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# Neighbour-Induced Alterations in Root Exudate Composition of Cover Crops: Buckwheat and Black Oat and their Impact on Redroot Pigweed

Çağla Görkem Eroğlu  
Agroscope Changins & University of Lausanne

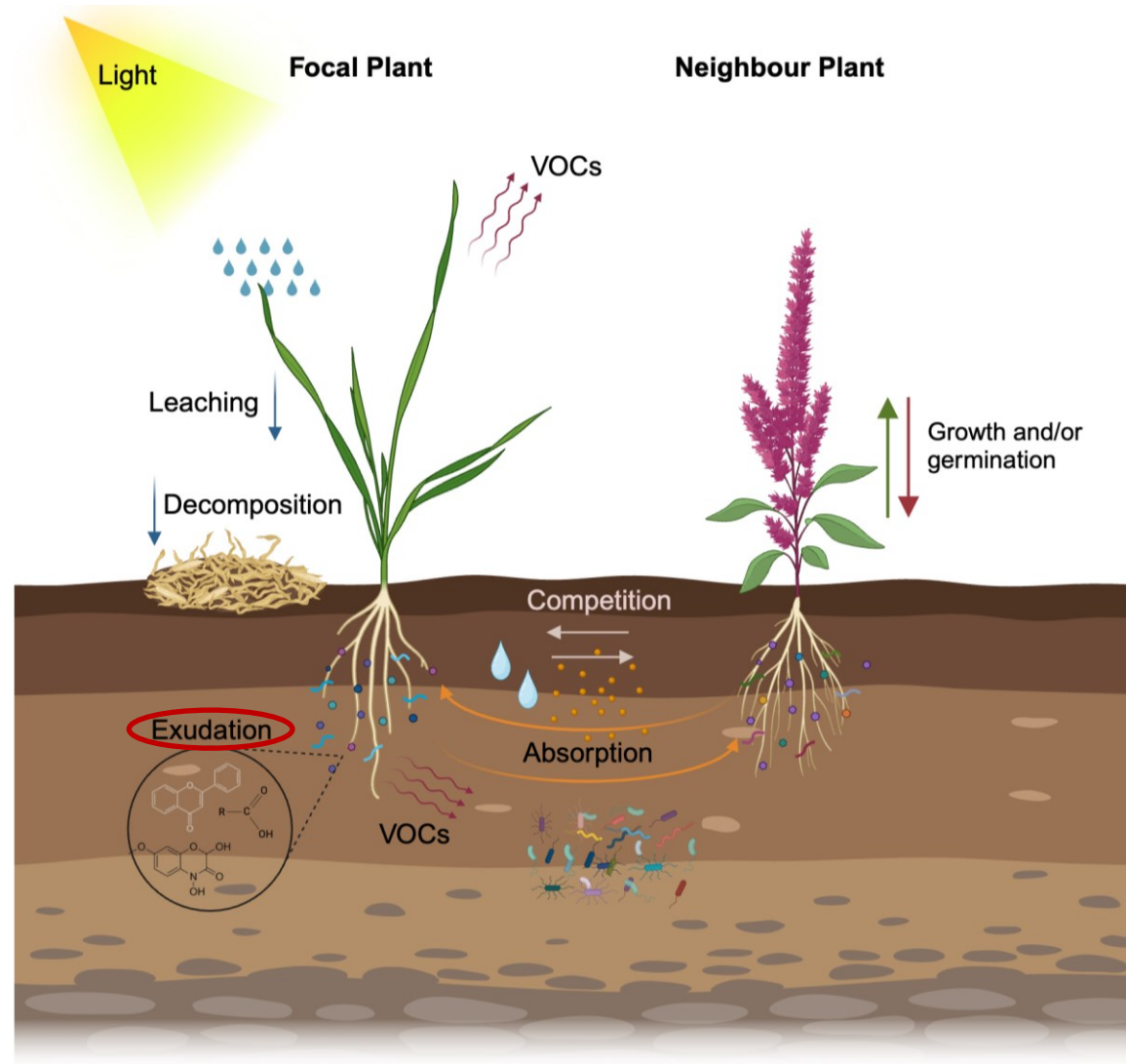
International Society of Root Research 12th International Symposium  
2–7 June 2024

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# Plant-Plant Interactions



## Biotic Factors

- Other organisms
- Plant factors  
(density, growth stage, fitness etc.)



