Suitability of gasification biochar as a renewable phosphorus fertilizer

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The future of biochar

End conference of the Interreg IVB project Biochar: climate saving soils

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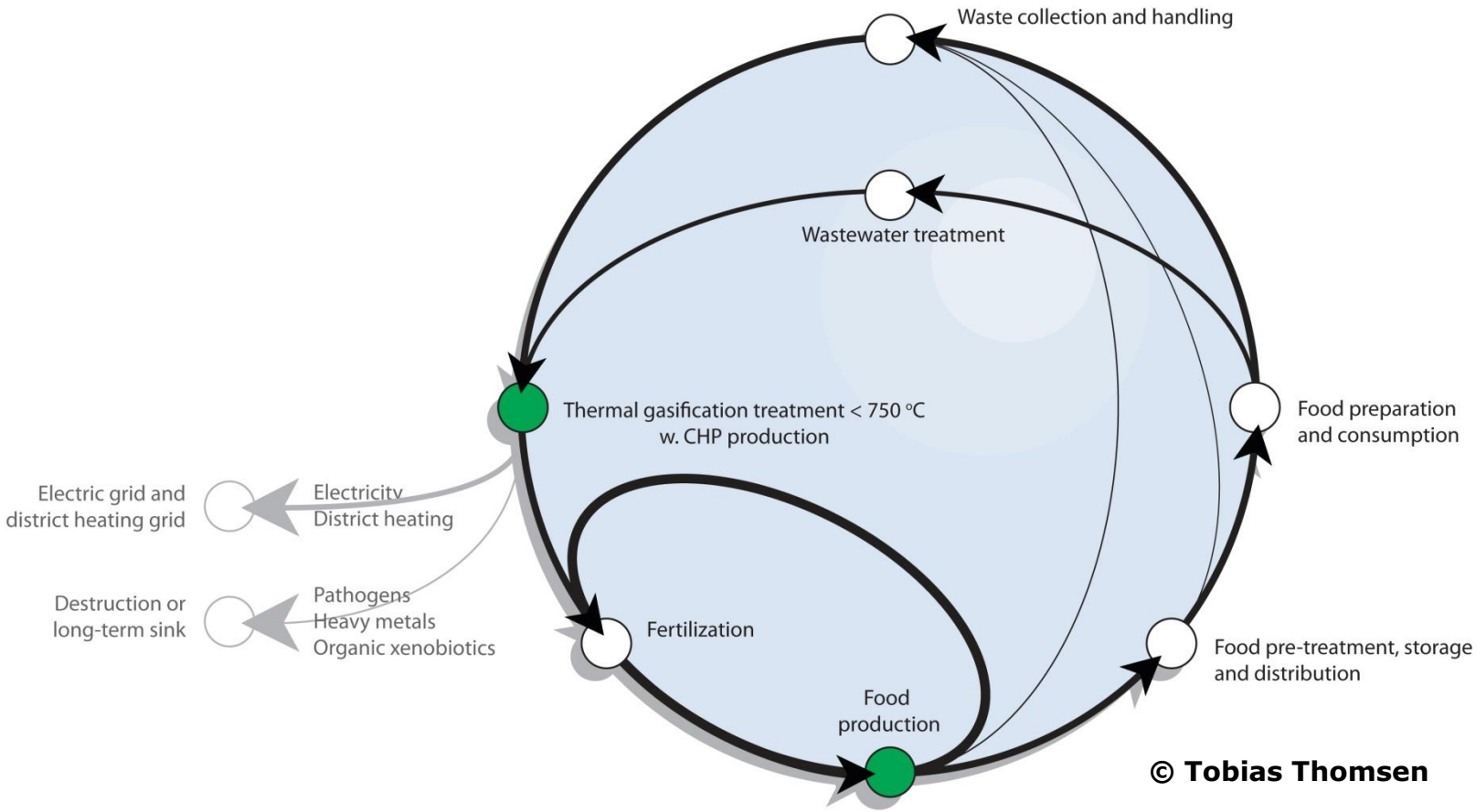
”Fuel flexible, efficient and sustainable low-temperature gasification”



Identification of valuable waste streams (straw, manure, sludge, industrial waste)

Thermal conversion (low-temperature gasification)

