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Short Comminucation

Analysis of length of wheat growing period in southeast part of the Lublin region of Poland

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The meteorological observations carried out in Europe since 1654, including systematic measurements of air temperature which were launched in Kew near London in 1697 (Schönwiese, 1987), reconstruction of historical data in the last few hundred years (Loockwood, 1979) and IPCC reports (Field *et al.,* 2014) indicate that the warming we have been witnessing since the 80s is the highest compared to the previous ones. This is the result of fundamental changes in the concentration of greenhouse gases, a significant increase of which has been observed for over 250 years (Hansen *et al.,* 2000). These changes have also been observed in the southeastern part of the Lublin region - the Zamoœæ region of Poland.

Weather conditions, particularly thermal and precipitation conditions, determine the potential period of crop cultivation. One of the consequences of the observed climate changes is the change of both the date of the beginning of the vegetation season and the date of its end. In the zone of temperate latitudes, time when the average daily air temperature permanently exceeds 5.0 degrees Celsius is generally considered as the crop growing period in this zone. The aim of this study is to determine the direction of changes in the beginning and end of the vegetation season in the south-eastern part of the Lublin region of Poland.

The daily air temperature measurements taken at a weather station in Zamoœæ (Lat. 50°42'N, Long. 23°15'E, altitude 212 m) and phenological observations conducted in the fields of winter wheat in the southeastern part of the Lublin region in Poland for 38 years (1976-2013) were used in this paper. The period in which, the air temperature was higher than or equal to 5.0 degrees Celsius, was considered as the vegetation season for winter wheat. Ten days (decade) mean data were calculated. The first decade in which the mean air temperature exceeded 5.0 degrees Celsius was determined as the beginning of the vegetation season, and the last decade, in which the average daily air temperature was higher than 5.0 degrees Celsius was determined as the end of the period. The number of days during the vegetation season in each year was calculated assuming that the vegetation season begins and ends in the middle of the decade starting and ending the vegetation season. The length of the vegetation season in each year was calculated, and the relationship between both the length of the vegetation period and the date of its beginning and end was determined.

It was found that over the past several years there had been a clear shift in the beginning date and end date of the vegetation season. Observations revealed a tendency to an earlier start of the vegetation season and the later end of it. The date of the end of the vegetation season had greater impact on the length of it than the beginning date.

The analysis of data showed that the earliest beginning of vegetation season was on 21-28 February in 1990 followed by 21-29 February in 2008 while the latest end of the vegetation period was observed in the decade 21-30 November 1996. Earlier beginning and later end of the vegetation season results in an increase in the length of the period. The shortest period (173 days) of the vegetation season was in both 1979 and 1993 and the longest period (263 days) was in 2008. The trend line indicates that the average increase in the length of the vegetation season of plants from year to year in the period 1976-2013 amounts to almost half a day. Each year, the vegetation season is increased by an average of 0.49 days (Fig. 1). This coefficient of the determination (R^2 =0.077) shows very poor compatibility of the empirical data with the linear trend model. As many as 93% of the variation (elongation) of the vegetation season was due to random factors, and only less than 7% was due to the trend function.

The correlation analysis showed that there is a high correlation between the length of the vegetation season and its earlier beginning. It is a negative correlation providing that the sooner the beginning of the date of the period, the

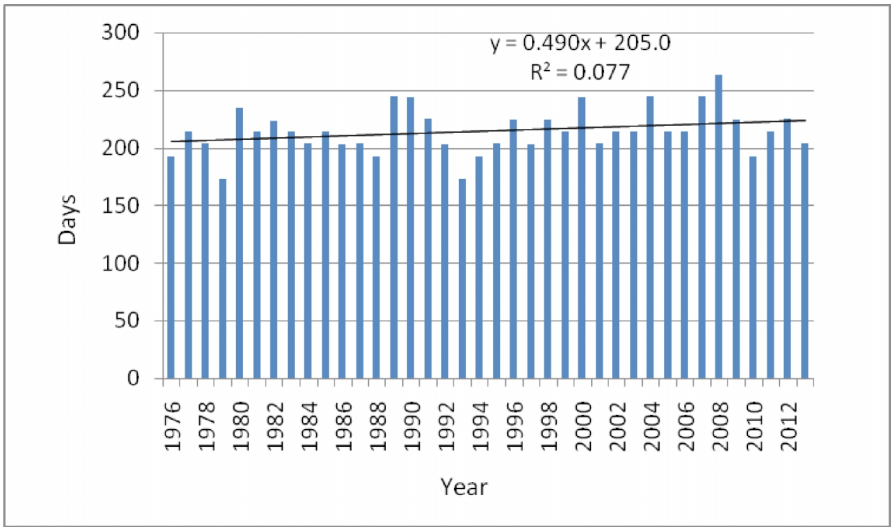

Fig. 1: Variation in the length of winter wheat growing period in the Zamocæ region during 1976-2013.

