Assessing Plant Health with new technologies

Ramon Navarra
Head of Agricultural Research Stations and
R&D Digitalisation at BASF

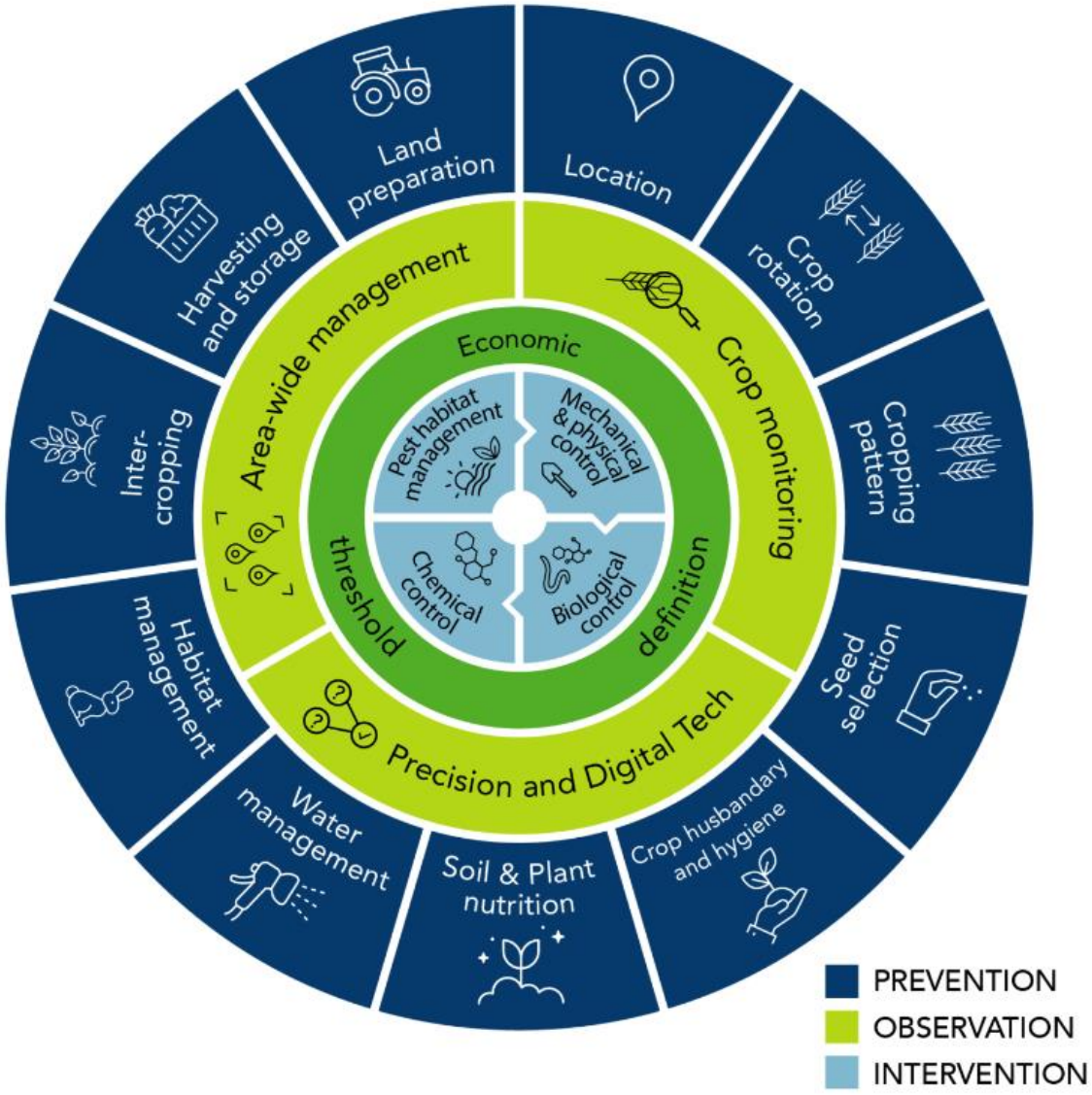
What is Plant Health?

