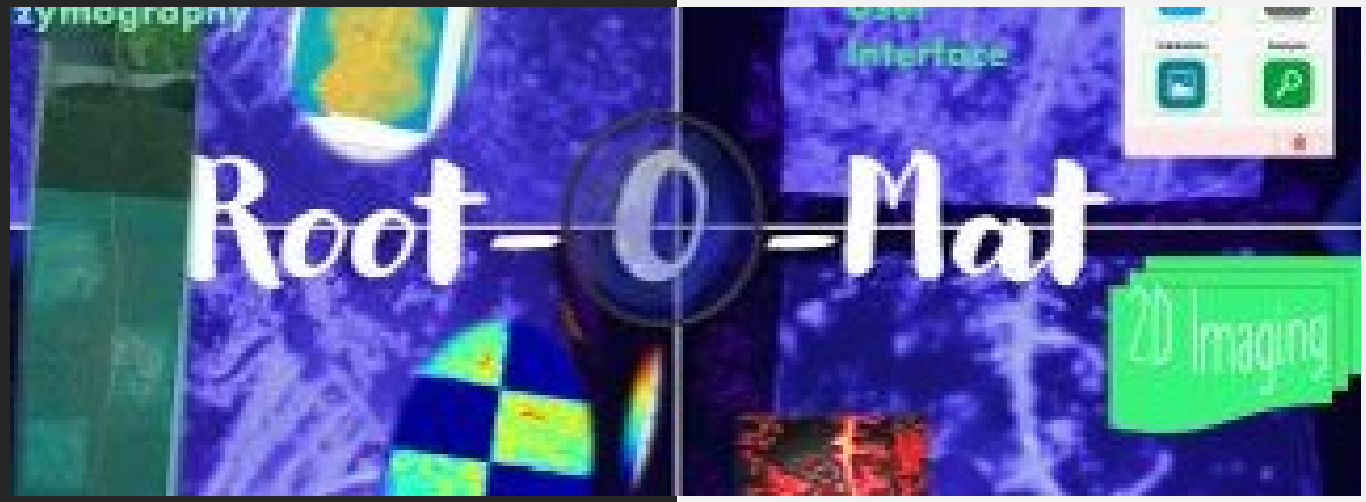
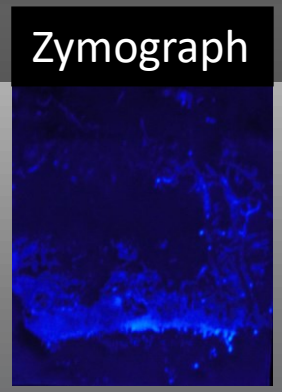


