PEDOLOGICAL DROUGHT INFLUENCE ON MAIZE YIELD QUANTITY AND QUALITY IN THE CRISURILOR PLAIN

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Abstract

The paper is based on the research carried out in an experiment placed on the preluvosoil from Agricultural Research and Development Station Oradea, during 2011-2012 in the following variants: V_1= Irrigated, without irrigation suspending; V_2= Irrigated, irrigation suspending in May; V_3 = Irrigated, irrigation suspending in June; V_4= Irrigated, irrigation suspending in July; V_5= Irrigated, irrigation suspending in August; V_6= Unirrigated. The hybrid used: Fundulea 376. In the variant with optimum irrigation, water reserve on 0-75 cm depth was maintained between easily available water content and field capacity.

Pedological drought was determined every year in the variant with unirrigated maize. The number of days with pedological drought was of 20 days in 2010, 93 days in 2011 and 75 days in 2012. Soil water reserve decreased bellow wilting point, too; the number of days with strong pedological drought were of 20 days in 2011 and 11 days in 2012.

In the unirrigated maize, the biggest number of days with pedological drought and the smallest yield protein content and protein yield were registered. The links between pedological drought and yield, between pedological drought and protein content are very significant statistically and they have an inverse form.

Irrigation suspending in different months of the maize irrigation season determined the pedological drought appearance and the yield and protein yield losses in comparison with the variant without irrigation suspending; the protein content of the maize grains are smaller than the value registered in the variant without irrigation suspending.

Key words: pedological drought, strong pedological drought, yield, protein content, irrigation, maize

INTRODUCTION

The Crişurilor Plain occupies the central part of the Western Plain of Romania and maize and winter wheat are cropped on the biggest surfaces (Borza, 2006, 2007). The first research regarding the maize irrigation in this area was started on the chernozem from Girişu de Criş in 1967 by Stepănescu and Mihăilescu. (Domuța, 2010, 2011)

In 1973 the research regarding the soil water balance were started at Girişu de Criş on the soil with groundwater at 2.5 m depth. The research was carried out by Stepănescu E. and Mihăilescu V. In 1976, Stepănescu E. changed the placement of research field for water balance study in Oradea. The soil samples were prelevated ten to ten days both in unirrigated and irrigated variant; soil moisture were determined and the graphs with soil water reserve dynamics on watering depth were made. The graphs were realized for watering depth (0-75 cm in maize). Using these graphs, Domuța C. (1995) determined number of days with soil water reserve bellow easily available water content and bellow wilting point.

In 2004, Domuța C., purposed the indices "pedological drought" and "strong pedological drought". The pedological drought was defined like the decrease of the soil water reserve on watering depth bellow easily available water content. Strong pedological drought was defined like the decrease of the soil water reserve on the watering depth bellow wilting point. These indices for drought characterization were used by Tuşa (1997) for soybean from Burnasului Plain, Petrescu (1999) for sugarbeet from Caracal area, Rădulescu (1999) for crops from South of Bărăgan. Vegh (2004) for potato from Crişurilor Plain, Violeta Şcheau (2005) for peach tree crop from Oradea area, Domuța Cr. (2010) for maize, soybean and sugarbeet from Crişurilor Plain; all these referenced papers are doctor degree thesis. Other research regarding the pedological drought in different crops was published by Borza (2006), Brejea (2008). The papers quantified the pedological drought in different periods and the inverse link with plants water consumption, level and quality of the yield.

This paper presents the results research obtained during 2010-2012 in an experiment with irrigation suspending in different months of the maize vegetation period.