- Plant health is the **physiological condition** of a plant, where **free from pests and diseases** the plant is able to **fully express its genetic potential.**

  This includes the **absence of harmful organisms** like insects, weeds, and pathogens, as well as the plant's **ability to cope with abiotic stresses** like drought, heat, and nutrient deficiencies.

- Plant health assessments are conducted to determine the **condition**, **vitality**, and **overall health of plants**

Plant health in integrated pest management



Plant health is an overarching term for emerging risks including pests, diseases and weeds, integrated pest management and innovation in plant protection

Source: Crop Life What is IPM? - CropLife Europe

Precision Application: Fertilisation Yara

Real-time variable rate nitrogen management

- A tractor-mounted real-time variable-rate nitrogen sensor
- Measures crop nitrogen requirement as the fertiliser spreader passes across the field
- Variably adjusts the fertiliser application rate in real-time

How does N-Sensor work?

The N-Sensor determines the nitrogen demand by measuring the crop's light reflectance covering a total area of approximately 50m^2 / sec. Measurements are taken every second with the system designed to operate at normal working speeds and all bout widths. Most sensing technology applied to agriculture is based on the typical light reflectance curve for vegetation (NDVI). N-Sensor measures light reflectance at specific wavebands related to the crop's chlorophyll content and biomass.

It calculates the actual N-uptake of the crop. Optimum application rates are derived from the N-uptake data and sent to the controller of the variable rate spreader or sprayer, which will adjust fertiliser rates accordingly.

The whole process of determining the crop's nitrogen requirement and application of the correct fertiliser rate happens instantaneously, with no time delay. This enables "real-time agronomy and application" to be possible.

Precision Application practices are based on an vegetation index

Source: Yara Yara N-Sensor ALS 2 | Nitrogen Management Tools | Yara UK

Pest monitoring with digital solutions by Bayer

Source Bayer: https://magicscout.app/de-AT/magictrap

Precision Application: Crop Protection products by xarvio

Variable Applications

The right dose at the right place.

Treat your fields as varied as they are while saving up to 27 €/ha****.

- Use automatically generated variable rate maps for your fields
- Benefit from field-zone specific dosing of crop protection & growth regulators for optimal results
- Compatible with most machinery terminals
- Automatic integration of management zones including buffer zones and trial plots
- Send and receive data wirelessly to and from your terminal via several connectivity options

**** 2019-2021: 98 sites in DE, FR, UK, UA

Source: xarvio Protection (xarvio.com)

Plant Health effects for agricultural practices

- **Assessing** plant health has the potential to contribute to the wider goal of ensuring the **sustainability** of primary production.
  It can be assessed by:
  - Increase Yield
  - Improving the marketable quality
  - Effect on the evolution of the crop: plant height, crop stage, etc

- New technologies are providing new tools to assess the plant health effects (for example: Vegetation indexes)
  - Vigor
  - Greening - Chlorophyl
  - Leaf area index & Biomass
  - Crop Coverage
  - Transpiration rate

