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研究论文

陕北黄土丘陵区撂荒草地群落生物量及植被土壤养分效应

杜峰，梁宗锁*，徐学选，山仑，张兴昌

西北农林科技大学，中国科学院水利部水土保持所，黄土高原土壤侵蚀与旱地农业国家重点实验室，陕西 杨陵 712100

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摘要 为了明确植被演替过程中植被与土壤的互动效应，为植被恢复提供依据。根据陕北黄土丘陵区36块不同年限（时间尺度为2～45a）的撂荒样地地上生物量、土壤养分和水分的测定结果，及4块典型撂荒群落样地地上/地下生物量，7种撂荒群落主要植物生长特性的测定，分析了撂荒演替过程中群落生物量与土壤养分的变化过程、趋势及其相互关系，进而探讨了撂荒演替过程中群落生物量对土壤养分的作用效应，并利用多元回归和通径分析法分析了土壤养分对群落生物量的作用。结果表明：（1）除速效磷外，撂荒演替过程中群落地上生物量和土壤有机质、全氮、全磷、全钾、NO_3-N、NH_4-N和速效钾都呈先减少后增加的趋势，步调基本一致。（2）从撂荒年限与土壤养分的相关性来看，0～20cm土壤有机质含量、速效磷含量和0～20、20～40cm 土壤层NO_3-N含量与撂荒年限相关显著，说明演替过程中有机质、速效磷和NO_3-N有较为明显的植被土壤效应，而其它土壤养分与撂荒年限相关不显著，不能排除演替初始条件和植物暂时固定的影响；从群落生物量与土壤养分的相关性来看，群落生物量对土壤有机质、全氮、磷、钾、NO_3-N、速效钾和速效磷含量具有正效应，而对NH_4-N具有负效应，但都不显著。（3）通径分析说明撂荒年限、土壤全氮、全钾、速效钾和土壤水分变异量对生物量表现为正的直接作用，其中以撂荒年限和土壤水分波动量作用较大，土壤养分对群落地上生物量的作用以土壤全氮最大，全钾和速效钾影响较小；演替过程中群落地上生物量的变化主要是由于植被盖度和群落组成种的生态学特性造成的（撂荒年限较大的直接作用），其次是由于撂荒演替过程中土壤水分的波动造成的（撂荒年限通过土壤水分的间接负作用）。（4）随着土层深度的加深植物根系生物量呈幂函数递减过程，演替后期群落根冠比有增加的趋势，演替后期序列种根冠比和根长也有增加的趋势，这些在一定程度上会影响到生物量积累和有机质分解等，进而会影响到植被土壤效应。

关键词 黄土丘陵区；撂荒演替；群落生物量；植被土壤养分效应

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The community biomass of abandoned farmland and its effects on soil nutrition in the Loess Hilly Region of Northern Shaanxi, China

DU Feng, LIANG Zong-Suo*, XU Xue-Xuan, SHAN Lun, ZHANG Xing-Chang

Northwest Sci-tech University of Agriculture and Forestry; Institute of Soil and Water Conservation, Chinese Academy of Sciences, Ministry of Water Resources; State Key Laboratory of Soil Erosion and Dryland Farming on the Loess Plateau, Yangling , Shaanxi Province 712100,China

Abstract In order to provide some basic foundation with revegetation, we need to deepen our understanding on the interactive effects of vegetation and soil. In this article, aboveground biomass, soil nutrition and moisture of 36 old-fields with different abandonment ages (from 2 to 45 years after abandonment), aboveground biomass of 4 typical old-fields, and growth characteristics of 7 predominant old-field species were measured. Changing pace, trend and relationship of community aboveground biomass and soil nutrition during secondary succession were evaluated; effects of soil nutrition on community aboveground biomass were analyzed using multianalysis and pathway analysis, and effects of aboveground biomass on soil nutrition were further discussed. The results show that: (1) Soil nutrition, including organic matter, total nitrogen, total phosphorus, total potassium, nitrate nitrogen, ammonium nitrogen, and active phosphorus, active potassium have the same changing pace and trends as the aboveground biomass does in the process of secondary succession, both decreased in earlier abandonment stage of succession, then increased subsequentl

y. (2) If offered from the correlation of soil nutrients and abandonment ages, effects of vegetatio n on 0-20 cm organic matter, active phosphorus, 0-20 cm and 20-40 cm nitrate nitrogen nutritio n are significant, while deduced from the correlation of soil nutrition and aboveground biomass, n o significant effects were observed. Hereinbefore, aboveground biomass account for only a part o f vegetation-soil nutrition effects. The effects of biomass to organic matter, total nitrogen, total pho sphorous, total potassium, nitrate nitrogen, active potassium and phosphorous are positive, ammo nium nitrogen is negative. (3) Abandonment ages, total nitrogen, total potassium, active potassiu m and soil moisture fluctuation have direct positive effects on the aboveground biomass of old-fiel d communities, abandonment and soil moisture fluctuation have more lager effects. Each ingredien t of soil nutrition has relative small effect, among them total nitrogen have larger effects than total a nd active potassium. The changes of aboveground biomass of old-field communities during succes sion are caused mainly by the changes of coverage and ecological characteristics of community sp ecies (the relatively larger direct effects of abandonment ages), and secondly by the soil moisture f luctuation (the relative smaller indirect effect of abandonment ages through soil moisture). (4) A s a dependent variable, underground biomass approach power function of soil depth, declines i n deeper layer. The root shoot ration of community tends to increase in later succession stages, lat er sere species also have increasing tendency. These will influence the accumulation of biomass an d decomposition of organic matter, and the vegetation-soil effects may be different.

Key words loess hilly region _ secondary succession of old-fields _ communities biomass _ vegetation-soil effects

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通讯作者 梁宗锁 liangzs@ms.iswc.ac.cn