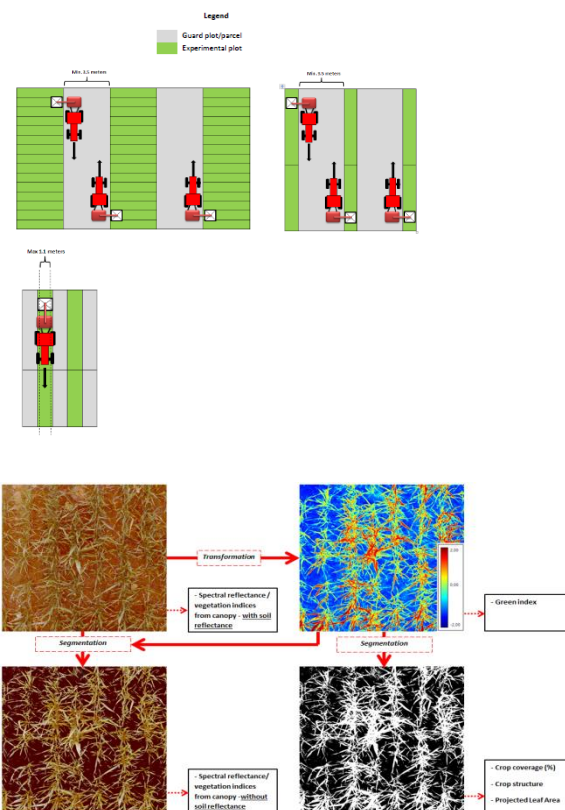
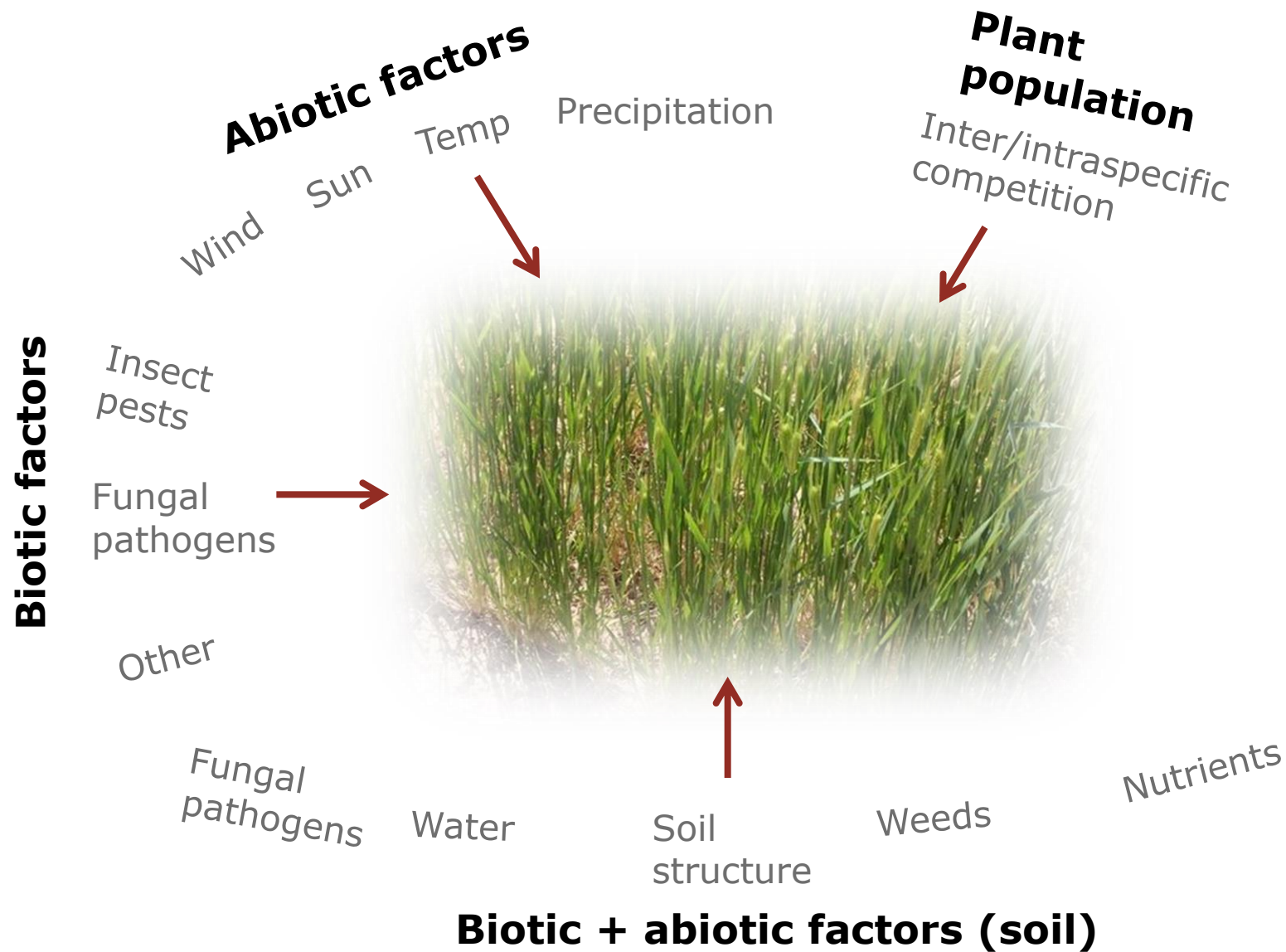


