# Some compounds of soil water balance and nitrate leaching

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## Abstract

Within the lysimetric station Zagreb - Maksimir, measurement of compounds of precipitation water balance in soil and nitrate ($NO_3^-$) was organized. In Garnier lysimeters measurements were carried out in undisturbed state alluvial, eutric brown soil and pseudogley soil of 0.6 m depth. In 1997, the measurements included precipitation, momentary state of available water in soil, and water runoff - percolation. Actual evapotranspiration and nitrate concentration in percolation water were determined, as well as yields. Maximum nitrate concentrations in percolation water of alluvial soil to 90.7 mg $NO_3^-$/l, eutric brown soil to 39.4 mg $NO_3^-$/l, and pseudogley soil to 42.1 mg $NO_3^-$/l were recorded in January and February, under conditions of maximum water runoff from soil.

## Introduction

Measurements of the compounds of balance of precipitation water in soil and nitrate leaching are a continuation of the research carried out by the Soil Science Department of the Faculty of Agriculture, Zagreb, started in 1989. The research included the most represented soils in the upper part of the Sava river basin - alluvial soil, eutric brown soil and pseudogley soil, mainly in ploughland areas, sporadically very intensively fertilized by nitrogen fertilizers. With respect to the importance of water management and balancing and regulation of the water regime on one hand, and protection of water resources on the other hand, this paper is a contribution to conservation and to reaching of this objective.

## Materials and methods

The lysimetric station Zagreb - Maksimir has 8 Garnier lysimeters, with the area of 0.237 sq. m. containing soil in undisturbed state, and two trial plots of the size of 15 sq. m. Eutric brown soil to the depth of 0.6 m has the retention capacity of 208.0 mm, alluvial soil 198.6 mm, and pseudogley soil 250.3 mm. Available soil water content to the same depth in eutric brown soil is 128.1 mm, in alluvial soil 150.9 mm, and in pseudogley soil 168.3 mm. Meteorological data come from the nearby weather station Zagreb - Maksimir. Actual evapotranspiration was calculated by means of the equation of precipitation water balance in soil (SRAKA, 1996). The agrotecnical treatment of crops in the trial - winter wheat and forage rape was standard. Fertilization was carried out in November 1996 with 48 kg/ha N, in March with 54 kg/ha, in May with 54 kg/ha N, and in Juny with 40 kg/ha N. Nitrate concentration in percolation water samples were determined by spectrometry at the wavelength of 436 nm over the yellow colour complex (phenodisulphonic acid) for average monthly water samples.

## Results

The annual runoff from eutric brown soil is 136.9 mm or 18.8 percent, from alluvial soil 130.2 mm or 17.9 percent, and from pseudogley soil 122.3 mm or 16.8 percent of the precipitation. The annual values of actual evapotranspiration are, for eutric brown soil 589.5 mm, for alluvial soil 621,7 mm, and for pseudogley 604.1 mm. Ten-day runoffs vary in a wide range from 0 percent of precipitation during the active vegetation period and maximum water consumption by evapotranspiration, to the full value of precipitation in conditions of full soil saturation in the non-vegetation period, *Figure 1* (*Graphs 1 - 3*). The dynamics of ten-day precipitation, actual evapotranspiration, supply of available water in soil and water surplus - deep runoff show that runoff of surplus water occurs only after replenishment of the supply of available water in soil and of the retention capacity. The frequency of the ten-day runoff is almost uniform for all soils in the trial. In pseudogley soil runoff was determined in 9 ten-day periods during the year, and in eutric brown soil and alluvial soil in 8 ten-day periods. The supply of available water is maximum in the cold, and minimum in the warm part of the year, Figure 1 (Graphs 1-3). The yield of winter wheat was on eutric brown soil 4.53 t/ha, on alluvial soil 5.72 t/ha, and on pseudogley 5.94 t/ha.The data in the *Table 1* show that nitrate concentrations in percolate of eutric brown soil and pseudogley soil did not exceed MAC for all water categories (N. N., 1984), while in the percolate from alluvial soil they were frequently above the maximum allowed concentrations, in particular after pre-sowing fertilization and later fertilizations of winter wheat and rape by nitrogen fertilizers. In early 1997, when water outflows are the highest, nitrate concentrations in percolate from all soils are also the highest.

## Conclusions

In meteorological, hydropedological and agrotechnical conditions of 1997, in the lysimeter station Zagreb - Maksimir, the ten-day precipitation is from 0.0 to 70.6 mm. The actual ten-day evapotranspira-

*Table 1:* **Nitrate concentrations in percolate, 1997**

| Month | mg $NO_3^-$/l | | |
|---|---|---|---|
| | Eutric brown soil | Alluvial soil | Pseudogley soil |
| January | 34.1 | 90.7 | 31.4 |
| February | 39.4 | 65.6 | 42.1 |
| March | 24.9 | 60.2 | |
| December | 1.8 | 0.1 | 0.6 |

Maximum allowed concentrations (MAC) for ground water category I and II 44.3 mg $NO_3^-$/l for ground water category III and IV 66.4 mg $NO_3^-$/l

