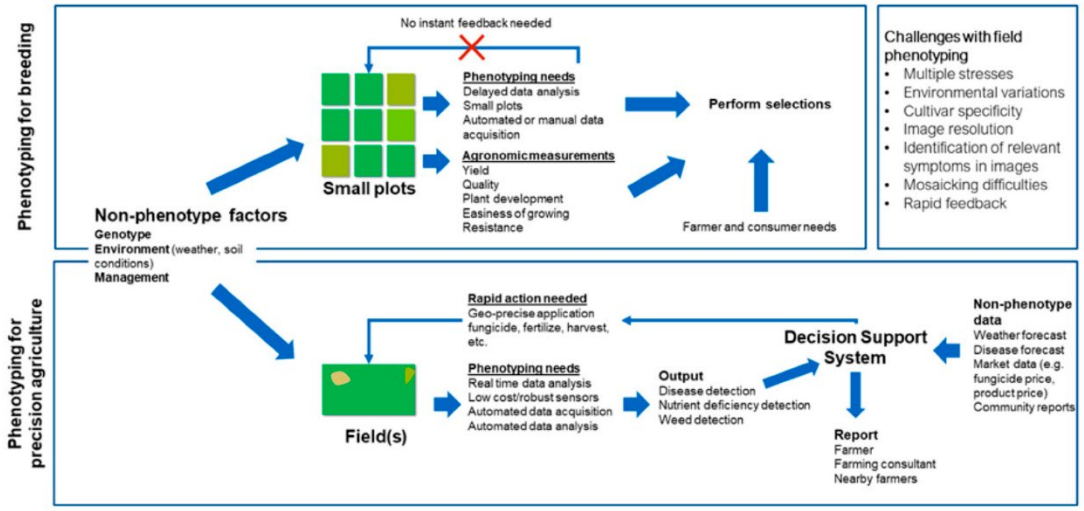
Detecting potato late blight in the field

Erik Alexandersson & Murilo Sandroni, Swedish University of Agricultural Sciences

Plant disease phenotyping for…

- Plant breeding
- Precisions agriculture



agronomy

MDPI

Review

High-Throughput Field-Phenotyping Tools for Plant Breeding and Precision Agriculture

Aakash Chawade [1,*], Joost van Ham [2], Hanna Blomquist [3], Oscar Bagge [3], Erik Alexandersson [4] and Rodomiro Ortiz [1]

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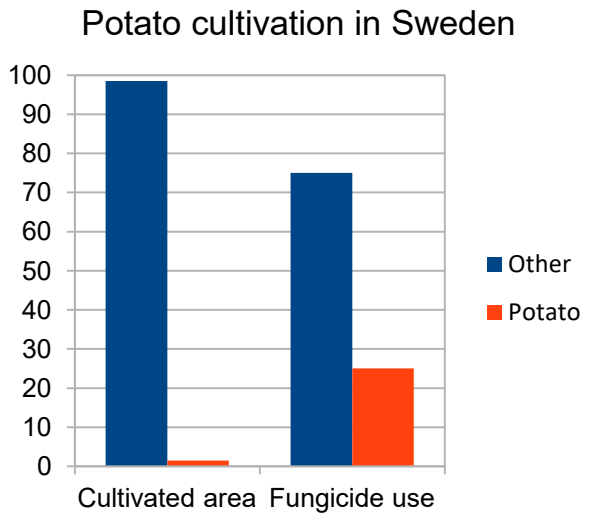
check for updates

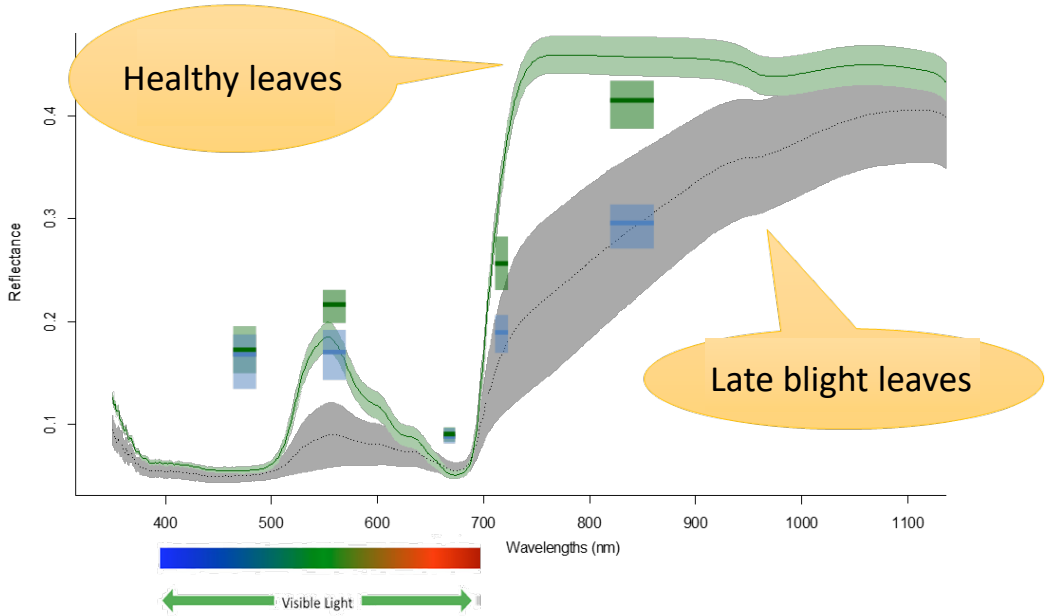
Abstract: High-throughput field phenotyping has garnered major attention in recent years leading to the development of several new protocols for recording various plant traits of interest. Phenotyping of plants for breeding and for precision agriculture have different requirements due to different sizes of the plots and fields, differing purposes and the urgency of the action required after phenotyping.

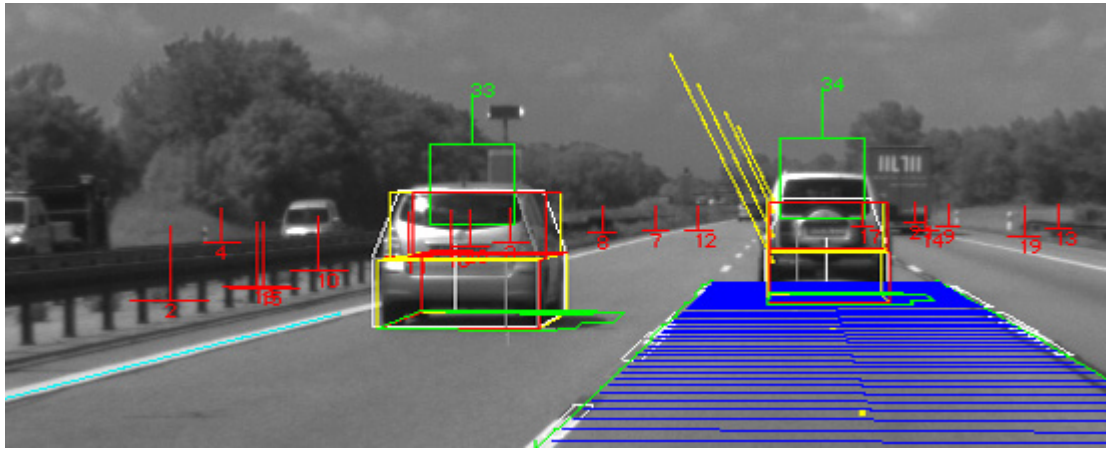
Relevance phenotyping Potato late blight

- Potato: high value crop and 3rd most important food crop
- *P. infestans* causing potato late blight costs 7 billion USD per year
- High fungicide use in Sweden – pro-active spraying
- Early and accurate detection
- Resistant breeding material needed