Examples for soil zymography

Dr. Sebastian Loeppmann

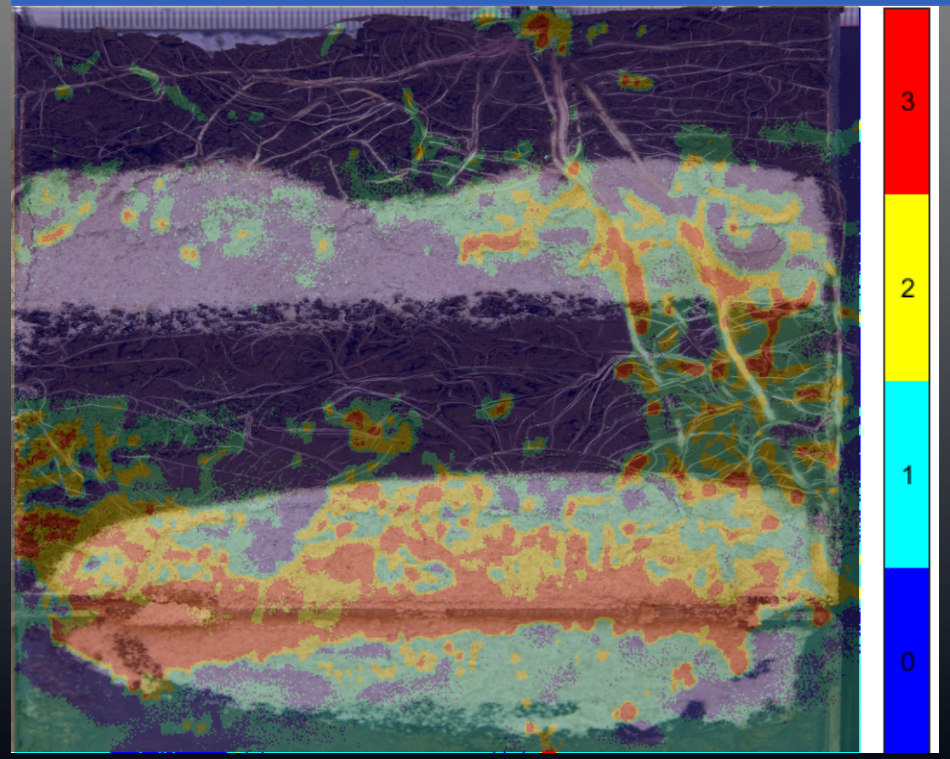
CAU Kiel

Image processing in soil zymography



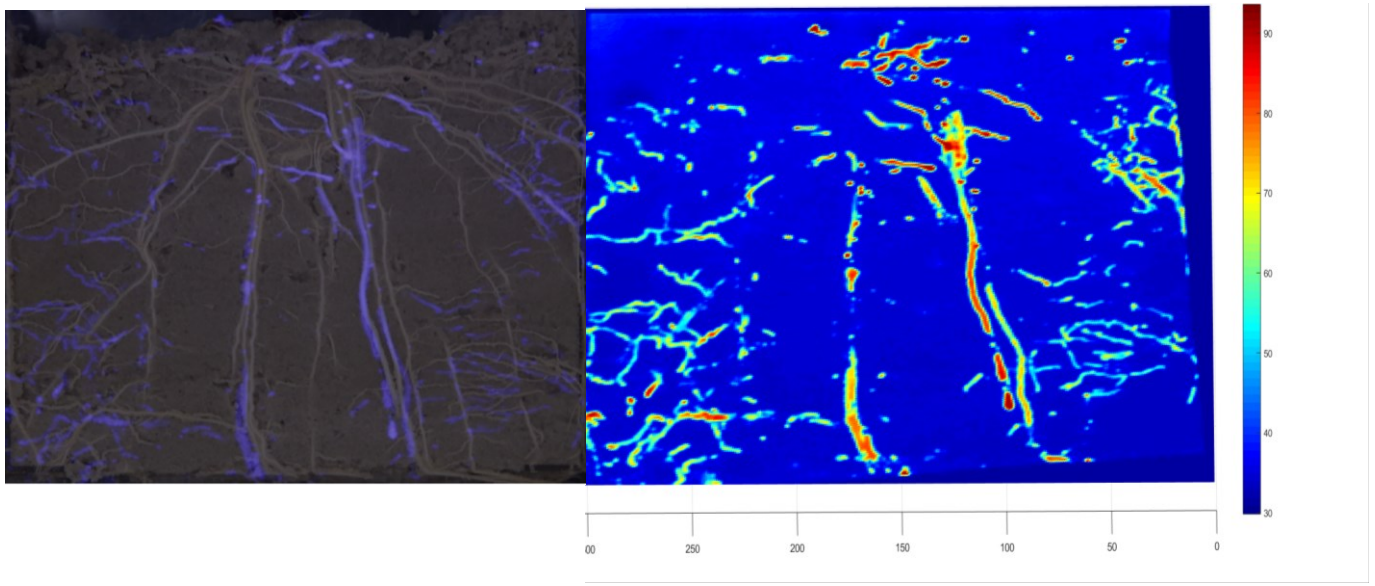
Aligned day-light and clustered image of the spatial distribution of enzyme activity in the rhizosphere of maize in a mix of layer derived from soil and sand.

Standardized image clustering for hot spot detection



ROOT-O-MAT

