RELATIONSHIP BETWEEN METEOROLOGICAL AND AGRICULTURAL DROUGHT IN DIFFERENT AGROCLIMATIC REGIONS IN POLAND

S u m m a r y

The results of the study on the relationship between meteorological and agricultural droughts in the cultivation of field crops (sugar beet, late potato, winter wheat and winter rape) on four soil types of different available soil water content and grasslands (3- and 2-cut meadows) on peat-moorsh and mineral-moorsh soils in four habitats with different intensity of ground water feeding are presented in the monograph.

The relationship between droughts is the relationship between their indices. Meteorological drought is quantified by standardized precipitation index (*SPI*) and standardized climatic water balance (KBW_s). To quantify agricultural drought intensity the following indices are used: crop drought index indicating the reduction of evapotranspiration in relation to potential evapotranspiration (*CDI*) and in relation to average evapotranspiration (CDI_w), standardized evapotranspiration ET_s as well as for grasslands only crop water deficits *N* and relative duration of insufficient soil moisture t_{ndst}.

The indices were calculated for the vegetation period (April–September) of 1970–2004. The daily records of meteorological parameters came from 40 meteorological stations, distributed uniformly in Poland.

According to *SPI* and KBW_s and to the assumed classification, the frequency of meteorological droughts was almost the same (29–30%). It means that meteorological drought can occur every 3 years. Meteorological droughts were identified in more than 50% meteorological stations in 8 years in 1970–2004. In 1982, 1992 and 2003 meteorological droughts occurred in 90% stations according to KBW_s and in 80% according to *SPI*.

Agricultural drought indices *CDI*, CDI_w and ET_s have different values, different variability and give different drought intensity and frequency for the same crop and soil. The biggest frequency and space variability of agricultural droughts were determined according to *CDI*. According to CDI_w and ET_s, the differences of drought frequency in the stations and the soils were small for all studied crops.

The reduction of evapotranspiration (*CDI*) depended on precipitation and available soil water content. *CDI* was the biggest on the soil of the smallest available soil water content. On the soils with the same available soil water content, the frequency of agricultural droughts according to *CDI* was the biggest for late potatoes (40–80%), then for sugar beet (20–70%),

much less for winter wheat (10–50%) and the least for winter rape (3–20%). In grasslands the average frequency of droughts according to *CDI* was the least (3%) in the wet habitat fed with ground water and the biggest (65%) in the dry habitat with no ground water feeding.

The biggest frequencies of agricultural droughts occur in the central and north-west part of Poland. The frequencies decline to the north and south.

Higher correlations between the agricultural drought indices *CDI*, *N*, t_{ndst} and the meteorological drought indices *SPI* and KBW_s were determined for all investigated soils and crops than in the case of CDI_w and ET_s. Higher correlations occurred on the soils with less available water content.

High and significant correlations were determined for sugar beet and late potatoes – 70–80% agricultural droughts were caused by meteorological droughts. For winter wheat the relationships were weaker (30–40%) and for winter rape practically there were not relationships between meteorological and agricultural droughts. The stronger relationships occurred in dry meadow habitats than in wet.

Using the determined linear regression equations one can assess the agricultural drought intensity quantified by the agricultural droughts indices *CDI*, *N* and t_{ndst} on the basis of the meteorological drought indices *SPI* and KBW_s, in the agroclimatic regions of Poland, on the soils and for the crops for which high correlation coefficients were obtained ($|r| > 0.7$). Relationships between meteorological and agricultural droughts are stronger in the dry regions (with low precipitation), on the soils with smaller available water content and for crops with bigger water demands.

The meteorological drought indices *SPI* and KBW_s can be used for agricultural drought monitoring knowing the specific regressions related to the soil water retention, the crop and the agroclimatic region.