FAUPE - Field Phenotyping of canopy

Technique, infrastructure and protocols - 2014



Complexity in Field Phenotyping



Complexity in Field Phenotyping

Biotic factors

Precipitation

Plant population

High-throughput screening

Precision

Accuracy

Non-destructive

Dynamical

Intuitive

Biotic + abiotic factors (soil)

Biotic factors

Wind

Insect pests

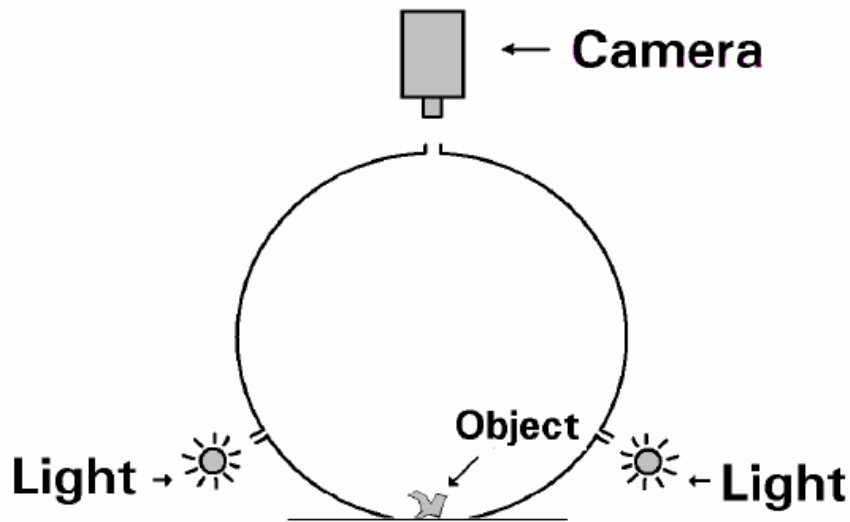
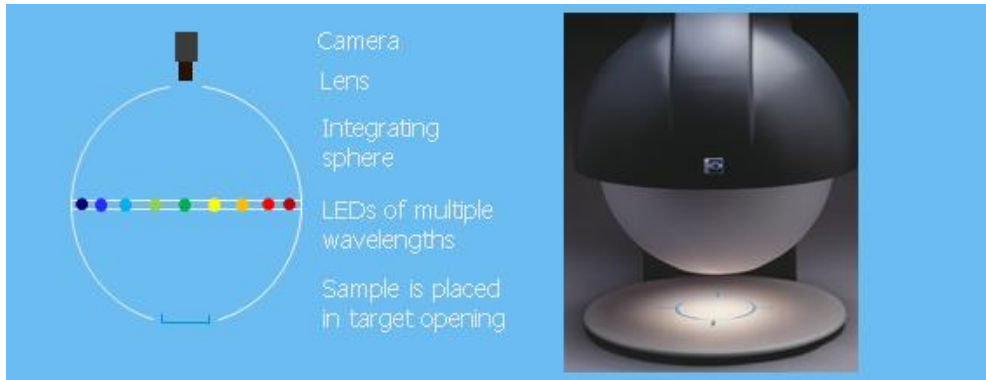
Fungal pathogens

