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IMPACT OF WEATHER-CLIMATIC PARAMETERS ON AGRICULTURAL PRODUCTIONS IN DOLJ COUNTY

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Impact of weather-climatic parameters on agricultural productions in Dolj County

Florina Cristina Roşca

El impacto de los parámetros climáticos para el tiempo en producciones agrícolas en el Condado de Dolj. Para una evaluación objetiva de las condiciones agrometeorologicas existentes en el área, en términos de su potencial agroproductivo, aparecio la necesidad de un estudio comparativo sobre las temporadas de crecimiento agrícolas y en el rango de 1980-2008, en el condado de Dolj. El régimen de agua de las plantas junto con el tratamiento térmico son algunos de los factores determinantes del rendimiento del metabolismo normal de la planta de cuerpo entero, teniendo de esta manera un papel fisiológico especial.

Palabras clave: Dolj, sequía, lluvias, temperaturas, anomalía de precipitación estandarizadas, Indice Lang de lluvia

Impactul parametrilor meteo-climatici în producţiile agricole din Judeţul Dolj. Pentru o apreciere obiectivă a condiţiilor agrometeorologice existente în zonă, sub aspectul potenţialului lor agroproductiv, a apărut necesitatea unui studiu comparativ pe anii agricoli şi pe sezoanele de vegetaţie în intervalul 1980-2008 în judeţul Dolj. Regimul de apă al plantelor împreună cu regimul termic sunt unii dintre factorii determinanţi ai desfăşurării normale a întregului metabolism al organismului vegetal, având în acest fel un rol fiziologic deosebit

Cuvinte cheie: Dolj, secetă, precipitaţii, temperaturi, anomalii standardizate de precipitaţii, Indicele de ploaie Lang

1. INTRODUCTION

Dolj county is part of the historical province of Oltenia, situated in the South-western part of Romania, in a fertile region of the Danube and in an area which has offered over the time favorable conditions to the development of agriculture, which year by year are experiencing the drought. "Dolj was one of the outbreaks of the drought" [1](Figure 1).

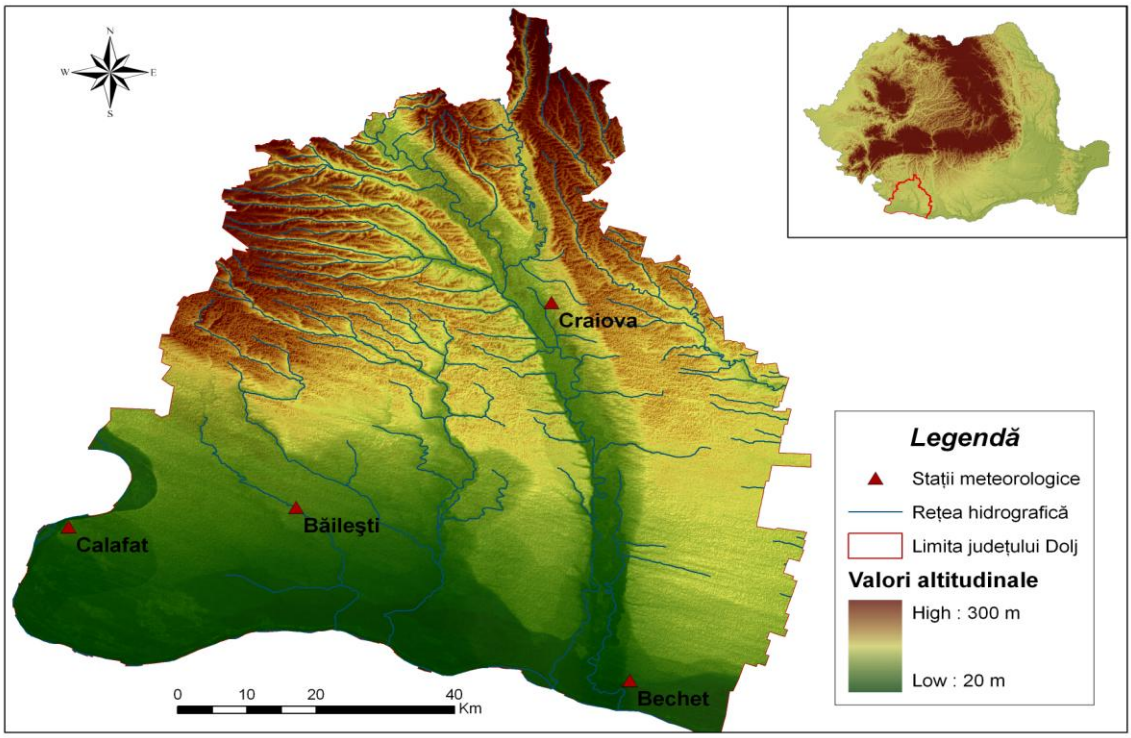


Figure 1. Location of weather stations in Dolj county

In this study were analyzed the impact of weather-climatic parameters, in the period 1980-2009 in Dolj county, appointed by N. Topor, "the focus of the drought" in Romania on agricultural crops of maize and sunflowers.

2. DATA SOURCES AND METHODS

Data source and types

Climate data used here come from weather stations archives in the studied area: Craiova, Bechet, Băileşti and Calafat which belong to the National Network of National Meteorological Administration. Rows of data cover a period of 29 years (1980-2009). The climate elements analyzed for identification of atmospheric droughts will be precipitation amounts and temperatures. Data on agricultural production at two plants studied, maize and sunflower seeds come from Regional Directorate of Statistics of Dolj, which belongs to the National Institute of Statistics.

Research methods used

To achieve the proposed study will be used both statistical and mathematical general methods and specific methods for studying thexcvxc main climate elements.

Among *statistical and mathematical methods* I used the percentage deviation and the standard deviation methods and also the method of least squares to calculate trends in precipitation used to identify the phenomenon of drought.

Among *specific methods* I used: weighted standardized precipitation anomaly (ASPP) and the index rain Lang.