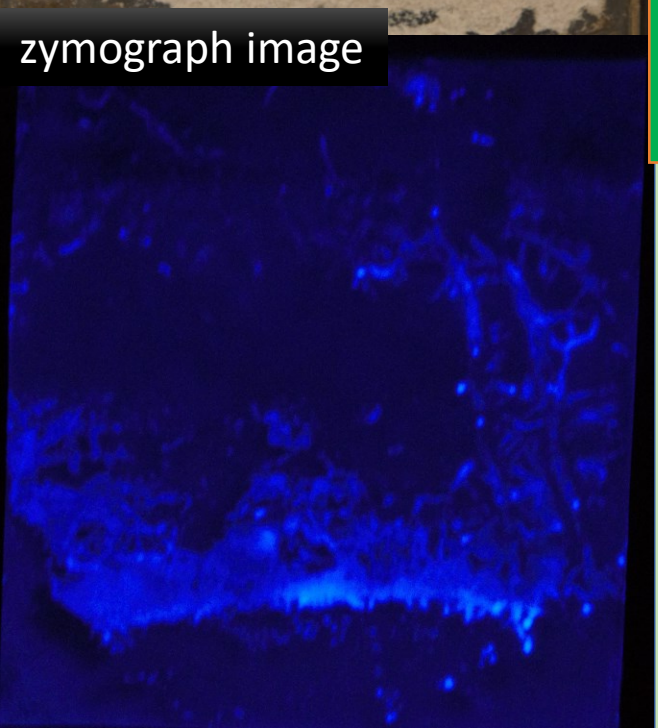
Zymograph of leucine amino-peptidase activity measured in a rhizobox filled with sand and planted with maize



aligned zymograph

calculated enzyme activity after proper calibration

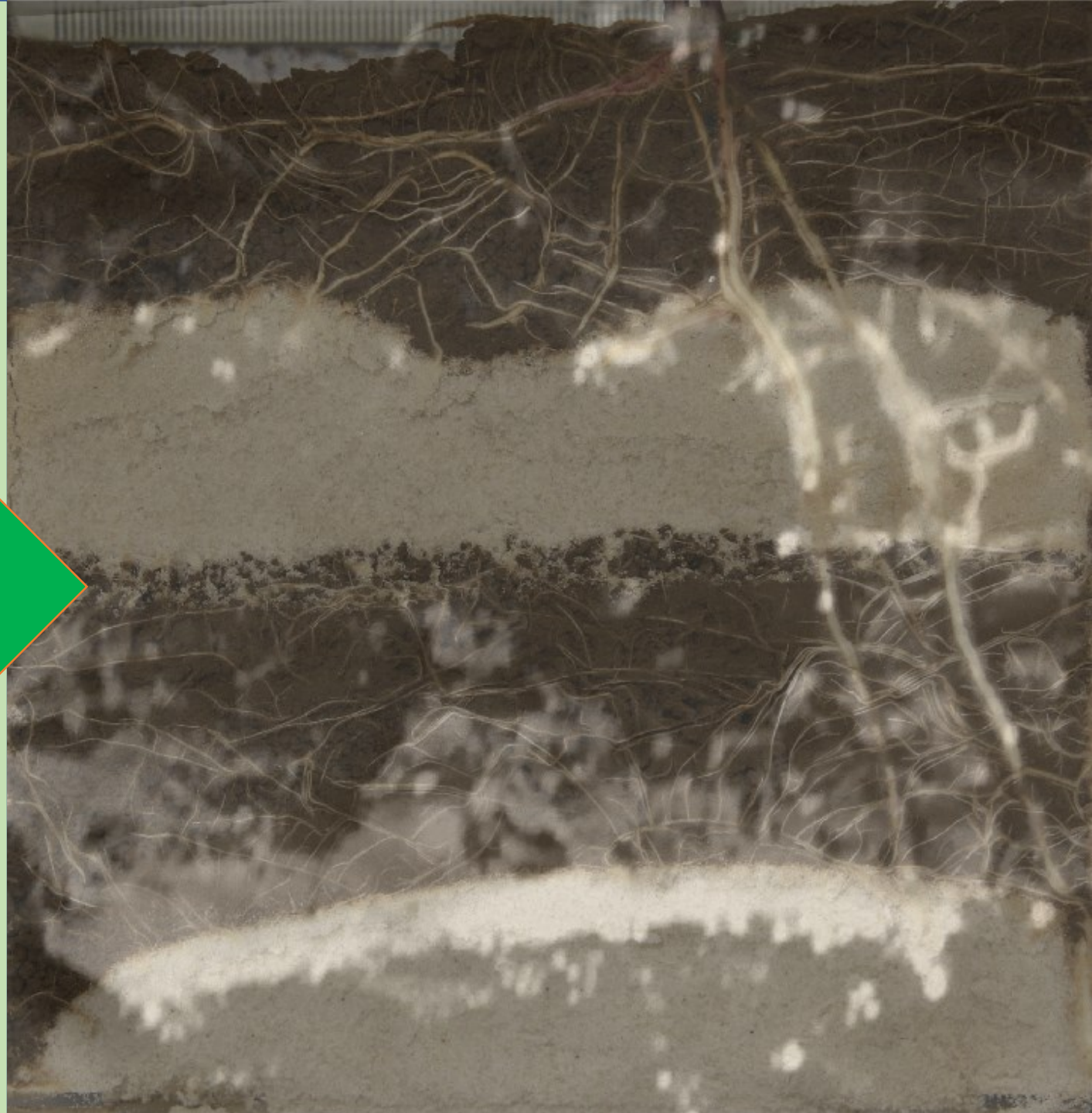
All image processing steps in one application!
Fast and standardized workflow!
Basic data statistics and data export for further analysis



