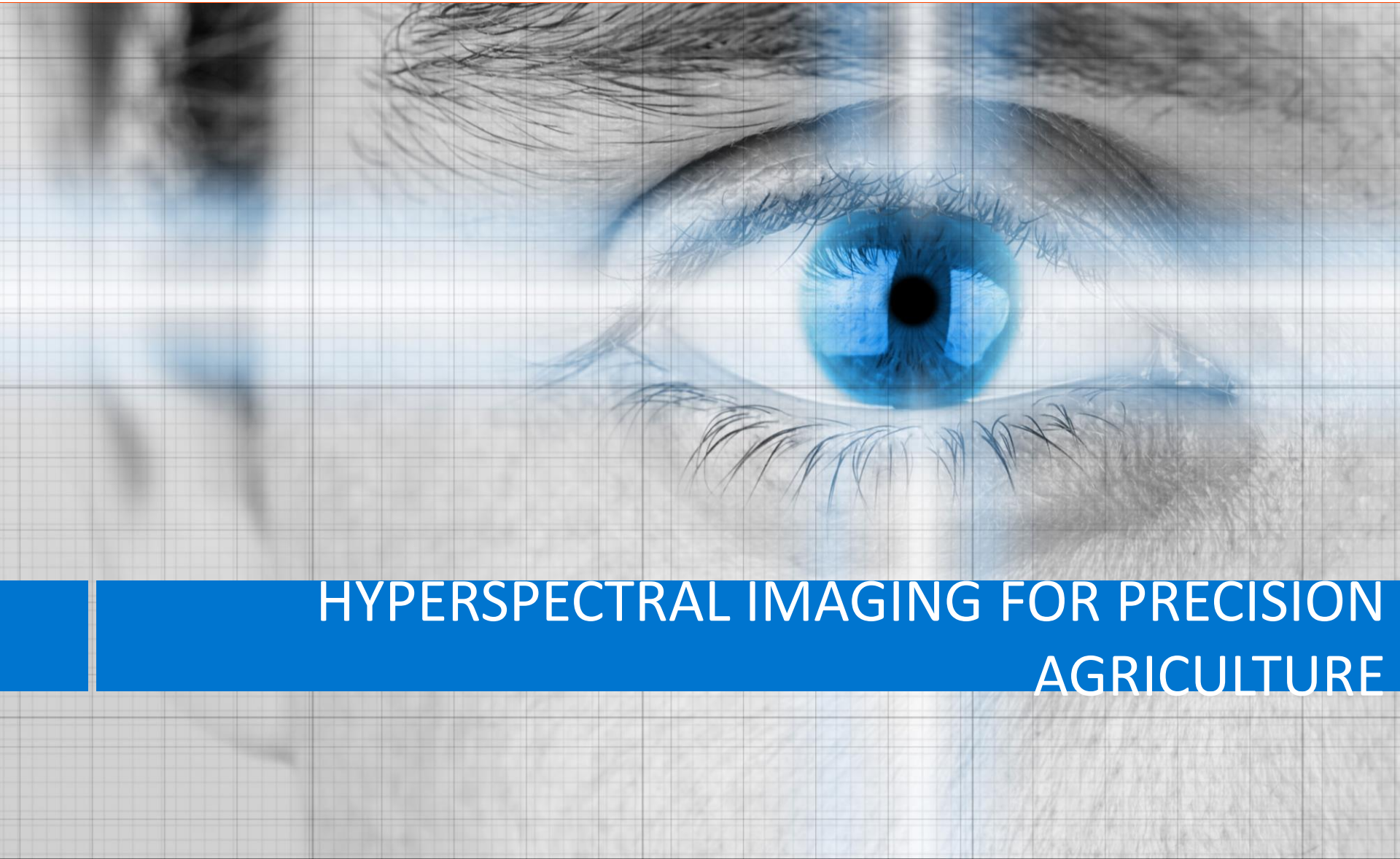


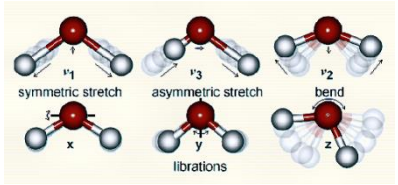
HYPERSPECTRAL IMAGING FOR PRECISION AGRICULTURE