Weighted standardized anomaly precipitation is calculated as:

$$ASPP = \frac{x_i - \bar{x}}{\sigma} \text{ *W where:}$$

xi = the amount of precipitation in a given year

$\bar{x}$ = Average annual amount of precipitation for the period analyzed (in this case, 30 years for most stations)

σ= standard deviation (also known as mean *square deviation*, *standard deviation*)

Standard deviation is calculated by taking the square root of the variance (σ2) and the formula for calculating the variance (σ^2) is:

$$\sigma^2 = \frac{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}{n} \text{ where } n \text{ is the number of the year.}$$

$$w = \frac{X1}{Xa}$$

x1= the amount of precipitation in a given mounth

xa= average annual amount of precipitacion in a mounth [after 2]

Once calculated these abnormalities, according to their results we could highlight the conclusions regarding the classification of a period (month, year) in a category, naming it dry, wet or normal (Table 1).

Table 1. Character of the rainfall anomaly years according to standardized precipitation

Rating	ASP
Dry	-0,51 ... ≤-2,5
Normal	-0,50 ... 0,50
Rainy	0,51 ...≥ 2,5

Lang rain index, also called the pluviothermal index, indicates the atmospheric moisture degree, as well as its variation; it can be calculated at an annual, summer or

vernal level [3, p. 155]. It increases with the altitude up to the condensation level, as the precipitation amounts get bigger and the temperature lower.

$$I = \frac{p}{t} \text{ where,}$$

p – the annual precipitation amount

t – the mean annual temperature

Lang rain index (pluviothermal index) or the pluvial factor displays higher values with the increase of the altitude.

3. RESULTS

Distribution of quantities of precipitation and temperature

Dolj county-level, during the period of 29 years, there have been variations in the quantity of precipitation, so that have become apparent years 1985, 1988 and 2000, with only 200 mm (Figure 2) and 150 mm in 1993. The annual average quantity is 300 mm, and this has been exceeded as years 1980, 1981, 1986, 1991, 1995, 1997, 1998, 1999, 2001, 2002, 2003, 2005, 2006 and 2008.

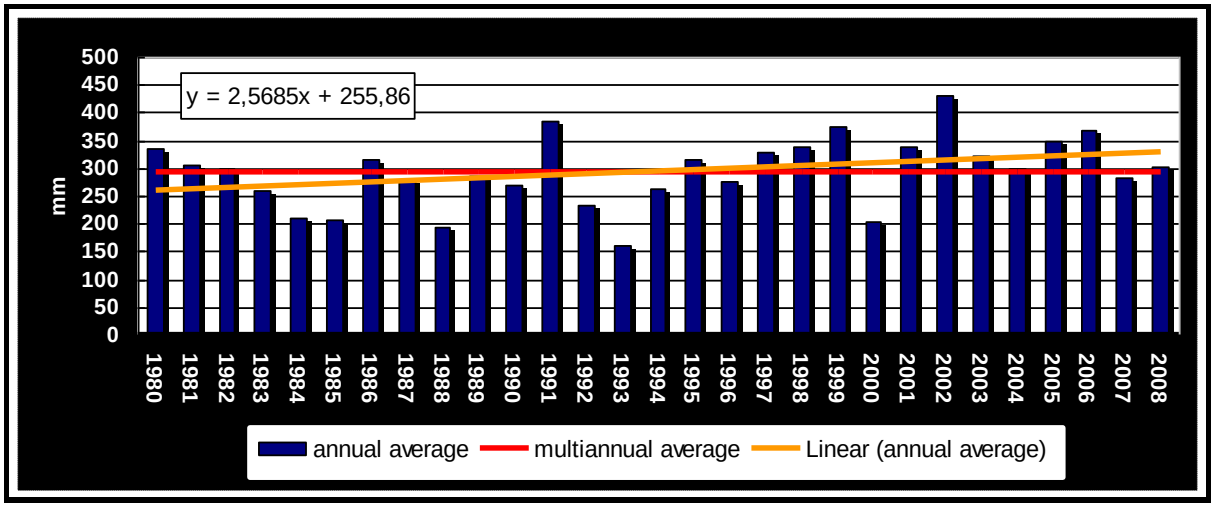


Figure 2. Distribution of rainfall in warm season in Dolj county

With regard to the heat, it has a tendency to rise, and this trend after 1998 exceed multi-annual average much, with the years with an average temperature of 20.5 °C, as is the droughty year 2007(Figure 3).

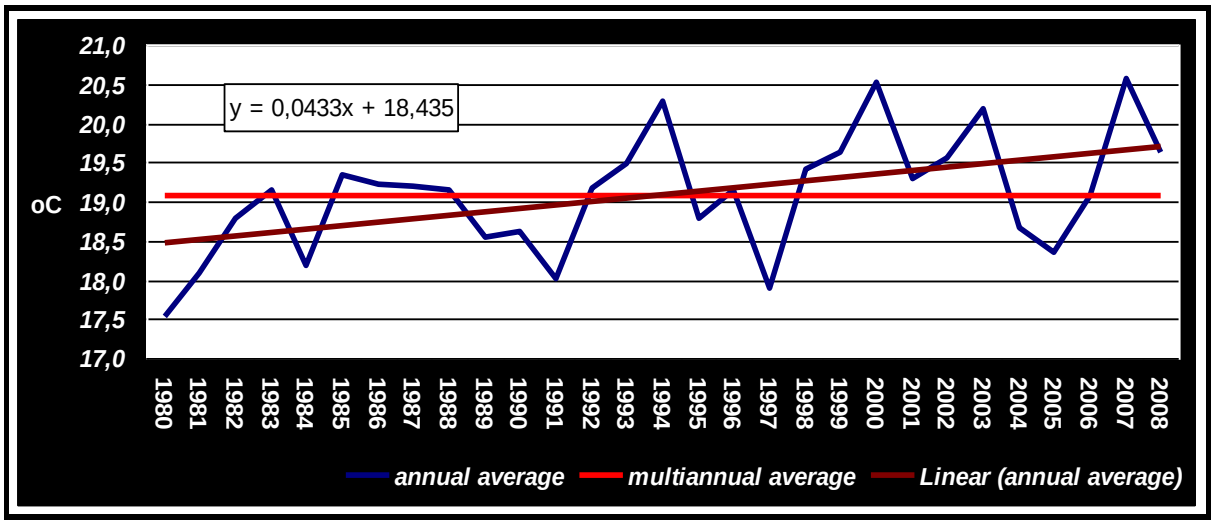


Figure 3. Distribution of temperatures in warm season in Dolj country Dolj

The temperature is constantly increasing in the Dolj county, where temperatures in the summer and sometimes in excess of 40 °C. Such crops are suffering due to the scarcity of rainfall, but also because of the high temperatures and increase from one year to the next. The phenomenon of drought being very common in this area hard trying the risk phenomenon.

