RESEARCHES REGARDING THE CROP ROTATION INFLUENCE ON PROTEIN CONTENT OF THE YIELD MAIZE IN THE CRIŞURILOR PLAIN CONDITIONS

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Abstract

The paper based on the researche carried out in the Agricultural Research and Development Station Oradea in the long term trial placed in 1990 on a preluvosoil. Two factors were studied: crop rotation (maize-monocrop; maize-wheat; maize-soybean-wheat) and water regime (unirrigated and irrigated). In comparison with unirrigated and irrigated monocrop, in the maize-wheat crop and especially in the maize-soybean-wheat crop rotation very significant yield gains were obtained all the three years. The irrigation determined the yield gains very significant statistically every year and in every crop rotation.

The smallest protein content and protein production were registered in the variant with maize monocrop and the biggest in the variant with wheat-maize-soybean crop. The irrigation determined the increase of the protein content.

Key words: crop rotation, irrigation, maize, yield, protein content

INTRODUCTION

The crop rotation is one of the factors with influence on the protein content of the maize grains (Cristea, 2004, Domuţa, 2010, Muntean et al., 2008, Şandor, 2008). The researches from Crişurilor Plain about crop rotation influence on yield maize emphasized the differences statistically assured in comparison with maize monocrop in the wheat maize crop rotation and the biggest differences in the maize-soybean-wheat crop rotation (Borza, 2006, 2007). Other researches (Domuţa 2006a, 2007, 2008) demonstrated a higher level of the protein content in the maize grains from irrigated variant in comparison with unirrigated variant. Our researches study the separate and combinate influence of the crop rotation and irrigation on level and quality of the yield based on the researches

MATERIAL AND METHODS

The research 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/cm^3). 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: a_1 – maize, monocrop; a_2 - maize-wheat; a_3 maize–wheat- soybean; Factor B: water regime:

b_1– unirrigated; b_2 – irrigated, maintaining the soil water reserve on the watering depth (0-75 cm for maize between the easily available water content and the field capacity.

Protein content in maize was determined using the usual methods in the laboratory of the Agricultural Research and Development Station Oradea.

The results researches was calculated using the variance analysis method (Domuța, 2006b)

RESULTS AND DISCUSSIONS

The research period was characterized by rainfall bigger than multiannual average in 2006 (684.0 mm vs. 615.1 mm) and smaller than multiannual average in 2007 and 2008 (556.1 mm and 585.7 mm vs 615.5 mm). In all the three year, the annual average temperature was situated over the multiannual average. The air humidity had the values smaller than multiannual average in the all three years.

The crop rotation and irrigation influence on maize yield level

In 2006, the smallest yields were obtained in the maize monocrop both in unirrigated conditions (4970 kg/ha), and in irrigated conditions (7560 kg/ha). The maize-wheat crop rotation determined the increase of the yields with 20% and 19% very significant statistically. The biggest yields were obtained in the maize-soybean-wheat crop rotation both in the irrigated and in the irrigated variant, 46%. The irrigation determined the yield gains very significant statistically in the all three crop rotation; in average on the crop rotation, the yield gains was of the 52%, very significant statistically.

The yields obtained in 2007 were smaller than the yields obtained in 2006, but the differences in comparison with maize monocrop were bigger than the differences registered in 2006.

The biggest yields both in the unirrigated conditions and in the irrigated conditions were registered in 2008. Relative differences in comparison with maize manocrop were the smallest from the studied period: 15.6% in unirrigated conditions and 17.8% in irrigated conditions in maize-wheat crop rotaion in 2007, 44% respectively 27.1% in maize-wheat-soybean crop rotation in 2008. (table 1)

Table 1

Crop rotation and water regime influence on maize yield (kg/ha), Oradea 2006 -2008

Crop rotation	Water regime				Average on the crop rotation	
	Unirrigated		Irrigated			
	kg/ha	%	kg/ha	%	kg/ha	%
2006						
Maize -monocrop	4970	100	7560	100	6270	100
Maize -wheat	5940	120	8980	119	7460	119
Maize-wheat-soybean	7260	146	11040	146	9150	146
Average on the regime	606	100	9190	152	-	-

	Crop rotation	Water regime	Water regime x Crop rotation	Crop rotation x Water regime
$LSD_{5\%}$	230	120	210	190
$LSD_{1\%}$	390	230	360	310
$LSD_{0,1\%}$	580	490	520	470

2007						
Maize -monocrop	3020	100	6100	100	4560	100
Maize -wheat	4320	143	8760	144	6540	143
Maize-wheat-soybean	5240	174	10300	169	7770	170
Average on the regime	4190	100	839	200	-	-

	Crop rotation	Water regime	Water regime x Crop rotation	Crop rotation x Water regime
$LSD_{5\%}$	250	140	240	200
$LSD_{1\%}$	390	300	410	340
$LSD_{0,1\%}$	560	450	630	520