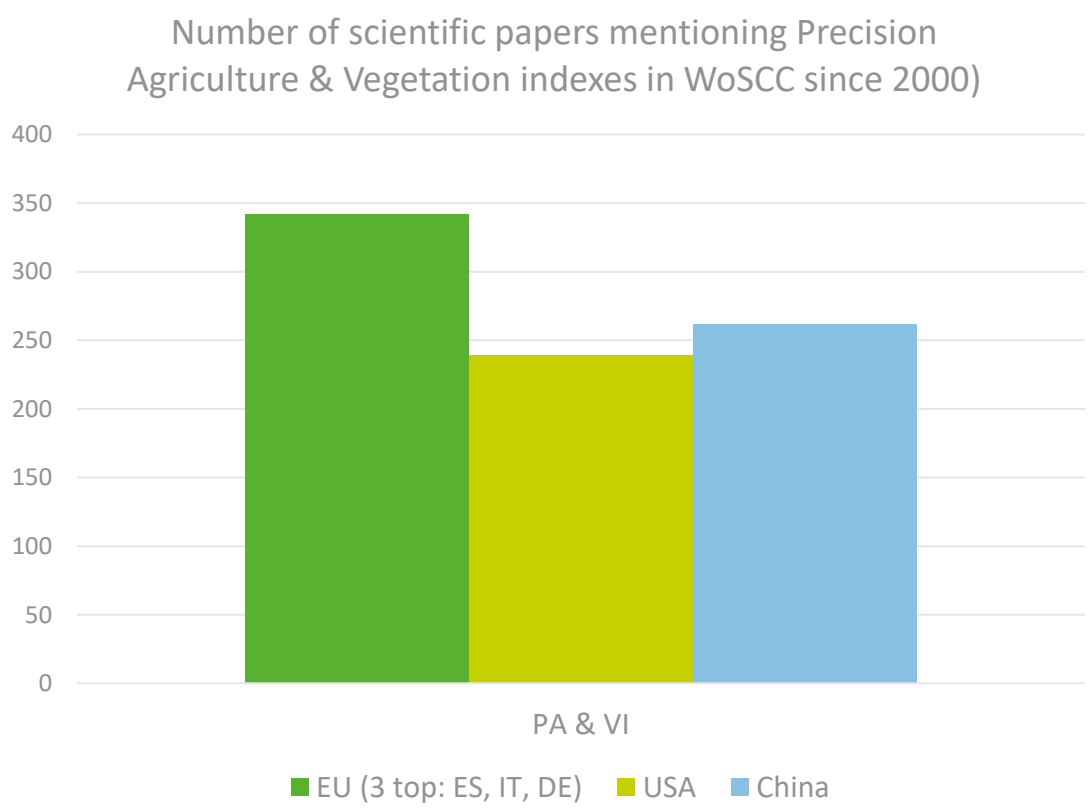
  And many more

New technologies are opening to assess the crops beyond the eye

Scientific community active on assessing Plant Health

Global State of Vegetation-Index Application in Scientific Studies in Precision Agriculture

Number of scientific studies indexed in the Web of Science Core Collection (WoSCC)