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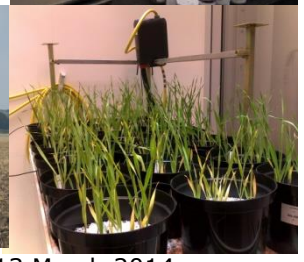
Char containing:

- **plant nutrients (K,P, Mg)**
- **carbon (up to 50 %)**
- **PAH, heavy metals?**

Lab, greenhouse, and field experiments

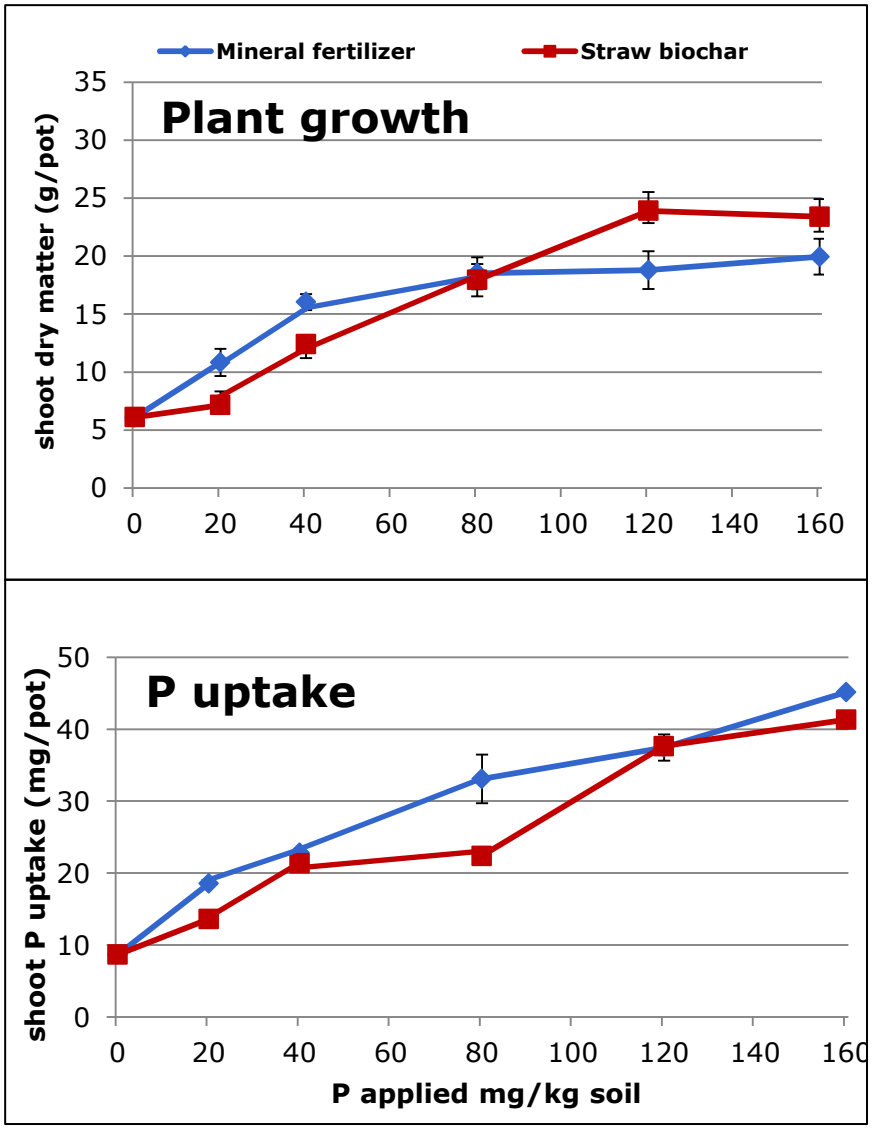


feedback

Soil-applied char is tested for:

- **fertilizer value**
- **soil carbon sequestration**

First screening of different gasification biochar/ash materials for their P fertilization effect



