TREE SPECIES INTERACTION AND SOIL DEPTH AFFECT THE RESPONSE OF ROOT EXUDATES TO DROUGHT

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“Root exudates ... are part of a belowground, inter-species language between plants and other plants, or other types of organisms”

HOW ROOTS AFFECT
SOIL ORGANIC CARBON (SOC) DYNAMICS

Decreasing SOC stocks of forests under climate change?

60% of photo-synthetically fixed C
(Kuzyakov & Domanski, 2000)

Stimulation of microorganisms

C loss from protective mineral associations

11% loss as exudates
(Jones et al., 2009)

Drying-rewetting cycles
1. Do trees invest in the production of root exudates under drought?
2. Do root exudation rates increase in deeper soil as a response to drought?
3. Do species growing in mixture exude more C?
METHODS

Experimental site

Five years of severe summer drought (KROOF experiment):

https://www.kroof.wzw.tum.de/ueberblick/
https://www.youtube.com/watch?v=KfO88XaoNvI

Beech (*Fagus sylvatica* L.) and Spruce (*Picea abies*) in monoculture and in mixture

Sampling

Root exudates (C concentrations) in the forest floor and the mineral soil (at 30 cm depth)

Four control plots, four plots under drought
DO TREES INVEST IN THE PRODUCTION OF ROOT EXUDATES UNDER DROUGHT?

Root exudation rates increase under drought in the forest floor.
Root exudation rates increase under drought only in the forest floor, while they decrease with drought in the mineral soil.
DO SPECIES GROWING IN MIXTURE EXUDE MORE C?

Beech tends to increase root exudation rates when growing together with spruce, while spruce shows the reverse response.

Response ratio $\ln(\text{mix/mono})$

- **Beech**: $p = 0.068$
- **Spruce**: $p = 0.070$

Dr. Melanie Brunn: Tree species interaction and soil depth affect the response of root exudates to drought.
CONCLUSION

• Similar to previous studies of herbaceous plants, we were able to measure an increase of root exudation rates as a response to drought in a mature forest.

• The response to elevate exudation rates under drought was only measured in the forest floor. In deeper soil, exudation rates decreased as a response to drought.

• Since root growth, sap flow and net photosynthesis decreased under drought at the site, it seems that root exudation is sustained by a few roots that may form hotspots in the zone between the organic layer and the mineral soil.

• There may be a potential benefit of spruce growing together with spruce due to a reduced belowground carbon loss.
THANK YOU!

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