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研究论文

气候变化背景下华北地区冬小麦生育期的变化特征

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摘要 以21世纪初近10年的冬小麦(*Triticum aestivum*)生育期调研数据和气象站点数据为基础，利用“多元逐步回归分析+ 残差插值”方法，绘制了2000年后华北地区冬小麦生育期等值线图，通过研究两个时期(1971－1980年和21世纪初近10年)华北地区气候资源及冬小麦生育期的变化，探讨了气候变化对华北地区冬小麦生育期的影响。结果表明：(1)华北地区北部年均气温及≥10 ℃积温增加显著，但降水减少，暖干趋势明显，中部和南部年平均气温和≥10 ℃积温也呈现增加趋势，但降水增多，日照下降，出现暖湿趋势；(2)除南部江苏、安徽两省冬小麦播种期无明显变化外，华北地区冬小麦播种期普遍推迟，一般在7－10天；冬小麦返青期变化较为复杂，西部地区的冬小麦返青期推迟2－10天，而东南部的山东、安徽及江苏地区冬小麦返青期明显提前，一般在5－7天；华北地区冬小麦的拔节期提前，北部地区幅度较大，为5－10天；冬小麦抽穗期推迟明显，以华北中部和北部最为明显，为10－15天；除华北南部胶东半岛外，华北大部分地区冬小麦成熟期推迟，一般在5－10天；(3)气候要素的波动是引起华北地区冬小麦生育期变化的主要原因：日照时数与冬小麦返青期和拔节期呈显著相关，日照时数减少，冬小麦返青期和拔节期提前，而受年平均气温升高的影响，冬小麦抽穗期有所推迟，积温的增加对冬小麦成熟期有推迟作用，同时降水对冬小麦生长的拔节和抽穗有促进作用。

关键词： 气候变化 生育期 华北地区 冬小麦

Abstract： *Aims* Climate change is generally accepted to be a critical problem. It affects crop growth stages through changes in sunlight, heat and moisture. Our objective is to investigate the development of winter wheat growth stages under climate changes in northern China to determine possible causes of changes.
Methods Based on data of winter wheat growth stages and meteorology, we used multiple stepwise regression + residual interpolation to determine changes in winter wheat growth stages in northern China since 2000. Changes were investigated for two periods: 1971－1980 and after 2000.
Important findings The north part of northern China, including Beijing, Tianjin, Hebei and Shanxi Provinces, showed a significant warming and drying trend. In Henan and Shandong Provinces, temperature and precipitation had increased and sunlight had decreased. Jiangsu and Anhui Provinces also showed a trend of decreased sunlight and increased annual average temperature and accumulated temperature over 10 ° C; however, the changes were small. Variations in climate cause changes in the growth stages of winter wheat. Compared to the 1970s, the sowing period had been delayed about 7－10 days after 2000 in most parts of northern China except Jiangsu and Anhui Provinces. The greening stage had advanced in the southeast, but was delayed in the northwest part of northern China. The jointing stage had advanced in northern China, especially in Beijing, Tianjin, Hebei, Shanxi and Shandong Provinces. It postponed the heading stage about 2－15 days. The harvesting stage had been postponed in most parts of northern China by 5－10 days. Variations in climate factors, mainly sunlight, temperature and precipitation, are the main influences on winter wheat growth stages. Greening and jointing stages showed significant correlations to annual average sunlight hours. An increase of annual average temperature more strongly affected the heading stage. An increase of accumulated temperature over 10 ° C can postpone maturity of the stage. Precipitation can promote the stages of jointing and heading.

Keywords： climate change, growth stages, northern China, winter wheat

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