PLUVIOMETRIC CHARACTER OF THE YEARS AND MONTHS OF THE AGRICULTURAL PERIOD 1992-2009, AT THE ORADEA WEATHER STATION

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Abstract

In this paper, we used monthly and annual amounts of precipitation recorded at weather station Oradea, during the agricultural years of 1992-2009. They have major importance in forecasting and warning of agro-horticultural crop watering, because the excess soil moisture results in overhydration of plants and finally, in root asphyxiation due to lack of oxygen. The pluviometric characterization of years and months of the above-mentioned period was based on the Hellman's criterion. The result was that the analyzed period was characterized by a pluviometric surplus regime, compared to the period of reference, 1931-2007. The rainiest years were 1996 and 2001, with positive deviations of over 40% from the multiannual average. The driest years were 2002 and 1992, with negative deviations of more than 25% compared to the multiannual average. The rainiest spell was 1996-1999, and the driest spell, 2002-2003. Most months of the agricultural period 1992-2009 were dry (97). But the total number of rainy months was also quite high (79).

Key words: atmospheric precipitation, deviation, pluviometric character, multiannual average.

INTRODUCTION

Atmospheric precipitation is the total quantity of condensation and crystallization of water vapours in the atmosphere, usually falling from the clouds and reaching the earth's surface as liquid, solid or in both forms simultaneously (according to „Directions for Weather Stations/Instrucţiuni pentru staţiile meteorologice", I.N.M.H., 1995).

In our country, precipitation is characterized by large space-time variability in the frequency, duration, amount, intensity and type, the richest precipitation occurring during periods of persistent cyclonic activity and the poorest during the predominant activity of the anticyclone. The richest rainfall occurs in the north-western half of the country, where it would be indicated that precipitation water is collected and stored, to be later used for irrigation of vegetable crops in protected areas, because these crops do not benefit directly from water from precipitation, which is of the best quality. On the territory of Romania, the annual amounts of precipitation decrease from west to east, as the continental climatic character increases (The Geography of Romania/Geografia României, vol.I, 1983; Dragotă, 2006; The Climate of Romania/Clima României, 2008; Domocoş, 2011).

MATERIAL AND METHODS

In this paper, we used monthly and annual amounts of precipitation recorded at weather station Oradea, during the agricultural years of 1992-2009. The data came from the archives of the National Administration of Meteorology.

The positioning of weather station Oradea in the agricultural area of Crişuri Plain urged us to realize the following analysis on agricultural years (range from October to September), not based on a calendar. This paper was intended to have a practical purpose, applicable in agro-horticulture, as water from rainfall has the lowest salt content, and in terms of quality is the best water for crop irrigation in protected areas, compared to other sources of water used to irrigate crops. The study of atmospheric precipitation on agricultural years aimed at understanding of the role played by water and soil moisture in physiological and biochemical processes of crop plants, such as growth and development, which is realized only in the presence of water and also serves as thermic regulator of tissues, through sweating and evapotranspiration. For most vegetables grown both in open field and in protected areas, high water content ensures product freshness and juiciness of the product, and water loss causes wilting of the edible part and impairment of quality (Indrea et al., 2009; Domocoş, 2011).

Table 1

Pluviometric character of months and years according to Hellman's criterion (Source: Fărcaş, 1988).

Monthly deviations	Yearly deviations	Qualificative (Rating)
over 50%	over 25%	Excessively rainy
between 31 and 50%	between 16 and 25%	Very rainy
between 21 and 30%	between 11 and 15%	Rainy
between 11 and 20%	between 6 and 10%	Moderately rainy
between -10 and 10%	between -5 and 5%	Normal
between -20 and -11%	between -10 and -6%	Moderately dry
between -30 and -21%	between -15 and -11%	Dry
between -50 and -31%	between -25 and -16%	Very dry
under -50%	under -25%	Excessively dry

The pluviometric characterization of years and months of the above-mentioned agricultural period was based on the "Hellman's criterion", a method of analysis proposed by climatologist with the same name. According to it, for the characterization of months or years in terms of non-periodic variations of precipitation, there will be compared the oscillations of the values from any year (or month) to "normal" values (multiannual averages). The resulted deviations are contained within certain limits and are expressed in percent. The climatologist Hellman considered some limits for the monthly and annual precipitation deviations (Fărcaş, 1988) (table 1).

