

## An Evaluation of Minimum Tillage in the Corn-wheat Cropping System in Hebei Province, China: Wheat productivity and water conservation

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### Abstract

In North China where the main crops are winter wheat and summer corn, current agricultural practices involve minimum tillage for corn and full tillage for corn or wheat, and require large amounts of irrigation water, especially during the wheat growing season. Conservation tillage (CT) is a promising method of water conservation, but local farmers still question whether it will affect the yield of winter wheat. We conducted fieldwork during 2011-2014 in Xushui, Hebei, China, in order to compare the effects of various methods of tillage, mulching, and irrigation on the yield, soil moisture, and soil temperature under a summer corn/winter wheat double cropping system. Wheat grain yield in 2012-2013 did not differ significantly because of tillage, residue, and irrigation treatments. This means that reduced irrigation did not affect grain yield for all the treatments. However, in 2013-2014, the yield for minimum tillage with residue mulch (MT<sub>m</sub>) was significantly higher (19.5%) than that for full tillage with residue removal (FT<sub>i</sub>). Yields for MT<sub>m</sub> with reduced irrigation were 10.2% significantly higher than FT<sub>i</sub> with reduced irrigation. The positive crop response to MT<sub>m</sub> may have been due to relatively higher topsoil moisture and soil temperature under MT<sub>m</sub> than under FT<sub>i</sub> during the winter period. Minimum soil temperature for the inter-row at the 5-cm depth under MT<sub>m</sub> remained slightly higher than that under FT<sub>i</sub> during the winter of 2012–2013, with colder weather than in 2013-2014. Hence, after our two-year field experiment, we concluded that MT<sub>m</sub> resulted in higher grain yields as compared with FT<sub>i</sub>, probably due to higher topsoil water content; MT<sub>m</sub> with reduced irrigation maintained high yields despite eliminating one round of irrigation. Therefore, MT<sub>m</sub> with reduced irrigation was more beneficial for winter wheat crop production in North China.

**Discipline:** Crop production

**Additional key words:** crop residue, soil temperature, soil water content, yield

### Introduction

North China possesses approximately  $3.6 \times 10^7$  ha of arable land, accounting for about 30% of China's total arable land, and produces up to 42% and 79% of China's corn and wheat, respectively (Du 2013). In this area, grain yield largely depends on irrigation; consequently, agricultural irrigation consumes more freshwater than that for other uses. North China is currently confronted with ever-greater demands for water and widespread water shortages. The excessive use of groundwater for large-scale agricultural

irrigation to produce high grain yields, and the decreasing water table in North China are issues of growing concern, not only among local residents but also government agencies and researchers (Zhang et al. 1999, Zhang et al. 2003, Qin et al. 2006, Pan et al. 2011). It is important to develop a new system of crop rotation designed to conserve water, while maintaining stable grain production.

Conservation tillage (CT) is well known and acknowledged as a promising tillage practice that focuses on reducing soil erosion and enhancing soil water conservation (Mannering & Fenster, 1983). CT generally involves no-

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