MATERIAL AND METHODS

The paper based on the research carried out in Agricultural Research and Development Station Oradea during 2010-2012 on the preluvosoil. There is a big hydro stability (47.5%) of the aggregates ($\Phi > 0.25$ mm) on ploughingland; bulk density (1.41 g/cm^3) indicates a low settling and total porosity is average; hydraulic conductivity is big (21.0 mm/h) on 0-20 cm. The watering depth (0-75 cm) was a fixed one (Grumeza et al., 1989) and field capacity (FC = 24.2% = 2782 m^3/ha) and wilting point (WP = 10.1 = 1158 m^3/ha) have median values. Easily available water content (Wea) was established in function of soil texture: Wea = WP + 2/3 (FC – WP); the value for 0-75 cm is 19.5% (2240 m^3/ha). (Brejea, 2010)

A drill is the water source for irrigation and their quality for irrigation is very good: pH = 7.2; Na^+ = 12.9%; mineral residue = 0.5 g/l; CSR = -1.7; SAR = 0.52.

The following variants were studied: V_1 = Unirrigated; V_2 = Irrigated without the irrigation suspending in the maize irrigation season; V_3 = Irrigated, with irrigation suspending in May, 4-9 leaves, V_4 = Irrigated, with irrigation suspending in June, 10-18 leaves; V_5 = Irrigated, with irrigation suspending in July, tassel growth – grains filling; V_6 = Irrigated, with irrigation suspending in August, grains filling-ripening. The surface of the experiment plot was 50 m^2. Number of repetition = 4; Irrigation method used was sprinkler with modifications for rectangular plots. Cultivar used: Fundulea 376. Fertilization system: $N_{120}P_{90}K_{60}$. A view from the variant without irrigation suspending is presented in the figure 1.

Fig.1 Fundulea 376 cultivar in the variant without irrigation suspending, Oradea

Soil moisture of 0-75 cm depth was determined ten to ten days. In the variant without irrigation suspending the moment of the irrigation use was when the soil water reserve on 0 – 75 cm depth decreased to easily available water content. In the variant with irrigation suspending in different months didn't irrigate in these months.

The protein content of the maize grains was established using the total nitrogen content by formula: total nitrogen x 6.25. Total nitrogen was determined by Kjeldahl method. (Brejea, 2010, Brejea, Domuţa, 2011)

Results research was processed by variance analysis and with the regression functions (Domuţa, 2006)

RESULTS AND DISCUSSION

Climate elements during 2010-2012

The multiannual (1931-2009) of the annual average air temperature registered during the maize vegetation period (April-September) is of 17.1^{0}C. The average values registered in the studied year were of 18.3^{0}C in 2010, of 19.0 in 2011 and of 19.8 ^{0}C in 2012. Monthly, regarding the biggest difference in comparison with multiannual average, the following situation was registered: in April + 2 ^{0}C (in 2012), in May, +1.8 (in 2012), in June +2.1^{0}C (in 2010), in July +3.8^{0}C (in 2012), in August, +3.4^{0}C (in 2012) and in September +3.2^{0}C (in 2012) (table 1).

The value of the multiannual average (1931-2009) of the rainfall registered during the maize vegetation period is of 367.0 mm; the rainfall registered in 2010 was of 499.1 mm in 2010, of 275.7 mm in 2011 and of 240.0 mm in 2012. Monthly, the biggest difference in comparison with multiannual average had the following values: -27.1 mm in April (2011), +57.8 mm in May (2010), -49.7 mm in June (2011), +54.4 mm in July (2011), -52.2 mm in August (2012) and +27.6 mm in September (2010).

In the year 2011 and 2012, the air humidity registered during April-September had the smaller value (64%; 63%) than the value of the multiannual average (72%); in 2010 the value (76%) is bigger than multiannual average. Monthly, the biggest differences in comparison with multiannual average were registered in in 2011 (-12% in April, -8% in May, - 11% in June) and in 2012 (-7% in July, -19% in August and -16% in September). (table 1).

Pedological drought

The climate conditions from 2010 determined the registration of the smallest number of days with pedological drought in unirrigated maize, 20 days. In the variants with irrigation suspending in July and August a number of 10 days with soil water reserve on 0-75 cm depth bellow easily available water content was registered (table 2). Strong pedological drought didn't register in this year. (table 3).

In unirrigated maize, in 2011, the pedological drought was present 93 days: 7 days in April, 31 days in May, 30 days in June, 10 days and 15 days in July and August, respectivelly. Irrigation suspending in the maize irrigation season determined pedological drought in the all month: 40 days by irrigation suspending in June, 38 days by irrigation suspending in May, 22 days by irrigation suspending in August and 17 days by irrigation suspending in July. There was strong pedological drought in 20 days: 6 days in June, 4 days in July and 10 days in August.