2008						
Maize -monocrop	6190	100	9900	100	8045	100
Maize -wheat	7160	115.6	11670	117.8	9445	117
Maize-wheat-soybean	8910	144	12710	128.3	10810	134
Average on the regime	7420	100	11426	154	-	-

	Crop rotation	Water regime	Water regime x Crop rotation	Crop rotation x Water regime
$LSD_{5\%}$	250	180	310	280
$LSD_{1\%}$	390	260	560	430
$LSD_{0,1\%}$	610	410	990	760

In average on the studied period, in comparison with maize monocrop, in the maize-wheat crop rotation the relative yield gains of 23% and 25% were obtained in unirrigated conditions; the differences determined in the variant with maize-wheat-soybean crop rotation were biggest: 51% in unirrigated conditions and 44% in irrigated conditions. The irrigation determined the yield gains very significant statistically every year, in average on the studied period the difference in comparison with unirrigated variant was of 64% (table 2)

Table 2

The influence of the crop rotation and irrigation on maize yield (kg/ha), Oradea 2006-2008

Crop rotation	Water regime				Average on the crop rotation	
	Unirrigated		Irrigated			
	kg/ha	%	kg/ha	%	kg/ha	%
Maize -monocrop	4730	100	7850	100	6290	100
Maize -wheat	5810	123	9800	125	7810	125
Maize-wheat-soybean	7140	151	11350	144	9250	147
Average on the regime	5890	100	9670	164	-	-

	Crop rotation	Water regime	Water regime x Crop rotation	Crop rotation x Water regime
$LSD_{5\%}$	250	140	230	210
$LSD_{1\%}$	370	250	410	320
$LSD_{0,1\%}$	610	510	605	540

The crop rotation and irrigation influence on protein content

In 2006 the smallest content of the protein was registered in the maize monocrop: 8.27% in unirrigated variant and 10.09% in irrigated conditions. In the wheat-maize crop rotation the protein content increased with 6.4% in unirrigated variant and with 7.8% in irrigated variant. The biggest protein content was registered in the maize-wheat-soybean; the differences in comparison with maize monocrop were of 19.7% in unirrigated variant and of 23.8% in irrigated variant. The same sense of the differences were registered in 2007 and 2008 but the absolute values of the protein content were smaller than 2006 (table 3).

Table 3

Crop rotation influence on protein content (%) of the grains in unirrigated and irrigated maize, Oradea 2006-2008

Variant	Water regime			
	Unirrigated		Irrigated	
	%	%	%	%
2006				
Maize -monocrop	8.27	100	10.09	100
Maize -wheat	8.80	106.4	10.88	107.8
Maize-wheat-soybean	9.90	119.7	12.26	123.8
2007				
Maize -monocrop	7.0	100	9.16	100
Maize -wheat	7.40	105.7	10.02	109.3
Maize-wheat-soybean	9.02	128.8	11.12	121.4
2008				
Maize -monocrop	6.75	100	9.02	100
Maize -wheat	7.18	106.4	9.98	110.6
Maize-wheat-soybean	8.86	131.2	11.38	126.2

The protein production obtained from the maize grains had the smallest values in the maize monocrop; in the maize-wheat crop rotation the protein production is bigger and in the maize-wheat-soybean crop rotation the biggest protein productions were obtained both in unirrigated and irrigated variant (table 4)

Table 4

Crop rotation influence on protein production of the unirrigated and irrigated maize, Oradea 2006-2008

Variant	Water regime			
	Unirrigated		Irrigated	
	Protein			
	Kg/ha	%	Kg/ha	%
2006				
Maize -monocrop	411	100	763	100
Maize -wheat	523	127	977	128
Maize-wheat-soybean	719	175	1353	177
2007				
Maize -monocrop	211	100	559	100
Maize -wheat	320	152	894	160
Maize-wheat-soybean	473	224	1145	205
2008				
Maize -monocrop	418	100	892	100
Maize -wheat	518	123	1164	131
Maize-wheat-soybean	789	189	1446	162

CONCLUSION

The paper based on the researches carried out during 2006-2008 in the experiment placed on the preluvosoil from Agricultural Research and Development Station Oradea in 1990 and the following conclusions were made:

- The smallest yields maize were obtained in the maize monocrop all the three years. In the maize –wheat crop rotation and especially in the maize-wheat-soybean crop rotation a bigger yields, very significant statistically, were obtained.
- The irrigation, maintaining soil water reserve on the watering depth (0-75 cm) between easily available water content and field capacity determined the yields gains very significant statistically, every year.
- The protein content of the maize grains from maize-wheat crop rotation and especially from maize-wheat-soybean crop rotation had bigger values than the values from maize monocrop. As well the protein production were bigger and relative differences were bigger than the differences between gross yield.
- The irrigation determined the improve of the protein content in the all crop rotation studied.

The yield gains, and the improve of the grains protein content, sustain the importance of the crop rotation and of the irrigation in the maize technology from Crişurilor Plain.

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