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干旱胁迫对杨树幼苗生长、光合特性及活性氧代谢的影响

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Effects of drought stress on the growth, photosynthetic characteristics, and active oxygen metabolism of poplar seedlings.

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摘要

2011年4—10月在山东省林业科学研究院试验苗圃,选取欧美I-107杨扦插苗为试材,采用盆栽控水试验,研究了不同水分处理(正常水分、轻度干旱、中度干旱和重度干旱)对杨树幼苗生长和气体交换、叶绿素荧光特性、活性氧代谢的影响.结果表明: 与正常水分处理相比,轻度、中度和重度干旱胁迫下的地径生长量分别下降12.8%、44.5%和65.6%,苗高生长量分别下降12.2%、43.1%和57.2%;随着胁迫强度的增加和胁迫时间的延长,杨树幼苗叶片的PSⅡ光能转化效率、实际量子产量、光化学猝灭系数、净光合速率和气孔导度在轻度胁迫下缓慢下降,而在中度和重度胁迫下迅速下降;非光化学猝灭系数在轻度胁迫下显著升高,而在中度和重度胁迫下先升高后降低;叶片超氧化物歧化酶(SOD)、过氧化物酶(POD)和过氧化氢酶(CAT)活性均先升高后降低,但对干旱胁迫和活性氧的响应存在一定差异;叶片相对电导率、丙二醛含量显著增加,质膜受损,大量离子外渗,且重度胁迫下质膜的损害最严重.轻度干旱胁迫下,I-107杨树幼苗具有较高的光合效率和较强的抗氧化保护酶系统;而中度和重度干旱下,其光合效率显著下降,抗氧化保护酶系统明显遭到破坏.

关键词: I-107欧美杨 干旱胁迫 地径 苗高 叶绿素荧光 活性氧代谢

Abstract:

A pot experiment was conducted to study the effects of different water treatments (normal irrigation, light drought, moderate drought, and severe drought) on the growth, gas exchange, chlorophyll fluorescence characteristics, and active oxygen metabolism of poplar (*Populus × euramericana* cv. 'Neva') seedlings in the experimental nursery of Shandong Forestry Academy from April to October, 2011. As compared with those under normal irrigation, the growth of the seedling's basal diameter under light, moderate, and severe drought stress decreased by 12.8%, 44.5%, and 65.6%, and the height growth decreased by 12.2%, 43.1%, and 57.2%, respectively. With the increasing extent and duration of drought stress, the maximal photochemical efficiency of PSⅡ, quantum yield, photochemical quenching coefficient, net photosynthetic rate, and stomatal conductance of the seedling leaves decreased gradually under light drought stress, while decreased rapidly under both moderate and severe drought stress. The non photochemical quenching coefficient increased significantly under light drought stress, but decreased after an initial increase under moderate and severe drought. The leaf superoxide dismutase (SOD), peroxidase (POD), and catalase (CAT) activities under drought stress decreased after an initial increase, but definite differences existed in the responses of the three enzymes to drought stress and reactive oxygen. The leaf relative electric conductivity and malondialdehyde (MDA) content under drought stress increased significantly, plasma membrane was damaged, and massive ions leaked out. The most serious damage of plasma membrane was found under severe stress. Under light drought stress, the seedlings had higher photosynthetic efficiency and stronger oxidative enzyme defense system; under moderate and severe drought stress, the photosynthetic efficiency decreased significantly, and the oxidative enzyme defense system was damaged remarkably.

Key words: *Populus × euramericana* cv. 'Neva' drought stress basal diameter seedling height chlorophyll fluorescence active oxygen metabolism.

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