



Project 2019.0219

# Nutrient management in greenhouse horticulture

## Validation Capillary Electrophoresis

The current system of nutrition dosing in greenhouse horticulture is based on adjustments once every 7-14 days after analysis of a sample of the nutrient solution around the roots. This means that levels of individual nutrients are regularly 30% or more different from the desired levels in the root environment. The processing of the nutritional analyses is not automated. The same applies to adjusting the food recipe and mixing the new food.

The processing of fertilising information requires a lot of knowledge and mistakes have far-reaching consequences for the health of the crop and the yield and quality. Dutch growers insist on more extensive automation of feeding while foreign growers refrain from recirculation of drainage water due to the risks.

The last ten years have been successful, but with hand measurements several nutritional strategies have been implemented such as end-cultivation strategies to exhaust nitrate and phosphate and dosing ammonium without pH and nose rot problems. In addition, the Manure Advisory Base (BemestingsAdviesBasis) has been digitised and combined with a balance model to follow the nutritional intake on a daily basis. Prototypes of the system proposed by the Sensor Factory have been tested at a water authority and at the tomato grower Royal Pride. The measurement principle proved reliable and stable as theoretically expected.

### Facts

**Project number:** 2019.0219

**Project name:**

Nutrient management in  
greenhouse horticulture - Validation  
Capillary Electrophoresis

**Customer:** WUR, The Sensor Factory

**Partners:** Wageningen University,  
The Sensor Factory

**Students:**

Student: Dejanire Barnier (National Graduate  
School of Chemistry of Montpellier)

**Others involved:**

Bob van Bijnen,  
(Project Manager CEW);  
Biense Hoogland,  
(Researcher CEW).

## Objective

The CE-system has been created to measure under greenhouse conditions as it is part of a 4-year project, in collaboration with the Wageningen University & Research, whose purpose is to improve the nutrient supply. To understand the capabilities and robustness of the CE-system within the greenhouse a validation is needed by making use of synthetic solutions and Standard Water.

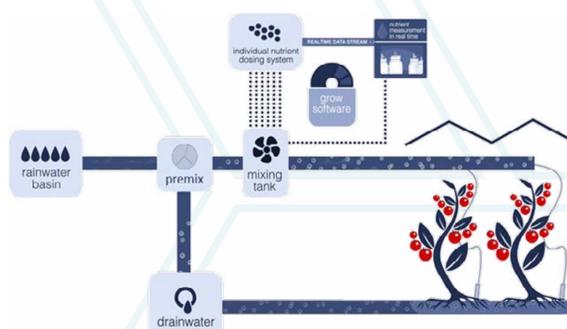
## Method of approach

The validation of the CE has been performed in order to ensure its capacity to analyse the ions ( $K^+$ ,  $Mg^{2+}$ ,  $NH_4^+$ ,  $Na^+$ ,  $Ca^{2+}$ ,  $Cl^-$ ,  $HCO_3^-$ ,  $NO_3^-$ ,  $SO_4^{2-}$ ,  $HPO_4^{2-}$ ) present in greenhouse water. In this study, the influence of conductivity, pH and temperature on the CE-system was determined.

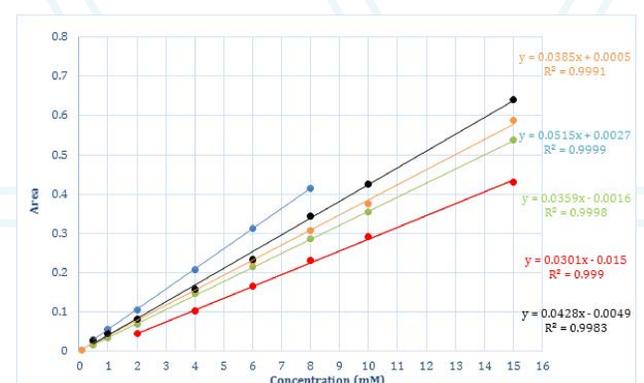
## Results

Ions	Linearity range (mmol.L <sup>-1</sup> )		LOD (mmol.L <sup>-1</sup> )	LOQ (mmol.L <sup>-1</sup> )	Repeatability Min - Max (%) Average	Accuracy  Min  -  Max  (%)
	C <sub>min</sub> -C <sub>max</sub>	R <sup>2</sup>				
K <sup>+</sup>	0.1 - 15	0.9991	0.2804	0.9348	1.00 - 46.7 7.11	0.78 - 16
Mg <sup>2+</sup>	0.5 - 8	0.9999	0.04912	0.1638	1.11 - 7.91 3.88	0.23 - 6.6
NH <sub>4</sub> <sup>+</sup>	0.5 - 15	0.9983	0.03243	0.1081	0.950 - 4.75 2.28	0.47 - 36
Na <sup>+</sup>	0.5 - 15	0.9998	0.1237	0.4122	0.939 - 5.36 2.00	0.14 - 3
Ca <sup>2+</sup>	2 - 15	0.999	0.0179	0.0595	1.43 - 6.09 2.65	0.12 - 4
Cl <sup>-</sup>	0.5 - 10	0.9878	0.8393	2.798	0.654 - 19 10.3	1.1 - 42
HCO <sub>3</sub> <sup>-</sup>	1 - 15	0.9957	0.7067	2.356	0.914 - 11.9 8.03	1.6 - 8
NO <sub>3</sub> <sup>-</sup>	1 - 20	0.9917	2.223	7.410	1.11 - 20.5 5.89	2.4 - 77
SO <sub>4</sub> <sup>2-</sup>	1 - 8	0.9777	1.286	4.288	1.22 - 37.1 14.0	3.1 - 18
HPO <sub>4</sub> <sup>2-</sup>	4 - 15	0.9804	2.304	7.680	2.60 - 19.5 9.97	1.6 - 10

Summary validation results



Full automated control of irrigation water



Linearity kations