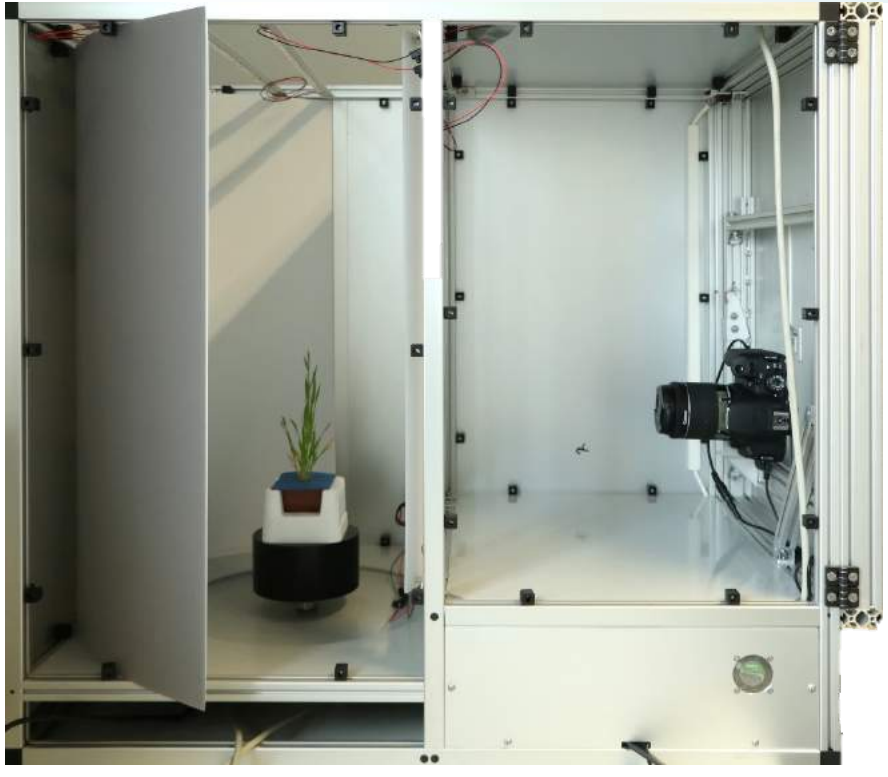
„A PhenoBox in every lab“

Development of a flexible, economic, open source phenotyping solution



2nd APPN meeting
2018-04-17

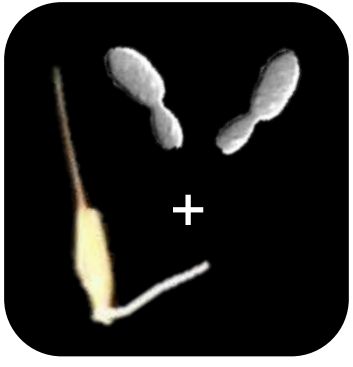
Angelika Czedik-Eysenberg
Sebastian Seitner
Djamei Group, GMI

