Acid Phosphomonoesterase in a Floodplain Forest Soil

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In forest soils, the decomposition and mineralization of organic compounds appear to be the preconditions for the natural supply of woody species with phosphorus. The release of orthophosphate ions from organic substances is implemented by phosphatases and phosphohydrolytic enzymes with acid or alkaline pH optimums.

Materials and methods

The study area is situated in the South Moravian floodplain forest growing in the alluvia of the lower reaches of the River Dyje. The approximately 100-year-old managed forest stand is composed of Quercus robur L. and Fraxinus angustifolia Vahl. as the dominant tree species.

According to the FAO-UNESCO system the soil type of this area was classified as eutric fluvisol. The seasonal dynamics of the activity of acid phosphomonoesterase /acid PME/ was monitored in 3 soil horizons: i/ Of /depth 1-2 cm/, ii/ Ah /depth 2-8 cm/, and iii/ Bg /depth 15-25 cm/. The soil samples were taken from 3 different plots in the moisture gradient during the 1988 season. Plot No. L 1 was the driest, plot L 2 was moderately moist and plot L 3 was the wettest. No significant climatic extremes were recorded in this area in 1988. The present soil status is the result of water management measures in the originally flooded region.

1 g of fresh soil was placed in a 100 ml incubation flask, to which 10 ml of succin-borate buffer /pH 4.7/ containing 500 μmol l^{-1} of p-nitrophenyl phosphate was added. The reaction mixture was incubated for 1 hour at 23 ^{o}C, after which 1.5 ml of the deproteinizing solution Urasol /which contains 3.7 mmol l^{-1} of uranyl acetate and 0.13 mol l^{-1} NaCl/, or 10% trichloroacetic acid was added to terminate the action of the enzyme on the substrate. The first filtration of the soil suspension followed addition of 1 ml of 0.1 mol l^{-1} $CaCl_2$. After adding 2.5 ml of 1 mol l^{-1} KOH to the filtrate, a second filtration was carried out. The absorbance of the yellow filtrate was measured using a spectrophotometer at 410 nm.

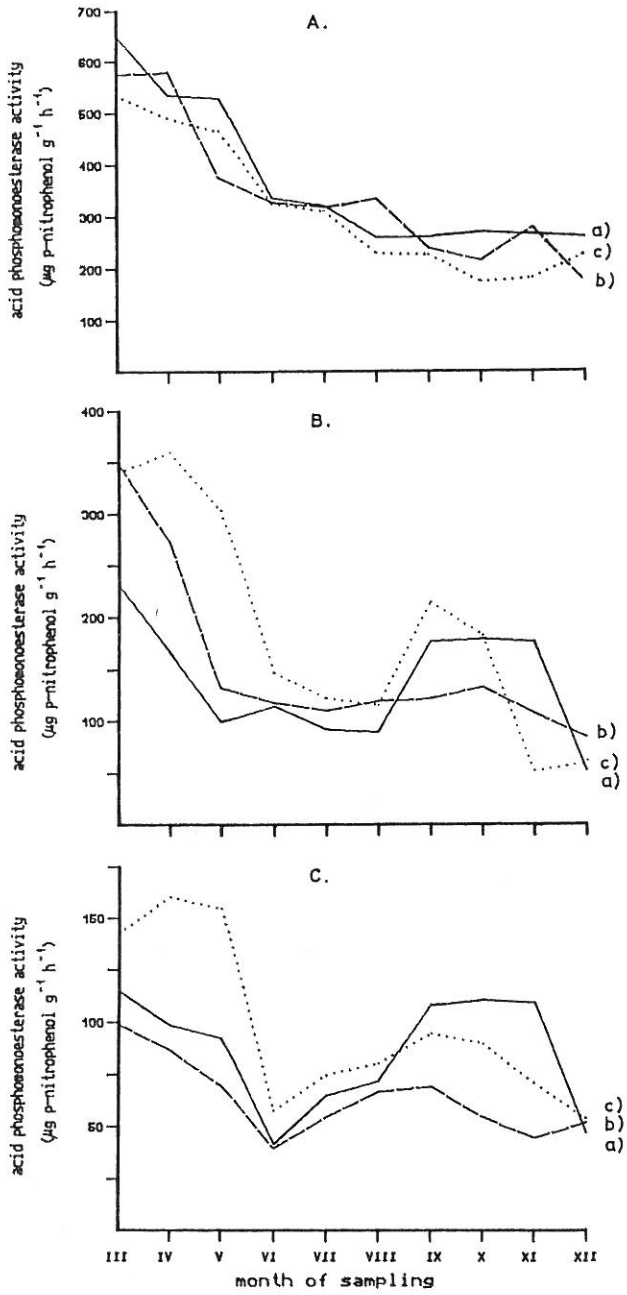

Fig. 1

Acid PME activity in the moisture gradient of three horizons in three study plots. Horizons: A. Of /1-2 cm/; B. Ah /2-6 cm/; C. Bg /15-25 cm/. Study plots: a/ L_1; b/ L_2; c/ L_3

Results

A decreasing trend in acid PME activity was found towards the lower horizons /Fig. 1/. In contrast to the highest activity in the organic horizon Of the activity of acid PME was 2-4 times lower in the Ah horizon. The value of acid PME activity in the Bg horizon was either 2-times lower or comparable with that in the Ah horizon.

The seasonal dynamics of acid PME activity in the Of horizon shows a significant spring maximum and a slowly decreasing trend in the rest of the season /Fig. 1A/.

Two-maxima dynamics is typical of both the Ah and Bg horizons /Fig. 1B and 1C/. The summer depression of acid PME activity was found in both cases.

Two-peak seasonal activity occurs in plot No. L 1, with both maxima reaching similar values. The seasonal activity in plot No. L 2 has a significant spring maximum and a slightly decreasing trend without any disturbances. Two-peak seasonal activity is also typical of plot No. L 3, the only difference being that the spring peak is much higher than the autumn one.

Discussion

HARRISON and PEARCE /1979/, BOLTON et al. /1985/, RAM et al. /1985/ and other authors pointed out the serious role of soil moisture in phosphatase activity. CHAZIEV /1982/ distinguished 3 different types of enzyme seasonal dynamics. The summer depression type with a higher peak either in the spring or in the autumn is comparable with the seasonal dynamics investigated in this paper. This type is typical of an ecosystem with a summer water deficiency /CHAZIEV, 1982/. The finding of similar seasonal dynamics in a floodplain forest ecosystem suggests that water management measures have a strong impact on the biological activity of the ecosystem.

References

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