RESEARCH REGARDING THE IMPACT OF THE CORRECTLY IRRIGATION SCHEDULING ON SOYBEAN FROM CRISURILOR PLAIN

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Abstract

The research was conducted at the Agricultural Research and Development Station Oradea in the preluvosoil condition and experience was located in 2007 after block method in four repetitions. In condition of unirrigation of soybean crop, pedological drought was present in 53 days in 2012 and 50 days in 2013. In months without irrigation, soil moisture on the 0-75 cm depth decreased below the easily available water content every year. A correctly irrigation scheduling and optimum irrigation regime determined yield gain very significant statistically each year, and in variant with irrigation suspending were obtained lower values of yield; differences from variant without irrigation suspending were statistically significant; The protein content in soybean grains compared with unirrigated variant increased Irrigation suspending in different months determined the decreasing of protein content, the differences being statistically assured.

Keywords*: irrigation scheduling, soybean, drought, yield, quality*

INTRODUCTION

Irrigation scheduling represents the prevision activity of the irrigation timing application, preparation and submission of data necessary for the beneficiary (Grumeza N. et al., 1989; Domuta C., 2009). The problem of establishing of correctly irrigation scheduling was and is an important concern of specialists in the field because a correctly irrigation scheduling assuring the highest yields; are also prevented the negative phenomena in the evolution of soil and groundwater (Domuta C., 2012, Domuta Cr. 2013).

Correctly irrigation scheduling prevents pedological drought. Decreasing of soil water reserve on watering depth below the easily available water content was considered period with pedological drought (Domuta C., 2005) given that Botzan M. (1966) defines the easily available water content as limit to which soil moisture can drop occurs without significant loss of the yield and that the irrigation technique the water reserve is mentioned between easily available content and field capacity.

Taking into account that in field conditions, soil moisture can decrease below the wilting point without plants wilting and die (because wilting point should not be understood as a fixed point but a point from a interval (Canarache A., 1990), decreasing of water reserve below the wilting point is considered strong pedological drought (Domuta C., 2005). Numbers of days with pedological drought or strong pedological drought are determined

through graphics with dynamics of water reserve in the soil resulting from decade determination of soil moisture.

MATERIAL AND METHOD

The research was conducted at the Agricultural Research and Development Station Oradea in the preluvosoil condition and experience was located in 2007 after block method in four repetitions. Experimental variants studied were:

V1 – Irrigated, without irrigation suspending, mainatining of soil water reserve between easily available water content and field capacity on depth by 0-75 cm;

V2 – Irrigation suspending in May (vegetative growing of soybean crop)

V3 – Irrigation suspending in June (vegetative growing – flowering at soybean crop);

V4 – Irrigation suspending in July (flowering - fertilization);

V5 – Irrigation suspending in August (fertilization – begining of seed maturation);

V6 – Unirrigated

Proper management of soil water regime in variant without irrigation suspending was based on the decade determination of soil moisture with irrigation whenever the soil water reserve on depth of 0-75 cm reached below the easily available water content. Simultaneously, and in variants with irrigation suspending was determined the soil moisture. Method of determination used was gravimetric method. Soil water reserve was determined by the formula:

$Ra = U \times DA \times H$

In which: Ra = soil water reserve; m^3/ha; U = soil moisture %; DA = bulk density; g/m^3; H = depth, cm.

Graphs of dynamics of soil moisture were performed to a depth of 0-75 cm, taking into account that in this depth the major hidrophysical indices have the following values: field capacity = 24, 2% (2782 m^3 / ha); wilting point = 10,1% (1158 m^3 / ha) and easily available water content = 19,5% (2240 m^3 / ha). Source of irrigation water used was an underground drilling; quality indexes characterize it as very good for irrigation. There was a sprinkler irrigation using a device adapted on rectangular plots. Variety used was Agat. Figure 1 shows aspects from research field.

Yield results and results regarding of protein content were calculated by the method of variance analysis (Domuta C., 2006).

Fig.1. Aspects from the research field, experiment with soybean, Oradea 2009

RESULTS AND DISCUSSION

Pedological drought at soybean crop

In condition of unirrigation, pedological drought was present in 53 days in 2012 and 50 days in 2013. In months without irrigation, soil moisture in the 0-75 cm depth decreased below the easily available water content (table 1). In unirrigated crop the soil moisture on 0-75 cm depth although decreased below the wilting point in 10 days in 2012 and for eight days in 2013 (table 2).

