



棉花早熟芽黄突变体叶绿素荧光动力学特性研究

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Research of Chlorophyll Fluorescence Dynamic Characteristic in A Cotton Virescent Mutant

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摘要

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摘要 以中棉所58及其航天诱变芽黄突变体为研究对象, 利用快速叶绿素荧光诱导动力学测定和JIP-test 数据分析方法, 研究了晴天条件下野生型(Wild type, WT)和突变体5个叶位叶片(倒1叶至倒5叶)的原初光化学反应的变化。结果表明, 突变体倒2叶最大光化学效率(F_v/F_m)最低, 至倒5叶时恢复正常。突变体叶片较高的K点的相对可变荧光值(W_k)表明放氧复合体受到损害。与野生型相比, 突变体新生叶片的O-J-I-P 荧光诱导曲线的初始斜率(M_o)升高, 标准化后的O-J-I-P 荧光诱导曲线、最大荧光强度及y轴之间的面积(S_m)、用于电子传递的量子产额(ϕ_{Eo})、反应中心捕获的激子中用来推动电子传递到电子传递链中超过 Q_A^- 的其它电子受体的激子占用来推动 Q_A^- 还原激子的比率(ψ_o)值降低, 表明叶片发育早期PS II受体侧的 Q_A^- 大量积累, 电子传递链受阻。通过分析突变体光合机构的比活性参数发现, 在叶片发育的早期, 突变体单位反应中心吸收的较多的能量以热和荧光的形式被耗散掉。突变体新叶发育前期黄化、后期变绿, 推测早期叶绿素合成受阻, 造成光系统损伤、光合性能下降。

关键词: 棉花 芽黄突变体 叶绿素荧光 光系统II

Abstract: In this research, CCRI 58 and its space virescent mutant vsp were used as materials to analyze the change of primary photochemical of different position leaves(the first to the fifth leaves from the top) by chlorophyll a fluorescence transient measurement and the relevantly analytical method, JIP-test on sunny days. The results showed that the maximum photochemical efficiency of photosystem II (F_v/F_m) and performance index (PI_{ABS}) displayed a tendency of progressive increase in the wild type from the first leaf from the top to the fifth leaf from the top, while in the mutant, the young leaves contained less chlorophyll, and the value of F_v/F_m and PI_{ABS} in the second leaf from the top showed the lowest level, then increased to normal level 10 days later(the fifth leaf from the top). Compared to the wild type, the high relative variable fluorescence intensity of K-step (W_k) in the young leaves meant that the oxygen-evolving complex(OEC) got damaged, and the increasing of approximated initial slope of the fluorescence transient (M_o), the reduction of normalized total complementary area above the O-J-I-P transient(S_m), quantum yield for electron transport(ϕ_{Eo}), probability that a trapped exciton moves an electron into the electron transport chain beyond Q_A^- (ψ_o) revealed that the Q_A^- accumulation was excessive in the acceptor side of PS II, the electron transport chain got blocked. The changes in the parameters of absorption flux per reaction center (ABS/RC), trapped energy flux per reaction center (TR_o/RC), electron transport flux per reaction center (ET_o/RC), dissipated energy flux per reaction center (DI_o/RC) showed that, in the early development of the leaf, the energy absorbed by reaction center was dissipated through heat and fluorescence. Above all, we speculated that because of the block of the chlorophyll biosynthesis at the early development of the young true leaves, the PS II got damaged and showed lower photochemical reaction efficiency.

Keywords: cotton virescent mutant chlorophyll fluorescence PS II

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