THE INFLUENCE OF THE CROP ROTATIONS AND FERTILIZERS ON WINTER WHEAT YIELD IN THE CONDITIONS FROM ORADEA

Oşvat Marius*, Domuţa Cornel, Jude Eugen*

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea; Romania, e-mail: mariusosvat@yahoo.com

Abstract

The paper is based on the research carried out during 2012-2014 on the preluvosoil from Agricultural Research and Development Station Oradea.The years of experiment were very different climatical conditions point of view. In average on the wheat+clover-maize-maize, the winter wheat yields were bigger than yields obtained in the wheat-maize crop rotation with 17% in the year 2012, with15% in 2013 and with 9% in rainy year 2014. In comparison with the control N_0P_0 in the variants with $N_{60}P_{40}$, $N_{90}P_{60}$ and$N_{120}P_{90}$ the yield incresed constantly The use of the potassium in every variant determined the yields gains in comparison with N_0P_0 agrofonds. In average on the crop rotation the potassium use determined the yield gains of 13% in 2012, of 11% in 2013 and 6 % in the year 2014.

Keywords: winter wheat, crop rotation, irrigation, yield, fertilizers

INTRODUCTION

In countries with advanced agriculture research about crop rotation performed in stationary experiments exceed 100 years. At Rothamstad, England, John Bennet Lawes in 1843 and Henry Gilbert established the Agricultural Experimental Station and famous experience with crop rotations and fertilizer (Budoi, 1996). Other long-term experience of over 100 years there in Woburn (England), Halle (Germany), Askov in Denmark.

In Romania, the first experiences with crop rotations were made after the establishment of the Romanian Institute for Agronomic Research but for various reasons this researches did not have continuity (Bilteanu, 2003; Borceanu et al. 2006).So, now lasting experiences are older than 50 years (ARDS Şimnic), 40 years (ARDS), 30 years (Moara Domneasca), Oradea (Vasiliu, 1959; Neamtu, 1996).

In Oradea, Colibas I. and Colibaş Maria were placed in 1981 experience with two levels of agricultural technology and scarification. Agrotechnical levels include a medium-level represented by crop rotation wheat-maize and fertilizer with $N_{60}P_{45}$ and a higher level consisting of a 6-year of crop rotation with clover and fertilization with N_{120}+P_{90}+50 t/ha manure (Gus et al. 2004; Hera et al., 1975). Research results obtained highlight superior values of the chemical, physical and biological parameters of soil in crop rotation and scarified with superior agricultural

technology and a higher level of production. Others experiments with crop rotation were placed by Colibaș I. and Colibaș M. (1984) in Pocola, by Zăhan P. in Oradea, by Domuța C. (1990) in Beiuș, by Domuța C. (1990) in irrigated conditions from Oradea. Since 1990 Domuta C. continues research and placed new experimental devices in the experimental field from Oradea.

MATERIAL AND METHOD

The researches were made at Agricultural Research and Development Station from Oradea in the preluvosoil conditions, in the experiment field made in 1999 by Domuta C.

Main physical and hydrophysical properties

Preluvosoil from the research field is characterized by a very high hydro stability of soil aggregates more than 0,25 mm, 47,5% of layer by 0-20 cm. The soil had a total medium porosity at depth by 0-20 cm, 20-40 cm, 40-60 cm and less in depth by 6-80 cm, 80-100 cm and 100-150 cm. Total porosity values decrease on the soil profile from the surface to depth. Hydraulic conductivity is high on the depth 0-20 cm, medium on depth by 20-40 cm and 40 cm, low and very low on the following depths studied.

Bulk density - 1.41 g/cm3 - characterizes a poorly compacted soil at depth 0-20 cm; on other depths studied the apparent weight highlights a moderately and strongly compacted soil (Brejea R., 2011, 2014). On watering depth (0-50 cm, 0-75 cm) and on 0-150 cm the soil is strongly compacted. (table 1).

Table 1

Physical and hydro physical properties of preluvosoil from research field of Oradea

Depth - cm -	Total aggregates %	Clay 0.002%	BD g/cm^3	K mm/h	PT %	Field Capacity		Wilting Point coefficient		Easily available water content	
						%	m^3/ha	%	m^3/ha	%	m^3/ha
0-20	47.5	31.5	1.41	21.0	21	24.2	682	9.2	259	19.2	542
20-40	-	34.1	1.52	10.5	49	23.6	717	9.4	286	18.9	575
40-60	-	39.8	1.58	4.4	48	25.1	768	11.1	351	19.9	630
60-80	-	39.3	1.65	1.0	43	24.4	828	10.8	356	20.4	672
80-100	-	38.8	1.57	0.5	40	23.8	766	12.2	383	20.4	640
100-150	-	37.6	1.54	0.1	39	24.0	1833	14.2	1093	20.6	1586
0-50	-	-	1.49	-	-	24.0	1787	9.7	720	19.2	1431
0-75	-	-	1.53	-	-	24.2	2782	10.1	1158	19.5	2240
0-100	-	-	1.55	-	-	24.3	3769	10.5	1627	19.7	3055
0-150	-	-	1.55	-	-	24.1	5611	11.7	2720	20.0	4646

Depending on soil easily available water content was set at 2/3 IUA.