SOIL

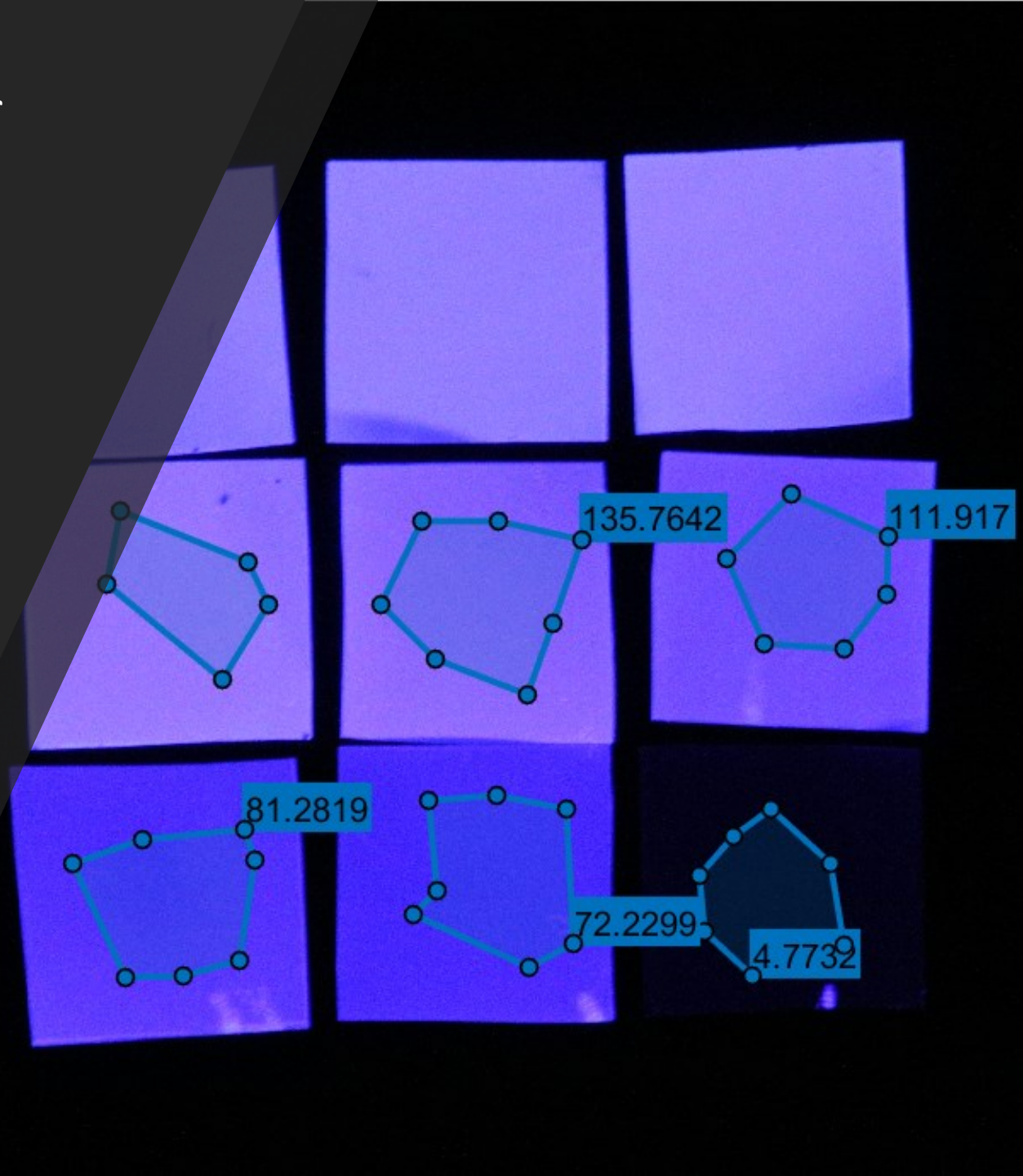
SAND

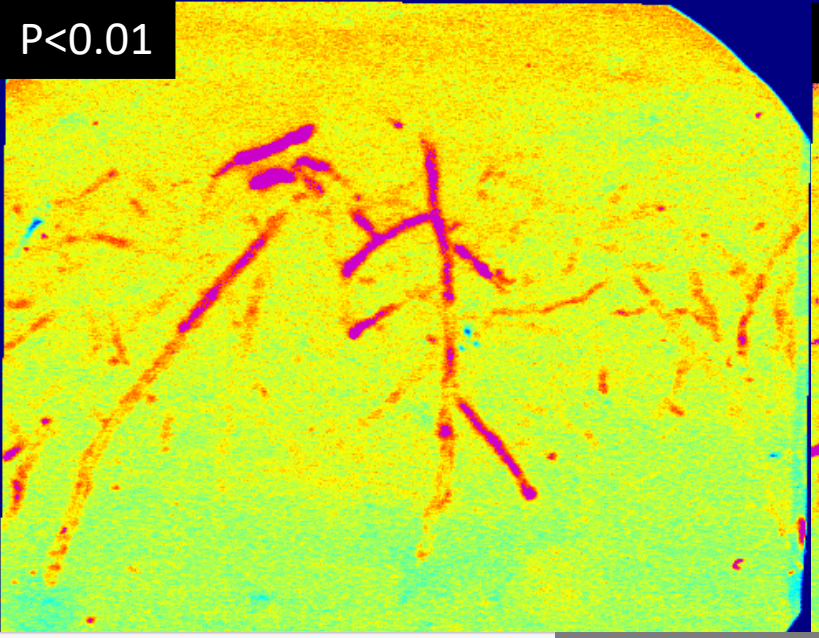
Image registration and Conversion to grey scale values

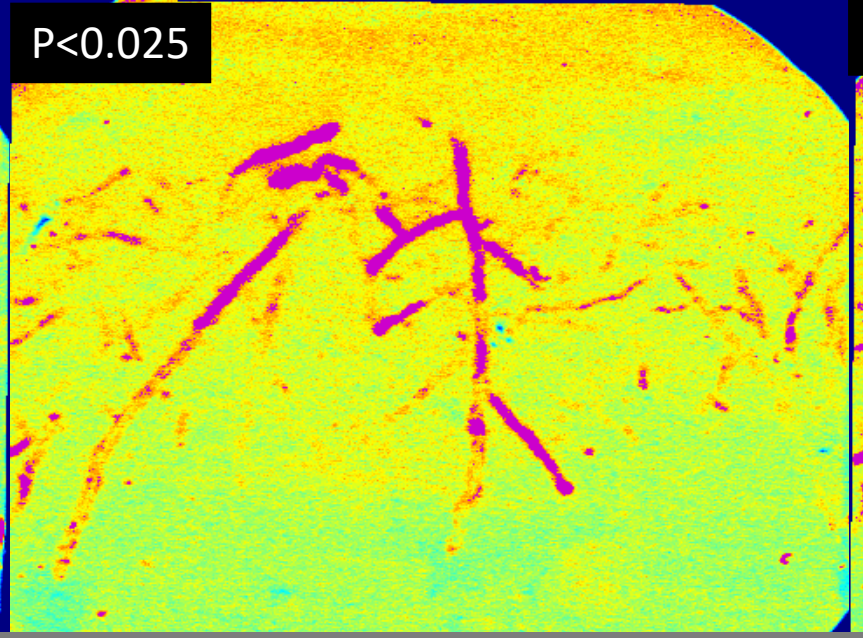


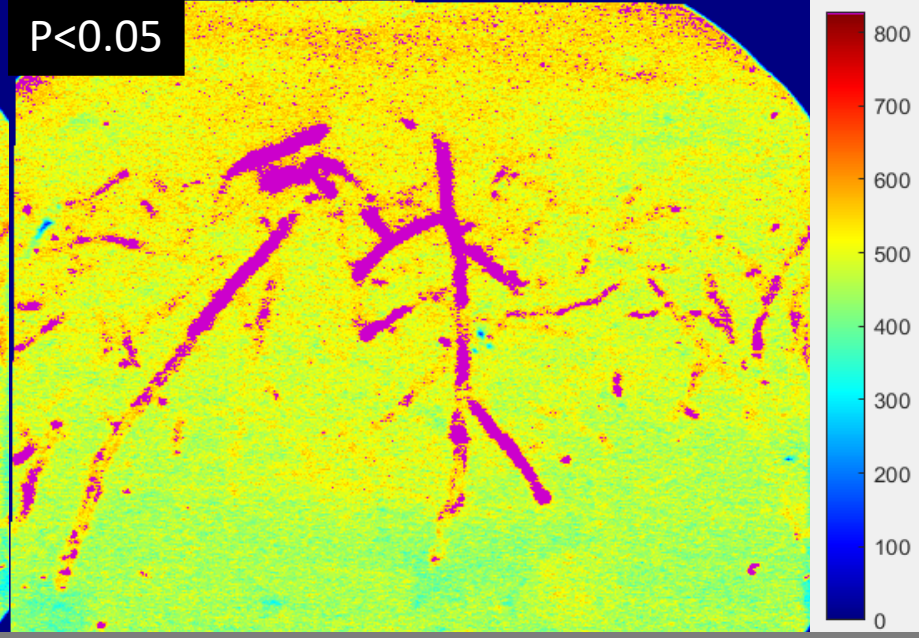
Root-o-Mat calibration of 2D Imaging techniques

- Simple AOI selection for calibration detection
- Manual entering of data into table
- Multiple calibrations are possible
- linear and non-linear calibration
- Background correction of images
- Basic fit statistics
- Export calibration curves









Manual Clustering

Mode

Hot Spots

Cold Spots

704.(

0.01 | 0.025

0.1 | 0.05

0.25 | 0.5

min 0

max 828

zsand

ROOT-O-MAT – Hot and cold spot detection

#Image saturation biases your results

Automatic Clustering (Otsu Method)

