SPECIFIC PHOSPHOLIPID FATTY ACID COMPOSITION OF THE MICROBIAL BIOMASS OF CALCAREOUS CHERNOZEM AND HUMIC SANDY SOILS

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Abstract

The specific phospholipid fatty acid (PLFA) composition of the microbial biomass of calcareous chernozem and humic sandy soils was determined using a gas chromatograph with flame ionization detector (FID) and MIDI-Inc. complex data analysis software. The total PLFA extracted from the soil characterizes the microbial biomass, and the quality of PLFAs can be used to determine the presence and dynamics of specific taxon groups.

The objective of our work was to select, modify and develop the most suitable method for the parameters of our measurement system from the several sample preparation methods recommended in the literature for the measurement of soil microbial communities based on PLFA determination.

The modified sample preparation method was used to compare the phospholipid fatty acid profiles of calcareous chernozem soil (Debrecen-Látókép) and humic sandy soil (Debrecen-Pallag) from pot experiments with significantly different properties. The calcareous chernozem soil had a higher and more diverse PLFA content. The total PLFA on chernozem was 23.16 nmol/g, in sandy soil was one third lower, 7.23 nmol/g, suggesting a higher living microbial biomass in chernozem soil.

Bacterial biomass was higher than fungal biomass in both soil types. The biomass of Gram-negative bacteria slightly exceeded that of Gram-positive bacteria on chernozem and significantly exceeded that of Gram-positive bacteria on the sand. In addition, we also analysed how significantly different water supply, ideal supply and drought stress modify the PLFA composition of the microbial community of calcareous chernozem.

Our results demonstrated that drought stress reduced the total PLFA from 23.16 nmol/g to 16.49 nmol/g. Drought stress reduced the PLFA biomarker of mycorrhizal fungi by about half. The biomass of Gram-negative and Gram-positive bacteria were also reduced, but their proportions were not affected by different water supplies. The fungi/bacteria ratio decreased slightly in the drought-stressed environment. Under drought stress, the ratio of saturated to monounsaturated PLFA fatty acids, which can be sensitive to environmental stress as a stress factor, increased compared to the value in the ideal water supply model.

In conclusion, our results showed that the chernozem soil had more types and higher amount of extractable phospholipid fatty acids, which allowed to estimate a higher living microbial biomass in this soil type than in sand. The mass of living microbial biomass present in calcareous chernozem soil was significantly reduced under drought stress.