Chemical properties

The soil in the research field has a slightly acid reaction throughout the depth studied, with increasing values from surface to depth,

Humus supply is poor, and the total nitrogen, low – medium on the entire depth researched.

C/N ratio has a value higher on depth of 0-20 cm (8.01) and decreases with depth determination.

Mobile potassium content of soil is low - medium, with values increasing from the arable layer (124.5 ppm on the 0-20 cm) to depth (145.4 ppm in the 100-150 cm) (Ciobanu, Domuta, 2003).

The soil content in exchangeable magnesium on soil profile has a similar pattern with potassium content, the soil being middle supplied with this item's full profile.

Manganese characterize the soil from field research like a soil with medium content at depth 0-20 cm and 20-40 cm and low content at next depths. The soil is moderately submezobazic on the entire deep studied (table 2).

Table 2.

Chemical properties of preluvosoil from research field of Oradea

Depth - cm -	pH (H_2O)	Humus %	N_{total} %	C/N	P_{AL}	K_{AL}	Mg^{+2}	Mn^{+2}	V %
					ppm				
0-20	6.8	1.75	0.127	8.01	50.8	124.5	254	34	79.8
20-40	6.11	1.71	0.157	6.11	36.6	119.9	309	27	70.1
40-60	6.35	1.44	0.156	4.89	20.7	144.7	396	22	85.9
60-80	6.35	-	-	-	16.1	139.7	199	22	85.9
80-100	6.63	-	-	-	9.3	145.4	496	23	86.0

The experiment include two factors:

Factor A: Crop rotation

a1 – winter wheat-maize

a2 – winter wheat + clover – winter wheat – maize

Facror B: Chemical fertilizers:

b1 – N_0P_0

b2 – $N_{60}P_{40}$

b3 – $N_{90}P_{60}$

b4 - $N_{120}P_{90}$

The yields obtained were calculated by the method of analysis of variance (Domuta, 2006).

RESULTS AND DISSCUSION

In 2012 and 2014 the annual rainfall exceeded the annual average with 19,5% (120.5mm), while in 2013 and 2014 were registered negative deviation from the annual average of 29,1% (-179.5mm) and 18,8 (-115.9 mm). Rainfall felt in 24-hour had close values to the maximum multiannual

one month in 2012 (September) and 2013 (October), and in March 25, 2014 maximum rainfall registered in 24 hours exceeded the maximum multiannual value (41,9 mm of 28,1mm). (table 3).

Table 3.

Rainfalls (maxim) from 24 hours and annual precipitations, Oradea 2012 – 2014

Year	Month												Total Rainfalls
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
2012	3.1	19.1	3.5	4.1	9.6	13.0	17.2	24.0	34.0	3.1	12.7	16.9	437.5
2013	16.3	27.8	5.6	20.2	15.6	8.8	21.1	0.0	24.8	30.6	20.1	18.9	501.1
2014	10.3	5.	41.9	16.4	13.0	12.8	18.4	29.6	17.8	12.8	19.2	4.8	737.5
Multiannual average (maxim)	21.6	39.0	28.1	38.5	44.2	85.8	61.0	49.5	41.8	36.0	27.9	36.4	617.0

The influence of crop rotation and fertilization on winter wheat yield

In the researches from Oradea, in 2012 compared with crop rotation: wheat-maize, crop rotations with clover-clover-wheat-maize achieved an yield gain on the 4 variants of fertilization about 3.0 q/ha, the achieved gain in the unfertilized was 2.1 q / ha (table 4).

Table 4.

Influence of crop rotation and chemical fertilizers on winter wheat yield, Oradea 2012

Variant	Crop rotation 1		Crop rotation 2		Fertilization with K_{60} in crop rotation 1	
	q/ha	%	q/ha	%	q/ha	%
N_0P_0	15.4	100	17.5	100	16.5	113
$N_{60}P_{40}$	18.3	118	22.1	126	21.0	139
$N_{90}P_{60}$	19.3	125	22.6	129	22.2	135
$N_{120}P_{90}$	20.1	131	23.0	131	22.9	139
Average	18.28	100	21.30	117	20.65	113

Crop rotation 1: winter wheat-maize; Crop rotation 2: winter wheat-clover-clover- maize

In 2013 the yields obtained in the every variants were bigger than in 2012. In the average on the crop rotation winter wheat-maize the field was of 20,22 q/ha. In the crop rotation winter wheat+clover-clover-maize, the average of the yields was of 23,2 q/ha, with 15,0 % bigger than the average on the crop rotation winter wheat-maize (table 5).