Other

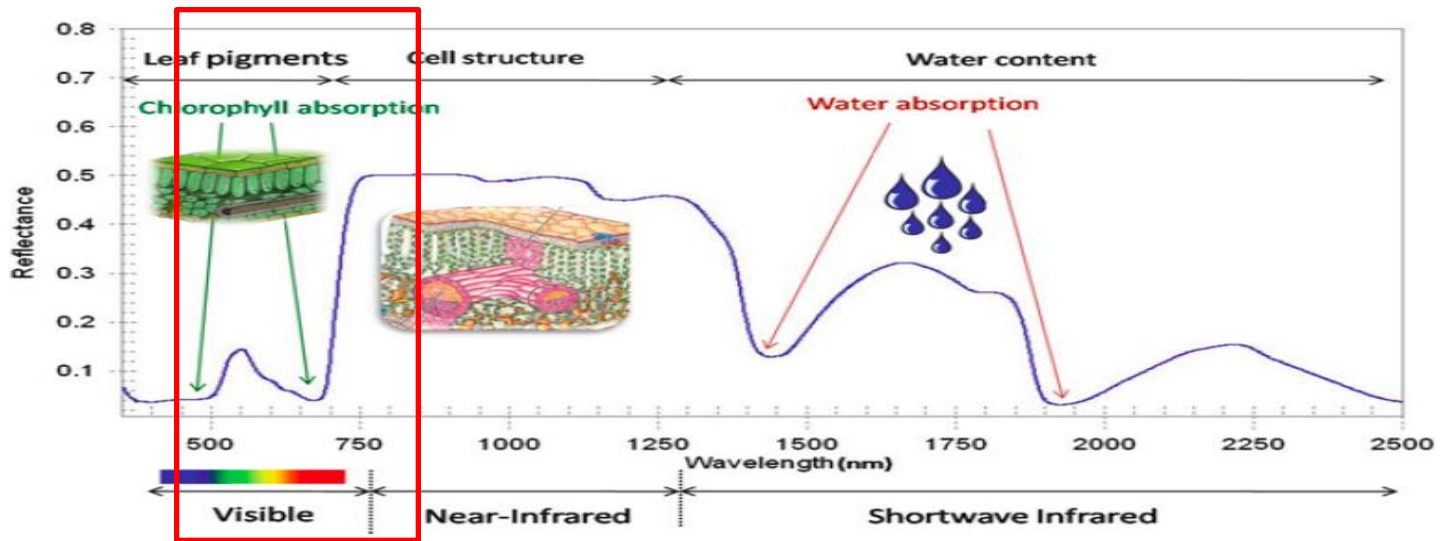
Fungal pathogens



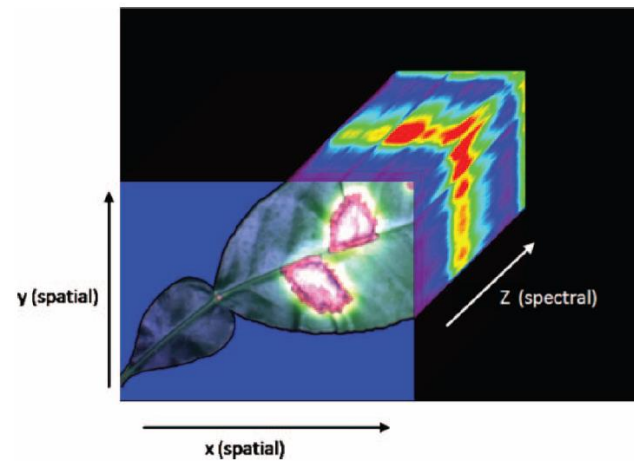
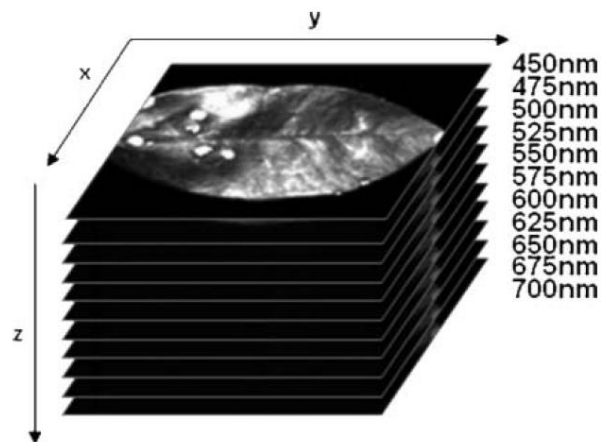
Multispectral Imaging Platform - Canopy



Spectral reflectance



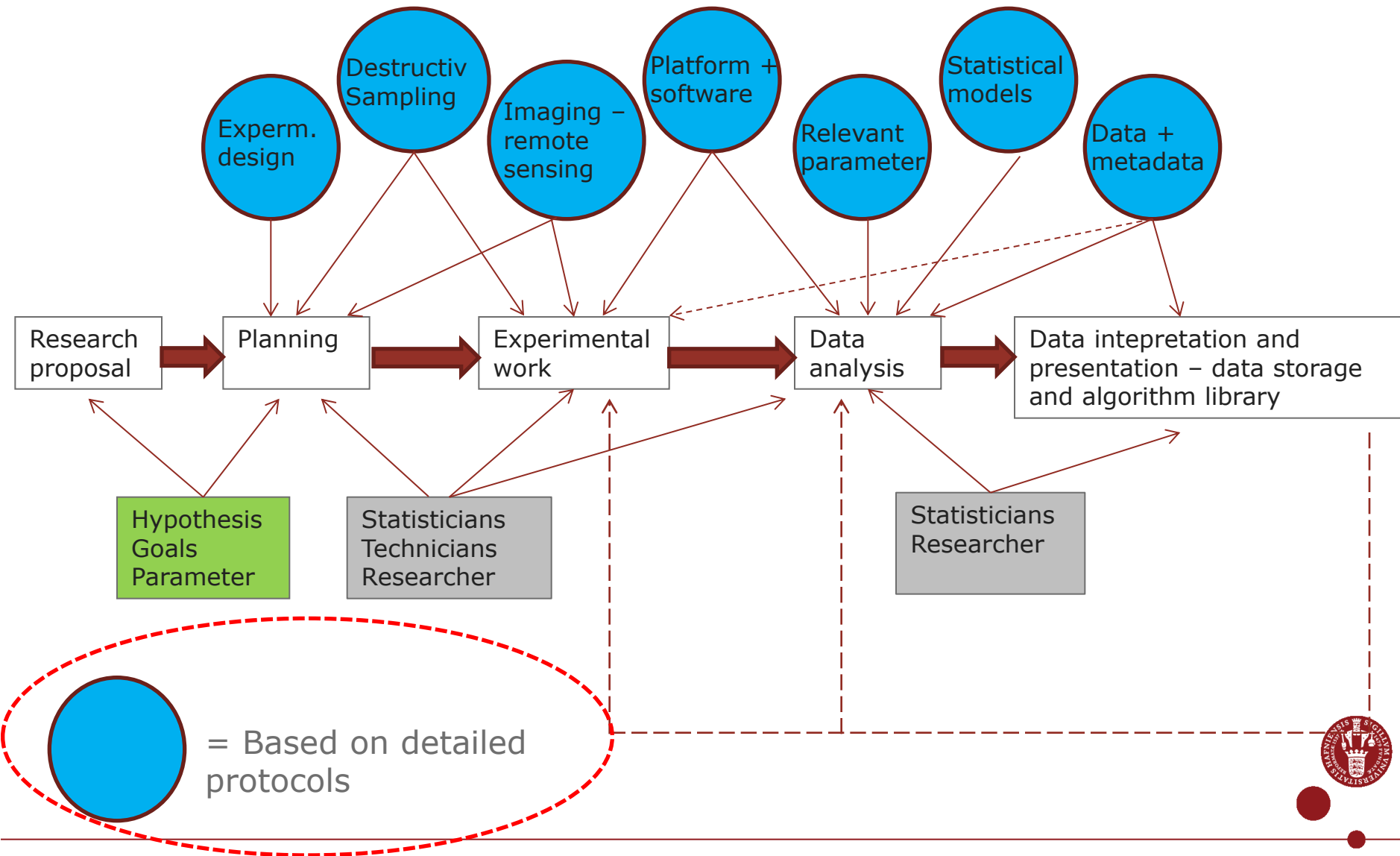
(Prabhakar et al., 2012)



