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Mn-oxidation and Reduction Capacity of Rhizosphere Microorganisms as Related to the Severity of Soil Borne Plant Diseases

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Abstract

Crop production is frequently limited by various soil-borne pathogens such as, Streptomyces, *Gaeumannomyces graminis*, Pythium, Sclerotium and Rhizoctonia. Micronutrients play a vital role in determining disease resistance in plants and among them Manganese (Mn) is of outstanding importance. The plant availability of Mn in soils depends on pH, redox potential and microbial activity in the rhizosphere. The activity of Mn-reducing microorganisms in the rhizosphere increases Mn solubility, while Mn can be immobilised by microbial Mn oxidisers Many pathogenic microbes exhibit a Mn-oxidising potential (e.g. *G. graminis*) and plant growth promoting microbes are often Mn-reducers (e.g. *Pseudomonas spp.*). However, little information is available on interactions of microbial activity with the Mn status of plants as related with suppression of soil borne pathogens. A better understanding of rhizosphere processes determining plant availability of Mn, may offer perspectives for alternative disease management strategies reducing environmental risks of pesticide applications. In this study, we tested two complementary microbiological methods to investigate the soil Mn-oxidising and Mn-reducing capacity of rhizosphere microorganisms in relation to the severity of soil-borne plant diseases ."Take-all" disease in wheat caused by the soil-borne fungus *G. graminis* var. tritici.was used as a model system. In a culture-dependent method, microbial populations were assessed, using an agar plating technique with selective media. Bacterial colonies of Mn reducers were identified by their clear halo in agar with finely suspended Mn (IV)-oxide, whereas Mn oxidisers were surrounded by dark deposits of oxidised Mn on agar containing reduced Mn^{2+}. In the second method, substrate-induced Mn reduction potential in soil was determined by incubating soil samples with MnO_2 and yeast extract solution for one week under continuous shaking (aeration). Reduced Mn was determined by Diethylenetriaminepentaacetic acid (DTPA) extractaction. The total number of Mn-reducers (log 6.01 to 7.42 cfu per g soil) in different soils was significantly correlated with DTPA extractable Mn (80 to 140 ppm), shoot Mn concentration (18 to 50 ppm) and the severity of take-all disease in wheat.

Keywords: Disease resistance, Mn-oxidisers and Mn-reducers, rhizosphere, Soil-borne pathogens

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