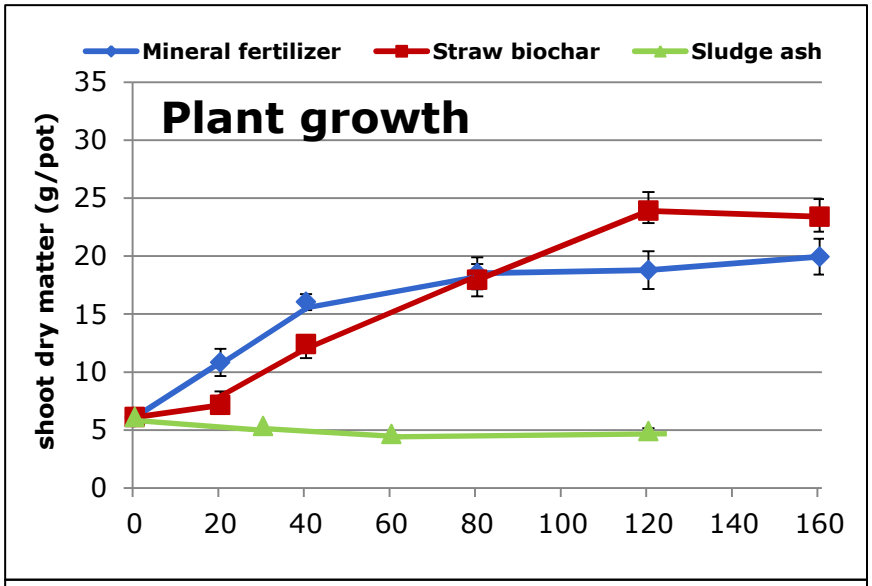
Barley growth at 80 mg P kg^{-1} soil as straw biochar (right) or KH_2PO_4 (left)

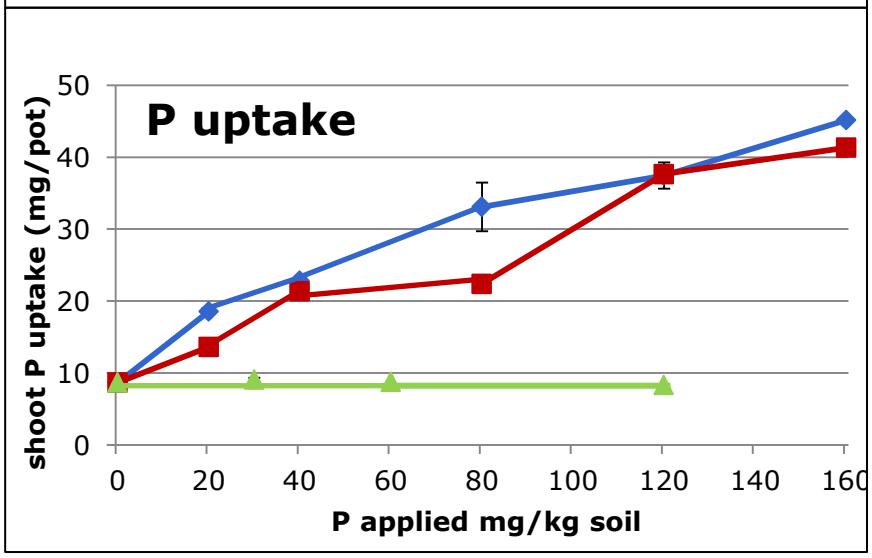
Characteristics of chars (ash) used

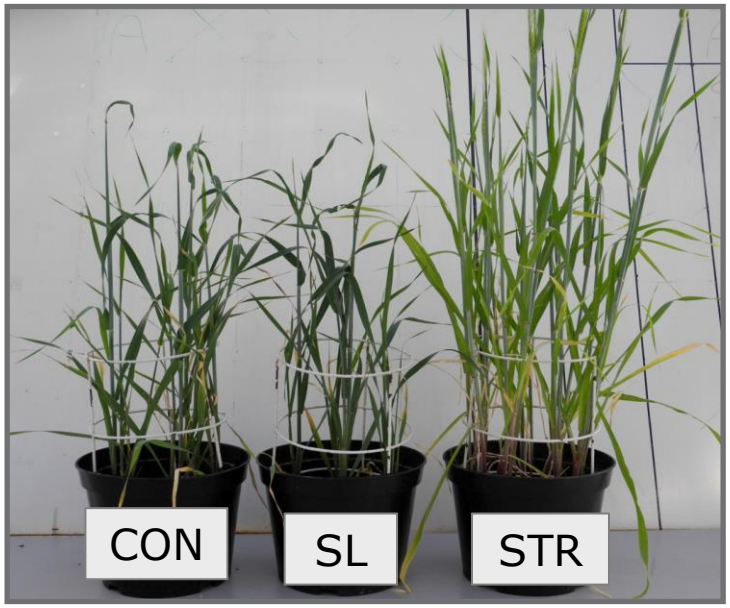
	Straw	Sludge 1
Total C (%)	48	6
P (%)	0.4	4.8
K (%)	7	0.9
Mg (%)	0.5	0.7
Fe (%)	0.2	10
Al (%)	0.4	3
Mn (mg/kg)	109	570
Mo (mg/kg)	3.2	8.1
Zn (mg/kg)	64	1330
pH	12	11

