

长期施用有机肥和过磷酸钙对潮土有效磷积累与淋溶的影响

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Effects of long-term application of organic fertilizer and superphosphate on accumulation and leaching of Olsen-P in Fluvo-aquic soil.

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- 摘要
- 参考文献
- 相关文章

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摘要

利用20年定位试验研究了施用化肥和有机肥对潮土耕层土壤有效磷(Olsen-P)含量与作物产量的关系及土壤Olsen-P积累和垂直移动规律的影响.结果表明:土壤Olsen-P含量在10~40 mg·kg⁻¹能保证小麦、玉米有较高的产量,土壤Olsen-P含量大于40 mg·kg⁻¹发生显著淋溶,轻壤质潮土Olsen-P发生淋溶的阈值为40 mg·kg⁻¹.连续施用化肥(NPK)和秸秆还田处理(SNPK)施磷量在77~90 kg·hm⁻²,平均每100 kg P·hm⁻²使耕层土壤Olsen-P提高0.63~0.72 mg·kg⁻¹,每年提高0.49~0.65 mg·kg⁻¹,达到淋失阈值需要45~60年.有机肥与化肥结合(MNPK、MNPK2和1.5 MNPK),年施磷量为210 kg·hm⁻²时,土壤Olsen-P(Y)与施肥年度(x)的关系为: $Y_{1.5MNPK} = 4.506x + 6.4464$ ($R^2 = 0.8862$), 平均每年增加4.5 mg·kg⁻¹,连续施用8年可使耕层土壤Olsen-P达到淋失阈值;年施磷量为125和140 kg·hm⁻²时,土壤Olsen-P与施肥年度的关系为: $Y_{MNPK2} = 2.4765x + 13.563$ ($R^2 = 0.9307$)和 $Y_{MNPK} = 3.1097x + 6.9615$ ($R^2 = 0.8562$), 平均每年增加2.47和3.1 mg·kg⁻¹,连续施用11年可使耕层土壤Olsen-P达到淋失阈值.有机无机肥结合处理土壤Olsen-P积累速度是化肥处理的3.5倍,过量施用有机肥增加了土壤Olsen-P的积累和淋失.

关键词: 潮土 长期定位试验 Olsen-P 积累与淋溶 有机肥

Abstract:

Based on a 20-year experiment of fertilization with organic and chemical fertilizers on a Fluvo-aquic soil under wheat-corn cropping system, this paper studied the relationships between Olsen-P concentration in plough layer and crop yields as well as the accumulation and vertical translocation of Olsen-P in soil profile. The results showed that when the Olsen-P concentration in plough layer maintained at 10-40 mg·kg⁻¹, the grain yields of wheat and corn were higher, whereas when the concentration of Olsen-P in plough layer was higher than 40 mg·kg⁻¹, it started to leach, which meant that in light loam Fluvo-aquic soil, the threshold value for P leaching might be 40 mg·kg⁻¹. In the treatments of chemical fertilization (NPK) and corn straw returning (SNPK) with the P application rate of 77-90 kg·hm⁻², the Olsen-P concentration in plough layer was increased by 0.63-0.72 mg·kg⁻¹ per 100 kg·hm⁻² of applied P, with an annual increment of 0.49-0.65 mg·kg⁻¹ and needed 45-60 years for reaching the threshold value for P leaching. In the treatments of chemical fertilization combined with manure application (MNPK, MNPK2, and 1.5MNPK), the formula of Olsen-P accumulation in 0-20 cm soil layer were $Y_{MNPK} = 3.1097x + 6.9615$ ($R^2 = 0.8562$), $Y_{MNPK2} = 2.4765x + 13.563$ ($R^2 = 0.9307$), and $Y_{1.5MNPK} = 4.506x + 6.4464$ ($R^2 = 0.8862$). It might take 8 years to reach the threshold value for Olsen-P leaching when the P application rate in treatment 1.5MNPK was 210 kg·hm⁻², 11 years when the P application rate in treatments MNPK2 and MNPK was 125 and 140 kg·hm⁻². Organic fertilization combined with chemical fertilization increased the Olsen-P accumulation rate being 2.5 times higher than chemical fertilization. Excessive application of organic fertilizer could increase the accumulation and leaching of Olsen-P in soil profile.

Key words: Fluvo-aquic soil long-term experiment Olsen-P accumulation and leaching organic fertilizer

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