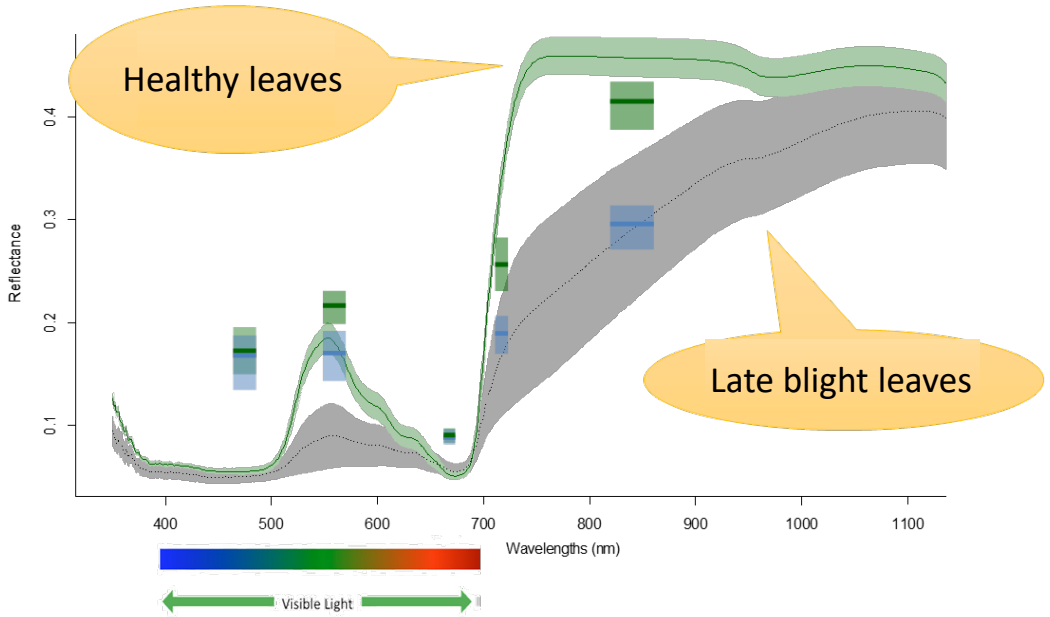
Spectral analysis vs computer vision



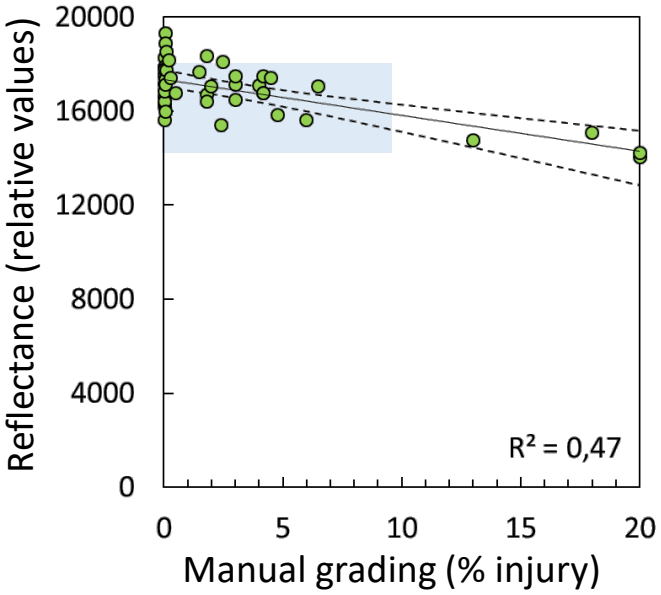


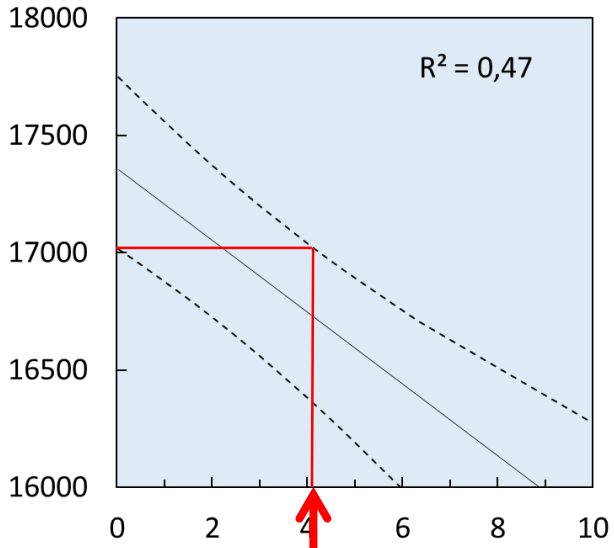
GitHub: Computer Vision

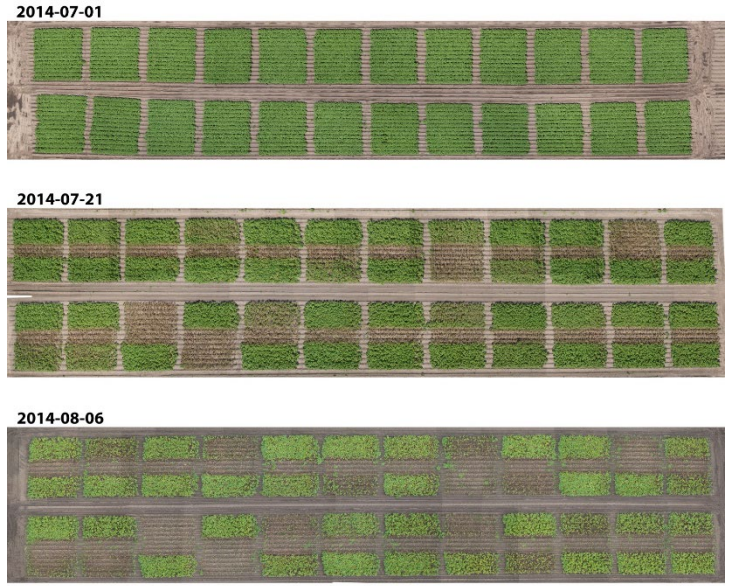
Spectral analysis vs computer vision



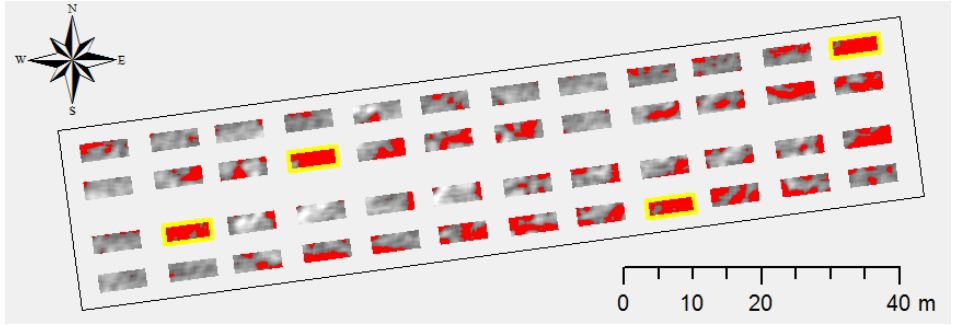
Late blight detection by spectral analysis