GMI
GREGOR MENDEL INSTITUTE
OF MOLECULAR PLANT BIOLOGY

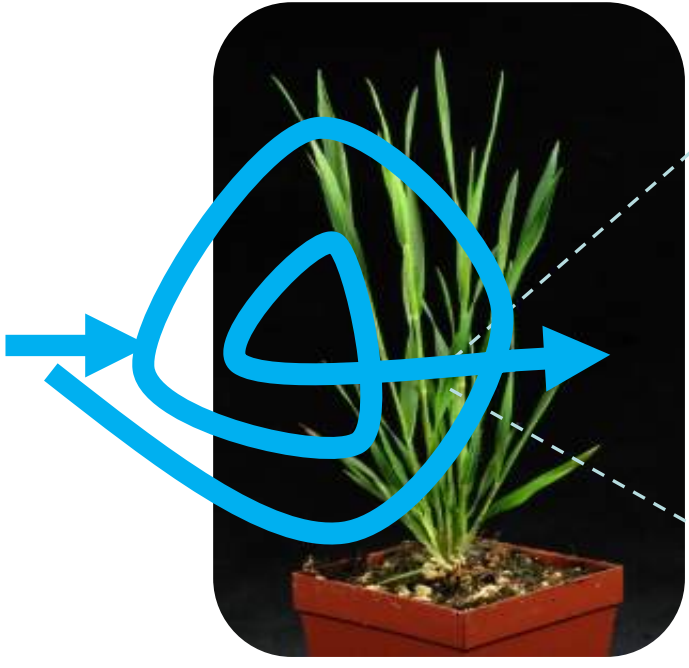
Vienna
BioCenter

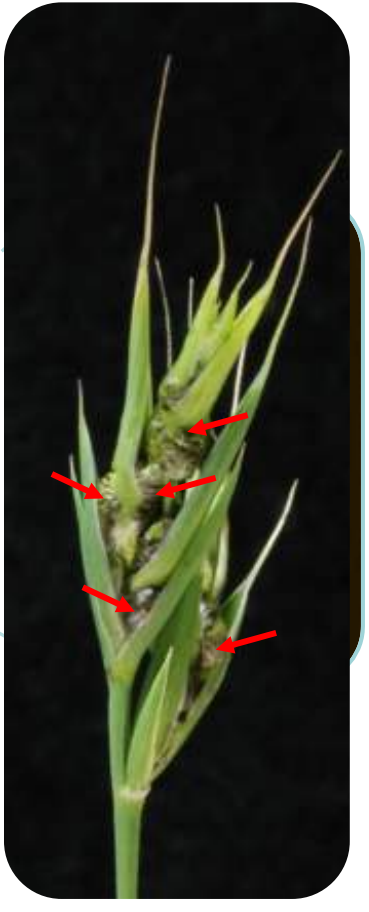
Ustilago bromivora is a headsmut

Backgrounds



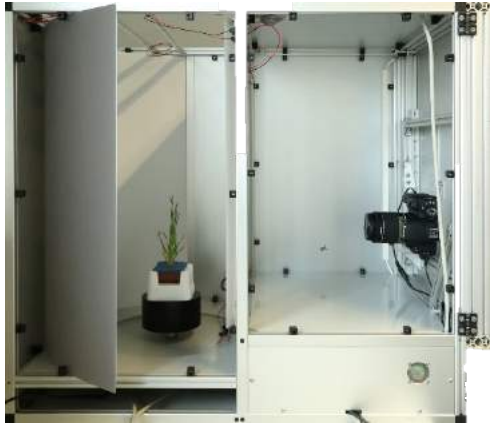
Brachypodium infected with *Ustilago bromivora*