RESULTS AND DISCUSSIONS

The Oradea weather station is located in the temperate-continental climate, with prevailing oceanic influences. It is exposed to frequent wet air masses advections from Western Europe. This determines the moderate character of the atmospheric precipitation regime. The station's location in the contact area between Western Plain and the Western Hills makes the air masses perform a forced upward movement, which increases nebulosity and therefore the amounts of precipitation (Măhăra, 1977; Cristea, 2004; Măhăra, Şerban, 2006; Şerban, 2008).

The multiannual average amount of precipitation rise to 615.2 mm (in the period 1931-2007). During the analyzed period 1992-2009, the average annual amount of precipitation stood at 633.6 mm. It was calculated for the agricultural years of the period above-mentioned. The value exceeds the multiannual value obtained in a longer period of time, as recent years have been very rainy.

Annual precipitation amounts have varied widely over the years (fig.1). Compared to the annual average of 633.6 mm, the highest annual amount rose to 875.8 mm and occurred in the agricultural year *1996*. This was the rainiest year. Another year with high values of precipitation was 2001, when annual precipitation amount stood at 868.5 mm.

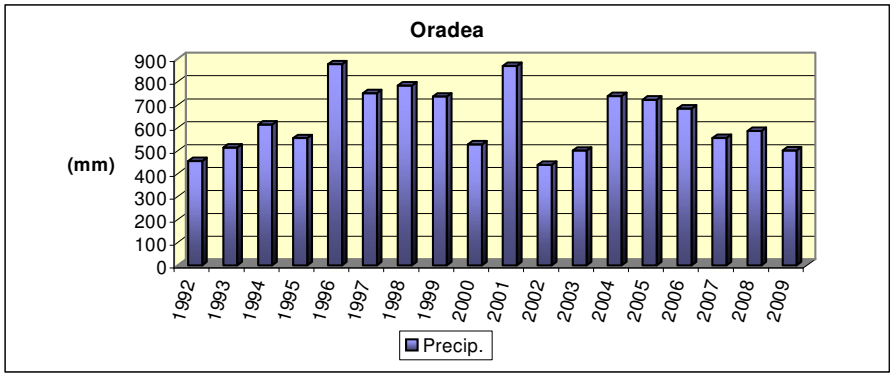

Fig. 1. Annual precipitation amounts at the Oradea weather station, on agricultural years of the period 1992-2009.

On the chart, we see that in most rainy years, annual precipitation exceeded 650 mm. These years are 8 in number. The rainiest spell was 1996-1999, when annual precipitation amounts ranged from 735.5 to 875.8 mm. There is added the spell of 2004-2006, when annual precipitation totalled values between 684.9 and 737.5 mm.

The lowest annual precipitation amount was only 438.1 mm and belongs to the agricultural year *2002*. This was the driest year of the

analyzed period. Another dry year was 1992, when the annual amount was only of 455.3 mm. The third dry year was 2003, with an amount of 500.9 mm. The driest spell of the analyzed period was 2002-2003, followed by 1992-1995. In the latter spell, annual precipitation amounts ranged from 455.3 to 614.3 mm.

For pluviometric characterization of years and months of the period 1992-2009, the deviations were calculated for yearly and monthly precipitation amounts, compared to the multiannual average of the period 1931-2007. The pluviometric character of the years of the studied period is shown in table 2.

Table 2

Pluviometric character of agricultural years of the period 1992-2009, at the Oradea weather station.

Pluvio-metric qualifi-cative	**Exce-ssively rainy**	**Very rainy**	**Rainy**	**Mode-rately rainy**	**Nor-mal**	**Mode-rately dry**	**Dry**	**Very dry**	**Exce-ssively dry**
Years	1996	1997	2006	-	1994	1995	2000	1993	1992
	1998	1999			2008	2007		2003	2002
	2001	2004						2009	
		2005							

From the table it is observed that during 1992-2009, at the weather station Oradea only 2 years were normal in terms of precipitation. There have been 8 rainy years and 8 dry years. The number of excessively rainy and very rainy years (7) was higher than the number of excessively dry and very dry years (5), confirming that the analyzed period was characterized by a pluviometric surplus regime.

