生态学报 Acta Ecologica Sinica

朱英华,屠乃美,肖汉乾,张国.硫对成熟期烤烟叶绿素荧光参数的影响.生态学报,2011,31(13):3796~3801

硫对成熟期烤烟叶绿素荧光参数的影响

Effect of sulfur on chlorophyll fluorescence of flue-cured tobacco at maturation stage

投稿时间：2010-12-28 最后修改时间：2011-4-21

DOI：

中文关键词: 烤烟 硫 叶绿素荧光 叶绿素含量 成熟期

English Keywords:flue-cured tobacco sulfur chlorophyll fluorescence chlorophyll content maturation stage

基金项目:国家烟草局和湖南省烟草局资助项目(05.02)

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中文摘要:

通过溶液培养法研究了硫(0.01-32 mmol/L)对成熟期烤烟叶绿素含量和叶绿素荧光参数的影响。结果表明,叶绿素a和叶绿素b含量随硫浓度的升高而逐渐增加,成熟期烤烟叶绿素a/b没有规律性变化。在2-32 mmol/L处理之间,烤烟叶片的有效光化学量子产量(*EQY*)、最大量子产量(F_v/F_m)、光合电子传递速率(*ETR*)随硫浓度增加而降低,非光化学猝灭(*NPQ*)、非光化学过程中的基本量子产量(F_o/F_m)、PSⅡ水裂解端失活程度(F_o/F_v)和PSⅡ反应中心关闭程度(1-*qP*)随硫浓度增加而升高,2 mmol/L处理的质体醌库($F_v/2$)低于0.01和4 mmol/L处理,但高于8-32 mmol/L处理。0.01 mmol/L处理烤烟的*EQY*和*ETR*低于2-8 mmol/L处理,但高于16 mmol/L和32 mmol/L处理;其F_v/F_m低于2和4 mmol/L处理,与8和16 mmol/L处理差异不大,都高于32 mmol/L处理;其F_o/F_m、F_o/F_v和1-*qP*与F_v/F_m变化趋势相反;0.1mmol/L处理的*NPQ*明显高于2-4mmol/L处理并且辐射强度在0-500μmol · m^{-2} · s^{-1}之间高于8-32 mmol/L处理,当辐射强度超过500μmol · m^{-2} · s^{-1}后低于8和16mmol/L处理。0.01mmol/L处理烤烟*EQY*、F_v/F_m和*ETR*的降低可能不是由$F_v/2$引起的,而是由于1-*qP*升高引起的;但16 mmol/L和32 mmol/L处理F_v/F_m 、*ETR*、*EQY*降低可能是1-*qP*与 $F_v/2$共同作用的结果。

English Summary:

A hydroponic experiment was carried out to study the effects of different concentrations of sulfur (0.01-32 mmol/L) on chlorophyll contents and chlorophyll fluorescence parameters of flue-cured tobacco leaves at maturation stage. Chlorophyll a and chlorophyll b contents of flue-cured tobacco leaves at maturation stage gradually increased with increasing concentrations of sulfur, but differences among the treatments were not significant. Chlorophyll a/b values of flue-cured tobacco leaves at maturation stage had no regular change but chlorophyll a/b values in the 0.01-8 mmol/L concentrations of sulfur were slightly higher than those in the 16 and 32 mmol/L concentrations of sulfur. As the sulfur concentration increasing from 2 to 32 mmol/L, there were decreases in the effective quantum yield (*EQY*), the maximum quantum yield of PSⅡ photochemistry in the dark-adapted state (F_v/F_m), and the photosynthetic electron transport rate (*ETR*) of flue-cured tobacco leaves at maturation stage, but increases in nonphotochemical quenching (*NPQ*), basal quantum yield of nonphotochemical quenching (F_o/F_m), PSⅡ water-splitting apparatus inactivation (F_o/F_v), and the degree of reaction center closure (1-*qP*). The plastoquinone pool ($F_v/2$) of flue-cured tobacco leaves at maturation stage in the 2 mmol/L concentration of sulfur was lower than that in the 4 mmol/L concentration of sulfur but higher than those in the 8-32 mmol/L concentrations of sulfur. The curves of $F_v/2$ of flue-cured tobacco in 8-32 mmol/L concentrations of sulfur were almostly overlapped. The *EQY*, and *ETR* of flue-cured tobacco leaves at maturation stage in the 0.01 mmol/L concentration of sulfur were lower than those in the 2-8 mmol/L concentrations of sulfur, but higher than those in the 16-32 mmol/L concentrations of sulfur. The F_v/F_m of flue-cured tobacco leaves at maturation stage in the 0.01 mmol/L concentration of sulfur was lower than those in the 2-4 mmol/L concentrations of sulfur but higer than that in the 32 mmol/L concentration of sulfur. There were not significantly different in the F_v/F_m among the 0.01, 8 and 16 mmol/L concentration of sulfur. The curves of 1-*qP*, F_o/F_m and F_o/F_v of flue-cured tobacco leaves at maturation stage in the 0.01 mmol/L concentration of sulfur were intertvined with 8 and 16 mmol/L concentrations of sulfur and higher than those in the 2-4 mmol/L concentrations of sulfur but lower than those in the 32 mmol/L concentration of sulfur. The *NPQ* of flue-cured tobacco leaves at maturation stage in the 0.01 mmol/L concentration of sulfur were significantly higher than those in the 2-4 mmol/L concentrations of sulfur. Similarly, the *NPQ* in the 0.01 mmol/L concentration of sulfur was higer than those in the 8-32 mmol/L concentrations of sulfur at photosynthetic active radiation (*PAR*) range 0-500 μmol · m^{-2} · s^{-1} but lower than those in 8 and 16mmol/L concentrations of sulfur at photosynthetic active radiation over 500μmol · m^{-2} · s^{-1}. The $F_v/2$ of flue-cured tobacco leaves at maturation stage in the 0.01 mmol/L concentrations of sulfur was lower than that in the 4 mmol/L concentration of sulfur, but higher than those in the 2 mmol/L and the 8-32 mmol/L concentrations of sulfur. These results suggested that the decreases in the *EQY*, F_v/F_m, and *ETR* of flue-cured leaves at maturation stage in the 0.01 mmol/L concentrations of sulfur did not result from a decreased plastoquinone pool, but from an increase in the degree of reaction center closure. In the 16-32 mmol/L concentrations of sulfur, the decreases in *EQY*,F_v/F_m, and *ETR* resulted from a combination of increased degree of reaction center closure and a decreased plastoquinone pool.

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