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Reed canary grass as a potential agent for phytoremediation and phytomining of strategic elements

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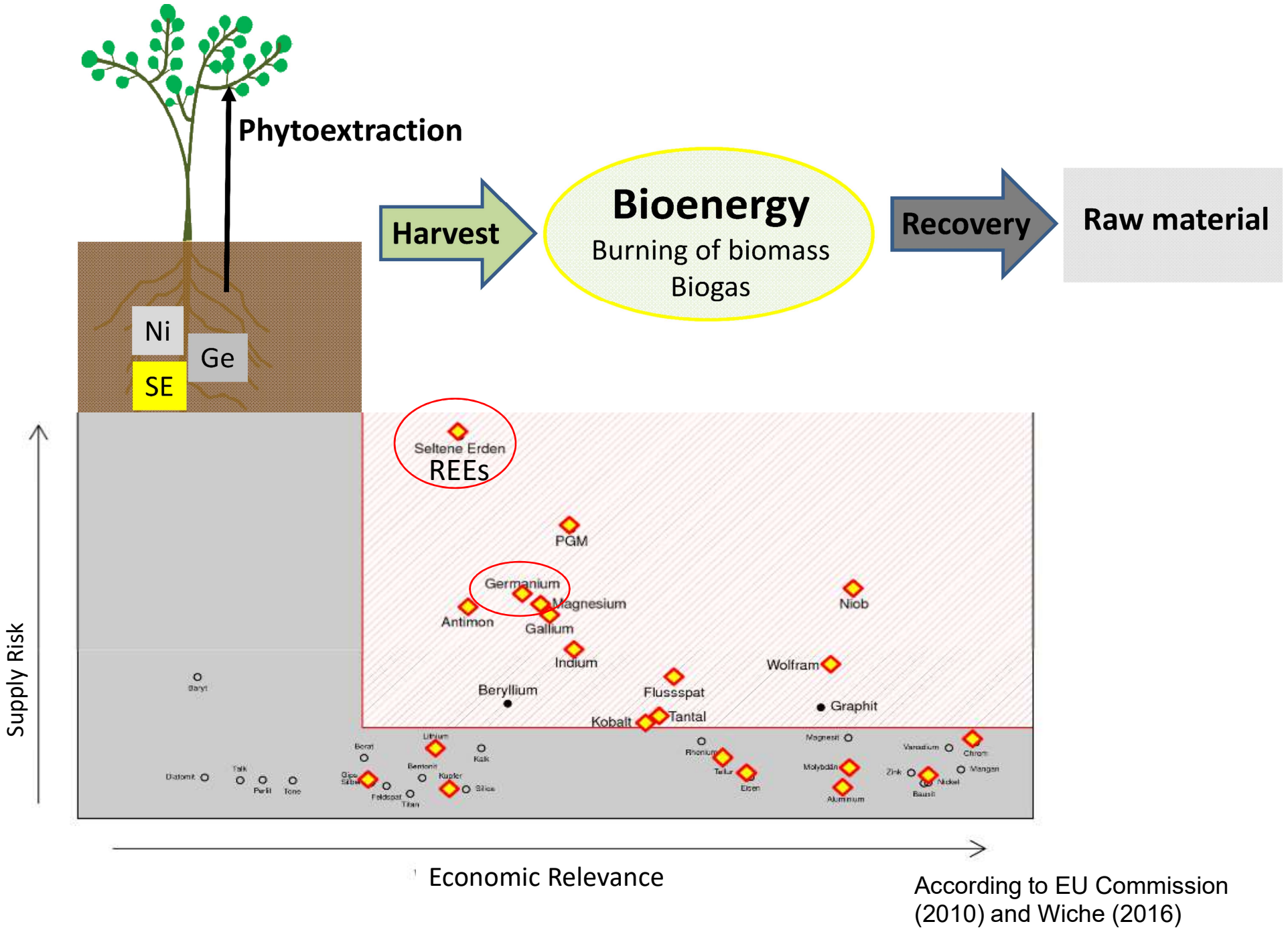
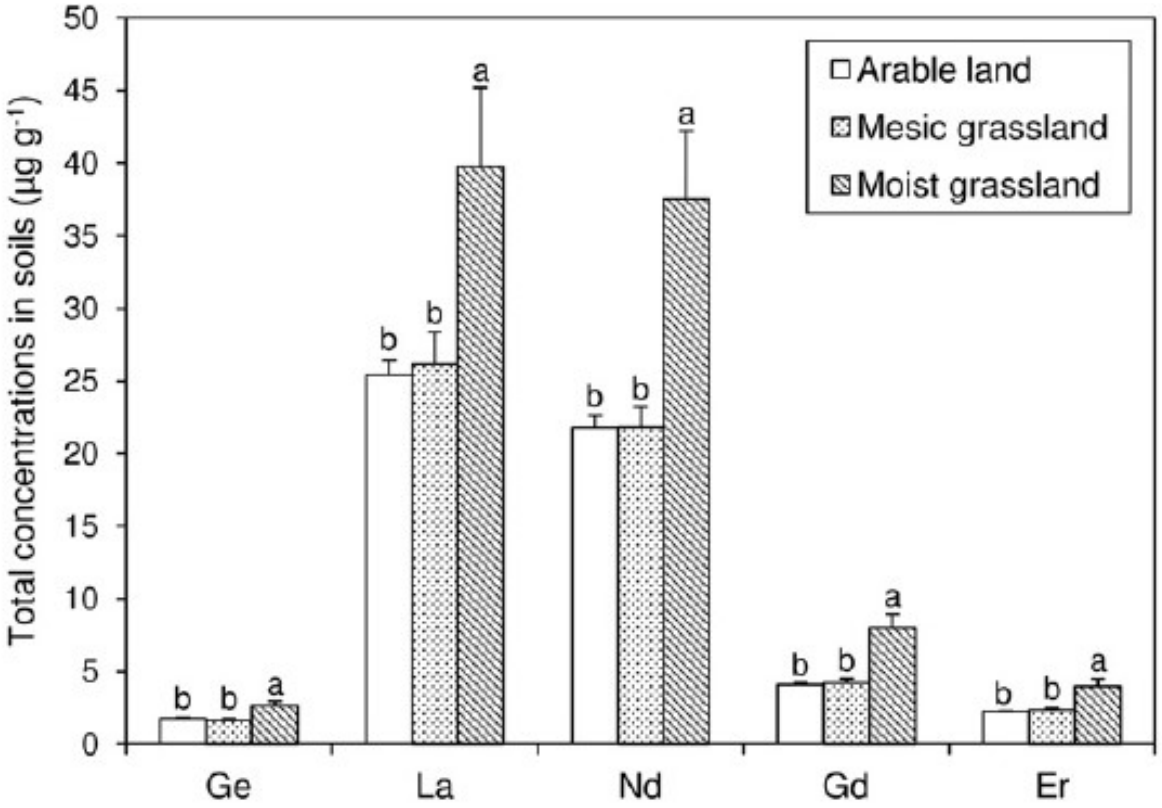


