

# DIGITAL DYNAMISM FOR **ADAPTIVE** FOOD SYSTEMS



Big Data  
in Agriculture  
CONVENTION

## 2020

19-23 OCTOBER. ONLINE & GLOBAL

LED BY:



INTERNATIONAL  
FOOD POLICY  
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AGROPECIA

A ONE CGIAR EVENT



Phenotyping and  
remote sensing to  
facilitate minimum  
data set requirements  
for crop simulation  
modelling

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# Phenotyping and remote sensing to facilitate minimum data set requirements for crop simulation modelling

- Crop models require extensive and/or intensive data sets to drive simulations
- Some data require significant resources such as green area index, light interception and water and nitrogen availability in the soil.
- As a result, the vast majority of field data sets are not ‘model friendly’.
- Discuss how high throughput phenotyping can supplement or potentially serve as proxies for some of the harder to phenotype traits required, in different modelling contexts.





# BREEDER FRIENDLY PHENOTYPING



Trait class / Approach:

## Handy-visual

Application / Traits:

Phenology, canopy  
architecture, disease, pests

1. Low resolution stereoscopic spectral radiometer  
(eyes) + supercomputer (brain).



Trait class / Approach:

## Handy-physiological

- NDVI/SPAD
- IR thermometer

Application / Traits:

Ground cover, green area,  
biomass, leaf greenness  
Canopy temp: fitness, root depth/capacity

2. Greenseeker for NDVI.  
3. IR thermometer for canopy temperature.



Trait class / Approach:

## High throughput

Application / Traits:

Spectral indices, thermal (IR) images

4. Drone for IR and spectral images.  
5. Phenocart.



Trait class / Approach:

## Precision

Application / Traits:

Growth analysis, above  
and below ground

- Radiation use efficiency,  
tiller dynamics
- Partitioning of N and C  
to different organs
- Root dry weight, depth, architecture

- Direct measurement  
(not shown in photos)
- Energy use efficiency  
(photosynthesis/respiration)
  - Transpiration
  - Chlorophyll fluorescence
  - Leaf water potential

6. Root growth analysis.  
7. Canopy growth analysis.



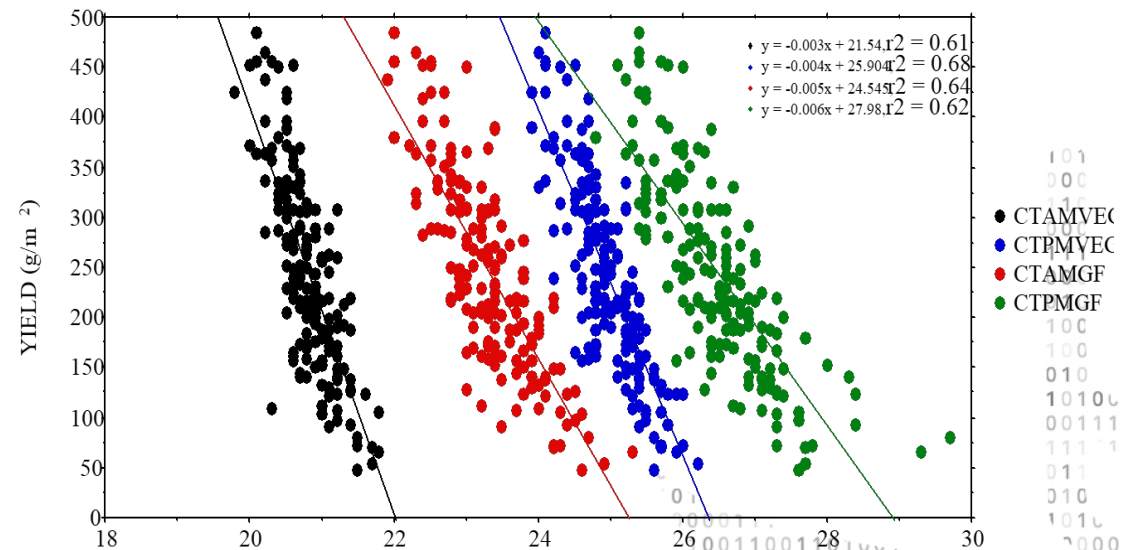
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# Canopy temperature (CT) correlated with yield under drought & heat stress



