

## 长期施肥对红壤pH、作物产量及氮、磷、钾养分吸收的影响\*

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Effects of long-term fertilization on pH of red soil, crop yields and uptakes of nitrogen, phosphorous and potassium

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**摘要** 在湖南祁阳典型红壤上进行不同施肥长期定位试验18年, 观测了土壤pH、作物产量和氮、磷、钾养分吸收量的变化。结果表明, 长期施用化学氮肥(单施氮肥、氮磷配施和氮磷钾配施)红壤pH明显下降, 其中以单施氮肥降幅最大, 18年降低了1.5个单位; pH降低主要发生在施肥的前8~10年, 当pH下降到4.5时, 其下降速度趋于缓慢并相对稳定。施用有机肥(化学肥料配施有机肥和单施有机肥), 土壤pH保持稳定或较试验开始有所升高, 以单施有机肥处理pH升幅最大, 升高1.0个单位。不施肥和施用化学氮肥的作物产量随着施肥年限均显著降低, 其中小麦产量平均每年下降11~104 kg/hm<sup>2</sup>, 玉米产量平均每年下降 24~210 kg/hm<sup>2</sup>; 而施用有机肥的作物产量保持稳定或稳定增加, 其中化学肥料配施有机肥的玉米产量平均每年增加 101 kg/hm<sup>2</sup>。施用化学氮肥处理(除氮磷钾配施处理的玉米外)作物产量和氮、磷、钾养分吸收量与土壤pH均存在极显著正相关。可见, pH降低是作物产量和氮、磷、钾养分吸收降低的主要原因之一; 而施用有机肥能改善红壤酸度, 尤其是化学肥料配施有机肥能获得持续高产, 是红壤区的最佳施肥模式。

**关键词:** 长期施肥 红壤 pH 作物产量 养分吸收量

**Abstract:** The effects of long-term (18 years) fertilization on pH of red soil, crop yields and uptakes of nitrogen, phosphorus and potassium were investigated in a wheat-maize experiment located in Qiyang, Hunan province. The results indicate that pH values of the red soil are significantly decreased under the applications of chemical nitrogen fertilizers, single application of chemical nitrogen fertilizer, mixed-application of chemical nitrogen and phosphorus fertilizers and mixed-application of chemical nitrogen, phosphorus and potassium fertilizers. The greatest decrease of 1.5 units of soil pH under the single chemical nitrogen fertilizer treatment is observed after 18 years fertilization compared with its initial pH value. The soil pH values under the chemical nitrogen fertilizer treatments are decreased significantly and then become stable after 8-10 years when soil pH≤4.5, while the application of manure or manure combined with chemical fertilizers could maintain or increase soil pH compared with their initial pH values of the experiment, in which the highest increase value of 1.0 unit is found in the manure treatment. Compared with the corresponding initial yields of the experiment, the yields for the no fertilizer and chemical nitrogen fertilizer treatments show decline trends of 11 to 104 kg/(ha·a) for wheat and 24 to 210 kg/(ha·a) for maize, respectively. However, in the manure combined with chemical fertilizers treatment, the yield of wheat has no remarkable change, and the yield of maize is increased 101 kg/(ha·a). The yields and uptakes of nitrogen, phosphorus and potassium for wheat and maize have significant positive correlations with soil pH under the chemical nitrogen fertilizer treatments (except yield and uptake in the treatment of mixed-application of nitrogen, phosphorus and potassium fertilizers). Soil acidification is one of the main factors limiting nutrient uptakes and crop yields. Application of manure could increase soil pH value, decrease soil acidity. Addition of manure combined with chemical fertilizers could maintain high yields of wheat and maize in the long run and is the best fertilization mode.

**Keywords:** long-term fertilization red soil pH crop yield nutrient uptake

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