According to EU Commission (2010) and Wiche (2016)

The Ge and REE-Pool in soil



Wiche et al. (2017)

Major objectives

I. Evaluate the variability of Ge and REE-accumulation among different genotypes and populations of *Phalaris arundinacea*

II. Evaluate effects of substrate properties (pH, organic matter content on the accumulation of Ge and REEs

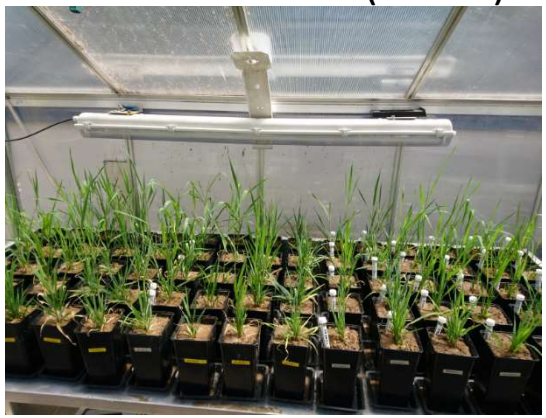
III. Explore the role of rhizosphere processes, particularely interactions with PGPR on the accumulation of the elements

IV. Investigate the fate of elements during anaerobic fermentation and burning of biomass

Methods: field and lab experiments

1. Screening of 20 genotypes and populations on two different soils

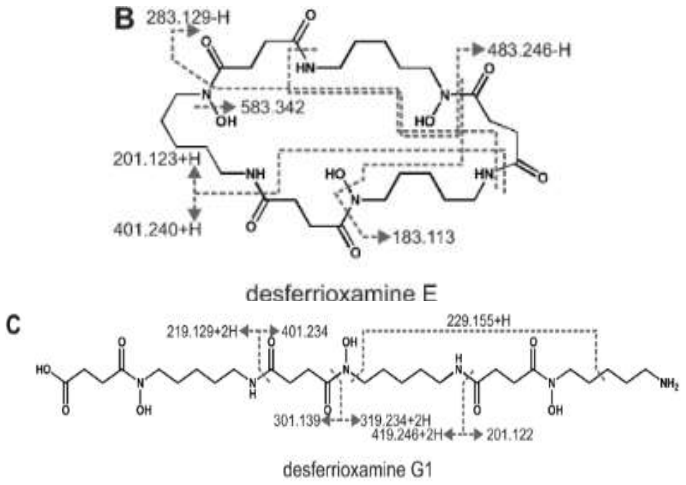
2. Inoculation with siderophore producers *A. oxydans* ATW2 and *Kocuria rosea* (ATW4)



3. Bioenergy: fermentation and buring

Soil A: pH = 7.8; SOM = 6.8 %;
1.6 mg/kg Ge;
140 mg/kg REEs

Soil B: pH = 6.6; SOM = 5.9 %;
1.7 mg/kg Ge;
139 mg/kg REEs



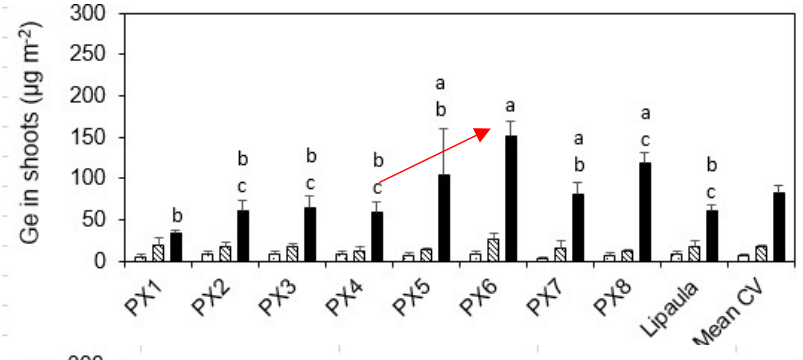
Wiche and Heilmeier (2016)

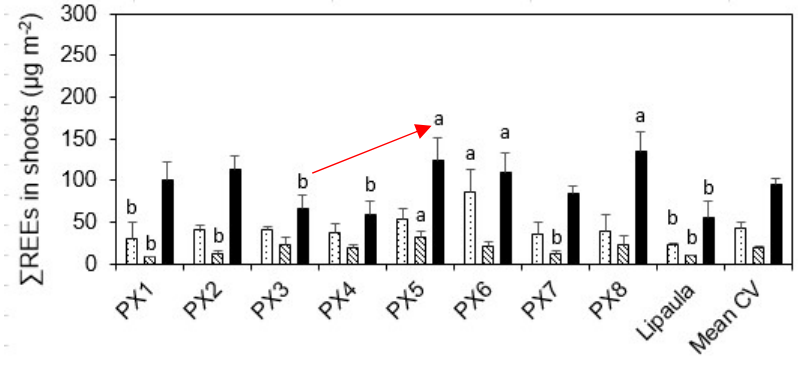
Schwabe, Wiche et al. (2021)

Results 1: genotypic variability

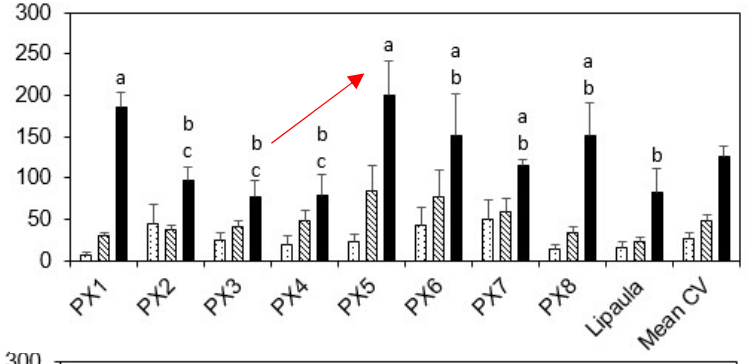
Symbol	Source of variation			
	Time	Genotype	Substrate	Genotype*Substrate
Yield	***	NS	***	NS
P	**	NS	NS	NS
Ca	***	(*)	NS	NS
Si	***	NS	**	*
Fe	***	*	***	*
Mn	***	NS	***	NS
Al	***	NS	***	NS
Pb	***	NS	***	NS
Cd	***	**	***	NS
Ge	***	*	***	*
LREEs	***	*	***	NS
HREEs	***	*	***	NS