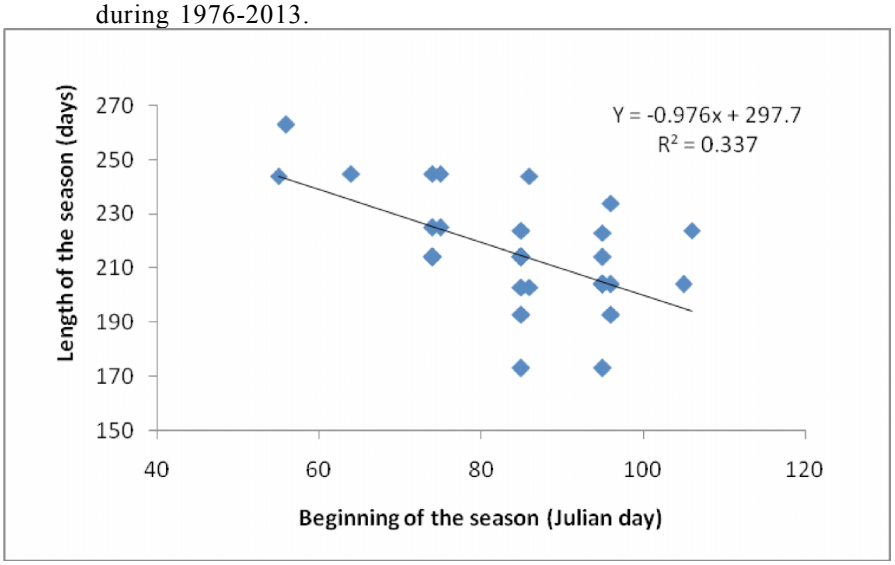

Fig. 2: The relationship between the date of the beginning of the vegetation season and its length.

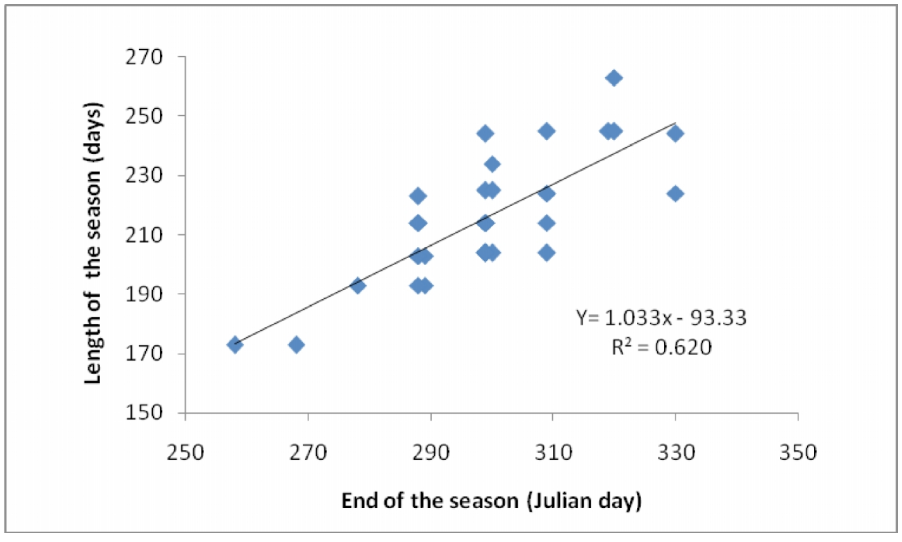

Fig. 3: Relationship between the date of the end of the vegetation season and its length.

longer it is, and the later the beginning of the date of the period, the shorter it is (Fig. 2). The value of the coefficient of determination (R^2=0.337) of the equation describing the relationship is significant at the level of 0.05, meaning that the length of vegetation period depends 33.7% on its earlier beginning and in 66.3% on other factors.

The coefficient of determination (R^2=0.620) of equation between the length of the vegetation season and the date of its end indicates a significant correlation (Fig. 3). This shows that later end of the vegetation season has more influence on the length of the season rather than its earlier beginning in the conditions of the southeastern part of Poland.

The observed changes in the length of the vegetation season may have serious consequences for agricultural production. The benefits resulting from the elongation of this period include, inter alia, the possibility of growing thermophilic crops and increase in the efficiency of livestock production as a result of increase in production of cost-effective feed and greater use of permanent grassland. Lengthening of the vegetation season is also a negative phenomenon, among which the most serious is the increase in the population of wintering pests of plants and animals and the increase in the incidence of fungal, bacterial and viral diseases (Bis *et al.,* 1993 and Samborski, 2013).

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