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CONSIDERATIONS ON THE CLIMATE CHARACTERIZATION OF THE AGRICULTURAL YEAR 2011 – 2012 FOR THE MAIZE CROP IN THE CENTRAL BĂRĂGAN PLAIN

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Abstract

The maize is a culture of strategic importance for a country's agriculture. The productivity of the maize crop has significant fluctuations from year to year because of the climate variability, but mostly because of the occurrence of extreme weather events. The aim of this paper is to analyze and correlate the agro-climatic resources with the agro-cultural production from the agricultural year 2011 – 2012, in the context of the present and predicted climate changes. The study area is the Central Bărăgan Plain. This area is located in a zone where dryness and drought phenomena are produced and are growing in frequency from the West and South-West to the East and North-East, in accordance with the degree of dryness. Taking into account the precipitation amounts, the agricultural year 2011 – 2012 was a year with a dry pluviometric regime. Therefore, the vegetation stage of the maize crop was medium and weak, in general, resulting an average maize production per hectare lower than in the previous years. Knowing the climate conditions and their impact on the main components of an agricultural system, of the level of yields and quality of the crops provides the possibility to reduce losses by respecting the adequate agricultural technologies.

Key words**:** *agricultural year, the Central Bărăgan Plain, hydric resources, maize, thermic resources*

INTRODUCTION

The climate is the main factor which influences the productivity of the agricultural systems. The crop is the result of the complex action among the plant, soil nutrients and the climatic, genetic, phyto-sanitary and technological factors (Ştefan Marcela, 2003) [11].

In order toachieve the agricultural management strategies, there should be included the assessment and climate data analysis because all the agro-climatic conditions of an agricultural year determines the crop value of a particular culture (Povară Rodica, 2000) [8]. In Romania, the winter wheat and maize are crops of strategic importance, which present significant fluctuations from year to year due to the variability (Mateescu Elena et al., 2004) [6].

The maize, by the achieved hybrids, is grown in the world, in the most varied climatic and soil conditions, being a plant with high requirements to different temperature and moisture throughout the growing season (Sandu I. et al., 2010). The climate analysis on the state of vegetation and the maize yields will be made for the agricultural year 2011 – 2012. In this agricultural year, there have been eight dry months, November being the driest month between 1961 to 2014, while July is the second of the first fifth driest months for the period 1961 – 2012, also being the hottest month of the last 53 years in Romania, with a positive deviation of 4.5 °C (NAM, 2014). There will be analysed the thermic and hydric resources from the air and from the ground surface for maize in the Central Bărăgan Plain. The Central Bărăgan Plain or the Ialomiţa Bărăgan Plain represents the central part of the Bărăgan Plain, being bordered by the Ialomiţa river and Călmăţui river, while the Eastern limit is given by the lower terrace head of the Danube river (Figure 1). The plain has a river-lake origin, with altitudes which decrease from 100 m at the West to 20 m at East and with fertile soils, being particularly favorable for the agricultural crops (Geography of Romania, 2005) [12]. Before 1990, about 86% of the

arable land was irrigated, most of the irrigation system being destroyed or left to degradation so that in 2010, only 6.9% of the agricultural land is equipped with an irrigation system (Sima Mihaela et al., 2015) [10].

MATERIALS AND METHODS

The climate analysis of the agricultural year 2011 – 2012 upon the state of vegetation and maize yield in the Central Bărăgan Plain will be based on the climate data from the meteorological stations Urziceni, Slobozia and Griviţa, the agro-meteorological information from the National Administration of Meteorology (NAM) and the production data from the Ialomiţa Department of Agriculture. The methods used in the data analysis are classical, of logical, space, comparative analysis, complemented by the modern ones as operations of GIS and graphics achieved with statistics software analysis of Microsoft Office Excel. We added to these, the references research and the field observations. Geographically, the three meteorological stations are considered representative for the Central Bărăgan Plain area (Fig. 1).

Fig. 1. The geographical localization of the Central Bărăgan Plain in Romania (up) and of the meteorological stations (down)
Source: own processing from www.google.ro

RESULTS AND DISCUSSIONS

Throughout the growing season, the maize presents different requirements to climatic conditions, with maximum values in the critic consumption stage which corresponds to July-August, when the phases of vegetation are produced: flowering, fecundation, grain filling and maturing of the maize plant in milk, wax and full. The main factors with a role in the growth, development and productivity of maize are: air temperature, surface soil temperature, precipitations and the air humidity.

The air temperature influences all the stages of the plant growth and development, but also the processes of photosynthesis, respiration and transpiration (Cofas Elena et al., 2014) [5].

