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RESEARCH CONCERNING INFLUENCE OF CROP ROTATION TO WINTER WHEAT ON THE REDDISH PRELUVOSOIL FROM MOARA DOAMNEASCA

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Abstract

This paper presents the average data in 1999-2009 years in the crop rotations field of Moara Domnească-Ilfov. The bifactorial experiment began in 1981 and was conducted in 4 repetitions. The variants have for A – Factor the crops rotations and for b – factor – nitrogen applications. A – factor we have: a_1 – wheat monoculture, a_2 – rotation wheat – maize, a_3 – rotation soya – wheat – maize, a_4 – rotation pea – wheat – sugar beet – maize. The B factor – nitrogen: b_1 – N_o and b_2 – N_{100}. In every experimental plot, we performed determinations on weeds, soil macroelements analyses, bulk density, total porosity and wheat yields in crop rotation. Finally, we proved that crop rotations are the central point of sustainable agriculture systems.

INTRODUCTION

Crop rotation with crops carefully studied are basic links of the sustainable agricultural system, but more than this, in terms of ecological agriculture practice, their role has taken on new valences: maintaining the balance in agricultural ecosystems, maintaining and enhancing soil fertility, reducing the energy consumption, control of weeds, pests and diseases, improving the efficiency of agro-fitotechnical measures from culture technology, achieving high yields, stable and high quality, etc.

All these favorable effects are achieved without additional investments but only through a good organization and performance skills of the persons that lead the production process in agriculture. Through the research undertaken, we want to strengthen in this paper the idea according to which the crop rotation is the main element of the system of sustainable agriculture [1, 2, 3, 4].

MATERIAL AND METHOD

This paper presents the average data collected during a long interval of time (between 1999 and 2009) in crop rotation fields from Moara Domnească Research Station belonging Faculty of Agriculture, UASMV Bucharest. It is important to mention that the experiment on crop rotations was founded in 1981, so it is 29 years old. This bifactorial experiment under split the method în 4 repetitions. The variants: A – Factor the crop rotation we have: a_1 – wheat monoculture, a_2 – 2 years rotation: 1. wheat – 2. maize; a_3 – 3 years rotation: 1. soya – 2. wheat – 3. maize; a_4 – 4 years rotation: 1. pea – 2. wheat – 3. sugar beet – 4. maize and B – Factor nitrogen: b_1 – N_o and b_2. – N_{100}. P_{70} was applied to all experimental plots.

The following technical operations and analyses were performed:

- weeding status, determined by the help of square frame 2-3 weeks before harvesting wheat crop;
- soil physical analyses: bulk density and total porosity, at 40 cm deep, after harvesting the crop on the agrofond N_0;
- soil chemical analyses: pH, humus (%), total nitrogen, carbon/nitrogen ratio, accessible phosphorus and mobile potassium, at 20 cm deep; for quantification of the results was used ICPA-1997 Methodology [5];
- the quantification of the crop yield on variants and repetitions and its calculation at sown area has been done in STAS conditions.

RESULTS AND DISCUSSION

1. The influence of crop rotation and of nitrogen to weed biomass (Table 1).

Determination of weed biomass allowed us to formulate the following observations:

a) The highest values regarding weed biomass were recorded on wheat monoculture on the agrofondul N_0 of 316 g/m^2 and on N_{100} of 206 g/m^2;

b) Starting of using rotation in wheat crop lead to a significant decrease of the weeding status, been recorded differences by comparison of monoculture of 73.1 - 78.8% on the agrofond N_0 and of 79.6 - 85.5 % on the agrofond N_{100};

c) Application of nitrogen dose of 100 kg/ha determined the decreasing of weeding level up to cu 34.8% in monoculture and up to 52.2% for crop rotation. This is explained through the fact that winter wheat under the influence of fertilizers and of a better previous plant produces more tillers, has a higher growth rate and inhibits the development of the weeds.

2. The influence of crop rotation on physical parameters as bulk density and total porosity (Table 2).

a) In all cases, the values of bulk density increased from surface to depth, as it follows: on 5 - 10 cm depth varies between 1.29 and 1.34 g/cm^3; on 15 - 20 cm depth between 1.36 and 1.42 g/cm^3; on 25 - 30 cm depth between 1.45 and 1.52 g/cm^3 and on 35 - 40 cm depth varies between 1.54 and 1.55 g/cm^3;

b) The values of total porosity decreased with depth from 46.5 - 48.4% on 5 - 10 cm depth to 38.1 - 38.3 % on 35 - 40 cm depth;

c) Crop rotation favorably influences the bulk density with up to 0.05-0.06 g/cm^3 and total porosity with up to 1.7-2.3%.

Table 1

Influence of crop rotation and of nitrogen to weed biomass

Crop rotation	N-dose	Weed biomass			
		g/m^2	%	difference %	
Monoculture	N_0	316	100.0	100.0	-
	N_{100}	206	65.2	-	100.0
2 years rotation (maize - wheat)	N_0	85	100.0	26.9	-
	N_{100}	42	49.4	-	20.4
3 years rotation (soya - wheat - maize)	N_0	75	100.0	23.7	-
	N_{100}	38	50.1	-	18.5
4 years rotation (pea - wheat - sugar beet - maize)	N_0	67	100.0	21.2	-
	N_{100}	32	47.8	-	14.5

Table 2

Bulk density and total porosity of reddish preluvosoil from Moara Domnească cultivated wheat in a crop rotations