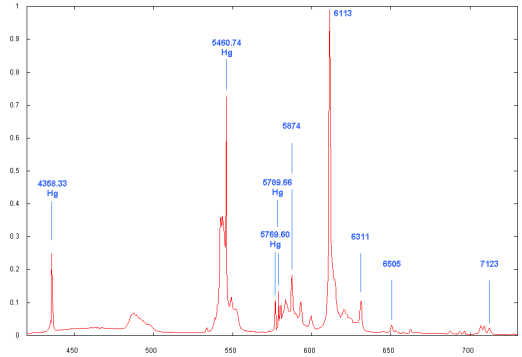
SPECIM
SPECTRAL IMAGING

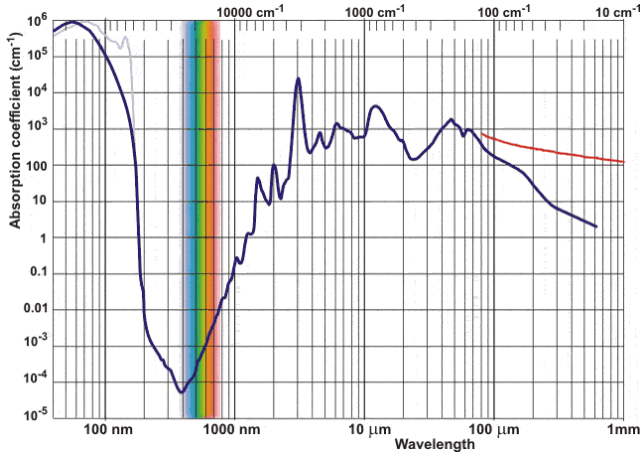
SPECTRAL IMAGING

SPECTRUM

- Spectrum is defined as the intensity of light as a functior of wavelength
- It can be presented for example as:
  - Emission spectrum
  - **Reflectance spectrum**
  - Absorption spectrum
  - Transmission spectrum
- Material dependent
  - Due to the molecular structure

