

Soil fungus-bacteria interaction network of *Pinus sylvestris* var. *mongolica* plantation in the Horqin Desert

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Abstract: 【Objective】 The aim of this study was to investigate the effects of different forest ages and soil factors on the characteristics of soil fungus-bacteria co-occurrence network of *Pinus sylvestris* var. *mongolica* plantation in the Horqin Dersert, and to further understand the microbial dynamics of the ecosystem. This not only provides scientific basis for soil management and ecological restoration, but also provides important guidance for sustainable management. **【Method】** In this study, the different forest ages (middle age, near mature and mature) was selected as the research object, and the soil fungus-bacteria network structure and grassland was compared by molecular ecological network analysis based on 16S rRNA high-throughput sequencing technology. The stability of the network was evaluated by three indexes: robustness, absolute value of negative positive cohesion ratio and average variability. At the same time, the correlation between soil fungus-bacteria network and soil factors was discussed by heat mapping. **【Result】** (1) With the increase of forest age, soil fungus-bacteria network became simpler and showed dynamic changes. The fungus-bacterial community interaction is the most dense in the aged forest, showing the highest anti-interference ability and stability of the network. Compared with pine plantation, soil fungus-bacteria network in sandy grassland was more complex. The synergistic relationship between bacterial communities was dominant in both plantation and sandy grassland, indicating that the interaction between bacterial communities was more intensive. (2) The key nodes in the soil fungus-bacteria network of different forest ages were different and all of them were bacterial OTU. The number of key nodes in the middle-age forest network is the largest, and the proportion of key nodes in Proteobacteria is the largest. Acidobacteria is a key node in the symbiotic network of both middle-aged and near-mature forests, indicating that Proteobacteria and Acidobacteria play a key role in maintaining the stability of the fungus-bacteria network, while the key node is not identified in sandy grassland. (3) The complexity of soil fungus-bacterial network was mainly affected by soil available phosphorus and soil water content ($P<0.05$), and the stability of the network was significantly correlated with soil organic matter and available phosphorus content ($P<0.05$), indicating that these soil factors played a direct or indirect role in shaping the structure and function of the microbial network. Therefore, it has an important influence on the ecological health of soil and plant growth. **【Conclusion】** Our results demonstrated that the soil fungus-bacteria network showed dynamic characteristics with the change of forest age. The complexity and stability of soil fungus-bacteria co-occurrence networks in plantations of different ages were different and affected by soil factors. To achieve sustainable management of *Pinus sylvestris* var. *mongolica*, it is recommended to pay attention to the control of soil available phosphorus, organic matter and water content in stand management, so as to maintain and improve the health and function of soil microbial community.