The number of days with pedological drought registered in 2012 was smaller than in 2011, 75 days in unirrigated maize. In the variants with irrigation suspending the following number of days with pedological drought was registered: 31 days in the variant with irrigation suspending in August, 13 days in the variant with irrigation suspending in July, 12 days in the variant with irrigation suspending in June and 4 days in the variant with irrigation suspending in May. The strong pedological drought was determined in 11 days (in August). (table 3)

Table 1

Climate elements, Oradea 2010-2012

Agricultural year	October	November	December	January	February	March	April	May	June	July	August	September	Average/ Total
Average air temperature, °C													
2010	11.3	7.7	3.0	-1.3	2.4	6.1	11.5	16.2	19.8	22.4	21.6	15.2	11.3
2011	8.2	9.2	0.5	-0.1	-1.2	6.0	12.4	16.8	21.2	21.8	22.6	19.3	11.4
2012	9.8	1.9	3.1	0.6	-5.7	6.5	12.5	17.2	21.8	24.6	23.4	19.5	11.3
Average 1931-2009	10.6	5.3	0.6	-2.0	0.3	5.0	10.5	15.8	19.1	20.8	20.0	16.2	10.2
Rainfall, mm													
2010	91.5	86.0	55.6	63.1	48.8	24.3	61.2	118.9	82.8	81.6	82.3	72.9	869.0
2011	52.5	76.7	91.2	25.5	19.4	28.7	19.0	56.5	35.2	125.3	8.9	30.8	569.7
2012	15.6	0.0	54.0	23.2	23.0	4.6	40.7	65.0	94.1	70.8	6.5	21.4	418.9
Average 1931-2009	39.7	48.7	50.4	34.3	38.7	34.6	46.1	61.1	84.9	70.9	58.7	45.3	613.4
Air humidity, %													
2010	80	85	81	86	87	74	77	76	73	75	77	78	79
2011	76	78	90	88	83	73	60	64	62	69	64	64	73
2012	72	80	89	86	81	57	66	69	68	62	52	59	70
Average1947-2009	79	84	88	85	86	86	72	72	73	69	71	75	78

Table 2

Number of days with pedological drought in maize in different variant with water provisionmnet, Oradea 2010-2012

Variant	Month					April - August
	April	May	June	July	August	
2010						
Unirrigated	0	0	0	10	10	20
Irrigated, without suspending irrigation in the crop's irrigation season	0	0	0	0	0	0
Irrigated, with irrigation suspended in May	0	0	0	0	0	0
Irrigated, with irrigation suspended in June	0	0	0	0	0	0
Irrigated, with irrigation suspended in July	0	0	0	10	0	10
Irrigated, with irrigation suspended in August	0	0	0	0	10	10
2011						
Unirrigated	7	31	30	10	15	93
Irrigated, without suspending irrigation in the crop's irrigation season	0	0	0	0	0	0
Irrigated, with irrigation suspended in May	7	31	0	0	0	38
Irrigated, with irrigation suspended in June	7	-	30	3	0	40
Irrigated, with irrigation suspended in July	7	-	0	10	0	17
Irrigated, with irrigation suspended in August	7	0	0	0	15	22
2012						
Unirrigated	2	20	10	12	31	75
Irrigated, without suspending irrigation in the crop's irrigation season	0	0	0	0	0	0
Irrigated, with irrigation suspended in May	0	2	2	0	0	4
Irrigated, with irrigation suspended in June	0	0	10	2	12	12
Irrigated, with irrigation suspended in July	0	0	0	10	3	13
Irrigated, with irrigation suspended in August	0	0	0	0	31	31

Table 3

Number of days with strong pedological drought in unirrigated maize, Oradea 2010-2012

Year	Month					April - August
	April	May	June	July	August	
2010	0	0	0	0	0	0
2011	0	0	6	4	10	20
2012	0	0	0	0	11	11