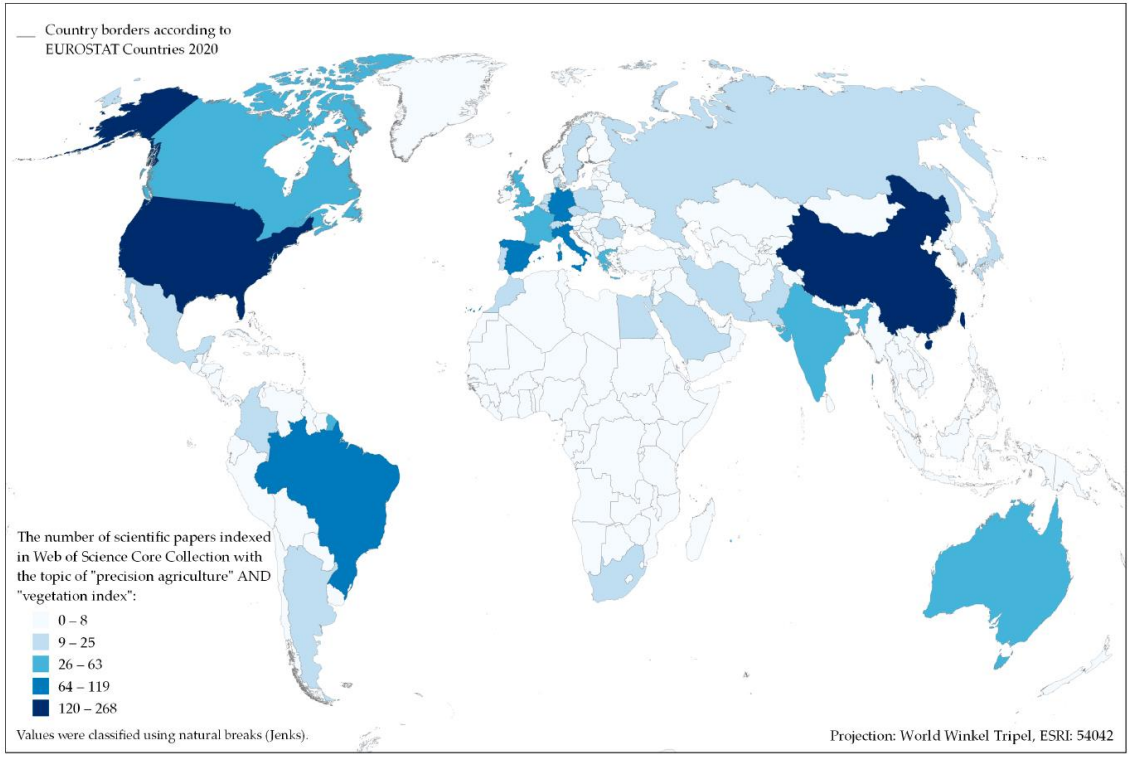


Figure 3. Global map of the number of scientific papers indexed in WoSCC since 2010 with the topic of "precision agriculture" AND "vegetation index".

Source: Radoˇcaj, D. *et al.