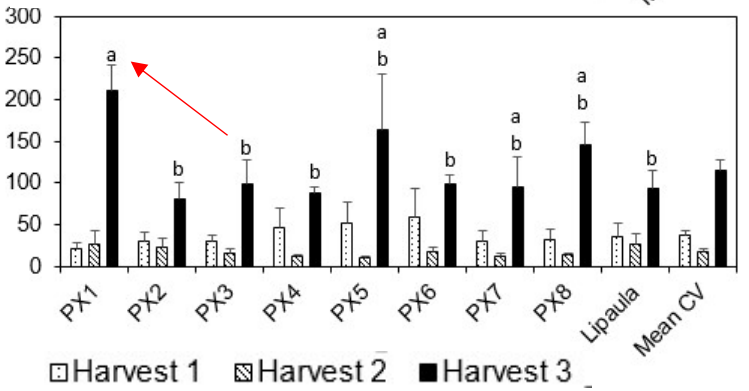
Substrate A



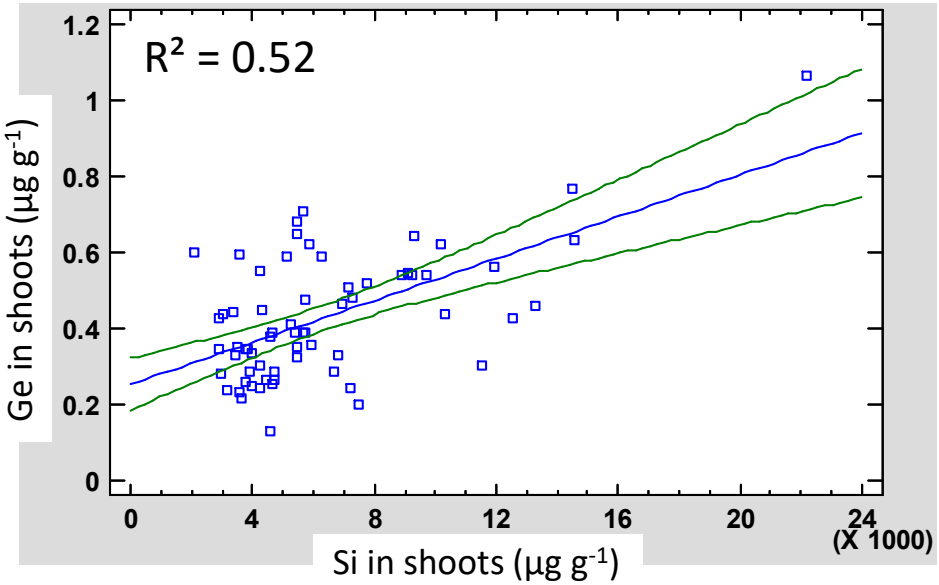


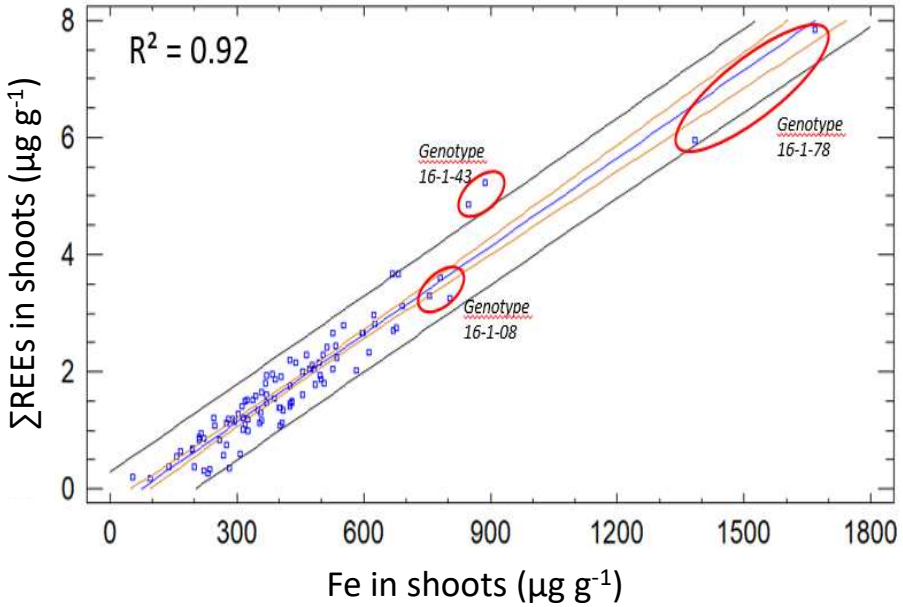
Substrate B



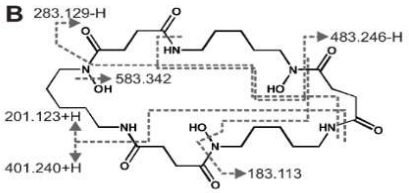


Results 2: uptake of Ge and REEs as a consequence of Si and Fe nutrition?

