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Effect of warming on β-glucosidase activity and root exudates depends on soil moisture: Combining Zymography with glucose imaging and enzyme kinetic

Seyed Sajjad Hosseini[1,2], Sayeda Rabia Sultan[2], Mehdi Rashtbari[2], Amir Lakzian[1], and Bahar S. Razavi[2]

[1]Department of Soil Science, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran,
[2]Department of Soil and Plant microbiome, Institute for phytopathology, University of Kiel , Germany

Temperature and soil moisture strongly affect plant root exudates and enzyme activities. Global warming may stimulate root exudation and enzyme activities while drought can drop releasing of root exudates and inhibit enzyme activities. However, how the interaction of warming and drought regulate these processes in the rhizosphere is poorly known. To clarify these interactions, wheat plants were grown for one month at 20 and 30 °C in drought (30% WHC) and optimum (70% WHC) condition. To investigate the pattern of root exudates releasing and enzyme activities, we combined β-glucosidase zymography with glucose imaging and enzyme kinetic.

Drought significantly decreased hotspots of glucose in compare to optimum condition at both temperatures. Releasing of glucose by wheat at 30 °C was 53% lower than at 20 °C in optimum condition. Hotspots of β-glucosidase activity in drought was 52% and 37.7% lower than in optimum at 20 and 30 °C, respectively. β-glucosidase hotspot at 30 °C was 12.2% lower than at 20 °C in optimum condition. The results of enzyme kinetic (V_{max} and K_m) showed that drought decreased β-glucosidase activity in compare to optimum condition at both temperatures. β-glucosidase activity at 30 °C was 2 times higher that at 20 °C in optimum condition. On the contrary, it was 56% lower than at 20 °C in drought condition. Drought increased K_m at 20 °C while decreased it at 30 °C in compare to optimum condition. The affinity of β-glucosidase for substrates in optimum condition was not affected by temperature. K_m value at 30 °C was lower than at 20 °C in drought condition. According to these results, the warming in optimum condition (high labile carbon availability) decreased enzyme production and substrates release and did not change the affinity of enzyme for substrates. While warming in drought condition (low labile carbon availability) produced an enzyme pool with high efficiencies and did not change enzyme production and substrates release.