

# RESEARCH CONCERNING THE INFLUENCE OF THE IRRIGATION IN POTATO CROP IN CRIȘURILOR PLAIN

## CERCETĂRI PRIVIND INFLUENȚA IRIGAȚIEI ASUPRA CULTURII CARTOFULUI ÎN CAMPIA CRIȘURILOR

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**Abstract.** *The research were carried out in Agricultural Research and Development Station Oradea in 2007-2009, in the conditions of the luvisol Ten to ten days determinations of the soil moisture emphasize that pedological drought and also strong pedological drought were present in all the three studied years. By applying irrigation was substantially improved the daily consumption and total water consumption of potato and were obtained verystatistically significant yield increases in all the three years studied; also, has increased the weight of large tubers in total yield and the quantity of tubers obtained at 1 m<sup>3</sup> of water consumption.*

**Key words:** potato, pedological drought, irrigation, water consumption, yield, water use efficiency

**Rezumat.** *Cercetările au fost realizate la Stațiunea de Cercetare Dezvoltare Agricolă Oradea în perioada 2007-2009 în condițiile unui preluvosol. Determinările decadaale ale umidității solului au evidențiat faptul că atât seceta pedologică cât și seceta pedologică accentuată a fost prezentă în toți cei trei ani studiați. Prin aplicarea irigațiilor s-a îmbunătățit substanțial consumul zilnic și consumul total de apă al cartofului, s-au obținut sporuri de producție foarte semnificative statistic în toți cei trei ani studiați; a crescut ponderea tuberculilor mari în totalul producției, iar cantitatea de tuberculi obținută la 1 m<sup>3</sup> de apă consumată*

**Cuvinte cheie:** cartof, secetă pedologică, irigare, consum de apă, producție, eficiența valorificării apei

### INTRODUCTION

The Crișurilor Plain occupies about 410.000 ha (Domuța C., 2003, 2009) in the NorthWest of Romania (Domuța C., 2003). This area is favorable for potato (Muntean L.S. et al., 2008). The potato is one of the most demanding plant as regards the continue water supply. Considering this, from 1976 at Agricultural Research and Development Station Oradea (1976-1980) Ștefănescu E. performs a research concerning the soil water balance in irrigated and unirrigated potato crop. The researches were continued by Buta Mihaela (1981-1983), Colibaș Maria (1984-1985), Colibaș Maria and Maria Șandor (1986), and in 1987-2010 by Domuța C.; the publishing results (Grumezea N. et al. 1989; Domuța C., 1995, 2003,

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2005, 2009 a, 2009 b, Borza I. et al., 2010) sustain the need of irrigation in providing an optimum water consumption and very statistically significant yield gains determined by irrigation. This paper present researches carried out during 2007-2009.

## MATERIAL AND METHOD

The researches were carried out in the conditions of luvosoil with a high degree of structuring (47,5%). On the watering depth (0-75 cm) of potato (Brejea R., 2010) the wilting point has a value of 10.1% (1158m<sup>3</sup>/ha) and the field capacity is 24.2% (2782 m<sup>3</sup>/ha). The clay content of soil (35.2%) determined an easily available water content (19.5%; is of 2240 m<sup>3</sup>/ha) at 2/3 from useful water capacity. In A<sub>p</sub> horizon the humus content of soil is of 1.8%, pH is of 6.5 and mobile phosphorus and potassium have values of 131.2 ppm, respectively 210 ppm.

The water source for irrigation is a drilling and the water is very good for irrigations: CSR= -1.7; SAR = 0.52. The irrigation method was the sprinkler and the adapted equipment used provided an accurate measurement and a uniform distribution of water.

The soil moisture was determined 10 to 10 days, and the water reserve on the 0-75 cm depth was maintained between easily available water content and field capacity, irrigating whenever is necessary. The soil moisture data allowed the drawing of dynamic graphs of soil moisture. The graphs permit to determine the days with the pedological drought (days with the water reserve on the watering depth under easily available water content) and the days with strong pedological drought (days with the water reserve on the watering depth under the wilting coefficient level (Domuța C., 2005). The potato water consumption was determined by the balance of water in soil method (Domuța C., 2009), balance depth use was 0-150 cm. Water use efficiency (WUE) was determined such as a ratio between yield and total water consumption of potato.

## RESULTS AND DISCUSSIONS

### Pedological drought at unirrigated potato

Annual rainfall recorded in the three years studied were 556.1 mm in 2007, 585.7 mm in 2008 and 504.1 mm in 2009. In the vegetation period of potato were registered 283.1 mm in 2007, 304.4 mm in 2008 and 241.5 mm in 2009. In this conditions the pedological drought manifested in every year. Water reserve on 0-75 cm depth decreases below easily available water content in 93 days in 2007, 88 days in 2008 and 101 days in 2009. The bigger number of days with pedological drought were registered in April in 2007, in August in 2008 and in May and June in 2009 (table 1).