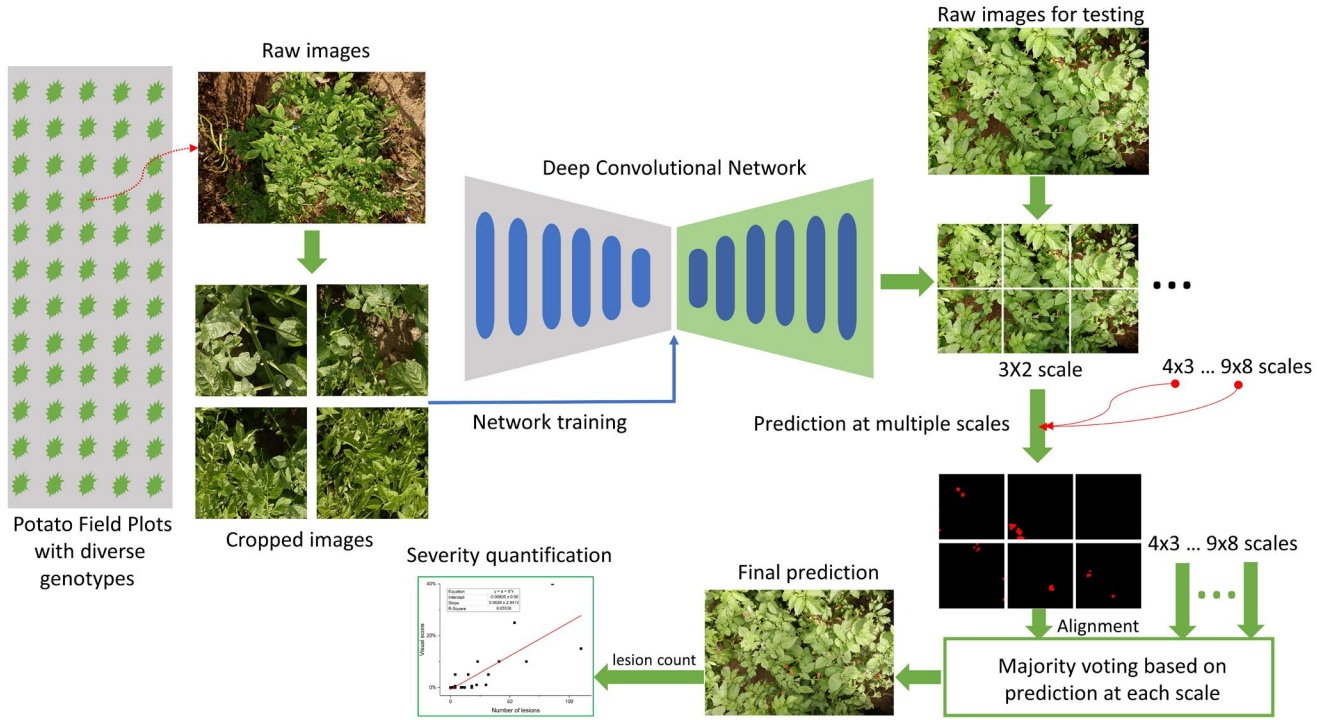




An infection of 5 % is associated with a significant decrease in mean reflectance in red-edge band



”Automatic late blight lesion recognition and severity quantification based on field imagery of diverse potato genotypes by deep learning”



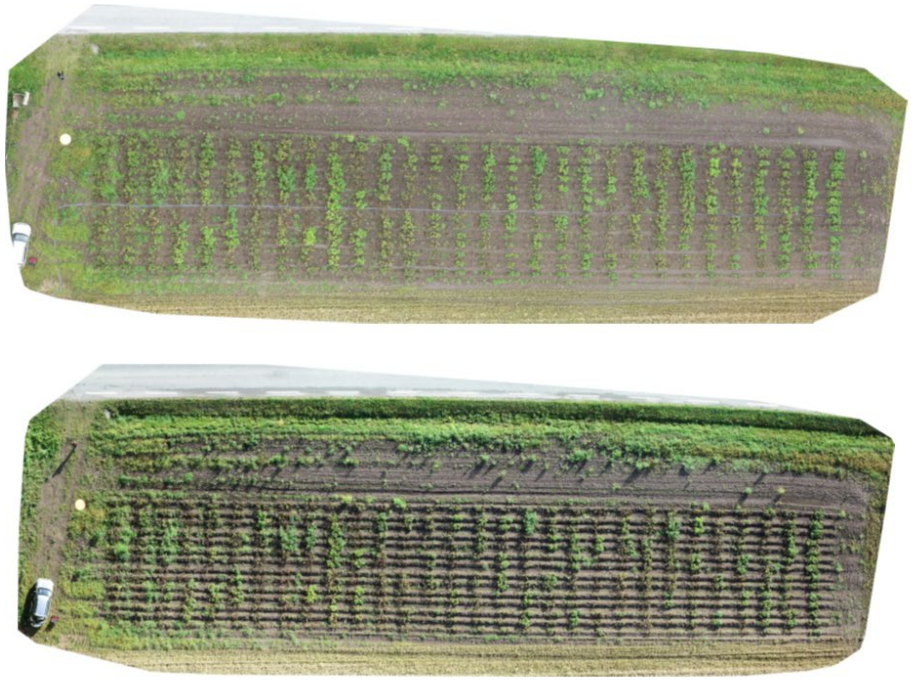
Junfeng Gao, Jesper Cairo Westergaard, Ea Høegh Riis Sundmark, Merethe Bagge, Erland Liljeroth, Erik Alexandersson

Under review

Book chapter ”Computer vision and less complex image analyses to monitor potato traits in fields”

Junfeng Gao, Jesper Cairo Westergaard and Erik Alexandersson

Under review



Detecting late blight in the field

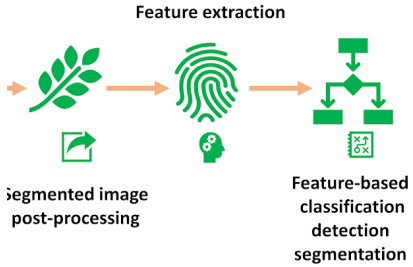
START

Spectral analysis

(5%)

Computer vision

(lesions: ~70%, pixels:~40%)



