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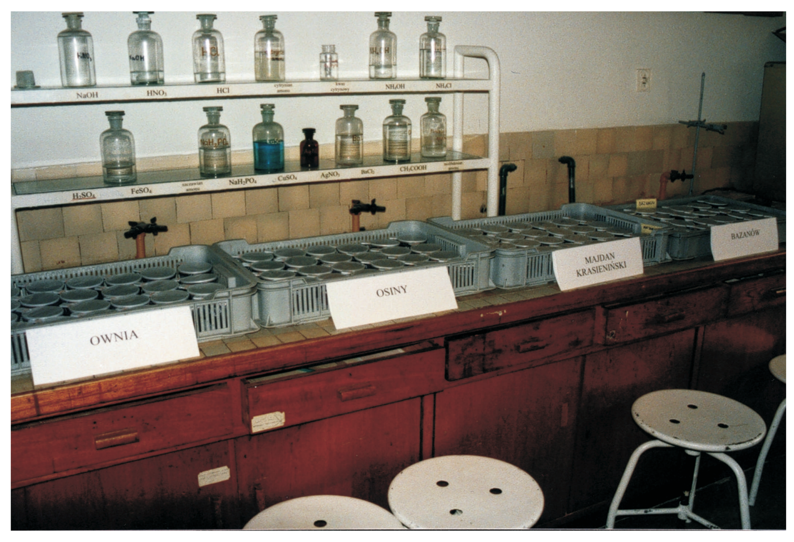
ACIDIFICATION AS A CONTROLLING FACTOR FOR THE CONTENT OF AN ACTIVE FORM OF NUTRIENTS IN SOIL

Aim, Material and Methods

The effect of soil acidification on the content of nutrients active form ($N\text{-}NH_4$, $N\text{-}NO_3$, $P\text{-}PO_4$, K^+, Ca^{2+}, Mg^{2+}, Zn^{2+}) in soil, was studied in a simple laboratory experiment (Pic. 1).

For the experiment, 4 kg total weight average soil samples were taken from 0-20 cm layout from 4 different soils. A soil material was sifted through a plastic sieve with a mesh size of 1 mm. The experimental unit was 250 g of soil sample in a plastic cup (Pic. 2). Different values of pH, which are occurring in Polish soils (pH: 3.5 - 7.5), were simulated in these samples. Simulation of the pH was carried out by the addition of NaOH (1 mol · dm^{-3}) and HCl (1 mol · dm^{-3} and 0.1 mol · dm^{-3}), as well as by maintaining a 60% full water volume for 6 months. Proper amounts of sodium hydroxide and hydrochloric acid were determined by buffer capacity of the soil. After incubation, under room conditions with a temperature of 20°C, single-time nutrients extraction was carried out by a 1 hour agitation of the soil material with redistilled water, at a ratio of 1 to 10 (soil to water). The soil-water mixture was filtered under pressure and the contents of $N\text{-}NO_3$, $N\text{-}NH_4$, $P\text{-}PO_4$, K^+, Ca^{2+}, Mg^{2+} and Zn^{2+}, were measured in the received solution. Nitrate nitrogen, ammonium nitrogen and phosphorus analyses were carried out by the colorimetric method. The contents of calcium, potassium and magnesium were determined by using the F-AAS method. The contents of zinc were determined by using the ET-AAS method. Laboratory experiment results were statistically worked out by analysis of variance double classification method with Tukey's confidence semi ranges. Values of pH were calculated in advance to hydrogen ions concentration in the water-soil suspension. The relationships between the hydrogen ions concentration in the water-soil suspension and nutrients active form concentration in soil, were estimated as simple correlation method and linear regression analysis.

The content of the selected nutrients active form was compared between soils with diversified pH. The assumption was that, the nutrient active form is most sensitive on leaching in the case of adequate water flow through the soil profile



Pic. 1. The laboratory experiment (2001).

Pic. 2. The plastic cup with soil sample closed by PARAFILM M in the laboratory experiment (2001).