CT under drought, at  
different growth stages  
and times of day

Seri/Babax RILs



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# Using NDVI (Greenseeker) to improve NUE





# Aerial remote sensing

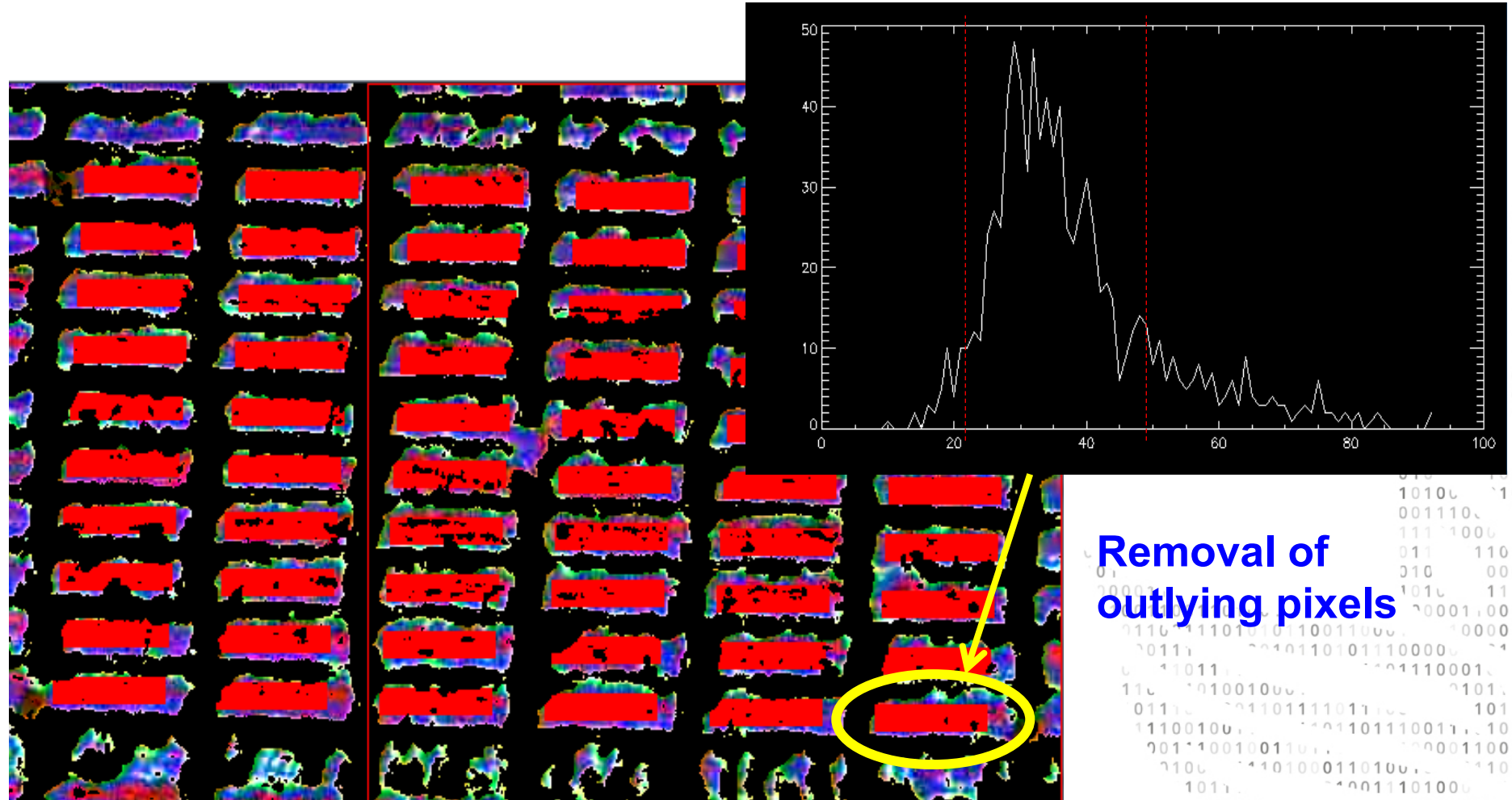
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Tattaris M, Reynolds MP, Chapman SC, 2016.  
A direct comparison of remote sensing approaches for high-throughput phenotyping in plant breeding.  
Front. Plant Sci. 7: 1131.

