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Evaluation of actual evapotranspiration influenced by different soil types and crops on tile-drained fields

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The objective of this paper is to compare the actual evapotranspiration (ETA) values of different crops in relation to soil types and tile drainage.

The daily and vegetation season sums of ETA were calculated in Dehtare catchment by the methods of energy balance and Bowen ratio. Bowen ratio is the ratio of sensible heat flux to latent heat flux and it was derived from the theory of turbulent diffusion. If some requests are fulfiled, the practically aplicable form of the expression Bowen ratioghows that the distribution of main components of energy balance (sensible and latent heat flux) can be determined by simply measuring the difference in air temperatures and humidities at two heights above the plant cover (0.5 and 2.0 m). The basic request is the equality of transport coefficients for vertical turbulent transport of heat and water vapours under the condition of neutral atmosphere stratification and sufficiently extensive plant cover. The Bowen ratio values have been chosen under conditions of the validity of the energy balance and Bowen ratio methods usage in the best way (i.e. from 10.00 to17.00 CET, at global radiation intensity $>$ 200 W.m^{-2}, Bowen ratio between 0 and 4, in the peak of growing season, i.e. late March or early May to late August). ETA values were determined by means of four weather stations A-D (A-above permanent grassland, B, C, D-above arable land: 2004-winter wheat, 2005-spring barley, 2006-winter rape). Every weather station was equipped with: one datalogger storing ten-minute averages of the measured data, two sensors measuring soil temperature, two sensors measuring air temperature and relative air humidity at two heights, one soil heat flux sensor and one balance meter. Station above permanent grassland was further equipped with a pyranometer measuring the intensity of

global radiation, an anemometer measuring wind speed and a wind rose measuring wind direction.

Differentiation of territory into recharge and discharge zones allows us to show that localities with drainage systems and areas which are downstream from the drainage systems can always be considered as discharge zones (A,B). Localities higher than drainage systems are recharge zones (C, D).

Although stations B, C, D had the same crop different results of ETA values were obtained. It is obvious ETA is related to the soil type. Stations A and B are located on Stagnosols which are little permeable and before construction of the tile drainage were waterlogged by springs. On the contrary, Cambisols on the stations C and D which were differentiated by various grittiness are quite permeable and they have a lower retention capacity.

Apart from the crops, higher ETA values and lower groundwater recharge were in Stagnosols although they are tile-drained. Higher amounts of water infiltrates into Cambisols (without tile drainage) in comparison with Stagnosols, hence there were lower sums of ETA values in Cambisols.

Considering crop effect, the highest ETA values were reached on the permanent grassland located on Stagnosols. This resulted from the fact of permanent canopy, high water requirements, shallow roots, canopy density etc.

The lowest sums of ETA have been indicated in the more permeable soils with a middle grittiness on Cambisols (C). Cambisols having poor or none grittiness (D) showed higher sums of ETA. Although Stagnosols are tile-drained, they have a higher refrigerant effect in the landscape than Cambisols without tile drainage. It was proved by low Bowen ratio values on Stagnosols (A - 0,49, B - 0,6) in comparison with Cambisols (C-0,92, D – 0,83). The lowest ETA (C) on the soil with middle grittiness responded to the highest Bowen ratio predicating of the lowest refrigerant ability in the landscape.