

D 1.4 Plant nutrition sensors

Plant and plant nutrition

Plants are organisms that are able to make their own nutrients from simple inorganic compounds and build them into complex ones through photosynthesis, which takes place in the chloroplasts of plants. The need of plants and the essential nutritional elements/components that a plant uses for growing is called plant nutrition (North Carolina Extension, 2022). These elements/components (plant nutrition) play an extremely important role because they are directly related to metabolic processes in plants and that plants cannot complete their life cycle without them.

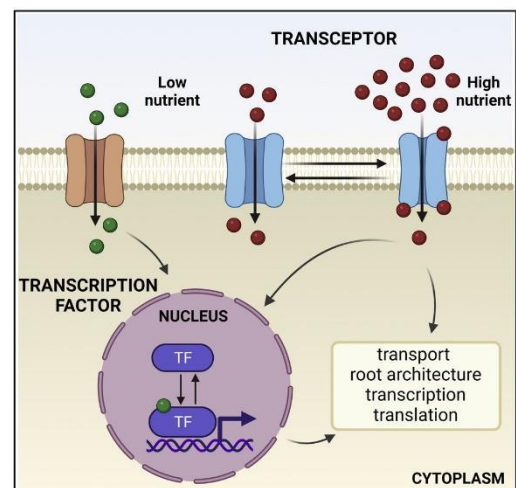
Essential elements include 16 chemical elements. In which, C, H and O account for about 96% of the dry matter of the plant but they are often not considered a true “nutrition”. Plant production usually focused on 13 nutrients provided from the soil such as the primary nutrients, macronutrients (N, P, and K), the second nutrients (Ca, Mg, and S), and the micronutrient elements (B, Cl, Cu, Fe, Mn, Mo, Zn). Although trace elements are required by plants in very small amounts, it has the same importance as macro and intermediate elements. The lack of one of the 13 nutritional elements affects production, productivity and quality of agricultural products even if they are added more than other elements. It is a key factor in determining the productivity and quality of agricultural products.

During the growing process, plants need to be provided with sufficient essential nutrients to be able to develop comprehensively for a high yield and quality. Nutrients are absorbed by plants from the soil, during long-term cultivation, the soil will gradually degrade due to many factors. Therefore, to ensure that plants are provided with adequate nutrients, plant nutrition management is needed. This management will help farmers know if their plants are lacking in essential elements and components to support their growth. It also avoids an excessive use of nutrients as well as loss of plant nutrients which lead to economic losses for farmers.

What are plant nutrition sensors and how do they function?

Nutrient sensors are equipment that respond to specific nutrient components. The focus of this primer will be on sensors that detect and monitor nutritious components of plants (Tetsuya Miyamoto et al, 2013).

Nutrition is an essential element for plant survival and growth. It is a key factor in determining the productivity and quality of agricultural products. Therefore, nutrient management is an important issue that farmers need to know in order to avoid the serious effects that occur when a plant lacks its essential nutrients.



"<https://www.sciencedirect.com/science/article/pii/S2589004222002991>" \1 "!"

Source : Podar et al. (2022)



ITFARM

According to Polar et al (2022), measurement of nutrient levels is carried out by primary sensors that typically involve either transeptors or transcription factors. Primary sensors are only now starting to be identified in plants for some nutrients. In particular, for nitrate, there is detailed insight concerning how the external nitrate status is sensed by members of the nitrate transporter 1 (NRT1) family.

Potential sensors for other macronutrients such as potassium and sodium have also been identified recently, whereas for micronutrients such as zinc and iron, transcription factor type sensors have been reported. This review provides an overview that interprets and evaluates our current understanding of how plants sense macro and micronutrients in the rhizosphere and root symplast.

The importance of applied plant nutrition sensors in agriculture

It is not easy to diagnose a plant that is deficient in nutrients just through the physical expression of the plant, therefore, applied plant nutrition sensors will help to solve the problems. The content and concentration of nutrients are usually measured by sensor and controlled through Electrical Conductivity (EC) or Total Dissolved Solids (TDS) and pH indexes.

According to the European Commission, a real-time soil nutrient sensor device measures nitrogen, phosphorus and potassium micronutrients, as well as the electrical conductivity and pH of the soil and delivers a result within five hours. The sensor components are enclosed in a porous ceramic or PVC material with readings displayed on a remote LCD controller.

Limitation

Smart sensors require continuous internet connectivity, however, this is sometimes not available in agricultural fields or farms.

Advanced technologies change so quickly that farmers are not always ready to adopt the latest IoT devices equipped with agriculture sensors.

As a device to collect data, sensors have not yet focused much on personal data protection of users.

Keywords

sensors

plant nutrition

nutrient sensors

Further information

Podar D., Frans J.M. Maathuis (2022). Primary nutrient sensors in plants.

<https://doi.org/10.1016/j.isci.2022.104029>.

<https://www.sciencedirect.com/science/article/pii/S2589004222002991>.

Miyamoto T., Wright G., and Hubert Amrein H. (2013). Nutrient sensors. [10.1016/j.cub.2013.04.002](https://doi.org/10.1016/j.cub.2013.04.002).

<https://morr.com/news/automated-plant-nutrient-delivery-systems/>

<https://content.ces.ncsu.edu/extension-gardener-handbook/1-soils-and-plant-nutrients>

<https://thehifarm.com/en/>





<https://cordis.europa.eu/article/id/156603-new-technology-for-sensing-soil-nutrients>



Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Project: Erasmus+ KA220-ADU, Duration: since 01-01-2022 till 30 01-07-2024



**Co-funded by
the European Union**