Sludge 1 = P chemically precipitated

First screening of different gasification biochar/ash materials for their P fertilization effect

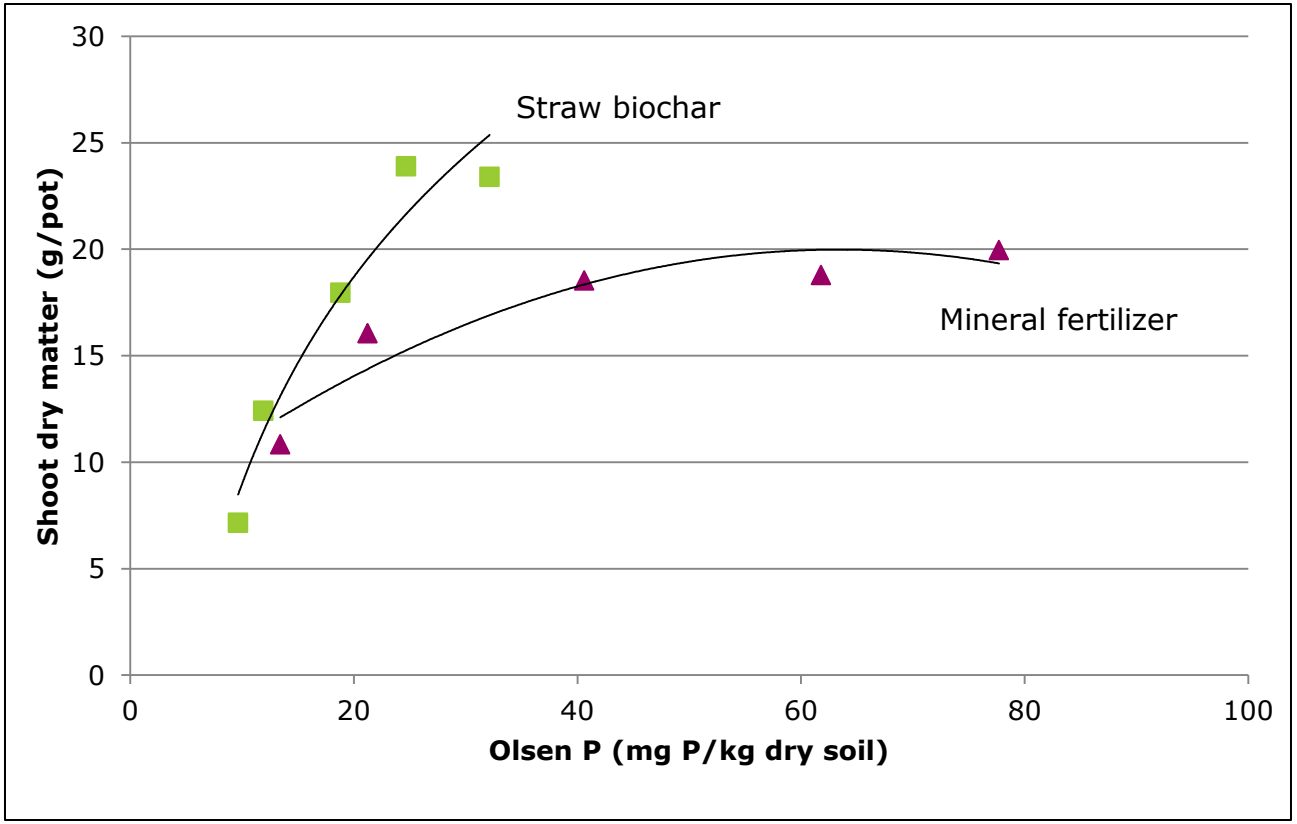






