



Crop Modelling
for Agriculture
and Food Security
under Global Change

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Integrative adaptation strategies for stabilizing wheat productivity with climate warming in China

Global wheat production faces growing threats from climate change, particularly climate warming, necessitating region-specific adaptive strategies. Climate warming impacts on crop production could arise from both rising mean growing season temperature and more frequently extreme heat stress events. Adapting to these two impacts could be substantially different, and the overall contribution of these two factors on the effects of climate warming and crop yield is not well known yet. With the improved process-based crop model, which can reproduce the extreme heat stress effects, the separate impacts of temperature increase and heat stress on wheat yield and production were quantified across the main wheat-producing region of China under both historical and future climate scenarios. Divergent responses of wheat yield to increasing temperature and heat stress were projected for the cooler northern sub-regions and the warmer southern sub-regions. Most negative impacts of climate warming are attributed to increasing mean growing-season temperature, while changes in heat stress are projected to reduce wheat yields by an additional 1.0% to 1.5% in northern sub-regions. This underscored the importance of considering the different regional and temperature impacts in climate change adaptation. Further, how adaptive strategies—adjusting sowing dates, anthesis dates, and enhancing heat tolerance—can mitigate the adverse impacts of warming on wheat yields across China's diverse wheat-producing subregions were evaluated through scenario analysis. Under warming scenarios, comprehensive adaptation strategies will significantly reduce potential yield losses in all four wheat producing subregions. A gene-based crop modelling with current wheat germplasms also reveal potential in stabling wheat growth duration under climate warming by breeding efforts. These findings offered actionable insights for sustaining wheat productivity amid climate change and enhancing food security in China.