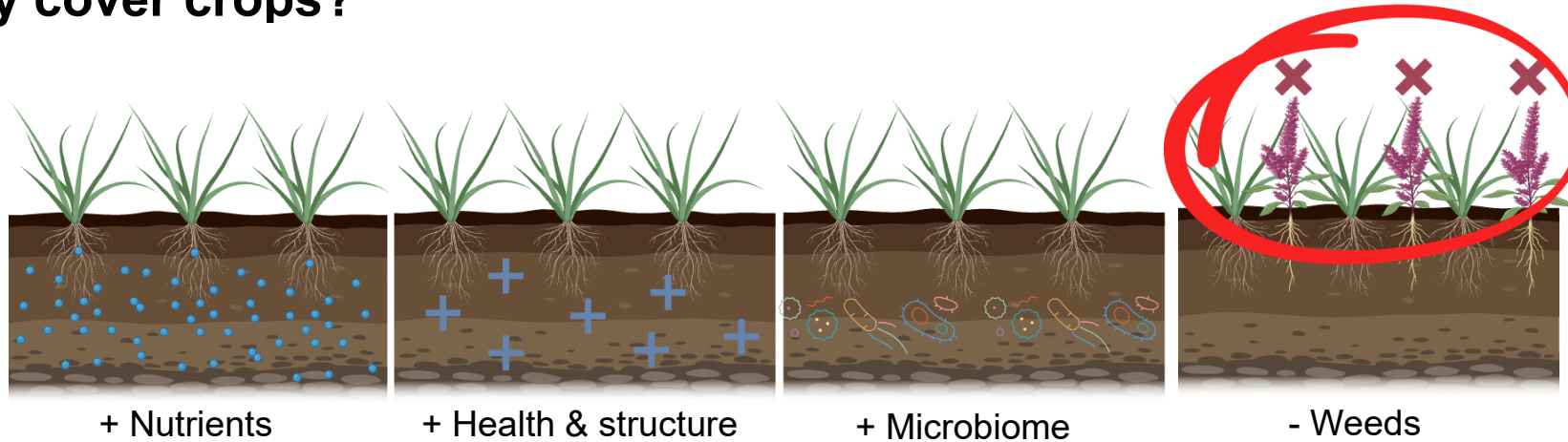
## Abiotic Factors

- Stress
- Light
- Humidity
- Temperature
- Soil type





## Why cover crops?



- Crop yield reduction by weeds
- Environmental and health concerns, herbicide resistance
- Competition, allelochemicals



**Buckwheat  
(BK)**



**Black oat  
(BO)**



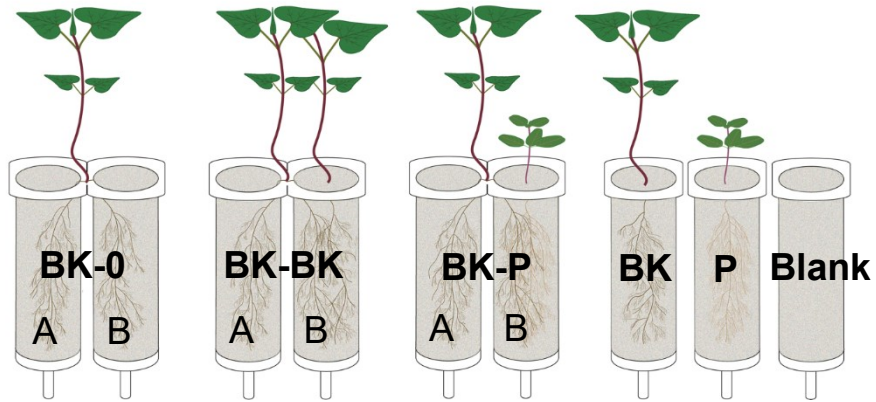
## Research Questions

- 1) Does the root exudate metabolome of buckwheat and black oat change in the presence of neighbours?
- 2) Are the responses different depending on the neighbour species?
- 3) Does the presence of neighbours impact the root system architecture?
- 4) Do buckwheat root exudates influence the root morphology of redroot pigweed?



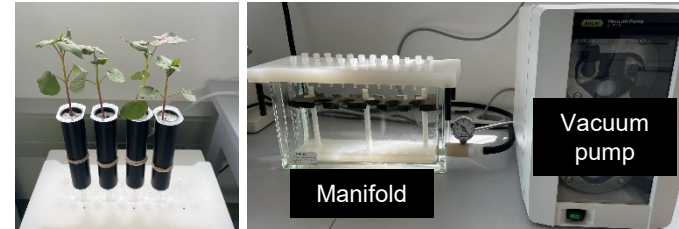
# Root Exudate Collection & Non-targeted LC-MS Analysis

## Buckwheat (BK)



P: Redroot pigweed

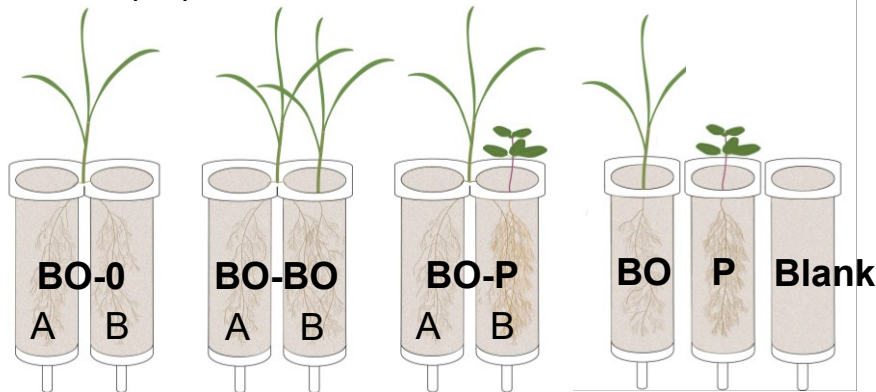
**Extraction**  
(MeOH-based extraction solution)



