RESEARCH ON THE INFLUENCE OF THE PEDOLOGICAL DROUGHT AND IRRIGATION ON SUGARBEET IN THE CRIŞURILOR PLAIN CONDITIONS

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Abstract

The researches performed aimed to establish the influence of the pedological drought and of the irrigation of the level of yield of sugarbeet. These were performed during 2014–2016 in the research field for soil water balance study from Agricultural Research and Development Station Oradea. The sugarbeet is one of the crops with high demands of water; the determinations made twice a month of the humidity of the soil show that on the dept of 0-75 cm the reserve of water has decreased under the level of the easily available water content in 2014 (115 days), in 2015 (91 days) and in 2016 (44 days). In these conditions for the maintaining of the water reserve between the easily available water content and the field capacity on the depth of 0-75 cm were irrigated with 4100 m³/ha in 2014, with 2700 m³/ha in 2015 and with 1200 m³/ha in 2016. The irrigation determined the increases of yield very significant statistically in all the studied years, the relative differences compared to the non irrigated version were of 151 % in 2014, of 102% in 2015 and of 71% in 2016. Considering that the pedological pedological drought was present in all the three years studied, is imposed the using of irrigation at the crop of sugarbeet, because the increases of yield compared to the non irrigated are very significant statistically.

Key words: sugarbeet, pedological pedological drought, irrigation, yield

INTRODUCTION

The sugarbeet is used first of all as raw material in the industry of sugar, assuring approximately 30% of the world sugar yield.

On an average yield of roots of 40 t/ha its results that the secondary products 15 - 30 t crowns and leaves (1.800 - 4.000 nutritive fodder units) 16 t molasses, 16 t pulps (1.000 nutritive fodder units). The total of *nutritive units* equivalate with a yield of over 5.000 kg/ha of maize or barley (Bîrnaure, 1979).

The molasses represents 4 - 5% of the weight of the beet processed and contains approximately 50% sucrose; is exploited in the alimentary industry and of the alcoholic products.

„The mud" resulted from the press filters, having an average content of 92,50% $CaCO_3$, and 2,15% $Mg(OH)_2$, of the dry substance, is used with good results for correcting the reaction of the acid soils.

Considering that the sugar is also a raw material of which can be obtained alchohol fuels, glycerin, acids (citric, glutamic), acetone, dextran lactopren etc., is foreseen that also in the future the world yield of sugard will increase hereinafter (Bîlteanu, 1991, 2003)

The sugarbeet is an intensive crop, very profitable, that exploits efficiently the organic and mineral fertilization, the irrigation water, the system of tractors and agricultural machines endowed, being also a good plant predecessor

for the majority of agricultural crops, contributing to the distruction of the weeds and the structuring of the soil.

The sugarbeet assures large yields only with a good supply of water along the entire period of vegetation (Bîrnaure, 1979, Vârban, 2008). The demands of the plant are variable along the period of vegetation. On seeding, the soil has to be well supplied with water, so that the seed would not arise staggering. In the months April and May the consumtion of the plants is not very high. Beginning with June and until the beginning of the September, the demands of the crop for humidity are high. On the appearance of the pedological drought, the plant reacts by reducing the foliar area, and on prolonged pedological drought the leaves are drying and they fall. Any reduction of the foliar index leads to losses of harvest (roots and sugar), even if the plany doesn't dye having the capacity to form new leaves when the normal climatic conditions return. On the insufficient supply with water is accumulated more harmfull nitrogen than in normal conditions. Darpoux and Debelley (1967), quoted by Bîrnaure (1979) consider that the decrease of the water consumption in the critical period with 10% compared to the real needs of the plant leads to the diminishing of the harvest with 16%. The water excess is very harmful too, the elimination of the air from the soil leading to the putrefaction of the roots.

On the sugarbeet for seed, the pedological drought is very prejudicial, especially in the period of blooming – the development of the seed.

MATERIAL AND METHOD

The researches were performed at the Agricultural Research and Development Station Oradea in the research field of soil water balance study, experiment of long duration founded in 1976. In 2014, 2015, 2016 in the period of vegetation of the sugarbeet (3^{rd} – 9^{th}) were registered 282 mm of precipitations in 2014, 365,5 mm in 2015 and 465,2 mm in 2016.

The research field is placed on a preluvosoil with the following profile Ap = 0 – 24 cm; El = 24 – 34 cm; Bt_1 = 34 - 54 cm; Bt_2 = 54 - 78 cm; Bt/c = 78 - 95 cm; C = 95 - 145 cm. Is remarked the fact that the migration of the colloidal argil determined the appearance of the horizont El with 31,6 % colloidal argil and two horizonts of accumulation of colloidal argil Bt_1 and Bt_2 with 39,8 % and 39,3 % colloidal argil. This is characterized by a very large hydrostability of the soild aggregates larger than 0,25 mm, 47,5 % on the layer of 0 - 20 cm. The soild has an average total porosity on the depth 0 - 20 cm, 20 - 40 cm, 40-60 cm and smaller on the depth 6-80 cm, 80-100 cm and 100-150 cm. The values of the total porosity decrease on the profile of the soil from the surface to the depth. The bulk density - 1,41 g/cm^3 – characterizes a soil weakly sagged on the

depth 0 - 20 cm.; on the other depths studied the apparent weight underline a soil moderately and strongly sagged. On the depths of irrigation (0 – 50 cm, 0 - 75 cm) and on 0 - 150 cm the soil is strongly sagged. The hydraulic conductivbility is large on the depth of 0 - 20 cm, average on the depths 20 - 40 cm and 40 cm, and very small on the following depths studied. The field capacity has an average value on the entie profile of soil and the coefficient of fading has, also, an average value up to the depth of 80 cm and larger unde this depth.