Table 1

Number of days with pedolgical drought in soybean, in different water assurance variants, Oradea 2012-2013

Variant	Month					IV-VIII
	IV	V	VI	VII	VIII	
2012						
1. Without irrigation suspending	-	-	-	-	-	0
2. Irrigation suspending in May (vegetative growing)	-	7	-	-	-	7
3. Irrigation suspending in June (vegetative growing - flowering)	-	-	-	-	-	0
4. Irrigation suspending in July (flowering - fertilization)	-	-	-	15	-	15
5.Irrigation suspending in August (fertilization – begining of seed maturation)	-	-	-	-	31	31
6.Unirrigated	-	7	-	15	31	53
2013						
1. Without irrigation suspending	-		-	-	-	-
2. Irrigation suspending in May (vegetative growing)	-	-	-	-	-	-
3. Irrigation suspending in June (vegetative growing - flowering)	-	-	6	-	-	6
4. Irrigation suspending in July (flowering - fertilization)	-	-	6	13	-	19
5.Irrigation suspending in August (fertilization – begining of seed maturation)	-	-	-	-	31	31
6.Unirrigated	-		6	13	31	50

Table 2

Number of days with strong pedological drought registered in unirrigated soybean in the conditions from Oradea

Year	*Month*					Total
	IV	V	VI	VII	VIII	IV-VIII
2012	-	-	-	-	10	10
2013	-	-	-	6	2	8

Irrigation scheduling of soybean crop in conditions of optimal water reserve and irrigation suspending

Maintaining of water reserve between easily available water content and field capacity on 0-75 cm depth of soybean crop determined following irrigation regime: in 2012: irrigation rate was 2400 m^3 / ha and a total of seven watering. The highest value of monthly irrigation rate (1200 m^3 / ha) was recorded in August. In variants with irrigation suspending in different months of the irrigation season, the values of irrigation rate decreased (table 3).

Table 3

Water regime of soybean in different variants of water assurance in the conditions from Oradea, 2012

Varaiant of irrigation	**April**		**May**		**June**		**July**		**August**		**Total**	
	∑m	**n**	**∑m**	**n**	**∑m**	**n**	**∑m**	**n**	**∑m**	**n**	**∑m**	**n**
1. Without irrigation suspending	-	-	600	2	-	-	600	2	1200	3	2400	7
2. Irrigation suspending in May (vegetative growing)	-	-	-	-	-	-	600	2	1200	3	1800	5
3. Irrigation suspending in June (vegetative growing - flowering)	-	-	600	2	-	-	600	2	1200	3	2400	7
4. Irrigation suspending in July (flowering - fertilization)	-	-	600	2	-	-	-	-	1200	3	1800	5
5.Irrigation suspending in August (fertilization – begining of seed maturation)	-	-	600	2	-	-	600	2	-	-	1200	4

∑m= irrigation rate; n = watering number

In 2013, irrigation rate had a value about 2800 m^3 / ha higher than 2012. Number of irrigation rate was the same (7) but monthly distribution was different (table 4).

Table 4

Water regime of soybean in different variants of water assurance in the conditions from Oradea, 2013

Varaiant of irrigation	April		May		June		July		August		Total	
	∑m	n	∑m	n	∑m	n	∑m	n	∑m	n	∑m	n
1. Without irrigation suspending	-	-	-	-	400	1	1200	3	1200	3	2800	7
2. Irrigation suspending in May (vegetative growing)	-	-	-	-	-	-	1200	3	1200	3	2800	7
3. Irrigation suspending in June (vegetative growing - flowering)	-	-	-	-	400	1	1200	3	1200	3	2400	6
4. Irrigation suspending in July (flowering - fertilization)	-	-	-	-	400	1	-	-	1200	3	1600	4
5.Irrigation suspending in August (fertilization – begining of seed maturation)	-	-	-	-	400	1	1200	3	-	-	1600	4

∑m= irrigation rate; n = watering number

Influence of irrigation on yield level in soybean

In 2012, in variant without irrigation suspending irrigation in season months of the soybean crop irrigation obtained a yield of 3080 kg / ha. Irrigation suspending in May resulted in a loss of yield (610 kg / ha, 20%) statistically distinct significant. In June irrigated and as a result yield was close to that obtained in the variant without irrigation suspending. Irrigation suspending in other months determined losses statistically significant about 44% by irrigation suspending in August and 34,0% by irrigation suspending in July. In unirrigated variant, soybean yield was only 520 kg / ha with 83% lower than yield obtained in the variant optimum water supplied using irrigation (table 5).

Table 5

Suspending irrigation influence in different month of vegetation period on yield in soybean crop, in the conditions from Oradea 2012

Variant	Yield		Difference		Statistically significant
	Kg/ha	%	kg/ha	%	
1. Without irrigation suspending	3080	100	-	-	Mt
2. Irrigation suspending in May (vegetative growing)	2470	80	-610	-20	00
3. Irrigation suspending in June (vegetative growing - flowering)	3030	98	-50	-2	-
4. Irrigation suspending in July (flowering - fertilization)	2030	66	-1050	-34	000
5.Irrigation suspending in August (fertilization – begining of seed maturation)	173	56	-1350	-44	000
6. Unirrigated	520	17	-2560	-83	000

LSD5% = 170
LSD1% = 310
LSD 0,1% = 680

In 2013, in unirrigated condition (1390 kg / ha) and in variant without irrigation suspending (3370 kg / ha) was obtained the smallest and largest soybean yield. Suspending irrigation in monthly irrigation season determined yield losses statistically assured compared with variant without irrigation suspension, the higher loss of yield (1590 kg / ha - 47%) was registered in the variant with irrigation suspending in August (table 6).

