

强光高温交叉胁迫对牡丹叶片PS II 和PS I 之间能量传递的影响

刘超¹, 袁野², 盖树鹏², 张玉喜², 刘春英², 郑国生^{1,*}

(青岛农业大学生命科学院, 山东青岛 266109)

Effects of Strong Light Coupled with High Temperature Treatment on Energy Transfer Between PS II and PS I in Tree Peony Leaves

LIU Chao¹, YUAN Ye², GAI Shu-peng², ZHANG Yu-xi², LIU Chun-ying², and ZHENG Guo-sheng^{1,*}

(Department of Life Science, Qingdao Agricultural University, Qingdao, Shandong 266109, China)

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摘要 以牡丹品种‘卷叶红’(*Paeonia suffruticosa* ‘Juanyehong’) 叶片为材料, 研究强光 (25 ℃, 1 400 μmol · m⁻² · s⁻¹)、高温 (45 ℃, 700 μmol · m⁻² · s⁻¹) 和强光高温 (45 ℃, 1 400 μmol · m⁻² · s⁻¹) 胁迫对其光系统的影响及其差异。结果表明, 3种胁迫下牡丹叶片PS II 最大光化学效率 (F_v/F_m) 和PS I 活性 ($\Delta I/I_o$) 均明显下降, 且处理2 h内 $\Delta I/I_o$ 比 F_v/F_m 下降程度大。随着处理时间的增加, PS II 向PS I 传递电子能力 (ϕ_{Eo}) 下降。强光胁迫下, 单位面积内反应中心数量 (RC/CS_m) 明显减少, 电子传递能力 (V_j) 变化不显著; 而高温胁迫下, PS II 受体侧受到抑制, 电子传递能力下降, 光化学效率随之下降, 导致单位面积内反应中心吸收、捕获的光能和电子传递的量子产额 (ABS/CS_m 、 TR/CS_m 、 ET/CS_m) 进一步减少。与单一胁迫相比, 虽高温强光交叉胁迫加重了光抑制程度, 但处理1 h内PS II 反应中心活性与单一胁迫差异不明显, 表明交叉胁迫并不是简单的两个单一胁迫相叠加。

关键词: 牡丹 光系统 强光高温 光抑制

Abstract: The effects and differences of three treatments including strong light (25 ℃, 1 400 μmol · m⁻² · s⁻¹), high temperature (45 ℃, 700 μmol · m⁻² · s⁻¹) and strong light coupled with high temperature (45 ℃, 1 400 μmol · m⁻² · s⁻¹) on photosystem in leaves of tree peony (*Paeonia suffruticosa* ‘Juanyehong’) were studied, respectively. The results indicated that both the maximum photochemical efficiency (F_v/F_m) and activity of PS I ($\Delta I/I_o$) obviously reduced under three treatments, and the decrease of $\Delta I/I_o$ was quicker than that of F_v/F_m within 2 h. With the increasing of treatment duration, the ability of electron transfer from PS II to PS I (ϕ_{Eo}) reduced. Under strong light stress, the number of reaction centers per unit area (RC/CS_m) displayed decrease, and difference of the ability of electron transfer (V_j) was not significant. Under high temperature stress, the main injured region tended to the PS II receptor side, and the ability of electron transfer from PS II to PS I was depressed, which resulted in that excess light energy under unsaturated light affected the activity of PS II reaction center and reduced the absorption of light energy (ABS/CS_m), the capture of light energy (TR/CS_m) and the energy quantum yield of electron transfer in reaction center (ET/CS_m). Compared with single stress, strong light coupled with high temperature aggravated the photoinhibition, but the activity of PS II reaction center had no significant difference under single and cross stress in the early stage (≤ 1 h). The results indicated that the effect of cross stress was not the simple superposition of two single stress.

Keywords: tree peony, photosystem, strong light and high temperature, photoinhibition

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