* «State of Major Vegetation Indices in Precision Agriculture Studies Indexed in Web of Science: A Review." 'Agriculture **2023**, 13, 707.

Example of Sensors & Equipment involved

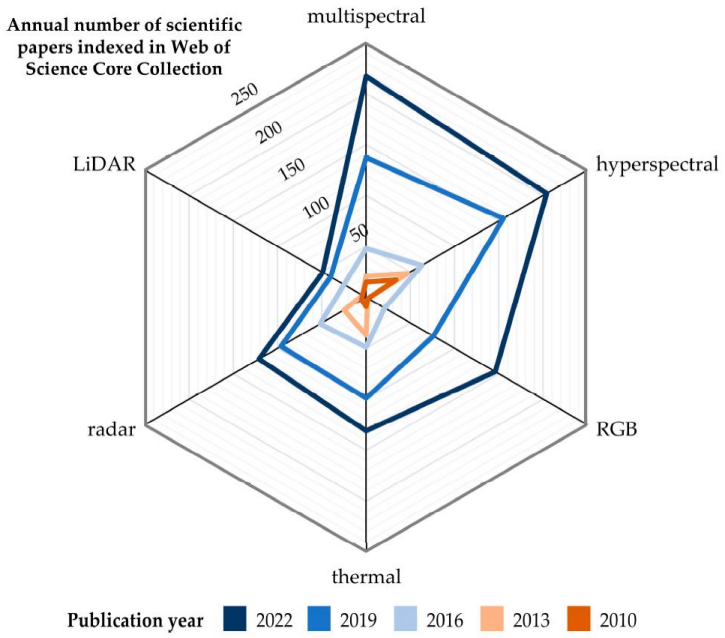
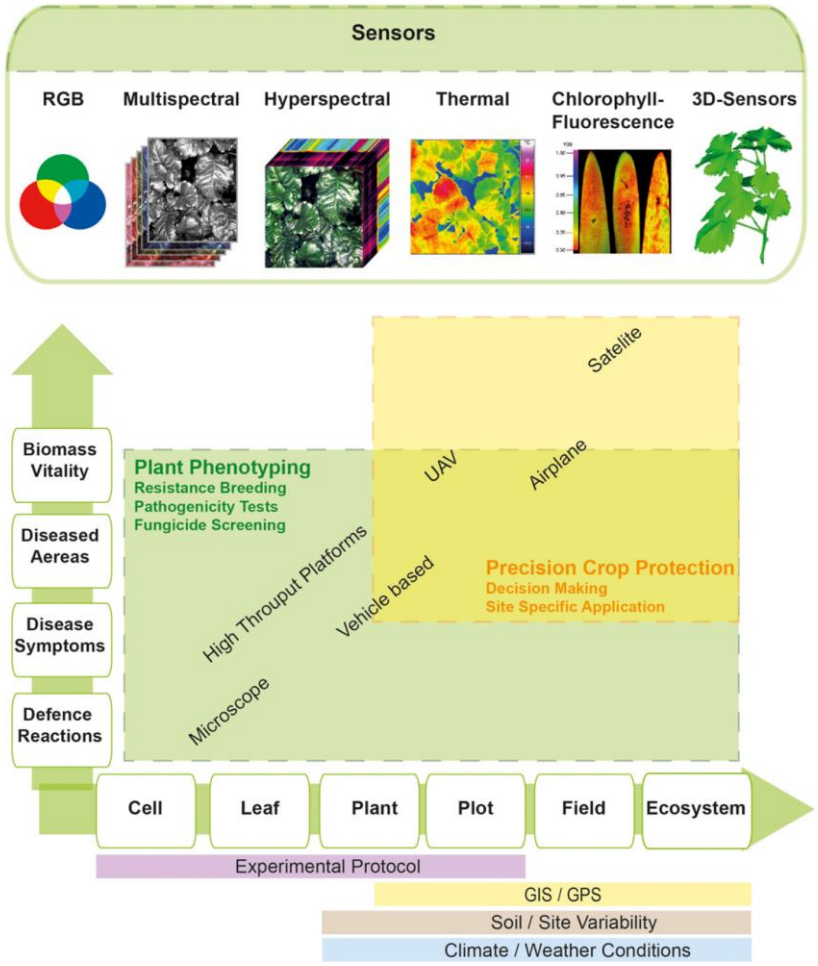


