Improving systems resilience and productivity through soil mulching and intercropping in arid areas

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Introduction

In arid environments, crop production is highly vulnerable to environmental stresses such as drought. Improved practices are needed to enhance the systems resilience while maintaining or increasing systems' productivity. This project determined (i) the responses of soil evaporation and moisture conservation to the integrated straw/plastic (double mulching) system, and (ii) the systems resilience and productivity in response to integrated cropping practices.

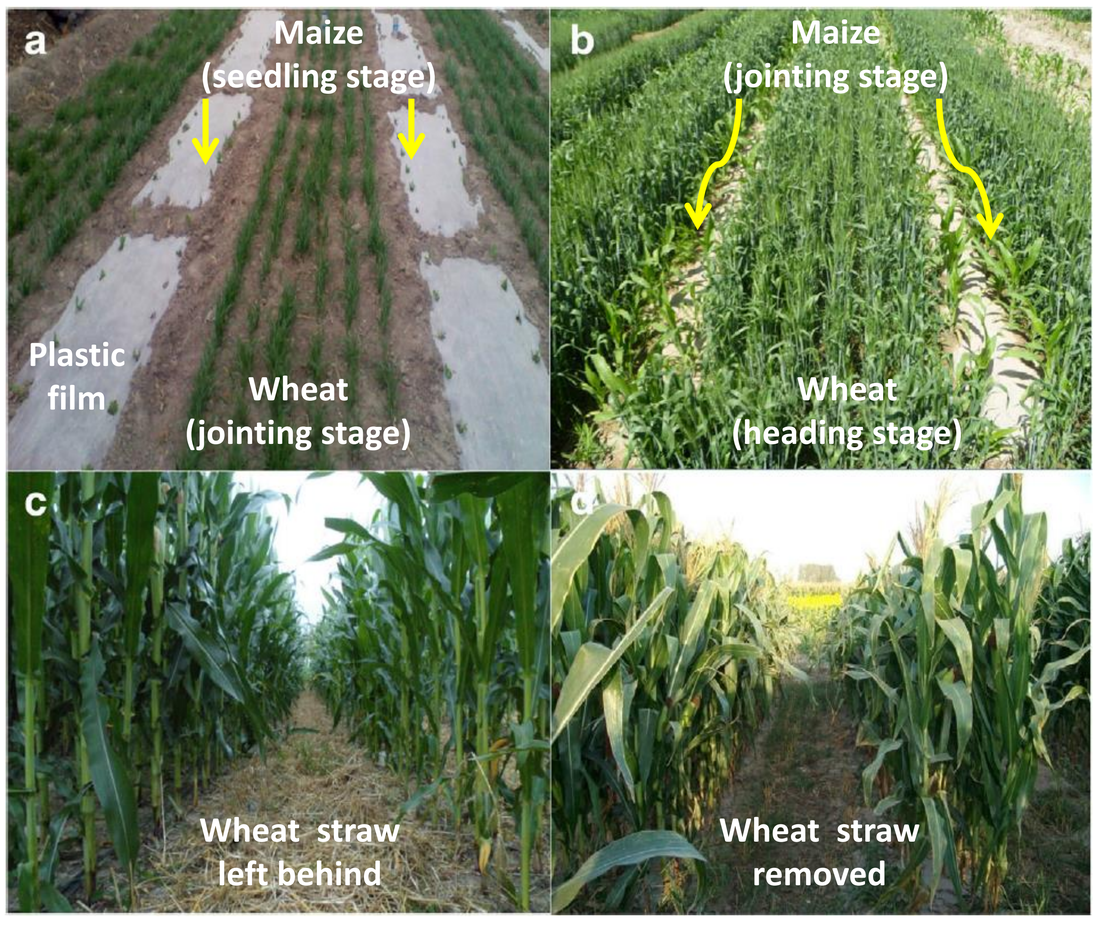

Fig. 1 Wheat-maize intercropping system with different mulching treatments

Materials & Methods

Two studies were conducted from 2009 to 2012. in Study 1, three types of mulching were applied to wheat-maize intercropping system (**Fig. 1**): 1) no-till with straw covering (NTS) and plastic film double mulching; 2) reduced tillage with straw incorporated (TIS); and 3) conventional tillage (CT) with straw removed. In Study 2, the wheat-maize intercropping, wheat mono-cropping, and maize mono-cropping systems were assessed under different water conservation treatments.

Results & Discussion

- Wheat-maize intercropping with plastic film and straw covering increased soil moisture by 3.8% before sowing, 5.3% during the wheat and maize co-growth period, 4.4% after wheat harvest, and 4.9% after maize harvest, compared to conventional practice (data not shown).
- The double mulching increased soil temperature of maize strips by 1.25 to 1.94°C than that of wheat strips in the top 10cm soil depth (**Fig. 2**).

