MEASURING OXYGEN AND PH IN THE ROOT ENVIRONMENT

By: Chris Blok, Wageningen UR Greenhouse horticulture

New sensors for making observations in the substrate directly at the roots will soon become available. The sensors will provide additional information that can give better insight into the growth and development of crops. The companies Fytagoras/FFEW, Peacock & Black and Cultilène discussed the possibilities and their experiences at a plant nursery.

"The new sensors work in accordance with optochemical principles, which means that a dye held in a polymer shows discolouration," Jan Joris Swart of Peacock & Black explained. "The level of discolouration depends on the oxygen or pH level and is measured with a fluorescence meter." To determine the pH level, the company uses two wavelengths; the ratio between the wavelengths is determined so that the sensor becomes insensitive to the ageing of the dye. The oxygen level is determined by the rate at which the emission of light fades after a saturating light pulse, in which the relationship between the gradient of the fading curve and oxygen level is known. The pH and oxygen sensors are inexpensive.

Experiences with the oxygen sensor

Substrate measurements have shown that a considerable decrease in oxygen occurs when the water level rises two to three percent above a marginal value. "This indicates that the input of oxygen becomes substantially slower if there is just a little too much water in the substrate," said Wessel Holtman of Fytagoras/FFW. Other measurements show that two instead of eight ppm of oxygen per litre of water in the root environment can reduce production by 10 to 30 percent with virtually no symptoms. In the daytime a root uses up to 50 mg of oxygen per cucumber plant per hour, which corresponds to 100 mg per hour per square metre.

Experiences with the pH sensor

Jan Willem Spaargaren of Cultilène described an experiment with the new low-cost sensor heads and pH sensor at the facilities of a plant grower. Normally the grower measures the water quality once a week with a glass electrode in one to three blocks, which first have to be squeezed (i.e. destructed) to subtract the water. In the new method, dozens of blocks were equipped with the new, low-cost sensor heads. The pH was read out with a hand meter that did not need to be calibrated. During a continuous measurement throughout one day, it was shown that with the screens shut in the evening, the pH increased by almost one full pH unit. The largest fluctuations in water quantity were visible around 13 to 18 days after the start of the cultivation, the point when little irrigation and lots of growth merge.

Conclusion

In the food industry, pH and oxygen levels are determined through the plastic packaging via pre-placed coloured spots. This light-based technology is now available for horticulture as well. The speed, ease and costs of the technology are more favourable than the former method for determining the oxygen and pH level. It has also been shown that the new technology provides a greater insight into cultivation management.

Partners in this HortiSeminar: Fytagoras/FFEW, Peacock & Black, Cultilène