Table 6

Suspending irrigation influence in different month of vegetation period on yield in soybean crop, in the conditions from Oradea 2013

Variant	Yield		Difference		Statistically significant
	Kg/ha	%	kg/ha	%	
1. Without irrigation suspending	3370	100	-	-	Mt
2. Irrigation suspending in May (vegetative growing)	3350	99	-20	-1	-
3. Irrigation suspending in June (vegetative growing - flowering)	2890	86	-480	-14	000
4. Irrigation suspending in July (flowering - fertilization)	2310	69	-1060	-31	000
5.Irrigation suspending in August (fertilization – begining of seed maturation)	1780	53	-1590	-47	000
6. Unirrigated	1390	41	-1980	-59	000

LSD5% =210
LSD1% = 396
LSD 0,1% = 720

Irrigation influence on yield quality in soybean crop

In 2012, the protein content of soybean grains was 41, 2% in the variant with optimum irrigation regime. Protein content of soybean grains decreased statistically unsignificant in variant with irrigation suspending in June; irrigation suspending in May, July and August determined losses of yield statistically assured; and in terms of unirrigated conditions was registered the biggest difference (25%) compared to variant without irrigation suspending (table 7).

Table 7

Suspending irrigation influence in different month of vegetation period on protein content of soybean crop, in the conditions from Oradea 2012

Variant	Protein		Difference		Statistically significant
	%	%	%	%	
1. Without irrigation suspending	41,2	100	-	-	Mt
2. Irrigation suspending in May (vegetative growing)	39,6	96	-1,6	-4	-
3. Irrigation suspending in June (vegetative growing - flowering)	41,0	99	-0,2	-1	000
4. Irrigation suspending in July (flowering - fertilization)	35,4	86	-5,8	-14	00
5.Irrigation suspending in August (fertilization – begining of seed maturation)	34,7	84	-6,5	-16	000
6. Unirrigated	30,7	75	-10,5	-25	000

LSD5% = 1,2
LSD1% = 3,4
LSD 0,1% = 5,7

In 2013, in unirrigated conditions and in variant without irrigation suspending was obtained the lowest (31,2%) and the higher value of protein content in soybean grains (41,2%). In months that were required irrigations, irrigation suspending caused decreases of the protein content, the differences in comparison with the variant without irrigation suspending is statistically assured (table 8).

Table 8

Suspending irrigation influence in different month of vegetation period on protein content of soybean crop, in the conditions from Oradea 2013

Variant	Protein		Difference		Statistically significant
	%	%	%	%	
1. Without irrigation suspending	41,1	100	-	-	Mt
2. Irrigation suspending in May (vegetative growing)	41,0	99	-0,1	-1	-
3. Irrigation suspending in June (vegetative growing - flowering)	39,3	96	-1,8	-4	0
4. Irrigation suspending in July (flowering - fertilization)	34,6	84	-6,5	-16	000
5.Irrigation suspending in August (fertilization – begining of seed maturation)	32,0	78	9,1	-22	000
6. Unirrigated	31,2	76	7,6	-24	000

LSD5% = 1,3
LSD1% = 3,7
LSD 0,1% = 6,1

CONCLUSIONS

Research conducted at the Agricultural Research Development Station Oradea in a preluvosoil conditions led to the following conclusions:

- Decade's determinations of the soil moisture showed that in unirrigation conditions, on depth of 0-75 cm (depth of soybean watering), water reserve decreased below the easily available water content in each year of the period studied, ranking into fewer days below the wilting point. Although in the variants with irrigation suspending pedological drought phenomena was registered in the months in which irrigation was needed and not irrigated.
- Establishing of moment of irrigation scheduling and optimum irrigation regime determined yield gain very significant statistically every year, and in the variant with irrigation suspending were obtained lower values of yield; differences from variant without irrigation suspending were statistically significant.
- Correctly irrigation scheduling and irrigation application determined the increasing of protein content in soybean grains compared with unirrigated variant. Irrigation suspending in different months determined the decreasing of the protein content, the differences being statistically assured.

The research results highlight that the correctly irrigation scheduling ensure the highest yield of soybean crop and the highest content in protein, and deviations from the optimum time application through irrigation suspending in different months of the irrigation season of soybean determine loss of the yield highly statistically significant and decreasing statistically assured of protein content in soybean crop.

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