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# Spatial and temporal variability of soil moisture on the field with and without plants*

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Spatial and temporal variability of the natural environment is its inherent and unavoidable feature. Every element of the environment is characterized by its own variability. One of the kinds of variability in the natural environment is the variability of the soil environment. To acquire better and deeper knowledge and understanding of the temporal and spatial variability of the physical, chemical and biological features of the soil environment, we should determine the causes that induce a given variability. Relatively stable features of soil include its texture and mineral composition; examples of those variables in time are the soil pH or organic matter content; an example of a feature with strong dynamics is the soil temperature and moisture content.

The aim of this study was to identify the variability of soil moisture on the field with and without plants using geostatistical methods. The soil moisture measurements were taken on the object with plant canopy and without plants (as reference). The measurements of soil moisture and meteorological components were taken within the period of April-July. The TDR moisture sensors covered 5 cm soil layers and were installed in the plots in the soil layers of 0-0.05, 0.05-0.1, 0.1-0.15, 0.2-0.25, 0.3-0.35, 0.4-0.45, 0.5-0.55, 0.8-0.85 m. Measurements of soil moisture were taken once a day, in the afternoon hours.

For the determination of reciprocal correlation, precipitation data and data from soil moisture measurements with the TDR meter were used. Calculations of reciprocal correlation of precipitation and soil moisture at various depths were made for three objects – spring barley, rye, and bare soil, at the level of significance of $p<0.05$. No significant reciprocal correlation was found between the precipitation and soil moisture in the soil profile for any of the objects studied. Although the correlation analysis indicates a lack of correlation between the variables under consideration, observation of the soil moisture runs in particular objects and of precipitation distribution shows clearly that rainfall has an effect on the soil moisture. The amount of precipitation water that increased the soil moisture depended on the strength of the rainfall, on the hydrological properties of the soil (primarily the soil density), the status of the plant cover, and surface runoff. Basing on the precipitation distribution and on the soil moisture runs, an attempt was made at finding a temporal and spatial relationship between those variables, employing for the purpose the geostatistical methods which permit time and space to be included in the analysis.

The geostatistical parameters determined showed the temporal dependence of moisture distribution in the soil profile, with the autocorrelation radius increasing with increasing depth in the profile. The highest values of the radius were observed in the plots with plant cover below the arable horizon, and the lowest in the arable horizon on the barley and fallow plots.

The fractal dimensions showed a clear decrease in values with increasing depth in the plots with plant cover, while in the bare plots they were relatively constant within the soil profile under study. Therefore, they indicated that the temporal distribution of soil moisture within the soil profile in the bare field was more random in character than in the plots with plants.

The results obtained and the analyses indicate that the moisture in the soil profile, its variability and determination, are significantly affected by the type and condition of plant canopy. The differentiation in moisture content between the plots studied resulted from different precipitation interception and different intensity of water uptake by the roots.

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