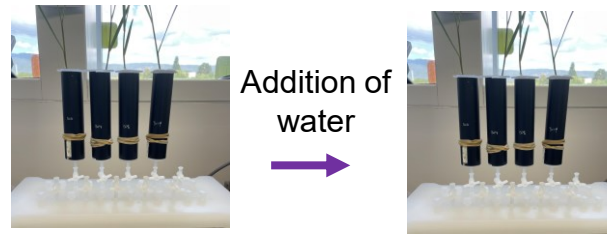
2-week-old BK in SPE tubes

**Non-targeted LC-MS Analysis**

## Black Oat (BO)



**First Extraction**  
(nanopure water)



2-week-old BO in SPE tubes

24 h

**Second Extraction**  
(MeOH-based extraction solution)



**Non-targeted LC-MS Analysis**

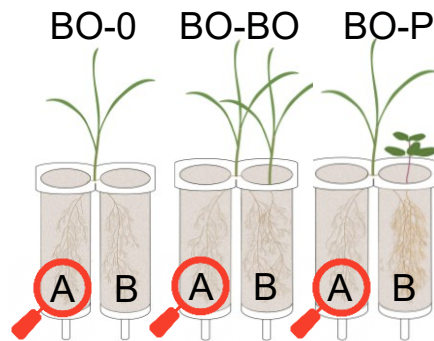
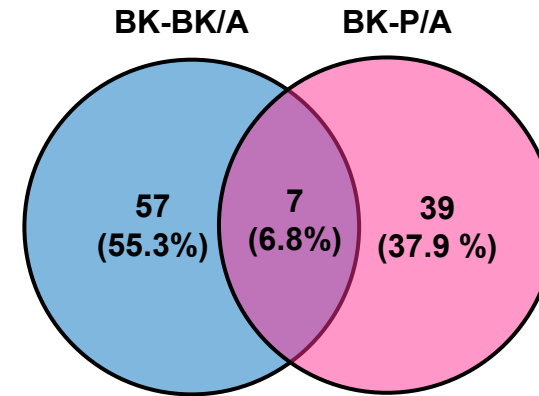
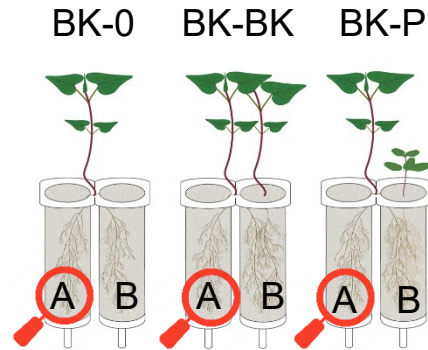


**Extraction solution:** 95% (w/v) Methanol, 4.95% (w/v) nano pure water, and 0.05% (w/v) formic acid, **Growth matrix:** 250-400  $\mu$  glass beads, **Growth solution:** 1/2 HG

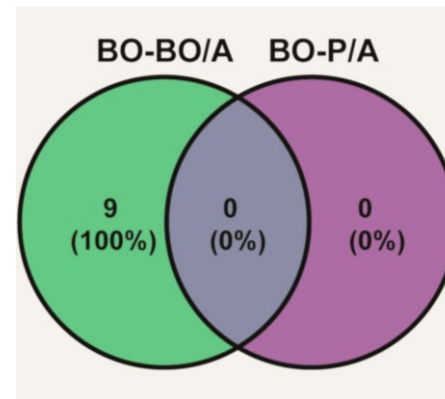
Erođlu, Ç. G., et al., 2024



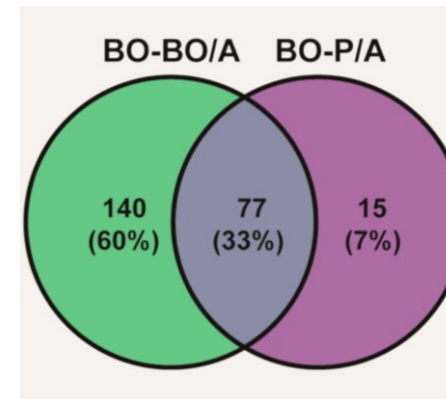
# The number of compounds upregulated uniquely by the presence of each neighbour



First extract (Water)

