COUNTERACTING THE EFFECTS OF METEOROLOGICAL DROUGHT IN PEAT-MUCK AND MUCKY SOILS

S u m m a r y

The aim of this study was to estimate the ways of counteracting the effects of meteorological drought characterised with the method of rain-free days' sequence [KOŹMIŃSKI 1983, 1986] on post-bog peat-muck and mucky soils based on field studies in Polesie Lubelskie in the years 1965–1998. The studies involved physical properties and water conditions of soils, ground water table dynamics, the moisture of the root zone, evapotranspiration and yielding of grasslands, spatial range of soil and hydrologic drought. The relationships between pF of the studied soils, drying time t and soil type, between classes of meteorological drought and the length of rain-free period, between maximum allowable and optimum ground water levels, evapotranspiration and soil type were also determined.

The study period was characterised by a high variability of the intensity of drought. The variability manifested itself in different frequency of occurrence of rain-free periods in the vegetation season (from 1 in 1978 to 6 in 1976), their length (from 11 to 34 days) and in the sum of days in rain-free periods (from 11 in 1978 to 93 days in 1976).

Studied soils differed in hydrologic input and moisture. This in turn was reflected in different thickness and type of organic soil formations and their transformation in peat-muck soils. In mucky soils the differences pertained to the amount of organic matter in the root zone and to grain size structure of mineral formations. Observed variability manifested itself in the occurrence of the following soil moisture prognostic complexes (SMPC): A – wet, AB – periodically wet, B – moist, BC – periodically drying, C – drying, CD – periodically dry, D – dry and the following potential hydrogenic moist habitats (PHMH): permeative wet Pa, permeative moist PB, permeative drying PC, flooded moist Zb, flooded drying Zc, flooded dry Zd.

Results from the extreme years of the highest (1976) and lowest (1978) sum of rain-free days revealed a close relationship between the dynamics of ground water table and the number of days in rain-free sequences, evapotranspiration and the type of soil. The amplitude of ground water fluctuations in peat-muck soils increased with the increase of the sum of rain-free days and with evapotranspiration and decreased with the degree of soil drying evaluated by SMPC and PHMH. In mucky soils the same amplitude increased with the increase of all three parameters. Numerical characteristics of this variability given in the paper may be used to assess the range of ground water table fluctuations in peat-muck and mucky soils depend-

ing on the sums of rain-free days, evapotranspiration and soil type in the habitats Pa, PB, PC, Zb, Zc, Zd.

There was a close relationship in studied soils between the dynamics of pF in the root zone and the sum of days in rain-free sequences, evapotranspiration and soil type. The range of pF fluctuations increased with the increase in the number of days in rain-free periods, evapotranspiration and with the degree of soil drying. Numerical characteristics of this relationship may be used to assess the range of pF changes in peat-muck and mucky soils depending on the sum of rain-free days, evapotranspiration and soil types in habitats Pa, PB, PC, Zb, Zc, Zd.

The effect of meteorological drought caused by a sequence of rain-free days on evapotranspiration and grassland yielding differed in relation to soil water potential in the root zone during harvests. Actual evapotranspiration and yield decreased with increasing soil water potential. Decreasing mean decade actual evapotranspiration resulted in decreasing actual yield q.

During meteorological drought 1976 the reclamation system did not provide enough easily available moisture in peat-muck soils in habitats PB, Zb, Zc and in mucky soils of the habitats PC, Zc, and Zd. During meteorological drought 1978 the reclamation system did not provide enough moisture to the root zone of peat-muck soils of habitat Zd and of mucky soils in habitats PC, Zc and Zd. These soils, even at short droughts, require intensive irrigation.

Spatial range of hydrologic and soil drought depends on the sum of days in rain-free periods, on evapotranspiration and soil types combined in SMPC and PHMH. The range increased with the increasing sum of rain-free days, evapotranspiration and with the degree of soil drying. Numerical characteristics of this range may be a basis for spatial assessment of irrigation requirements depending on the sum of rain-free days, evapotranspiration and soil types acc. to SMPC and PHMH.

There was a relationship in studied soils between moisture of the root zone (expressed in pF units), drying time t and soil type. Numerical characteristics of this relationship may be used to assess present value of pF in peat-muck soils of the habitats Pa, PB, Zb, Zc and Zd and in mucky soils of the habitats PC, Zc, Zd between June and September based on drying time t in the rain-free period T acc. to KOŹMIŃSKI [1983, 1986].

The length of the rain-free period T resulting in a decrease of soil moisture in the root zone to pF = 2.7; 3.0; >3.0 decreased in studied soils with increasing soil drying. Numerical characteristics of this relation given in the paper allows to classify meteorological drought based on the length of rain-free period T as moderate (pF = 2.7), strong (pF = 3.0) or extreme (soil moisture decreased to pF > 3.0) in soil types combined in SMPC and PHMH.

To improve the efficiency of irrigation one should use the characteristic of allowable levels of h_{max} for pF = 2.3; 2.5, 2.7 in peat-muck and mucky soils in relation to evapotranspiration and soil type. This characteristic is useful for current exploitation of irrigation systems of peat-muck soils in habitats Pa, PB, Zb, Zc, and Zd and of mucky soils in habitats PC, Zc and Zd. It allows for estimating the temporal changes of allowable ground water depths adjusted to actual grassland evapotranspiration.

Maintaining optimum ground water table depth in post-bog peat-muck and mucky soils is necessary to equilibrate capillary rising and evapotranspiration, to protect soils from organic matter mineralisation and to obtain maximum yield at a given water consumption. Characteristics of optimum ground water levels h_{opt} for pF = 1.7, 1.9, and 2.1 given in the paper for peat-muck and mucky soils in relation to evapotranspiration and soil type is useful in current exploitation of irrigation systems in peat-much soils of the habitats Pa, PB, Zb, Zc, Zd and in mucky soils of the habitats PC, Zc, and Zd. It enables estimation in a dynamic way the temporally variable optimum ground water levels adjusted to present course of grassland evapotranspiration. Maintenance optimum ground water levels is a prerequisite for improving wrong air-water relations observed in forest and field ecosystems adjacent to peat-muck and mucky soils.