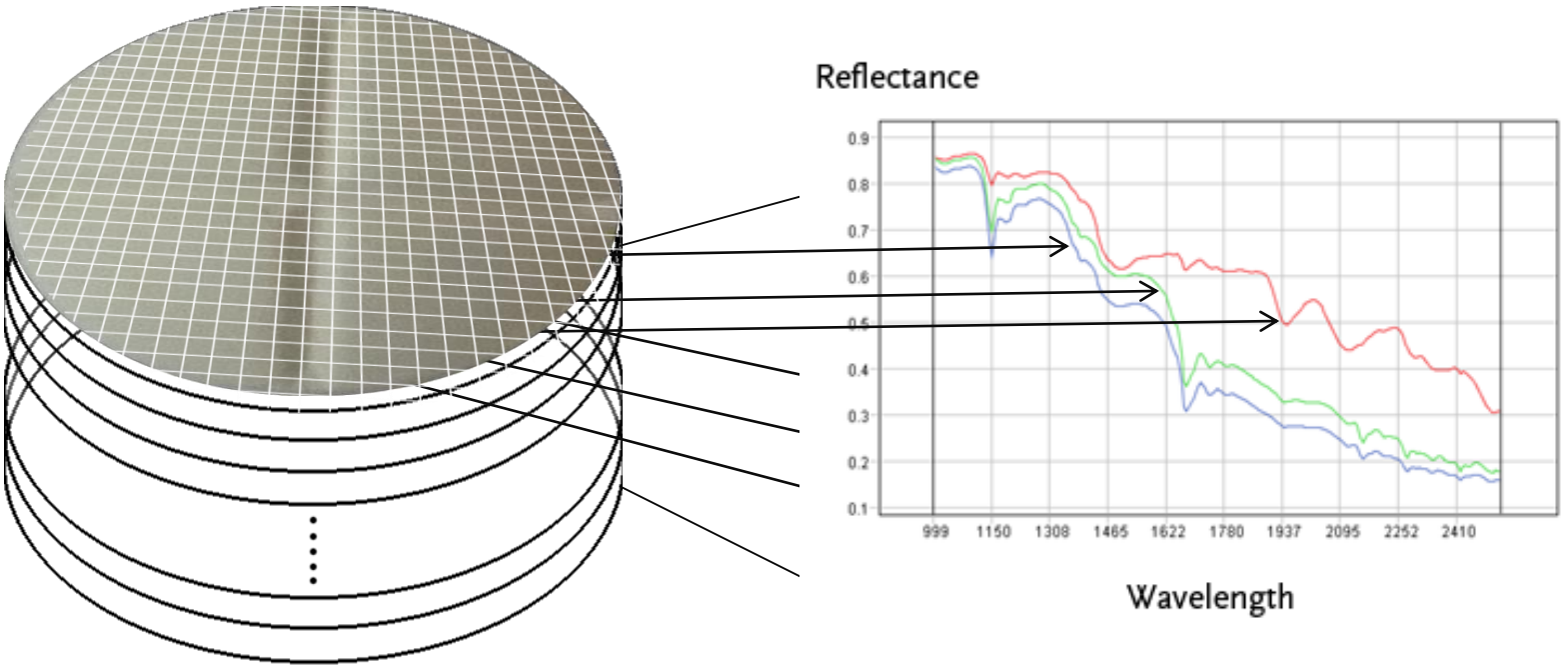






Photons are absorbed and this causes rotation and vibration of water molecules (heating the sample)

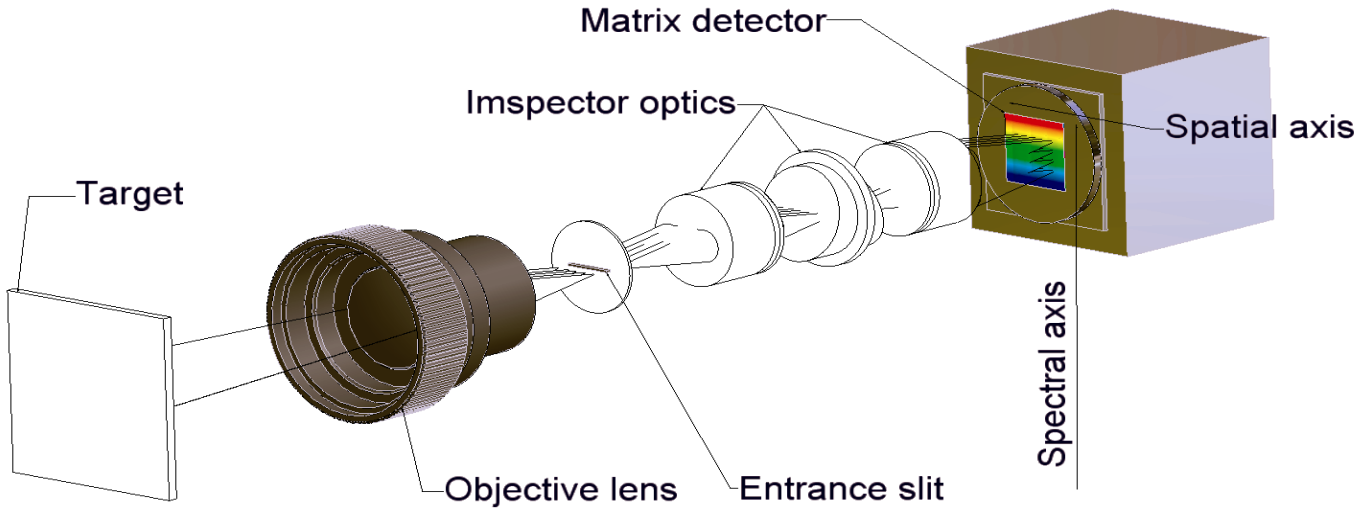
WHAT IS HYPERSPECTRAL IMAGING ?



HOW TO PRODUCE HYPERSPCETRAL DATA

PUSH-BROOM APPROACH

- A line-scan device
- Full spectra of the all spatial positions along the imaged line is recorder in one single snapshot
- Target must be imaged line-by-line to form the 2D image



HOW TO AQUIRE 2D SPECTRAL IMAGES?

