Can Pyrolysis Chars Increase Corn Yield and Sequester Carbon in Conservation Tillage Systems?

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ABSTRACT

Pyrolysis is the thermochemical conversion of biomass under low oxygen conditions. Pyrolysis produces gases, biooils, and char products, all of which can be used as fuels. There is also considerable interest in the use of the char byproduct as a soil amendment. There is evidence that char may be beneficial to plant growth, improve soil conditions, and contribute to stable soil carbon. If char can sequester carbon and benefit crop yields in Southeastern soils, char amendments may work well with conservation tillage systems to improve soil quality. We evaluated the effect of soil amendment with peanut hull and pine chip pyrolysis char in a Tifton soil on corn (*Zea mays*) yield, soil nutrient status, and stable soil carbon over two growing seasons as a preliminary indication of how pyrolysis char might be used in row crop production systems.

Microplots (6 x 7 ft) were amended with peanut hull and pine chip pellet char produced at 400^{o} C with steam as a carrier gas. For each char type, a completely randomized design with four replicates was used with char rate (0, 5 tons ac^{-1}, 10 tons ac^{-1}) and N fertilizer (with and without) as treatment factors. Soil samples were taken before plots were amended, at week 4 and 16 after planting, and at harvest during the first year, and again before planting and after harvest the second year. Soils were analyzed for total C, N, S, pH, N, NH4-N, NO3-N, and Mehlich I P, K, Ca, Mg, Mn, and Zn. Soil moisture and CO_2 efflux from the soil surface were periodically measured during the growing season. Corn yield and aboveground biomass was determined by hand-harvesting.

Analyses of the char indicated that a significant amount of nutrients could be added with the peanut hull char at the 5 tons ac^{-1} rate (190 lbsN ac^{-1}, 2.3 lbs P_2O_5 ac^{-1}, and 59.8 lbs K_2O ac^{-1}). Nutrient additions with the pine chip char were low, and no differences in available nutrients were seen; however, peanut hull char addition did increase Mehlich I nutrients in the soil and in corn tissue, particularly in Year 1. Char addition increased soil organic carbon. Although small increases in CO_2 evolution were seen in the field following char incorporation, there were no significant effects of char rate on CO_2 efflux. There were no significant effects of char rate on corn yield during either Year 1 or Year 2. There was a response of corn biomass compared to the control to the highest peanut hull char rate during Year 1. Although no yield increases were seen in this study, we also did not see yield decreases. Ongoing work is investigating the potential for N immobilization at higher char rates. We conclude, though more work is needed

to evaluate char effects within a longer rotation in a conservation tillage system, there is potential to apply char before transitioning to conservation tillage to sequester carbon and improve soil quality.