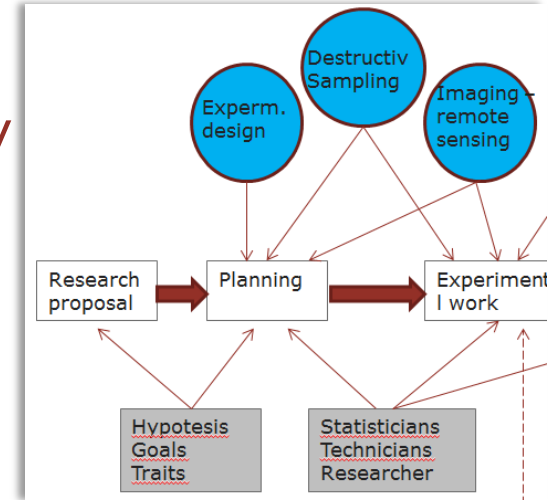
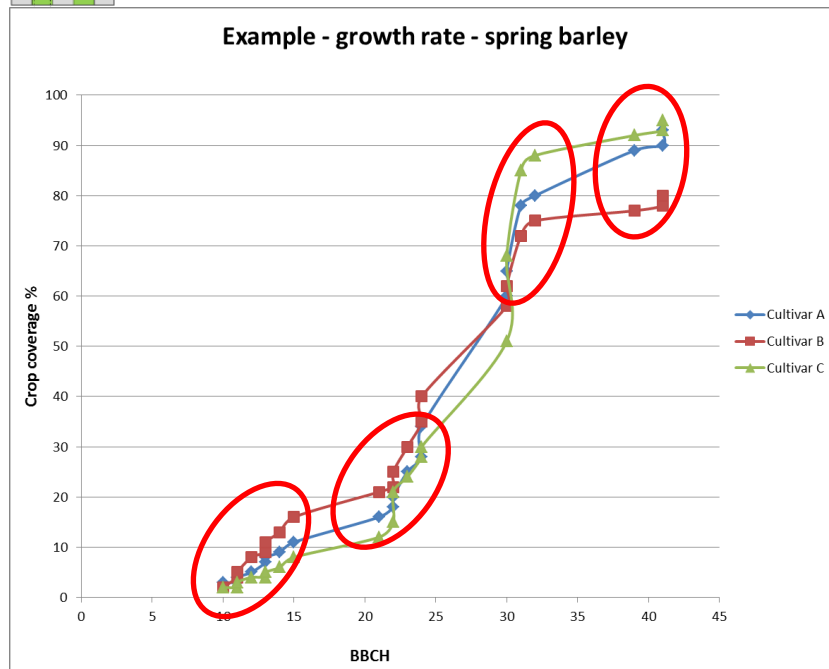
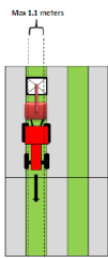
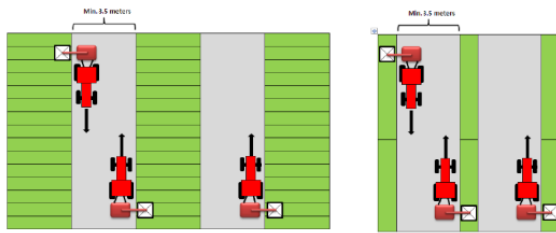
(Bock et al., 2010)