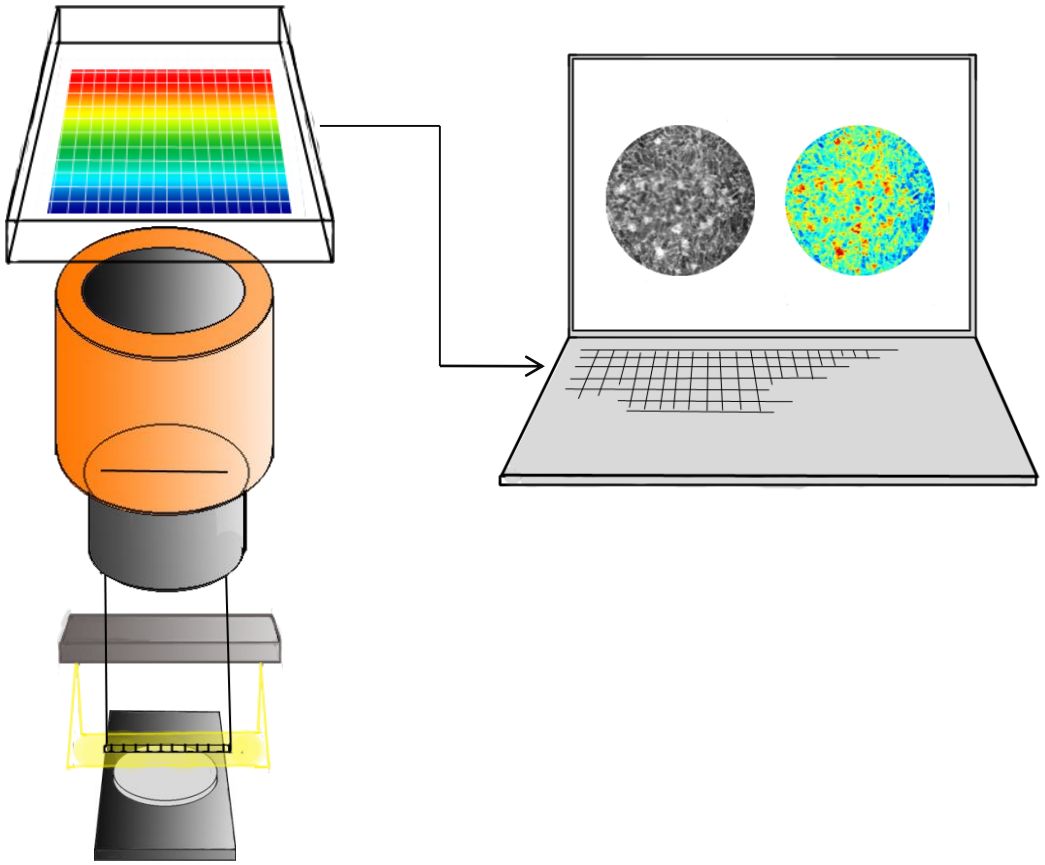
Sensor with 2D detector array

Imaging spectrograph with input slit

Fore objective

Line light source

Sample stage



SPECIM FX AND IQ CAMERAS

SPECIM FX10

VNIR (400–1000 nm)

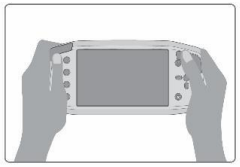
SPECIM FX17

NIR (900–1700 nm)

