Long-term nitrogen fertilization can increase the availability of residual phosphorus in arable soil

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Abstract Id: 300
Submitted: 30. September 2019
Event: 8th International Nitrogen Initiative Conference (INI2020)
Topic: 4a - Threats for terrestrial biodiversity; understanding of nutrient cycles and biosphere-atmosphere interaction

The agriculture in the Czech Republic has been characterized in the past thirty years by a reduction of 37% in basic fertilization with organic fertilizers, basic fertilization with phosphorus and potassium (a reduction of 73% and 82%, respectively), and conversely by increasing fertilization with mineral nitrogen (by 31%). Local farming is destined mainly by economic criteria irrespectively to established agricultural practice; i.e. to crop rotation, to the use of organic fertilizers, and phosphorus and/or potassium mineral fertilizer.

Despite the abandonment of traditional farming practices, yields supported by increasing doses of mineral nitrogen fertilization continue to increase. One explanation is clear - the phosphorus reserves in the soil from fertilization in the past (between 1905 and 2005) are twice the average hectare reserves of phosphorus in neighbouring Austria and Poland (but at the same time a quarter less) than in Germany. And the annual balance of -2.1 kg P / ha allows such intensive agriculture for another 690 years.

An experiment was conducted to determine how mineral nitrogen (N) fertilization, the accompanying loss of natural soil structure and the breakdown of macro-aggregates affect changes in phosphorus availability in local arable soil. In the case of the disintegration of macro-aggregates into the original soil particles, i.e. sand, silt and clay, the sources of phosphorus are no longer spatially protected and plants gain the advantage of easier access to residual phosphorus accumulated in the soil from mineral fertilizer in the past. We hypothesise that the major sources of phosphorus, which are strongly bound in the solid phase of the soil (a type of orthophosphate anion species and phytate), have become the subject of direct trade between roots and soil without the need to stimulate microorganisms.

The timing of the experiment was to the 5th vegetation period in 2017, to the non-vegetation period 2017/2018, and to the 6th vegetation period in 2018. Mineral N fertilizer

was applied annually in half dose (68 kg N per hectare) and in full dose (136 kg N per hectare). In the fourth year of the experiment, the stability of the aggregates increased by 12.5% in the non-fertilized variant over the variants fertilized with mineral nitrogen The obtained cumulative results generally confirm a higher availability of phosphorus in mineral nitrogen fertilized soils, with a greater difference being found at a soil depth of 50 cm (about 34%) than at a depth of 25 cm (about 18%). Although there is evidence that long term nitrogen fertilizer application leads to mobilization of soil phosphorus, the real size of the residual P pool that can potentially be mobilized in this questionable way remains unknown.