Select Image

zsand

No. of Classes

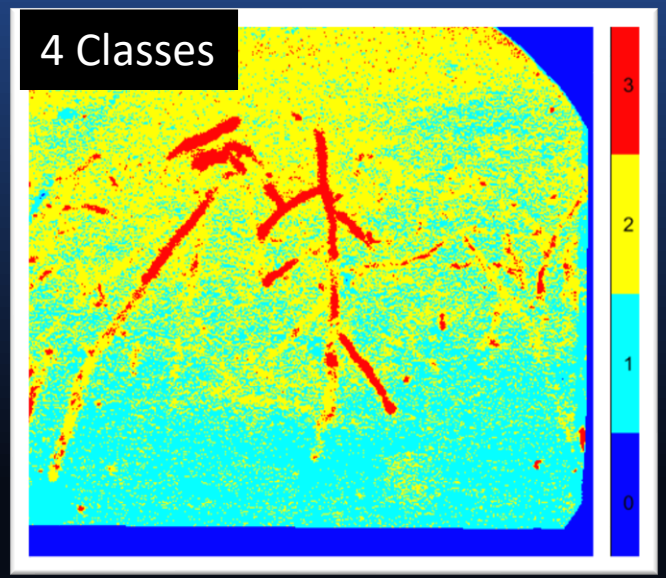
8

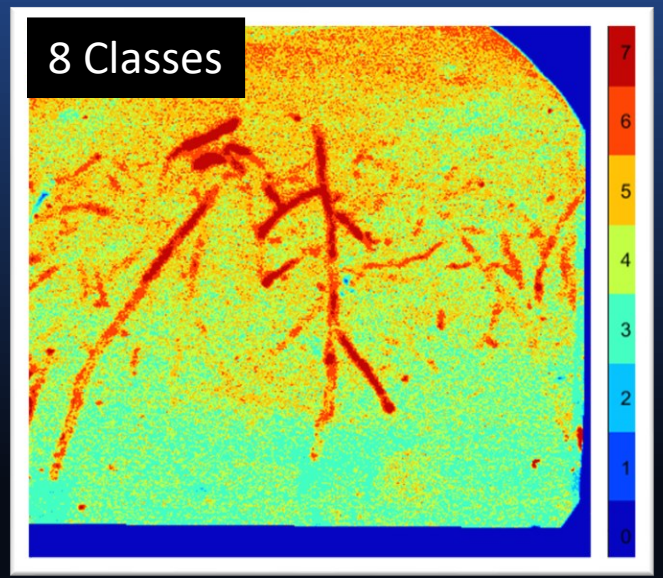
Select Image for Comparison

z sand

Compare

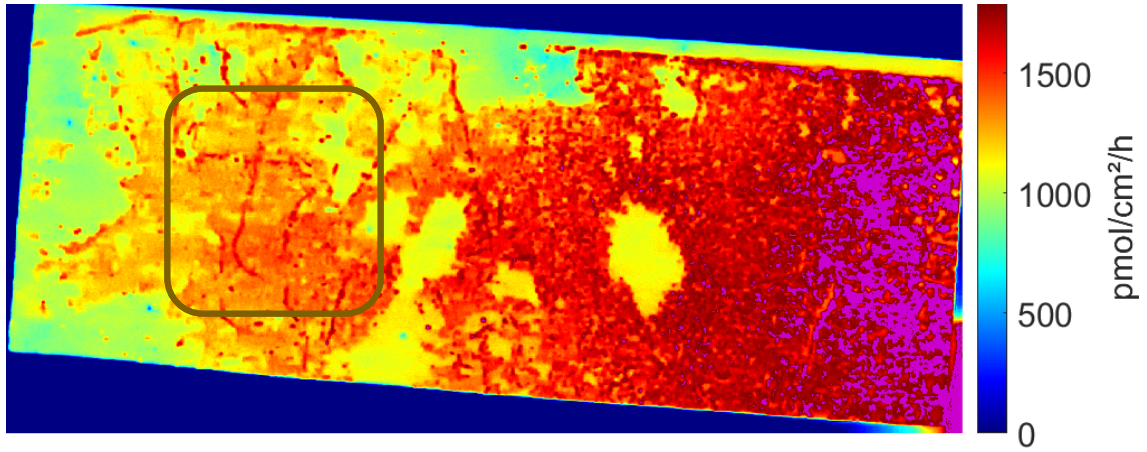
Statistics

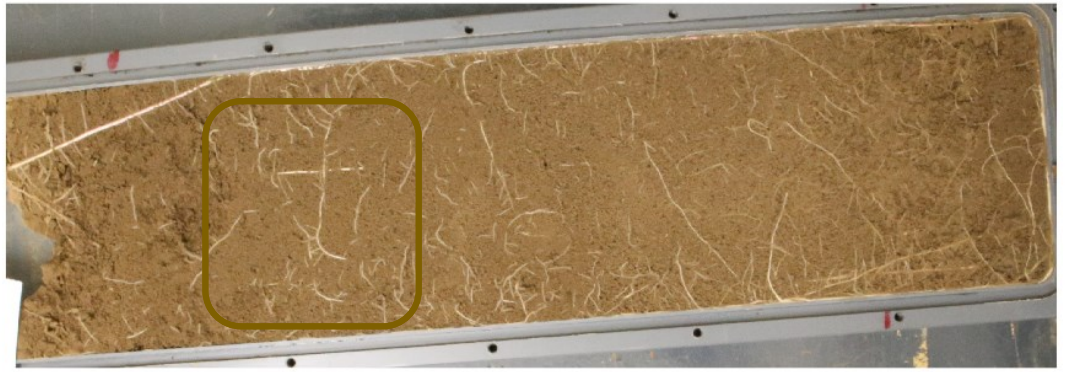




Acid phosphatase

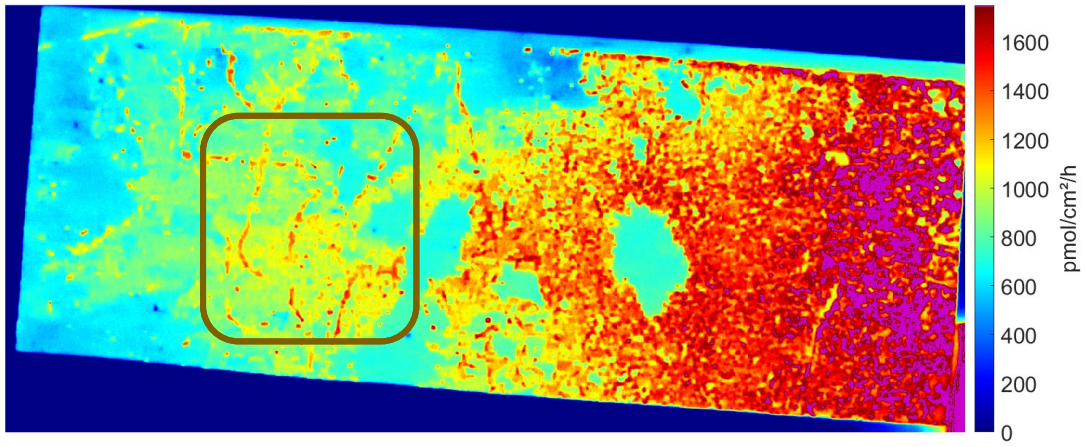
The violet color depicts saturated pixels (max DN) in the resulting image of the calibrated zymographs.