SPECIM
SPECTRAL IMAGING

SPECIM IQ

– Smart Hyperspectral Camera –



SPECIM
SPECTRAL IMAGING

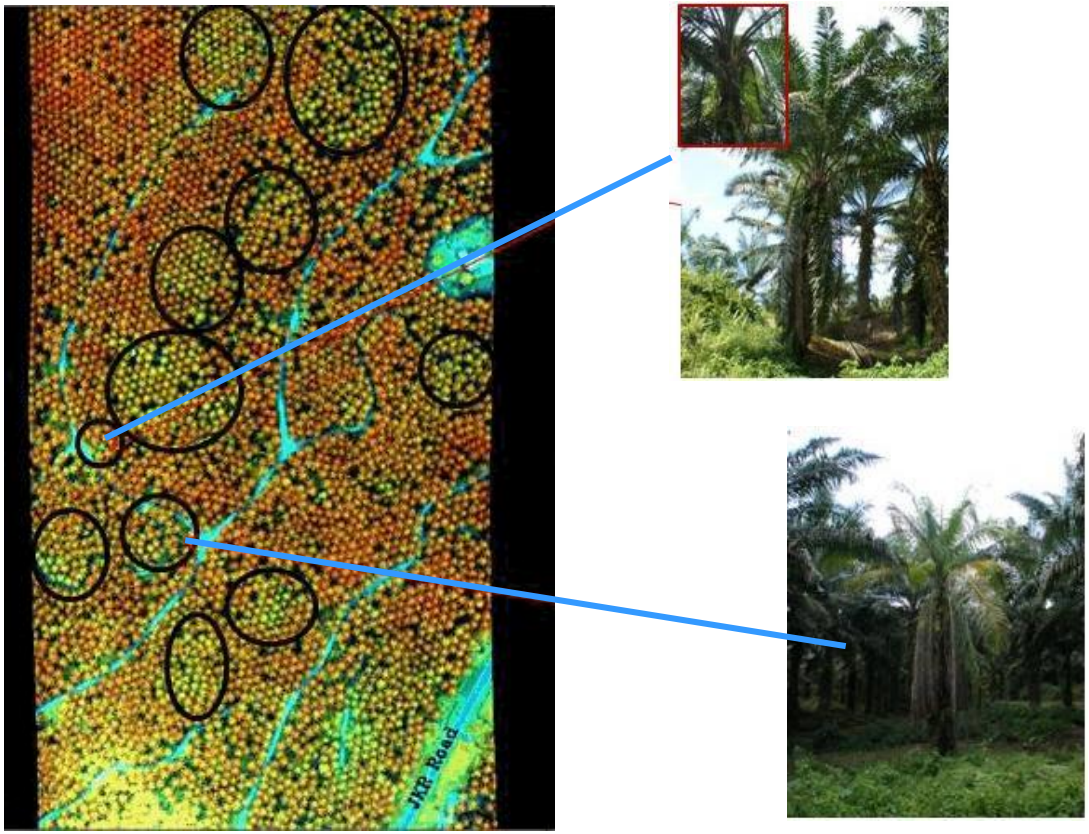
SPECIM
SPECTRAL IMAGING

IN PRECISION AGRICULTURE

VEGETATION HEALTH MAPPING

Airborne HSI in VNIR provides sensitive and high resolution detection and mapping of a **fungus disease in oil palm trees**

>50 km^2/h
@0.5 m ground resolution
@50 m/s (100 knots)