FAUPE 2014: The overall infrastructure and protocols

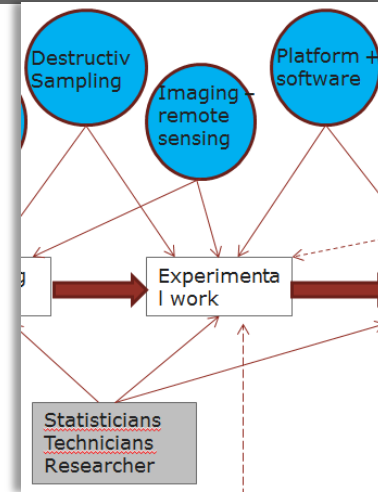


Experimental design and imaging strategy



- Experimental planning and design
- Location of experiment
- General management
- Data collection
- Remote sensing and destructive harvest
- **What parameters to measure**
- **.....And when to measure!?**

Imaging during season



- Before imaging
 - Calibration
 - Session template
 - On-the-go algorithm
- During imaging
 - Light calibration
 - Quality tjeck
 - Possible bias
- After imaging
 - Quality tjeck of data
 - Safe storage of data
 - Replace outliers

Image analysis and parameter estimates

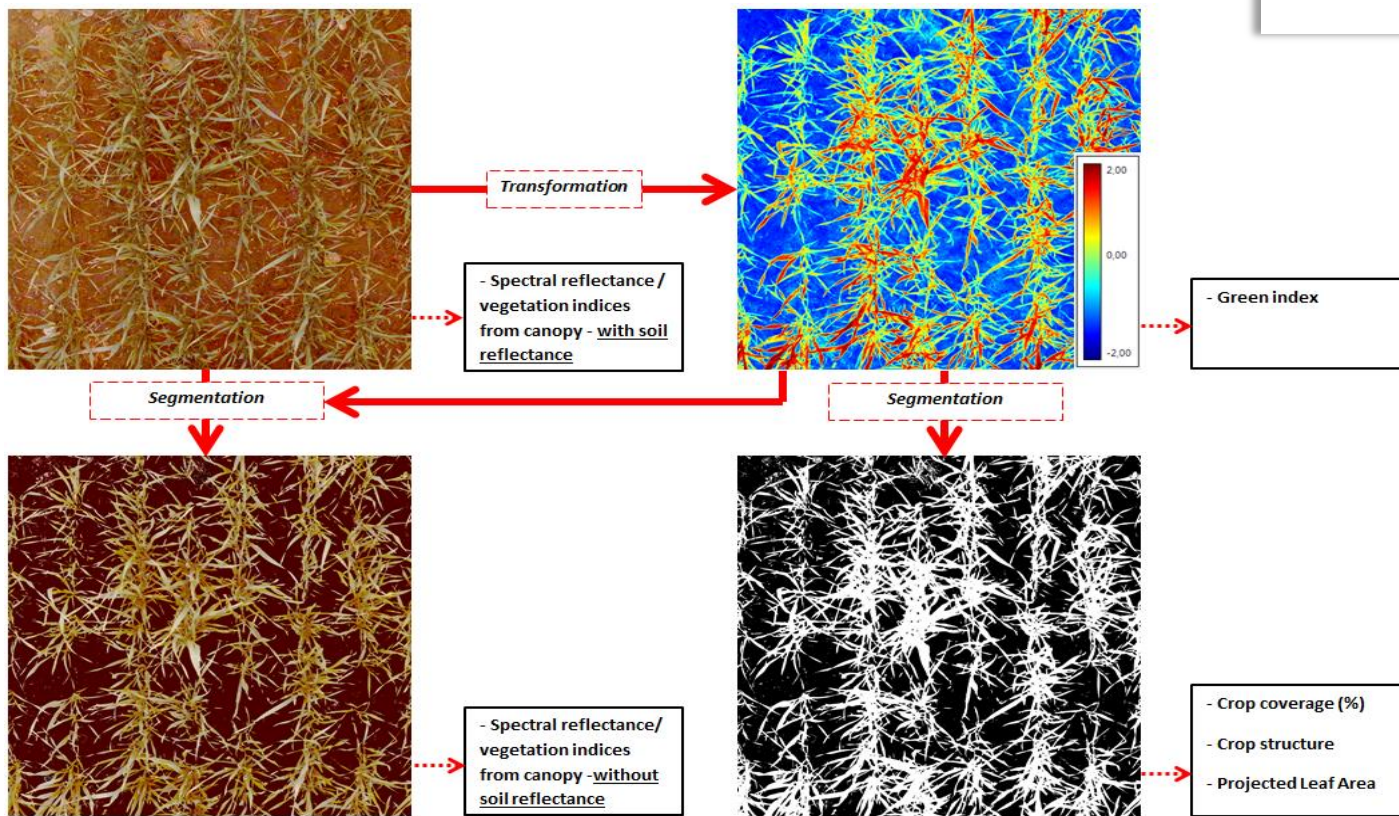
