Poster Presentation

MS090.P02

Textile electrochemical biosensor for plant science and precision farming

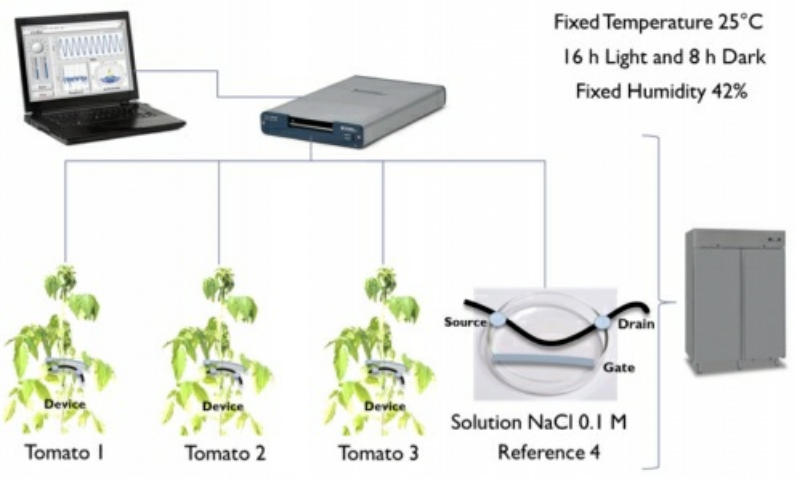
Andrea Zappettini[1], Nicola Coppedè[1], Michela Janni[1], Manuele Bettelli[1], Calogero Leandro Maida[2], Francesco Gentile[3], Marco Villani[1], Roberta Rotolo[2], Salvatore Iannotta[1], Nelson Marmiroli[1]

[1]Imem-Cnr, Parma, Italy, [2]Dept. of Environmental Science, University of Parma, Parma, Italy, [3]Dept. of Electrical Engineering and Information Technology, University Federico II, Napoli, Italy

E-mail: zapp@imem.cnr.it

In vivo integrated plant monitoring by biocompatible devices represents a key point for precision farming. Increasing efforts in research development have been done to preserve natural environment and increase crop yield, developing new methodologies that allow the application of the "right treatment in the right place at the right time". Here a biomimetic textile biosensor has been implemented in tomato plants, to monitor their ionic activity, during growth and development, directly integrated in plant tissues. The active channel of the biosensor is prepared using a textile fiber, directly incorporated in the plant stem and the device presents a textile Organic Electro Chemical Transistor architecture. The response of the sensors, calculated as modulation of channel current, together with the kinetic characteristic of the signal, have been monitored in several tomato plants for six weeks. Thus, the biological activity of several tomato plants has been constantly monitored, by measuring the concentrations of electrolytes in the plant lymph at different gate voltages. The devices detected cyclical modifications which match with the typical night/day alternation. An innovative data analysis system, that combines the quantitative response with kinetic characteristics of the signal, was introduced to improve sensitivity and increase the significance of the collected information. The data confirm the ability of the biosensor to monitor cyclic behavior of biochemical characteristics of tomato sap, controlling their fine modifications. The proposed biosensors did not alter the plant morphology even after six weeks of operations and thus resulted perfectly integrated within the plant tissues, thanks to the biomimetic structure of the natural textile fibers. The information on biochemistry of the plant sap can give an insight view on the plant conditions, and allow the optimization of their irrigation and nutrition. The combination of this novel biological dependent transistor, which we call "bioristor", together with biochemical and statistical analysis represent an early detection of the plant physiological conditions that allow to optimize growth conditions and rapidly act for plant recovery in case of stress.

G. Tarabella, et Al. J. of Mat. Chem. 22 (2012) 23830-23834.
N. Coppedè, et Al. J. of Mat. Chem. B, 2 (2014) 5620–5626.
E. Battista, et Al. Organic Electronics, 40 (2017) 51-57.



Keywords: in vivo sensors, OECT, phenotyping