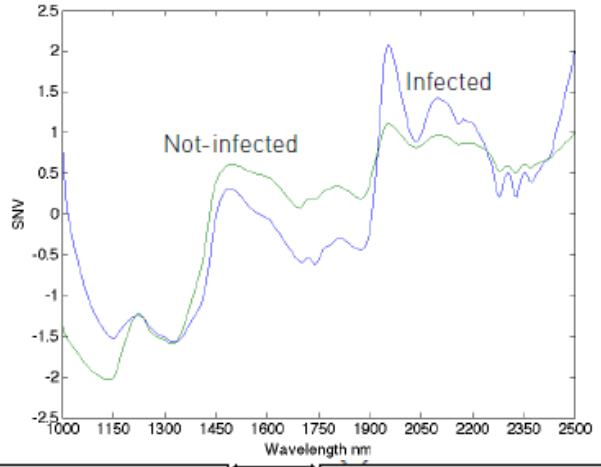


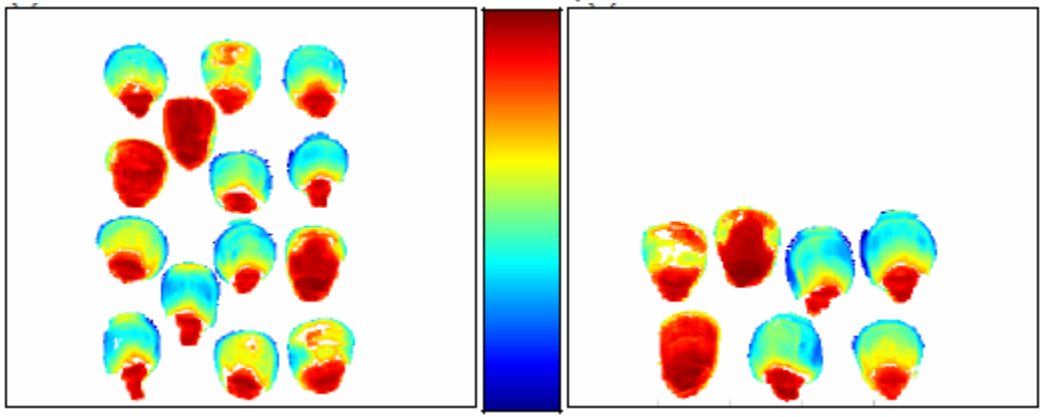
Sarawak Forest Department, Malaysia

BIOSAMPLE HEALTH IN MICROSCALE

SWIR detection of fungal infection in maize kernels

Quick scanning of 1 to 2 seconds over a kernel minimizes heat load





University of Stellenbosch, South Africa

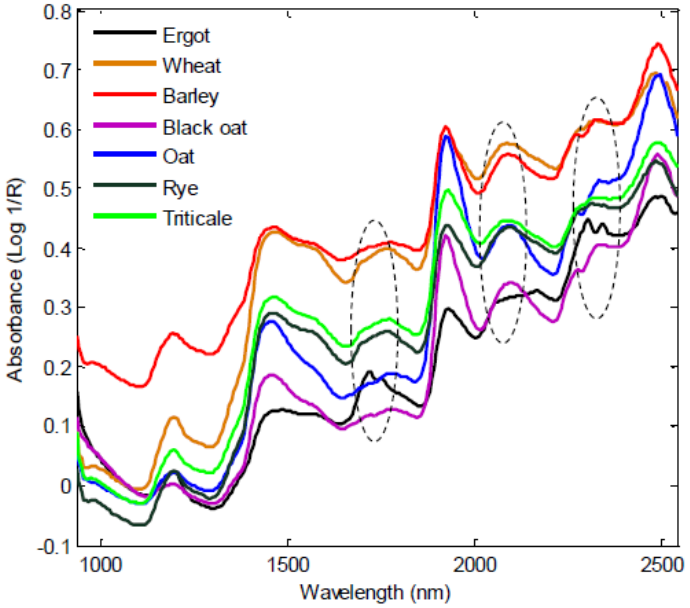
ERGOT DETECTION

- Detection of fungies in wheat
  - Toxicity
  - Norm:<0.05%
- SWIR
- 7 samples
  - Ergot concentration from 0.01% to 1%

Walloon agricultural research centre

ERGOT DETECTION

- Detection of fungies in wheat with SisuChema



Walloon agricultural research centre

DEVICES SUITABLE FOR FIELD WORK

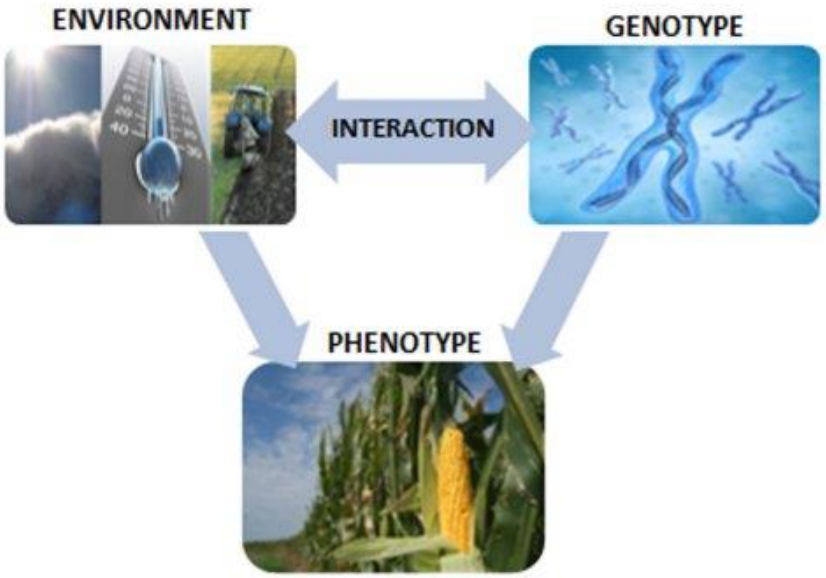
- Growth phase
- VNIR, NIR and SWIR ranges
- Possibility to control also the processing

PLANT PHENOTYPING

Analyses of plant structure and function (architecture, growth, physiological performance)