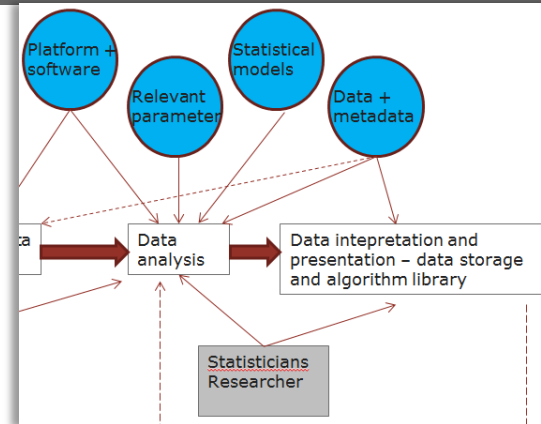
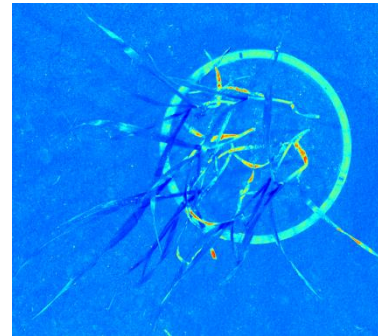
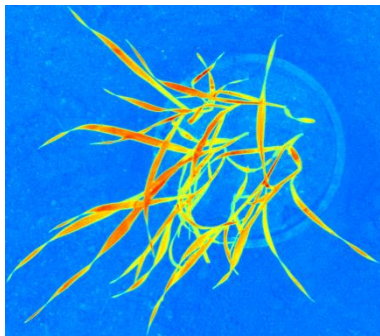
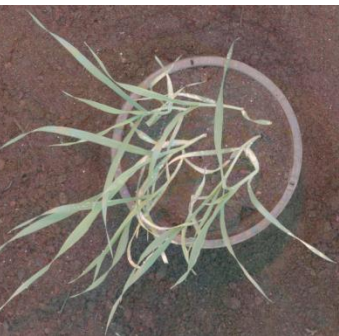
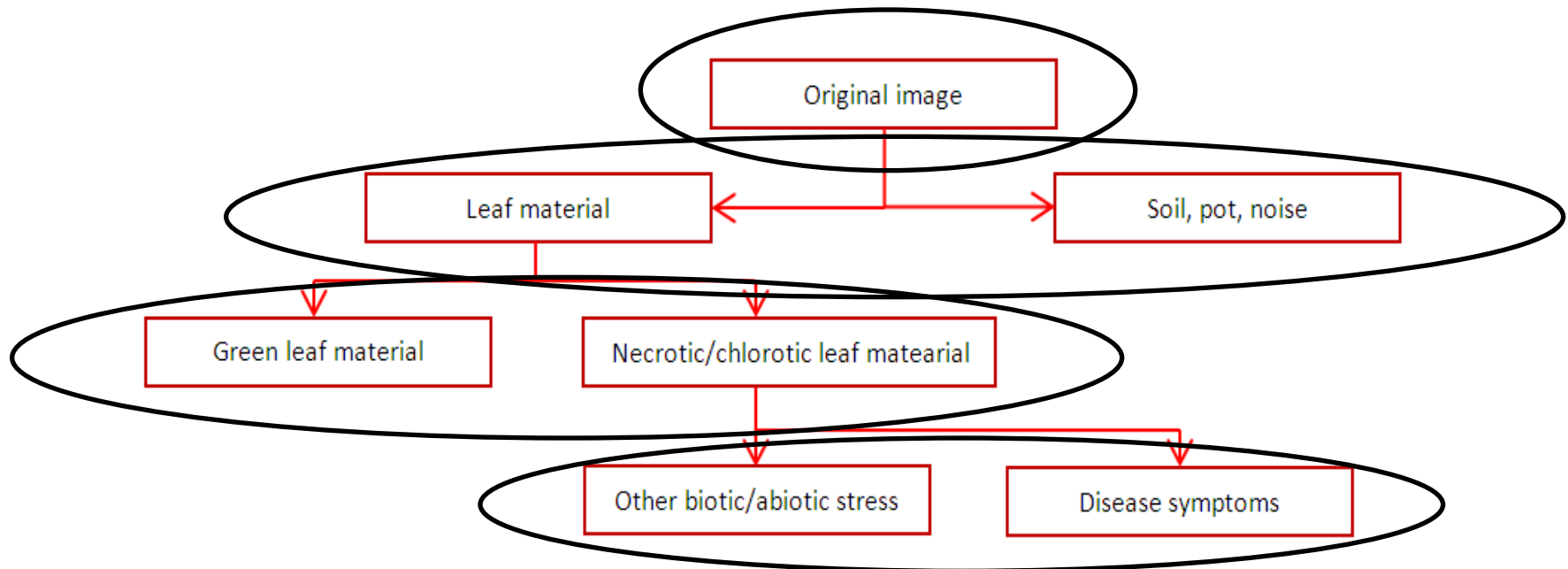
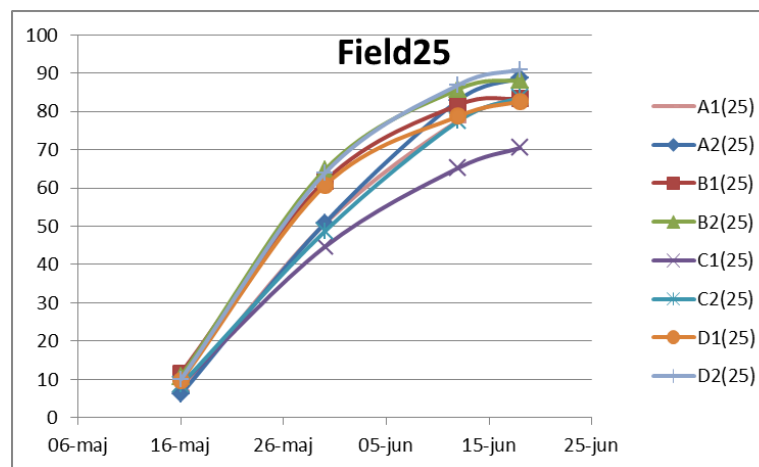
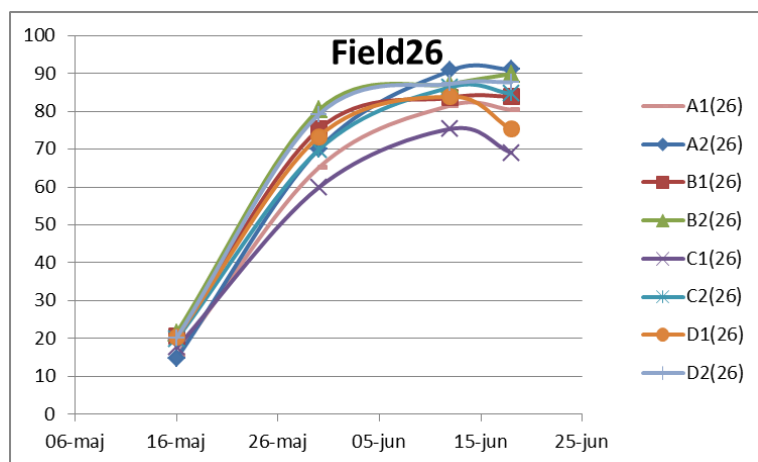
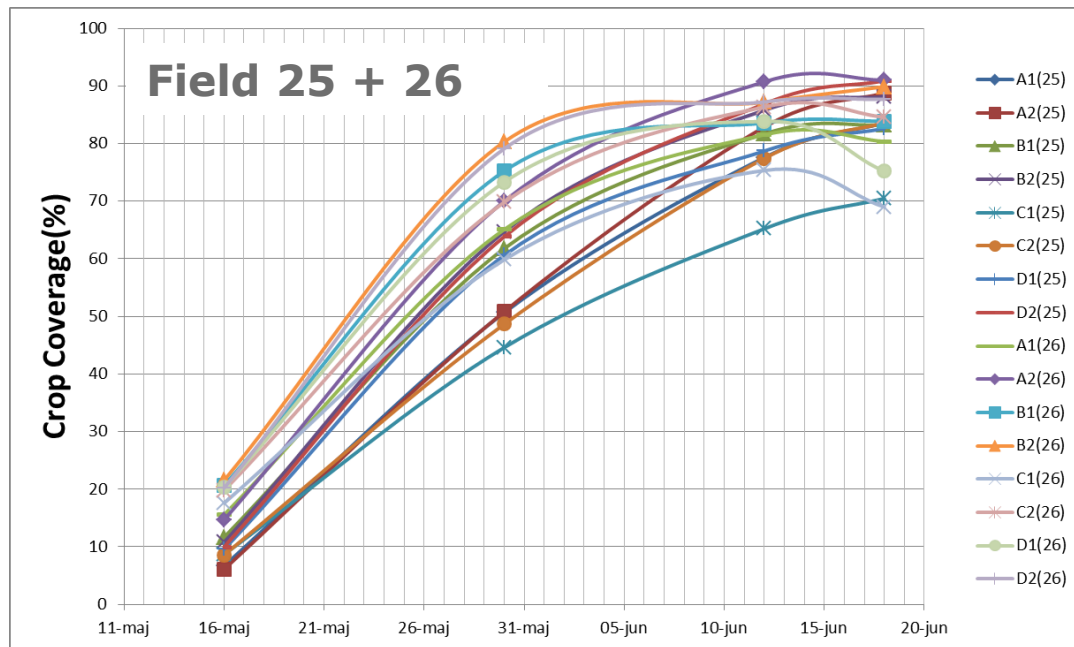
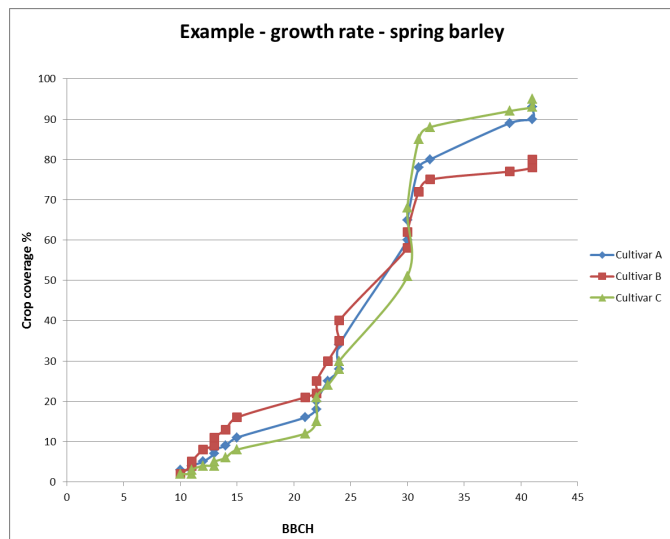


