土 壤 学 报
ACTA PEDOLOGICA SINICA
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陈 林,张佳宝,赵炳梓,黄 平.不同施氮水平下土壤的生化性质对干湿交替的响应[J].土壤学报,2013,50(4):675-683.Chen Lin,Zhang Jiabao,Zhao Bingzi and Huang Ping.Soil fertility and its response to drying-wetting alternation as affected by nitrogen fertilization rate[J].Acta Pedologica Sinica,2013,50(4):675-683

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不同施氮水平下土壤的生化性质对干湿交替的响应

Soil fertility and its response to drying-wetting alternation as affected by nitrogen fertilization rate

投稿时间： 2012-08-28 最后修改时间： 2012-12-21

DOI：10.11766/trxb201208280334

中文关键词： 施氮水平 土壤肥力 干湿交替 生化性质

Key Words:Nitrogen fertilization rate Soil fertility Drying-wetting alternation Biochemical properties

基金项目:国家重点基础研究发展规划（973计划）项目(2011CB100506)资助

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中文摘要:

以中国科学院封丘农业生态试验站水氮耦合长期试验地为研究平台，采集五个施氮水平（施氮0、150、190、230、270 kg hm^{-2}）下表层0~20 cm土壤并测定其土壤肥力参数（土壤pH、全氮、全磷、全钾、碱解氮、速效磷、速效钾、有机碳）。结果表明：施氮降低了土壤pH、速效磷、全钾，增加了全氮、碱解氮、有机碳，除有机碳随施氮水平的增加而增加外，其他肥力参数并未随施氮水平的增加而发生规律性变化。土壤经过0、3、6、10次干湿交替，培养60 d后测定其生物和化学性质（土壤铵态氮、硝态氮、溶解性有机碳、脲酶活性、脱氢酶活性、微生物生物量碳、土壤基本呼吸）。双因素方差分析显示干湿交替次数对铵态氮、硝态氮、无机氮、溶解性有机碳、脱氢酶活性、微生物生物量碳和土壤基本呼吸均有极显著作用，而干湿交替次数和施氮水平对除脱氢酶活性以外的其他土壤性质均无交互作用。五个施氮水平下土壤硝态氮、无机氮、溶解性有机碳、脲酶活性、脱氢酶活性和微生物生物量碳均随干湿交替次数增加而增加，土壤基本呼吸随干湿交替次数增加而降低。高施氮水平（施氮超过190 kg hm^{-2}）下土壤性质的变异系数更小并能更好地发生聚类。研究表明当土壤遭遇干湿交替时，高施氮水平下土壤更能维持其生化性质的稳定。

Abstract:

In the field of a long-term experiment on integrated water and nitrogen management in the Fengqiu National Agro-ecological Experiment Station, soils samples were collected from plots subjected to different nitrogen fertilization rates (NR), i.e. 0, 150, 190, 230 and 270 kg hm^{-2} per season, separately for analysis of parameters of soil fertility (i.e. soil pH, total N, total P, total K, alkalytic N, available P, available K and organic C). Results show that nitrogen fertilization decreased soil pH, available P and total K, but increased total N, alkalytic N and organic C to a varying degree. Apart from organic C which gradually increased with the increase in NR, no other parameters demonstrated any regular changes with increasing NR. After being subjected to 0, 3, 6 and 10 cycles of drying-wetting alternation and 60 days of incubation, soil samples were analyzed for chemical and biological properties (i.e. ammonium N, nitrate N, dissolved organic C, urease activity, dehydrogenase activity, microbial biomass C and basal soil respiration). Two-way ANOVA demonstrates that the number of drying-wetting cycles (NDW) considerably (p< 0.001) affected ammonium N, nitrate N, inorganic N, dissolved organic carbon, dehydrogenase activity, microbial biomass C and basal soil respiration, and that NR and NDW had no significant interactive effects on soil properties, except for dehydrogenase activity. Irrespective of NR, nitrate N, inorganic N, dissolved organic C, urease activity, dehydrogenase activity and microbial biomass C increased with NDW, while BSR responded reversely. Soil properties variation coefficients in soils under high-rated nitrogen fertilization (> 190 kg hm^{-2}) were lower, and easier to get cluster. The above findings demonstrate that in soils subjected to drying-wetting alternation, high-rated nitrogen fertilization may help maintain their biochemical stability.

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