Figure 6. Radar plot of the number of scientific papers indexed in WoSCC since 2010 with the topic of "precision agriculture" AND particular sensor type for each three years.

Source: Radoˇcaj, D. et al. «State of Major Vegetation Indices in Precision Agriculture Studies Indexed in Web of Science: A Review." Agriculture **2023**, 13, 707.



Source: Mahlein, AK.»Plan Disease Detection by Imaging Sensors – Parallels and Specific Demand for Precision Agriculture and Plant Phenotyping " The American Phytopathological Society, **2016**

ANYmal (ANYbotic)

Spot (Boston Dynamics)

(BASF)

DJI

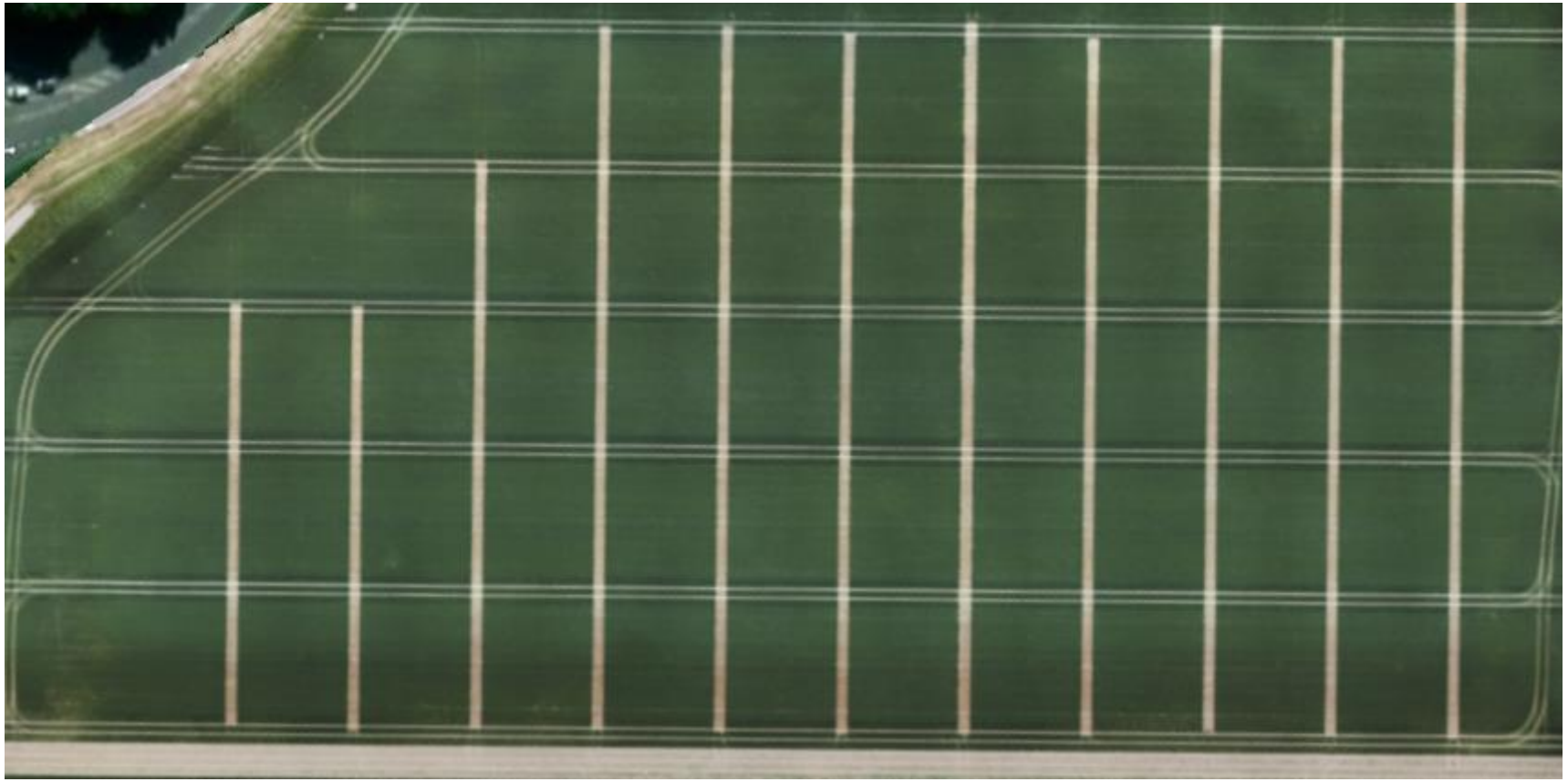
Selection of sensor and equipment depends on required spatial resolution and spectral resolution

CropLife EUROPE

Vegetation Indexes for Spot Application (R&D Trial)

Spot detection?!

(Soruce: BASF)