For the agricultural year 2011 – 2012 in the Central Bărăgan Plain, the annual average temperature was 11.7 °C (Figure 2). In Figure 2, it can be observed the annual regimes of the air temperature for all the three meteorological stations, being represented by the highest monthly average values recorded. The annual average temperature fluctuated between 11.7 °C at the station Griviţa and 12 °C at the station Urziceni, being higher than the climatological normal for this area, of 10 – 11°C (NAM, 2008) [14].

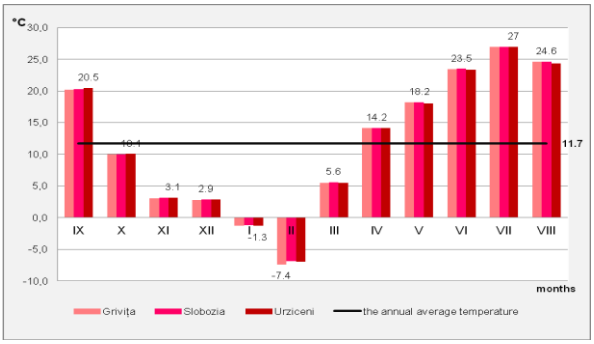

Fig. 2. The annual regime of the air temperature (°C) at the meteorological stations in the Central Bărăgan Plain, in the agricultural year 2011 – 2012
Source: processed data after NAM, 2016 [14]

The monthly averages have ranged between -7.4 °C for February at the station Griviţa and 27 °C for July at the station Urziceni (Figure 2). In the critical period of maize, the air temperature was of maximum 34.5 °C in July and of 32.5 °C August at Griviţa; 38 °C in July and 41 °C in August at Slobozia and 34.3 °C in July and 32.3 °C in August at Urziceni. These values have exceeded the maximum critical of 30 °C, comparing to the air temperature requirements in the critical

period of maize (Berbecel O. et al., 1970) [3]. The minimum threshold of 10 °C for July was not achieved at any meteorological station in the Central Bărăgan Plain, the minimum air temperature being 19.1 °C at Urziceni, 15.5 °C at Slobozia and 18.8 °C at Griviţa. Instead, the minimum threshold of 16 °C was reached on August at the station Slobozia, where the minimum temperature reached 11 °C. At the other stations, the minimum temperature was 17.1 °C at Griviţa and 17.2 °C at Urziceni.

The surface soil temperature has a significant importance in achieving the maize crop, affecting the root growth, the increase of the aerial parts and the completion phases of vegetation. Soil temperatures less than 16 °C do not mature the maize and the roots develop best at a temperature of 24 °C (Sandu I. et al., 2010) [9]. In the Central Bărăgan Plain, the average soil surface temperature was 14.1 °C, for the agricultural year 2011 – 2012 (Figure 3). In Figure 3, there are represented the annual regimes of the surface soil temperatures at the three meteorological stations, being shown the greatest values of the monthly average temperatures. The annual average temperature at the soil surface was 13.9 °C at Urziceni, 14.1 °C at Griviţa and 14.2 °C at Slobozia.

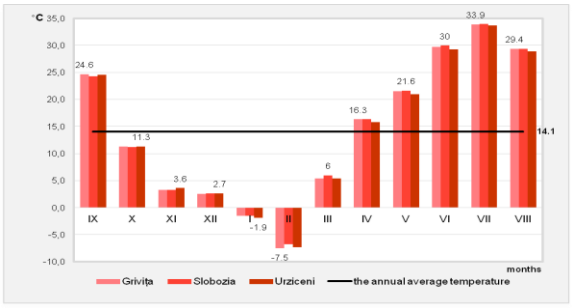

Fig. 3. The annual regime of the surface soil temperature (°C) at the meteorological stations in the Central Bărăgan Plain, in the agricultural year 2011 – 2012
Source: processed data after NAM, 2016 [14]

In April, corresponding to the period of sowing, the average temperature at the soil surface oscillated between 15.8 °C at the station Urziceni and 16.3 °C at the stations Slobozia and Griviţa. In August, when the maize reaches maturity, upper air organs develop best in soil temperatures of 28 °C. In this month, the recorded values varied between 28.9 °C at Urziceni and 29.4 °C at Slobozia and Griviţa. Due to the plasticity of the maize crop, this plant can be considered resistant to drought in relation to the relative humidity requirements. The water requirement of maize is directly proportional to the development of the plant, so that the maximum consumption is recorded in the phases of earing, fecundation and corn grain formation.

