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# Impact of maize cob and wood-derived biochar on soybean plant growth and soil aggregate structure in dry land

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Soil structure plays important roles in land degradation, soil fertility, and agricultural productivity and thus has great ecological importance. Soil aggregation is a crucial soil function for maintaining soil porosity and enhancing the stability of soil structure to prevent soil erosion. Biochar was reported to be a binding agent for organic matter in aggregate formation and thus alleviate aggregates degradation. Therefore, this study attempts to a) investigate the impact of the biochar on soybean plant growth, plant nutrients content and soil chemical properties; b) analyze the effect of maize cob biochar (CB) and wood biochar (WB) on soil aggregate structure in vulnerable dry land area.

Field trial was performed on two sandy soil fields (at MLZ and BDG village) and one loamy clay soil field (at RQ village) which located in Ningxia, China. Two treatments (20 t $ha^{-1}$ of CB and WB application) and control were repeated 7 times. In this study, we analyzed biomass, grain yield, and nutrients content of soybean plant while soil nutrients were observed as well. Nine soil aggregate size classes (ASCs) were obtained (>10, 10-7, 7-5, 5-3, 3-2, 2-1, 1-0.5, 0.5-0.25 and <0.25 mm) through dry sieving to analyze soil structure. In addition, soil dry mean weight diameter (dMWD), dry geometric mean diameter (dGMD), and structure coefficient (Ks) were measured to estimate the aggregate stability, erodible fraction, and agronomically valuable fraction. After that, redundancy analysis and ridge regression analysis were applied for further data processing.

Our results indicated **a) biomass and grain yield:** both CB and WB significantly increased shoot biomass in loamy clay soil by 48.7% and 45.0%, respectively. In the two sandy soils, biochar indicated no significant enhancement on the plant growth and grain yield. Even though, the mean value of grain yield increased by 29.7% and 35.1% with the CB and WB application in the MLZ field, respectively. CB application also increased the mean value of grain yield by 34.2% in the BDG field. Although the data shows insignificant difference with high standard errors due to field heterogeneity, the mean values can still give insights into agricultural field practices; **b) soil aggregate structure:** soil type exerted stronger influence on soil aggregation and plant growth rather than biochar. The sandy field in MLZ showed high soil loss potential by wind erosion referring to a low value of dGMD, and the loamy clay field showed the highest dMWD, dGMD and Ks values for an ideal aggregate structure for crop growth. Findings indicate

that biochar had no significant influence on aggregate structure in both sandy and loamy clay soils; **c) soil nutrients:** CB can significantly increase soil total carbon content in RQ and BDG fields. Soil potassium content can be enhanced by CB application in loamy clay soil.