Optimum irrigation regime

Maintaining the soil water reserve on the watering depth (0-75 cm) between easily available water content and field capacity determined to use the irrigation every year. In the variant without irrigation suspending, the irrigation rate used were of 50.0 mm (in July) in 2010, 350.0 mm (30.0 mm in April, 60.0 mm in May, 120.0 mm in June, 50.0 mm in July and 80.0 mm in August) in 2011 and of 265.0 mm (25.0 mm in April, 50.0 mm in May and June respectivelly 80.0 mm in July and 60.0 mm in August) in 2012. Irrigation suspending in different months determined the decrease of the irrigation rate value. (table 4)

Table 4

Irrigation rate of the maize in different variants of water provisionment, Oradea 2010-2012

Variant	Month					April - August
	April	May	June	July	August	
2010						
Irrigated, without suspending irrigation	-	-	-	50.0	-	50.0
Irrigated, suspending irrigation in May, 4-9 leaves	-	-	-	50.0	-	50.0
Irrigated, suspending irrigation in June, 10-18 leaves	-	-	-	50.0	-	50.0
Irrigated, suspending irrigation in July, tassel growth – grains filling	-	-	-	-	-	-
Irrigated, suspending irrigation in August, grains filling-ripening	-	-	-	50.0	-	50.0
2011						
Irrigated, without suspending irrigation	30.0	60.0	120.0	50.0	80.0	350.0
Irrigated, suspending irrigation in May, 4-9 leaves	30.0	-	120.0	50.0	80.0	280.0
Irrigated, suspending irrigation in June, 10-18 leaves	30.0	60.0	-	50.0	80.0	220.0
Irrigated, suspending irrigation in July, tassel growth – grains filling	30.0	60.0	120.0	-	80.0	290.0
Irrigated, suspending irrigation in August, grains filling-ripening	30.0	60.0	120.0	50.0	-	260.0
2012						
Irrigated, without suspending irrigation	25.0	50.0	50.0	80.0	60.0	265.0
Irrigated, suspending irrigation in May, 4-9 leaves	25.0	-	50.0	80.0	60.0	215.0
Irrigated, suspending irrigation in June, 10-18 leaves	25.0	50.0	-	80.0	60.0	215.0
Irrigated, suspending irrigation in July, tassel growth – grains filling	25.0	50.0	50.0	-	60.0	185.0
Irrigated, suspending irrigation in August, grains filling-ripening	25.0	50.0	50.0	80.0	-	205.0

Pedological drought influence on maize yield

In the year with the smallest number of days with pedological drought, 2010, the biggest maize yield was obtained. Irrigation suspending in May, June, July determined the yield bigger than the yield obtained in the unirrigated conditions. The biggest yield was obtained in the variant without irrigation suspending (table 5).

In the year with the biggest number of pedological drought, 2011, the smallest yield maize was registered in unirrigated variant. The irrigation determined the maize yield gains very significant statistically both in the variant without irrigation suspending and in the variants with irrigation suspending.

The yield registered in 2012 in unirrigated variant was of 7580 kg/ha. In the variant without irrigation suspending and in the variant with irrigation suspending in different months of the irrigation season the yield increased very significant statistically.

On average on the studied period the irrigation suspending in August determined the smallest yield gain in comparison with unirrigated variants. This variant is followed by the variants with irrigation suspending in May, June, July.

Table 5

Pedological drought influence on yield in different variants of maize water provisionment, Oradea 2010-2012