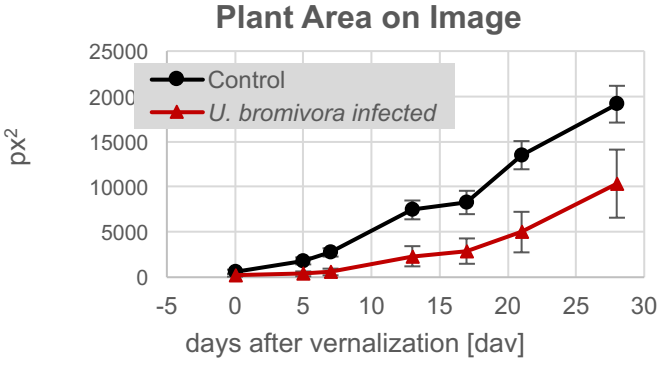


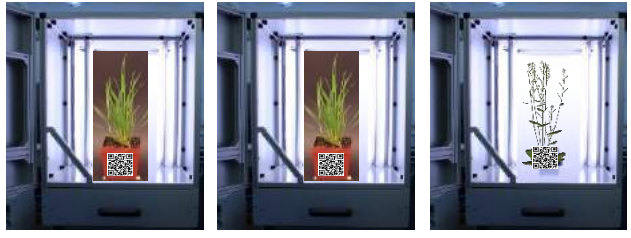
Roadmap of this talk

Backgrounds



PhenoBox & PhenoPipe

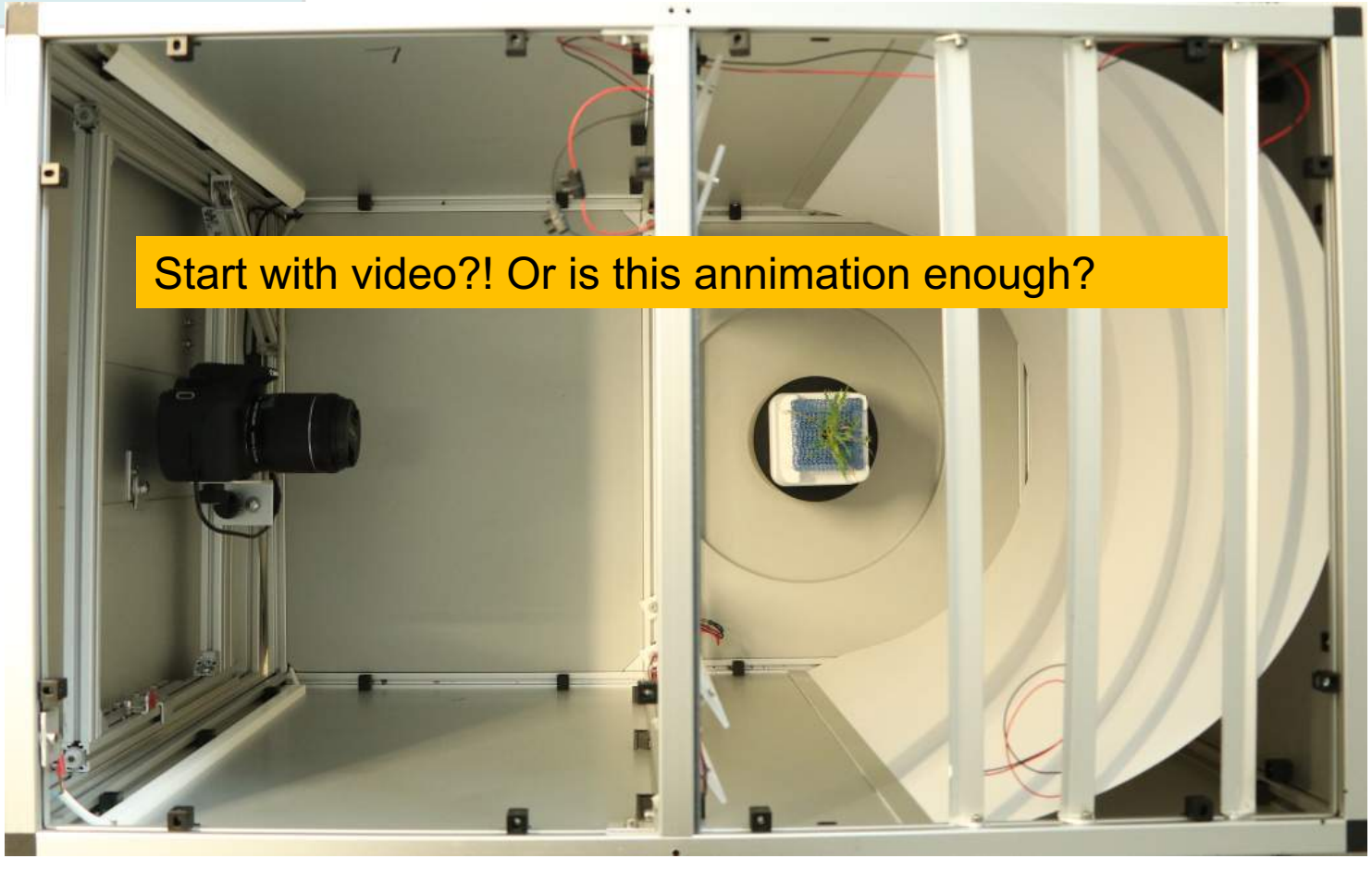


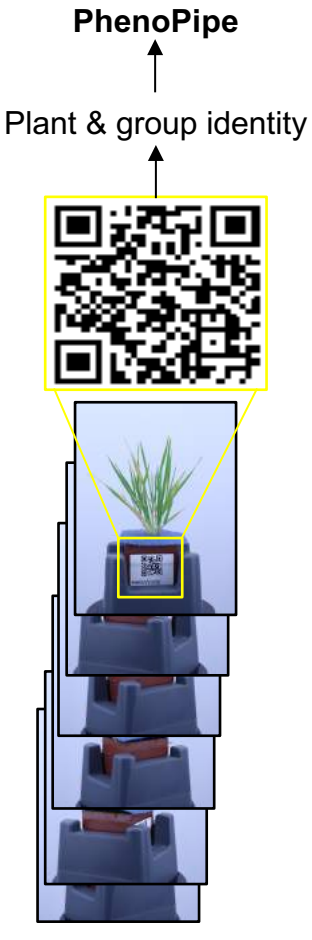


biology

technology

The PhenoBox





Main Steps in Phenotyping Analysis

Process

- Define experimental groups
- Labeling
- Imaging
- Data storage and management
- Image feature extraction
- Data analysis and visualization