Evolution agricultural crops in conditions of rainfall anomalies in maize and sunflowers

In the period under review developments in production of grain maize, has had oscillations, standing out the years with large productions such as the 1986, 1987, 1991 and years with small producion such as 1993, 2000, 2002 and 2007 (Figure 4).

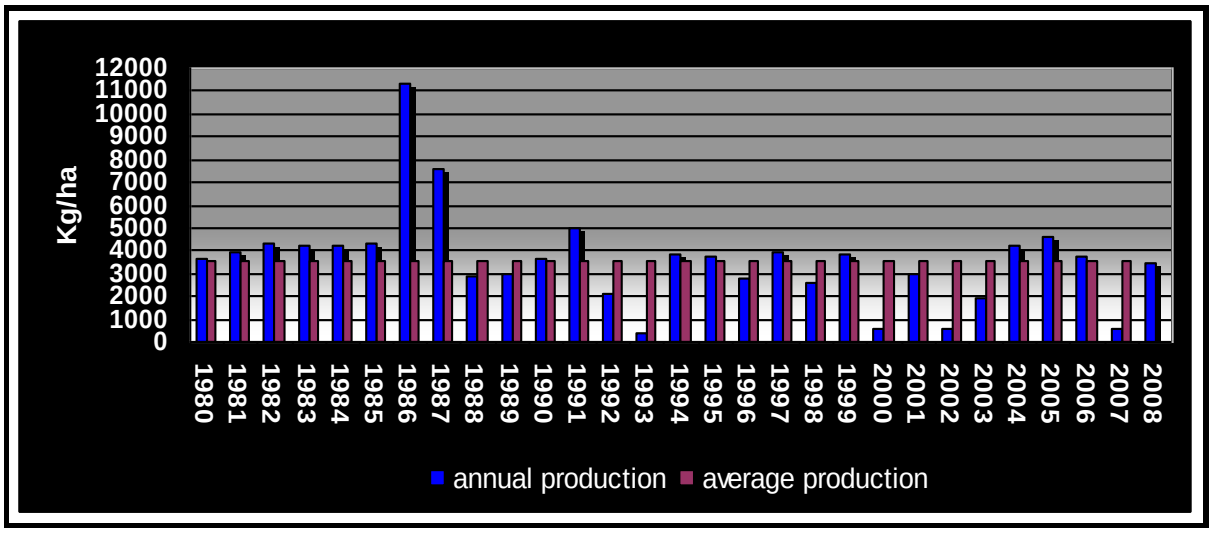


Figure 4. Evolution of production of maize registering in Dolj country (1980-2008)

Thanks to step natural conditions, in the past, the sands and sandy soils were tilled with a limited number of agriculture plants and the yields where small and unstable. Social condiţions in zone was precarious. For the capitalization of the climate and soil conditions for the sandy soil region in Dolj country by cultivating maize, it is necessary to use varieties with large production abilities and a proper tehnology for the crops [4].

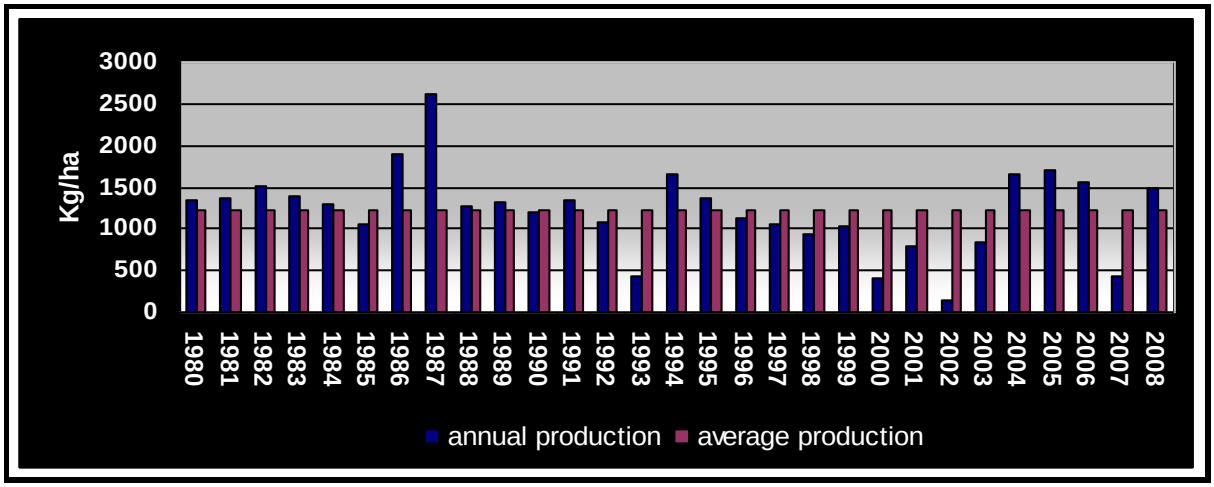


Figure 5. Evolution of production of sunflowers registering in Dolj country (1980-2008)

The sunflower production than was recorded in the years: 1986, 1987, 1994, 2004, 2005, and in 2006 and 2008. Also there have been years like 1993, 2000, 2002 and 2007, with very low yields compared to multi-annual average (Figure 5).

