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Effects of Elevated Temperature on Microbial Growth and Enzyme Kinetic During Transition from Rhizosphere to Root-Detritusphere

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Microbial growth and enzyme activity depend on carbon availability, which strongly differs in rhizosphere and root-detritusphere. Elevated temperature is expected to intensify enzymatic processes in these spheres. However, the response of soil enzyme activity to elevated temperature may be influenced by microbial growth, driven by variations in carbon availability. Therefore, our study investigated the response of enzyme kinetic parameters to elevated temperature during transition from rhizosphere to root-detritusphere and potential linkage to microbial growth. For this purpose, we measured active microbial biomass (AMC) and growth rate (μ) through substrate-induced growth respiration, as well as kinetic parameters of □-glucosidase (GLU) in rhizosphere (six weeks after planting) and root-detritusphere (four weeks after shoot cutting) of wheat at two different temperatures, 20 □C and 30 □C.

At both temperatures, a higher μ was observed in the root-detritusphere compared to the rhizosphere. Elevated temperatures significantly enhanced μ by 2.13 and 2.23 times in the rhizosphere and root-detritusphere, respectively. Additionally, AMB in root-detritusphere was lower than in the rhizosphere at both temperatures. Notably, at 30 □C, AMB in the rhizosphere and root-detritusphere was 4.7 and 2.9 times lower than that at 20 □C, respectively. The lower AMB in root-detritusphere and higher temperature, results from microbial starvation caused by rapid substrate uptake and fast growth. At 20 □C, V_{max} of GLU in root-detritusphere was higher than in rhizosphere, whereas at 30 □C, the trend was reversed. Elevating the temperature from 20 □C to 30 □C within the rhizosphere resulted in an increase of 98% in the V_{max} of GLU. Conversely, in the root-detritusphere, this temperature shift led to a reduction of 29% in the V_{max} of GLU. The findings indicate that a reduction in AMB within the root-detritusphere leads to a downregulation of enzyme production. However, enzyme production in the rhizosphere is intricately regulated by both living roots and soil microorganisms, rendering it unaffected by changes in AMB.