应用生态学报 2007 18 (07): 1441-1446 ISSN: 1001-9332 CN: 21-1253/Q

研究报告

硝酸根胁迫对黄瓜幼苗叶片光合速率、PSⅡ光化学效率及光能分配的影响

苏秀荣[1], 王秀峰[2], 杨凤娟[2], 魏珉[2]

[1]山东农业大学化学与材料科学学院， 山东泰安 271018;[2]山东农业大学园艺科学与工程学院，山东泰安 271018

收稿日期 2006-8-2 修回日期 网络版发布日期 2007-7-25 接受日期 2007-4-9

摘要 研究了不同浓度NO_3^-胁迫对黄瓜幼苗叶片光合速率、PSⅡ光化学效率及光能分配的影响. 结果表明，当NO_3^-浓度较低时（14～98 mmol·L^{-1}），适当增加NO_3^-浓度，可增强黄瓜幼苗叶片对光的捕获能力，促进光合作用. 随着NO_3^-浓度的进一步增加（140～182 mmol·L^{-1}），PSⅡ光化学效率降低，电子传递受到抑制，净光合速率降低；吸收的光能中，通过天线色素的热耗散增加，用于光化学反应的能量降低，光化学效率下降. 140和182 mmol·L^{-1} NO_3^-处理黄瓜幼苗叶片6 d后净光合速率(P_n)极显著下降，分别比对照降低了35%和78%；PSⅡ最大光化学效率(F_v/F_m)、天线转化效率(F_v'/F_m')、实际光化学效率(Φ_{PSII})、光化学猝灭系数(q_P)均低于对照，非光化学猝灭(*NPQ*)高于对照，激发能在两个光系统间的分配不平衡性($\beta/\alpha-1$)增大. 高浓度NO_3^-处理的黄瓜幼苗叶片各荧光参数变化幅度比低浓度大. 当光照增强时，高浓度NO_3^-胁迫下黄瓜幼苗叶片吸收的光能中应用于光化学反应的份额(*P*) 显著降低，天线热耗散的份额(*D*)显著增加. 天线热耗散是耗散过剩能量的主要途径.

关键词 NO_3^-胁迫 光化学效率 光能分配 净光合速率

分类号

Effects of NO_3^- stress on photosynthetic rate, photochemical efficiency of PSⅡ and light energy allocation in cucumber seedling leaves.

SU Xiu-rong[1], WANG Xiu-feng[2], YANG Feng-juan[2], WEI Min[2]

[1]College of Chemistry and Material Science, Shandong Agricultural University, Tai'an 271018, Shandong, China;[2]College of Horticulture Science and Engineering, Shandong Agricultural University, Tai'an 271018, Shandong, China

Abstract

This paper studied the effects of different NO_3^- concentration on the photosynthetic rate, photochemical efficiency, and absorbed light energy allocation in cucumber seedling leaves. The results indicated that when the available NO_3^- concentration in the medium was low (14-98 mmol $NO_3^-\cdot L^{-1}$),an appropriate supplement of NO_3^- could enhance the capability of cucumber leaves in capturing light energy, and promote the photosynthesis. However, with further increase of NO_3^-, the photochemical efficiency of PSⅡ decreased, electron transfer restrained, and net photosynthetic rate as well as the absorbed light energy used in photochemical reaction of PSⅡ decreased. At the same time, the light energy used in antenna heat dissipation increased,
while the photochemical efficiency decreased. After treated with 140 and 182 mmol $NO_3^-\cdot L^{-1}$ for 6 days, the photosynthetic rate (P_n) was decreased by 35% and 78%, respectively, maximal PSⅡ efficiency at open centers in the absence of NPQ (F_v/F_m), antenna efficiency at open centers in the presence of *NPQ*(F_v'/F_m'), actual PSⅡ efficiency (Φ_{PSII}) and photochemical quenching (q_P) were lower, non-photochemical quenching (*NPQ*) was higher, and the deviation from full balance between PSⅠ and PSⅡ (β/α-1) was improved significantly, compared with the control. The fluctuant ranges of these chlorophyll fluorescence parameters were increased at higher NO_3^- concentration, compared with those at lower NO_3^-concentration. The absorbed light energy allocated to the photochemical reaction of PSⅡ (*P*) was reduced by high light intensity and high NO_3^-concentration. Meanwhile, the proportion allocated in antenna heat dissipation (*D*)

increased significantly. Antenna heat dissipation was the main way for excessive energy dissipation.

Key words NO_3^- stress photochemical efficiency light energy allocation photosynthetic rate

DOI:

通讯作者