The PhenoPipe

Overview

Information

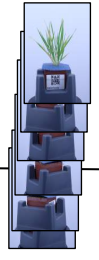
Web Interface

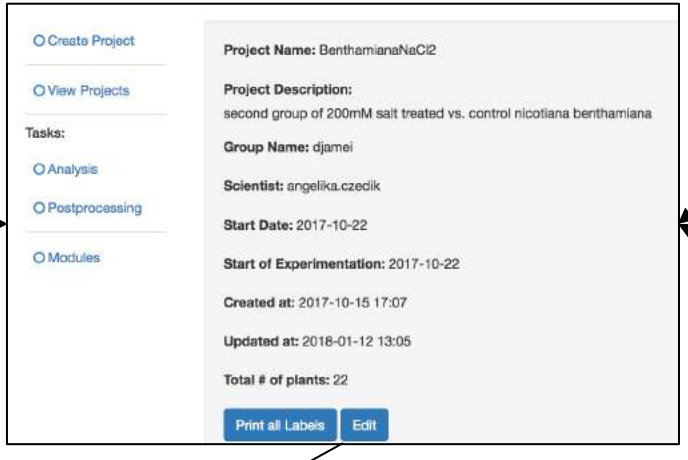
PhenoBox

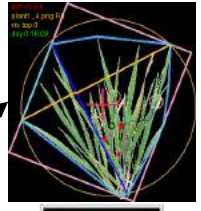
Feature Extraction

Klukas et al., 2014

Postprocessing Stacks







The PhenoPipe

Process

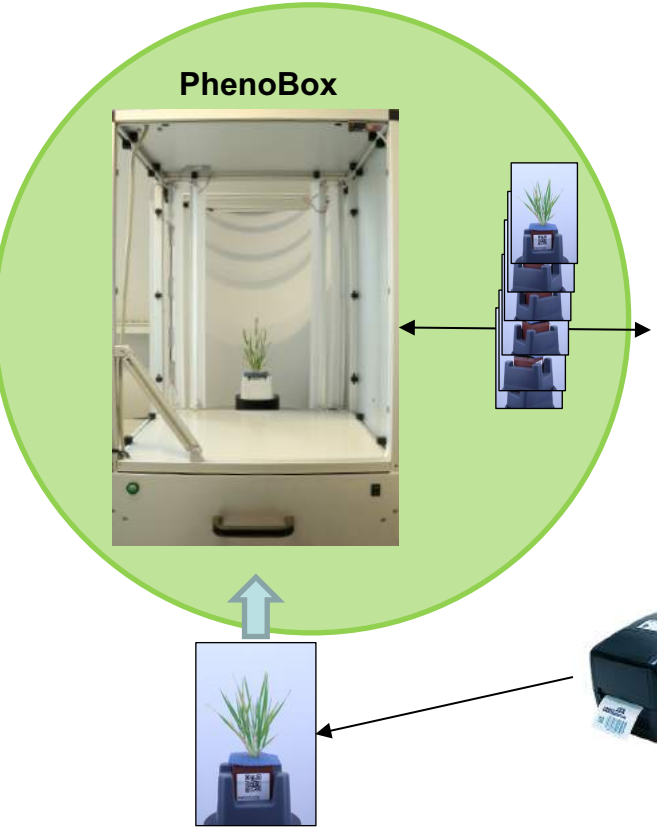
Information

Web Interface

PhenoBox

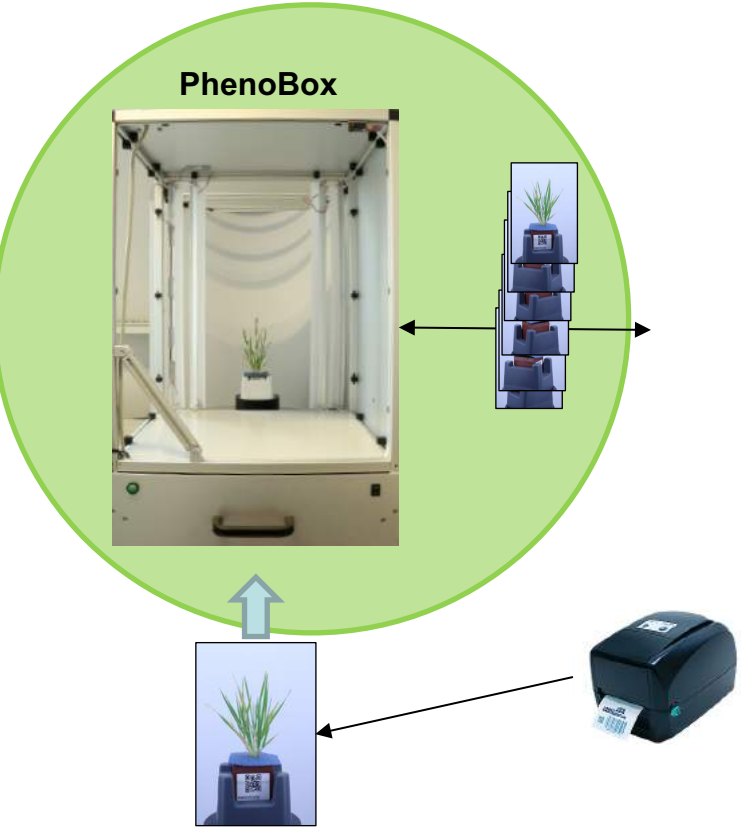
The PhenoPipe

Labeling/Imaging



The PhenoPipe

Labeling/Imaging



- Print Labels directly from Web Interface
- Plant identification based on QR-Code
- Automated naming and grouping of images
- Automatic creation of Timestamps

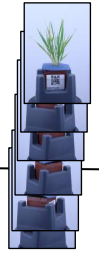
The PhenoPipe

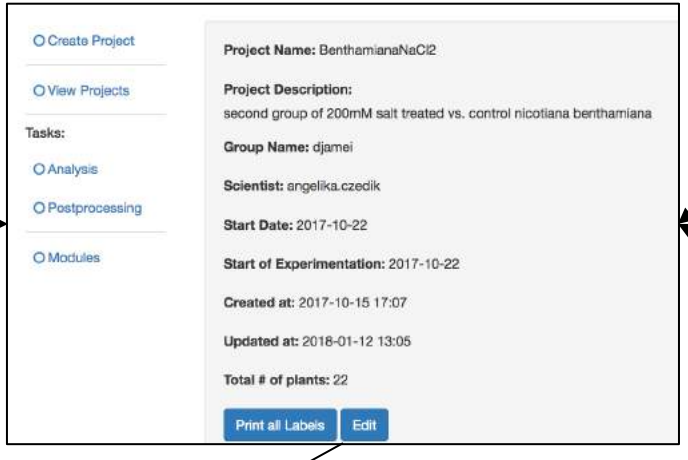
Process

Information

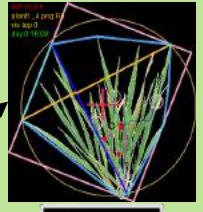
Web Interface

PhenoBox





Feature Extraction



IAP

Klukas et al., 2014

Postprocessing Stacks

The PhenoPipe

IAP

Feature Extraction

Klukas et al., 2014

- Open Source high-throughput Image Analysis
- Customized to be used in PhenoPipe
- Works by defining ‘Pipelines’ to analyze images
- Users can upload their own pipelines

