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Crop Breeding for Drought-Resistance Varieties using Smart Sensors

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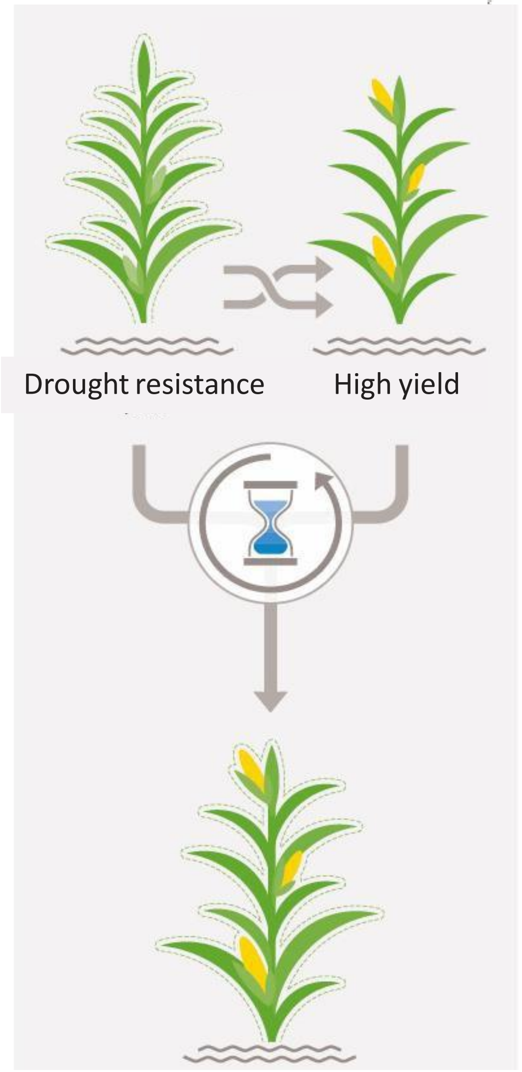
Background

- Improving crops yield under water-limited conditions is the most daunting challenge faced by breeders
- Relevant phenotyping plays an increasingly pivotal role for the selection of drought-resilient varieties
- One of main limitation is to identify the quantitative trait that govern yield and related traits across different water regimes.



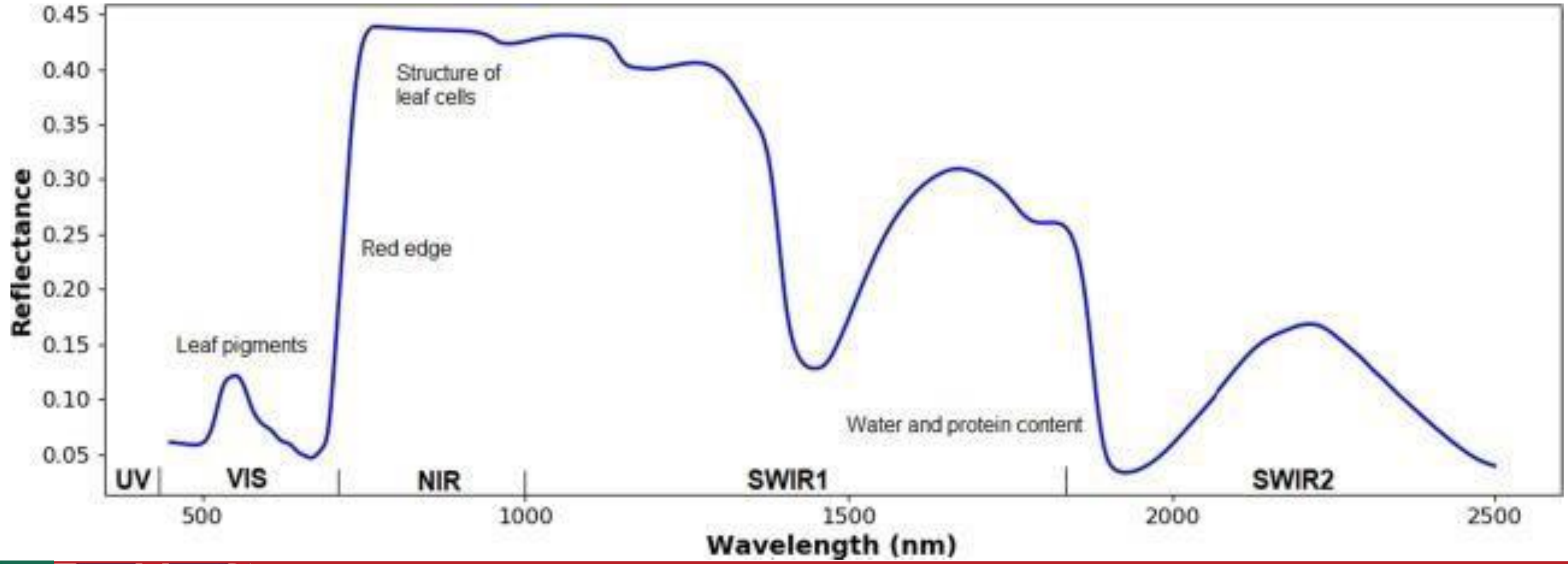
Water-Use Efficiency and Drought Tolerance

