IRRIGATION OPPORTUNITY IN SOYBEAN IN THE MODERATE WET AREA OF THE CRIŞURILOR PLAIN DURING 2006 – 2008

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Abstract

Regarding the irrigation opportunity of the soybean in the moderate wet area of the Cri□urilor Plain, some arguments are presented: the ten to ten determination of the soil`s moisture on the irrigation depth emphasized the decrease of the soil's water reserve under the value of the easily available water content, and a small number of days under the wilting point every year of the period 2006-2008; the participation of the irrigation with 19-48% in the covering sources of the optimum water consumption; the yield gains, very significant statistically every year, the improvement of the water use efficiency with 17.6 – 30.2%.

Keywords: soybean, soil moisture, water consumption, yield, yield gain, water use efficiency.

INTRODUCTION

The water requirement in the soybean crop is relatively high. Bazza M. 1989. Bîlteanu Gh. (2003) considers a 31-61% smaller yield in the droughty years in comparison with the years with optimum rainfall. Berbecel O. and Valuţă Gh. (quoted by Domuţa C., 2005) consider that drought determines 14-52% yield losses in the flowering period and of 41-87% in the grain formation period.

MATERIAL AND METHODS

The research was carried out in Oradea during 2006-2008, in the soil water balance research field. The experiment was placed in 1976 on a preluvosoil from one field from the Agricultural Research and Development Station Oradea. The preluvosoil from the research field is a low acid one, with a low humus content and with a median phosphorus and potassium content. The wilting point and the field capacity values were median. The soil texture determined an easily available water content of 2/3 from the difference between the field capaciy and the wilting point. The irrigation depth in soybean from this area is of 0-75 cm (Grumeza N. and Klepş Cr., 2005).

The soil's moisture was determined twice during one month; when the value of the soil water reserve on the 0-75 cm depth decreased until it reached the value of the easily available water content, irrigation was used

in order to maintain the soil water reserve between the easily available water content and the field capacity. As a consequence, the optimum water consumption was registered in the irrigation variant. The plants water consumption was established using the method of the soil water balance (Botzan M. 1966).

The significant differences between the yield registered in the irrigated and unirrigated variants were determined using the variance analysis method (Domuța C., 2006).

RESULTS AND DISCUSSION

The pedological drought in unirrigated soybean

The determination of the soil's moisture made twice a month permitted to determine the number of days with the values of the available water content under those of the wilting point.

The lowest number of days with pedological drought was registered in 2006 (68 days) and the highest one in 2007 (120 days). In 2008, a number of 95 days with pedological drought was registered in the unirrigated soybean. The highest number of days with pedological drought was registered in June 2007, July 2006 an in August 2008, considering a monthly variation (table 1).

Table 1

The number of days with pedological drought in unirrigated soybean, Oradea 2006-2008

Year	Month						Total
	April	May	June	July	August	September	
2006	0	0	0	29	10	29	68
2007	8	24	26	25	21	16	120
2008	0	6	20	24	31	14	95

The value of the soil's moisture on the 0-75 cm depth decreased reaching a position under the value of the wilting point, every year studied; 4 days in July 2006, 4 days in July and 2 days in August in 2007, and 8 days in August and 5 days in September in 2008 (table 2).

Table 2

The number of days with strong pedological drought in unirrigated soybean, Oradea 2006-2008

Year	Month						Total
	April	May	June	July	August	September	
2006	-	-	-	4	-	-	4
2007	-	-	-	4	2	-	6
2008	-	-	-	-	8	5	13

The soybean's optimum water consumption

The plant's optimum water consumption is considered to be registered when the value of the soil's moisture is between the the values of the the easily available water content and the field capacity (Botzan M., 1966). In the studied period, in order to get the soybean's optimum water consumption, irrigation was made every year. The optimum irrigation regime included an irrigation rate of 1100 m^3/ha and 3 rates in 2006, 2900 m^3/ha and 7 rates in 2007, 3350 m^3/ha and 7 rates in 2008. Considering the month, the highest irrigation rate was used in July: 1100 m^3/ha in 2006, 1000 m^3/ha in 2007 and 2008; in August 2008, 1000 m^3/ha were used, too (table 3).

Table 3

The optimum irrigation regime in soybean, Oradea 2006-2008

Year	Month												Total	
	April		May		June		July		August		September			
	∑m	n	∑m	n	∑m	n	∑m	n	∑m	n	∑m	n	∑m	n
2006	-	-	-	-	-	-	1100	3	-	-	-	-	1100	3
2007	200	1	400	1	700	2	1000	2	600	1	-	-	2900	7
2008	-	-	500	1	850	2	1000	2	1000	2	-	-	33500	7

∑m = the irrigation rate;
n = number of rates;

Irrigation determined the increase of the daily water consumption in comparison with the daily water consumption in the unirrigated variant; the realtive differences had values between 3% (in June) and 115% (in September) in 2006, between 24% (in August) and 95% (in June) in 2007 and between 6% (in April) and 131% (in August) in 2008 (table 4).

