CROP ROTATION AND IRRIGATION INFLUENCE ON PROTEIN AND GLUTEN CONTENT OF THE WHEAT GRAINS IN THE CRIŞURILOR PLAIN CONDITIONS

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Abstract: *The paper is based on the researches carried out during 2007-2009 in the long term trial placed in 1990 on the preluvosoil from Agricultural Research and Development Station Oradea. The preluvosoil from the research field is characterized by the presence of the horizons Bt_1 (34-54 cm depth) and Bt_2 (54-78 cm depth); the colloid clay eluviation determined to appear the El horizon with 31.6% colloid clay. On 0-20 cm depth, the soil has a big percentage of macroagregates (Φ > 0.25 mm), 47.5% bulk density is of 1.41 g/cm^3 and total porosity is median one, hydraulic conductivity is of 21.0 mm/h. The values of the pH indicates a low acid soil, humus, total nitrogen, phosphorus and potassium content are low. The source of irrigation water was a drill of 15 m depth. The chemical parameters of the irrigation water were the following: fixed mineral residue 0.5 g/l; SAR index 0.52; CSR index= -1.7%; N. Florea class = II; there are not some problemes regarding the use of irrigation use.There are two factors of the experiment: crop rotation (wheat-monocrop, maize-wheat; maize-soybean-wheat) and water regime (unirrigated; irrigated). Optimum water provisionment was assured in the irrigated variant maintaining the soil water reserve between easily available water content on 0-50 cm depth. The biggest protein and gluten content were determined in the wheat grains from maize-soybean-wheat crop rotation both in unirrigated and irrigated variant and the smallest values were registered in the wheat monocrop. In the irrigated variant the smaller values protein, wet and dry gluten were registered but the differences are unsignificant. The research results emphasized the importance ogf the crop rotation to obtain an wheat yield with good panification index. The research results are part in the project: PN–II–ID–PCE–2008 2; 690/2009"The study of influences of some technological elements upon the wheat yield quality in the conditions of the North-Western part of Romania".*

Key words: *wheat, crop rotation, yield, protein content, gluten content, irrigation*

INTRODUCTION

The importance of the crop rotation on the quantity and on the quality of the yield is well-knwon (DINCĂ D., 1982, BUDOI GH., PENESCU A., 1996; GUŞ P. şi colab., 1998; Bandici Gh., 1998; DOMUȚA C., 1995, 2005, ARDELEAN I. 2006). The paper presents the results of the research regarding the influences of the crop rotation and of the irrigation in an experiment from the Crişurilor Plain that lasted 18 years. The results regarding the level of the yield and protein, gluten, content, fall index and deformation index are emphasized.

MATERIAL AND METHODS

The investigations were carried out in Oradea on a preluvosoil with the pH value of 6.8, having 1.75% of humus content, 22.0 ppm and 145.4 ppm for the phosphorus and potassium contents. The hydrostability of the macro-aggregates on the ploughed depth was high (47.5%) and the total porosity was medium (46%). The bulk density was high on all the soil's profiles. (1.41-1.65 g/cm3). The field capacity and the wilting point had medium values

in all soil profile (23.6 – 25.1 % respectively 9.2-14.2 %) and the easily available water content was established at 2/3 from the difference between the field capacity and the wilting point.

The experiment started in 1990 and the factors studied are: Factor A: crop rotation: a1 – wheat, monocrop; a_2 - wheat-maize; a_3 – wheat – maize – soybean; Factor B: water regime: b_1 – unirrigated; b_2 – irrigated, maintaining the soil water reserve on the watering depth (0-50 cm for wheat) between the easily available water content and the field capacity.

Protein and gluten, wet gluten were determined using the usual methods.