Variant	Yield		Difference		Statistically significant
	Kg/ha	%	Kg/ha	%	
2010					
Unirrigated	12910	100	-	-	Ct
Irrigated, without suspending irrigation in the crop's irrigation season	14900	115.5	1990	15.5	***
Irrigated, with irrigation suspended in May	14780	114.5	1870	14.5	***
Irrigated, with irrigation suspended in June	14810	114.8	1900	14.8	***
Irrigated, with irrigation suspended in July	14880	115.2	1970	15.2	***
Irrigated, with irrigation suspended in August	13100	101.5	190	1.5	-
$LSD_{5\%}$ 250; $LSD_{1\%}$ 470; $LSD_{0.1\%}$ 740					
2011					
Unirrigated	6880	100	-	-	Ct
Irrigated, without suspending irrigation in the crop's irrigation season	13600	197.7	6720	97.7	***
Irrigated, with irrigation suspended in May	10100	146.8	3220	46.8	***
Irrigated, with irrigation suspended in June	10770	156.6	3890	56.6	***
Irrigated, with irrigation suspended in July	11970	174.0	5090	74.0	***
Irrigated, with irrigation suspended in August	11400	165.7	4520	65.7	***
$LSD_{5\%}$ 270; $LSD_{1\%}$ 510; $LSD_{0.1\%}$ 790					
2012					
Unirrigated	7580	100	-	-	Ct
Irrigated, without suspending irrigation in the crop's irrigation season	14150	186.7	6570	86.7	***
Irrigated, with irrigation suspended in May	12370	163.2	4790	63.2	***
Irrigated, with irrigation suspended in June	12000	158.4	4420	58.4	***
Irrigated, with irrigation suspended in July	10900	143.8	3320	43.8	***
Irrigated, with irrigation suspended in August	10870	143.4	3290	43.4	***
$LSD_{5\%}$ 310; $LSD_{1\%}$ 540; $LSD_{0.1\%}$ 910					
Average 2010-2012					
Unirrigated	9123	100	-	-	Ct
Irrigated, without suspending irrigation in the crop's irrigation season	14216	155.9	5093	55.9	***
Irrigated, with irrigation suspended in May	12417	136.1	3294	36.1	***
Irrigated, with irrigation suspended in June	12526	137.3	3403	37.3	***
Irrigated, with irrigation suspended in July	12583	138.0	3460	38.0	***
Irrigated, with irrigation suspended in August	11790	129.3	2667	29.3	***
$LSD_{5\%}$ 277; $LSD_{1\%}$ 507; $LSD_{0.1\%}$ 813					

An inverse link very significant statistically was quantified between number of days with pedological drought from studied variants and yield maize (fig.1.)

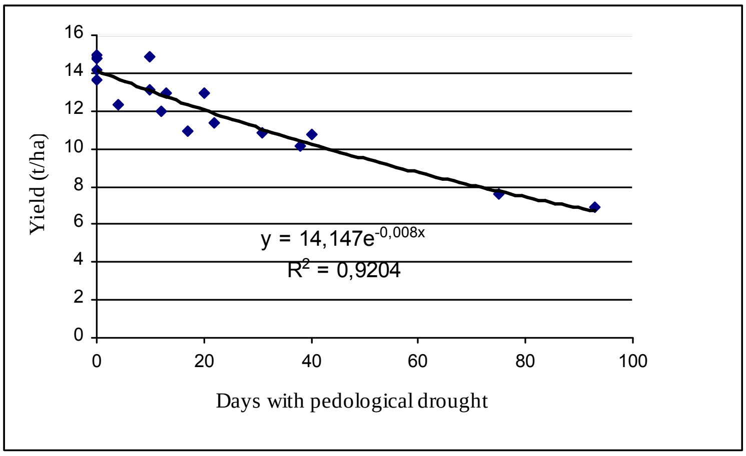

Fig. 1. Correlation between number of days with pedological drought and maize yield, Oradea 2010-2012

Pedological drought influence on protein content of the maize grains and on protein yield

In unirrigated conditions, the biggest protein content of the maize grains was registered in the year 2010, when the biggest quantity of rainfall and the smallest number of days with pedological drought were registered. The smallest protein content of the maize grains were registered in the year (2011) with the smallest rainfall and the biggest number of days with pedological drought. The pedological drought produced by irrigation suspending in different months of the irrigation season determined a smaller protein content than the value obtained in the variant without irrigation suspending. Irrigation suspending in August determine the smallest values of the protein content (table 6).

