Correlation between precipitation and evaporation in lysimeters with various surface types

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Summary

In a weighing lysimeter experiment of 8 years the effect of different soil cultivation methods on the soil water regime was examined. These 8 years represented different meteorological situations, especially different amounts of precipitation, which means different water inputs getting into the lysimeter system. In order to get information on the hydrological situations that did not occur during the investigated period correlation between precipitation and evaporation calculated in the lysimeters was determined to predict evaporation for various water inputs. The method of trendline fitting based on regression analysis was used for that purpose. On the base of the results the examined five soil surface types (uncultivated control, seed-bed, seed-bed+crust breaking, cloddy surface, seed-bed+straw cover) could be ranged into three different groups according to their hydrological behaviour.

Introduction

In the Karcag Research Institute of University of Debrecen, Hungary, a weighing lysimeter experiment has been carried out since 1993 to determine the effect of different soil cultivation methods on the soil water regime. Water balances calculated by means of weighing lysimeters are valid only for the meteorological circumstances that are characteristic for the given examination period, hence not all the meteorological variations can be investigated. In order to get information on the hydrological situations that did not occur during the investigated period correlation between precipitation (water input) and evaporation calculated in the lysimeters was determined.

Method

The precipitation data measured and the evaporation data calculated in the lysimeters for half-year (May-October) periods were used in the cases of the treatments that were examined in several years (1993-1999) of the experiment (uncultivated control, seed-bed, seed-bed+crust breaking, cloddy surface, seed-bed+straw cover). By fitting trendlines based on regression analysis on the measured points it was possible to predict evaporation values for the hydrological situations that did not occur during the investigated period.

Results and Discussion

The correlation between the precipitation and the evaporation is shown in *Figure 1*. Close exponential correlation could be found between the two variables (r=0.9609-0.9996***). According to the results the investigated five soil surface types could be ranged into three different groups.

The first group is represented by the uncultivated variant (control: CON).

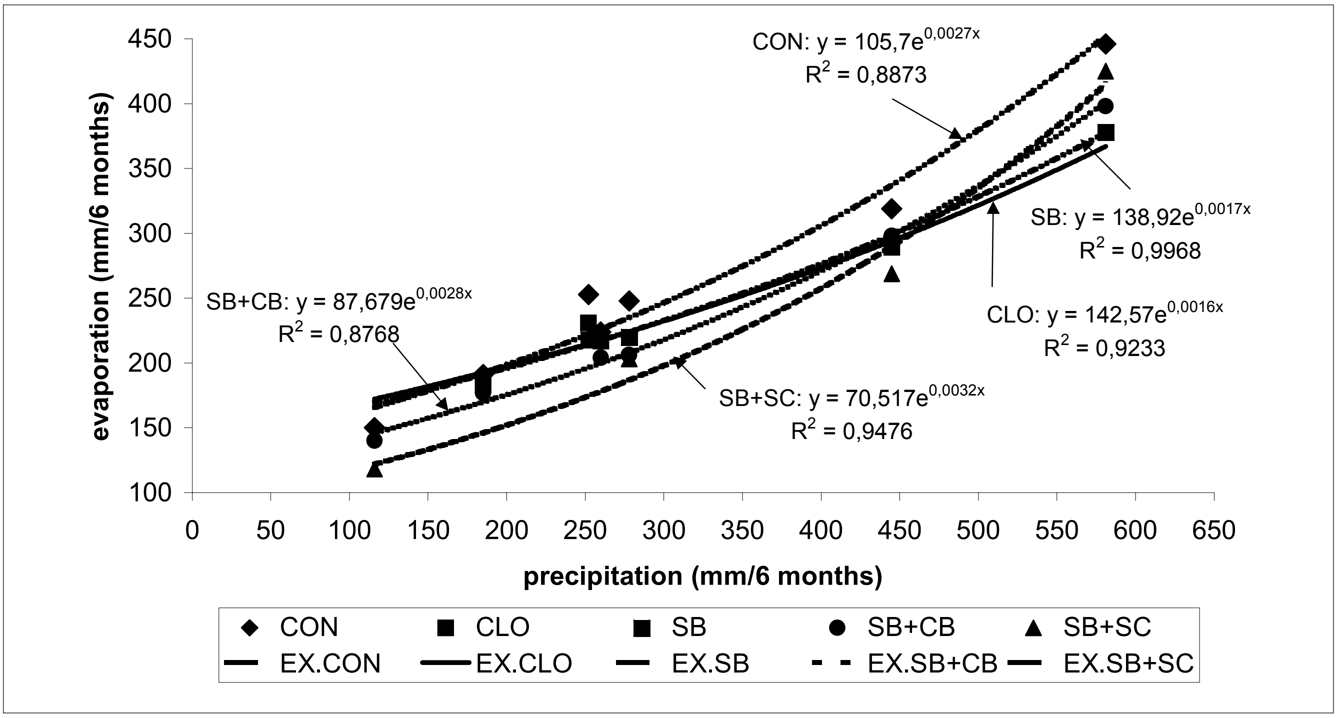

Figure 1: **Correlation between precipitation and evaporation on the base of lysimeter data (May-October 1993-1999)**

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This variant can be characterised with the smallest evaporation surface area, but because of its unfavourable soil structure the input water can not infiltrate into the soil and be stored in the deeper layers, hence the water remained on the surface can provide the possibility of evaporation for the longest time. The highest evaporation losses characterise this variant in the precipitation range above 300 mm.

Two soil surface types (seed-bed: SB, cloddy surface: CLO) belong to the second group, both represent mechanical treatments without added material. Practically, there is no difference between the evaporation of these variants. Comparing them to the untreated variant less evaporation loss could be figured out in the precipitation range above 300 mm. This fact can rather be explained with their better water permeability (more deep percolation water was measured) than their evaporation decreasing effect. The drying effect of soil cultivation occurred in the precipitation range below 300 mm due to the bigger evaporation surface area of these two treatments.

The third group is represented by the seed-bed+straw cover (SB+SC) and the seed-bed+crust breaking (SB+CB) treatments. Comparing these treatments to the others it is obvious that in the range of 100-400 mm precipitation the evaporation was much lower. This fact could be explained by the direct evaporation decreasing effect of the straw cover (like mulching) and the dry isolation layer created by crust-breaking. If the precipitation exceeds 450-500 mm higher evaporation will have to be taken into consideration in the case of the straw covered treatment as the straw layer retains the moisture like a sponge and the wet soil can not take it up. During the dry periods the moisture content evaporates directly from the straw. The infiltration rate of this treatment is the best up to 450 mm precipitation, and according to the relevant curve the most even too, which can be explained by the „water regime buffering effect“ of the straw layer. Similar increasing evaporation characterises the crust breaking treatment in the precipitation range above 500 mm as the regular shallow cultivation makes the drying out of the cultivated upper layer possible causing increased evaporation from the moistened topsoil.

Conclusions

According to the results the statement can be concluded that probably there is a certain water input amount (in the case of the given 6 month period it is 450 mm) where there is no difference in the amount of water evaporated from the cultivated treatments. In the case of soil cultivation treatments that have evaporation decreasing effect in the lower precipitation range high evaporation losses must be taken into account in the extremely wet periods. The most unfavourable water regime can be expected from the uncultivated soil surface.

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