Table 4

The influence of irrigation on the soybean's daily water consumption, Oradea 2006-2008

Year	Variant	Month					
		April	May	June	July	August	September
2006	Irrigated	28.9	28.9	35.8	36.2	25.5	11.3
	Unirrigated	30.1	30.1	36.7	56.9	47.4	24.3
	Difference	104	104	103	157	18	215
2007	Irrigated	20.2	21.7	23.1	42.5	31.0	21.7
	Unirrigated	32.7	36.0	45.0	55.6	38.5	35.9
	Difference	162	166	195	131	124	165
2008	Irrigated	27.1	29.3	44.9	41.1	21.3	19.2
	Unirrigated	28.8	34.9	60.0	66.3	49.1	21.0
	Difference	106	119	134	161	231	109

As a consequence, the highest values of the total water consumption were registered in the irrigated variant; the relative differences in comparison with the soybean's water consumption in the unirrigated variant were of 15% in 2006, of 45% in 2007 and of 44.9% in 2008. The main

source for covering the water consumptiomn was the rainfall registered during the vegetation period, both in the unirrigated and irrigated conditions in 2006 and 2007. In 2008, the main source to get to the optimum water consumption was the irrigation, 48%, the irrigation rate used was bigger than the rainfall registered, with a 300 m^3/ha of water difference. The irrigation represented 19% and 44% from the soybean's optimum water consumption, in 2006 and 2007 (table 5).

Table 5

The total water consumption of the unirrigated and irrigated soybean and the covering sources, Oradea 2006 – 2008

Year	Variant	∑(e+t)		Covering sources			
		m^3/ha	%	IR-FR	Rv	∑m	
						m^3/ha	%
2006	Unirrigated	5275	100	1776	3459	-	-
	Irrigated	6090	115	1491	3499	1100	19
2007	Unirrigated	4530	100	700	3776	-	-
	Irrigated	6566	145	110	3776	2900	44
2008	Unirrigated	4715	100	1695	3020	-	-
	Irrigated	7012	149	642	3020	3350	48

∑(e+t) = total water consumption;
IR-FR= initial reserve – final reserve
Rv = rainfall during the vegetation period;
∑m= irrigation rate

In all years of the studied period, the irrigation determined the yield gains, very significant statistically. In 2006, the yield gains determined by irrigation was of 34.0%. The highest value of the yield gains was registered in 2007, the relative difference compared to the unirrigated variant was of 447%. The relative difference registered in 2008 was of 197,7% (table 6).

Table 6

The influence of the irrigation on the yield in soybean, Oradea 2006-2008

Variant	Yield		Difference		Statistical significance
	kg/ha	%	kg/ha	%	
2006					
Unirrigated	2620	100	-	-	Mt
Irrigated	3510	134.0	8.90	34.0	xxx
DL 5%	180	DL 1%	3.10	DL 0.1%	6.30
2007					
Unirrigated	580	100	-	-	Mt
Irrigated	3170	547	2590	447.0	xxx
DL 5%	180	DL 1%	290	DL 0.1%	518
2008					
Unirrigated	1350	100	-	-	Mt
Irrigated	4020	297.7	2670	197.7	xxx
DL 5%	190	DL 1%	280	DL 0.1%	540

Irrigation determined the improvement of the water use efficiency in all of the studied years. In 2006, the water use efficiency increased with 17.6%. The biggest difference registered was of 402% in 2007; in 2008, the relative difference between the water use efficiency from the irrigated variant and the unirrigated one was of 98% (table 7).

Table 7

The influence of irrigation on the water use efficiency (WUE) and irrigation water use efficiency (IWUE) in soybean, Oradea 2006 – 2008

Year	Variant	WUE		IWUE	
		kg/m^3	%	kg yield gain/m^3	%
2006	Unirrigated	0.49	100	-	-
	Irrigated	0.58	117.6	0.81	100
2007	Unirrigated	0.12	100	-	-
	Irrigated	0.48	402	0.89	110
2008	Unirrigated	0.29	100	-	-
	Irrigated	0.57	198	0.80	98

The highest value of the irrigation water use efficiency (IWUE) was registered in 2007, 0.89 kg yield gains/m^3. The values of the IWUE in 2006 and 2007 were of 0.81 kg yield gains/m^3 respectively of 0.80 kg yield gains/m^3 (table 7).

CONCLUSIONS

The paper is based on the research carried out during 2006 – 2008 on the preluvosoil from the research field in Oradea. The results led to the following conclusions:

- The determination of the soil's moisture emphasized the fact that the value of the soil water reserve decreases on the irrigation depth under the values of the easily available water content in (68 days in 2006, 120 days in 2007 and 95 days in 2008) and under the wilting point in 4 days in 2006, in 6 days in 2007, and in 13 days in 2008.
- When maintaining the soil water reserve between the easily available water content and field capacity on 0-75 cm (irrigation depth) irrigation rates of 1100 m^3/ha, 2900 m^3/ha and 3350 m^3/ha were used in 2006, 2007 respectively 2008.
- The use of irrigation determined the increase of the daily water consumption values. As a consequence, the total water consumption increased with 15% in 2006, with 45% in 2007 and with 49% in 2008. In order to get to the optimum water consumption, irrigation was necessary every year; its

participation in the covering sources of the water consumption was of 19% in 2006, of 44% in 2007, of 48% in 2008.

- The yield gains determined by irrigation were very significant statistically, every year; their relative values were of 34% in 2006, of 447% in 2007 and of 197.7% in 2008.
- Irrigation determined the improvement of the water use efficiency (kg/m^3) with 17.6% in 2006, with 302% in 2007 and with 98% in 2008.

All the results emphasized the need for irrigation in the soybean in the Crisurilor Plain conditions.

REFERENCES

1. Bazza M., 1989, Crop – soil – water – atmosphere relations FAO/IAEA Seibesdorf.
2. Bîlteanu Gh., 2003, Fitotehnie, Editura Ceres, Bucureşti.
3. Botzan M., 1966, Culturi irigate, Editura Agrosilvică, Bucure□ti.
4. Domuța C., 2005, Irigarea culturilor, Editura Universității din Oradea.
5. Domuța C., 2006, Tehnică experimentală, Editura Universității din Oradea.
6. Grumeza N., Klepş Cr., 2005, Amenajările de irigații din România, Editura Ceres, Bucureşti.