Electronic Tongue Using Case-Based Reasoning (Cbr): Application To Monitoring Nutrient Solutions In Fertigation

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A simplified four-electrode electronic tongue based on Case-Based Reasoning (CBR) (Fig. 1) is here proposed as a multisensor system for the efficient qualitative analysis of nutrient solutions employed in hydroponics, the growing of plants without soil, which is becoming a usual technique in greenhouse crops. The nutrients required by plants are dissolved in the irrigation water and regularly flushed into the medium, being this process known as fertigation. First attempts to monitor recirculating nutrient solutions in these crops were only based on the measurement of electrical conductivity (EC) and pH [1]. In the present work, the CBR-based multisensor system is enlarged with two additional potentiometric sensors, being the data provided by the sensors array evaluated by means of CBR, which shows more advantages than other pattern recognition techniques such as ANN [2]. Given that nitrate is one of the main components in this type of samples, the sensors array includes a homemade sensor involving a biopolymer-clay nanocomposite that shows a remarkable sensitivity towards this anion [3].

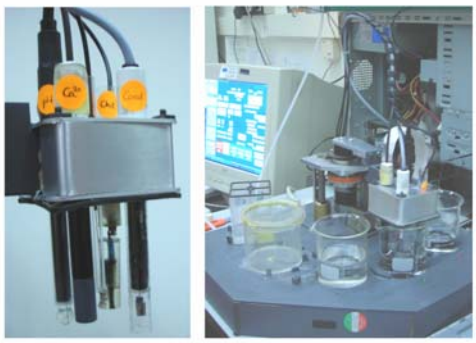

Fig. 1 Images of the 4-electrode array and the automated robotic system

In contrast to other samples measured by electronic tongues such as foodstuffs, clinical, industrial and environmental samples, which may differ considerably in their composition [4], nutrient solutions used in fertigation have the same ionic composition with concentration varying in a narrow range. The CBR-based electronic tongue comprising a reduced number of sensors is able to discern among these nutrient solutions of alike composition. The long-term stability of this multisensor system, which has been proved with continuous data uptake during two weeks, allows the comparison of new unknown solutions with past cases registered in previous days. CBR processing is able to learn and evolve from past experience, and this requires a set of sensors offering stable responses. In addition, drift and weight corrections can be applied to the CBR in order to improve the discrimination ability of the whole system.
These successful preliminary results are the basis for the future incorporation of this CBR-based multisensor system in a fully automated configuration for an entire monitoring of greenhouse crops. Thus, the aim is to optimize the system to be able not only to detect changes in the ionic composition of nutrient solutions, but to actuate in order to adjust them taking into account the plants requirements.

References

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