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Differential Impacts of Whole-Growth-Duration Warming on the Grain Yield and Quality between Early and Late Rice

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Abstract : The impacts of whole-growth warming on grain yield and quality in double rice cropping systems still remain largely unknown. In this study, a two-year field whole-growth warming experiment was conducted with two inbred indica rice cultivars (Zhongjiazao 17 and Xiangzaoxian 45) for early season and two hybrid indica rice cultivars (Wanxiangyouhuazhan and Tianyouhuazhan) for late season. The results showed that whole-growth warming did not affect early rice yield but significantly decreased late rice yield, which was caused by the decreased grain weight that may be related to the increased plant respiration and reduced translocation of dry matter accumulated during the pre-heading phase under warming. Whole-growth warming improved the milling quality of late rice but decreased that of early rice; however, the chalky rice rate and chalkiness degree were increased by 20.7% and 33.9% for early rice and 37.6 % and 51.6% for late rice under warming, respectively. We found that the crude protein content of milled rice was significantly increased by warming in both early and late rice, which would result in deterioration of eating quality. Besides, compared with the control treatment, the setback of late rice was significantly reduced by 17.8 % under warming, while that of early rice was not significantly affected by warming. These results suggest that the negative impacts of whole-growth warming on grain quality may be more severe in early rice than in late rice. Therefore, adaptation in both rice breeding and agronomic practices is needed to alleviate climate warming on the production of a double rice cropping system. Climate-smart agricultural practices ought to be implemented to mitigate the detrimental effects of warming on rice grain quality. For instance, fine-tuning the application rate and timing of inorganic nitrogen fertilizers, along with the introduction of organic amendments and the cultivation of heat-tolerant rice varieties, can help reduce the negative impact of rising temperatures on rice quality. Furthermore, to comprehensively understand the influence of climate warming on rice grain quality, future research should encompass a wider range of rice cultivars and experimental sites.

Keywords : climate warming, double rice cropping, dry matter, grain quality, grain yield
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