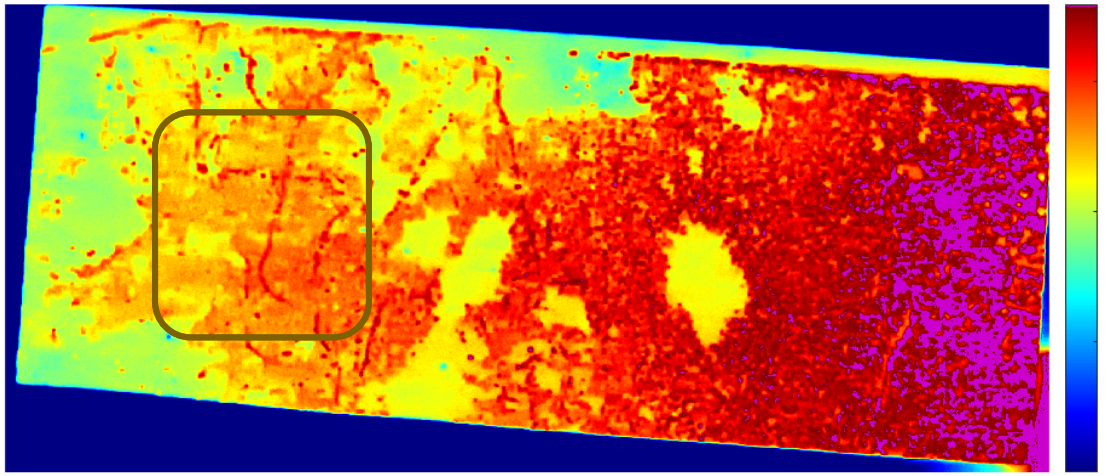




Acid phosphatase

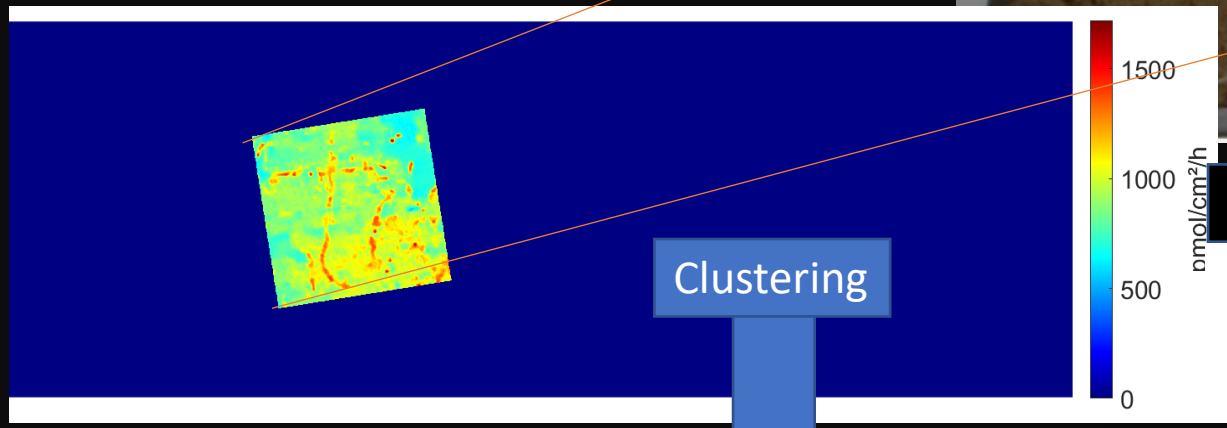
Comparison between linear and polynom fit (identically scaled). In the subsoil of the rhizotrone a higher moisture content compared to the topsoil may have induced higher enzyme activity.





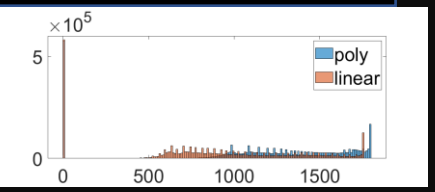
ROOT-O-MAT – Image registration

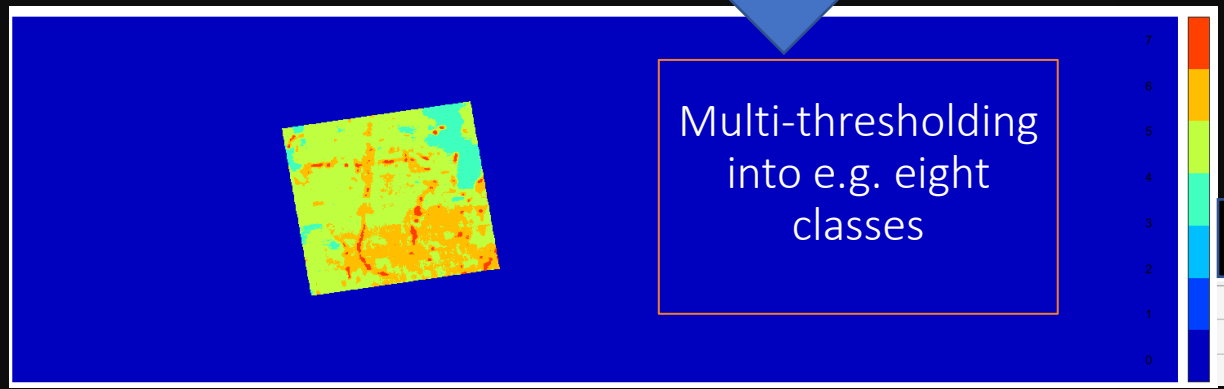
AOI was converted to grey scale image and referenced to the day-light image via control point selection GUI



