Effect of Mulching on the Water Balance of Sorghum in Weighing Lysimeters

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Abstract

Weighing lysimeter experiments has been carried out since 1992 at the Karcag Research Institute of the University of Debrecen CAS. By means of these experiments new information can be gained on the processes of the soil water regime, on the dynamics and characteristics of the water balance components influenced by soil utilization in case of different climatic and hydrological situations, on the moderation possibilities of unproductive losses (evaporation, deep percolation) and on the heat regime changes induced by various soil surface formations and covering. In 2006 a complex experiment was set in the lysimeters that involves soil cultivation and irrigation elements.

Introduction

Researches focus on the control of soil water regime in order to improve the efficiency of water use are of great importance. The determination of the effects of technological elements influencing the soil water regime (mulch layer, heat isolating soil surface, mitigation of cracking, etc.) can contribute to the elaboration of water preserving technologies as the elements of up-to-date and sustainable crop production. The control of soil water regime is an effective environmental protective process at the same time, which is of great importance to prevent soil degradation and to mitigate the pollution of our water funds.

Material and methods

The experiment was set in 9th May, 2006 with the treatments indicated in *Table 1*.

Sugar-sorghum (BERÉNY) was used as indicator crop. It was sawn in 9th May, 2006, the proper plant spacing was set subsequently. The soil of the units simulating conventional tillage was dug down to 25 cm depth, while shallow cultivation was applied in the mulching treatments mixing 1 kg/2m² (5 t/ha) straw of winter wheat into the upper 10 cm layer. Adequate plant nutrition was applied too (90:90:40 g/2m² NPK fertilisers), according to the nutrient demand of sorghum. At the same time probes measuring soil-moisture and temperature at four different layers were inserted into the soil of the lysimeter units. The irrigation experiment was started on 17th July. The date of the last irrigation day was 24th August. The units (S1-S6) got 25, 75, 125, 25, 75 and 125 mm of irrigation water respectively. According to the principle of weighing lysimetry, the facility is suitable for the calculation of the water balance of each unit. On the base of the adequate water balance equation valid for the given situation:

Table 1: **The treatments of the lysimeter experiment**

Lysimeter unit	Soil cultivation treatment	Irrigation treatment
S1	mulching	-
S2	mulching	half dose
S3	mulching	full dose
S4	conventional	-
S5	conventional	half dose
S6	conventional	full dose

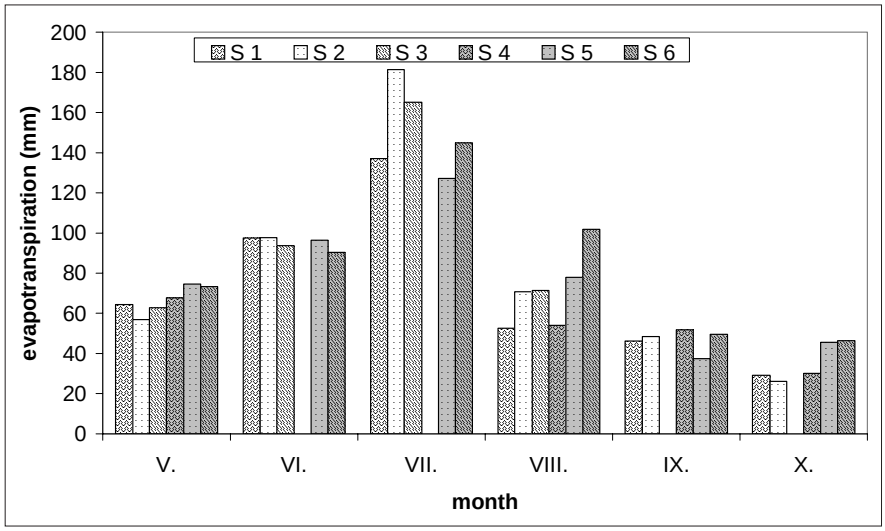

Figure 1: **Evapotranspiration in the lysimeters, May-October 2006**

$$E = P + I - D + \Delta W$$

where E = evaporation (mm), P = precipitation (mm), I = irrigation water (mm), D = drain water (mm), ΔW = the change of the weight of the soil column (water balance). As all the factors of the water balance equation, except for evaporation, can be measured and expressed in mm, the evaporation value can be calculated.

Results

The data gained so far show the effect of the different treatments very well. In the respect of water balance the more intensive transpiration (*Figure 1*) of the irrigated units is obvious, though at the beginning growing phases not significant differences were observed.

