Effects of processing conditions and biomass modification on phosphorus availability from sugarcane bagasse ash to soybeans

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Abstract

Brazilian farming industry consumed around 2.2 million tons of phosphorus (P) fertilizers in 2016. The agricultural industry depends on imported P fertilizers and over 98% of P fertilizers were used for sugarcane, soybean and maize production.

An alternative is to use P from sugarcane bagasse. Bagasse is the fibrous plant material remaining after extraction of sugarcane juice, and it is combusted for energy production. Remaining ash contains up to 0.6 wt% P. The use of bagasse ash (BA) as P fertilizer could decrease the annual import of P fertilizers by 6% of the imported P fertilizer based on 2016 values. Since the bioavailability of P from BA to plants is poorly investigated, this study addresses the effects of (i) gasification temperature (710-849°C), (ii) processing method (gasification vs. combustion), (iii) biomass modifications by co-processing bagasse with chicken manure (BA+CM), and (iv) the soil (Brazilian Oxisol soil vs. nutrient poor substrate) on the bioavailability of P from BA to soybeans (*Glycine max*).

Gasification of BA at 806 °C resulted in significantly highest uptake of P by soybeans and was around 0.33 mmol after 51 days growing. The bioavailability of P significantly increased due to co-gasification of bagasse and chicken manure (BA+CM) and the soybeans took up around 16% more P. Compared to the nutrient-poor substrate, the bioavailability of P in BA+CM ash treated Oxisol soil was significantly lower by 46% and there was no significant effect of processing method on the bioavailability of P from the BA+CM ash to soybeans. Contrary to the Oxisol soil, the bioavailability of P from co-combusted BA+CM ash was significantly higher compared to co-gasified BA+CM ash. In conclusion, co-processing of bagasse with nutrient rich residues can increase the value of BA as P fertilizer. The bioavailability of P from ash to plants depends on the P forms. Mineralogical analyses of ash P forms by NMR and X-ray diffraction are in progress and will be presented at the conference.

Keywords: sugarcane bagasse ash (BA), gasification, combustion, temperature, Oxisol, nutrient poor substrate, availability of phosphorus (P) from BA to soybeans, NMR and X-ray diffraction