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Kommission IV: Bodenfruchtbarkeit und Pflanzenernährung

Biogeochemie gekoppelter Stoffkreisläufe (NPK) unter traditioneller Landnutzung

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Titel
Phosphorus bioavailability in soil profiles of a long-term fertilizer experiment: The evaluation of their bioaccessibility

Abstract
Global agricultural productivity depends on the use of finite phosphorus (P) resources of which not only the topsoil, but also subsoil, can hold immense reserves. To assess potential soil contribution to plant nutrition, we compared the P status of Stagnic Cambisol profiles in experimental plots that received different P fertilizer applications (control, triple superphosphate (TSP), compost, compost+TSP) for 16 years. Sequential fractionation was combined with P K-edge X-ray absorption near edge structure (XANES) spectroscopy to identify the chemical P speciation. Fertilized topsoils (21 to 69 kg P $ha^{-1}a^{-1}$) showed P reserves larger by a factor of 1.2 to 1.4, and subsoil P reserves larger by a factor of 1.3 to 1.5 than those of the control. P-XANES revealed the predominance of inorganic P species such as moderately labile Fe- (46 to 92%), Al- (0 to 40%), and Ca- (0 to 15%) P compounds besides organic P (0 to 13%) in all treatments. The fertilizer application slightly altered P speciation throughout the profiles, but the type of fertilizer had no significant effect on it. Optimal plant growth requirements are restricted by the exchangeable P from the solid phase within the soil solution. Therefore, ongoing research focuses on the accessibility of P from P loaded amorphous Fe- and Al-hydroxides, previously identified as the predominant abiotic P forms. To assess their P desorption potential, P-33 rhizotron experiments combined with P-33 isotopic exchange kinetics (IEK) are underway. Preliminary results indicated that besides differences in P binding capacity of soil hydroxides, physical soil parameters, such as the matric potential, strongly control soil P availability, thus plant P acquisition rates can vary among different soil types. Our results gained new detailed information about P bioavailability under agricultural practice. The investigations towards P bioaccessibility may contribute to improved interpretation of soil P tests and reduced fertilizer recommendations.