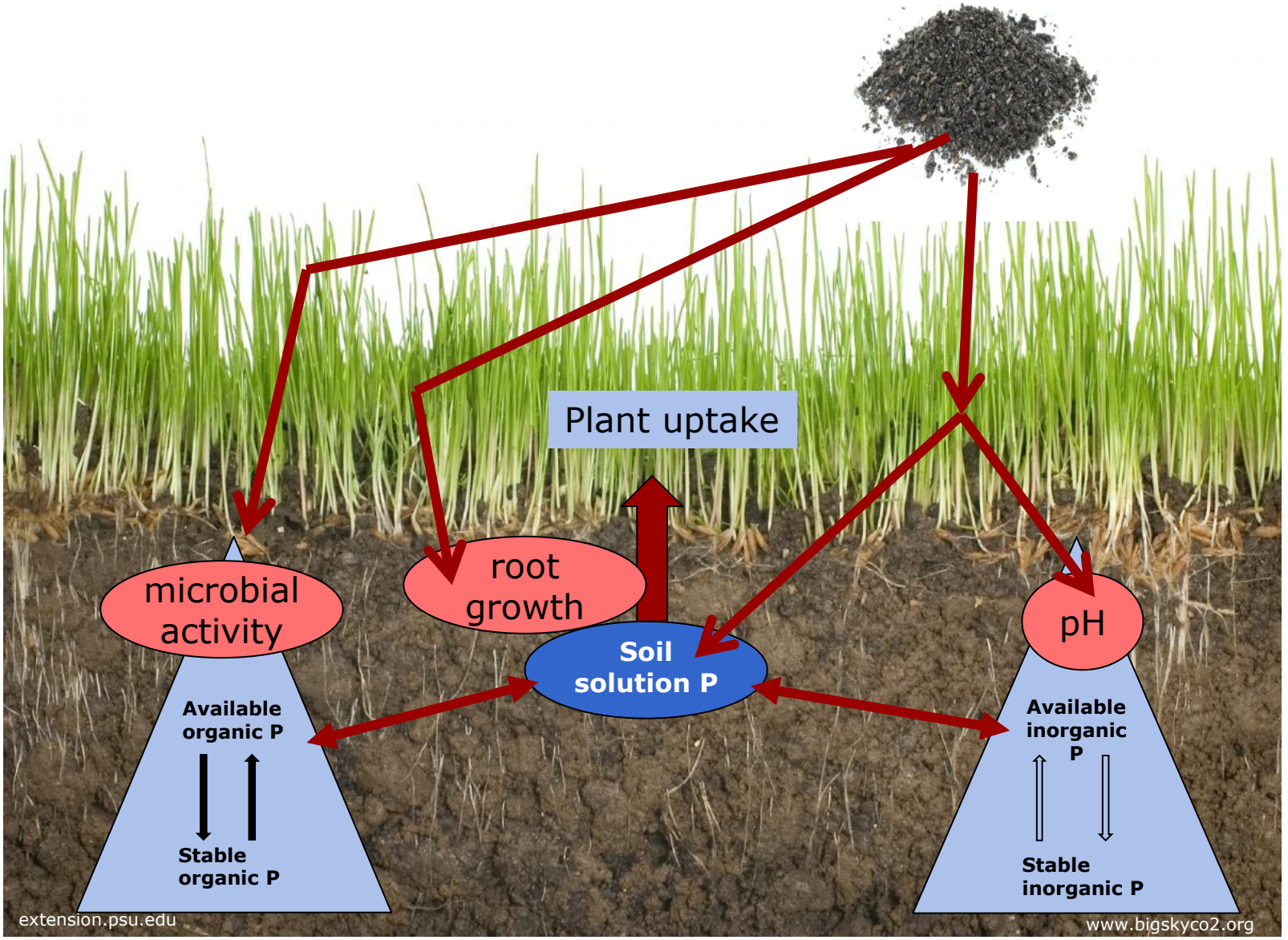
Barley growth response to ash amendments:
CON= control without P
SL= sludge ash (230 mg P kg^{-1} soil)
STR = straw ash (160 mg P kg^{-1} soil)

Olsen P/yield



First conclusions:

- ✓some gasification biochar materials can increase plant P uptake in pot experiments
- ✓strong dependency on feedstock used
- ✓in comparison with mineral P, higher application rates (as total P) are required to achieve the same yield
- ✓Olsen-P probably not an appropriate soil parameter to predict plant response


Plant uptake
microbial activity
root growth
pH
Soil solution P
Available organic P
Stable organic P
Available inorganic P
Stable inorganic P
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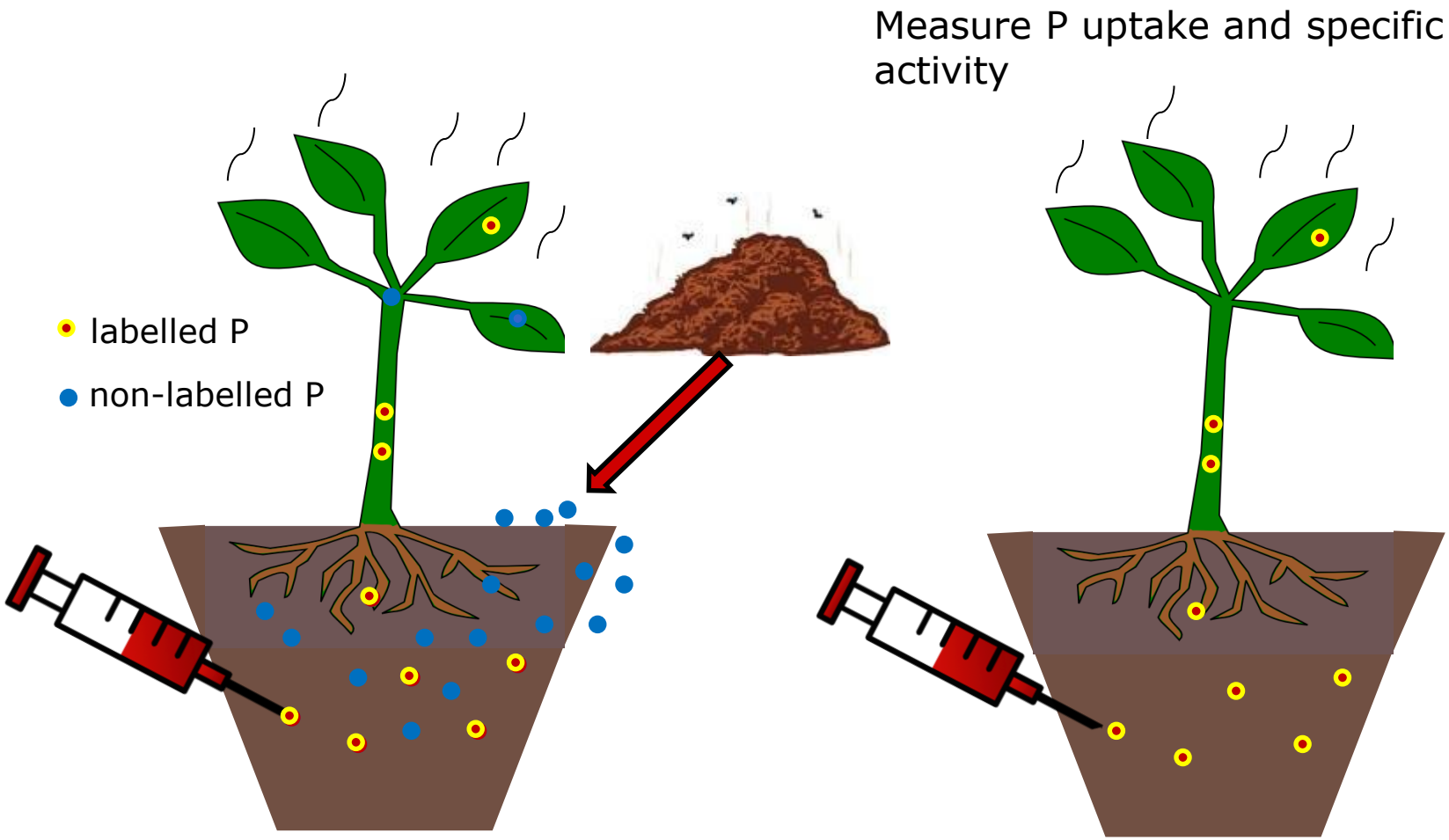
Pot experiment using a ^{33}P dilution method