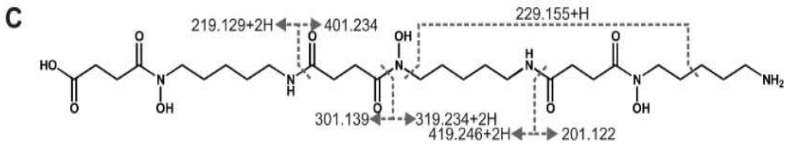




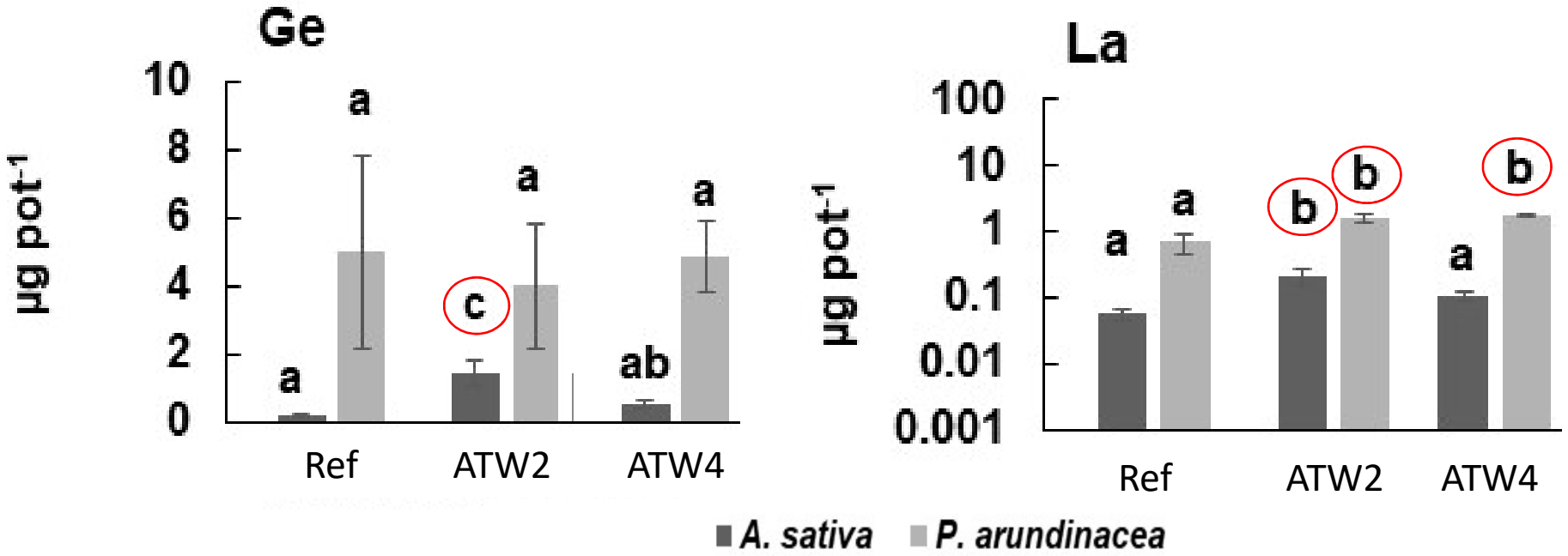
Results 3: inoculation with PGPR for enhanced phytoextraction