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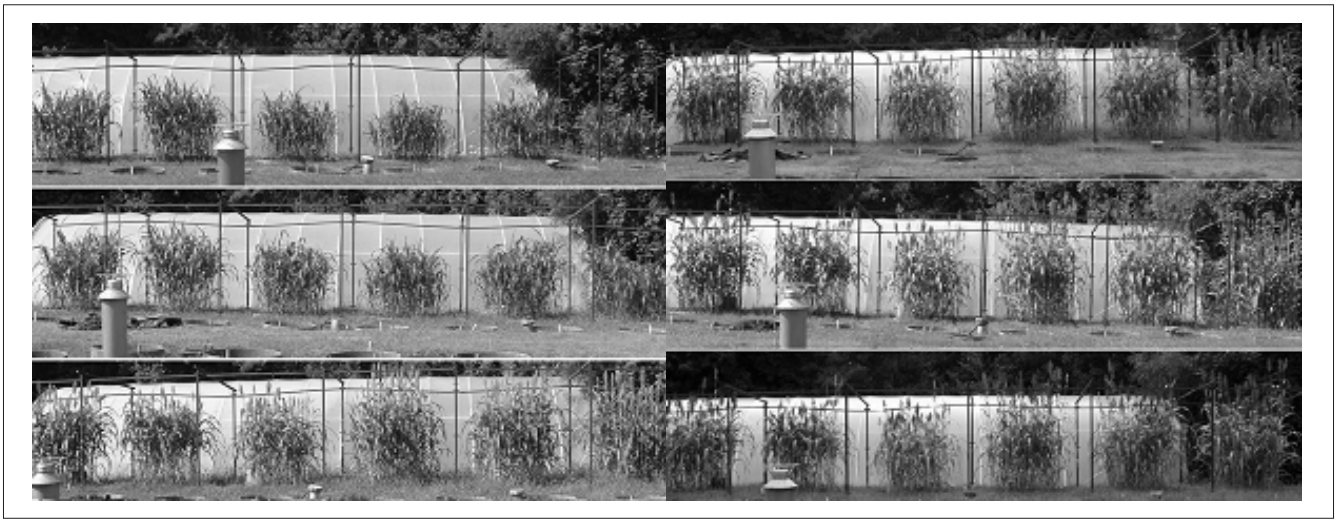

Figure 2: **Growth of the plants (10-17-31 July, 02-14-21 August 2006)**

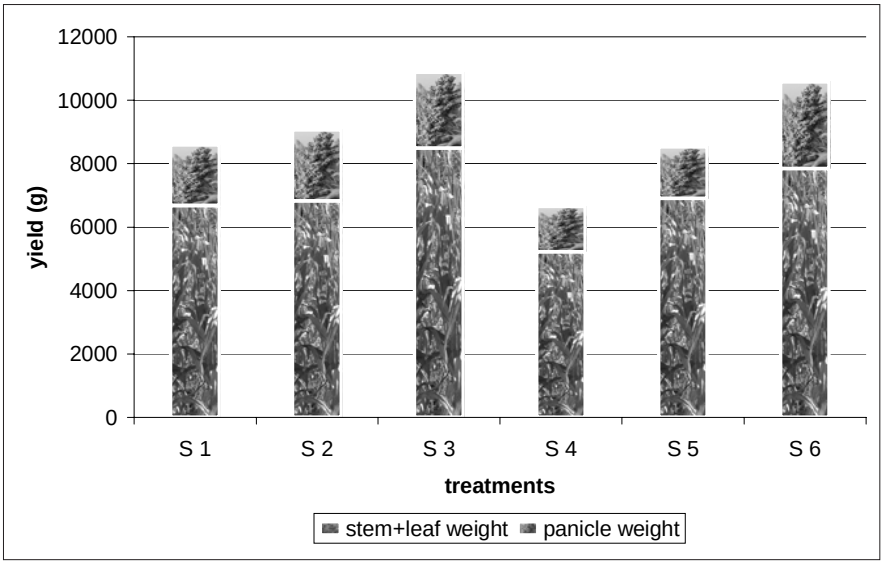

Figure 3: **Yields of Sorghum in the lysimeters**

In the month of July the differences became more characteristic. The growth of the plants was also regularly observed, the height of them was measured weakly in July and August. We could detect a more intensive growing of the plants of the lysimeter units without mulching during the initial development, which can be explained with the cooling effect of mulching: the soil temperature in the conventionally cultivated units became sufficient for the germination and the initial growth earlier than in the units with mulching. Later, when not the soil temperature, but the soil moisture content became the major factor determining plant growth, the tendency was the opposite: the indicator plants in the mulched units were higher. This process can be seen in the photos of *Figure 2*. All our observations concerning plant growth and water balance were proven by the yield data. The stem+leaf parts and the panicles of the indicator crops were separately harvested and weighed. *Figure 3* shows that both irrigation and mulching had positive effect on crop yield. In the mulched units quite high yields were reached even without irrigation (S1). Among the conventionally cultivated units only the yield of S6 unit with full dose irrigation was higher than the yield of any of the mulched units.

Conclusions

The positive effects of mulching on the moisture-, heat- and air regime of the soil is indisputable. By means of mulching the unproductive evaporation loss can be considerably moderated, which is of great importance in case of the production of plants with high water demand. The more favourable water regime manifested in higher yields makes mulching not only soil protective, but economically favourable as well.