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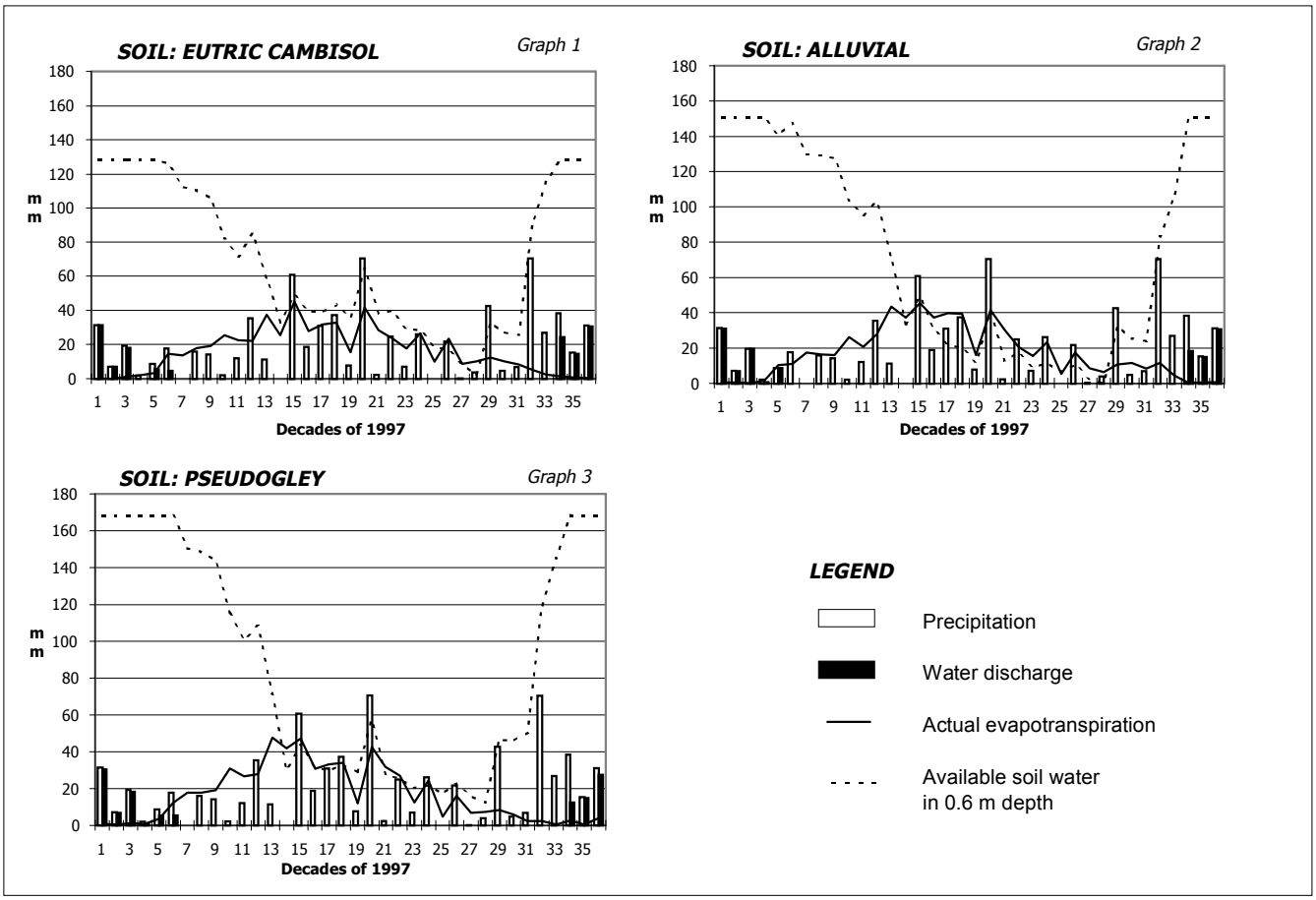


*Figure 1:* **Precipitation, water discharge, actual evapotranspiration and available soil water**

tion is, for eutric brown soil, from 0.0 to 45.1 mm, for alluvial soil, from 0.0 to 45.4 mm, and for pseudogley soil from 0.4 to 47.6 mm. Ten-days outflows from eutric brown soil are from 0.0 to 31.4 mm, from alluvial soil from 0.0 to 30.9 mm , and from pseudogley soil from 0.0 to 30.5 mm. Determined concentrations of $NO_3^-$ in the percolate of eutric brown soil are 1.8 to 39.4 mg $NO_3^-$/l, in the percolate from alluvial soil 0.1 to 90.7 mg $NO_3^-$/l, and in the percolate from pseudogley soil from 0.6 to 42.1 mg $NO_3^-$/l. Nonpermissible concentration for all categories of water, according to Croatian law, of 90.7 mg $NO_3^-$/l was recorded only in very permeable alluvial soil of the lightest texture. Therefore, more attention should be paid to the use of nitrogen fertilizers, in particular on alluvial soils of lighter texture around the Sava river.

## Literature

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