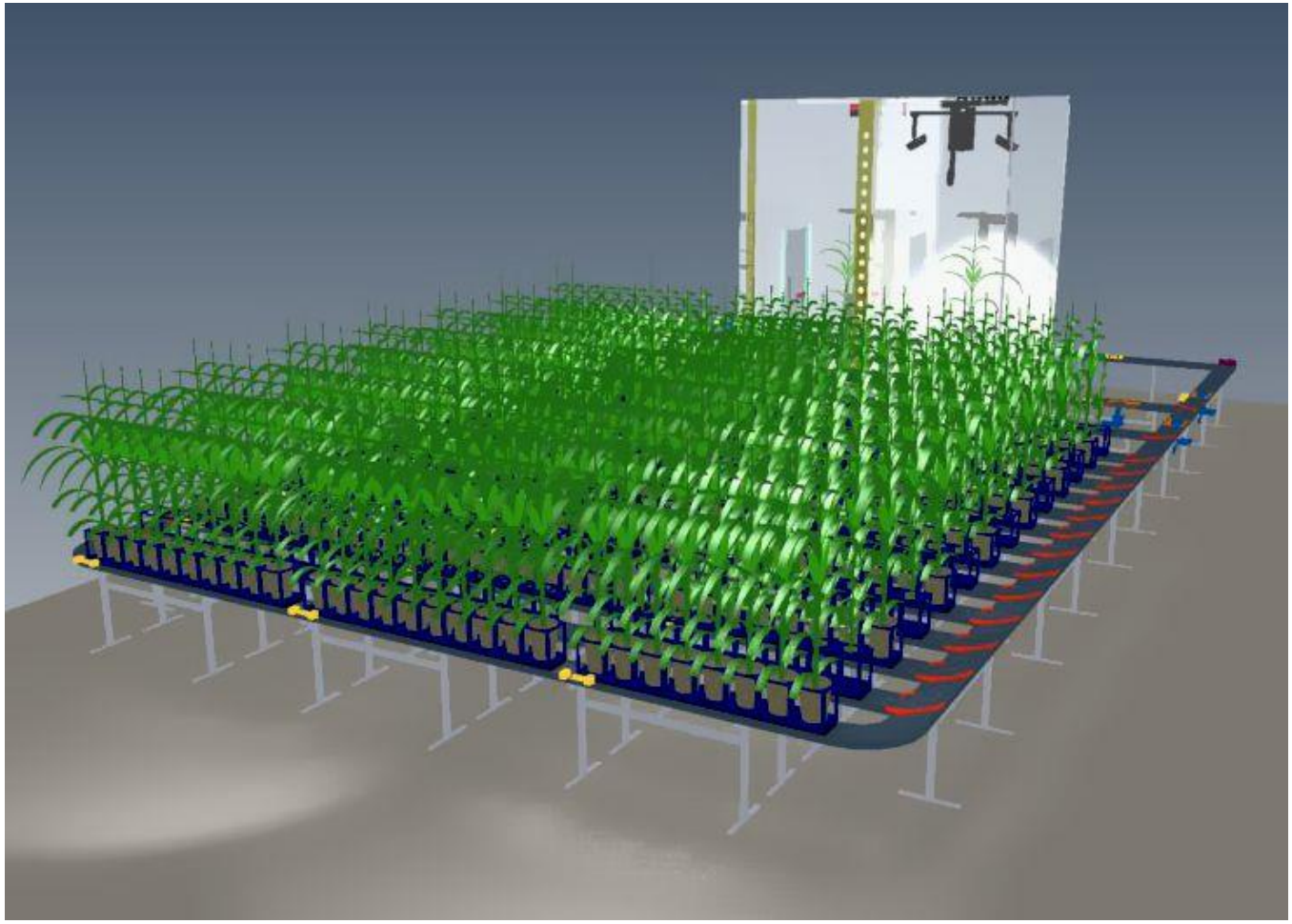
Often plant performance is determined and plant varities compared under stress (soil water deficit, heat, fungal infection,...

Plants are imaged and traits are determined by image analysis.