Table 1

**The analysis of the number of days with water reserve (WR) bellow easily available water content (Wea) on 0-75 cm depth, at unirrigated potato, Oradea 2007-2009**

Year	Vegetation period -days-	Days with WR < Wea					
		IV	V	VI	VII	VIII	Total
2007	160	26	10	15	15	17	93
2008	156	-	10	20	27	31	88
2009	147	14	31	10	31	13	101

The water reserve decreases below the wilting coefficient in 12 days in 2007, 9 days in 2008 and in 27 days in 2009 (table 2).

Table 2

**The analysis of the number of days with water reserve (WR) bellow the wilting point (WP) on 0-75 cm depth, at unirrigated potato, Oradea 2007-2009**

Year	Vegetation period - days -	Days with WR<WP					Total
		IV	V	VI	VII	VIII	
2007	160	-	4	5	3	-	12
2008	156	-	-	-	5	4	9
2009	143	-	-	4	13	10	27

#### The optimum water regime

For maintaining the water reserve on 0-75 cm between easily available water content and field capacity the following irrigation rate was used: 3000 m<sup>3</sup>/ha in 2007, 2800 m<sup>3</sup>/ha in 2008 and 3700 m<sup>3</sup>/ha in 2009 (table 3).

Table 3

**Irrigation regime necessary to maintain the water reserve between easily available water content and field capacity on the watering depth of potato (0-75 cm) Oradea, 2007-2009**

Year	V		VI		VII		VIII		V-VIII	
	Σm	n	Σm	n	Σm	n	Σm	n	Σm	n
2007	1300	3	800	2	900	2	-	-	3000	7
2008	500	1	11100	3	700	2	500	1	2800	7
2009	1000	2	700	2	1400	3	-	-	3700	9

Σm = irrigation rate; n = number of watering

#### The influence of irrigation on the potato water consumption

Irrigation determined an increase of the daily water consumption values of the plants. The biggest differences in comparison with unirrigated variante were registered in June (88%) in 2007 and in July (74%) in 2008 and 2009 (table 4).

Table 4

**The influence of irrigation on the daily water consumption, Oradea 2007-2009**

Year	Variant	April		May		June		July		August	
		m <sup>3</sup> /h a	%	m <sup>3</sup> /h a	%	m <sup>3</sup> /h a	%	m <sup>3</sup> /h a	%	m <sup>3</sup> /ha	%
2007	Unirrigated	16.1	100	23.3	100	31.0	100	33.1	100	25.7	100
	Irrigated	26.5	165	38.7	166	58.3	188	41.8	126	32.8	127
2008	Unirrigated	27.2	100	28.8	100	40.7	100	28.9	100	21.9	100
	Irrigated	28.4	104	36.9	128	56.2	138	50.2	174	25.8	118
2009	Unirrigated	24.4	100	27.6	100	36.9	100	30.2	100	25.0	100
	Irrigated	26.9	110	38.8	141	60.2	163	52.4	174	27.6	110
Average	Unirrigated	22.6	100	26.6	100	36.2	100	30.7	100	24.2	100
	Irrigated	27.3	121	38.1	143	58.2	161	48.1	157	28.7	119

Irrigation determined also an increase of the total water consumption values of potato with 53% in 2007, 41% in 2008 and 43% in 2009 (table 5).

Table 5

**The total water consumption of unirrigated and irrigated potato and the covering sources from Oradea, 2007-2009**

Variant	Total water consumption		The coverage sources of total water consumption; m <sup>3</sup> /ha		
	m <sup>3</sup> /ha	%	R <sub>i</sub> -R <sub>f</sub>	The rainfall from vegetation period	Irrigation
2007					
Unirrigated	3868	100	1037	2831	-
Irrigated	5915	153	84	2831	3000
2008					
Unirrigated	4237	100	1193	3044	-
Irrigated	5975	141,0	131	3044	2800
2009					
Unirrigated	4314	100	1899	2415	-
Irrigated	6174	143	59	2415	3700

R<sub>i</sub> = Initial reserve of the water (at planting); R<sub>f</sub> = Final reserve (at harvest)

#### The influence of irrigation on the potato yield

In all the three years studied, the irrigation determined an yield gains very significant statistically. In 2007 the yield gain obtained in irrigated variant comparative with unirrigated variant was of 111%. An yield gain more higher registered in 2008, of 119%. The highest yield gain (21340 kg/ha; 210%) was obtained in 2009. In average of the studied period, the yield obtained in irrigated variant (34200 kg/ha) was higher with 137.2% (19780 kg/ha) than the yield obtained in unirrigated variant (table 6).