Figure 2 shows that there are periods of consecutive years with pluviometric surplus and periods of consecutive deficient years in rainfalls. During the analyzed period there were 2 periods of 3 and 4 consecutive years with pluviometric surplus, and 3 periods of 2, 3 and 4 years consecutively deficient in rainfalls. The longest period with surplus was 1996-1999, and the longest deficient period was 1992-1995.

The rainiest years were 1996 and 2001, with positive deviations of over 40% from the multiannual average. The driest years were 2002 and 1992, with negative deviations of more than 25% compared to the multiannual average.

Table 3 shows the pluviometric character of months in the studied period 1992-2009. It is noted that most months have been dry (97), and the fewer with normal precipitation amounts (40). The total number of rainy months was also quite high (79). In this table, the total number of rainy months includes all the months that were rated from "moderately rainy" to

"excessively rainy", and the total number of dry months, all that were rated from "moderately dry" to "excessively dry".

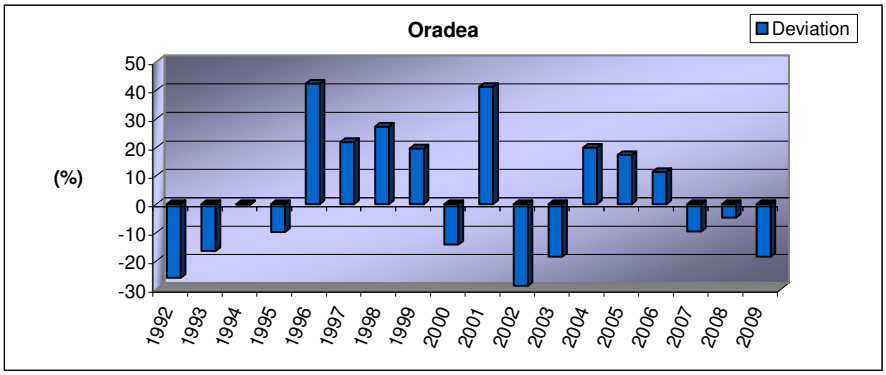

Fig. 2. Rainy, normal and dry agricultural years based on Hellman's criterion, at the Oradea weather station (1992-2009).

Table 3

Pluviometric character of months in the agricultural period 1992-2009, at the Oradea weather station.

Years	Number of months		
	RAINY	NORMAL	DRY
1992	2	0	10
1993	2	4	6
1994	4	5	3
1995	3	3	6
1996	7	1	4
1997	6	2	4
1998	4	2	6
1999	6	2	4
2000	4	1	7
2001	6	2	4
2002	2	1	9
2003	4	3	5
2004	7	0	5
2005	5	5	2
2006	6	2	4
2007	4	2	6
2008	3	4	5
2009	4	1	7
Total	**79**	**40**	**97**

The highest number of dry months was registered by the agricultural year 1992 (10 months). The 10 dry months were consecutive, resulting in a very long deficient period: *November 1991 – August 1992*. The years with the highest number of rainy months were 1996 and 2004 (7 months).

CONCLUSIONS

During the agricultural period 1992-2009, the rainiest years were 1996 and 2001, when the annual precipitation amounts exceeded 860-870 mm. They recorded positive deviations of over 40% from the multiannual average. The rainiest spell was 1996-1999. The driest years were 2002 and 1992, when the annual amounts of precipitation have fallen below 440-460 mm. They have recorded negative deviations greater than 25% compared to the multiannual average. The driest spell was 2002-2003, followed by 1992-1995.

The number of excessively rainy and very rainy years was higher than the number of excessively dry and very dry years, confirming that the analyzed period was characterized by a pluviometric surplus regime, compared to the period of reference, 1931-2007.

Most months of the agricultural period 1992-2009 were dry (97). But the total number of rainy months was also quite high (79). The longest period of consecutive deficient months was November 1991 – August 1992 (10 months).

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