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生草提高山核桃林土壤有机碳含量及微生物功能多样性

Intercropping grasses improve soil organic carbon content and microbial community functional diversities in Chinese hickory stands

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中文摘要:

山核桃(Carya cathayensis)是中国特有的高档干果和木本油料树种，但高强度经营导致林地土壤性质的改变，为了解生草对土壤的修复效果，在山核桃主产区设置了紫云英(Astragalus sinicus)、油菜(Brassica campestris)、黑麦草(Lolium perenne)和免耕 4种处理，对土壤有机碳及微生物功能多样性进行分析。结果表明，不同生草栽培后，山核桃林地土壤总有机碳(total organic carbon，TOC)质量分数显著增加，与免耕相比，种植油菜、黑麦草、紫云英4 a后土壤TOC分别提高了23.12%，26.61%和24.74%，增加的组分以羰基碳为主，但并未改变土壤碳库的稳定性；同时也显著提高了林地土壤微生物量碳(microbial biomass carbon，MBC)和水溶性有机碳(water-soluble organic carbon，WSOC)的质量分数，MBC增加了138.61%～159.68，WSOC提高了56.24%～69.47%%。3种生草的土壤微生物活性(average well color development，AWCD)显著高于免耕，微生物多样性指数(Shannon index, H)和均匀度指数(evenness index, E)则表现为油菜、紫云英处理显著高于免耕。研究表明，生草栽培能有效提高林地土壤TOC质量分数和微生物功能多样性，为山核桃林地土壤修复和科学管理提供参考。

英文摘要:

Abstract: Chinese hickory (Carya cathayensis Sarg) is a unique tree species with seeds used for high-grade oil production. It is mainly distributed in northeastern China and is in high abundance on Tianmu Mountain, located at the junction of Zhejiang and Anhui provinces. Intensive management, including heavy application of chemical fertilizer and long-term application of herbicides, has resulted in serious soil loss and degradation. To evaluate the potential of sod-culture to improve soil fertility and microbial activities of Carya cathayensis forest land, we conducted a field intercropping experiment using four treatments: Chinese milk vetch (Astragalus sinicus L.), rape (Brassica campestris L.), ryegrass (Lolium perenne L.), and a no-tillage control. We compared the response of various components of total organic carbon (TOC) and microbial community functional diversity in each treatment. We found that interplanting rape, ryegrass, and Chinese milk vetch increased TOC contents by 23.12%, 26.61%, and 24.74% (P<0.05) compared with clean tillage, while there were no significant differences in TOC contents among the grass intercropping plots. After intercropping grasses for 4 years, the concentrations of microbial biomass carbon (MBC) in the plots of intercropping rape, ryegrass, and Chinese milk vetch were increased by 138.61%, 159.68%, and 144.24% respectively. The concentrations of water-soluble organic carbon (WSOC) in the plots of intercropping rape, ryegrass, and Chinese milk vetch were increased by 56.24%, 69.47%, and 66.05% respectively. There were no significant differences in MBC or WSOC concentrations among the intercropping treatments. The three interplantings increased soil carbonyl C by 29.9%-36.9% (P<0.05), and decreased alkyl C, O-alkyl C and aromatic C by 10.0%-16.4%, 18.9%-20.9%, and 10.5%-16.6%, as compared with clean tillage (P<0.05). However, there were no significant differences in the increase in soil carbonyl C and the decreases in alkyl C, O-alkyl C, and aromatic C among the treatments of intercropping grass. The ratios of aliphatic C/aromatic C, hydrophilic C/hydrophobic C, and aromaticity in soil under Chinese hickory were not affected by intercropping grasses. Interplanting grasses markedly improved microbial community functional diversity. The soil microbial activity (AWCD) values of the three intercropping treatments were much higher than the no-tillage treatment (P<0.05), while there were no significant differences in the soil AWCD values among intercropping grasses treatments. The microbial diversity indexes (H) and evenness index（E） in the treatments of rape and Chinese milk vetch were much greater than the treatment of no-tillage (P<0.05), but there was no significant difference between the ryegrass and no-tillage treatments. The results of this study demonstrated that sod cultivation is an effective soil management practice that improves soil quality and eliminates the detrimental effects of clean tillage in Chinese hickory production.

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