Table 6

**The influence of the irrigation on potato yield, Oradea 2007-2009**

Variant	Yield		Difference		Statistical signification
	Kg/ha	%	Kg/ha	%	
2007					
Unirrigated	17600	100	-	-	Control
Irrigated	37100	211	19500	111	***
LSD <sub>5%</sub> 270		LSD <sub>1%</sub> 490		LSD <sub>0.1%</sub> 830	
2008					
Unirrigated	15500	100	-	-	Control
Irrigated	34000	219	18500	119	***
LSD <sub>5%</sub> 430		LSD <sub>1%</sub> 690		LSD <sub>0.1%</sub> 1070	
2009					
Unirrigated	10160	100	-	-	Control
Irrigated	31500	310	21340	210	***
LSD <sub>5%</sub> 510		LSD <sub>1%</sub> 720		LSD <sub>0.1%</sub> 1150	
Media 2007-2009					
Unirrigated	14420	100	-	-	Control
Irrigated	34200	237.2	19780	137.2	***
LSD <sub>5%</sub> 403		LSD <sub>1%</sub> 633		LSD <sub>0.1%</sub> 1017	

The participation of the big tubers in total yield increase very significant statistically in the irrigated variant in comparison with the unirrigated, the differences being 13,1% in 2007, 16,3% in 2008 and 21.2% in 2009 (table 7).

Table 7

**The influence of irrigation on the participation of the great tubers in the potato yield, Oradea 2007-2009**

Variant	Great tubers		Difference		Statistical signification
	%	%	%	%	
2007					
Unirrigated	73.2	100	-	-	Control
Irrigated	82.8	113,1	9.6	13.1	***
LSD 5% 2.3		LSD 1% 4.6		LSD 0.1% 7.9	
2008					
Unirrigated	72.6	100	-	-	Control
Irrigated	84.5	116.3	11.9	16.3	***
LSD 5% 3.1		LSD 1% 5.2		LSD 0.1% 9.4	
2009					
Unirrigated	70.1	100	-	-	Control
Irrigated	85.0	121.2	14.9	21.2	***
LSD 5% 2.9		LSD 1% 5.1		LSD 0.1% 8.2	
Media 2007-2009					
Unirrigated	72.0	100	-	-	Control
Irrigated	84.1	116.8	12.1	16.8	***
LSD 5% 2.8		LSD 1% 5.0		LSD 0.1% 8.5	

#### The influence of irrigation on the water use efficiency

The irrigation determined the increase of the quantity of tubers at 1 m<sup>3</sup> consumed water, the differences from unirrigated being 38% in 2007, 55% in 2008 and 24% in 2009 (table 8).

Table 8

**The influence of irrigation on the water use efficiency (WUE) at potato, Oradea 2007-2009**

Variant	WUE		Difference	
	Kg/ m <sup>3</sup>	%	Kg/ m <sup>3</sup>	%
Unirrigated	4.55	100	-	-
Irrigated	6.27	138	1.72	38
Unirrigated	3.66	100	100	-
Irrigated	5.69	155	2.03	55
Unirrigated	4.65	100	-	-
Irrigated	5.78	124	1.13	24

## CONCLUSIONS

1. At unirrigated potato the pedological drought was present in 93 days in 2007, 88 days in 2008 and 101 days in 2009. The strong pedological drought was present in 12 days in 2007, 9 days in 2008 and 27 days in 2009.

2. For maintaining the soil water reserve on 0-75 cm between easily available water content and field capacity a specifically irrigation regime was used; the irrigation rate use were of 3200 m<sup>3</sup>/ha in 2007, 2800 m<sup>3</sup>/ha in 2008 and 3500 m<sup>3</sup>/ha in 2009.

3. The irrigation determined the increase of the daily water consumption of potato and finally the increase of the total water consumption with 35% in 2007, 29% in 2008 and 42% in 2009.

4. The irrigation determined yield gains very significant statistically every year; the relative differences in comparison with unirrigated variant were of 111% in 2007, of 119% in 2008 and of 210% in 2009.

5. The yield quantity of the tubers obtained at 1 m<sup>3</sup> consumed water increased in irrigated variant in comparison with unirrigated variant with 38% in 2007, 55% in 2008 and with 24% in 2009.

6. The presence of pedological drought in all the three years studied and the positive influence of the irrigation on the daily consumption and total water gains consumption, the very significant statistically yield, the improvement of the great tubers percent in the total yield and the gains increase of the water use efficiency are important arguments for the potato irrigation in the Crișurilor Plain.

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