There is an inverse link between the number of days with pedological drought and protein content of the maize grains (fig. 2)

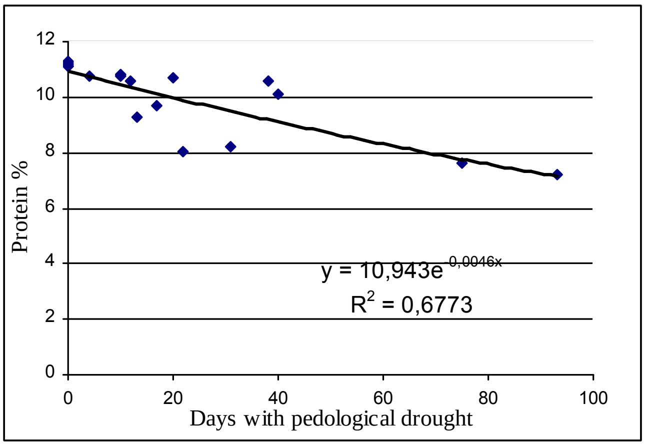

Fig. 2. Correlation between the number of days with pedological drought and protein content of the maize grains, Oradea 2010-2012

Table 6

Pedological drought influence on the protein content in different variants of maize water provisionment, Oradea 2010-2012

Variant	Protein		Difference		Statistically significant
	%	%	%	%	
2010					
Unirrigated	10.70	100	-	-	Ct
Irrigated, without suspending irrigation in the crop's irrigation season	11.28	105.5	0.58	5.5	**
Irrigated, with irrigation suspended in May	11.26	105.3	0.56	5.3	**
Irrigated, with irrigation suspended in June	11.14	104.2	0.44	4.2	*
Irrigated, with irrigation suspended in July	10.80	100.9	0.10	0.09	-
Irrigated, with irrigation suspended in August	10.76	100.6	0.06	0.06	-
$LSD_{5\%}$ 0.25; $LSD_{1\%}$ 0.52; $LSD_{0.1\%}$ 1.02					
2011					
Unirrigated	7.20	100	-	-	Ct
Irrigated, without suspending irrigation in the crop's irrigation season	11.1	154.2	3.9	54.2	***
Irrigated, with irrigation suspended in May	10.60	147.3	3.4	47.3	***
Irrigated, with irrigation suspended in June	10.10	140.3	2.9	40.3	***
Irrigated, with irrigation suspended in July	9.70	134.8	2.5	34.8	***
Irrigated, with irrigation suspended in August	8.05	111.8	1.15	11.8	**
$LSD_{5\%}$ 0.32; $LSD_{1\%}$ 0.66; $LSD_{0.1\%}$ 1.15					
2012					
Unirrigated	7.62	100	-	-	Ct
Irrigated, without suspending irrigation in the crop's irrigation season	11.15	146.4	3.53	46.4	***
Irrigated, with irrigation suspended in May	10.75	141.1	3.13	41.1	***
Irrigated, with irrigation suspended in June	10.60	139.1	2.8	39.1	***
Irrigated, with irrigation suspended in July	9.30	122.1	1.68	22.1	***
Irrigated, with irrigation suspended in August	8.20	107.6	0.58	7.6	**
$LSD_{5\%}$ 0.92; $LSD_{1\%}$ 0.61; $LSD_{0.1\%}$ 1.08					
Average 2010-2012					
Unirrigated	8.51	100	-	-	Ct
Irrigated, without suspending irrigation in the crop's irrigation season	11.18	131.3	2.67	31.3	***
Irrigated, with irrigation suspended in May	10.87	127.8	2.36	27.8	***
Irrigated, with irrigation suspended in June	11.00	129.2	2.49	29.2	***
Irrigated, with irrigation suspended in July	9.93	116.0	1.42	16.0	***
Irrigated, with irrigation suspended in August	9.00	105.8	0.49	58	**
$LSD_{5\%}$ 0.29; $LSD_{1\%}$ 0.60; $LSD_{0.1\%}$ 1.08					

The protein yield calculation emphasizes the bigger relative difference between irrigated and unirrigated variant. In average, on the studied period, the differences regarding the yield were of 55.9% in the variant without irrigation suspending, 36.1%; 37.3%; 38.0% and 29.3% in the variants with irrigation suspending in May, June, July and August respectivelly. The difference regarding protein yield were of 105% in the variant without irrigation suspending, 74.1%; 78%; 61% and 37% in the variants with irrigation suspending in May, June, July and August respectively (table 7).

