



Does gasification and biochar amendment provide a viable solution to balance greenhouse gas emissions, energy requirements and orchard residue management?

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By converting biomass residue to biochar, we can generate power cleanly and sequester carbon resulting in overall greenhouse gas (GHG) savings when compared to typical fossil fuel burning and waste disposal. This on-farm research study provides a long-term and high frequency assessment of GHG emissions from biochar amended-soils in an organic walnut orchard in the Central Valley of California, USA. We also estimated the GHG offsets from the conversion of walnut residue into energy through gasification at the on-site walnut processing plant. Soil fluxes of carbon dioxide (CO₂) and nitrous oxide (N₂O) were monitored over 29 months in a 3.6 ha walnut orchard following management and precipitation events. We compared four treatments: control, biochar, compost, and biochar combined with compost. Events involving resource inputs such as fertilization or cover crop mowing induced the largest N₂O peaks with average 0.13 kg N₂O-N ha⁻¹ day⁻¹, while precipitation events produced the highest CO₂ fluxes in average 0.124 Mg CO₂-C ha⁻¹ day⁻¹. Biochar alone decreased N₂O fluxes in two out of 23 measured events, however, not with enough significant magnitude to modify annual or seasonal totals. This indicates that biochar-induced decreases in N₂O fluxes may occasionally occur without significant changes in total emissions. Additionally, biochar alone or in combination with compost did not alter annual or seasonal cumulative CO₂ emissions. For this particular study, the conversion of orchard waste into energy and C sequestration through biochar amendment offset 100.3 Mg CO₂-Ceq year⁻¹. Thus, given that biochar did not alter cumulative GHG emissions from soils, we conclude that, in the scenario of this study, the use of biochar as a strategy to decrease farm-level GHG emissions is obtained through the gasification of orchard residue into energy and through biochar C sequestration, and not as a tool to decrease soil CO₂ and N₂O emissions.