Indirect labelling technique



P derived from fertilizer (%P_{dff}): 100*[1-($SA_{plant+\ fert}$/$SA_{plant-fert}$)]

Treatments: untreated control
mineral P
sludge ash
straw biochar
} 80 mg P /kg soil (sludge 120)



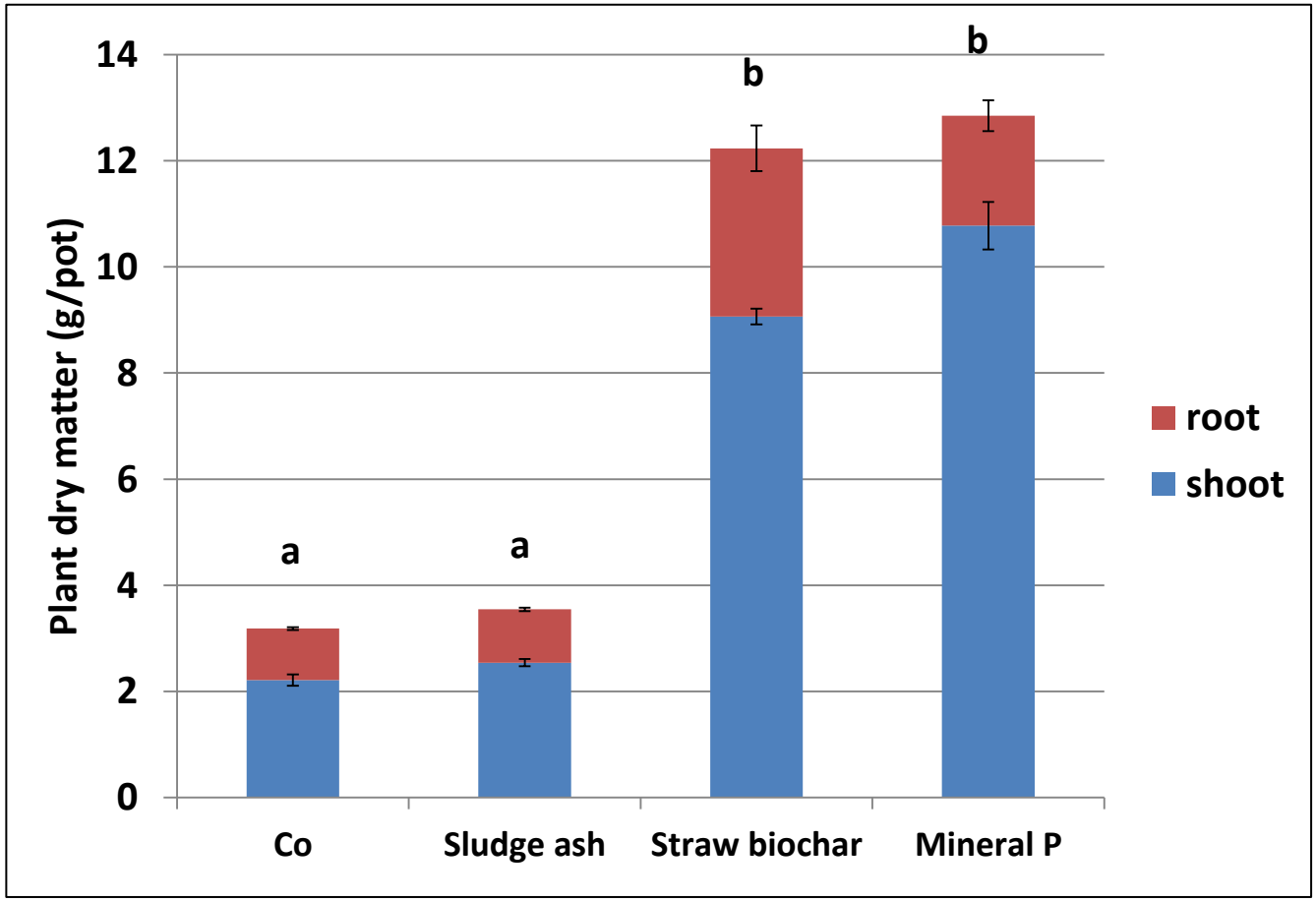




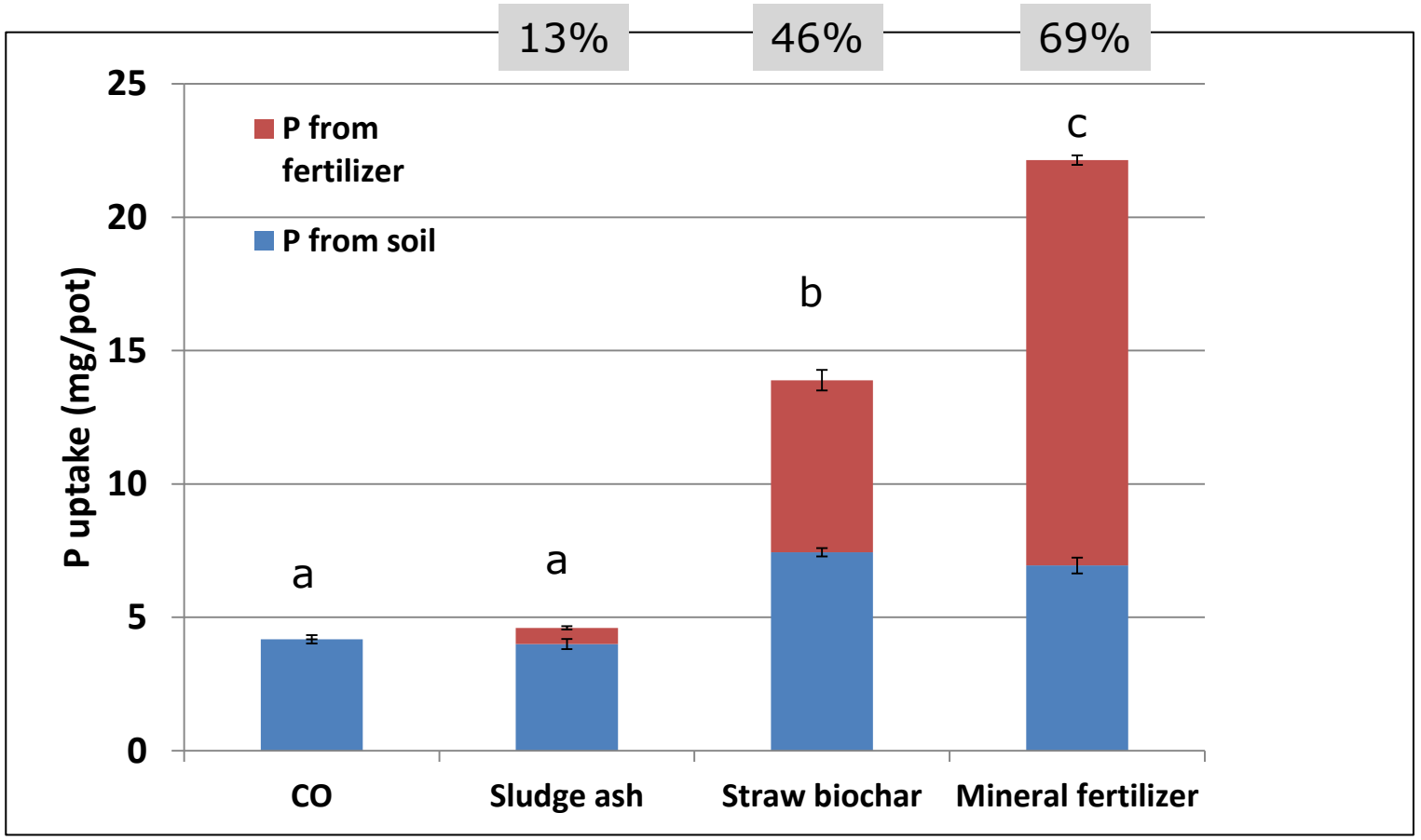

4 weeks incubation | **7 weeks growth period**

Analysis:
biomass
P uptake
SA

Plant dry matter



Distribution of total P taken up



Conclusions

- ✓plant P uptake from biochar
- ✓difference in plant P uptake between biochar and mineral fertilizer mainly due to P in biochar (not soil P)
- ✓lower P availability in biochar
- ✓to be able to more precisely evaluate the P availability in biochar compared to mineral P, more experiments are needed (**different soil type, crop type**, soil P availability…)


Thanks for your attention!