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The effect of biochar on plant pathogens and rhizosphere microbiology

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ILVO research aims to identify and develop novel ways to sustain and restore soil quality and enhance plant health. One interesting strategy is the incorporation of biochar products into the soil or substrate. The presented research uses biochar products derived from urban and farm waste and produced in the FP7-Fertiplus project (www.fertiplus.eu). We investigate the effect on plant pathogens and plant health in general, and elucidate the role of the rhizosphere microbiology in this process. Bio-assays were developed to assess the effect of biochar soil amendments on the soil-borne plant-parasitic nematodes Meloidogyne chitwoodi on bean and carrot, Globodera sp. on potato and fungal pathogens Rhizoctonia solani, Sclerotinia sclerotiorum and Verticillium dahliae on lettuce, and on the air-borne Botrytis cinerea disease in strawberry. The effect of biochar varied with the type of biochar, the biochar dose, and whether it was combined with compost. For example, mixing 1% (dry weight, DW) biochar made from press cake at 600°C in field soil had a significant effect on the viability of the Rhizoctonia sclerotia; whereas no effect on the (micro)sclerotia viability has been noticed for the other types of biochar tested. Incorporation of 3% (DW) biochar produced from holm oak at 650°C in peat significantly reduced the incidence of Botrytis cinerea on strawberry leaves; whereas 1% (DW) amendment had no effect. Compost amendment reduced the plant-parasitic nematode population on carrot and potato, but this effect was absent in case of additional biochar application. We also investigated if all these biochar effects were correlated with changes in plant biomass, soil chemical and physical properties (water retention, nutrients, pH, EC, etc.) and rhizosphere microbiology. The latter was done using phospholipid-derived fatty acid (PLFA) analysis, 16S rDNA PCR-denaturing gradient gel electrophoresis (PCR-DGGE) analysis and next-generation-sequencing (NGS) of the bacterial metagenome. The DGGE analysis showed no clear shifts in the bacterial rhizosphere population two months after 1% DW PROININSO650 biochar incorporation in field soil, whereas preliminary PLFA and NGS data suggested changes in the rhizosphere microbiome.