

Molecular Speciation of Phosphorus in Long-term Located Fertilization by Liquid-state Nuclear Magnetic Resonance Spectroscopy

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Abstract

The long-term substitution of mineral phosphorus (P) fertilizers by manure fertilizers combined with nitrogen (N) fertilizer can effectively reduce water pollution and slow down the consumption of P rock resources. Knowledge is needed about how those affect soil P forms to understand soil P cycling and plant P uptake. However, these mechanisms have not been fully elucidated. Therefore, we studied the effects of long-term fertilization on soil P forms in different soil depths. The results of the 40 years field experiments showed that fertilization can significantly improve the P extraction efficiency using NaOH-EDTA in different soil depths. The majority of P was in the form of orthophosphate for all the treatments, which constituted 14.9-483.6 mg/kg (0-20 cm), 24.1-224.4 mg/kg (20-40 cm), and 23.7-59.5 mg/kg (40-60 cm). The proportion of organic P forms was significantly increased by long-term fertilization in 20-40 cm soil layer. The concentrations of all P compounds in topsoil increased significantly under the treatment of the combination of manure fertilizer and mineral fertilizers (N and P). The addition of manure fertilizer extremely increased the stereoisomers of IHP (myo-IHP, scyllo-IHP, neo-IHP, and D-chiro-IHP) and the proportion and concentration of corrected diesters. Fertilization year had no significant difference in IHP stereoisomers and phosphate diester. The results indicate that in the long-term, different fertilization treatments and different soil depths had the best overall effect, which could significantly increase yield and the content of orthophosphate directly absorbed by crops and IHP stereoisomers that could be used by plants in the long run.

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