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BEST PRACTICES

Precision irrigation of greenhouse crops in Mediterranean area

Institutional information

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Summary

Explain your case in one or two sentences

This text aims to propose irrigation management techniques that could be applied to soil-based or soilless greenhouse crops.

Background information: How was the situation previous to your actions?

For many years, irrigation was applied to crops at fixed time intervals and quantities (i.e. time clock scheduling) and, more recently by estimating the quantity of solar energy corresponded to the irrigation dose consumed by the transpiration. However, it has been well documented that none of these two methods are sufficiently accurate to satisfy the crop irrigation needed when used as a solo criterion for irrigation. In principle, a time lag between water supply and transpiration often occurs in the case of time clock scheduling, while irrigation based on solar radiation is not taking into account other climatic factors which affects transpiration, such as the vapor pressure deficit. Therefore, irrigation scheduling should be based on more complex evapotranspiration models, which correlate to greenhouse climatic and plant data.

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What were the needs you identified?

Optimal irrigation scheduling of greenhouse crops is very important, since it influences the rhizosphere environment, media water potential and salt accumulation, which in turn affect plant growth, photosynthesis, crop production and quality. Irrigation control involves the determination of both timing and quantity of water application. To optimize productivity, plants must never run out of readily available water or be subjected to conditions that cause stress and reduce plant growth.

What solution you found to cover those needs?

As abovementioned, there are several approaches for making irrigation decisions in a greenhouse crop, the most common of them being timer-based, sensor-based, and model-based methods. A system that exploits all these approaches multiplies the efficiency of irrigation control in greenhouses

What actions did you take to reach the solution?

- Monitor and record the greenhouse and crop microclimate parameters (air temperature and relative humidity, solar radiation, and nutrient solution applied to and drained from the crop and substrate volumetric water content).
- Process and analyse the collected data.
- Application of models to estimate parameters and simulate processes.
- Analyze models' results to produce recommendations.

If any, which partners or other organisations did you involve during the process?

- Institute for Bio-Economy and Agri-Technology, Greece
- Agricultural Research Institute, Cyprus

What were the main problems or difficulties you had to face?

- The interactions between the microclimate and the physical conditions of the plants have to be well known.
- As the accuracy of the models is crop specific and highly depends on the microclimate of the greenhouse, models must firstly be calibrated for the specific crop under the prevailing greenhouse environmental conditions.
- It's better to monitor continuously and automatically groups of plants distributed in several positions within the greenhouse rather than individual plants which may not provide representative data related to the plant water status.

What is the situation now, after your actions?

- Crop water needs can be accurately estimated in advance.
- The water used by the plant can be estimated accurately in a short interval rate.
- 100% increases of water- and fertilizer-use efficiency have been achieved.

- The simplified Penman-Monteith equation transpiration model is recommended to calculate greenhouse crop transpiration rates.

Main lessons learned along the way? *

Precise irrigation should involve the determination of the timing and the quantity of each irrigation event which may be estimated based on the climate of the greenhouse, monitoring of the substrate, or evaluated different plant indicators of water stress. Irrigation scheduling should be based on complex evapotranspiration models, which correlate to greenhouse climate and plant data. There is a need to develop a commercial irrigation controller unit, in order to model and monitor the soil-plant-atmosphere utilizing artificial intelligence analyses.

Sources:

Katsoulas N, Bartzanas T, Kittas C, 2017. Online professional irrigation scheduling system for greenhouse crops. Acta Hortic. 1154. ISHS 2017. DOI 10.17660/ActaHortic.2017.1154.29

Nikolaou G, Neocleous D, Katsoulas N, Kittas C, 2017. Irrigation management techniques used in soilless cultivation. In Webster DG (ed), 2017. Advances in hydroponics research, pp 1 – 32. Nova Science Publishers, Inc., New York

Nikolaou G, Neocleous D, Katsoulas N, Kittas C, 2019. Irrigation of Greenhouse Crops. Horticulturae 5, 7; doi:10.3390/horticulturae5010007.