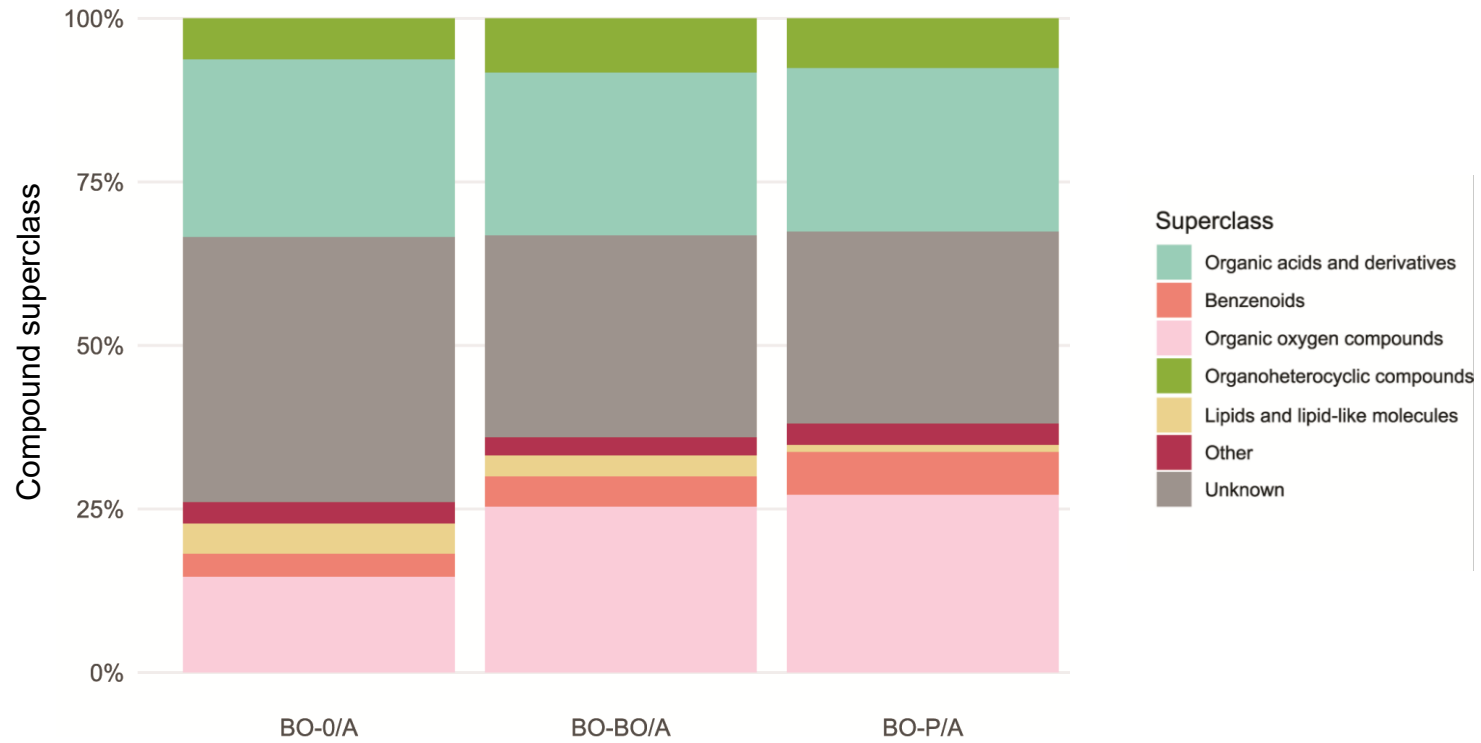


Second extract, 24h (MeOH-based extraction solution)





## Compound superclass of BO root exudates





## Research Questions

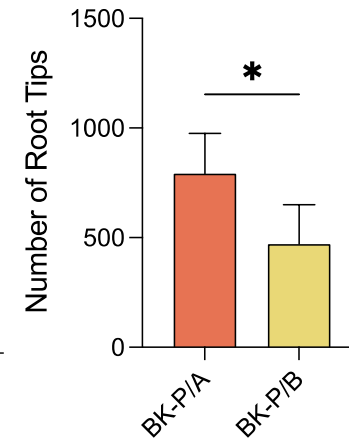
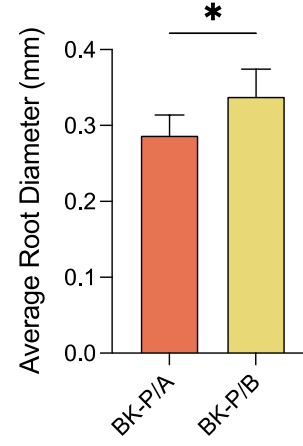
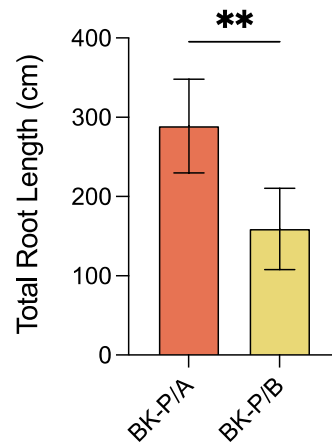
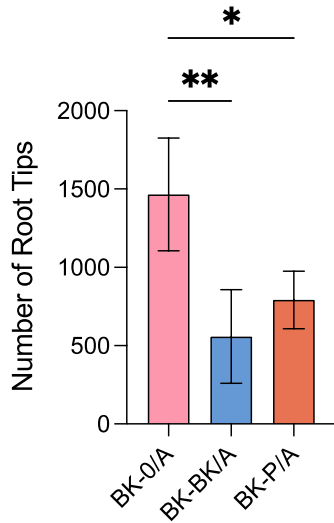
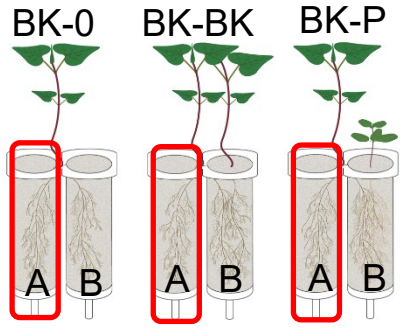