The relative air humidity influences the vital processes of the plants such as: sweating, pollination, flowering and fructification. In the Central Bărăgan Plain, the annual average relative humidity for the agricultural year 2011 – 2012, was 72.9%, ranging between 70.9% at Urziceni to 74.0% at Slobozia (Fig. 4).

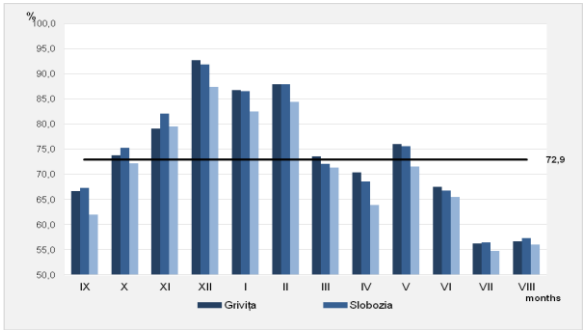

Fig. 4. The annual regime of the relative air humidity (%) at the meteorological stations in the Central Bărăgan Plain, in the agricultural year 2011 – 2012
Source: processed data after NAM, 2016 [14]

Precipitations provides the crop not only by the annual rainfall amount, but by their allocation during the growing season of the maize. The annual amount of precipitation in the Bărăgan Plain is 464.7 mm for the agricultural year 2011 – 2012, varying between 421.6 mm at Griviţa, 438.7 mm at Slobozia and 534.0 mm at Urziceni (Figure 5).

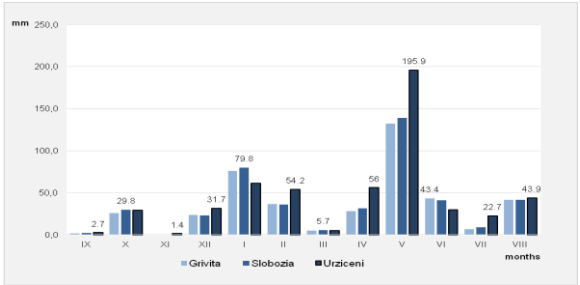

Fig. 5. The annual regime of the precipitations (mm) at the meteorological stations in the Central Bărăgan Plain, in the agricultural year 2011 – 2012
Source: processed data after NAM, 2016 [14]

In Figure 5, there are presented the annual precipitation regimes at the three stations in the Central Bărăgan Plain, the values showing the biggest monthly average values.The optimal and critic limits of the precipitations on intervals specific to the maize crop are presented in Tabel 1.

Table 1. The optimum/critical limits rainfall on maize crop characteristic intervals

time period	optimum	Rainfall (mm) in the agricultur year 2011 – 2012	meaning
IV	41 – 60	34.8	moderate draughty
V – VI	151 – 200	193.7	optimum
VII – VIII	151 – 200	55.1	extremely draughty
V – VIII	301 – 400	248.8	moderate draughty
IX – VIII	601 – 700	464.7	moderate draughty

Processed data after NAM, 2016 [14]

The moisture reserve in the soil profile of 0 – 100 cm, in non-irrigated maize crop has registered particularly low values (Co-600 m^3/ha), the pedological drought being extreme and strong in July (NAM, 2013). The soil moisture deficit continued in August.

By analyzing the climate data from the three meteorological stations, one can notice the continental climate character of the climate in the Central Bărăgan Plain, the annual average values of the various climatic parameters indicating a relative uniformity in their distribution. The extreme values highlight the major non-periodic variations of the climate in this territory (Bogdan Octavia, 1980) [4]. Also in the context of the climate changes, based on the climate scenarios predicted, the maize yields fall because of the higher air temperature and water stress, which shorten the growing season (Mateescu Elena and Alexandru D., 2010) [7].

CONCLUSIONS

The agricultural year 2011 – 2012 was characterized by an air temperature higher than normal and by a water stress, both in the air and in the soil, which had negative complex consequences on the state of vegetation and maize crop such as: forcing the stage of the maize plants; the drying, the rolling of the leaves and the partial or total drying of the leaves; delays up to 10 – 15 days between the emergence of tasseling and the forming of cobs and the incomplete or sterile formation of the cobs.

In this climate context of the agricultural year 2011 – 2012, on the territory of the Central Bărăgan Plain, the average maize production was 3,175.6 kg/ha, with 1,788.1 kg/ha less than in 2011 (DAJIL, 2016) [13].

Knowing the climate information is a necessity in agriculture, being an instrument useful in order to ensure the satisfactory yields, year by year, only if the cultivation technology is respected.

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