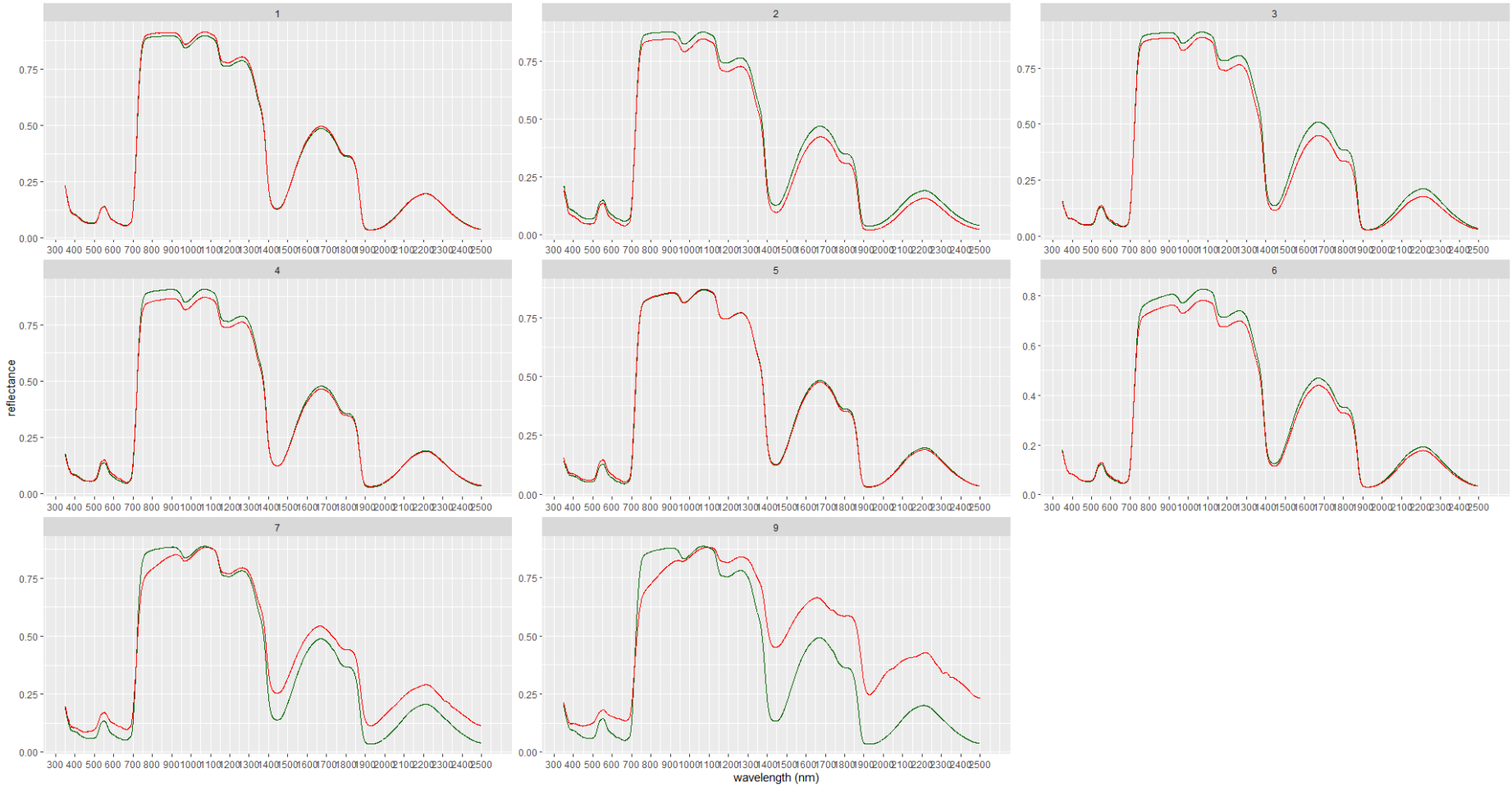
Spectral analysis

Controlled climates
Gene expression
Pathogen quantification

Joint?

?

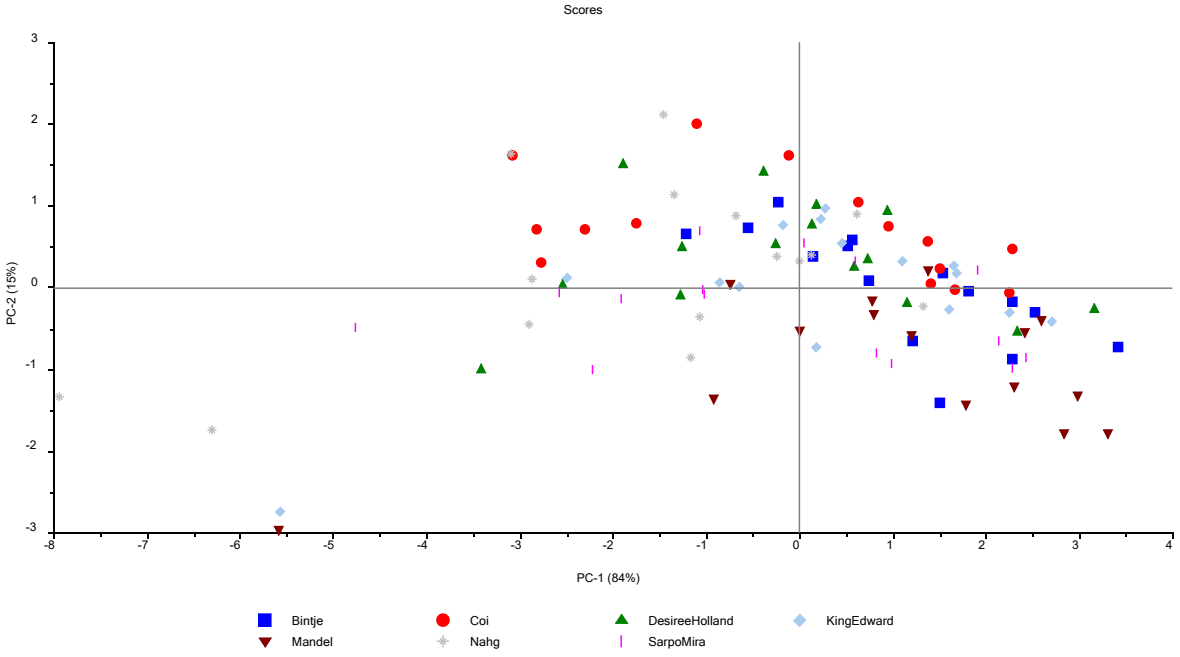
Controlled environment (Biotron), 2019



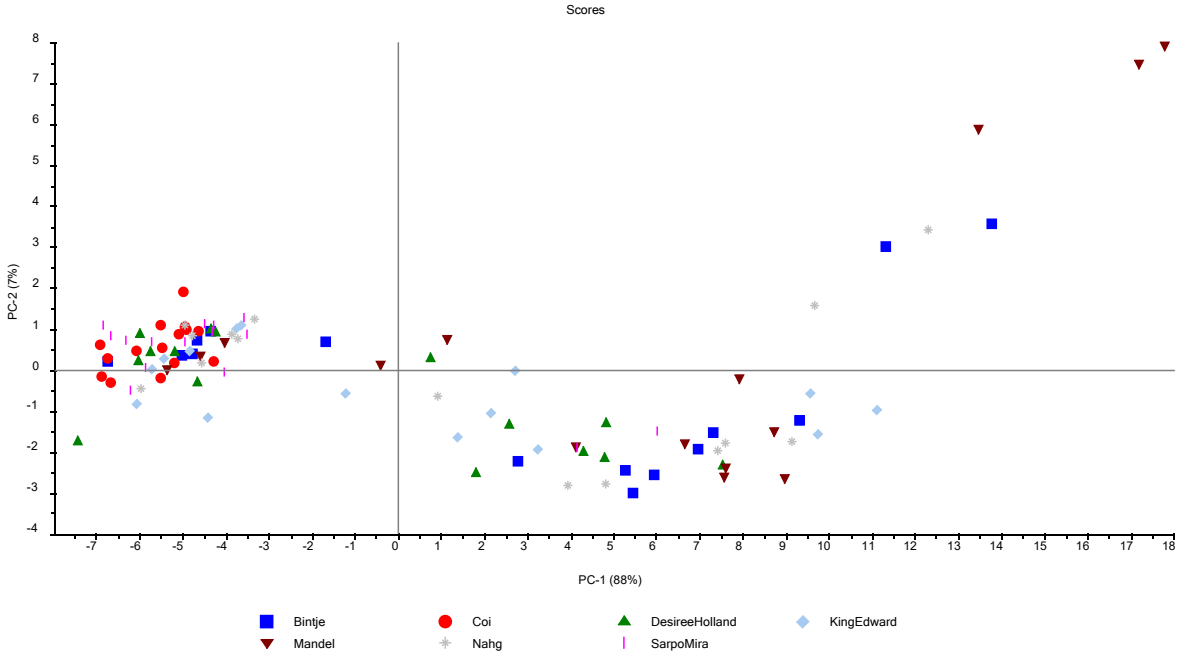
Average reflectance from control (in green) and infected (in red) potato plants (cv. Bintje) on different dates.