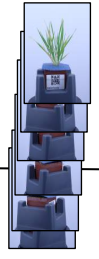
The PhenoPipe

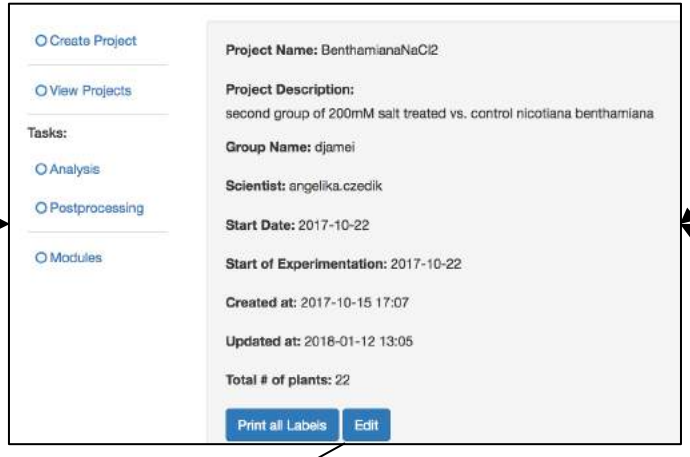
Process

Information

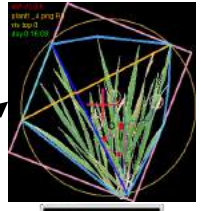
Web Interface

PhenoBox





Feature Extraction



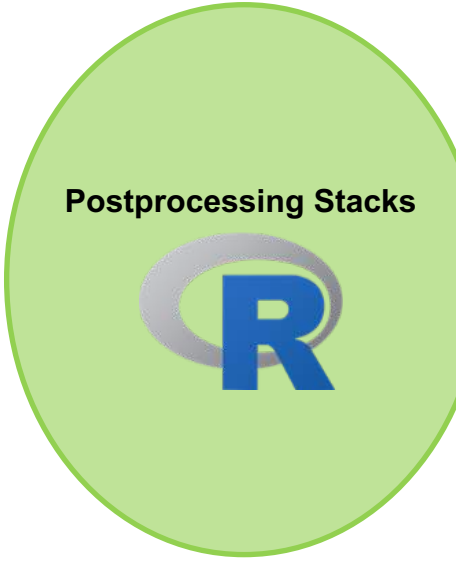
Klukas et al., 2014

Postprocessing Stacks

Postprocessing

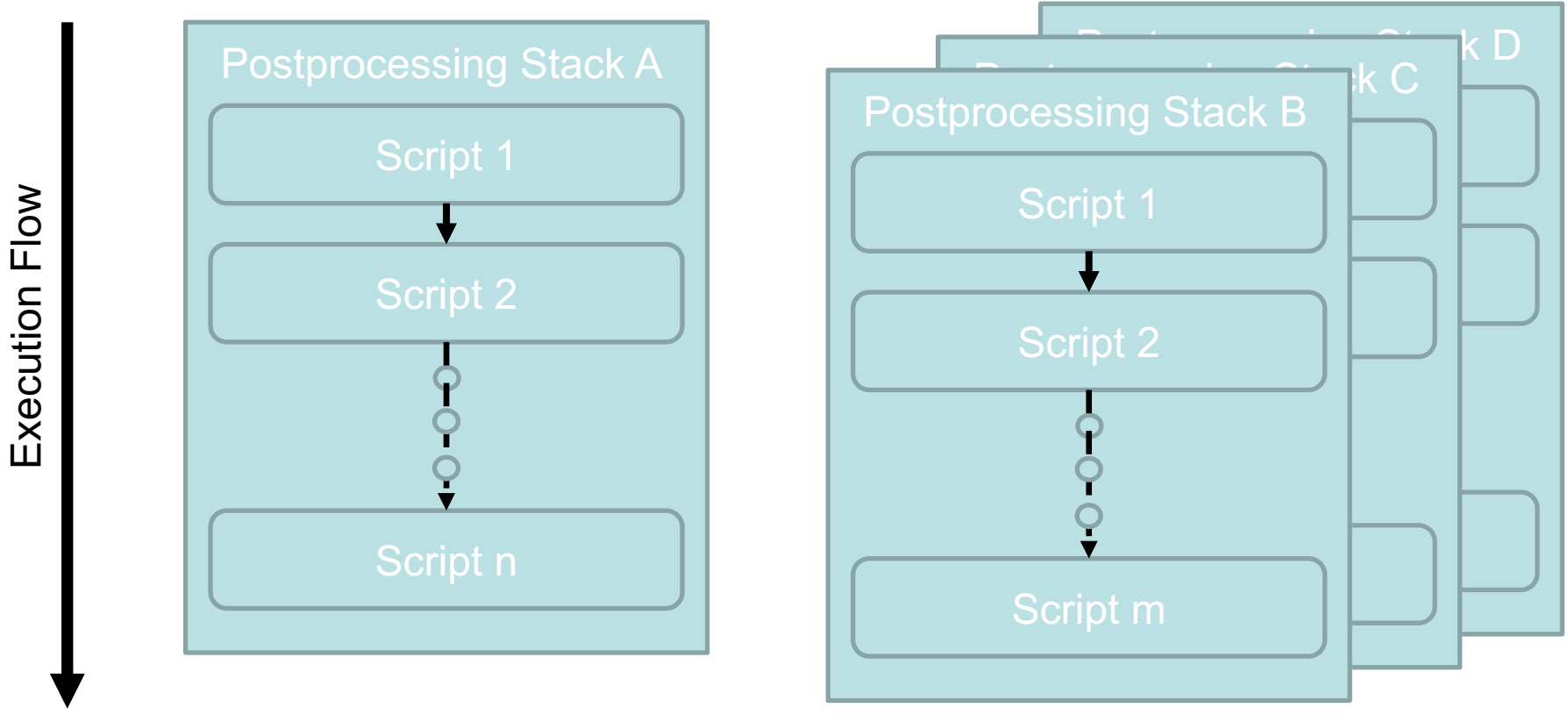
- Modular approach
- Multiple scripts form so called ‘Postprocessing Stacks’
- Each script can pass information on to the next
- Multiple Stacks can be applied/executed simultaneously
- Tied into the web interface
  - Status Messages
  - Progress indication