- 1) Does the root exudate metabolome of buckwheat change in the presence of neighbours?
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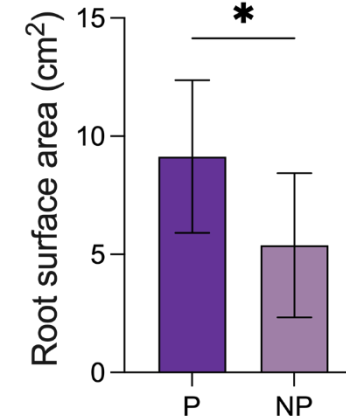
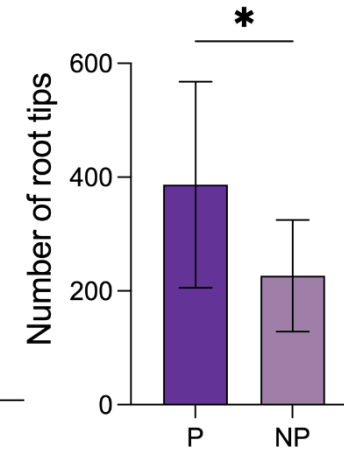
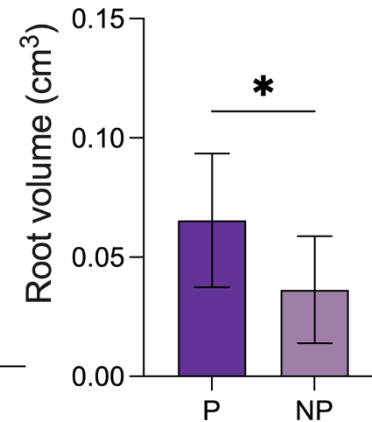
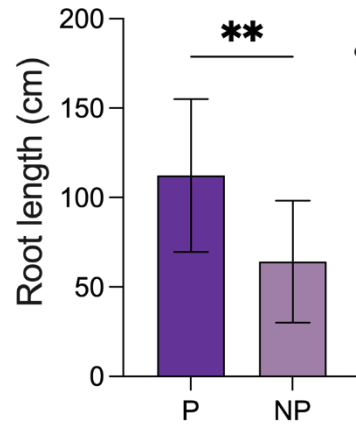
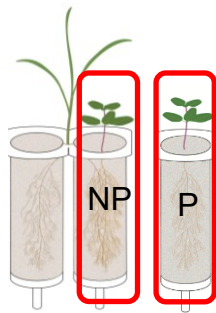
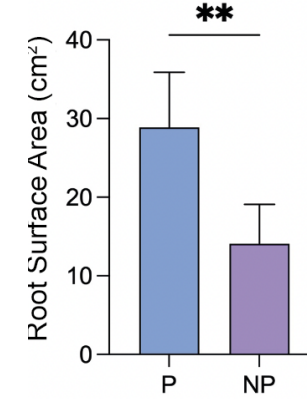
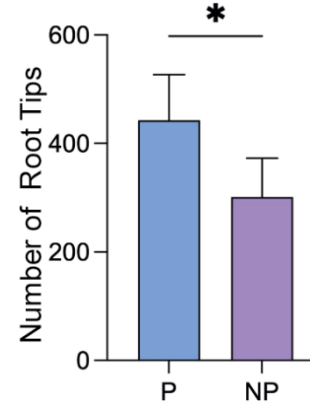
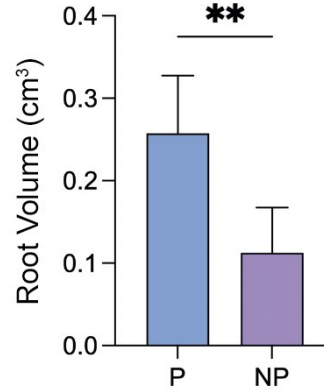
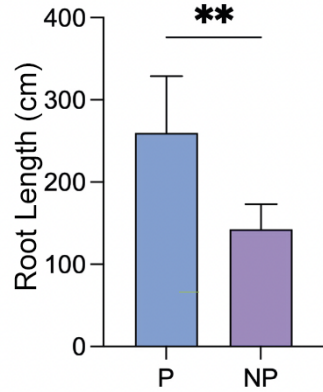
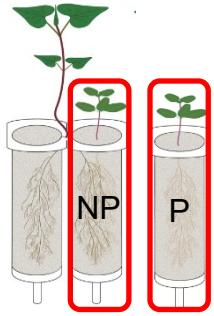
# The impact of the presence of BK and P neighbours on root parameters of BK



