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三峡库区马尾松根系生物量的空间分布

Spatial distribution of root biomass of *Pinus massoniana* plantation in Three Gorges Reservoir area, China

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中文摘要:

以三峡库区主要植被马尾松人工林为研究对象,用内径为10 cm的根钻,分别在马尾松中龄林、近熟林和成熟林内,据树干0.5、1.0、1.5 m和2.0 m处设置取样点,各样点按0-10、10-20、20-30、30-40、40-60 cm将土壤分为5个垂直层次,对马尾松根系的空间分布格局进行调查。结果表明:(1)三峡库区马尾松总根系生物量(0-10 mm)为中龄林(4.72 t/hm²)显著高于成熟林(2.94 t/hm²)和近熟林(2.40 t/hm²)($P < 0.05$)。细根(0-2 mm)生物量随年龄增加而递减,差异不显著($P > 0.05$);(2)马尾松3个林龄中根系生物量表现出一定的水平分布特征,但具体趋势表现各异,细根生物量最大值均出现在距离样木1.0 m处;(3)细根主要分布在土壤上层,其中47.53%-71.73%的活细根集中在0-20 cm土壤深度内,且随土层的加深,其生物量明显减少。粗根(2-10 mm)则主要分布于20-60 cm土层范围内;(4)根系直径越小,受环境变化越明显。马尾松细根生物量分布主要受土壤深度的影响,树龄和不同水平距离对细根分布格局影响不显著($P > 0.05$),各因素对粗根生物量的影响均未达到显著水平($P > 0.05$)。

English Summary:

Roots play an important role in individual plant carbon budgets and ecosystem-level carbon and nutrient cycling. Considerable research has concentrated on the vertical distribution and seasonal dynamics of fine root biomass. However, the spatial distribution of root biomass has been poorly studied. Our objectives are to determine how fine root biomass changes with horizontal distance, and to examine the spatial distribution of fine root biomass in stands of different ages. The horizontal and vertical distribution of root (0-10mm diameter) biomass for three *Pinus massoniana* plantations of different ages, 20, 30 and 46 year-old, in the Three Gorges Reservoir area, Hubei Province, China, was studied. Ten cm diameter soil cores were collected in July, 2010 at different horizontal distances (0.5, 1.0, 1.5 and 2.0m) from the stem. Each soil core was separated into five sections at depths of 0-10, 10-20, 20-30, 30-40 and 40-60 cm. Roots (0-10mm) were first separated into living and dead roots. Then both categories were classified into two diameter classes, that was, two groups for fine roots (0-1mm and 1-2mm), and two groups for coarse roots (2-5mm and 5-10mm). Roots were dried at 80°C to a constant mass and weighed. Our results indicated the average fine root biomass of *P. massoniana* in the Three Gorges Reservoir area was 0.56 t/hm², which is within the range of worldwide fine root biomass (<2-5mm diameter), but lower than the average fine root biomass of subtropical evergreen needleleaf forest. The total root biomass (≤ 10 mm diameter) for *P. massoniana* forest for the 20, 30 and 46 year-old stands was 2.40, 4.72 t/hm², and 2.94 t/hm², respectively, and differences between them were statistically significant ($P < 0.05$). However, the fine root biomass (0-2mm diameter) declined insignificantly with an increase in forest age ($P > 0.05$). In all three stands, living root biomass was much higher than dead root biomass. Fine root biomass in all the stands peaked at 1.0 m from the stem, but fine root biomass in stands of different ages changed differently as the horizontal distance increased. Fine root biomass was mainly concentrated in the upper soil layer and decreased as soil depth increased. For all ages of stands, 47.53%-71.73% of living roots were observed in the 0-20cm soil layer. The majority of coarse roots (2-10mm diameter) were at a depth of 20-60cm. We concluded smaller roots were more sensitive to environmental change than larger roots, based on an analysis of the interactions between the spatial distribution of fine root biomass and soil depth, distance from stem and stand age. Spatial distribution of fine root biomass was very significantly influenced by soil depth ($P < 0.01$), but effects of stand age and horizontal distance from the tree stem were not significant ($P > 0.05$). Also, all these factors had no significant influence on the spatial distribution of coarse root biomass ($P > 0.05$). The results indicate more consideration should be given to research on the spatial distribution of roots and the effects of these integrated factors on root distribution.

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