}Customizable



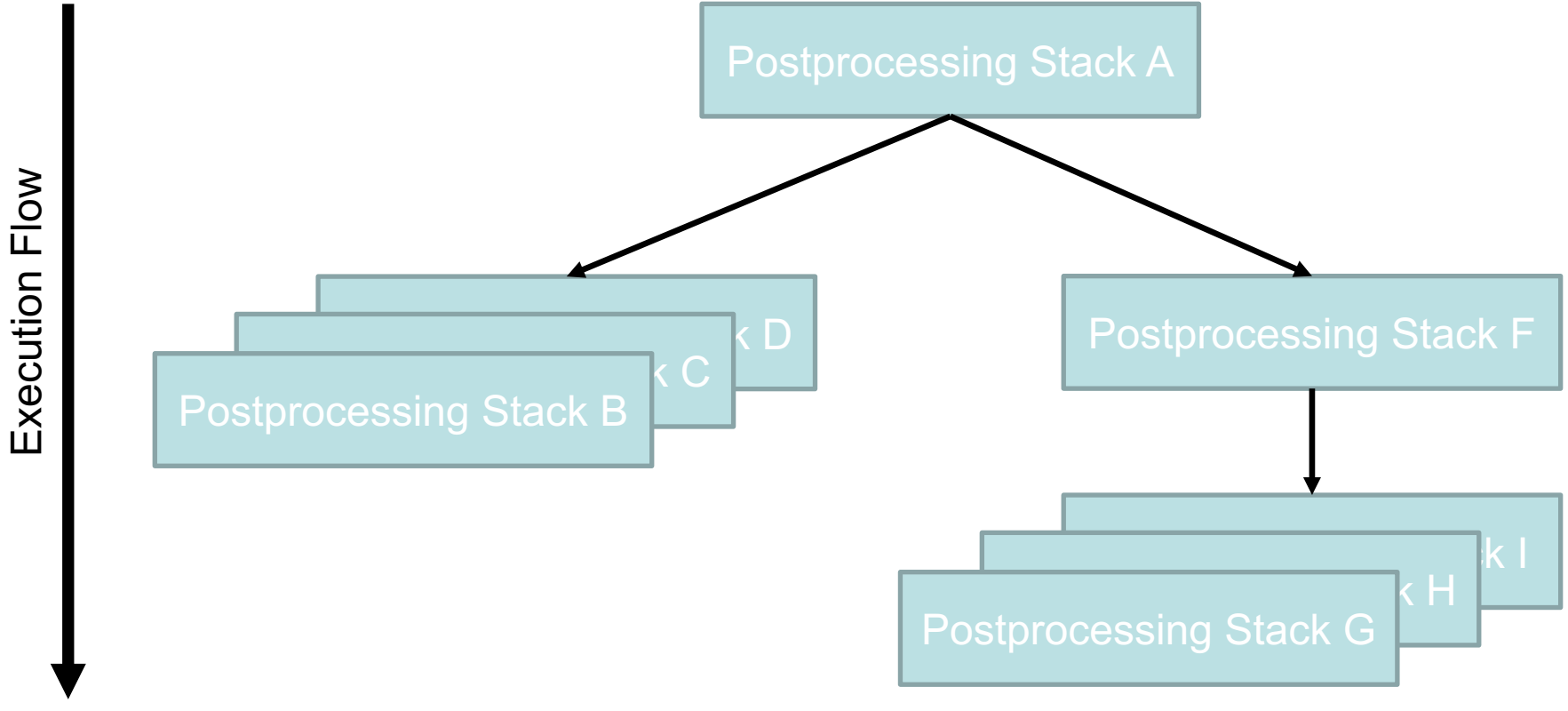
Postprocessing

Stacks



Postprocessing Future

Plans



The PhenoPipe

Overview

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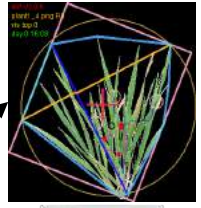
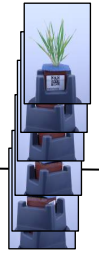
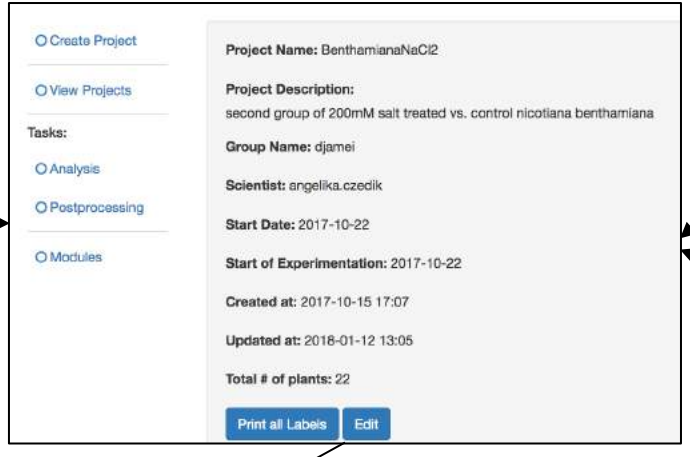