The interval of active humidity IUA or the useful capacity of water has great value on the depth 0 - 80 cm and average on the depth 80 - 150 cm. On the depths of irrigation used in the research field the interval of active humidity has a great value.

Depending on the texture of the soil the easily available water content was established at 2/3 IUA.

The soil from the research field has a weak acid reaction on the entire studied depth, with increasing values from the surface to depth. The supply with humus is weak and that with nitrogen total, weak – average, on the entire researched depth. The report C/N has a greater value on the depth 0 - 20 cm (8.01) and decreases with the depth of determination.

The fertilization year by year with shots of Phosphorus specific to the agro technique of the irrigated soild determined the increasing of the Phosforus level of the soild from the research field so after 39 stationary researches the quantity of mobile Phosphorus from the soil increased on the ploughing layer from 22,0 ppm (average soil supplied) to 150,8 ppm (soil very well supplied).

The soild is moderate sub meso basic on the entire depth studied.

The versions studied: 1) non irrigated; 2) irrigated, with the maintaining of the water reserve between the easily available water content and the field capacity on the depth of 0-75 cm. For this purpose was determined the humidity of the soil from 10 to 10 days.

The surface of the experimental lot: 50 m^2. Number of repetitions: 4.

The hybrid of sugarbeet used was Rubin. This was created by the company Danisco, Danemarca. It is a triploid monogerm hybrid of NZ type. The Rubin hybrid is average tolerant to the attack of the fungus Cercospora beticola. The hybrid has a high capacity of yield, accomplishing in average of 3 years 72,9 t/ha roots and 8,9 t/ha white sugar.

The system of fertilization included: manure 40 t/ha; nitrogen 180 kg/ha; Phosphorus 150 kg/ha; potassium 80kg/ha.

The manure, the Phosphorus (superphosphate) and potassium (potassium salt) were applied in the autumn before the performing of the ploughing, the nitre was applied in the spring before the seeding.

The crop was manintained clean of weeds by manual extirpation; also were performed preventive treatments against the diseases of the sugarbeet. Also the entire technology applied followed the creating of optimum conditions for the sugarbeet crop.

The interpretation of the result was accomplished with the help of the analysis of variation. (Săulescu, 1967, Domuta, 2006)

RESULTS AND DISCUSSION

The pedological pedological drought at the non irrigated sugarbeet crop

In the "Dictionary of science of the soil" the pedological drought is defined as "pedological drought due especially to reduced humidity of the soil, which, even in satisfying athmospheric conditions, don't allow the absoption by the plants of a sufficient quantity of water from the soil" (Conea et al. 1977). Domuţa (2004) considers the formulation "reduced humidity" to vague and proposes that the notion of pedological pedological drought to be related to hydrophysical indices and especially to the easily available water content that represents "the point between the interval of accessible humidity up to which the humidity from the soil can decrease without the crops to be sensitively affected", and as a consequence has proposed the following notions:

- the pedological drought, defined as the period in which the reserve of the soil on the depth of irrigation of crops is situated under the level of easily available water content;

- the accentuated pedological drought, defined as the period in which the reserve of the soil on the depth of irrigation of crops is situated under the level of the fading coefficient, understanding the fading coefficient as a point from an interval and as a fixed point.

The twice a month determination of the humidity of the soil and the graphic representation of the water reserve from the soil on the irrigation depth with the underlying of the hydrophysical indices of the soil allowed the establishing of the number of days with pedological pedological drought on the crop of sugarbeet.

In 2014 the pedological drought was present beginning with May and until September, totalizing 115 days. In 2015 the total number of days with pegological pedological drought was of 91, this phenomenon being met beginning with the month of May and continuing until September. In 2016 the pedological pedological drought has totalized a number of 44 days. (table 1.1).

Table 1.1.

The number of days with pedologcal drought [+)] registered at the non irrigated crop of sugarbeet, Oradea 2014-2016

Year	Number of days of pedological drought						
	in month						Total
	IV	V	VI	VII	VIII	IX	
2014	0	7	17	30	31	30	115
2015	0	3	12	24	22	30	91
2016	0	4	0	0	15	25	44

*) days with water reserve on the irrigation depth (0-75 cm) under the level of easily available water content

The optimum regime of the irrigation in sugarbeet

Is considered that a crop benefits of an optimum regime of water if the humidity on the irrigation depth is maintained between the minimumlimit and the capacity of field. (Grumeza et al., 1989). In the period studied to maintain the water reserve between the easily available water content and the field capacity, the regime of irrigation was different from an year to another depending on the regime of the precipitations.