Controlled environment (Biotron), 2019

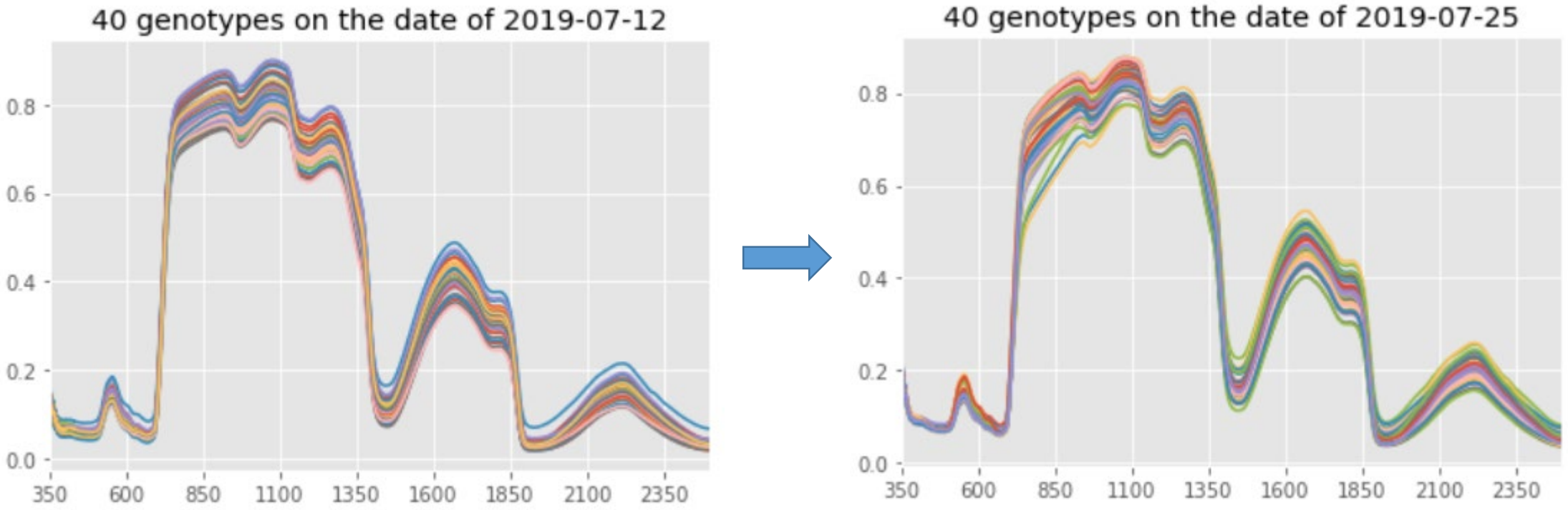
Before infection



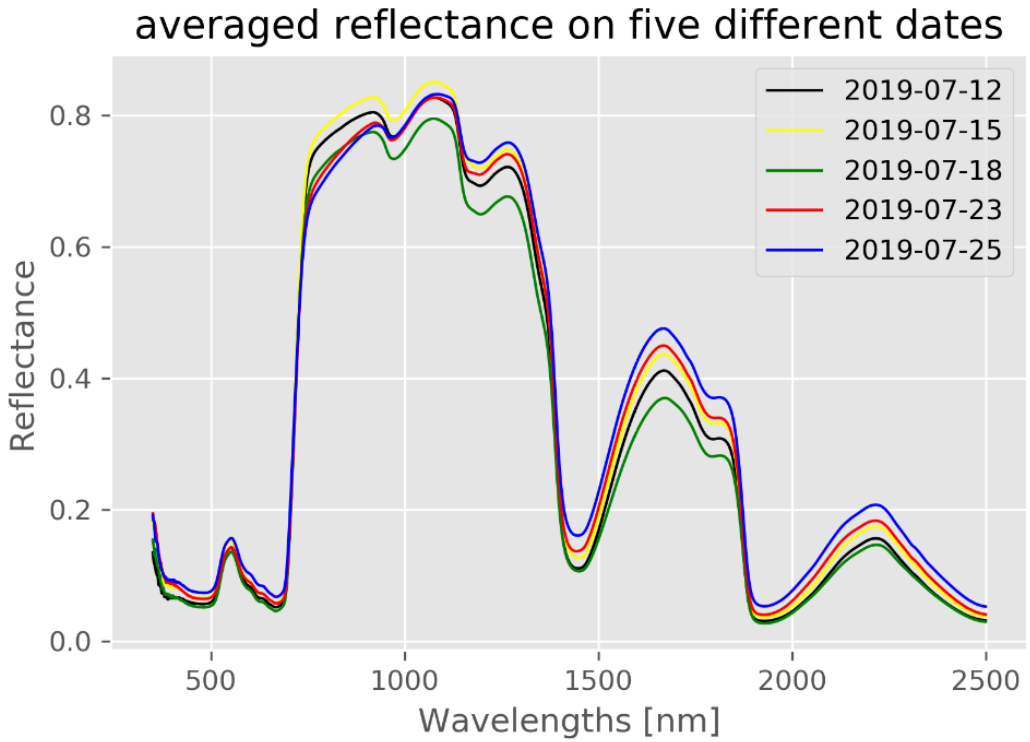
Last timepoint

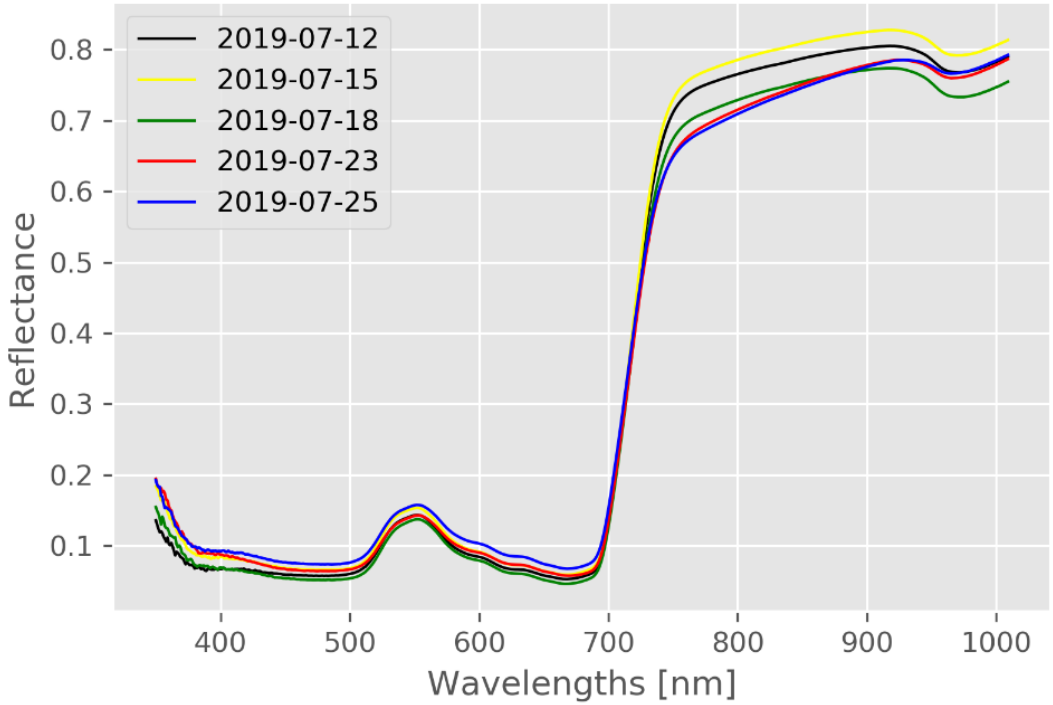


Field, 2019

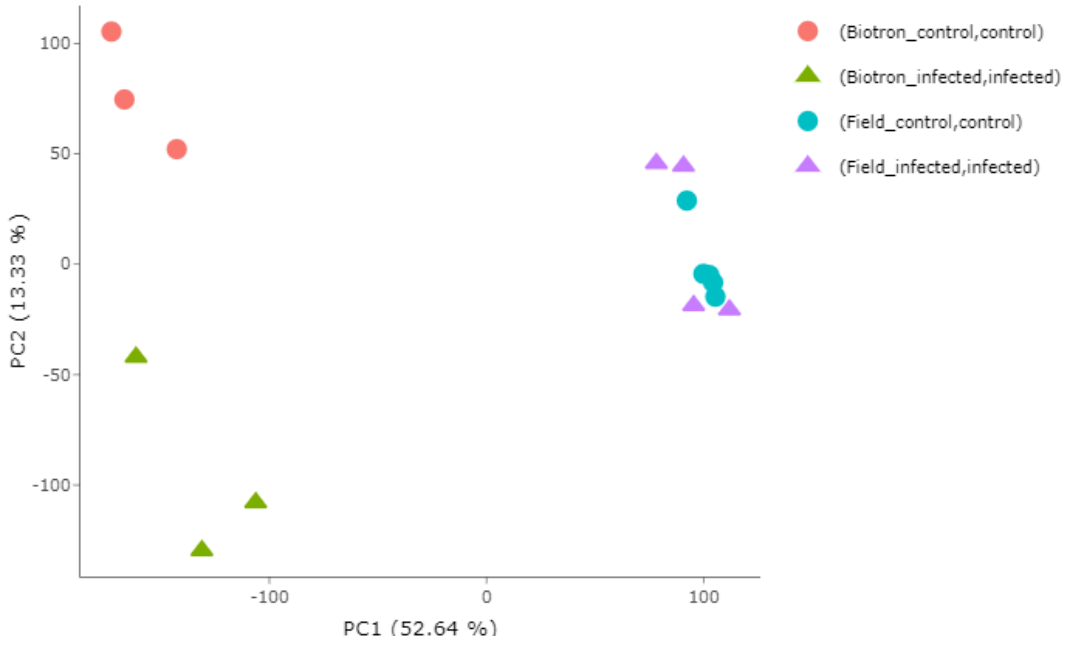

40 genotypes on the date of 2019-07-12
0.0
0.2
0.4
0.6
0.8
350
600
850
1100
1350
1600
1850
2100
2350
40 genotypes on the date of 2019-07-25
0.0
0.2
0.4
0.6
0.8
350
600
850
