

西南石质困难立地优势灌木近自然恢复研究

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摘要: 我国西南地区大面积碳酸盐岩出露地表, 将土层、植被切割成非连续单元, 构成岩-土为主的斑块生境。特别是裸岩集中区, 不合理的土地利用方式(栽种玉米等)加速了水土流失及植被退化。传统爆破碎石风险过高而被放弃, 苗木移栽面临育苗成本高, 后期运苗及水源补给困难导致苗木存活率低、生态服务功能差等瓶颈。基于自然解决方案(NBS), 加快以自然演替为驱动力的投资少和生态服务功能相对完整的植被恢复进程, 是解决石质困难立地植被恢复问题的重要手段之一。岩石切割地上植被引发负面生态效应, 但其也能富集降雨等大气沉降物改善局部生态条件。植物有性繁殖体能否顺利萌发、出苗和生长, 是石质困难立地植被近自然恢复的核心环节。因此, 开展石质微生境水、热和光再分配过程与地带性植被更新关系研究, 将有助于探寻植被恢复有利微位点, 并解决石质困难立地造林过程中成苗率低等突出问题。研究团队依托地表岩溶带模拟观测平台, 开展了多种石质微生境生态因子与灌木更新物候长期监测。结果表明: (1) 不同石质微生境近地表小气候、土层水热因子时空特征分异明显。土面对夏季近地表上层空间产生显著的加热效应, 秋季则对下层空间产生显著的降温效应; 石沟加速了冬、春季浅表层土壤水分流失, 石坑、土面则促进了深层土壤水分富集。(2) 不同石质微生境灌木幼苗出土能力排序为土面>石坑>石沟>裸地, 幼苗存活能力排序为土面>石沟>石坑>裸地, 幼苗生长能力排序为裸地>土面>石沟>石坑。(3) 土壤水分是石质困难立地灌木幼苗形成的关键限制因子, 而土壤水分和温度共同调控了幼苗生长。上述研究结果为植被近自然恢复有利微位点的识别与筛选提供了理论依据, 为石质困难立地近自然恢复技术研发提供了重要参考。

The study of near-natural restoration of dominant shrubs on difficult rocky sites in Southwest China

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Abstract: Large area of carbonate rock outcrops are exposed in Southwest China, which divide soil layer and vegetation into discontinuous units and form patchy habitats dominated by rock-soil. Especially in areas with concentrated rock outcrops, unreasonable land use (such as planting corn) have accelerated soil erosion and vegetation degradation. Traditional blasting and rock breaking are abandoned due to their high risks. Seedling transplanting faces bottlenecks such as high seedling costs, and difficulties in seedling transportation and water supply in the later stage, resulting in low seedling survival rate and poor ecological service functions. According to the Natural Based Solutions (NBS), accelerating the vegetation restoration with low investment driven by natural

succession and relatively complete ecological service functions is one of the important means to improve vegetation restoration in difficult rocky sites. Rock outcrops separate the vegetation and cause negative ecological effects, but they enrich atmospheric precipitation such as rainfall to improve local ecological conditions. Whether the sexual propagules of plants can germinate, emerge and grow or not largely determines restoration success in difficult rocky sites. Therefore, the study of relationship between the redistribution of water, heat and light in rocky microhabitats and zonal vegetation regeneration will help to explore favorable microsites for vegetation restoration and solve prominent problems such as low seedling rate during afforestation on rocky difficult sites. Relying on the simulation observation platform of karst surface zone, we conducted long-term monitoring of ecological factors and shrub regeneration phenology in various rocky microhabitats. The results showed that: (1) The temporal and spatial characteristics of near-surface microclimate and hydrothermal factor in different rocky microhabitats were significantly different. The earth flatland (EF) had a significant heating effect on the upper space near the surface in summer and a significant cooling effect on the lower space in autumn; the rocky gully (RG) accelerated the loss of shallow surface soil water in winter and spring, while the rocky pits (RP) and EF promoted the enrichment of deep soil water. (2) The order of shrub seedling emergence ability in different rocky microhabitats was $EF > RP > RG > \text{bare land (BL)}$, the order of seedling survival ability was $EF > RG > RP > BL$, and the order of seedling growth ability was $BL > EF > RG > RP$. (3) Soil moisture is the key limiting factor for the formation of shrub seedlings in rocky difficult sites, while soil moisture and temperature jointly regulate seedling growth. Our study provided a theoretical basis for the identification and screening of microsites that are favorable for near-natural restoration of vegetation, and provided important guidance for the development of near-natural restoration technology in rocky difficult sites.