

# Effect of biochar application to soil potassium availability

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### Instruction



Biochar has become a research hotspot in agriculture, ecology, environment, energy and other fields.





Biochar has little effect on soil nutrient . Excessive application will reduce crop yields, possibly due to its higher pH. (SP Sohi,2010; M Laghari ;2016)



# **Objectives**



Potassium is deficiency in most farmland in China, limiting crop production (He et al., 2015). Therefore,

- to investigate the effects of biochar application on soil K dynamics and crop responses in different soil types,
- to study the influences of biochar application on soil microbial activity, especially the development of K-dissolving bacteria



# **Materials**





#### **Properties of biochar**

Chemical properties	Values
EC (dS m <sup>-1</sup> )	2.26
рН	9.07
Total organic carbon (g kg <sup>-1</sup> )	487.6
Total N (g kg <sup>-1</sup> )	13.56
Total P (g kg <sup>-1</sup> )	9.17
Total K (g kg <sup>-1</sup> )	21.35
CEC (cmole <sub>+</sub> kg <sup>-1</sup> )	57.12

Note: Produced by pyrolyzing at 450 C.



## **Materials**





Alfisol

Entisol

#### **Properties of soil**

Soil type	рН	OM <sup>a</sup> (g kg <sup>-1</sup> )	CEC (cmol kg <sup>-1</sup> )	Sand (%)	Silt (%)	Clay (%)	Alkali-N (mg kg <sup>-1</sup> )	Olsen-P (mg kg <sup>-1</sup> )	Sol-K <sup>a</sup> (mg kg <sup>-1</sup> )	Ex-K <sup>a</sup> (mg kg <sup>-1</sup> )	Nonex-K <sup>a</sup> (mg kg <sup>-1)</sup>	Main K-bearing minerals
Alfisol	5.71	15.77	32.5	27.4	51.4	21.2	87.3	25.6	54.43	161.17	512.51	l <sup>a</sup> (10%), F <sup>a</sup> (3%)
Entisol	7.81	13.74	18.5	39.2	48.3	12.5	72.1	15.8	19.39	107.72	525.07	l (22%), F (5%)

<sup>a</sup>OM, organic matter; Sol-K, water-soluble K; Ex-K, exchangeable K; Nonex-K, nonexchangeable K; I, illite; F, feldspar.



### **Biochar effects on crop K uptake**





**Figure 1:** Biochar effects on crop K uptake. Error bars represent standard deviations. Different letters indicate significant differences in mean values between soils and biochar treatments, P < 5%, Tukey test. ANOVA results are also given: "\*\*P < 0.1%, "\*P < 1%, \*P < 5%.

- Plant K uptake increased with the biochar application rates.
- The response differed between soil type and crop period.
- In wheat periods, plant K uptake from the Alfisol was higher than from the Entisol, due to higher basic fertility in the Alfisol than Entisol.
- In maize period, crop K uptake from the Entisol was higher than that form Alfisol.





- Biochar increased soil soluble K and exchangeable K, and the effect for Alfisol was higher than Entisol, due to its higher cation exchange capacity (CEC).
- In the Entisol, the Nonex-K that was fixed during the wheat period, which prolongs its release and support maize growth.



#### **Biochar effects on soil microbes**



microbial abundance in two soils at the end of the maize period. Error bars represent standard deviations. Different letters indicate significant differences in mean values between soils and biochar treatments, P < 5%, Tukey test. ANOVA results are also given: \*\*\* P < 0.1%, \*\*P < 1%, \*P < 5%; ns, not significant.

Alfisol

Entisol

B5 B10 B25 B5 B10 B25 B0 B5 B10 B25 Biochar increased the total bacteria and K-solubling bacteria number, ٠ and the effect of alfisol on total bacteria number was great than the ultisol, but for K-solubling was inverse.



# Biochar effects on mineral K release and the relation with KDB



Figure 6: Biochar effects on soil mineral K release (left) after harvest and the relationship with abundance of K-dissolving bacteria (right). Error bars represent standard deviations. Different letters indicate significant differences between soils and biochar treatments, P < 5%, Tukey test. ANOVA results were also given: \*\*\*P < 0.1%, \*P < 5%. Linear regression was performed to check the relationship between mineral K release and K-dissolving bacteria number, \*P < 5%.

### Min-K release in the Entisol was significantly enhanced with biochar application, but not for alfisol.



#### Conclusion

- Biochar has great potential for increasing crop K uptake through the enhancement of soil K availability.
- Soil type affects the effect of biochar on soil K dynamics, Entisol is good for K fixation and release processes, and prolongs the effects of biochar on crop K uptake.
- Biochar addition could enhance the growth of Kdissolving bacteria and thus promote mineral K release in the soil.



- Biochar enhance the Min-K release, but the abundance of KDB were much lower when compared to previous studies applying KDB, K-bearing minerals, or together (Sheng, 2005; Rahimzadeh et al., 2015).
- Therefore, co-application of biochar with KDB may be a good practice to ensure KDB colonization and to maximize the effects on soil K availability.



### Thanks!