IAP

Klukas et al., 2014

PhenoBox

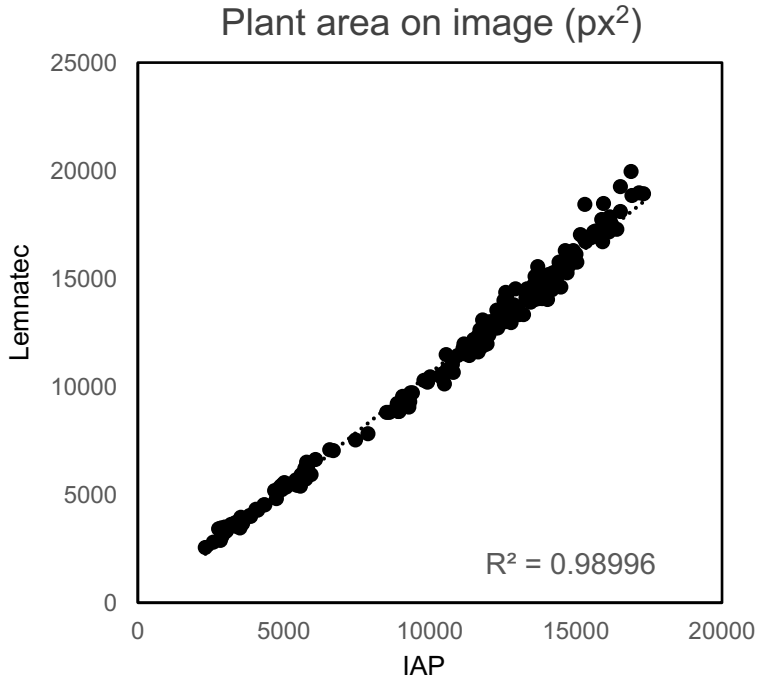




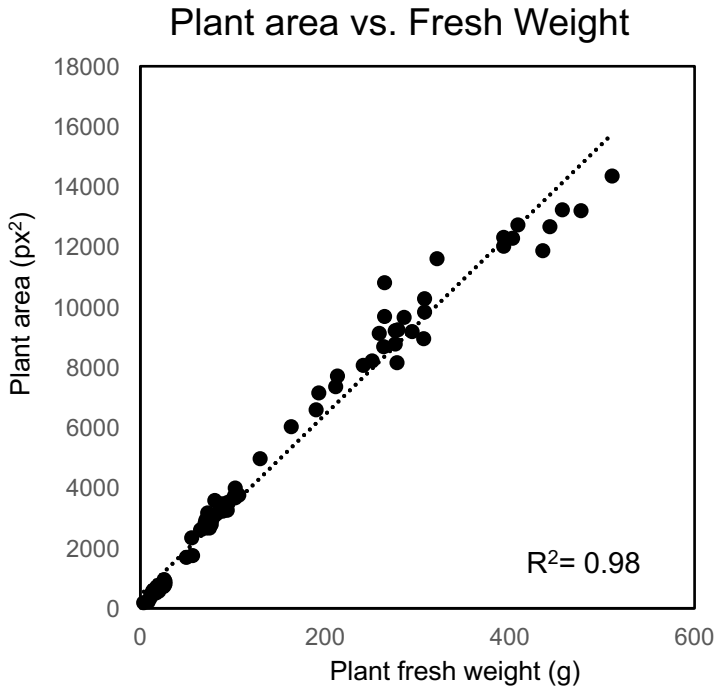
Postprocessing Stacks

How reliable is the PhenoBox-PhenoPipe system?

Benchmarking



Lemnatec results reproducible by IAP
IAP covers additional traits

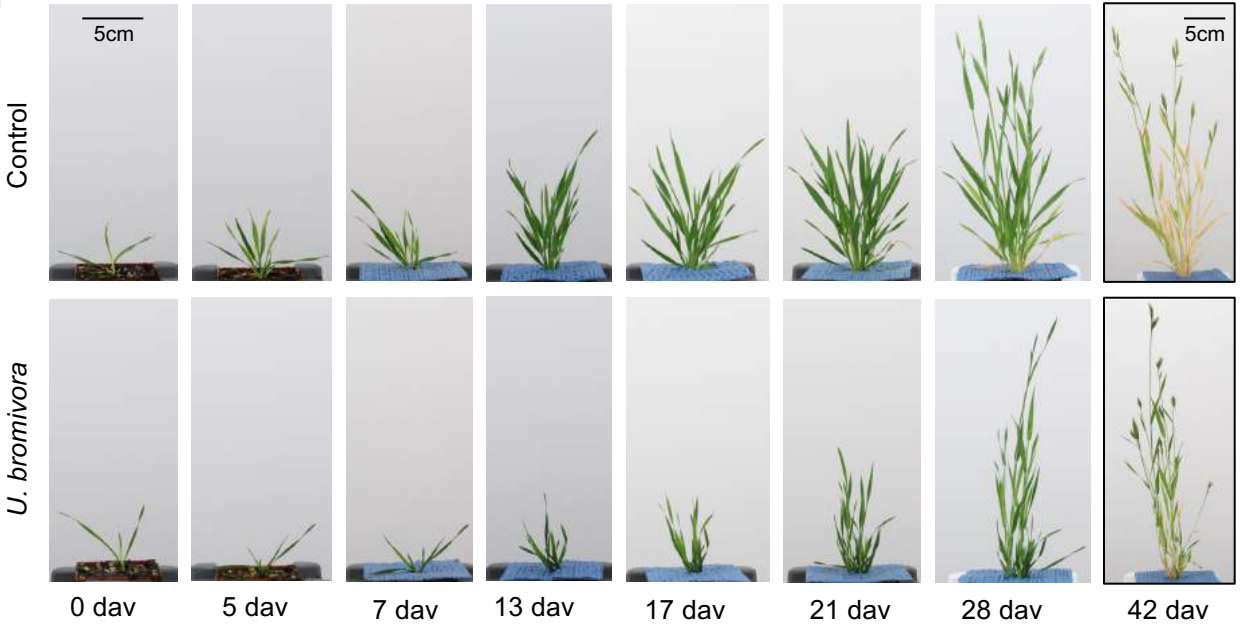


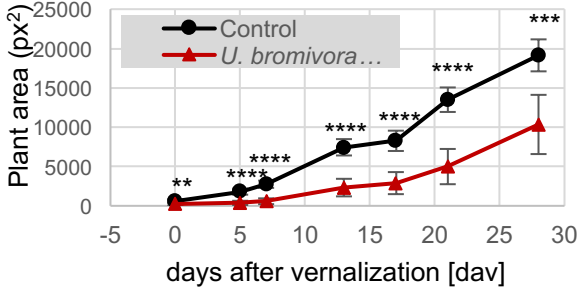
Plant area is an effective proxy for fresh weight over a wide range of plant sizes.

