# Precision Phenotyping

## Non-contacting high throughput sensing of drought stressed wheat plants

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### Introduction

Drought is the most important limiting factor for crop production and it is becoming an increasingly severe problem in many regions of the world. Classical measurements for estimating water status in plants using oven drying or pressure chambers are tedious and time-consuming. In the field, frequent changes in environmental conditions may further influence the measurements and thus require fast measurements . As well as, the simplified, rapid assessment of the plant water status or related properties such methods are not only useful for irrigation management purposes, but would also allow for the efficient screening of large populations of plants as part of a high-throughput system to precisely evaluate the phenotype for breeding purposes .

### Material and Methods

**Non-contacting high throughput sensing methods**

1- Passive reflectance sensors
2- Active reflectance sensors
3- Laser-induced chlorophyll fluorescence sensing
4- Thermographic camera
5- Thermal near infrared sensor
6- GPS unit

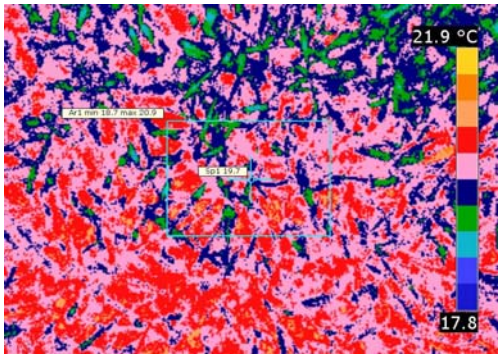
**Physiological parameters to detect drought stress in plants**

1- Leaf water potential (bar)
2- Leaf water content (%)
3- Relative water content (%)
4- Plant water content (%)
5- Plant water mass (kg/m$^2$)
6- Aerial biomass (kg/m$^2$)
7- Canopy temperature ($^o$C)
8- Leaf temperature ($^o$C)

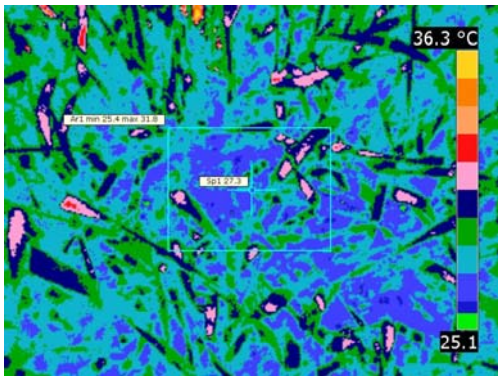
### Objectives and Results

Development of non-contacting methods that can be used for the evaluation of drought stress of crops under field and control conditions.

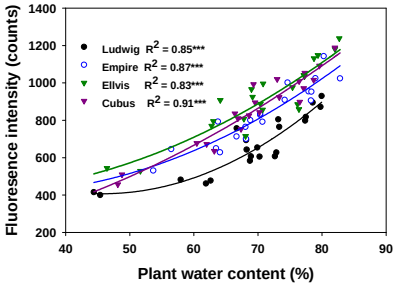

Near infrared temperature sensor to measure canopy temperature.

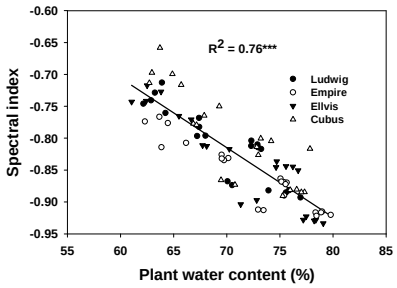


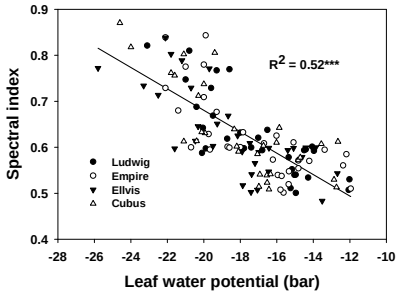

Canopy temperature of wheat under irrigated conditions was measured by thermographic camera.

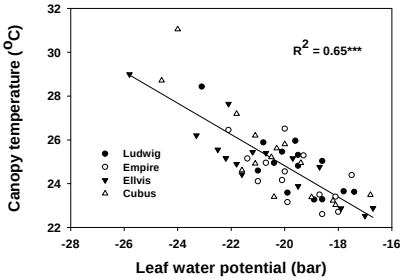



Canopy temperature of wheat under water-stressed treatment was measured by thermographic camera.



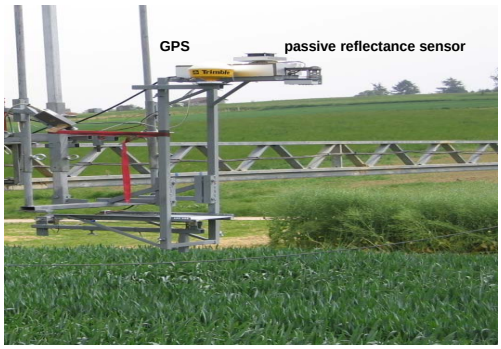



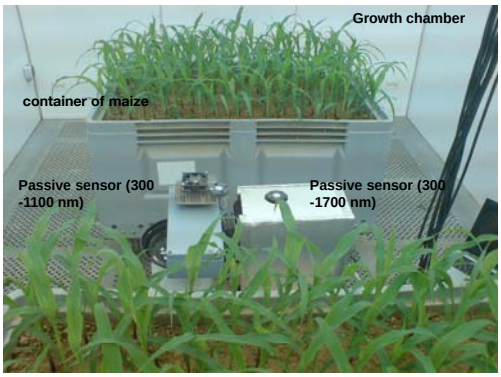





Two laser-induced chlorophyll fluorescence sensors were used to measure water status in wheat under field conditions.




Passive reflectance sensor measuring at wavelengths between 300 -1100 nm with GPS were used to measure water status in wheat under rain-out shelther conditions.




Two passive reflectance sensors measuring at wavelengths between 300 -1700 nm were used to measure leaf water potential of maize under growth chamber conditions.

### Conclusions and Outlook

The results indicate the possibility that time-consuming destructive methods could be replaced by rapid, non-destructive methods.

This technology may open an avenue for fast, high-throughput assessments of water status in plants, which would simultaneously be useful for screening large numbers of plants (e.g., in breeding) as well as being equally important for management related actions.