1100
1350
1600
1850
2100
2350

Field, 2019

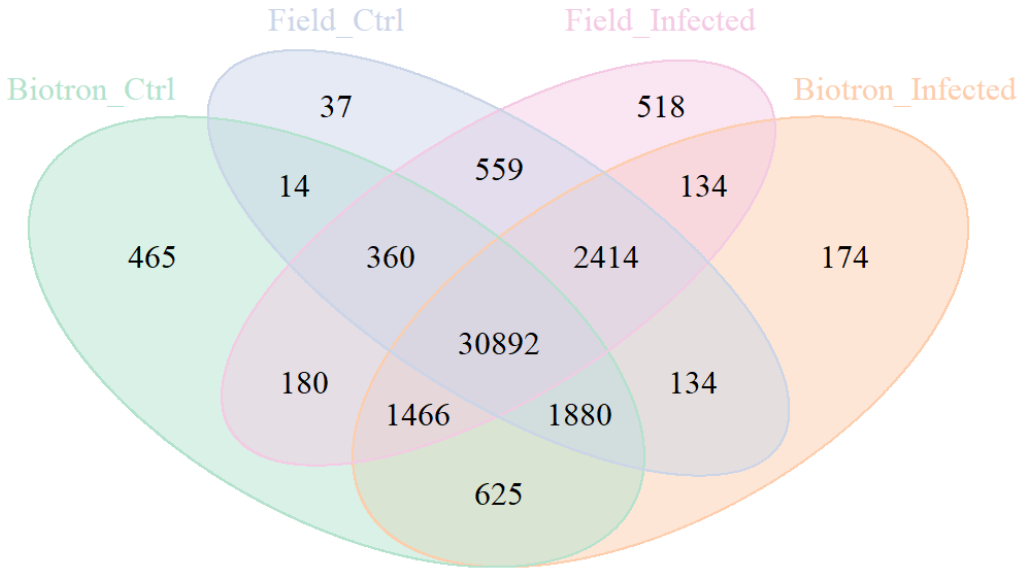

averaged reflectance on five different dates
2019-07-12
2019-07-15
2019-07-18
2019-07-23
2019-07-25
Reflectance
Wavelengths [nm]
0.0
0.2
0.4
0.6
0.8
500
1000
1500
2000
2500


2019-07-12
2019-07-15
2019-07-18
2019-07-23
2019-07-25
Reflectance
Wavelengths [nm]
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
400
500
600
700
800
900
1000

