

花后高温对持绿型小麦叶片衰老及籽粒淀粉合成相关酶的影响

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摘要 试验选用持绿型冬小麦(*Triticum aestivum*) ‘豫麦66’ (‘Ym66’)和‘淮麦8号’ (‘Wm8’)为研究材料,以当地生产上起主导作用的冬小麦品种‘小偃22’ (‘XY22’)和‘小偃6号’ (‘XY6’)为对照。花后用塑料薄膜搭建增温棚进行高温处理,测定各品种绿叶数目、叶绿素和丙二醛(MDA)含量及叶片细胞膜透性,并研究籽粒灌浆成熟期高温对持绿型小麦籽粒淀粉合成相关酶及粒重的影响。结果表明,高温处理后,各品种的绿叶数目和叶绿素含量都减少,MDA含量和膜透性都增加,说明高温加速了小麦叶片衰老。同时,各品种籽粒中与淀粉合成相关的酶(蔗糖合成酶(SS)和腺苷二磷酸葡萄糖焦磷酸化酶(AGPP)、可溶性淀粉合酶(SSS))活性都低于正常生长下的籽粒中的酶活性,其中高温对籽粒SS和AGPP活性的影响不显著,而对籽粒SSS活性的影响显著($p = 0.015$)。品种间比较,持绿型小麦在两种处理下,都表现出较多的绿叶数目和较高的叶绿素含量;且3种与淀粉合成相关的酶活性也都高于非持绿型小麦,说明持绿型小麦酶活性受高温抑制程度较小。相关性分析表明,所有品种籽粒SS、AGPP、SSS活性都与籽粒灌浆速率成极显著的正相关(相关系数 r 分别为0.905、0.419和0.801)。因而,持绿型小麦不仅具有较好的持绿特性,而且籽粒中与淀粉合成相关的3种酶活性都较高,这有利于其籽粒淀粉的合成,从而增加籽粒产量。

关键词: 酶活性 籽粒 高温 淀粉合成 持绿 冬小麦

Abstract: *Aims* Our objectives were to explore the influence of high temperature on enzymes of grain starch synthesis in stay-green wheat (*Triticum aestivum*) and reveal heat tolerance in stay-green wheat. *Methods* We used the stay-green wheat ‘Wm8’ and ‘Ym66’ and the control varieties ‘XY6’ and ‘XY22’ as experimental materials. A warming cover of plastic film was used to carry out the high-temperature treatment. After anthesis, we measured green leaf number, chlorophyll content, malonaldehyde (MDA) and membrane permeability, as well as the activities of the enzymes of grain starch synthesis were measured. *Important findings* High temperature after anthesis promotes rapid leaf senescence. For all four varieties, the green leaf number and chlorophyll content significantly decreased, but the MDA content and the relative electric conductivity increased markedly. The stay-green wheat varieties had higher green leaf number and chlorophyll content and lower MDA content and relative electric conductivity than the control cultivars after high temperature treatment. In grains, the activities of the enzymes of grain starch synthesis (sucrose synthase, SS; adenosine diphosphate glucose pyrophosphorylase, AGPP; and soluble starch synthase, SSS) in all four varieties decreased after high temperature treatment. But activities of these enzymes in the stay-green wheat were also higher than those in the control wheat, suggesting that it was beneficial for the starch accumulation in grain of stay-green wheat under high temperature. Among the three enzymes, a significant difference existed in SSS activity between the high temperature treatment and the control, and activities of the above three enzymes were positively and significantly correlated with grain-filling rate ($r = 0.905, 0.419$ and 0.801 , respectively), so they play a key role in starch synthesis in the grain of wheat. Above all, the stay-green wheats have better resistance to high temperature than other varieties, and they have strong photosynthesis capacity and higher grain weight. Hence, breeding new cultivars with the stay-green characteristic would reduce the influence of high temperature stress during grain filling in wheat production.

Keywords: enzyme activity, grain granule, high temperature, starch synthesis, stay-green, winter wheat

收稿日期: 2011-02-21; 出版日期: 2011-06-30

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引用本文:

石慧清, 龚月桦, 张东武. 花后高温对持绿型小麦叶片衰老及籽粒淀粉合成相关酶的影响. 植物生态学报, 2011,35(7): 769-778.

SHI Hui-Qing, GONG Yue-Hua, ZHANG Dong-Wu. Effect of high temperature on leaf senescence and related enzymes of grain starch synthesis in stay-green wheat after anthesis. Chinese Journal of Plant Ecology, 2011,35(7): 769-778.

链接本文:

<http://www.plant-ecology.com/CN/10.3724/SP.J.1258.2011.00769> 或 <http://www.plant-ecology.com/CN/Y2011/V35/I7/769>

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