CROP ROTATION INFLUENCE ON THE WHEAT YIELD'S QUANTITY AND QUALITY IN THE CRISURILOR PLANE

INFLUENȚA ROTAȚIEI CULTURII ASUPRA CANTITĂȚII ŞI CALITĂȚII PRODUCȚIEI DE GRÂU ÎN CÂMPIA CRIŞURILOR

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Abstract: *The paper is based on the researches carried out in an experiment set up in 1990 in Oradea, on a preluvosoil. The experience has two factors – factor A is crop rotation (a1 – wheat monocrop, a2 – wheat, maize; a3 – wheat – maize - soybean) and the B factor is the water regime (b1 – unirrigated, b2 – irrigated) with maintaining the soil water reserve between the easily available water content and field capacity on watering depth (0 – 50cm). The researches carried out between 2005 – 2007 have shown the smallest of the gross protein content, wet gluten, dry gluten, deformation index and fall index registered in the wheat monocrop. In the wheat-maize crop rotation the values of the quality indexes have improved, the differences were statistically assured. The biggest values of these indexes were obtained in the wheat – maize – soybean crop rotation, the differences when reported to monocrop being very significant in all the studied years, in the conditions in which, in the durable agricultural system is the central pivot, and the researches carried out show the importance of the crop rotation with a large number of plots and the importance of the soybean crop as a forerunner for wheat, it's effects being positive on the both on the quantity and the quality of the wheat yield, as well as the protein, dry gluten, wet gluten content, fall index and the deformation index.*

Rezumat: *Lucrarea se bazează pe cercetările efectuate în experiența înființată în 1990 pe preluvosolul de la Oradea. Experiența are doi factori: factorul A, rotația culturilor (a1- grâu monocultură, a2 – grâu – porumb, a3 – grâu - porumb-soia) şi factorul B, regimul de irigare (b1 –neirigat, b2-irigat). În cadrul experienței se asigură menținerea rezervei de apă din sol între plafonul minim şi capacitatea de câmp, pe adâncimea de udare (0-75 cm). Cercetările s-au efectuat în perioada 2005-2007 şi evidențiază conținutul minim de proteine, gluten umed, gluten uscat la grâul monocultură şi valorile minime ale indicelui de deformare şi ale indicelui de cădere înregistrate la aceeaşi cultură. În cazul rotației grâu-porumb, valorile indicilor de calitate au fost mai bune decât cele înregistrate la grâu monocultură, diferențele fiind asigurate statistic. Cele mai mari valori ale indicilor au fost obținute în cazul rotației grâu-porumb-soia, diferențele raportate la valorile obținute în monocultură fiind foarte semnificative în toți anii studiați. În condițiile în care asolamentul este pivotul central al unui sistem de agricultură durabil, cercetările efectuate au evidențiat importanța acestuia. De asemenea, având ca suport un număr mare de loturi demonstrative, cercetările au evidențiat importanța culturii de soia ca plantă premergătoare grâului, efectele fiind pozitive atât pentru calitatea, cât şi pentru cantitatea producției, precum şi pentru conținutul în proteine, gluten umed sau gluten uscat. Efecte pozitive s-au înregistrat şi în cazul indicilor de deformare şi de cădere.*

Key words: *crop rotation, dry gluten, wet gluten, protein, fall index, deformation index, wheat*
Cuvinte cheie: *rotația culturilor, gluten uscat, gluten umed, indice de cădere, indice de deformare, grâu*

INTRODUCTION

The importance of the crop rotation on the quantity and on the quality of the yield is well-known (DINK D., 1982, BOUDOIR GHz., SENESCE A., 1996; GUS P. IF COLA., 1998;

BANDAI GHz., 1998; DOMICAL C., 1995, 2005). 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 Plane that lasted 18 years. The results regarding the level of the yield and protein, gluten, content, fall index and deformation index are emphasized.

MATERIALS 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; a2 - wheat-maize; a3 – wheat – maize – soybean; Factor B: water regime: b1 – unirrigated; b2 – 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.

In 2006 and 2007 in the wheat vegetation period from spring and summer 287.2 mm and 143.4 mm rainfall were registered. The irrigation rate used was of 40.0 mm in 2006 and of 325.0 mm in 2007.

Protein, dry gluten, wet gluten, fall index, deformation index were determined using the usual methods.

RESULTS AND DISCUSSION

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

In 2006, 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 2007 determined a 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 1)

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

In 2006, 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 2)

The protein content determined in 2007 was bigger than in 2006, 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 2).