RESULTS AND DISCUSSIONS

The annual rainfall in the 2007 year was of 556.1 mm and in the 2008 year was of 585.7 mm; the rainfall of 134.3 mm and of 174.3 mm were registered during April-June period; the average of temperatures for the period April-June were of 17.5°C in 2007 and of 16.5 °C in 2008 (table 1)

Table 1

Climate elements of the agricultural year 2007 and 2008
(after meteorological station Oradea)

Speciffication	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	Summ Average
Air temperature °C													
Agricultural year 2007	11,2	6,6	2,3	4,3	4,7	8,7	12,2	18,2	22,2	23,6	22,3	14,4	12,6
Agricultural year 2008	10,3	3,7	-0,4	1,4	3,4	6,5	11,6	16,9	21,0	20,9	22,0	15,4	11,0
Multiannual average*	10,7	5,3	0,6	-2,0	0,3	5,0	10,4	15,8	19,0	20,8	20,3	16,2	10,2
Rainfall, mm													
Agricultural year 2007	24,4	27,4	9,7	36,8	69,3	13,0	3,2	80,6	50,5	67,6	82,4	91,2	556,1
Agricultural year 2008	75,1	62,6	29,4	21,3	12,5	67,9	43,3	38,9	92,1	69,3	27,3	46,0	585,7
Multiannual average*	39,9	48,9	50,2	34,5	38,8	34,3	46,6	61,6	84,7	71,5	58,3	45,8	615,1
Air humidity, %													
Agricultural year 2007	70	79	84	79	81	63	46	61	59	53	63	72	66
Agricultural year 2008	77	82	86	82	74	71	67	65	68	67	61	67	72
Multiannual average*	79	84	88	85	86	77	72	72	73	69	71	75	78

* - 1936-2006

The influence of the crop rotation and irrigation on the wheat yield quantity

In 2007, in both unirrigated and irrigated conditions, the smallest yield wheat were obtained in wheat monocrops, 4310 kg/ha and 4960 kg/ha. In wheat maize crop rotation the yields increased with 33.6% and with 30.2%. the biggest yields were obtained in the wheat-maize-soybean crop rotation, the differences were of 62.6% and of 59.8% compared to the wheat monocrop.

The drought in 2008 determined an yield level smaller than in 2006. In unirrigated conditions, in wheat monocrop the yield was of 1310 kg/ha and in irrigated conditions of 2970 kg/ha. In the wheat – maize crop rotation the yield increased with 89.3% and with 69%; the increase in the wheat-maize-soybean crop rotation was of 157% and of 129.2 % (table 2)

Table 2

The influence of the crop rotation and irrigation on the wheat yield in a long term trial, Oradea 2007-2008

Crop rotation	Yield, kg/ha		Average on crop rotation
	Unirrigated	Irrigated	
2007			
Wheat – monocrop	4310	4960	4635
Wheat – maize	5760	6460	6110
Wheat-maize-soybean	7010	7930	7460
Average on regime	5693	6450	-

	Crop rotation	Water regime	Water regime x crop rotation	Crop rotation x water regime
LSD 5%	176	129	192	212
LSD 1%	310	204	330	326
LSD 0.1%	524	374	542	512

2008				
Wheat – monocrop	1310	2970		2140
Wheat – maize	2480	5020		3750
Wheat-maize-soybean	3370	6810		5090
Average on regime	2390	4933		-

	Crop rotation	Water regime	Water regime x crop rotation	Crop rotation x water regime
LSD 5%	180	130	190	172
LSD 1%	320	220	340	310
LSD 0.1%	540	410	560	496

The influence of the crop rotation and irrigation on the protein content of the wheat grains

In 2007, the smallest content of protein was registered in wheat monocrop, 7.1% in unirrigated conditions. In the wheat-maize crop rotation, the protein content of the grains increased with 45% in unirrigated conditions and with 46% in irrigated conditions. In wheat-maize-soybean, the increase was bigger compared to the wheat monocrop: 73% and 77% (table 3)

Table 3

The influence of the crop rotation and irrigation on the protein content (%) of the wheat grains in a long term trial, Oradea 2007-2008

Crop rotation	Protein content				Average on crop rotation
	Unirrigated		Irrigated		
	%	%	%	%	
2007					
Wheat – monocrop	7.1	100	6.9	100	7.0
Wheat – maize	10.3	145	10.1	146	10.2
Wheat-maize-soybean	12.3	173	12.2	177	12.25
Average on regime	9.9	100	9.73	98.2	-