No significant change is observed in Black Oat root parameters when P neighbours are present (*results not shown here*)



# The effect of the presence of BK and BO on P root parameters



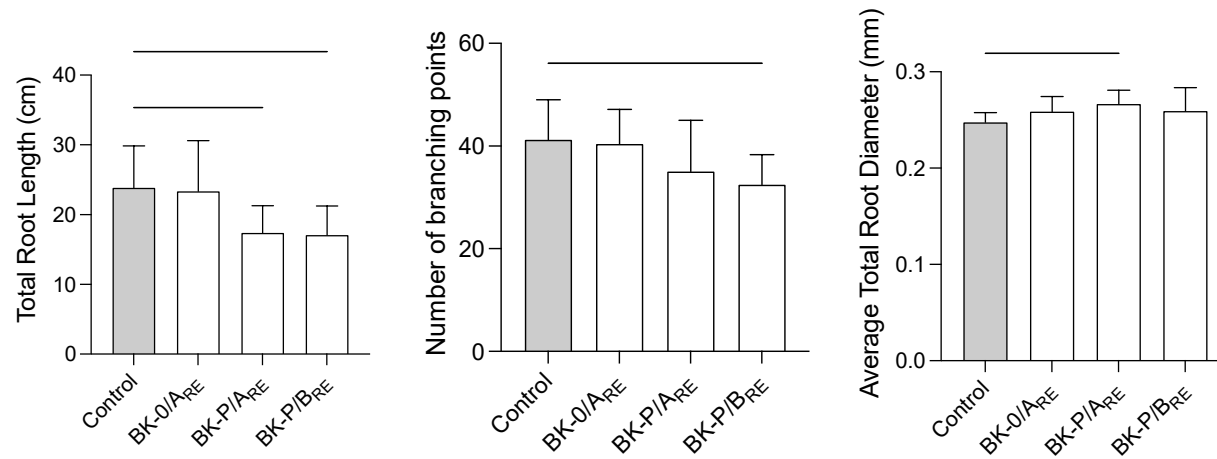
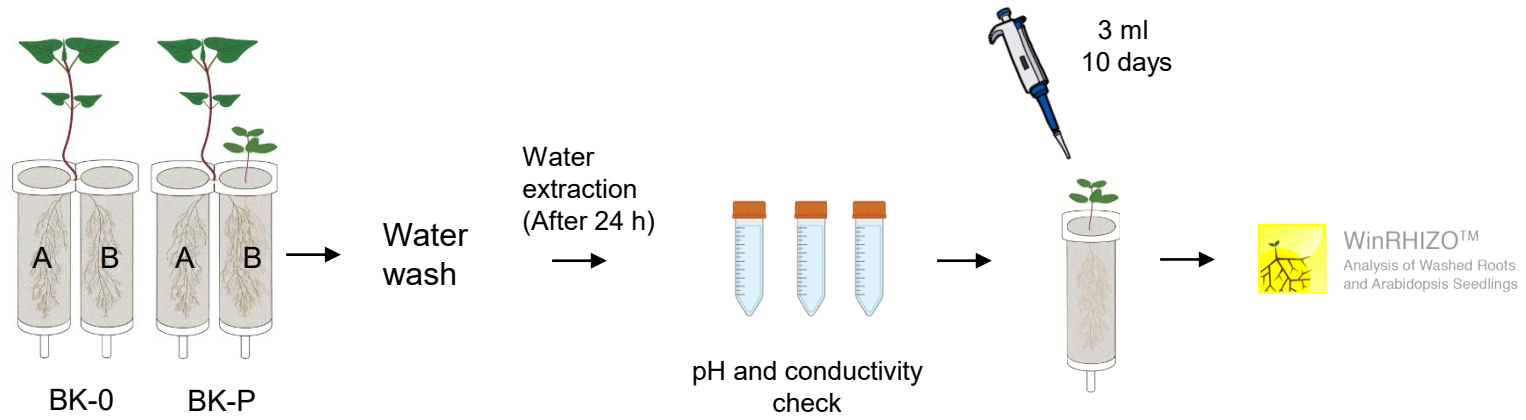


## Research Questions

- 1) Does the root exudate metabolome of black oat change in the presence of neighbours?
- 2) Are the responses different depending on the identity of the neighbour?
- 3) Do the BK and BO root exudates have an impact on redroot pigweed growth?