AUTOMATED PLANT PHENOTYPING PLATFORM

SPECIM
SPECTRAL IMAGING



SMO bvba
Belgium

PRECISION FARMING

- Data fusion
  - VNIR (also SWIR)
  - Photo diode arrays
  - GPS
- Growth stage

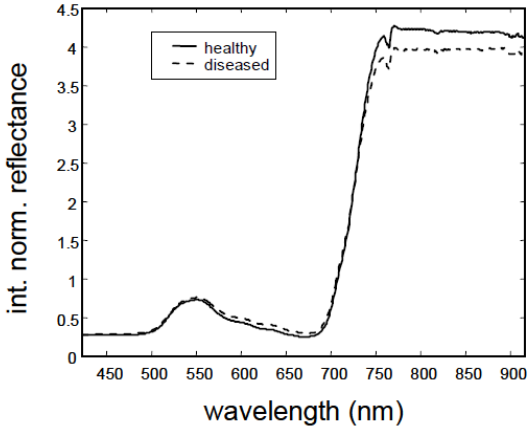
University of applied sciences Osnabrück

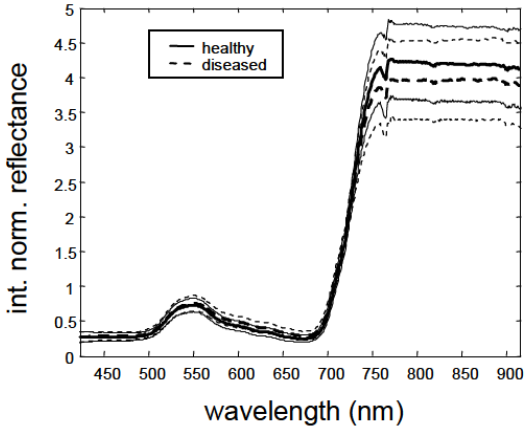
DISEASE DETECTION

- Wheat monitoring
  - VNIR (also SWIR)
- Infection
  - Accurate treatment

Yellow rust

Septoria





Catholic University of Leuven

STRESS MONITORING

With IQ camera

SEEDS RESEARCH

- Seeds, kernels, plants
  - Classification
  - Diseases
  - Plant breeding
- Animal feed research
- Durum wheat classification
  - Vitreous Kernels content

    High protein and gluten

    Hard grain
  - Sorting to vitreous and non-vitreous kernels

    Patch quality and price

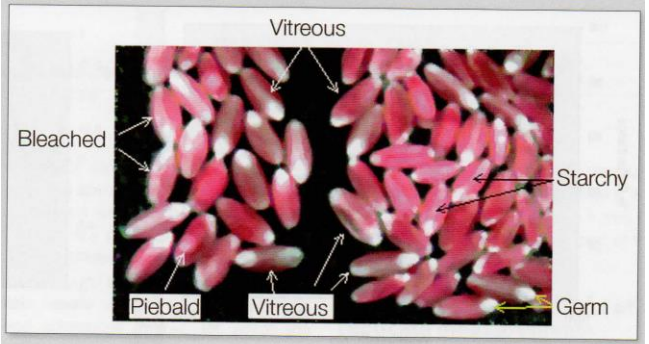


Figure 3. Colour image representation of CWAD wheat scanned with the hyperspectral system showing vitreous, starchy and bleached kernels; Germ areas appear as bright white spots on the kernel ends.

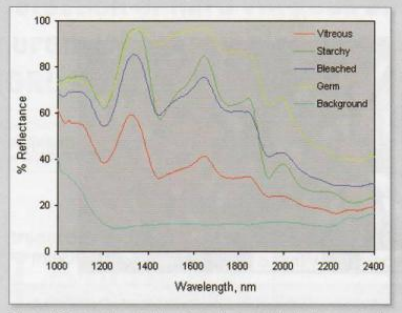


Figure 4. Spectral characteristics of selected regions in the hyperspectral image.

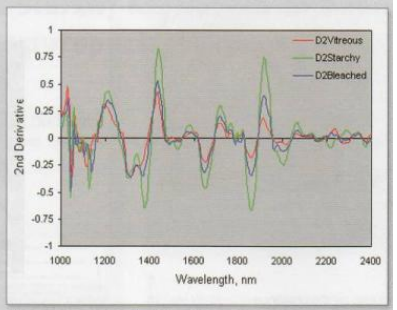


Figure 5. Second-order derivative of spectra for vitreous, starchy and bleached kernels.

Canadian Grain Research Laboratory

SPECTRAL IMAGING