desferrioxamine E

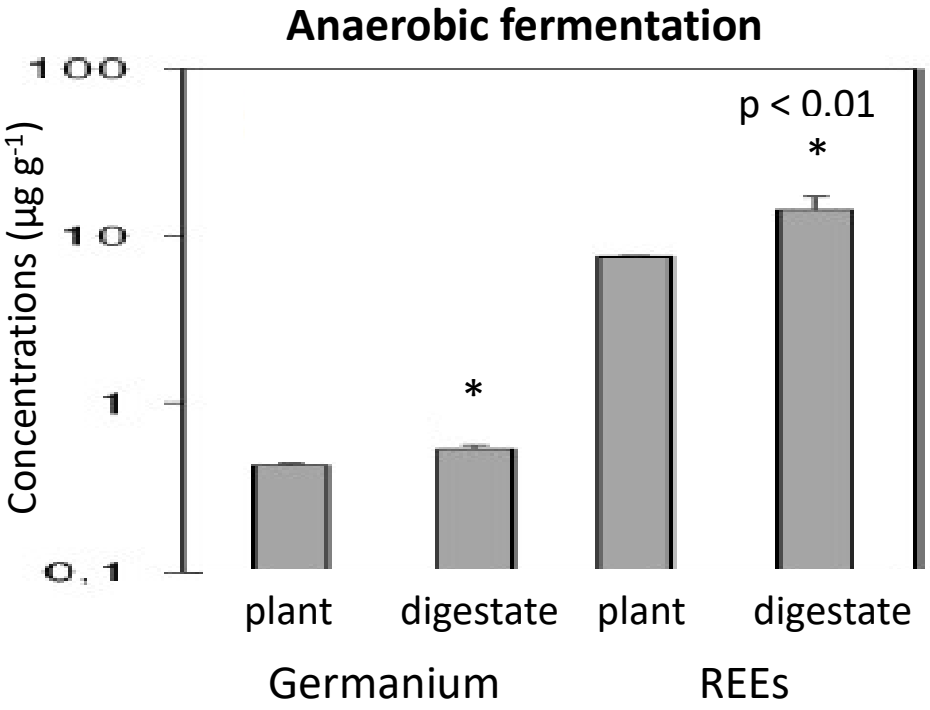


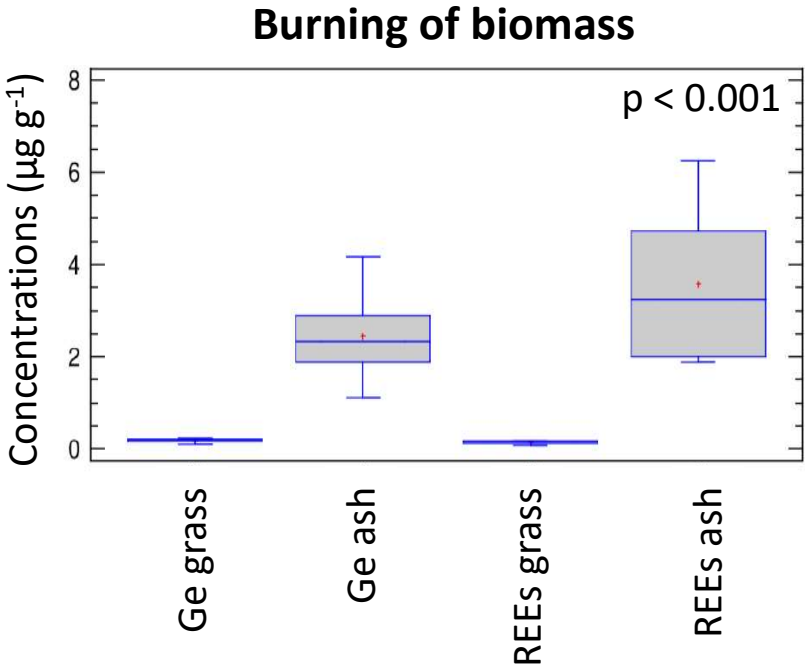
desferrioxamine G1



Schwabe and Wiche et al. (2021)

Results 4: enrichment of Ge and REEs during bioenergy production





Conclusions and outlook

- Clear effects of harvest date and substrate properties with highest phytoextraction efficiancy under *acidic* soil conditions
- Clear genotypic variation in Ge and REE accumulation among genotypes which is an important prerequisite for breeding of „phytomining cultivars“
- Correlation between Si/Ge and Fe/REEs indicates relationship between target element accumulation and plant nutrition
- Inoculation of plants with PGPR is a powerful tool to enhance phytoextraction efficiancy
- Ge and REEs are enriched in digestates and ashes by a factor of 4-10
- Under optimal conditions (cultivar, substrate, harvest date, inoculation with PGPR) maximum phytoextraction of 60 g/ha Ge and 90 g/ha REEs can be expected
- Pilot study still necessary to evaluate economic efficiency under real field conditions