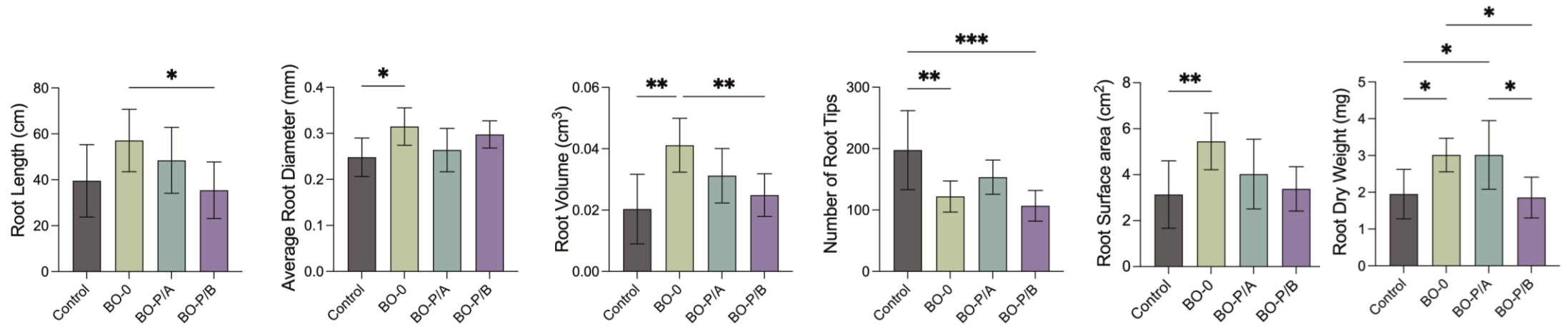
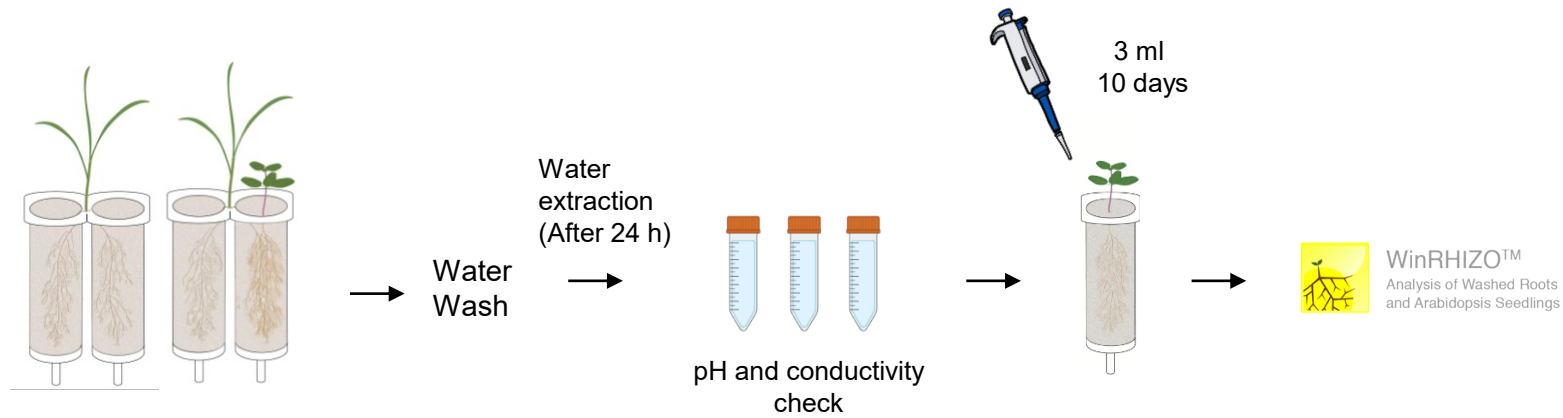
# BK root exudate treatment on P



Controls were received water instead of root exudates, and each system was supplied with ½ HG every other day



# BO root exudate treatment on P



Controls were received water instead of root exudates, and each system was supplied with ½ HG every other day.