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

In 2006, 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 3)

Table 1

The influence of the crop rotation and irrigation on the wheat yield in a long term trial, Oradea 2006-2007

Crop rotation	Protein content		Average on crop rotation
	Unirrigated	Irrigated	
2006			
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

2007			
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

Table 2

The influence of the crop rotation and irrigation on the protein content (%) of the wheat grains in a long term trial, Oradea 2006-2007

Crop rotation	Protein content				Average on crop rotation
	Unirrigated		Irrigated		
	%	%	%	%	
2006					
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

2007					
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 values of the gluten content in 2007 were bigger than in 2006 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 3)

Table 3

The influence of the crop rotation and irrigation on the wheat grains' gluten in a long term trial, Oradea 2006-2007

Crop rotation	Dry gluten				Average on crop rotation
	Unirrigated		Irrigated		
	%	%	%	%	
2006					
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

2007					
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

The influence of the crop rotation and irrigation on the deformation index

In 2006, the smallest values of the deformation index were registered in wheat monocrop, 20.0% in the unirrigated variant and 19.8% in the irrigated variant. In the wheat-maize crop rotation the values of the deformation index increased with 9% and in the wheat-maize-soybean crop rotation

The values of the deformation index in 2007 were bigger than in 2006. The smallest values were registered in wheat monocrop, 22.2 mm in the unirrigated variant and 21.9 mm in the irrigated variant. In the wheat-maize crop rotation, the values of the deformation index increased with 4% and 3% and in the wheat-maize-soybean crop rotation with 10% and 9% (table 4).

The influence of the crop rotation and irrigation on the fall index

The smallest values of the fall index from 2006 were registered in the wheat monocrop, 188 seconds in unirrigated conditions, and 180 seconds in irrigated conditions. In the wheat-maize crop rotation, the values of the fall index increased with 28% and 29% and in the wheat-maize-soybean crop rotation with 55% and 51% (table 5).

Table4

The values of the deformation index under the influence of the crop rotation and irrigation in a long term trial, Oradea 2006-2007

Crop rotation	Fall index				Average on crop rotation
	Unirrigated		Irrigated		
	mm	%	mm	%	
2006					
Wheat – monocrop	20.0	100	19.8	100	19.9
Wheat – maize	21.3	109	21.0	109	21.15
Wheat-maize-soybean	22.9	117	22.4	117	22.65
Average on regime	21.5	100	21.1	98.1	-

	Crop rotation	Water regime	Water regime x crop rotation	Crop rotation x water regime
LSD 5%	0.85	0.4	1.3	1.1
LSD 1%	1.7	0.9	2.0	1.9
LSD 0.1%	2.1	1.7	3.4	2.7

2007					
Wheat – monocrop	22.2	100	21.9	100	22.1
Wheat – maize	23.1	104	22.6	103	22.8
Wheat-maize-soybean	24.4	110	24.0	109	24.2
Average on regime	23.2	100	22.8	98	-

	Crop rotation	Water regime	Water regime x crop rotation	Crop rotation x water regime
LSD 5%	0.85	0.4	1.3	1.1
LSD 1%	1.7	0.9	2.0	1.9
LSD 0.1%	2.1	1.7	3.4	2.7

Table 5

The influence of the crop rotation and irrigation on the fall index in wheat in a long term trial, Oradea, 2006-2007

Crop rotation	Fall index				Average on crop rotation
	Unirrigated		Irrigated		
	Seconds	%	Seconds	%	
2006					
Wheat – monocrop	188	100	180	100	184
Wheat – maize	240	128	232	129	236
Wheat-maize-soybean	291	155	280	151	286
Average on regime	240	100	230	96	-

	Crop rotation	Water regime	Water regime x crop rotation	Crop rotation x water regime
LSD 5%	7	5	9	8
LSD 1%	19	14	21	19
LSD 0.1%	39	29	56	47

2007					
Wheat – monocrop	208	100	200	100	204
Wheat – maize	262	126	250	125	256
Wheat-maize-soybean	308	148	298	149	303
Average on regime	259	100	249	96	-

	Crop rotation	Water regime	Water regime x crop rotation	Crop rotation x water regime
LSD 5%	5	4	8	6
LSD 1%	14	11	17	15
LSD 0.1%	27	21	32	28

CONCLUSIONS

The researches carried out 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, dry 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, statistically speaking, 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 insignificant 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 Plane.

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