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Evaluating the potential risk of dusts generated from biochar-amended agricultural soils under simulated tillage







High potential for dust generation from agricultural fields!



 Biochars are often very porous and have high surface areas

 Carcinogenic or endocrinedisrupting suspects may be generated during the biochar production procedure





 Biochar particles may lower the cell viability

Research Questions

1: More dust produced?

Non amended soils



Biochar amended soils





2: Dust containing more toxic compounds?



Field Sampling vs Laboratory Simulations

Field Sampling



Laboratory Simulation

Southard et al., 2006

settling chamber rotating chamber



Lab approach selected.....

- Minimize logistical challenges: -Weather conditions
 -Agronomic practices
 -Tillage operation conditions
- A controlled approach is better for comparing effects from selected variables

Domingo and Southard, 2006

<u>Soils</u>

Materials

Silt Loam (SiL)



Sandy Loam (SL)



Biochars



Walnut shell or WS at 900 °C

Ponderosa pine wood or PW at 500, 700 and 900 $^\circ\mathrm{C}$



Dust collection



Biochar content determination



CALUX Bioassay



If any aryl hydrocarbons (dioxins, poly aromatic hydrocarbons, etc.) are present, the cell fluoresces.

Denison et al., 2004

Evaluating impact of biochar type (constant application rate)



Airborne particle concentration

Biochar content in dust

Li et al. Sci. Total Environ. 2018

Walnut shell biochar (WS900) at varied application rate



Airborne particle concentration

Biochar content in dust

Li et al. Sci. Total Environ. 2018

Why does WS 900 biochar result in more dust emissions?

Potassium ions disperse aggregates and form finer particles



WS 900 biochar contains a considerable amount of potassium (>5% by mass)

Walnut shell biochar (WS900) at varied moisture levels



Airborne particle concentration

Biochar content in dust

Li et al. Sci. Total Environ. 2018

Bioassays to probe potential toxicity



Using different biochars

Using WS 900 with different dose

Li et al. Sci. In prep.

Bioassays to probe potential toxicity



Impact of biochar type

Impact of application rate (WS900)

What might be there in WS 900 and what are the possible causes?



Different feedstock have different chemical composition





Production procedures are different: O₂ contents? Metal catalyzation?





Char with more dioxin-like compounds



Char with less dioxin-like compounds

/eclorStock

Need further exploration

Summary

- WS 900 biochar amended soils emitted more dusts than soil alone, and with higher contents of dioxin-like compounds in dusts;
- Not all biochars are problematic for dust emissions (e.g. PW biochars).
- To reduce dust, biochar can be incorporated in bands directly above the drip tape at low and high rates, and buried;
- Apply only when wind levels are low and with water added to biochar if possible;
- Appropriate personal protection equipment is required, this include respirators that are verified to fit the user;
- Test biochars in advance





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