# Thermal imagery: Data processing





# Not so 'breeder friendly' phenotyping



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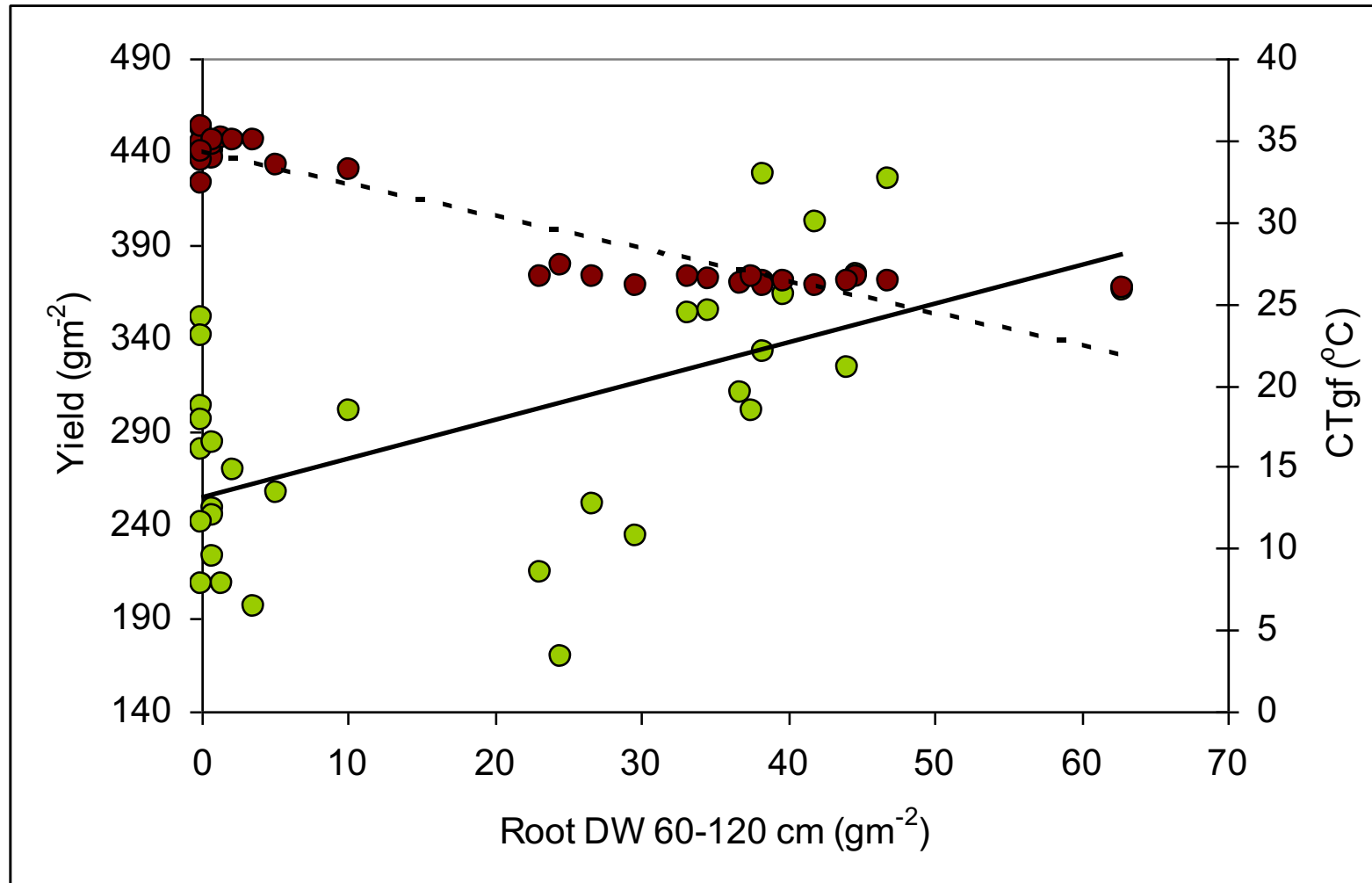
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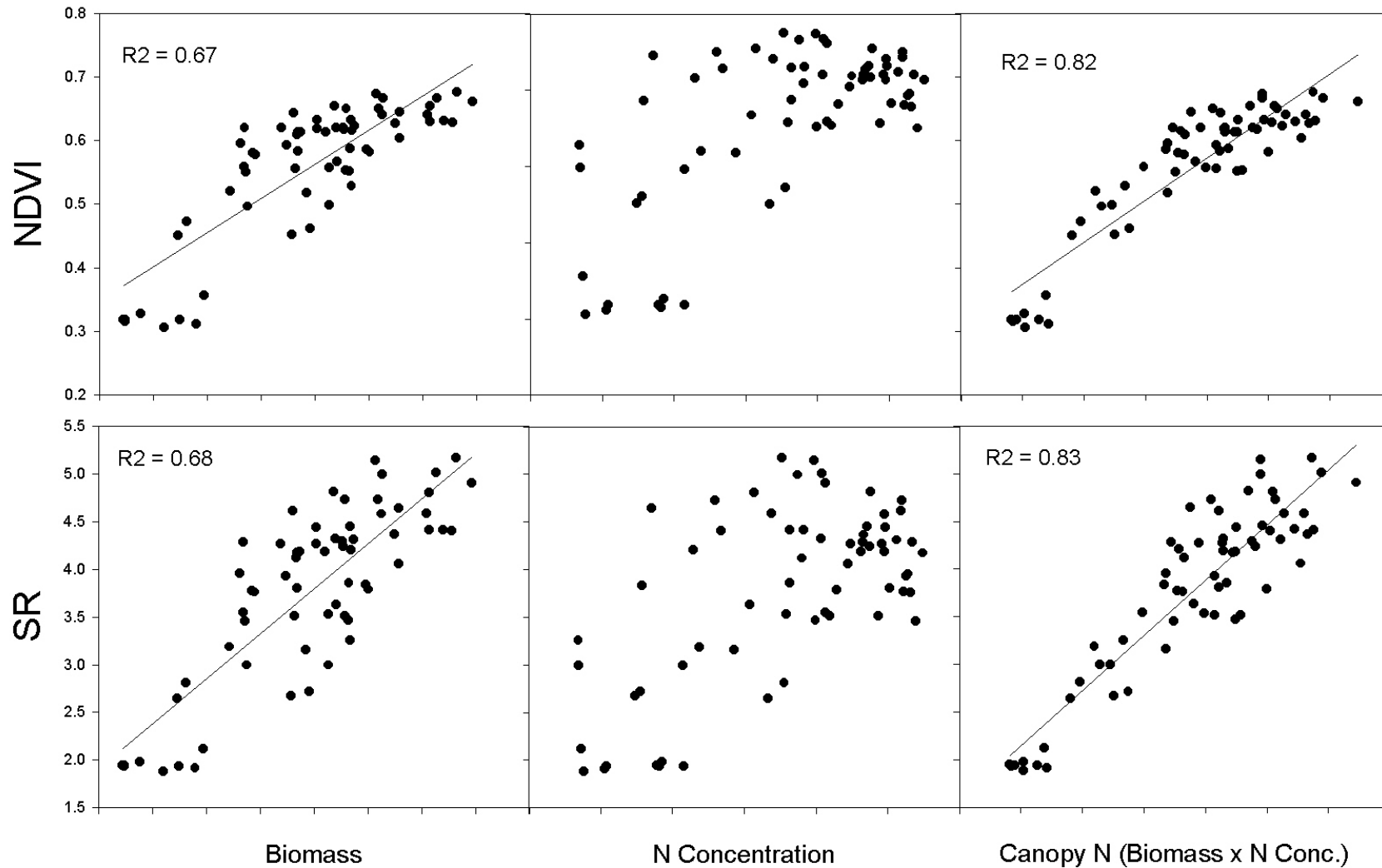
# Deep root profiles under drought stress

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# Remote sensing estimates of Canopy N

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# New research program

- Testing remote-sensed data in crop simulations with the view to increase general availability and accessibility of inputs to crop models and boost scale-out
- CONACYT, Purdue, CIMMYT/FFAR funded PhD Program for Luis Vargas



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# THANK YOU



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Platform for  
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[bigdata.cgiar.org](http://bigdata.cgiar.org)

