Intelligent FluoroSensor: a fast tool to determine fluorescence characteristics

Sándor Lenk[1], András Herein[1], Péter Mayer[1], Éva Jeszenszky[1], Maaike Wubs[2], Alain Palloix[3], Anja Dieleman[4], Attila Barócsi[1]

[1] *Department of Atomic Physics, Budapest University of Technology and Economics (BME), Budafoki út 8, 1111 Budapest, Hungary, barocsi@eik.bme.hu*
[2]*Horticulural Supply Chains,Wageningen University, Droevendaalsesteeg 1, 6708PB ,Wageningen, the Netherlands.*
[3] *Génétique et Amélioration des Fruits et Légumes, UR 1052, INRA-Avignon, BP 94, 84143 Montfavet Cedex, France.*
[4] *Wageningen UR Greenhouse Horticulture (WUR), PO Box 644, 6700 AP Wageningen, The Netherlands.*

The aim of the Smart tools for Prediction and Improvement of Crop Yield (SPICY) project is to develop a suite of tools to help breeders in predicting the phenotypic response of genotypes for complex traits, like yield, under a range of environmental conditions. The project particularly focuses on developing tools for predicting phenotypic performance (e.g. growth, yield) of a genotype by means of an integrated gene-to-phenotype model, thereby reducing the effort of phenotyping new pepper genotypes. As part of the project, fluorescence tools are being developed by BME. (For further information, see www.spicyweb.eu).

Rapid measurements of steps in the photosynthesis process may provide valuable information on the growth potential of a genotype and provide essential parameters for the crop growth model. The measurement of fluorescence induction kinetics can be correlated to the photosynthetic activity of plants (for current review see: Buschmann, 2007). The light-induced heating of leaves can be correlated to the stomatal conductance (Bajons et. al 2005) and non-photochemical quenching (Kana and Vass 2008). As the different photochemical and non-photochemical quenching responses are related to different plant species and cultivars, in the SPICY project, the above methods were combined for genotype characterization and phenotype prediction.

A new instrument for the measurement of fluorescence and leaf surface temperature kinetics was developed by BME, which allows semi-automated tests for the users. Each Intelligent FluoroSensor (IFS) starts a new measurement automatically after closing its leaf-clip and the sample/sensor system is relaxed. When the measurement is completed, the digital data are transferred to the central unit based on a modified FluoroMeter Module (FMM) system.

The collection of the first large scale data and their evaluation has been completed. It shows promising results for the prediction of plant genotypes by an extended analysis of variance of certain parameters as well as by data mining algorithms of the whole kinetic curves. The data analysis showed that the first part of the kinetic curves – including the fluoresencence maximum – is most suitable for characterising genotypes. It means that the measurement time can be reduced, thus making the tool suitable for high throughput experiments.

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