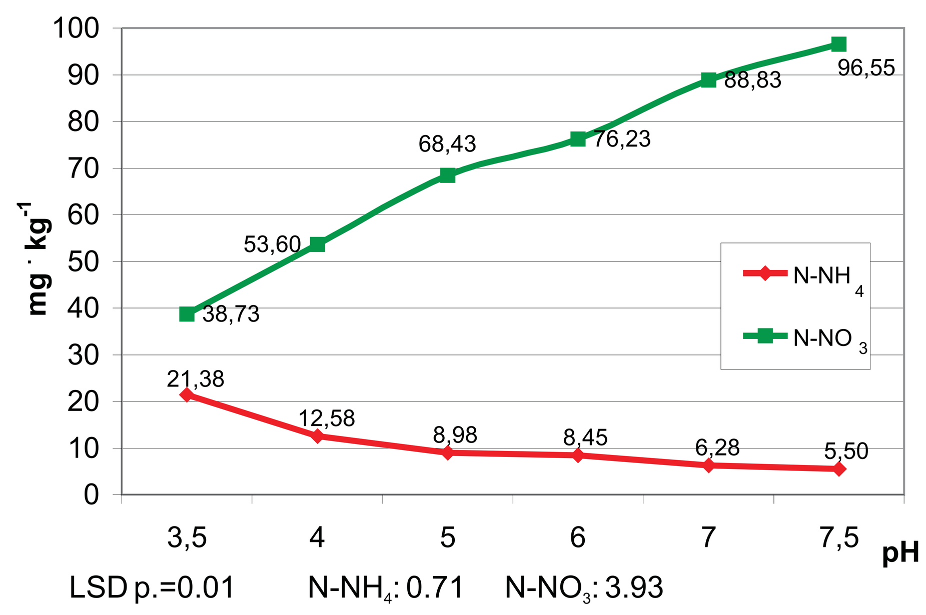


Fig. 1. Average content of nutrients active form ($N\text{-}NH_4$, $N\text{-}NO_3$) in soils.

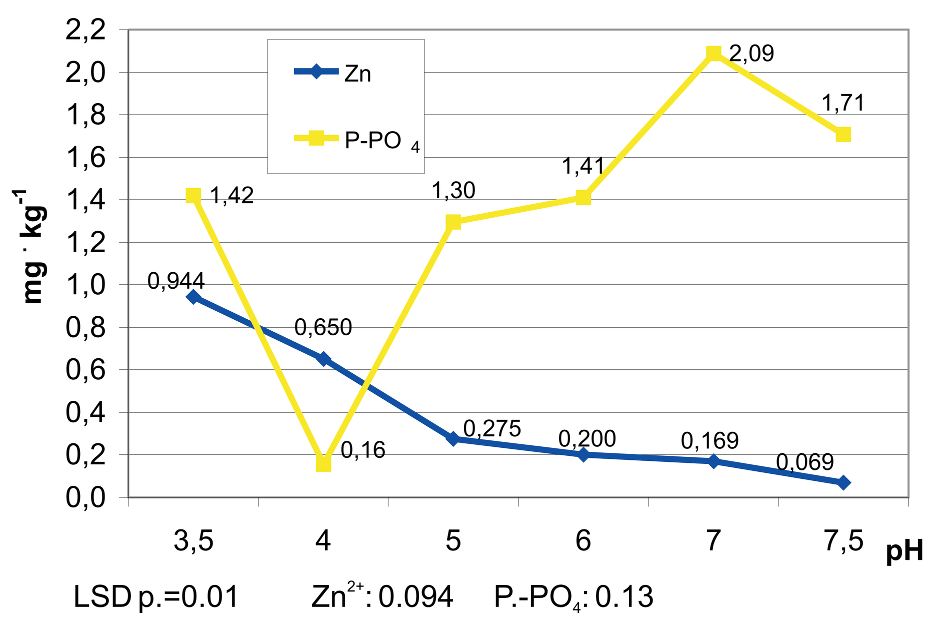


Fig. 2. Average content of nutrients active form (Zn^{2+}, $P\text{-}PO_4$) in soils.

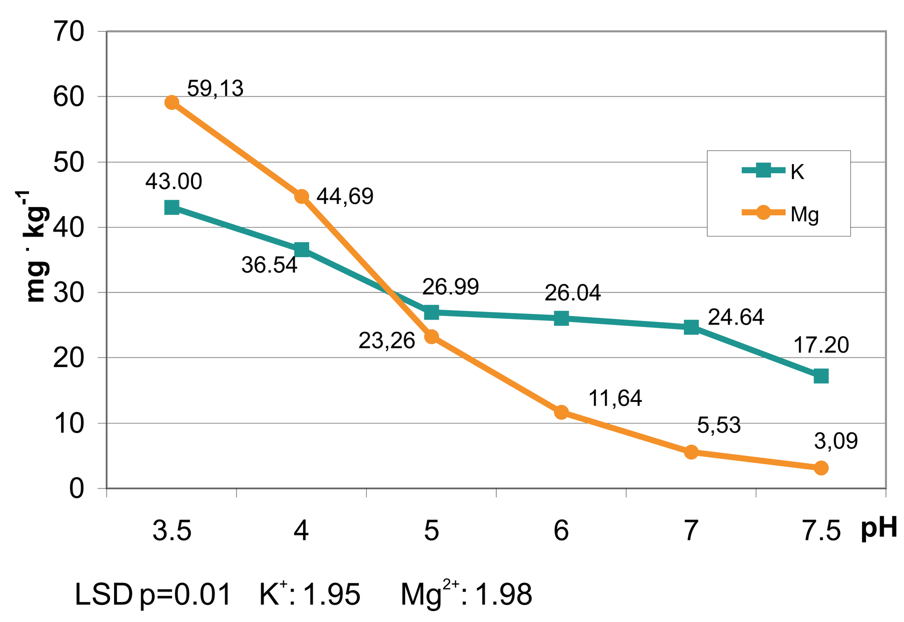


Fig. 3. Average content of nutrients active form (K^+, Mg^{2+}) in soils.