Trial for drone application in winter wheat: Disease Yellow Rust PUCCST

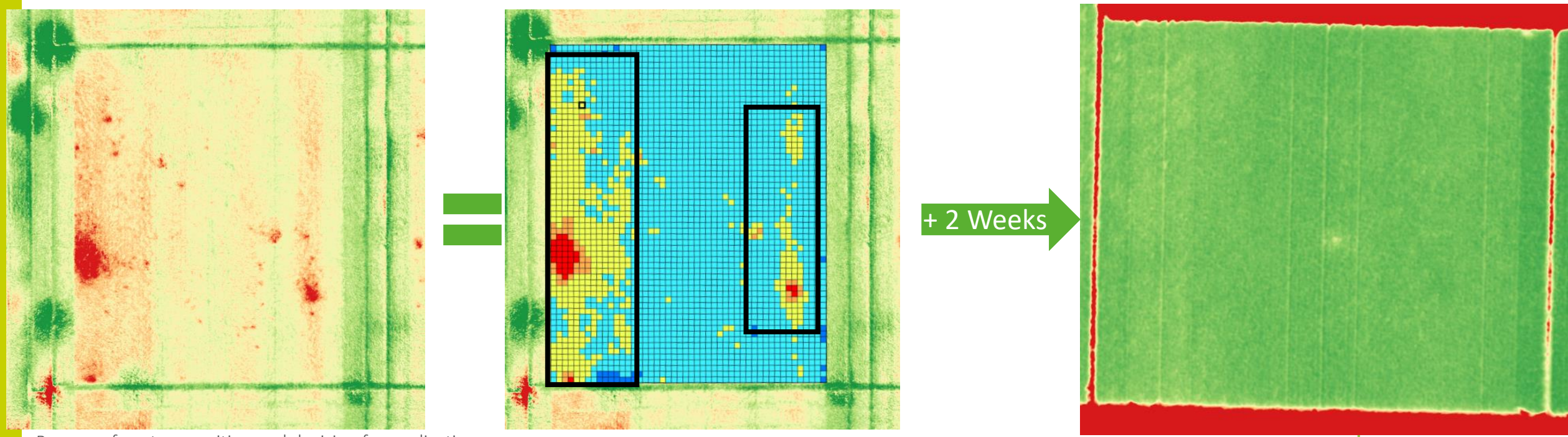
(Soruce: BASF)

Source: BASF

Vegetation indexes for spot application (R&D Trial)

Spot detection + Spot Spray

- Detection of areas with disease (using vegetation indexes) and translation to an application map
- Reduction of the area applied & volume



Process of spot recognition and decision for application

Source: BASF

Plant Health Assessment is Relevant

- **Quantifying Plant Health** is relevant
  - **Technology** is already **available** in the market
  - Crop Life supports the development
  - For the **implementation** of Precision Agriculture and it is already a **reality**
  - To assess the plant health **effects** of **agricultural practices**
    (for example: the use of Plant Growth Regulators, Crop Protection Products, Bio-stimulants)
  - To assess the plant health effects in **field trials**
    New EPPO standard should provide guidelines on its use

CropLife EUROPE

Assessing Plant Health with new technologies

Ramon Navarra
Head of Agro Research Stations and R&D Digitalisation at BASF

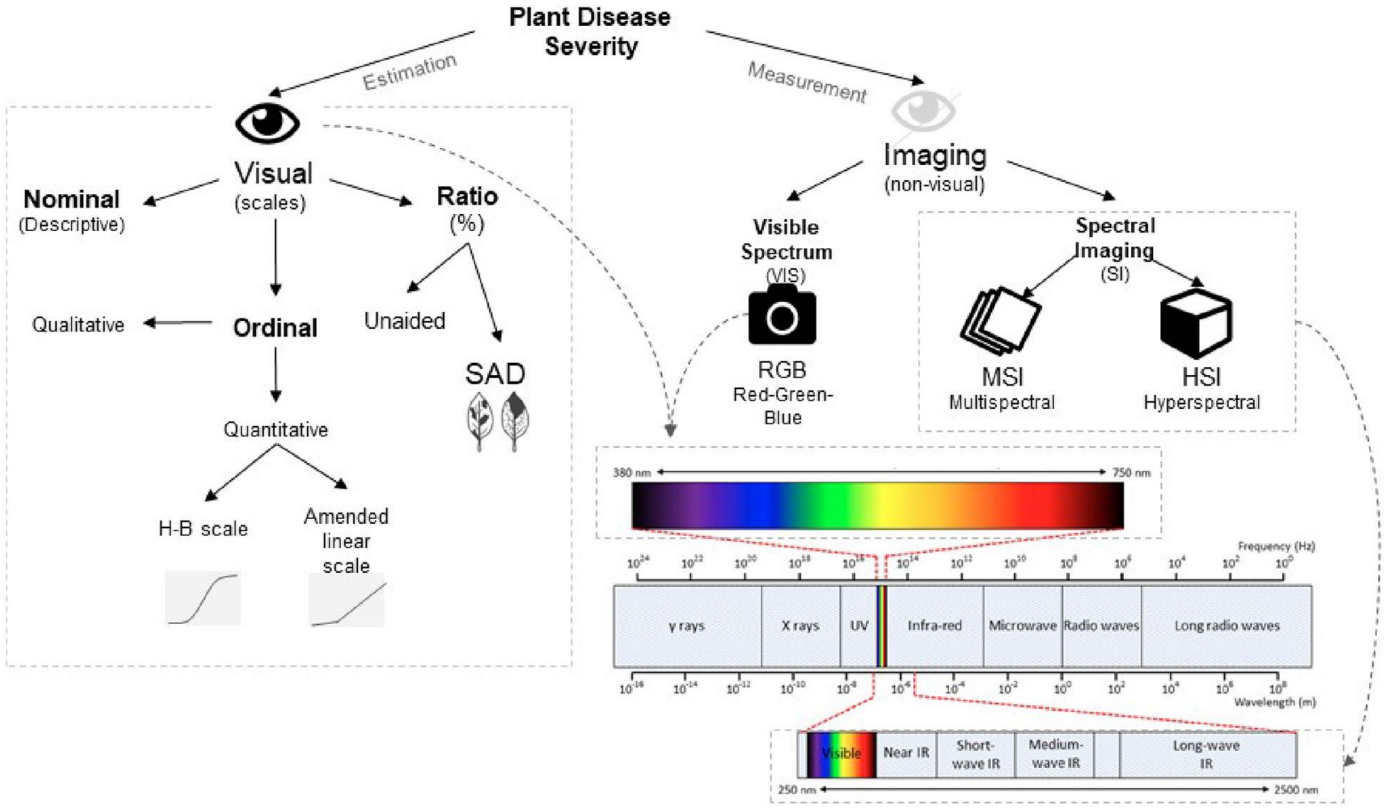
What is Plant Health?