- Water-use efficiency (WUE) is the amount of dry matter produced (grain yield) per unit of water lost through evapotranspiration.

- The challenge for Dryland agriculture is to breed high drought tolerance variety that can produce maximum dry matter (yield) using minimum available water (reduce the evapotranspiration).

Hyperspectral sensors and phenotyping

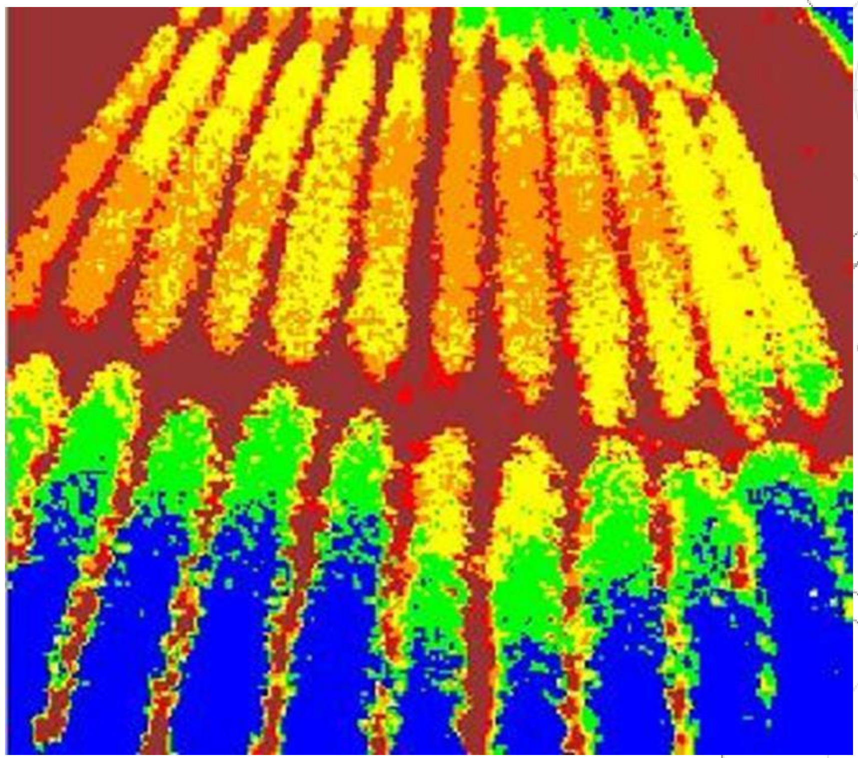
Understanding the interactions between plants and the incident light is essential to select suitable hyperspectral sensors to discover the physiological and biochemical properties of the plants.



Thermal sensors

- Plant phenotyping for drought tolerance based on leaf gas exchange is complex and time consuming and can show poor repeatability due to the high stomatal sensitivity to small changes in environmental conditions