Table 7

Pedological drought influence on the protein yield in different variants of maize water provisionment, Oradea 2010-2012

Variant	Protein yield		Difference		Statistically significant
	Kg/ha	%	Kg/ha	%	
2010					
Unirrigated	1381	100	-	-	Ct
Irrigated, without suspending irrigation in the crop's irrigation season	1681	121.7	300	21.7	***
Irrigated, with irrigation suspended in May	1664	120.5	283	20.5	***
Irrigated, with irrigation suspended in June	1649	119.4	268	19.4	***
Irrigated, with irrigation suspended in July	1607	117.3	226	17.3	***
Irrigated, with irrigation suspended in August	1409	102.1	28	2.1	*
$LSD_{5\%}$ 13.2; $LSD_{1\%}$ 36.4; $LSD_{0.1\%}$ 72.6					
2011					
Unirrigated	495	100	-	-	Ct
Irrigated, without suspending irrigation in the crop's irrigation season	1510	305	1015	205	***
Irrigated, with irrigation suspended in May	1071	216	576	116	***
Irrigated, with irrigation suspended in June	1087	220	592	120	***
Irrigated, with irrigation suspended in July	1161	235	666	135	***
Irrigated, with irrigation suspended in August	918	186	423	86	***
$LSD_{5\%}$ 12.15; $LSD_{1\%}$ 36.9; $LSD_{0.1\%}$ 91.1					
2012					
Unirrigated	578	100	-	-	Ct
Irrigated, without suspending irrigation in the crop's irrigation season	1627	228	1049	182	***
Irrigated, with irrigation suspended in May	1330	230	752	130	***
Irrigated, with irrigation suspended in June	1272	220	694	120	***
Irrigated, with irrigation suspended in July	1014	175	436	75	***
Irrigated, with irrigation suspended in August	891	154	313	54	***
$LSD_{5\%}$ 13.16; $LSD_{1\%}$ 37.87; $LSD_{0.1\%}$ 98.2					
Average 2010-2012					
Unirrigated	776	100	-		Ct
Irrigated, without suspending irrigation in the crop's irrigation season	1589	205	813	105	***
Irrigated, with irrigation suspended in May	1350	174	574	74	***
Irrigated, with irrigation suspended in June	1378	178	602	78	***
Irrigated, with irrigation suspended in July	1249	161	473	61	***
Irrigated, with irrigation suspended in August	1061	137	285	37	***
$LSD_{5\%}$ 12.95; $LSD_{1\%}$ 37.07; $LSD_{0.1\%}$ 87.3					

CONCLUSIONS

The research carried out at Agricultural Research and Development Station Oradea during 2010-2012 determined the following conclusions:

- The rainfall registered during the maize vegetation period (499.1 mm in 2010, 275.7 mm in 2011 and 240.0 mm in 2012) and soil water reserve didn't maintain the soil water reserve on 0-75 cm depth between easily available water content and field capacity and the following irrigation rates were needed: 50.0 mm in 2010; 350 mm in 2011 and 265.0 mm in 2012.

- Pedological drought was determined every year in the variant with unirrigated maize. The number of days with pedological drought was of 20 days in 2010, 93 days in 2011 and 75 days in 2012. Soil water reserve decreased bellow wilting point, too; the number of days with strong pedological drought were of 20 days in 2011 and 11 days in 2012.
- In the unirrigated maize, the biggest number of days with pedological drought and the smallest yield protein content and protein yield were registered. The links between pedological drought and yield pedological drought and protein content are very significant statistically and they have an inverse form.
- Irrigation suspending in different months of the maize irrigation season determined the pedological drought appearance and the yield and protein yield losses in comparison with the variant without irrigation suspending; the protein content of the grains are smaller than the value registered in the variant without irrigation suspending.

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