

非对称性增温对冬小麦籽粒淀粉和蛋白质含量及其组分的影响

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Effects of Asymmetric Warming on Contents and Components of Starch and Protein in Grains of Winter Wheat under FATI Facility

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摘要

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摘要 气候变暖呈现明显的非对称性, 冬春季和夜间的增温趋势显著。参考国外先进的田间开放式增温方法, 2007—2009年在江苏南京开展了昼夜不同增温对冬小麦籽粒淀粉和蛋白质含量及其组分的影响研究。全天、白天和夜间3种增温处理分别显著提前了冬小麦的灌浆期, 并改变了灌浆期高于32℃高温的出现时间和天数, 引起了籽粒中淀粉组分、蛋白质含量及蛋白质组分的明显变化。3种增温处理中, 冬小麦总淀粉含量差异不显著, 但均显著提高了籽粒中直/支淀粉的比例。其中白天增温的直/支比最高, 两年分别比对照提高6.9%和46.2%。增温处理使籽粒中总蛋白质含量显著降低, 并呈现对照>白天>夜间>全天的趋势。与对照相比, 全天、白天和夜间增温的籽粒蛋白质含量两年平均分别下降9.1%、5.4%、6.9%。增温处理对籽粒蛋白质组分的影响比较复杂, 但两年结果表明, 白天增温对蛋白质组分的影响趋势一致, 均清蛋白含量最低, 球蛋白含量最高, 谷/醇比最低。上述结果表明, 气候变暖不仅将影响作物的生育时期, 而且还直接影响温度高低。增温对冬小麦品质的影响比较复杂, 不同年份及变暖情景之间的增温效应差异显著。

关键词: 气候变暖 开放式增温 冬小麦 籽粒品质 淀粉 蛋白质

Abstract: Climate warming presents significantly asymmetric trends with greatly seasonal and diurnal differences, greater temperature elevations existing in the winter-spring season than in the summer-autumn season and at the nighttime than at the daytime. To date, this is till lack of evidence about the effects of asymmetric warming on the quality of winter-wheat grain based on field experiments. Here, we performed field warming experiment under free air temperature increased (FATI) facility to investigate the impacts of asymmetric warming on the contents and components of starch and protein in winter-wheat grain during 2007-2009 in Nanjing, Jiangsu province, China. The results showed that the all-day warming (AW), daytime warming (DW), and nighttime warming (NW) treatments significantly advanced the grain-filling stage and changed the appearance time and days of high temperature above 32° C in grain-filling stage, consequently resulting in obvious changes of starch component, protein content and protein components. Treatments AW, DW, and NW had no significant impact on the starch content of winter-wheat grain but tended to increase the ratio of amylose content to amylopectin content. The highest values of the ratio of amylose content to amylopectin content existed in the DW plots which were 6.9% and 46.2% higher than those in the control plots in the two years, respectively. The content of grain protein was significantly decreased by warming with the content order of CK > DW > NW > AW. Warming decreased the grain protein contents by 9.1%, 5.4%, and 6.9%, respectively in the AW, DW, and NW treatments on average of the two years. The effects of warming on grain protein components were complicated. However, DW showed a regular impact on protein components. The two-year result showed that the lowest content of albumin and the greatest content of globulin occurred in the DW plot with a lowest ratio of glutelin content to gliadin content. All these results demonstrate that the effects of asymmetric climate warming on the quality of winter-wheat grain are complicated with significant differences among warming patterns and experimental years.

Keywords: Climate warming Free air temperature increased (FATI) Winter wheat Grain quality Starch Protein

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