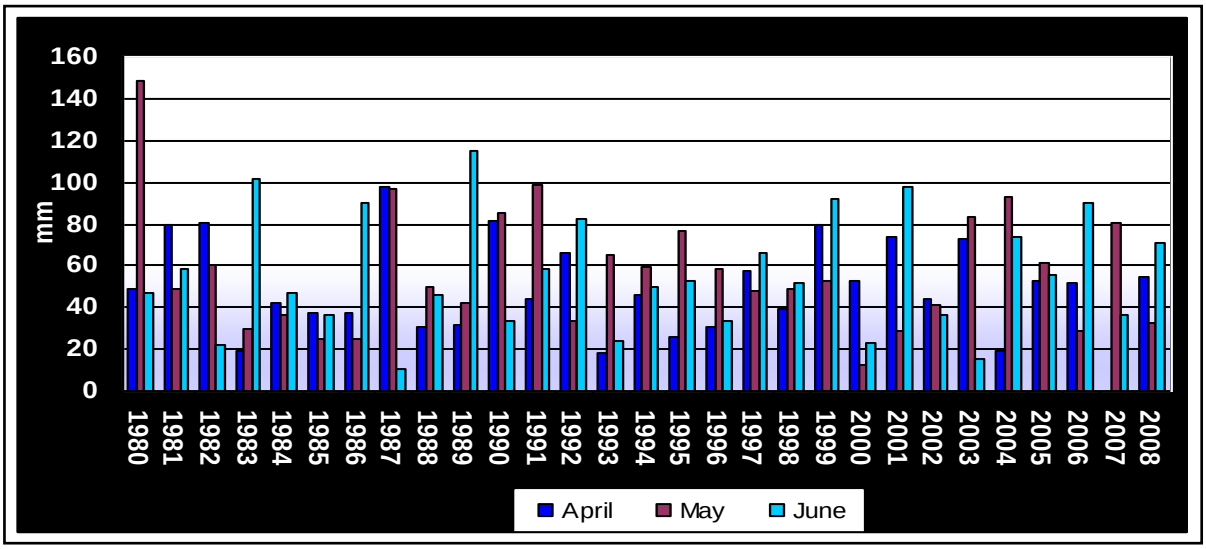


Figure 6. The quantity of rainfall recorded in the first three months of plants studied

Agroclimatic potential of growing season

It has been reviewed years by the small production, and as an example I looked at 1993, who had a small amount of rainfall in the germination period, only 18.1 mm, which covered only 18% of the optimal requirements of the two plants. (Figure 6). In 2007, the situation was more negative, the amount of precipitation was only 0.3 mm, covering 0.3% of plants during germination.

The situation is different in 1987, when amount of rainfall was losing 97.8 mm, covering 96% of requirements optimally. The sunflower the maximum quantity of water shall be recorded during the spring and early summer, after which a decrease in apparent during the months of July and august, due to weather drought.

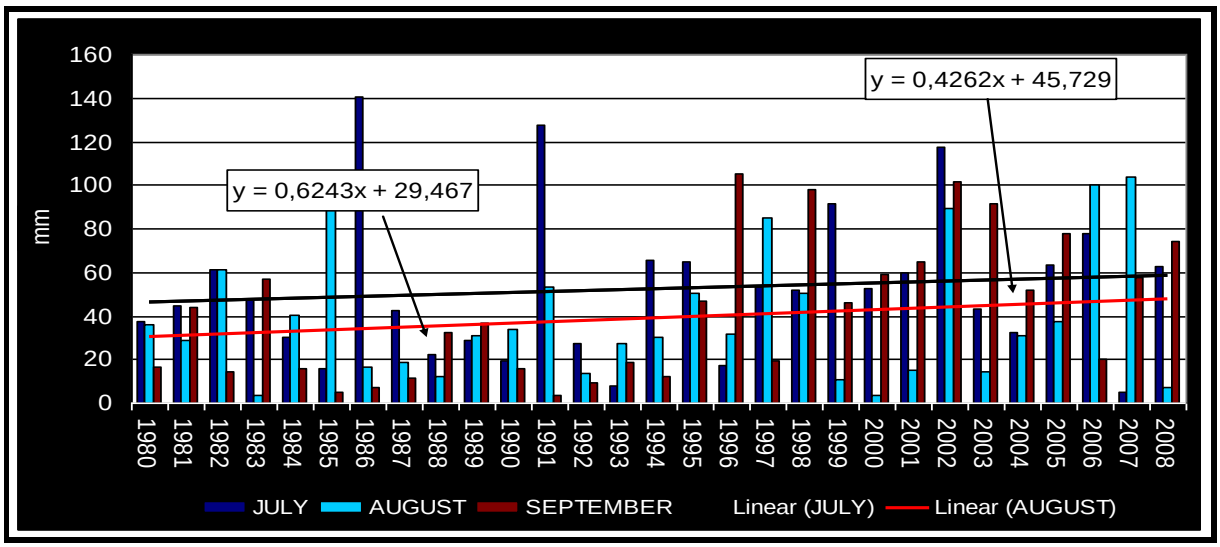
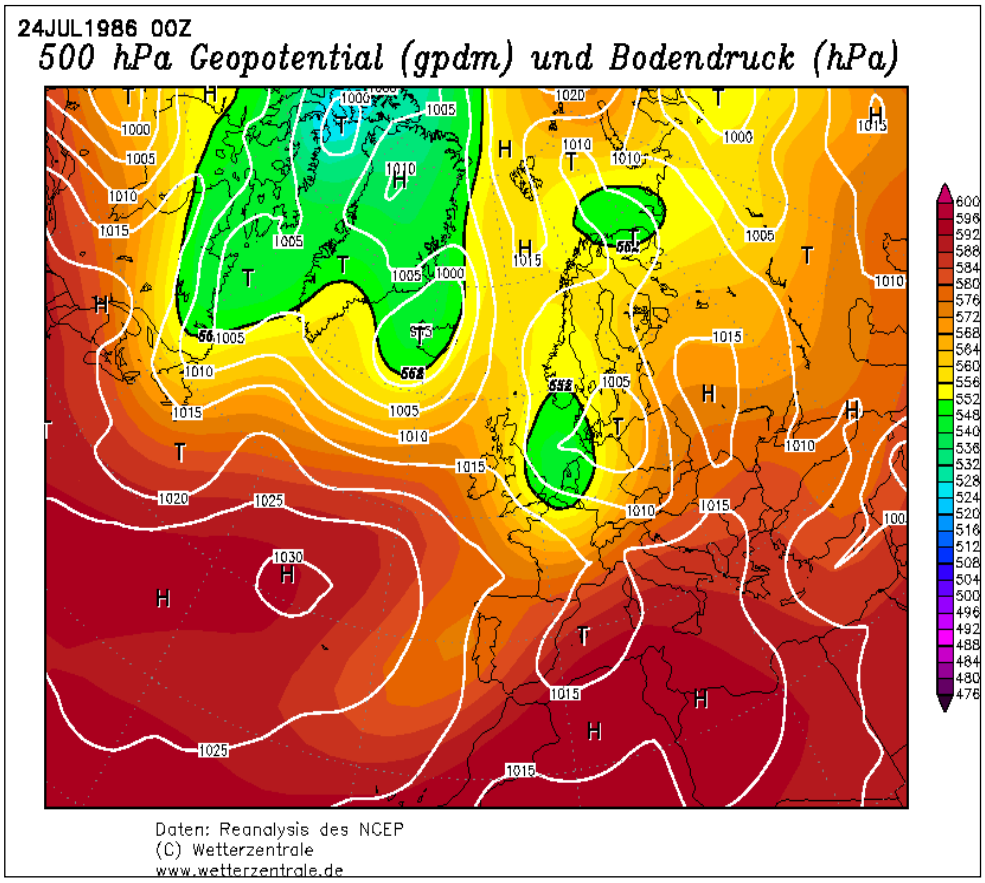