RNAseq from both Biotron and field

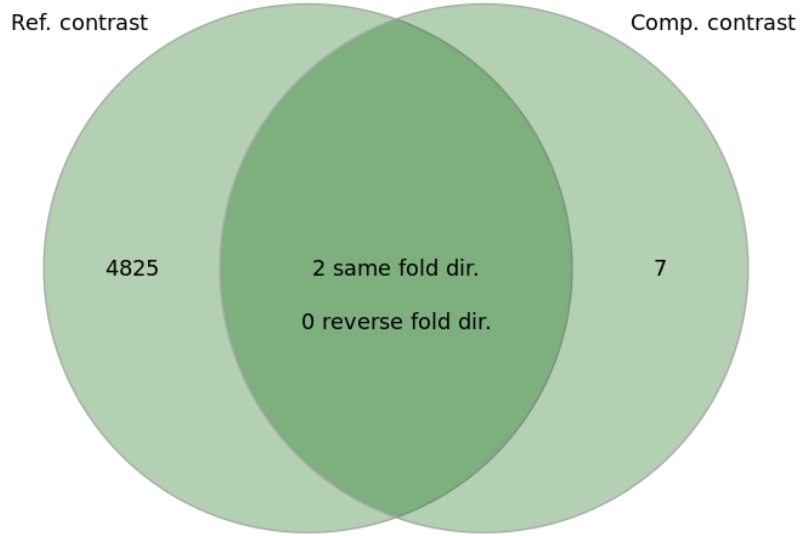


Global expression

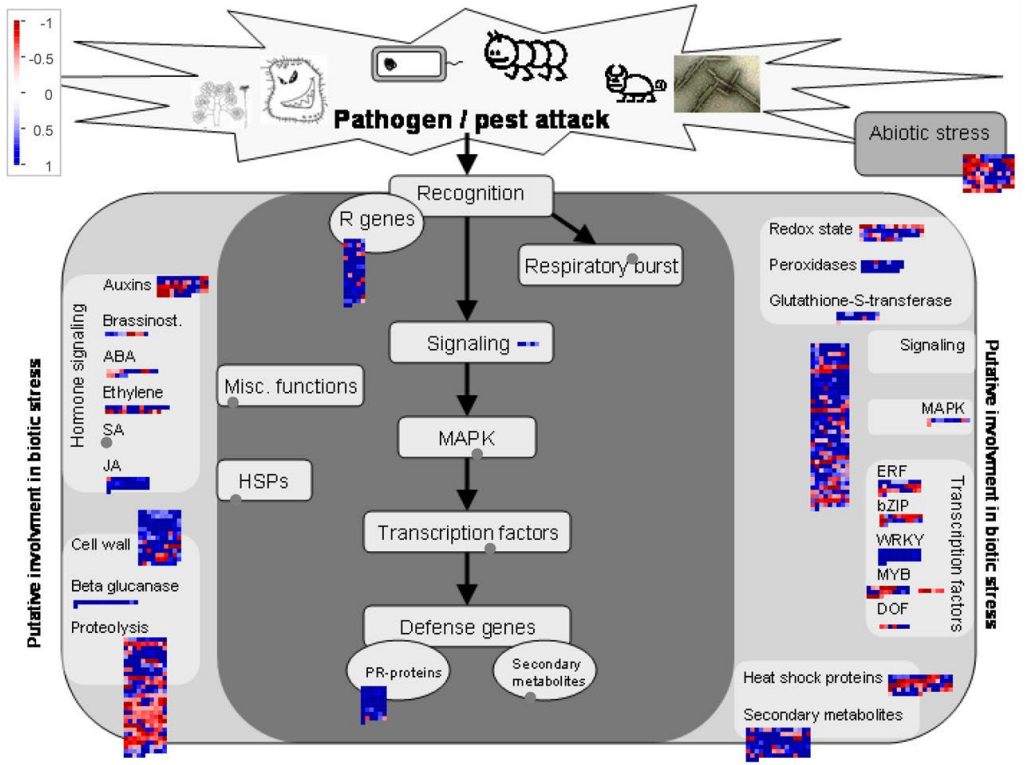


RNAseq from both Biotron and field

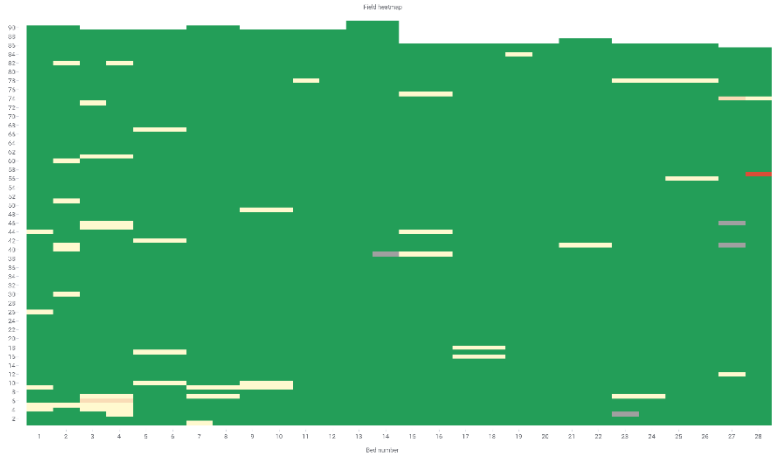
B.Inf-B.Ctrl x F.Inf-F.Ctrl



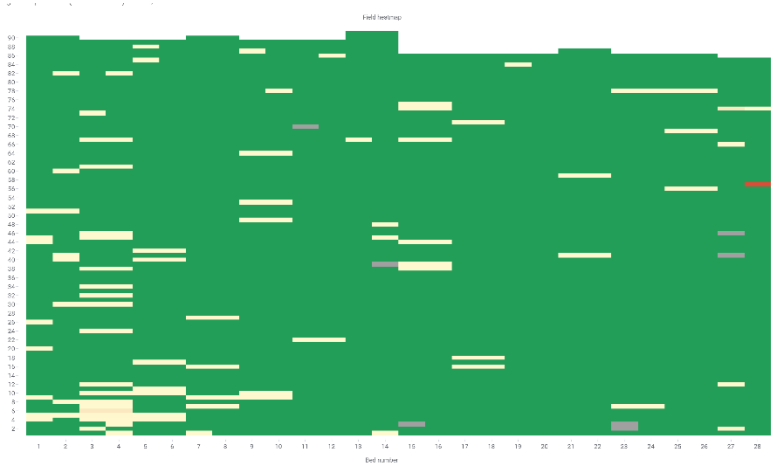
Metabolic pathways involved



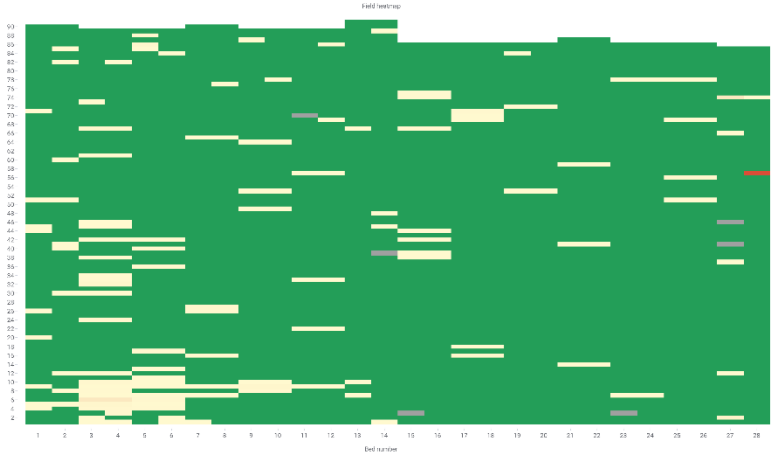
2020



13-Jul-2020



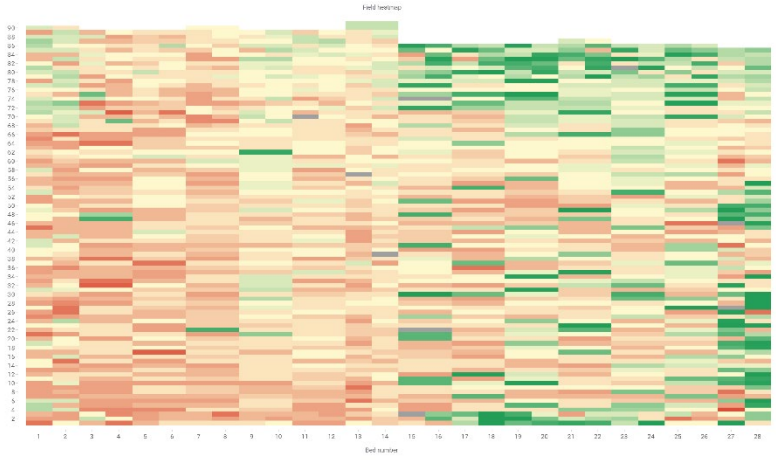
15-Jul-2020



17-Jul-2020

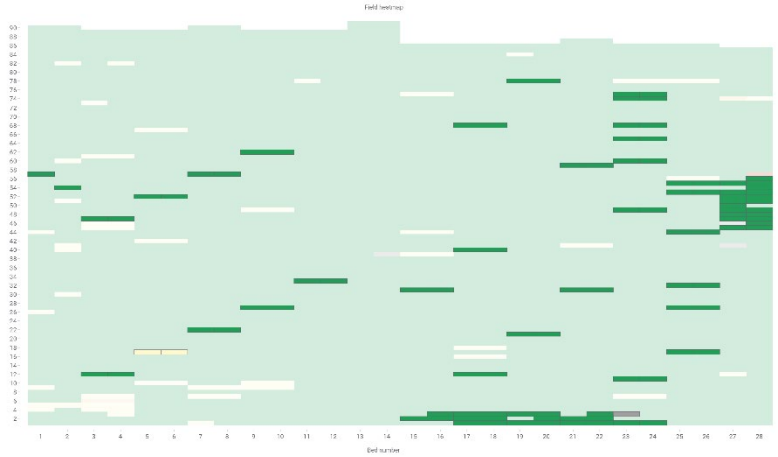
20-Jul-2020

25-Jul-2020



31-Jul-2020

2020



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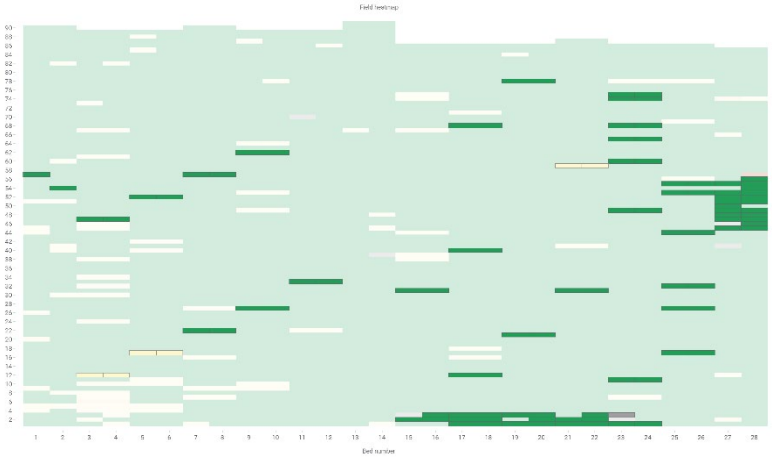

