

Biochar and compost as amendments in copper-enriched vineyard soils – stabilization or mobilization of copper?

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Copper is an important ingredient for several fungicides that have been used in agriculture. For organic viticulture, several diseases as e.g. downy mildew (*Plasmopara viticola*) can only be antagonized with Cu-containing fungicides. This long-lasting dependence on Cu-fungicides has led to a gradual Cu enrichment of vineyard soils in traditional wine-growing areas, occasionally exceeding 300 mg/kg. Although these concentrations do not affect the vines or wine quality, they may impair soil microbiological functions in the top soil layer or the root growth of green cover plants. Therefore measures are demanded that reduce the bioavailability of copper, thereby reducing the ecotoxicological effects. The use of biochar and compost as soil amendment has been suggested as a strategy to immobilize Cu and reduce the exchangeable fractions. This study consisted of lab and greenhouse experiments that were designed to test the sorption and desorption behavior of copper in vineyard soils with or without biochar and/or compost as soil amendment.

Slightly acidic soils (pH<6) showed a clearer biochar-induced immobilization of copper with biochar than neutral or alkaline soils. The analyses of leachate waters of microlysimeter experiments showed that the biochar effects were more evident for a reduction of the ionic form Cu^{2+} than for total soluble copper, even in alkaline soils. Biochar modified with citric or tartaric acid did not significantly decrease the solubility of copper based on total dissolved concentrations although CEC was higher than in unmodified biochar. Treatments consisting of compost only or that had an equal amount of compost and biochar rather had a mobilizing effect on biochar. Sorption experiments with different DOC concentrations and biochar, however, showed a positive effect on copper sorption. Apparently in vineyard soils the predisposition to form organic-Cu-complexes may outbalance the binding possibilities of these complexes to biochar, occasionally resulting in enhanced mobilization. Presumably immobilization of copper with biochar would work best in acidic soils low in organic carbon and with low or no compost addition although this might be at odds with standard vineyard soil management practices.