Figure 7. Fluctuations in rainfall during the maximum requirement for water plant culture studied

During the period of maximum water requirement in 1993 the amount of water from precipitation of 7.8 mm, made the plants to suffer in the accumulation phase, where resulted in grain and sterility in Sunflower capitula are undersized. This is due to low rainfall which covered the 4% of the County's needs optimally. In 2007, during the period of accumulation in grain, in July, the amount of rainfall has covered only a small percentage of 2.04% of requirements optimally. (Figure. 7). We have a different situation in 1986 when there was a quantity of phase phenologica 140,3 mm in phenological stage of accumulation in grain and in rainfall has covered 57% of optimum requirements.



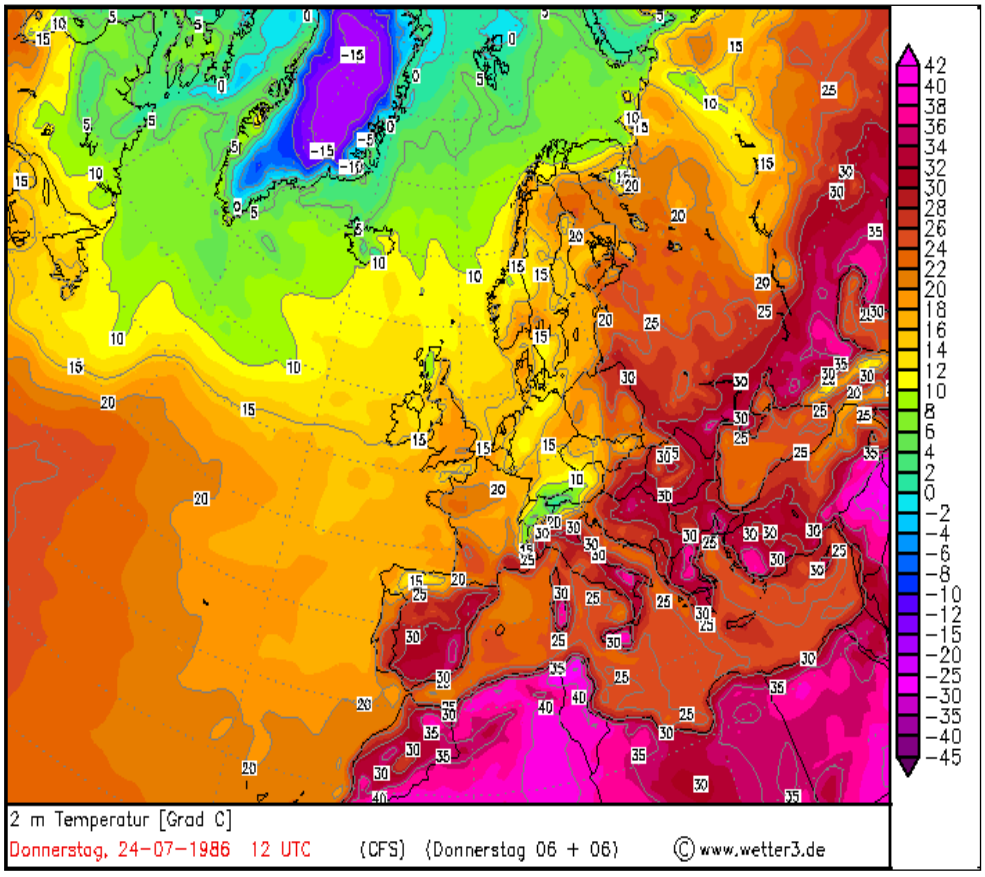


Figure 8. Synoptic conditions generate rainfall

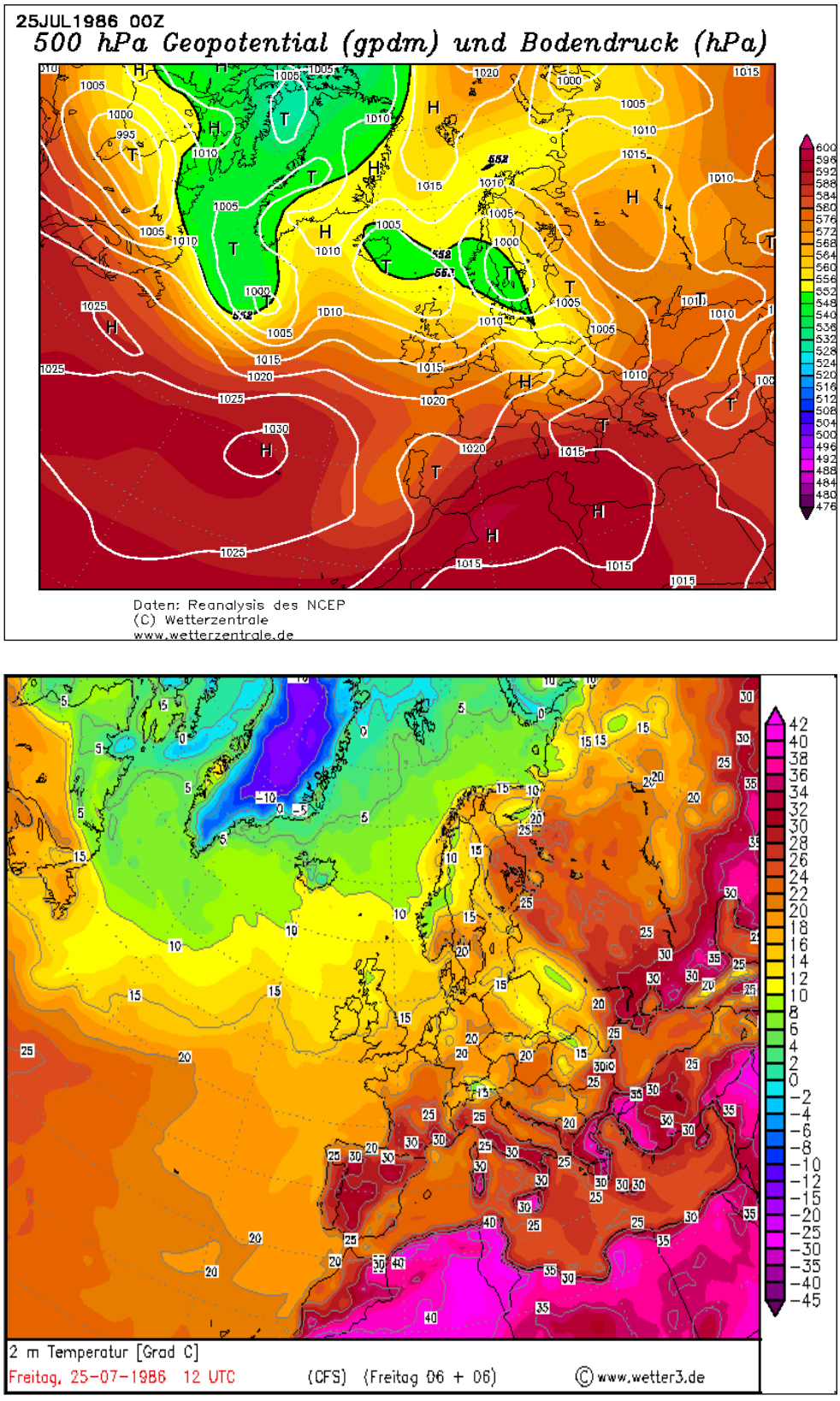
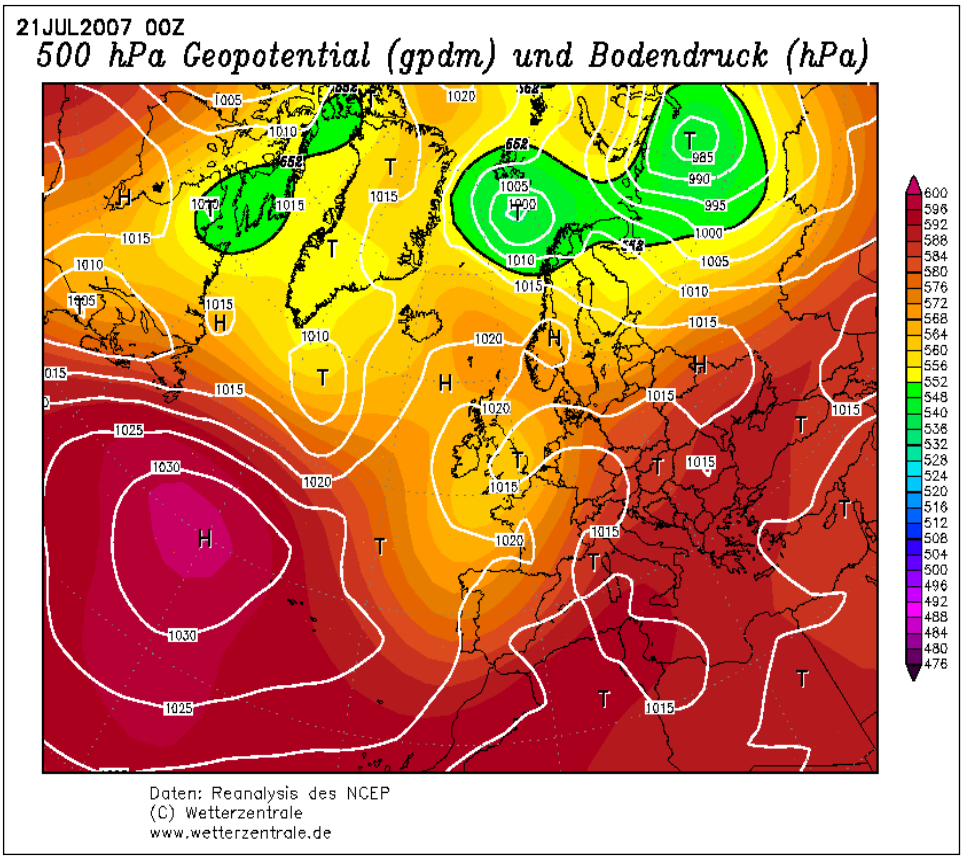


Figure 9. Synoptic Conditions generate quantities of precipitation (25.07. 1986)



