

# Low-cost Near InfraRed (NIR) spectrometer measuring plant stress to design and steer agroecological systems

## Benefits of the measurement of Eh and pH of leaves

Work and a recent bibliographic study<sup>1</sup> have made it possible to correlate the development of pests and diseases with specific oxidation-reduction conditions (measured through the redox potential, Eh) and acid-base (pH) of plants, in relation to the conditions of soil, cultural practices, genotype and climatic conditions.

It would thus become possible to diagnose or even quantify the effect of certain stresses undergone by cultivation via these measures. This opens up new perspectives on the management of practices for agro-ecological crop protection by regulation of Eh-pH conditions. Such a prophylactic approach would maintain the plant in good health, under conditions unfavourable to pests, rather than having to fight against these pests once they have developed, often by overoxidation.

## Current measurement issues

Conventional electrochemical measurements are very delicate and time-consuming, which makes them impractical for farmers. Due to these measurement difficulties, the number of references on the conditions of plant balance and the impact of practices remains very limited.



Figure 2: Eh-pH electrochemical measurement (left) and with NIR on wheat, rice and in vineyards (left to right)

## The NIR spectroscopy innovation

Portable near infrared spectrometry (NIRS) would make it possible to overcome these difficulties. This has been shown in wheat and rapeseed first with measurement campaigns combining classic electrochemistry (Eh, pH, CE) and spectrometry with the spectrometer developed by the company SENSEEN<sup>2</sup>, during 2020 and confirm now in rice and wine in 2021.

SENSEEN which was created in May 2020 brings the state-of-the-art of miniaturized spectrometers combined with AI-based chemometrics. With several thousands of electrochemical measurements and corresponding spectrums, the company succeeded to develop models using neurons network and giving +87% accuracy of predictions<sup>3</sup>

Measure to progress for driving towards a sustainable planet.

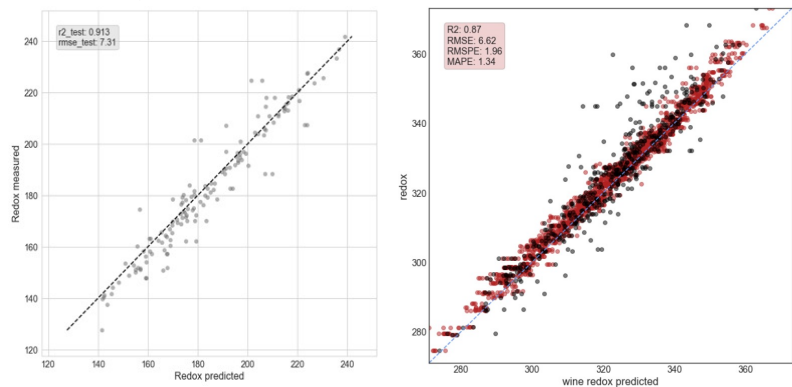


Figure 3: Eh predictions using MLP on wheat (right) and vine (left) thanks to calibration made possible by measurements done by Ver de Terre production and Estandon

## Future

The simple, reliable, fast and inexpensive measurement by portable near infrared spectrometry of these plant health indicators should make it possible to develop a unique expertise on the effects of agricultural practices and thus to have practical tools for redox control of the plant health.

1. Husson et al. 2021. Soil and plant health in relation to dynamic sustainment of Eh and pH homeostasis: A review. *Plant & Soil*. doi.org/10.1007/s11104-021-05047-z

2. [www.senseen.io](http://www.senseen.io) [www.cirad.fr](http://www.cirad.fr) Contact: [olivier.husson@cirad.fr](mailto:olivier.husson@cirad.fr); [philippe.cousin@senseen.io](mailto:philippe.cousin@senseen.io)

3 Cousin, Husson and all 2021. Innovative measurements to drive sustainable agriculture: the agroecology case (to be soon published in Journal of Advanced Agriculture Technologies)