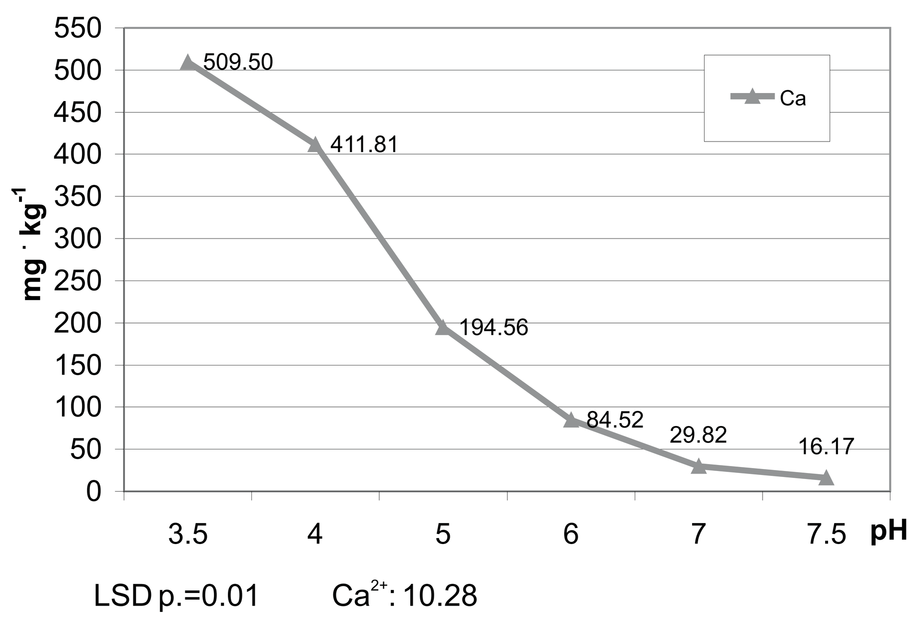


Fig. 4. Average content of nutrients active form (Ca^{2+}) in soils.

Coefficient	$N\text{-}NH_4$	$N\text{-}NO_3$	$P\text{-}PO_4$	K	Ca	Mg	Zn
R	0.5802**	-0.7187**	-0.0553	0.4351*	0.8585**	0.7319**	0.6843**
B	42.404	-147.952	-0.989	73.4488	1494.61	176.104	2.5107

* Significant at p = 0.05 ** Significant at p = 0.01

Tab. 1. Correlation R and regression B coefficients relationship of Y = BX + C between pH converted to hydrogen ion concentration H^+ in the soil suspension (X) [mmol H^+ · kg^{-1}] and content active form of nutrients in soil (Y) [mg · kg^{-1}].

Conclusions

1. Soil acidification clearly influences on the nutrients mobility in the laboratory experiment, where it was eliminated or standardized due to the impact of other environmental factors.

2. The content of nitrate nitrogen in the soil was decreased significantly as acidification increased, probably as a result of nitrification limitation efficiency which is conducted by autotrophic bacteria.

3. The content of $N\text{-}NH_4$, K^+, Ca^{2+}, Mg^{2+} and Zn^{2+} was increased as soil acidification increased. It was probably connected with mechanics of exchangeable cations displacing from sorption complex by H^+ and Al^{3+} ions, reduction of sorption complex capacity and organic matter sorption capacity due to the acidification.

4. Influence of acidification on the phosphorus mobility in soil was not significant as for the others nutrients. But low $P\text{-}PO_4$ content under pH 5.5 could be effect of phosphorus immobilisation to insoluble compounds with Al and Mn.

Summary

The effect of soil acidification on the content of nutrients active form ($N\text{-}NH_4$, $N\text{-}NO_3$, $P\text{-}PO_4$, K^+, Ca^{2+}, Mg^{2+}, Zn^{2+}) in soil, was studied in a simple laboratory experiment, which included a soil material from 4 different soils. Different pH values which are occuring in Polish soils (pH: 3,5; 4,0; 5,0; 6,0; 7,0; 7,5), were simulated by the addition of particular volumes NaOH or HCl according to buffer capacity of the soil. 60% of field water volume was maintained for 6 months. Extraction of basic micro- and macronutrients was carried out with redistilled water after their incubation. Soil - water mixture was filtered under pressure and after that the contents of nutrients active forms were measured in received solution. It was found that acidification of the soil influenced the contents of some nutrients active forms. These forms are susceptible to leaching in case of water flowing through soil profile.

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