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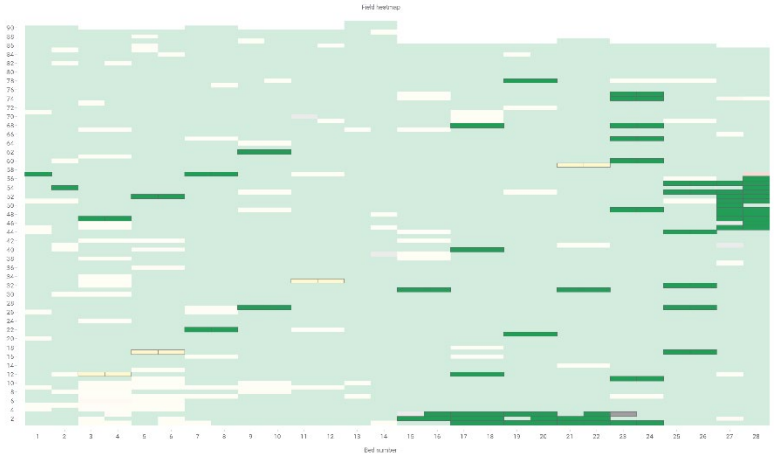

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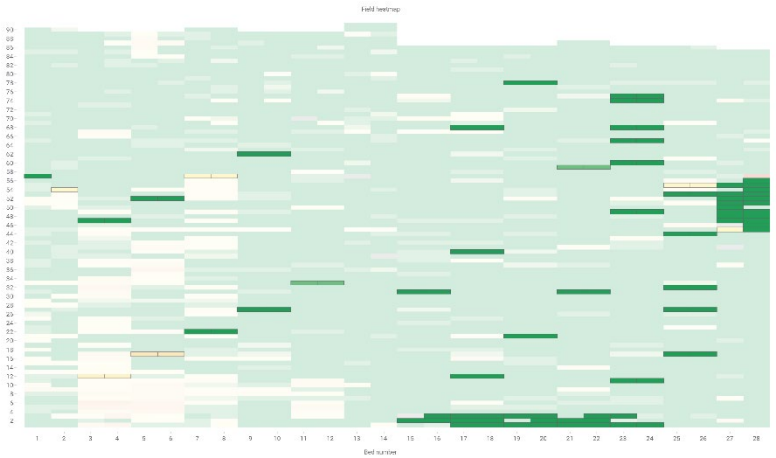

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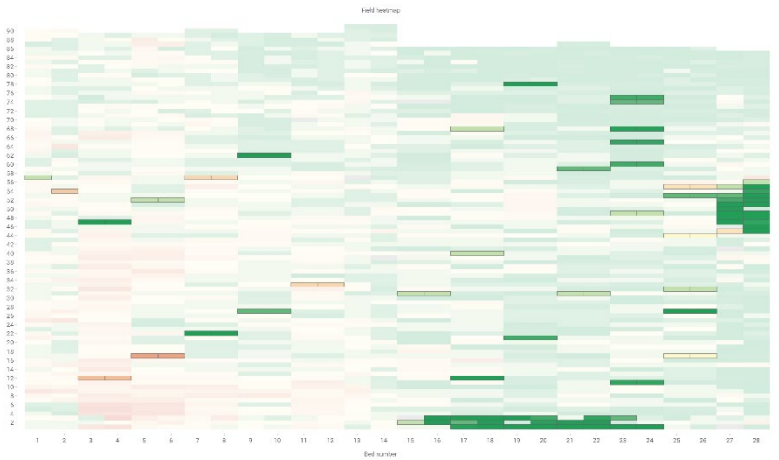

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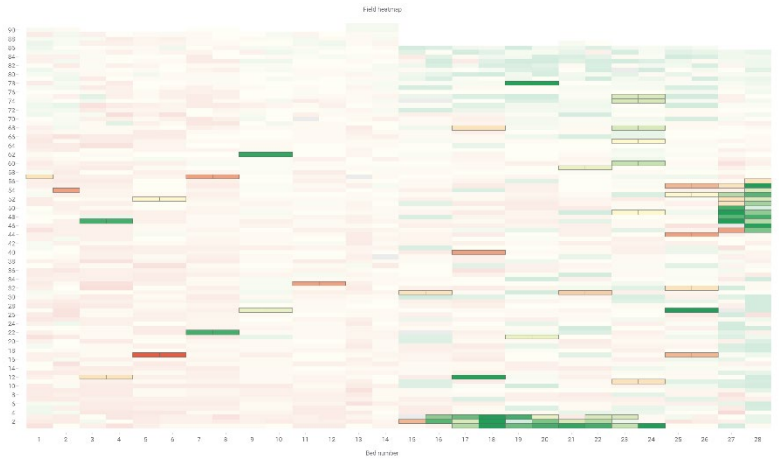
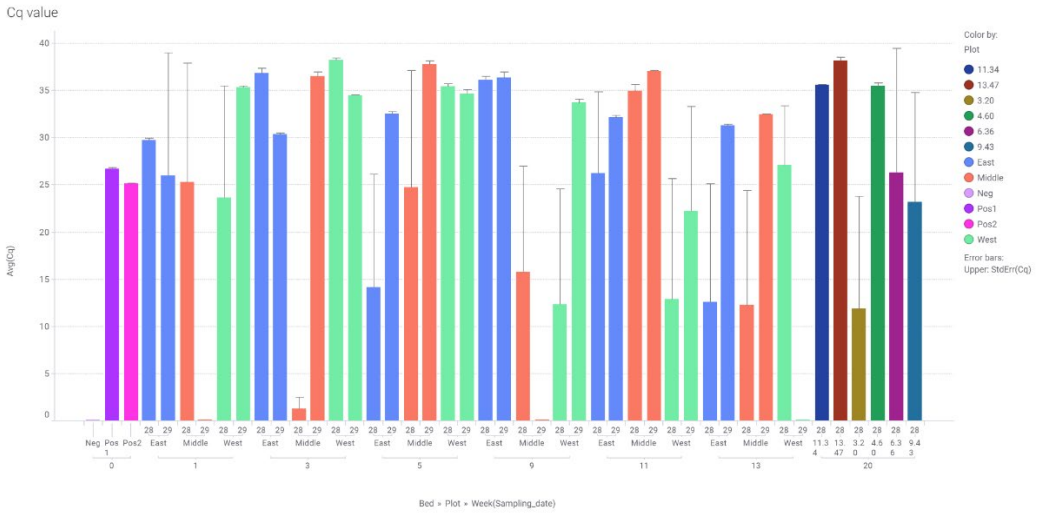


31-Jul-2020

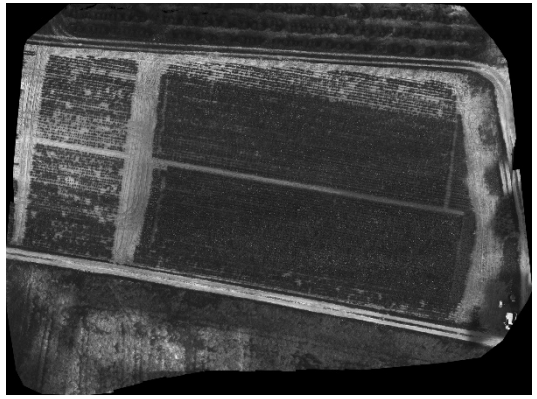
2020

DNA quantification



Next steps:

- Spectral data 2019+2020
- Correction/normalization
- PLSR



Acknowledgements

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