# 根系损伤强度对不同大小毛白杨生长及光合特性的影响

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**摘 要：**【目的】探究不同形态大小与断根起苗移栽强度对毛白杨生长情况和生物量分配及光合特性的影响，为形态差异毛白杨响应根系损伤及应对措施提供理论依据和指导。【方法】采用双因素试验设计，季末在 20 加仑桶种植的一年生“北林雄株一号”毛白杨中筛选大苗（高 317.44cm、胸径 14.3mm、地径 29.95mm）和小苗（高 154.18cm、胸径 4.43mm、地径 12.44mm））2 种形态苗木，次年 3 月初以低强度损伤（T1-10 倍地径）、高强度损伤（T2-4 倍地径），模拟不同断根起苗强度，同时设置不损伤对照组（CK）模拟未断根苗木。测定植株形态、生物量动态及光合特征，分析苗木形态大小对根系损伤强度的响应情况。【结果】根系损伤强度和毛白杨不同形态大小对生物量分配和光合影响显著。根系损伤显著抑制了毛白杨树高和胸径的增长，大树对于损伤的响应更大，高强度损伤降低树高 39.36%、胸径 23.68%，而小树的影响更小，相同比例损伤下仅降低树高 11.4%、胸径 19.6%，更低损伤强度对小树的高生长几乎无影响（P＞0.05），仅对地径的影响差异显著，树高生长动态呈现显著差异，损伤后的小树任然成近似“s”形生长曲线，更大树则几乎无出现生长高峰；损伤后各形态毛白杨生物量显著降低，大树在高强度损伤时减少了 59.62%的生物量，小树损伤苗木则减少了 42.65%，损伤植株更倾向于增加地上部分生长的比例，根系干重及根茎比显著小于对照组；根系损伤后 6 月、7 月、8 月各形态树木光合指标均显著低于未损伤处理， 8 月相对较小的树木光合指标对比与未损伤树木差距显著减小，但仍存在显著差异。【结论】树木根系损伤对不同形态大小的植物响应情况相似，大苗在损伤初期的响应更明显，也需要更长的恢复期，相对小的苗木与未损伤处理的差异更小。在起苗标准范围内选择更小的苗木移栽有利于减缓苗木缓苗带来的不利影响，更快的恢复生长，提高造林效果。因此，应充分考虑苗木形态大小和起苗强度的叠加效应，对于揭示毛白杨造林当年缓苗机理具有重要意义。

**关键词：**根系损伤；形态大小；造林规格；毛白杨；光合特性

## Effects of root damage intensity on the growth and photosynthetic characteristics of hairy poplars of different sizes

**Abstract:**【Objective】To investigate the effects of different morphological sizes and root-breaking transplanting intensities on the growth, biomass allocation and photosynthetic characteristics of poplar, and to provide theoretical basis and guidance for the response of morphologically different poplars to root damage and countermeasures. 【Methods】 A two-factor experimental design was adopted, and two types of seedlings (height 317.44cm, diameter at breast height 14.3mm, diameter at ground leve l29.95mm) and small seedlings (height 154.18cm, diameter at breast height 4.43mm, diameter at ground level 12.44mm) were screened at the end of the season in the 20-gallon buckets of the one-year old "beilin Xiongzhu No.1" Populus tremula. )) 2 forms of seedlings, in early March of the following year with low intensity damage (T1-10 times the diameter of the ground), high intensity damage (T2-4

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times the diameter of the ground), to simulate the different intensity of root-breaking starting seedlings, while setting up no damage control group (CK) to simulate the unbroken root seedlings. Plant morphology, biomass dynamics and photosynthetic characteristics were measured to analyze the response of seedling morphology and size to root damage intensity. 【Results】The intensity of root injury and different morphological sizes of Populus tremula significantly affected biomass allocation and photosynthesis. Root damage significantly inhibited the growth of tree height and diameter at breast height of Populus tremula, and the response of large trees to damage was greater, with high intensity damage reducing tree height by 39.36% and diameter at breast height by 23.68%, while the effect of small trees was even smaller, with the same proportion of damage reducing tree height by 11.4% and diameter at breast height by 19.6%, and the effect of even lower damage intensity on the high growth of small trees was almost non-existent ($P>0.05$), and the effect of the difference in diameter at breast height was significant, and tree height growth dynamics showed a significant difference. The growth dynamics of tree height showed significant differences, the small trees after damage still became an approximate "s" shaped growth curve, while the larger trees almost did not show growth peaks; the biomass of the various forms of aspen was significantly reduced after damage, the large trees in the high-intensity damage reduced the biomass by 59.62%, and the small tree damage seedlings reduced by 42.65%. The root dry weight and root to stem ratio were significantly smaller than those of the control group; the photosynthetic indexes of the trees in June, July and August after root damage were significantly lower than those of the uninjured treatment, and the gap between the photosynthetic indexes of the relatively small trees in August and those of the uninjured trees was significantly reduced, but there was still a significant difference. 【Conclusion】 Tree root damage responded similarly to plants of different sizes, with larger seedlings responding more clearly in the early stage of damage and requiring a longer recovery period, and smaller seedlings differing less from the uninjured treatment. Selecting smaller seedlings for transplanting within the range of seedling starting criteria is conducive to slowing down the adverse effects of seedling retardation, restoring growth faster, and improving silvicultural effect. Therefore, the superposition effect of seedling size and seedling starting intensity should be fully considered, which is of great significance for revealing the mechanism of seedling retardation in poplar afforestation in the same year.

**Key words:** root damage; morphological size; silvicultural specification; Populus tremula; photosynthetic characteristics