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Influence Factors on Reference Crop Water Consumption in Zhengzhou City, Henan Province

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Background and Objectives

As one of the major grain production areas in China, grain production in Henan Province is highly dependent on irrigation. However, the groundwater level in Henan Province continues to decline as grain production increases annually. In recent years, the groundwater overdraft area has reached a quarter of the province's area. Grain production, limited by the amount of water resources, needs to follow the path of water-adapted agriculture.

Crop water consumption is the key to formulating crop irrigation schedule. The main influence factors are meteorological parameters, including average temperature, average water vapor pressure, wind speed at 2 m height, and sunshine hours. The objective of this study was to analyze the influence of meteorological factors on reference crop water consumption and determine the sensitivity of the influence factors in the Zhengzhou City of Henan Province.

Methods

Based on climate data from 1955–2014, the reference crop water consumption was calculated using the Penman–Monteith formula, and the influence of meteorological factors on the reference crop water consumption was analyzed using the orthogonal design method of four factors and three levels. And the obtained theoretical results were verified by field examples.

Results

Results showed that: the sensitivity of the reference crop water consumption from large to small as wind speed at 2 m height, average temperature, sunshine hours, and average water vapor pressure. Reference crop water consumption was positively correlated with the average temperature and the wind speed at 2 m height. However, the interaction of these two factors had a non-significant effect on reference crop water consumption. The average water vapor pressure and sunshine hours had a non-significant effect on reference crop water consumption.

Conclusions

The verification experiment results revealed that both average temperature and wind speed at 2 m height positively affected on reference crop water consumption. This study can provide a scientific basis for improving the estimation and prediction of crop water consumption, formulating crop irrigation schedules, and understanding the impact of climate change on crop water consumption.

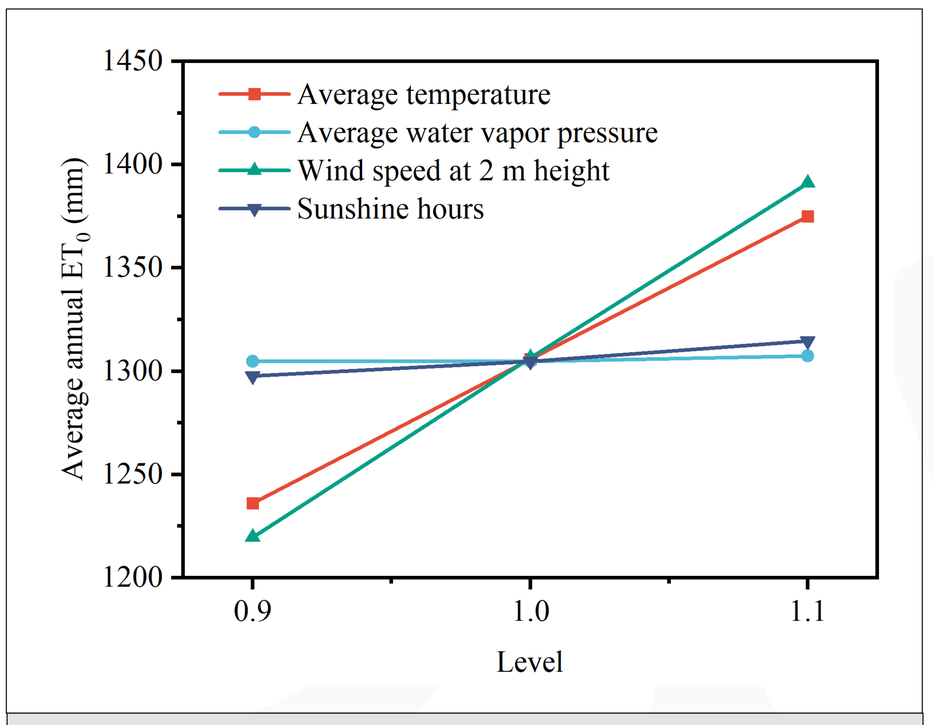

Figure 1 Trends for average annual ET_0 with influencing factors and levels (2005–2014).

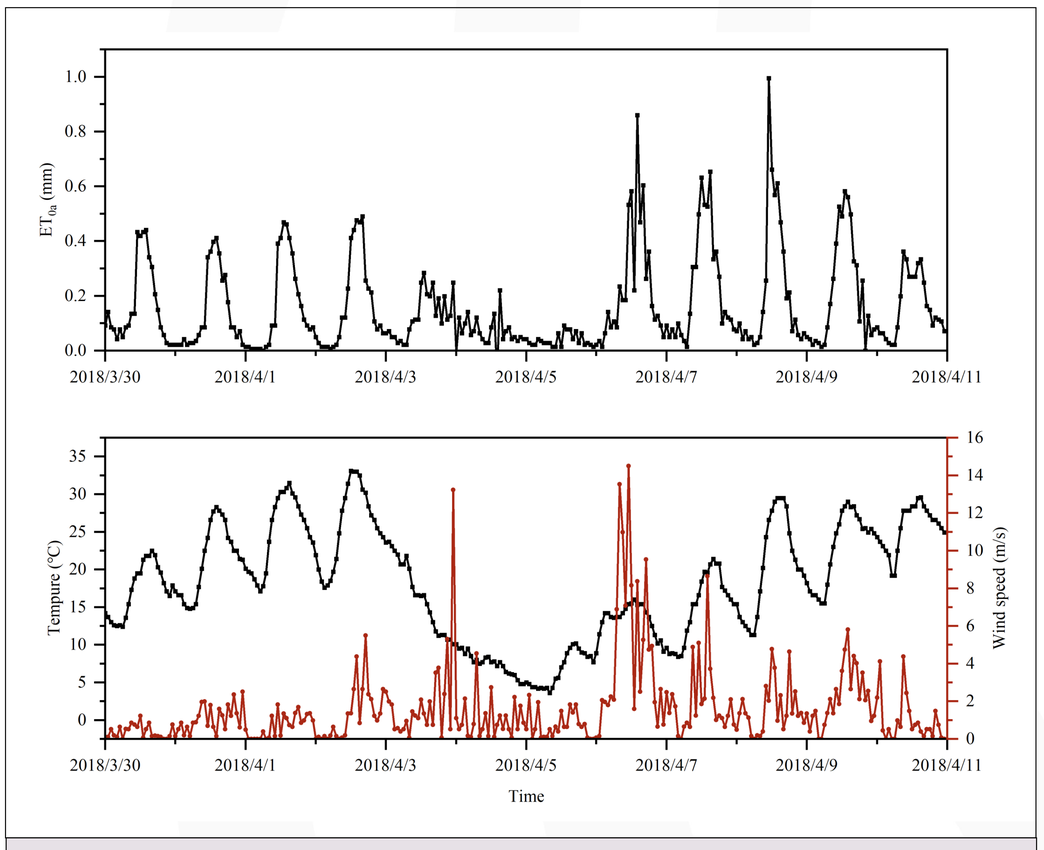

Figure 2 Changes of ET_{0a} from March 30th to April 10th, 2018).