Perspective
Volume 12:2, 2023

Irrigation & Drainage Systems Engineering

ISSN: 2168-9768 **Open Access**

Wheat Field with High Yields, Water Efficiency and Optimal Supplemental Irrigation

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Introduction

Water-saving cultivation with limited irrigation is a promising method in the Huang-Huai-Hai Plain of China, where water scarcity and uneven precipitation distribution are major threats to agricultural sustainability, particularly winter wheat (*Triticum aestivum L.*) production. From 2007 to 2015, an eight-year field study was conducted in this region using the same water and fertilizer management as during the sowing stage of winter wheat, which received either no irrigation (rain-fed) or supplemental irrigation (SI). Under rain-fed conditions, the proportion of water consumed from jointing to maturity averaged 56 percent, but reached 64 percent under optimal SI conditions. During the various growth phases, the primary water supply that was suitable for achieving both high yield and high water use efficiency (WUE) had a volume that was nearly constant. During the growing season, the optimal seasonal SI decreased in proportion to an increasing natural water supply, and its contributions to the seasonal evapotranspiration ranged from 11% to 44%. Rain-fed grain yield, as well as the optimal SI amounts required from sprouting to jointing or from sprouting to anthesis, and the main water supply at sowing were found to have significant regression relationships with rain-fed grain yield. Model forecasting for on-demand irrigation receives significant theoretical and technical support from these findings. The results also indicated that SI, which is calculated by simultaneously taking into account the change in precipitation, the state of the soil's water storage, and the status of crop evapotranspiration, is an important method for winter wheat to achieve high yield and conserve water [1].

Description

One of China's most important agricultural production regions, the Huang-Huai-Hai Plain (3HP) is dominated by the winter wheat-summer maize annual double-cropping system. While the 3HP has approximately 25% of China's arable land, produces 71% of the nation's wheat and 33% of its maize, it receives less than 7% of the country's total water resources. Based on multiple years of observations of evapotranspiration (ET, crop water consumption) in the winter wheat-summer maize double cropping system with a large-scale weighing lysimeter, the annual agricultural water consumption is approximately 800–900 mm. In this region, the annual precipitation averages 556 millimeters and ranges from 500 to 800 millimeters. However, only 150 to 180 millimeters fall during the winter wheat growing season, accounting for only 25 to 40% of winter wheat's total water requirement. As a result, the primary method for meeting the water requirements for winter wheat's growth, development, and yield formation is irrigation. Traditionally, farmers irrigated winter wheat four to six times during the season, using 300–400 millimeters of water in total, putting the groundwater reserves in grave danger. In this region, crop irrigation uses more than 80% of the groundwater resources. Numerous environmental issues have resulted from excessive irrigation of groundwater sources. As a result, effective technologies for conserving water must be developed [2-5].

Conclusion

When there is a limited supply of water, the timing and quantity of irrigation are two crucial factors in boosting water use efficiency (WUE). The timing of irrigation is typically determined by indicators based on crop water status or soil moisture conditions. The crop water stress index, which is based on the canopy surface temperature and is the most commonly used index for quantifying crop water stress, can also be used to schedule crop irrigation. Numerous researchers have estimated the divergence points of physiological processes, such as leaf and stem expansion, photosynthesis, transpiration, stomatal conductance, leaf turgor pressure, and leaf water potential, at the threshold values of plant-available soil water content during water stress. In addition, previous research has highlighted a number of advantages associated with employing the soil water potential as an accurate description of the soil water regime. Typically, the Pan Evaporation Method or the outcomes of a series of irrigation-level experiments were used to determine the amount of irrigation. Irrigation, precipitation, and soil water loss were used to estimate crop ET. Climate shifts and irrigation practices had a significant impact on crop ET. As a result, implementing on-demand irrigation in accordance with crop requirements ought to play a significant role in reducing irrigation and increasing precipitation and soil water use efficiency

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How to cite this article: Zhang, Jingwen. "Wheat Field with High Yields, Water Efficiency and Optimal Supplemental Irrigation." *Irrigat Drainage Sys Eng* 12 (2023): 373.

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Received: 01 February 2023, Manuscript No. idse-23-90180; **Editor assigned:** 03 February 2023, PreQC No. P-90180; **Reviewed:** 15 February 2023, QC No. Q-90180; **Revised:** 22 February 2023, Manuscript No. R-90180; **Published**: 28 February 2023, DOI: 10.37421/2168-9768.2023.12.373