Crop rotation	Bulk density (g/cm^3)	Soil depth (cm)			
	Total porosity (%)	5 – 10	15 – 20	15 – 30	35 – 40
Monoculture	bulk density	1.34	1.42	1.52	1.55
	total porosity	46.5	43.2	39.1	38.1
2 years rotation (maize - wheat)	bulk density	1.29	1.36	1.45	1.54
	total porosity	48.4	45.5	42.0	38.3
3 years rotation (soya - wheat - maize)	bulk density	1.29	1.36	1.46	1.54
	total porosity	48.4	45.5	41.6	38.3
4 years rotation (pea - wheat - sugar beet - maize)	bulk density	1.30	1.37	1.47	1.54
	total porosity	48.0	45.1	41.2	38.3

3. The influence of crop rotation and of nitrogen on some chemical properties of the soil (Table 3).

The chemical soil analyses: pH, humus (%), total nitrogen, carbon/nitrogen ratio, accessible phosphorus and mobile potassium, present variable influences that evidenced the following aspects:

a) The soil reaction was moderately acidic, ranging between 5.10 and 5.40, with no clear influences due to crop rotation; it has observed a decreasing tendency of soil reaction on the agrofond N_{100} that can be attributed to nitrogen fertilizers with acidic reaction. Differences between N_0 and N_{100} are lower with 0.19-0.30 pH units.

b) The humus content of the soil indicates a middle content, ranging between 2.14-2.33%, with an increasing tendency on nitrogen fertilized agrofond;

c) The total nitrogen level is between 0.123-0.145%, with an increasing trend under crop rotation and nitrogen dose influences;

d) Carbon/nitrogen ratio ranges between 9.31 and 10.08, lower values being recorded at crop rotation with nitrogen fertilized agrofond;

e) The mobile phosphorus from soil indicated a middle content with values between 42 and 54 ppm, higher values being observed at monoculture due to low absorption level;

f) The mobile potassium from soil ranges between 144-183 ppm, higher values being recorded at monoculture due to low level of extraction.

Table 3

pH, humus, N-total, carbon/nitrogen ratio, P-accessible, K-mobile analyses at 20 cm deep in reddish preluvosoil of crop rotations from Moara Domnească

Crop rotation	N-dose	pH	Humus (%)	Nt (%)	C/N	P_{AL} (ppm)	K_{AL} (ppm)
Monoculture	N_0	5.34	2.14	0.123	10.08	53	183
	N_{100}	5.15	2.26	0.130	10.08	54	180
2 years rotation (maize - wheat)	N_0	5.40	2.19	0.129	9.85	46	153
	N_{100}	5.10	2.29	0.134	9.93	44	140
3 years rotation (soya - wheat - maize)	N_0	5.37	2.21	0.138	9.28	47	150
	N_{100}	5.14	2.31	0.144	9.31	42	144
4 years rotation (pea - wheat - sugar beet - maize)	N_0	5.32	2.21	0.136	9.41	45	158
	N_{100}	5.12	2.33	0.145	9.31	43	150

4. The influence of crop rotation and of nitrogen on wheat yield (Table 4).

The crop yields have raised a lot under the influence of nitrogen and crop rotation, as it follows:

a) The highest yields has been recorded at 3 and 4 years crop rotation and was of 24.7 q/ha and 24.6 q/ha on agrofond N_0 and of 38.0 q/ha respectively, 37.8 q/ha pe N_{100}, with yield gain statistically assured of 6.5-6.4 q/ha on N_0 şi 7.8-7.4 q/ha on N_{100}.

b) Nitrogen dose of 100 kg N/ha assured crop yields of 12.2-13.3 q/ha, yield gain statistically assured very significant.

Table 4

Wheat yields in crop rotation at Moara Domnească (average 1999-2009)

Crop rotation	**N-rate**	**Wheat yields**				
		q/ha	**%**	**difference q/ha**		
Monoculture	N_0	18.2	100.0	Mt.	Mt.	-
	N_{100}	30.4	167.0	12.2***	-	Mt.
2 years rotation (maize - wheat)	N_0	22.5	100.0	Mt.	4.3*	-
	N_{100}	35.6	158.2	13.1***	-	5.2**
3 years rotation (soya - wheat - maize)	N_0	24.7	100.0	Mt.	6.5**	-
	N_{100}	38.0	153.9	13.3***	-	7.8***
4 years rotation (pea - wheat - sugar beet - maize)	N_0	24.6	100.0	Mt.	6.4**	-
	N_{100}	37.8	153.6	13.2***	-	7.4***
Dl 5% (q/ha)				3.76		
Dl 1% (q/ha)				5.13		
Dl 0.1% (q/ha)				6.91		

CONCLUSIONS

1. Crop rotation determined the decreasing of weeding level in comparison with monoculture with 73.1-78.8% on the agrofond N_0 and with 79.6-85.5 % on the agrofond N_{100}.
2. The application of nitrogen dose of 100 kg/ha led to the decreasing of weeding level with up to 34.8% in monoculture and up to 52.2% in crop rotation.
3. Crop rotation favorable influences the bulk density with up to 0.05-0.06 g/cm^3 and total porosity with up to 1.7-2.3%.
4. The chemical soil analyses (pH, humus, total nitrogen, carbon/nitrogen ratio, accessible phosphorus and mobile potassium) evidenced improvement tendencies under crop rotation influence.
5. The application of 100 kg N/ha determined production yields of 12.2-13.3 q/ha, an increase which is statistically assured a highly significant.

6. Crop rotation of 3 and 4 years conducted on the highest yields of 24.7 q/ha and 24.6 q/ha respectively, on the agrofound N_0 and 38.0 and 37.8 q/ha, respectively on N_{100}, with yield gain statistically assured of 6.5-6.4 q/ha on the agrofond N_0 and 7.8-7.4 q/ha on the agrofound N_{100}.

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