	Crop rotation	Water regime	Water regime x crop rotation	Crop rotation x water regime
LSD 5%	0.8	0.5	1.1	1.0
LSD 1%	1.6	1.2	2.5	2.3
LSD 0.1%	3.2	2.9	4.9	4.3

2008					
Wheat – monocrop	9.0	100	8.8	100	8.9
Wheat – maize	10.9	121	10.6	120	10.8
Wheat-maize-soybean	12.7	141	12.2	139	12.5
Average on regime	10.9	100	10.5	96	-

	Crop rotation	Water regime	Water regime x crop rotation	Crop rotation x water regime
LSD 5%	0.7	0.4	0.9	0.8
LSD 1%	1.3	1.0	2.2	1.9
LSD 0.1%	2.7	2.5	3.8	3.7

The protein content determined in 2008 was bigger than in 2007, in all the variants. The smallest values were registered in the wheat monocrop, too: 9% in the unirrigated variant

and 8.8% in the irrigated variant; in the wheat-maize crop rotation , the values of the protein content increased with 21.1% and 20.5% and in the wheat-maize-soybean crop rotation the biggest differences registered were 41.1% and 38.6% (table 3).

The influence of the crop rotation and of the irrigation on the gluten content

In 2007, the smallest values of the gluten content were registered in wheat monocrop, 9.5% in the irrigated variant and 9.3% in the unirrigated variant. In the wheat-maize crop rotation, the values of the gluten content increased with 23.3% and with 38% and 39% in the wheat-maize-soybean crop rotation (table 4)

The values of the gluten content in 2008 was bigger than in 2007 in all the variants. The smallest values were registered in wheat-monocrop, too: 10.7% in the unirrigated and 10.4% in the irrigated variant. In the wheat-maize crop rotation, the values increased with 19% and 20% and in the wheat-maize soybean crop rotation with 35% and 37% (table 4)

Table 4

The influence of the crop rotation and irrigation on the wheat grains' gluten in a long term trial, Oradea 2007-2008

Crop rotation	Dry gluten				Average on crop rotation
	Unirrigated		Irrigated		
	%	%	%	%	
2007					
Wheat – monocrop	9.5	100	9.3	100	9.4
Wheat – maize	11.7	123	11.4	123	11.55
Wheat-maize-soybean	13.1	138	12.9	139	13.00
Average on regime	11.4	100	11.2	98.2	-
	Crop rotation		Water regime	Water regime x crop rotation	Crop rotation x water regime
LSD 5%	0.97		0.71	1.21	1.19
LSD 1%	1.76		1.22	2.12	2.08
LSD 0.1%	2.91		2.29	4.02	3.79
2008					
Wheat – monocrop	10.7	100	10.4	100	10.5
Wheat – maize	12.8	119	12.5	120	12.7
Wheat-maize-soybean	14.4	135	14.2	137	14.3
Average on regime	12.6	100	12.4	98	-
	Crop rotation		Water regime	Water regime x crop rotation	Crop rotation x water regime
LSD 5%	0.84		0.63	0.96	0.90
LSD 1%	1.53		1.12	1.84	1.72
LSD 0.1%	2.64		2.08	3.24	2.96

CONCLUSIONS

The researches carried out in 2007 and 2008 in a long term trial placed in 1990 on the preluvosoil from Oradea emphasized the need for using crop rotation in wheat because the smallest yields were obtained in wheat monocrop. The wheat-maize crop rotation and especially the wheat-maize-soybean crop rotation determined important yield gains, all of them being statistically assured.

The smallest values of the protein, and gluten, deformation index and fall index were obtained in wheat monocrop. The wheat-maize crop rotation determined bigger values and differences that were statistically assured. The biggest differences compared to wheat monocrop were registered in the wheat-maize-soybean crop rotation.

Irrigation with maintaining the soil water reserve on the watering depth (0-50 cm) between the easily available water content and the field capacity determined the yield gains very significant, in all the variants. The yield quality indexes had smaller values in the irrigated

variants in comparison with the unirrigated variants but the differences were unsignificant statistically.

The results regarding the yield's quality and quantity emphasized the huge importance of the crop rotation in wheat crops and sustain the need for irrigation in the wheat crops from the Crisurilor Plain.

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