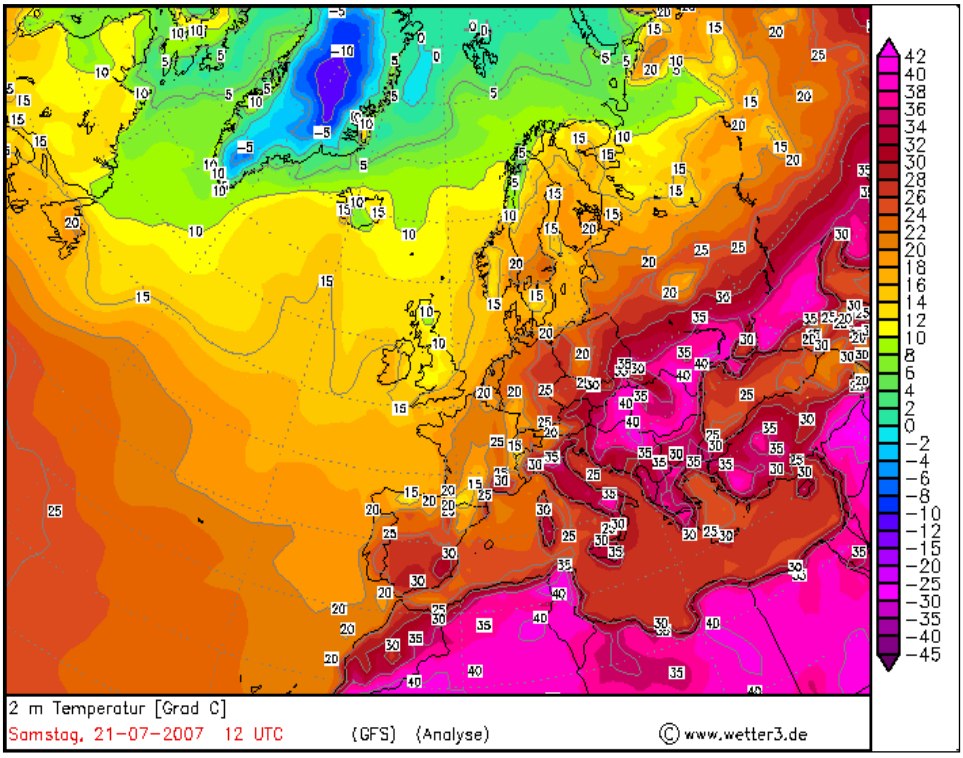


Figure 10. Conditions among generation phenomenon of drought

Synoptic conditions generate rainfall and drought

On 24 July 1986, the south of Romania was under the influence of the tropical air masses, temperatures of 30 °C on almost the whole territory of the country. In Western Europe recorded a low pressure cyclone system with pressure in the Center core of 1005 hPa, and with lower temperatures of up to 10°C. From Scandinavia to the center of Europe gets a cooler of altitude (Figure 8).

During the day of July 25, cyclonic activity is to intensify along with the penetration of cold core Center of Europe from Scandinavia that has a 1000 hPa pressure at the center of so hot tropical air mass comes into direct contact with a mass much cooler air from Scandinavia, but on average air temperature by up to 15 °C (Figure 9).

Amid this system anticiclonic, the quantities of rainfall have deprived the Dolj county, being almost totally lacking in these conditions an outbreak of drought. Analysis for longer periods of time of climatic factors make the major role in the growth and development of plants such as rainfall highlighted the uneven nature of their activities. In the area south of the country were reported the most powerful fluctuations of precipitation.

Annual frequency according to ASPP

The frequency analysis on rainfall areas it can be seen that during the 29 years analysed during the germination of plants considered rainy field is equal to that of the dry, but the situation has undergone some changes since the submission of the vegetative phases in the period of maximum water requirement, July and august, there have been a number of 10 drought years, 5 rainy years and corresponding to the month of July and 9 drouthy years and 6 rainy years in august (Figure 11).

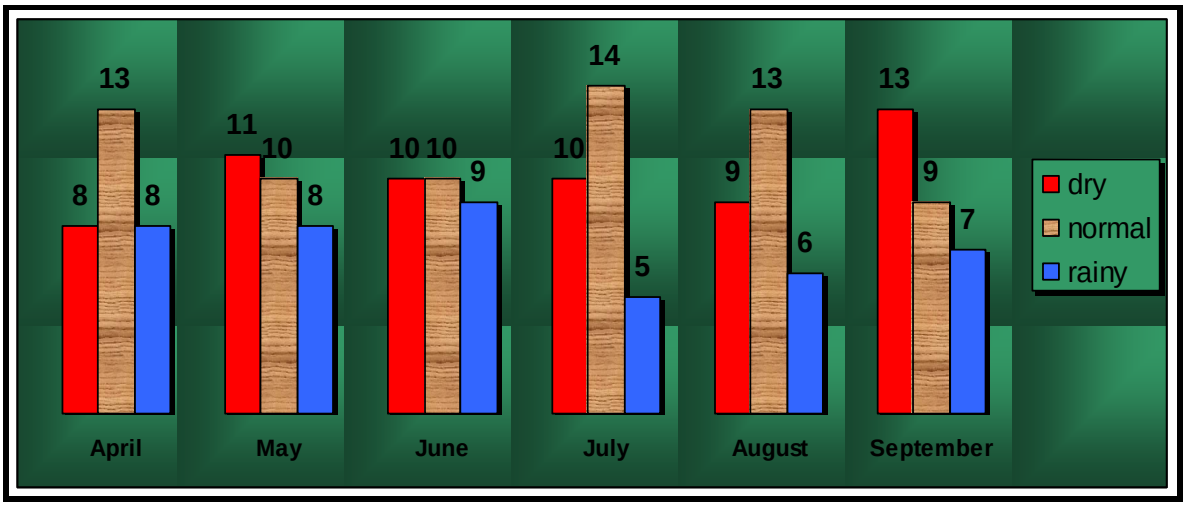


Figure 11. The average yearly frequency on rainfall areas in the Dolj country (1980-2008)

The precipitation falling in the territory has led to the emergence of a dearth of water from precipitation, from water requirements of the atmosphere, beginning in April. These deficit up in September, including ensuring the progressively during the growing season, so in the summer months (July and August) to record over 100 mm. Such percentage increases throughout the range of the dry vegetation phases, peaking in July to have a rate of 34%, and in September a 45% (Figure 12).