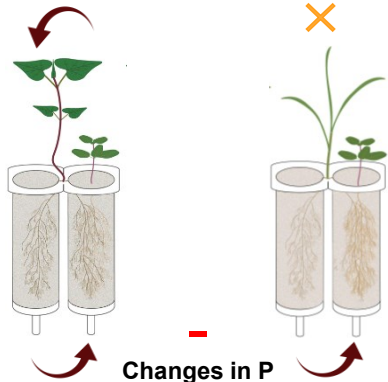


# Summary

## The interaction induces changes in BK and P root morphology

### Changes in BK

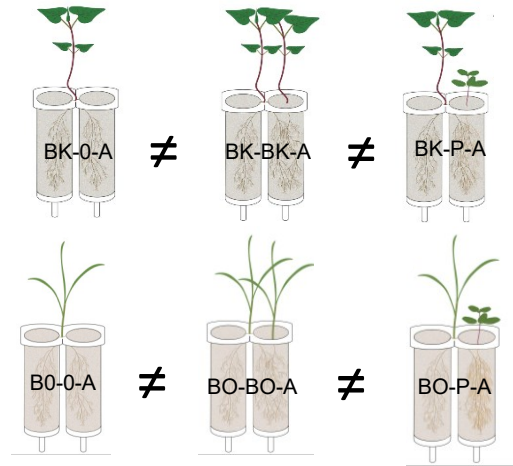
- Number of root tips



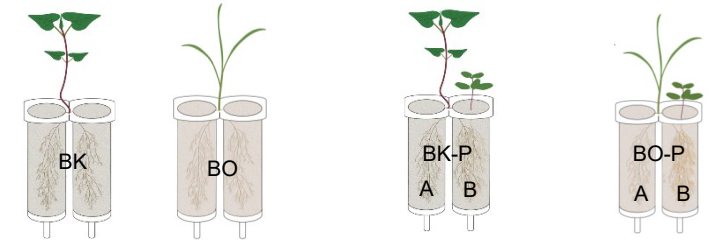
### Changes in P

- Length
- Number of branching points
- Tips
- Surface area
- Volume

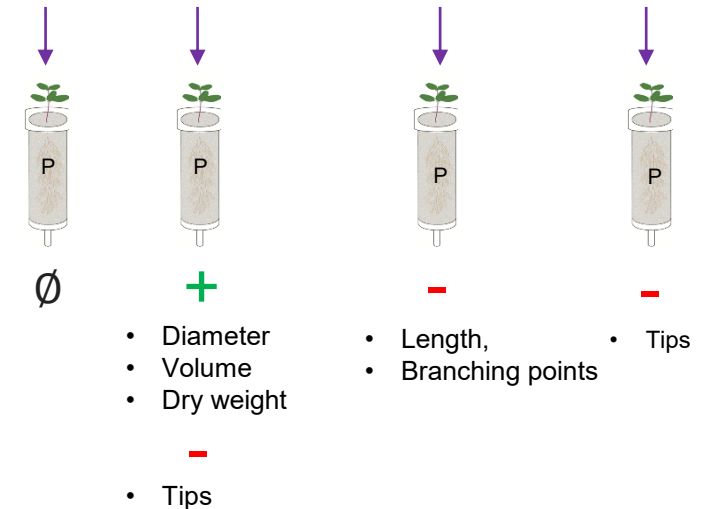
## Root exudate metabolomes change in response to neighboring plants.

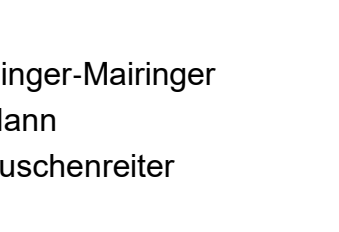
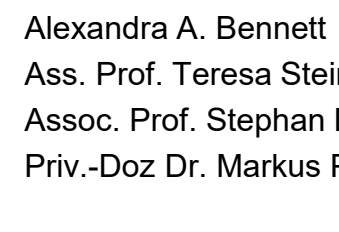
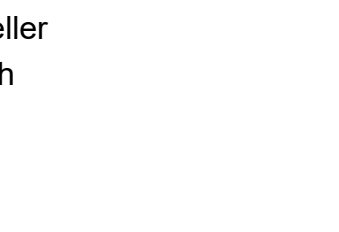
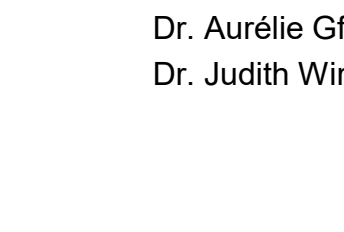
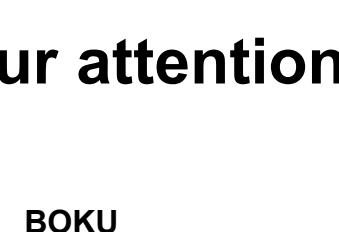
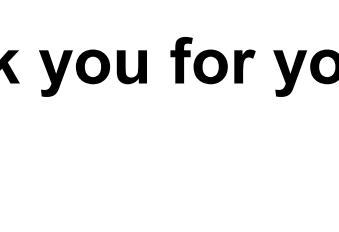
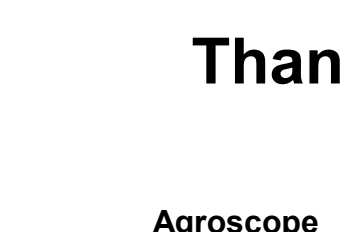
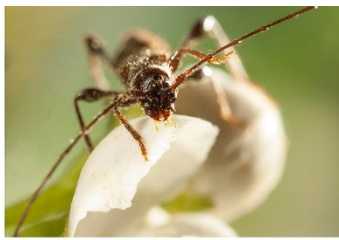


## Root exudates have an impact the P root system



### Root exudate treatments





# Thank you for your attention

## Agroscope

Dr. Aurélie Gfeller

Dr. Judith Wirth

## BOKU

Alexandra A. Bennett

Ass. Prof. Teresa Steininger-Mairinger

Assoc. Prof. Stephan Hann

Priv.-Doz Dr. Markus Puschenreiter