Clustering

Histogram statistic





Multi-thresholding into e.g. eight classes

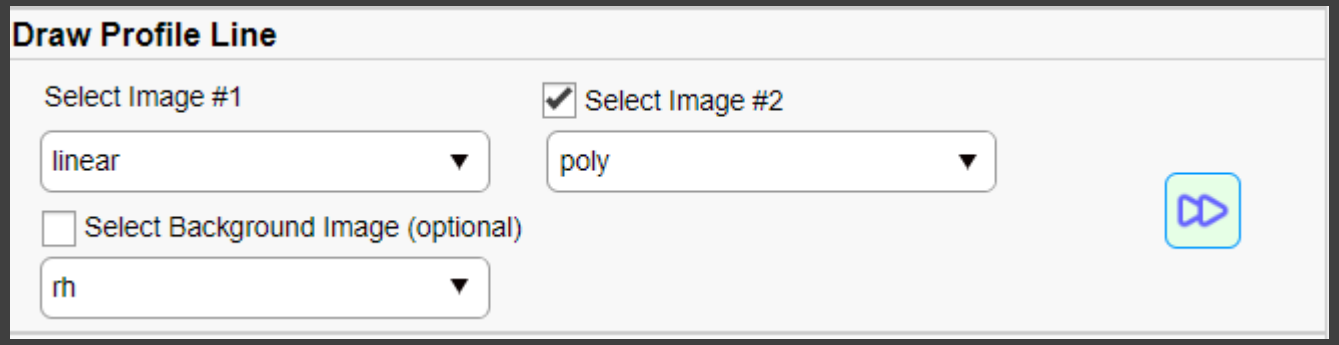
AOI statistic: linear vs. polynom fit

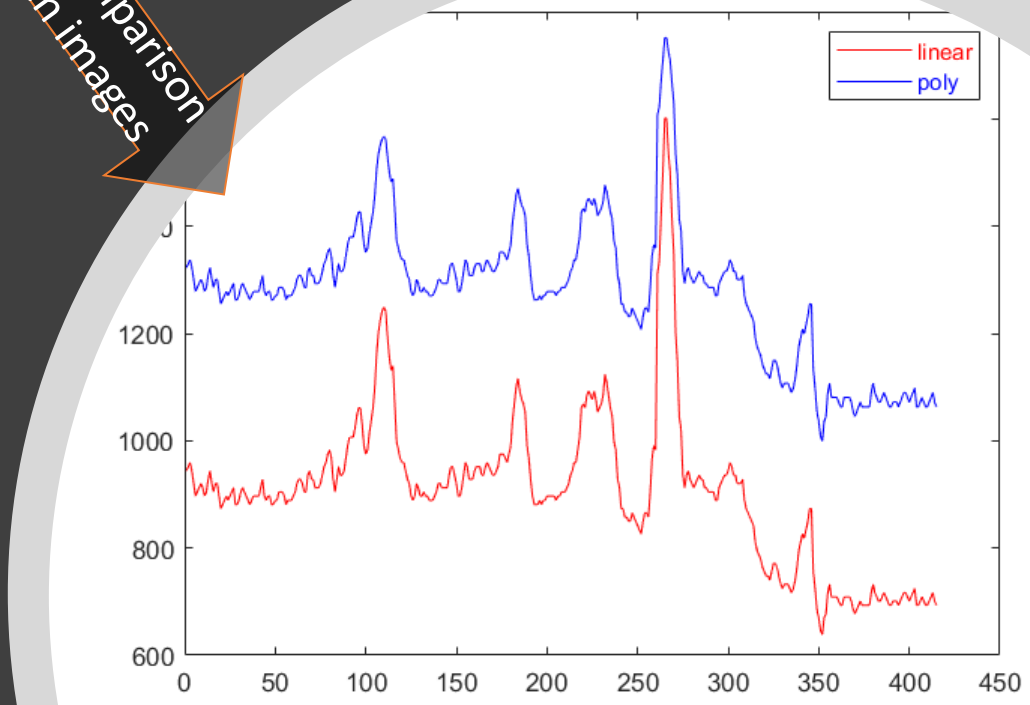
	mean Image #1	std Image #1	saturated #1	mean Image #2	std Image #2	saturated #2
1	1053.94	336.58	7494.51	1372.21	267.12	7697.21