In 2014 for the optimum supply with water of the sugarbeet were used 4100 m³/ha of water (were applied 8 irrigations), and in 2015 the norm of irrigation used was of 2700 m^3/ha and were applied 7 irrigations, and in 2016 was used the smallest norm of irrigation (1200 m³/ha), were applied 4 irrigations.

Table 1.2.

The optimum regime of the irrigation in sugarbeet, Oradea 2014-2016

Year	Month												Total	
	IV		V		VI		VII		VIII		IX			
	Σm	n	Σm	n	Σm	n	Σm	n	Σm	n	Σm	n	Σm	n
2014	-	-	500	1	500	1	900	2	1000	3	500	1	4100	8
2015	-	-	300	1	500	1	800	2	800	2	300	1	2700	7
2016	300	1	300	1	-	-	-	-	300	1	300	1	1200	4

Σm = norm of irrigation (m^3/ha);
n = number of irrigations

The influence of the irrigation on the yield of sugarbeet

In 2014 in conditions of non irrigation was obtained a yield of sugarbeet of 31150 kg/ha, and in conditions of irrigation, the yield increased with 151%, being obtained a yield of 78200 kg/ha roots of sugarbeet. (table 1.3.)

Table 1.3.

The influence of the irrigation on the yield of sugarbeet, Oradea 2014

Variant	Yield		Difference		Statistical significance
	Kg/ha	%	Kg/ha	%	
Nonirrigated	31150	100	-	-	**Ct**
Irrigated	78200	251	47050	151	***

$LSD_{5\%}$ 1970;
$LSD_{1\%}$ 3840;
$LSD_{0,1\%}$ 5820

In 2015, the yield obtained in condition of non irrigation (39710 kg/ha), and in conditions of irrigation (80100 kg/ha) was larger than in the previous year. The difference between the two versions of maintaining of crop: non irrigated and irrigated (40390 kg/ha) is very significant statistically, by the applying of the irrigation was obtained an increase of yield very significant statistically of 102%. (table 1.4.)

Table 1.4.

The influence of the irrigation on the yield of sugarbeet, Oradea 2015

Variant	Yield		Difference		Statistical significance
	Kg/ha	%	Kg/ha	%	
Nonirrigated	39710	100	-	-	Ct
Irrigated	80100	202	40390	102	***

$LSD_{5\%}$ 1210;
$LSD_{1\%}$ 3910;
$LSD_{0,1\%}$ 7030

In 2016, were registered the biggest yield both in nonirrigated (50100 kg/ha), and in conditions of irrigation (85700 kg/ha). The difference between the two versions of maintaining of crop: non irrigated and irrigated (35600 kg/ha) is very significant statistically, by the applying of the irrigation was obtained an increase of yield very significant statistically of 71%. (table 1.4.)

Table 1.5.

The influence of the irrigation on the yield of sugarbeet, Oradea 2016

Variant	Yield		Difference		Statistical significance
	Kg/ha	%	Kg/ha	%	
Nonirrigated	50100	100	-	-	Ct
Irrigated	85700	171	35600	71	***

$LSD_{5\%}$ 1800;
$LSD_{1\%}$ 5120;
$LSD_{0,1\%}$ 9300

In average on the studied period, by applying the irrigation was obtained an increase of yield very significant statistically of 102% between the variant non irrigated and that irrigated. (table 1.6.)

Table 1.6.

The influence of the irrigation on the yield of sugarbeet, Oradea 2014-2016

Variant	Yield		Difference		Statistical significance
	Kg/ha	%	Kg/ha	%	
Nonirrigated	40320	100	-	-	Ct
Irrigated	81333	202	41013	102	***

$LSD_{5\%}$ 1660;
$LSD_{1\%}$ 4290;
$LSD_{0,1\%}$ 7383

CONCLUSIONS

The paper is based on researche performed during 2014–2016 at the Agricultural Research and Development Station Oradea; these following to establish the influence of the pedological drought and of irrigation on the level of yield of sugarbeet.

The twice a month detrminations of the humidity of the soil showed that on the depth 0 – 75 cm, the water reserve has decreased under the level of the easily available water content in 2014 (115 days), 2015 (91 days) and 2016 (44 days). In these conditions for the maintaining of the water reserve between the easily available water content and the field capacity on the depth of 0 – 75 cm was irrigated with 4100 m³/ha in 2014, with 2700 m³/ha in 2015 and with 1200 m³/ha in 2016.

The irrigation has determined the obtaining of incrases of yield very significant statistically in all the years studies, the relative differences compared to the non irrigated version were of 151 % in 2014, de 102% in 2015 şi de 71% in 2016.

Because the pedological drought was present in all the three years studied, is imposed the using of irrigation at the crop of sugarbeet because the increases of yield compared to non irrigation are very significant statistically.

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