Save Water and Fertilisers with the AquaTag, a low-cost, contact-less Soil Moisture Sensor

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Background

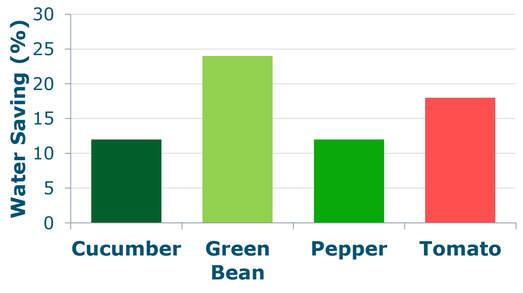
In general, manual control of irrigation can lead to over doses of water invoking drainage, or under doses leading to yield reduction. By using soil moisture sensors to control irrigation, up to 50% of water can be saved, while maintaining crop yields and quality [1]. Optimal use of water also reduces leaching of fertilisers. Horticulture, especially in (semi) arid areas, can benefit thereof. Existing soil moisture sensors are relatively expensive, and while sensors only measure locally and moisture content may vary largely within a valve section, their use can become very costly. The AquaTag (Figure 1) is a new, patented concept of a non-contact soil moisture meter [2]. It has low cost and can thus be used in large numbers in order to determine an average true moisture content of a valve section. The AquaTag was initially developed in the Netherlands for irrigation management of containers plants [3]. In this project it was successfully demonstrated in greenhouses for soil-grown vegetables in Turkey in a greenhouse area nearby Izmir. The main aim was to keep the technology easy accessible for small-scale growers, and give them possibilities for saving water, fertilizer, energy and operational costs, under sub-optimal growing conditions.

Figure 1. The AquaTag (version especially for container plants).

Figure 2. The AquaTag placed in a PVC jacket with a cucumber cultivation.

Results

In the sensor-controlled valve sections the growers achieved a less dynamic moisture content and a saving of 13-24% of the water compared to the unregulated valve sections. In organic farming that was 12 %



Approach

Growers (cucumber, pepper, green bean and tomato) placed five sensors in soil at 15 cm depth per valve section (Figure 2). Measurements were carried out once per day with the hand-held meter. Growers decided about a possible irrigation and water amount based on the obtained average moisture content, taking into account soil type and crop stage. Water uses (monitored with water flow meters) were compared with those of valve sections where the growers determined the irrigation themselves, without use of the sensors. Growers were visited every five days by a researcher, who recorded data from sensors and water meters.

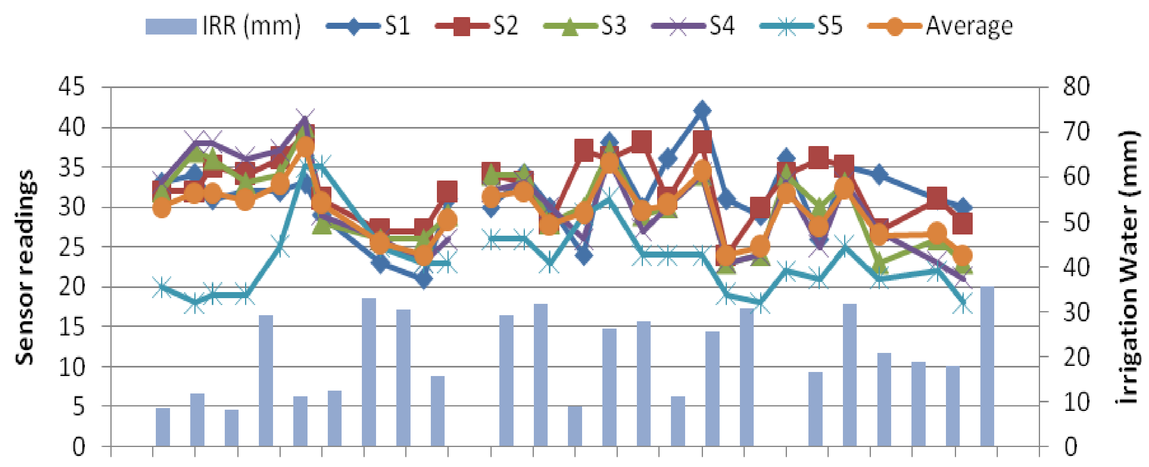


Figure 3. Sensor measurements and average values of moisture content (in %) and water gifts recorded during summer 2013 for a cucumber cultivation.

References

[1] J. Balendonck, A. Pardossi, H. Tuzel, Y. Tuzel, M. Rusan, F. Karam, FLOW-AID – a Deficit Irrigation Management System using Soil Sensor Activated Control: Case Studies. In: Transactions of the Third International Symposium on Soil Water Measurement Using Capacitance, Impedance and TDR, Murcia, Spain, 7-9 April 2010.

[2] M.A. Hilhorst, G.J.N. Doodeman, "A radio frequency tag," EP 2141635 A1, 2010.

[3] J. Balendonck, M.A. Hilhorst, W. Stenfert Kroese, G. Meijer. A Wireless Passive Soil Water Content Sensor Tag. ISEMA2013, 10th International Conference on Electromagnetic Wave Interaction with Water and Moist Substances, Weimar (D), 25-27 Sept. 2013.

The AquaTag is developed by SensorTagSolutions in close collaboration with Delft University of Technology, TNO, Eindhoven University of Technology and several Dutch engineering companies. Wageningen University Greenhouse Technology developed the monitoring and control strategy. EGE University adapted this approach for Turkish application and conducted experiments on location at nine growers in Orhanli village. This project is supported by the Ministry of Economy, Agentschap-NL, under the program "Partners for Water" (PVWS12003).

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