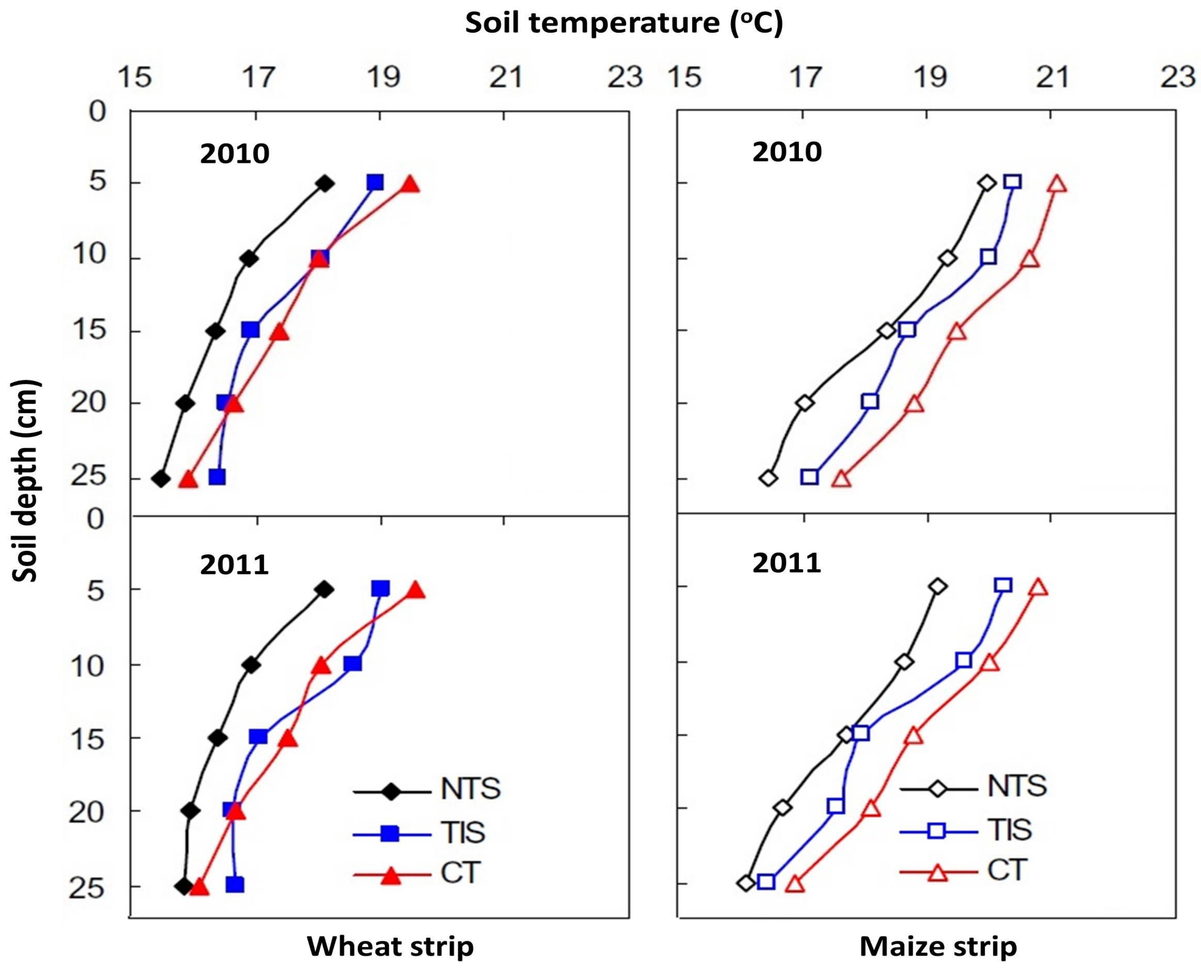

Fig. 2 Soil temperature in the 0-25 cm depth measured in the wheat and maize strips of the intercropping system under different straw mulching approaches

- Straw mulching increased the secondary super-compensation effect of intercropped maize by 11 to 26% from leaf, stem and sheath of maize, which contributed an increased yield of 14 to 33%, compared to the maize in the other treatments (**Table 1**).
- The intercropping with mulching increased total grain yield by 74% and harvest index by 12%, compared with the conventional practices (**Table 1**).

Table 1 Grain yields of wheat and maize in mono-planting and wheat-maize intercropping systems under different mulching and tillage treatments

	2010			2011			2012		
	Wheat	Maize kg ha^{-1}	Total	Wheat	Maize kg ha^{-1}	Total	Wheat	Maize kg ha^{-1}	Total
Mono-cropping									
NTS	–	13,470	13,470	6858	–	6858	–	13,247	13,247
TIS	–	12,760	12,760	6496	–	6496	–	12,157	12,157
CT	–	11,460	11,460	6383	–	6383	–	11,650	11,650
Intercropping									
NTS	5203	11,101	16,304	5193	10,972	16,165	4687	11,377	16,064
TIS	5355	9865	15,220	5199	10,369	15,568	4772	10,173	14,946
CT	5155	9107	14,261	4899	9806	14,703	4505	9857	14,362

Conclusions

Intercropping wheat with maize under straw mulching was shown to be highly effective in reducing water stress and enhancing the systems resilience and productivity in arid areas.