Image analysis – coverage



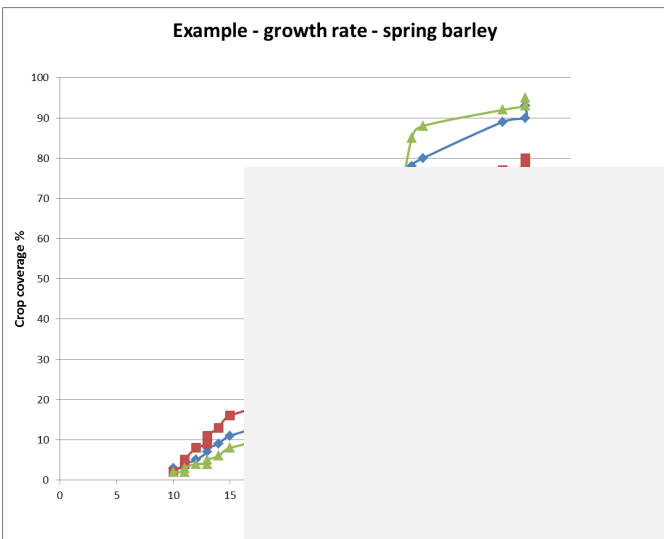
$$RFC = \frac{\text{Leaf coverage with disease symptoms of entire population (\# of pixels)}}{\text{Total leaf area of entire population (\# of pixels)}}$$

Statistical modelling and interpretation



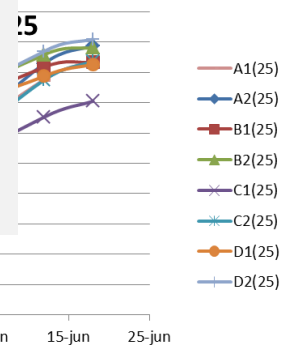
Statistical modelling and interpretation

Example - growth rate - spring barley



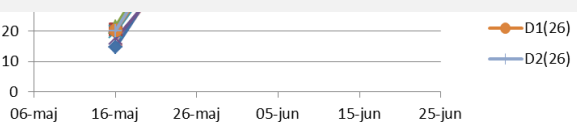
Non-linear
Dynamic
Mixed models
Covariates
etc...

- A1(25)
- A2(25)
- B1(25)
- B2(25)
- C1(25)
- C2(25)
- D1(25)
- D2(25)
- A1(26)
- A2(26)
- B1(26)
- B2(26)
- C1(26)
- C2(26)
- D1(26)
- D2(26)



BBCH 25			
Variety	Mean crop coverage	Std. dev	Coefficient of variation
ambition	42.71	6.59	15.4
audi	39.59	8.13	20.5
evolution	42.42	3.13	7.4
gardner	34.80	5.94	17.1
genius	45.69	3.78	8.3
hereford	51.70	6.85	13.2
hubery	39.90	2.66	6.7
ibiasano	43.45	5.16	11.9
jensen	50.90	6.06	12.0
mariboss	47.52	6.93	14.6
makslov	45.67	3.95	8.7
pietro	40.49	3.03	7.5
sj079509-038	71.72	6.00	8.4
sj854003	35.97	4.27	11.9
tuareg	43.20	4.64	10.7

BBCH 36			
Variety	Mean crop coverage	Std. dev	Coefficient of variation
ambition	71.81	4.74	6.6
audi	75.63	6.59	8.7
evolution	68.42	5.02	7.3
gardner	67.60	3.74	5.5
genius	68.08	3.68	5.4
hereford	70.24	4.75	6.8
hubery	74.27	3.47	4.7
ibiasano	73.93	4.84	6.5
jensen	74.38	3.81	5.1
mariboss	68.46	2.50	3.6
makslov	67.23	2.43	3.6
pietro	68.04	2.76	4.0
sj079509-038	87.29	3.06	3.5
sj854003	77.25	1.96	2.5
tuareg	68.33	4.84	7.0



Milestones in 2014

March: Draft of protocol for multivariate image analysis. Draft of protocol for field phenotyping procedure with multispectral imaging platform

April: Draft of protocol for planning experimental designs that includes multispectral imaging

October: Presentation of preliminary results from root v.s. aboveground phenotyping in barley experiment

October: Presentation of results from multispectral imaging in cereal/potatoe cultivars

November: A testing platform for automatic data/metadata transfer between field platforms, databases and analytical platforms.

November: Final protocols vs 1 for multivariate image analysis, field phenotyping procedures, experimental designing and imaging strategies. Will include a protocol for some statistical work

December: Suggested design for database system for phenotyping data including integration of root- and aboveground phenotyping data

December: Present results on improved protocols/methods for root phenotyping and canopy phenotyping