Table 5.

Influence of crop rotation and chemical fertilizers on winter wheat yield, Oradea 2013

Variant	Crop rotation 1		Crop rotation 2		Fertilization with K_{60} in crop rotation 1	
	q/ha	%	q/ha	%	q/ha	%
N_0P_0	19.3	100	22.6	100	21.9	111
$N_{60}P_{40}$	20.2	105	23.8	105	22.4	102
$N_{90}P_{60}$	20.1	104	22.9	101	22.6	103
$N_{120}P_{90}$	21.2	110	23.5	104	23.3	106
Average	20.2	100	23.2	115	22.5	111

Crop rotation 1: winter wheat-maize; Crop rotation 2: winter wheat-clover-clover- maize

The biggest yields were obtained in the year 2014. In average on the crop rotation winter wheat-maize the yield was of 33.6 q/ha. In the crop rotation winter wheat-clover-clover-maize the average yield increased with 9% (table 6).

Table 6.

Influence of crop rotation and chemical fertilizers on winter wheat yield. Oradea 2014

Variant	Crop rotation 1		Crop rotation 2		Fertilization with K_{60} in crop rotation 1	
	q/ha	%	q/ha	%	q/ha	%
N_0P_0	31.5	100	35.9	100	35.2	106
$N_{60}P_{40}$	32.8	117	36.6	102	36.1	103
$N_{90}P_{60}$	33.4	106	36.7	102	36.2	103
$N_{120}P_{90}$	36.7	120	37.8	105	37.1	105
Average	33.6	100	36.78	109	36.15	106

Crop rotation 1: winter wheat-maize; Crop rotation 2: winter wheat-clover-clover- maize

Fertilizing with nitrogen and phosphorus determined obtaining of very significant yield gain at all doses. Using potassium in equal dose with the dose of phosphorus determined obtaining of increased yield gain that grows with increasing of fertilizer rates. It should be noticed that in the unfertilized variant the yields obtained in the three years of research registered values between 10.9 and 17.4 q / ha; through the fertilization with nitrogen and phosphorus were obtained increases yield with values between 63 and 143%. and using of potassium determined to obtain yield increases between 78 and 178% (Table 7).

Table 7

The influence of crop rotation and chemical fertilization on winter wheat yield, Bihor, 2012-2014

Variant	Crop rotation 1		Crop rotation 2		Fertilization with K_{60} in crop rotation 1	
	q/ha	%	q/ha	%	q/ha	%
N_0P_0	14.7	100	18.5	100	14.7	109
$N_{60}P_{40}$	24.0	171	26.6	144	26.1	178
$N_{90}P_{60}$	30.7	209	33.0	178	33.6	244
$N_{120}P_{90}$	35.7	243	39.0	147	40.2	173
Average	26.28	100	29.28	111	28.65	109

Crop rotation 1: winter wheat – maize; Crop rotation 2: winter wheat-clover-clover- maize

Fertilizing maize with manure applied in rate of 25 tones/ha registered significant yield increases at next crop – winter wheat. Compared with unfertilized variant were registered a yield increase of 69.9%. Organic-mineral fertilization determined the increase of yield gain compared to unfertilized variant with values of 147-271% (table 8).

Table 8.

Influence of organo-mineral fertilization on winter wheat yield (q / ha) in the conditions of Bihor, 2012-2014

N_0P_0	$N_{60}P_{40}$	$N_{90}P_{60}$	$N_{120}P_{90}$	Average
13.3	22.6	31.3	37.8	26.25
Manure 25 t/ha apllied to maize crop + NP				
23.4	32.9	41.8	49.4	36.87

CONCLUSIONS

The results research were obtained during 2012-2014 in the experiment placed in 1999 in the Agricultural Research Station Oradea and the conclusions are:

- the years of experiment were very different climatical conditions point of view;
- in average on the winter wheat + clover-maize-maize, the winter wheat yields were bigger than yields obtained in the wheat-maize crop rotation with 17% in the year 2012, with15% in 2013 and with 9% in rainy year 2014;
- in comparison with the control N_0P_0 in the variants with $N_{60}P_{40}$, $N_{90}P_{60}$ and $N_{120}P_{90}$ the yield incresed constantly;
- the use of the potassium in every variant determined the yields gains in comparison with N_0P_0 agrofonds. In average on the crop rotation the potassium use determined the yield gains of 13% in 2012, of 11% in 2013 and 6 % in the year 2014.

The research results emphasized the importance of crop rotation with clover on the preluvosoil from Oradea and the need to fertilize with NPK in the winter wheat crop.

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