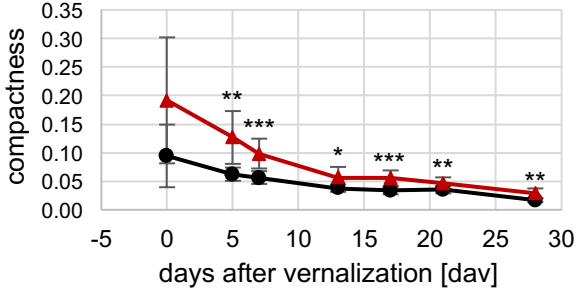
Experiments conducted in *Brachypodium distachyon* ABR4 plants

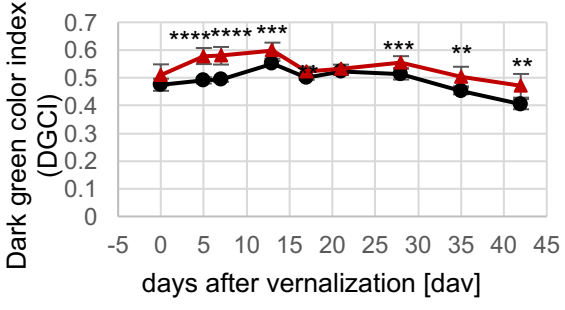
Phenotypic effects of *U. bromivora* infection

Phenotyping





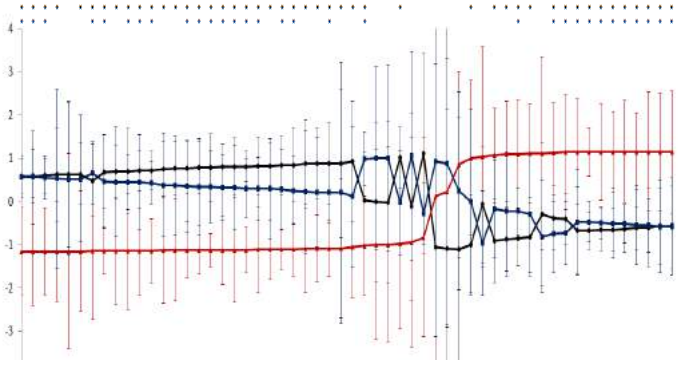




Phenotyping to predict *U. bromivora* infection outcome

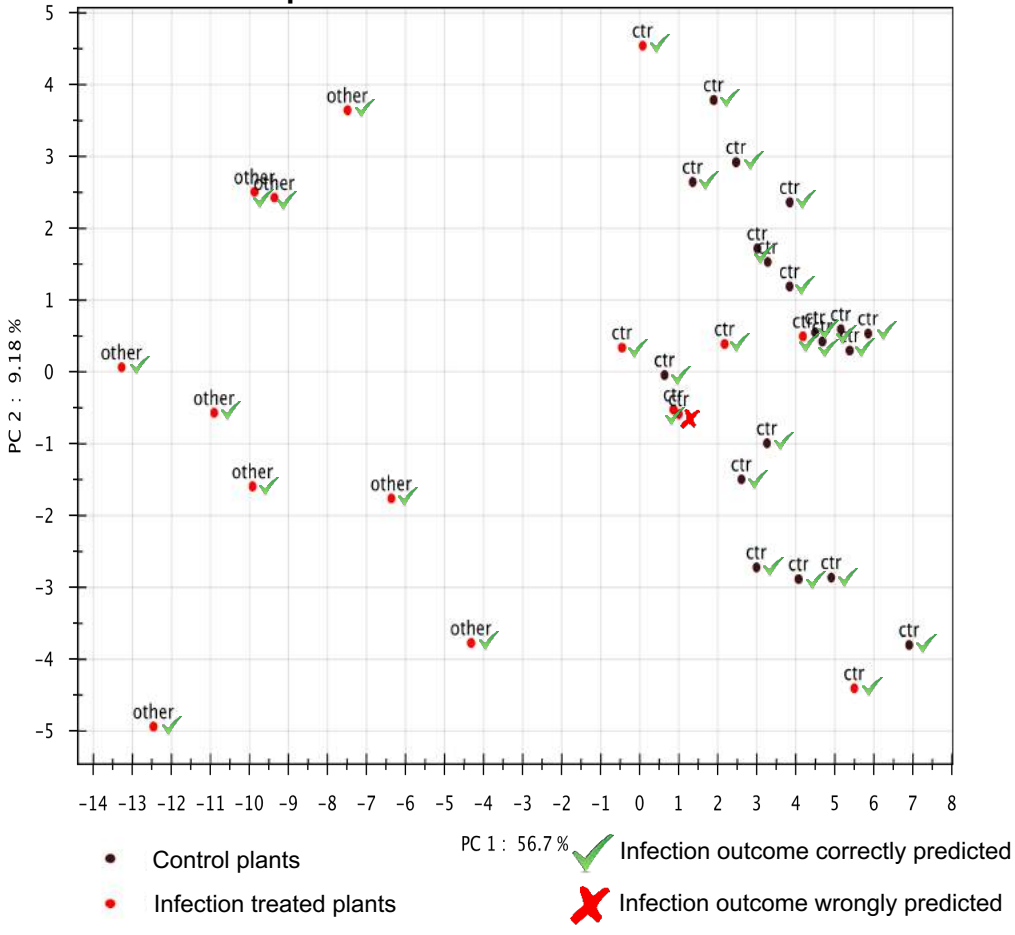
Analysis

Control | Infected | Failed Infection



Average values of image traits **control**, **infected**, **failed**
(z-score transformed)

5 dav - prediction of infection outcome



Summary

- Define experimental groups ✓
- Labeling ✓
- Imaging ✓
- Data storage and management ✓
- Image feature extraction ✓
- Data analysis and visualization ✓

Affordable ✓

Customizable by User

All **Open Source**

https://github.com/Gregor-Mendel-Institute/PhenoBox-System

Outlook

- Easier Installation
- Faster QR-Code decoding
- Image Previews and Data Visualization in the Web Interface
- More powerful postprocessing options
  - Stack dependencies
  - Parameterization
- Postprocessing Stack and IAP Pipeline sharing options
  - Make them available to certain people or groups
- Option to set PhenoBox/Camera parameters up front
  - Read via QR-Code

Acknowledgements

Thank you!

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Djamei Lab

IMP Workshop
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Ümit Seren &
Erich Birngruber,
MENDEL

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