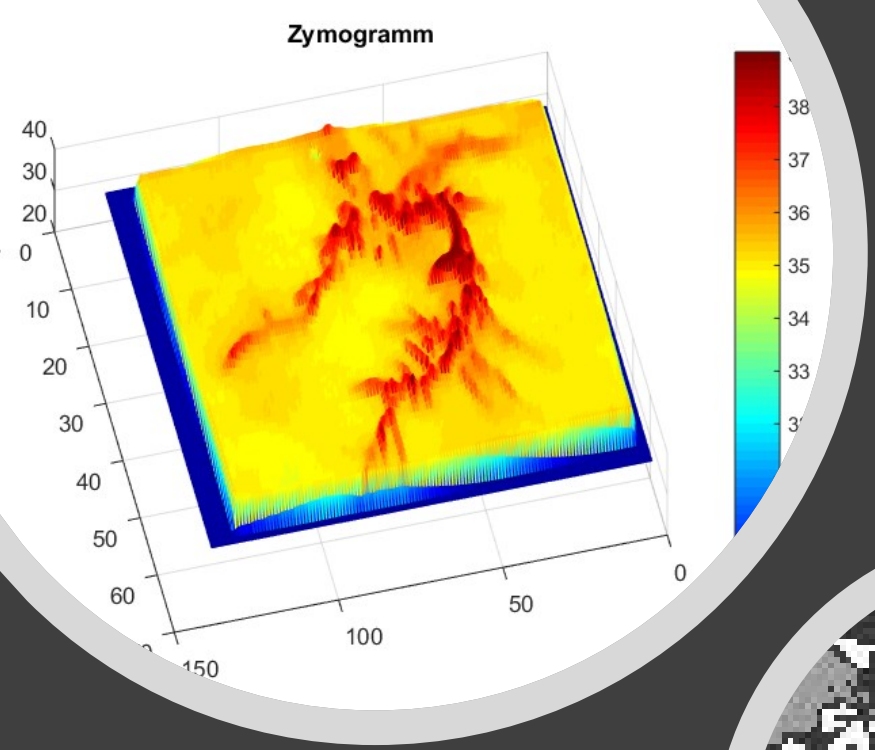
Manual drawing of profile line

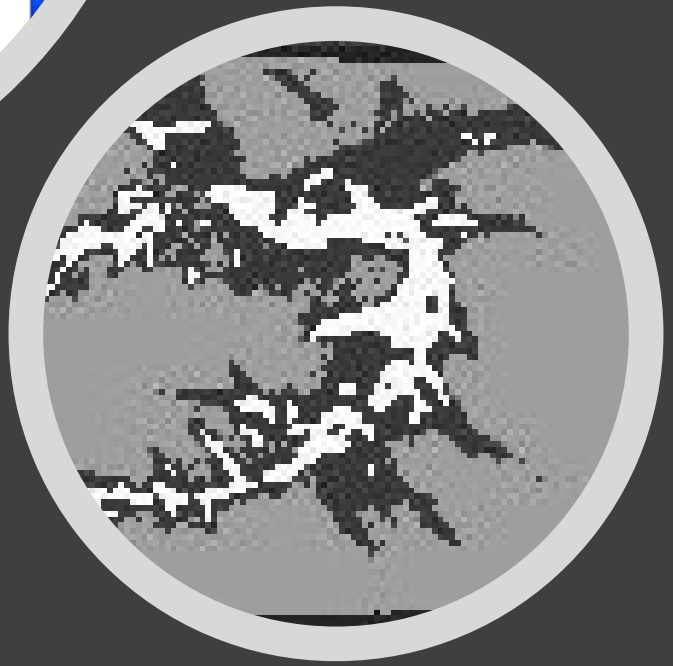
Enzyme activity along a profile line determined for a single rhizotrone calibrated by linear (red) and polynom (blue) fit

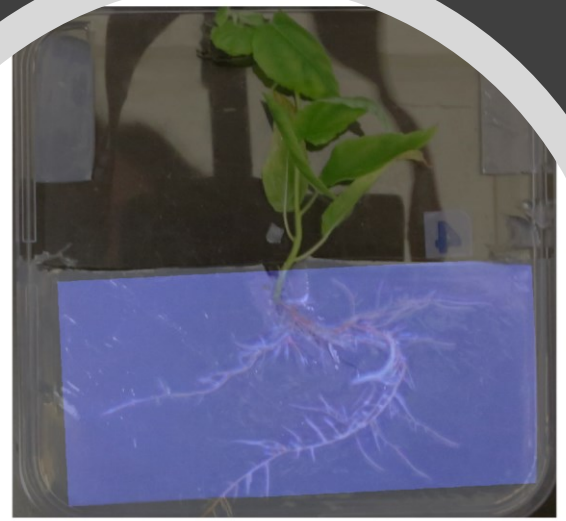
Direct comparison between images







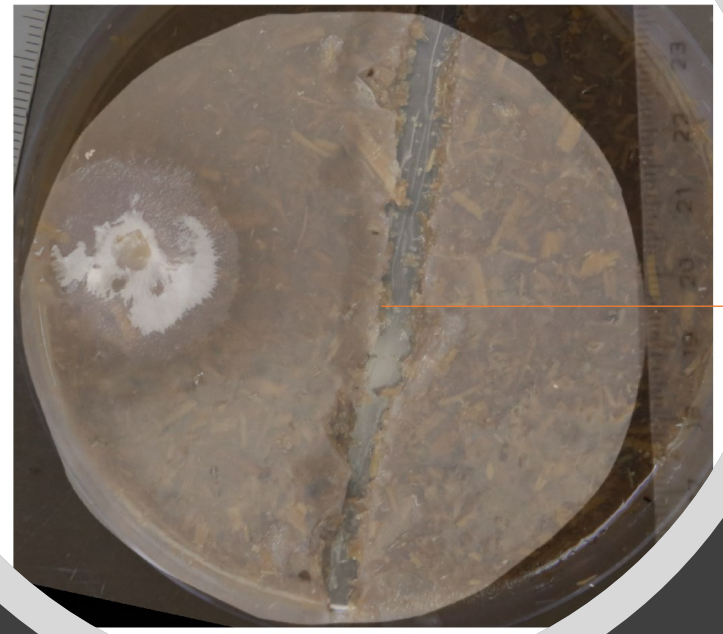




ROOT-O-MAT

We planted a little tree on agarose and analyzed the enzyme activity by zymography without any soil.

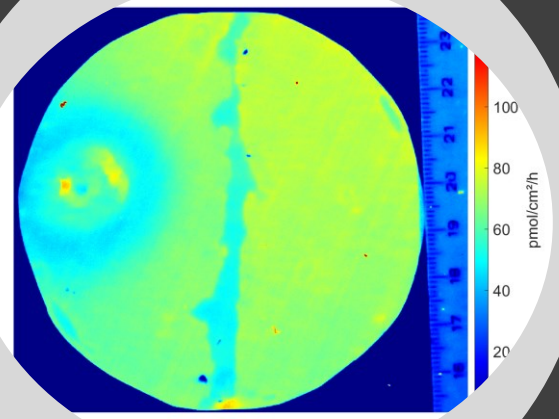
ROOT-O-MAT



Registered and grey scale converted zymograph

The barrier without agarsoe

Fungi grown on agarose, and we measured the enzyme activity by zymography without any soil.



Two areas of interest for comparison