- Plant health has a **major impact** the **economy**, **food** and **biodiversity**.

- Contributing to **early detection** of plant health and **a more efficient monitoring** assessments play an important role in delivering the objectives of the new **"Farm to Fork Strategy“** and supporting **new farming practices**.

- Plant health assessments are conducted to determine the **condition**, **vitality**, and **overall health of plants**

"Beyond the Eye" to assess plant health



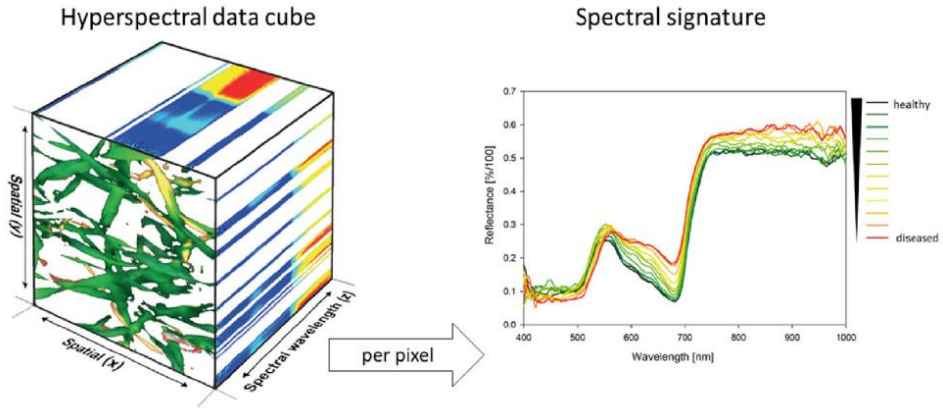


Fig. 5 "Spectral data cube". Three-dimensional structure of hyperspectral imaging data with two spatial dimensions y and x and a spectral dimension z. Each image pixel contains the spectral information over the measured range. In this example, the reflectance from barley leaves diseased with rust is illustrated at different disease severities

Source: Bock, C.H. *et al*. «From visual estimates to fully automated sensor-based measurements of plant disease severity: status and challenges for improving accuracy." Phytopathology Research **2020** (2:9).