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Biochar Soil Amendment Enhances Tomato Resistance to some Soil Borne Diseases

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Abstract

The present study aimed to determine whether biochar soil amendment can improve tomato resistance against wilt (caused by Fusarium oxysporum) and root rot (caused by Rizoctonia solani) diseases under greenhouse conditions. It was also attempted to unravel the physiological and biochemical mechanisms involved in biochar-mediated systemic responses of plant to these phytopathogens. The plants were cultivated into plastic pots, containing soil mixtures (clay and sand; 1: 3 v/v) that was homogenized with or without biochar 5 % by weight. The soil mixtures in which the plants grown were either infested with F. oxysporum, R. solani or left un-inoculated. There were altogether six treatments, each with 10 replicates. In the absence of biochar, fungal pathogen infection adversely influenced the plant growth, reducing the total plant biomass by up to 69 % and 55 % in F. oxysporum and R. solani, respectively, compared to the controls. Disease incidences were comparatively higher, being 86.6±5.7 % and 80.0±10.0 % for F. oxysporum and R. solani, respectively. Similarly, the disease severities were highest in the absence of biochar, reaching 75.0±3.0 % and 67.6±6.8 % for F. oxysporum and R. solani, respectively. Biochar amendment significantly improved plant growth and vigour, an effect that was more pronounced for infected plants. 5 % biochar treatment led to enhance the total biomass by up to 20 % (non-infested controls), 93 % (F. oxysporum inoculated plants), and 75 % (R. solani inoculated plants) relative to the respective controls. Plants grown in amended substrate exhibited remarkably higher resistant to F. oxysporum and R. solani (indicated by 85 % and 80 % lower diseased incidences and 84 % and 80 % lower disease severities). This was coincided with an improved water balance, increased phenolic compound and higher PAL and PO activities. Our results revealed that biochar soil utilisation could negate some of the detrimental effects caused by F. oxysporum and R. solani, conferring higher resistance and survival of tomato plants under constrained conditions.

Keywords: Biochar, enzyme activity, Fusarium wilt, phenolic compounds, Rizoctonia solani, tomato

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