditions and constraints for a number of practical growing systems in the Mediterranean. It focuses on innovative, simple and affordable, hard- and software concepts; particularly a maintenance free tensiometer, a wireless and low-power sensor network; an expert system for farm zoning and crop planning in view of expected water availability and quality; and an irrigation scheduler for allocation of multiple water sources. The system is being evaluated at five sites located in Italy, Turkey, Lebanon, Jordan and the Netherlands, which differ in the type of local constraints, irrigation structures, crop types, local water supplies, availability of water and water sources in amount and quality, the local goals, and their complexity.

Methodology

The FLOW-AID system consists of irrigation controllers, distributed over the irrigated farm zones. They are connected via a wireless link to a local computer that regularly reads out sensor data and updates the scheduling programs running autonomously in the controllers. A Decision Support System containing an expert system with "best practice irrigation rules", running either on the local or remote (connected via internet) computer helps growers to optimise their scheduler programs in view of the expected water availability and climatic conditions on a long-term as well as short-term basis. During three growing seasons, the system components are mainly being evaluated at Mediterranean test-sites. Over the years, the system is enhanced and the final system was shown to farmers during the 3rd year at the test-sites. The FLOW-AID system is being developed through a close partnership between research institutes, universities and SME's.

Intensified use of technology in the field (Lebanese case study)

Results

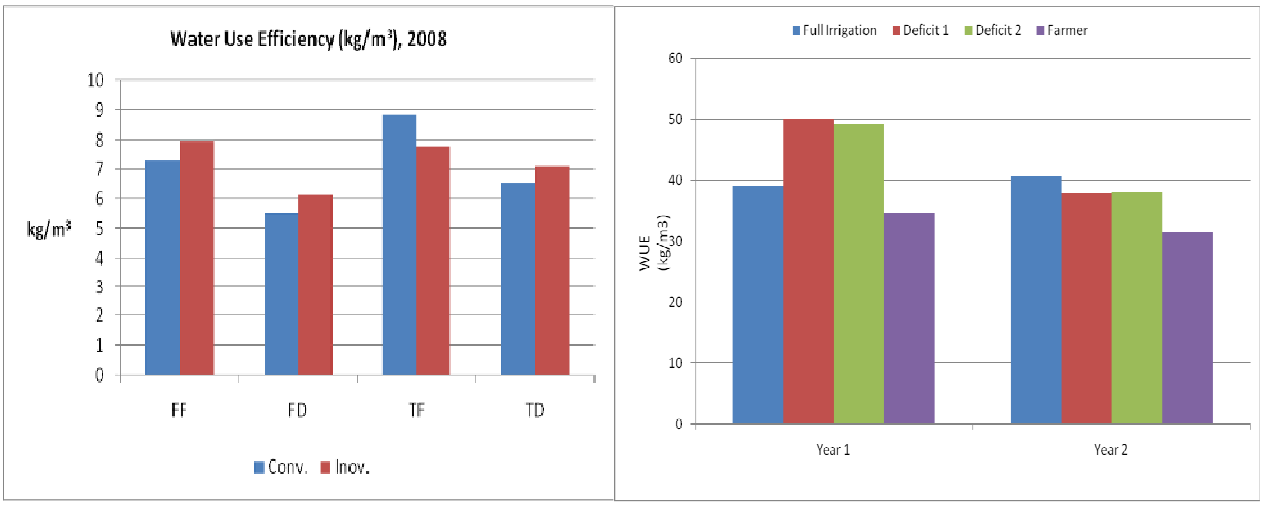
Industry and SME's may take up the following research results to build new hardware and software for deficit irrigation systems:

1. Low-cost sensor and controller technology: a solid-state tensiometer; a wireless, low-power sensor network for soil moisture and EC sensors; an irrigation controller for optimal irrigation scheduling.
2. A Decision Support (Expert) System to assist in farm zoning and crop planning, in view of expected water availability (amount and quality); a crop response model for deficit irrigation; and a deficit irrigation scheduling module that allocates available water(s) among several plots.

The SME partners involvement already ensures that the results will be implemented in a short time into adequate and appropriate products for the end-user irrigation market. The participation of the Mediterranean test-sites ensures that the final products will also be fine-tuned to the [economic and physical] conditions of non-European markets, where the largest growth for irrigation equipment is expected.

Case studies have shown that compared to current practices, by using innovative technologies, the water use efficiency can be raised up to 10% while maintaining the existing crop yields.

Application of new technologies cost money. Some case studies have shown that by using technology and adapting strategies one could even raise the productivity up to 10%, while the amounts of water and nutrients being used where less than current practices. By using treated waste water resources farmers could benefit from the already available nutrients in these water sources. Farmers might use this extra income for investing in new technologies.



Result of the Jordan case study (left) in which conventional and innovative irrigation practices are compared under standard and deficit regimes. It was shown that when using fresh water sources the water use efficiency can easily be raised with 10%. When using marginal water resources (treated waste water), irrigation management is more complex, but one can make use of the extra nutrients in the water source. Result of the Turkey case study (right) show that innovative irrigation practices, whether with full irrigation or under deficit, give a better (10-40%) water use efficiency compared to farmer practice.

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The following briefs are available through www.flow-aid.eu

Technology Briefs

A New sensor to measure matric potential: The dielectric tensiometer

Wireless sensor systems for irrigation management High density measurement of soil moisture, EC and temperature

A Crop Planning and Farm Zoning Tool

Crop stress response model: Assessment of crop yield response to water and salinity stress

Optimal management of irrigation under scarcity: A decision support system, description and working of the system

Sensor activated Irrigation Controllers: Precise management of irrigation water to minimise environmental damage & wastage

Sensor Activated Fertigation Controllers: Managing fertigation and dual water irrigation in container crops

Case Study Results

LEBANON: Optimizing Farm Water management Using Smart Irrigation Controller: Field grown eggplants under different irrigation regimes

JORDAN: Irrigation strategy with dual quality water: Irrigation with Fresh and Treated Wastewater under full and deficit soil moisture conditions for Tomato Crop

TURKEY: More Yield, less water and less leaching: Minimization of leaching for cucumber grown in greenhouses under mild winter conditions.

ITALY: Dual Water Irrigation of Pot Ornamentals: Saving water resources in ornamental nursery industry

THE NETHERLANDS: More yield, more quality and less emission of nitrate: Soil grown Iceberg lettuce under rain-fed conditions

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Coordination, wireless sensor network and irrigation scheduler
Water management, agronomy, ICT systems, software/hardware, optimal control engineering, soil sensors, crop response to irrigation with saline water, optimal use of low-quality water.

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Dielectric tensiometer
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Farm Zoning based on long term water availability
Crop planning and modelling irrigation management. irrigation technology and scheduling, sprinklers, micro-irrigation., agricultural water management and conservation, GIS-based methods for agro-environmental management and irrigation advisory services.

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Crop response model for drought and salinity Test-site (Italy)
Horticultural science, crop biology and modelling. crop response to environmental stress, such as cold temperature, drought and salinity, crop model versus soil water status and weather.

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Test-site (Turkey)
Yield and quality response to water management, water use efficiency, modern irrigation techniques, reclamation of saline and alkaline soils, hydrological modelling, reuse of new techniques on land consolidation and development of farm structures for regional conditions.

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Fertigation, wastewater reuse for irrigation, training and capacity building programs. Coordination and consultancy for international Potash Institute and International Atomic Energy Agency in the field of fertilizer use and fertigation.

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Test-site (Lebanon)
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Software for irrigation management
Turn-key software development for automation and irrigation management, database management and data collection systems, internet, client/server, web based, multimedia, mobile and wireless.

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