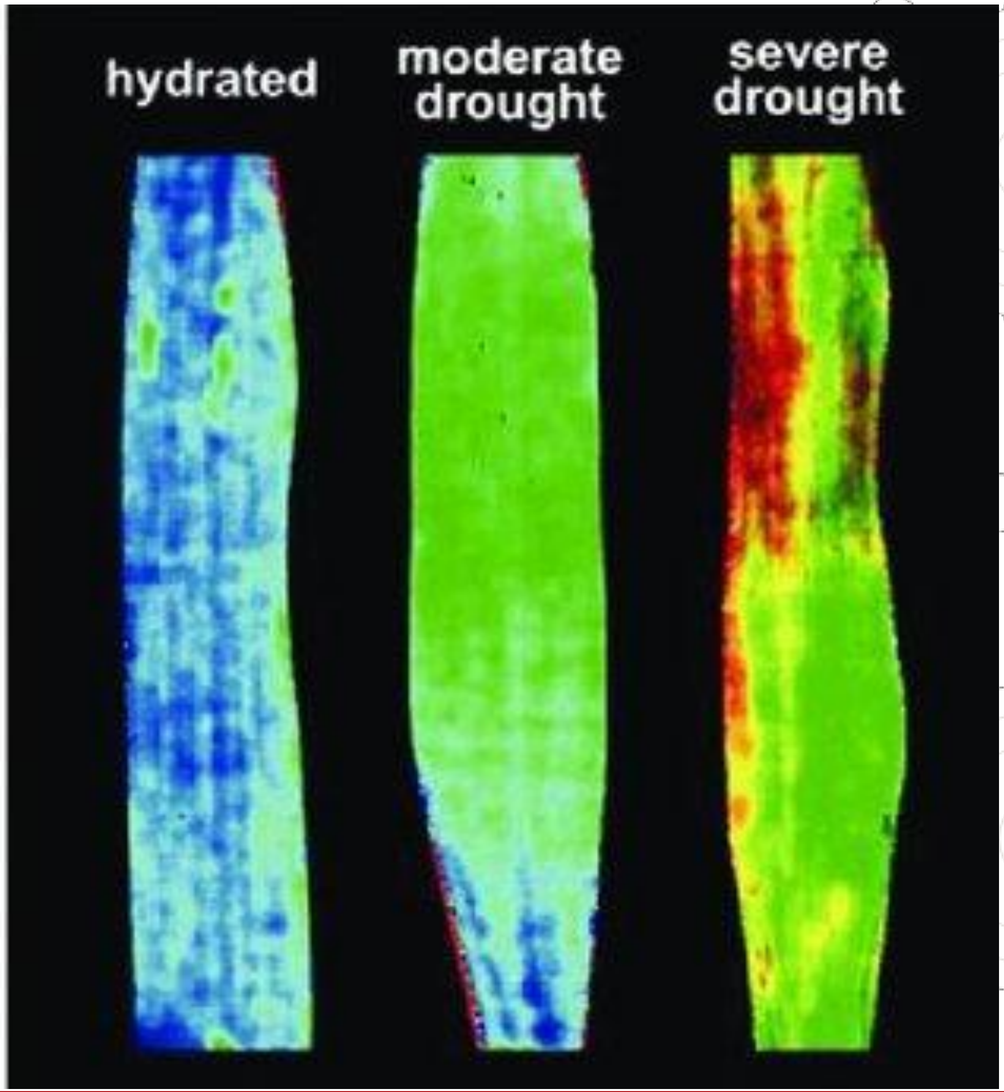
- Thermal imaging emerged as a non-invasive promising technique to monitor remotely and non-destructively crop's water status based on the inverse relation between leaf temperature and transpiration rate



Fluorescence imaging

Chlorophyll fluorescence is directly related to plant photosynthesis and the physiological state of vegetation. Thus, chlorophyll fluorescence has been used as a powerful, non-destructive and reliable tool in plant physiology for understanding the primary events of photosynthesis and the effects of stress on photochemistry.

The close relationships between the fluorescence and soil water contents demonstrated that fluorescence can detect early water stress.



State of art Phenotyping platform

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The phenotyping platform is a unique facility and is the world's first glasshouse designed to trial crop soil systems at pilot scale under a multi-sensor gantry.

Sensor platform – The Gantry

(1)RGB Camera: Measure growth, biomass, development and stress

(2)Hyperspectral camera

- **Visible - NIR E-Series**: Used for biomass, physiology, pigments, water status, stress, diseases, vegetative indices-
- **SWIR (short wave infrared):** Measures water content or water distribution

(3)FLIR camera (Thermal imaging): Used for measurement of heat and rate of transpiration

(4) Fluorescence camera: Measures photosynthetic parameters

(5)Laser scanner: Measure growth, geometry, organ-resolved information

Applications

- Plant breeding and better crop selection for improved dryland stress resistant varieties
- Enhance resource use efficiency using smart tool to apply inputs (fertiliser and water)
- Early crop disease detection tools
- Improve the efficacy of agrichemical applications
- Yield and biomass prediction

Thank you

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