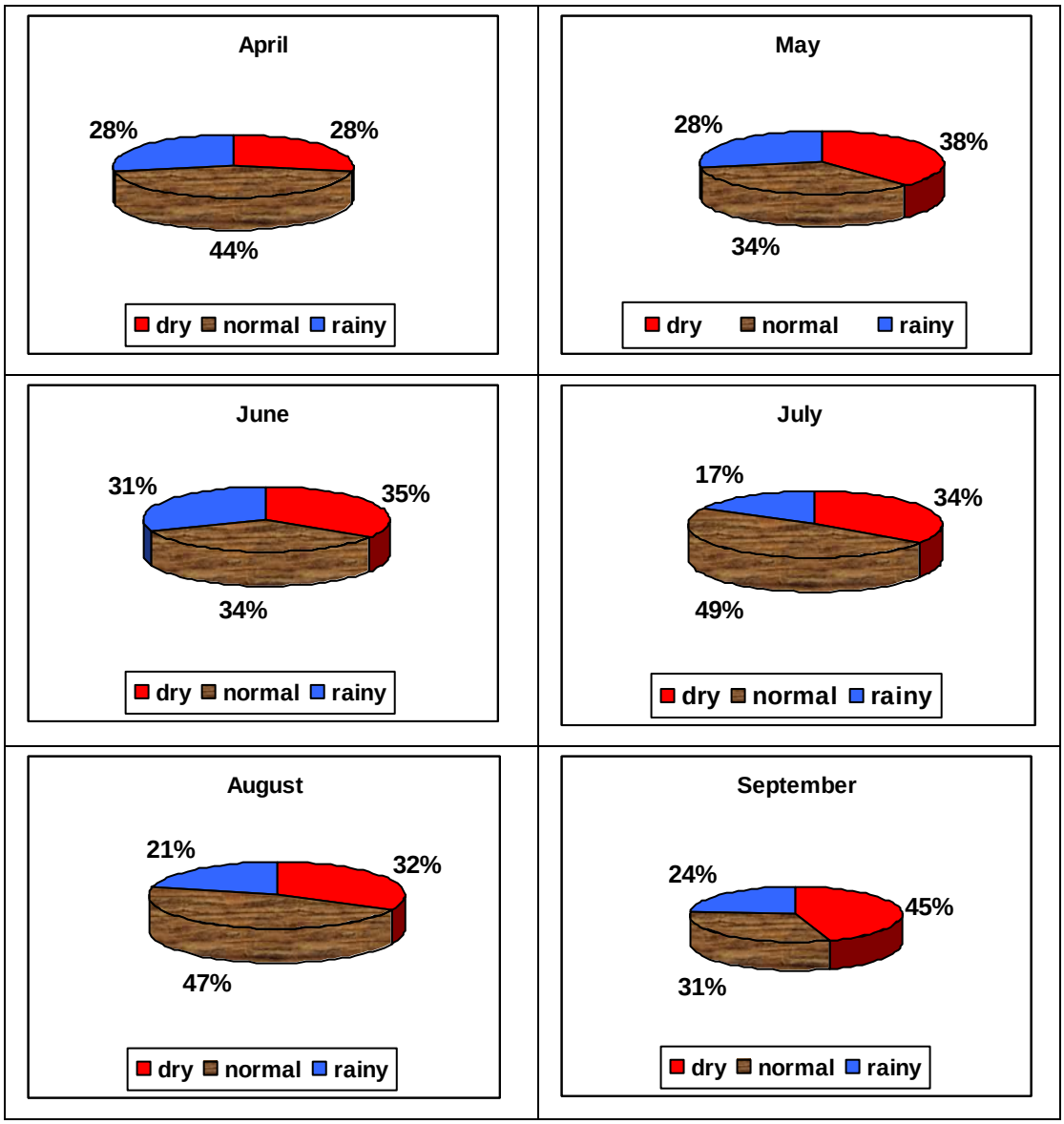


Figure 12. The average frequency of vegetative season months of growing plants according to ASPP

Lang rain index

During the 29 years the ratio of rain which fell during the period of vegetation and temperature are insufficient for farming in the area, placing the area in a desert

climate (Figure 13). According to the schedule with the development index, we have Lang rain index during the analysis period a large

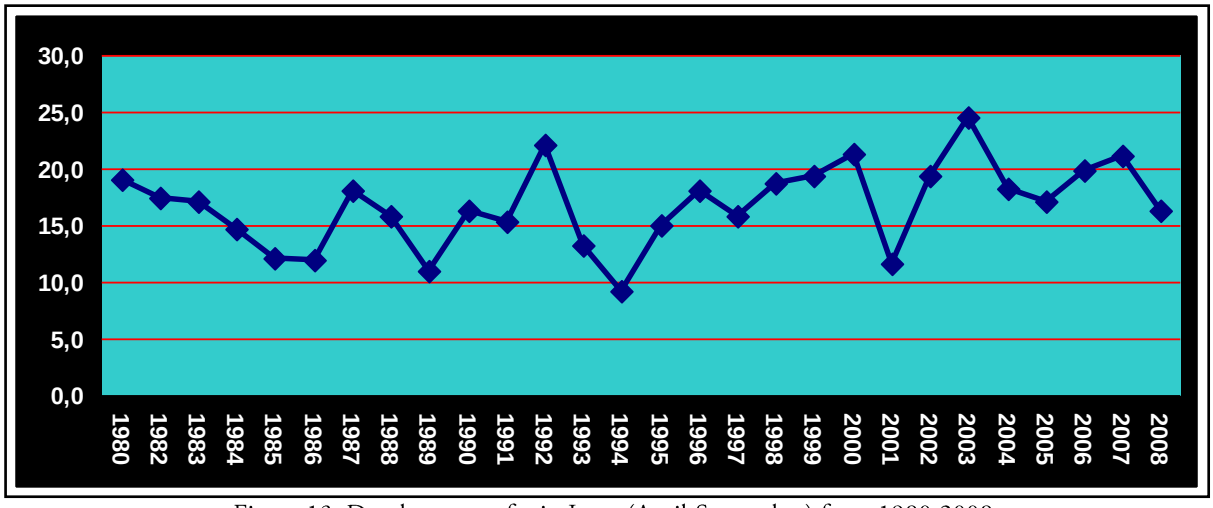


Figure 13. Development of rain Lang (April-September) from 1980-2008

proportion of the early desert, but with the qualifier and qualifier barren years [7] (Table 2).

In the period of vegetation of plants of culture according to the calculated values for Dolj county, you can abserv over the period of 29 years only four years had higher values which place the area in a more economically friendly climatologic.

Table 2. The character of years pluviometric depending on Lang rain index

Lang rain index (R)	The climate characteristic
> 160	Wet
160-100	Temperate wet
100-60	Temperate warm
60-40	Semiarid
40-20	Arid
20-0	Desert landscape

4. CONCLUSIONS

In the area of existing hydrological resources are insufficient for the growth and development of plants, primarily drought during the growing season. In 1993- reduced amount of rainfall in the month of June (24,4 mm) and 7,8 mm in July related to excessive temperatures in the air (35-40 °C) have caused disturbances on physiological characters of maize hybrids and sunflower seeds, especially the skin surface and foliage in phenophase occurrence and of the head paniculelor.

In 2007-harsh conditions (excessive temperatures and prolonged drought) have resulted in a drastic fall in production of sunflower and corn. The quantitative yielding damage, are associated with qualitative injuries represented by decrease of weight and germination of corn and sunflower seeds.

Mitigation effects:

Mitigating the effects of the introduction of new varieties of plants to cope with drought in proportion to the quantities of precipitation in weather forecasts and area in general.

In order to reduce the risk phenomenon of the drought, which affects Dolj country, propositions of mitigation methods are being made: the restoration of irrigation systems, the use of different systems of management practices that aim to reduce the losses incurred in the soil during drought and afforestation of the wind (with Acacias, most resistant to drought).

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