Scientific Papers, UASVM Bucharest, Series A, Vol. LIII, 2010, ISSN 1222-5339

INFLUENCE OF ORGANIC AND MINERAL NITROGEN FERTILIZATION ON WHEAT YIELD ON THE REDDISH PRELUVOSOIL IN THE DANUBE PLAIN

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Keywords: *nitrogen organic and mineral fertilization, nitrogen valuation coefficient, wheat production*

Abstract

Research was performed in the course of a bifactorial experiment of 3x5 type made according to the split plot method aimed to study nitrogen organic and mineral fertilization on winter wheat in a winter wheat – winter barley – sugar beet crop rotation. The findings were that organic fertilization with 30 t/ha manure and 5 t/ha sugar beet leaves and crowns determined very significant production boosts of 5.78 q/ha and 5.63 q/ha respectively compared to the unfertilized treatment and the nitrogen mineral fertilization with no organic fertilization generated very significant production boosts up to the dose of N_{150} where the production boost was of 16.29 q/ha.

Combining organic fertilization – the after-effect of 30 t/ha manure – and mineral fertilization – N_{150} led to maximum production of 46.35 q/ha.

Highest nitrogen valuation coefficient of 12.38 kg wheat/kg N a.s. was recorded in the organic fertilization with 30t/ha manure, followed by the N_{60}, then by the treatment with no organic fertilization combined with the dose of mineral nitrogen of N_{60} with 11.47 kg wheat/kg N a.s.

INTRODUCTION

The rational valuation of the reddish preluvosoil in a system of sustainable agriculture means differentiated application in the short-term crop rotations according to the soil fertility level and the production level targeted by nitrogen organic and/or mineral fertilizers with steady amounts of phosphorus [1, 2].

The study of the valuation degree of mineral nitrogen found in the production [3, 4] is an important limiting element when determining a rational fertilization level.

The present paper aims to determine the influence of mineral and organic nitrogen on wheat production and the nitrogen valuation coefficient at different supply levels of mineral and organic nitrogen.

MATERIAL AND METHOD

Research was performed at the Belciugatele Teaching Station – Moara Domneasca Research and Production Farm in the agrotechnical experimental field on reddish preluvosoil in the northwestern Romanian Plain, in the year 2009.

Soil has a humus content of 2.1-2.2% in the A horizon, clayey-loamy texture with 55% physical clay, weakly supplied with nitrogen and phosphorus and well supplied with potasium.

The climate has an annual mean temperature 1.7°C higher than normal because the monthly normal values are exceeded in all months except for January, especially in early summer and autumn. Spring began early, in March and April the temperatures being 2.4°C and 0.8°C respectively higher than normal (Figure 1) and the summer temperatures were typical (1.3°C up to 2.0°C higher than normal).

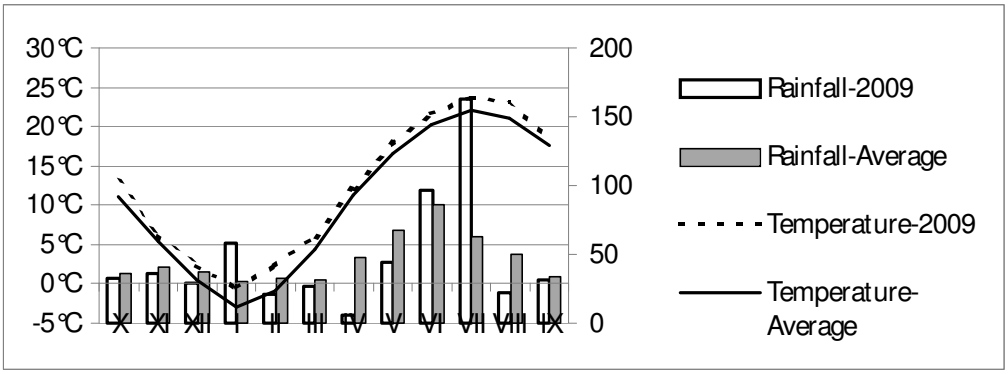

Fig. 1. Climatic conditions at Moara Domneasca in 2008/2009 and the means values

The precipitation amount of 566.8 mm was practically at the normal level. Under these circumstances, the essential thing was their distribution in the sowing-tillering period 98.0 mm being absorbed and 349.8 mm in the growing season, out of which 96.4 mm in June, the month with the most consumption, which insured relatively good water supply for the plants.

Air relative moisture had a mean annual value of 72.8%, 5.8% lower than the normal value, with mean monthly values lower than the normal ones.

On the whole, the agricultural year 2008/2009 was very favourable regarding temperature and water, with a distribution of precipitation very close to the values of plant evapotranspiration, avoiding periods of thermal and water stress and at the same time having lower than normal values of air relative moisture.

Experimental factors. The experiment was bifactorial, set according to the split plots method in 3 repetitions, with the factor A – organic fertilization and the factor B – mineral fertilization.

Factor A had following the graduations: a_1 – unfertilized organically, a_2 – fertilized with 30 t/ha manure and a_3 – 40 t/ha sugar beet leaves and crowns.
Factor B had the following graduations: a_1 – unfertilized, a_2 – N_{60}, a_3 – N_{100}, a_4 – N_{150} and a_5 – N_{200}.

RESULTS AND DISCUSSION

Production results obtained. Regarding the *influence of nitrogen organic fertilization* on winter wheat production (Table 1) there can be seen very significant production boosts of 5.78 q/ha under 30 t/ha manure and 5.63 q/ha under 40 t/ha sugar beet leaves and crowns.

Table 1

Influence of organic nitrogen fertilization on winter wheat production on reddish preluvosoil (Moara Domneasca, 2009)

Treatment	Production		Difference		Significance
	q/ha	%	q/ha	%	
a_1 – unfertilized organically	26.14	100.00	Mt	-	
a_2 – 30 t/ha manure	31.92	122.11	5.78	22.11	***
a_3 – 5 t/ha sugar beet leaves and crowns	31.77	121.53	5.63	21.53	***

$Dl_{5\%}$ = 0.762 q/ha; $Dl_{1\%}$ = 1.263 q/ha; $Dl_{0.1\%}$= 2.363 q/ha

Concerning the *influence of nitrogen mineral fertilization* on winter wheat production (Table 2), there can be seen very significant production boosts of 6.88 q/ha, 11.24 q/ha and 16.29 q/ha corresponding to the treatments b_2 – N_{60}, b_3 – N_{100} and b_4 – $N_{150;}$ the 10.81 q/ha increase in the treatment b_5 – N_{200} even very significant it's in a trend of decreasing production.

Following the *influence of nitrogen mineral fertilization* on winter wheat under no organic fertilization and under organic fertilizers there can be seen a differentiation of the expressed results by increases up to the dose of N_{150} after which its level decreases (Table 3).

With no organic fertilization, the highest production, of 42.43 q/ha, resulted from the dose of N_{150}, while the same mineral fertilizer combined with 30t/ha manure resulted in a maximum of 46.35 q/ha. When fertilizing with 40 t/ha sugar beet leaves and crowns, production was close to the one obtained with no organic fertilization, but higher than this one except for that with N_{150} which was slightly lower than under no fertilization.

Table 2

Influence of mineral nitrogen fertilization on winter wheat production on reddish preluvosoil (Moara Domneasca, 2009)

Treatment	Production		Difference		Significance
	q/ha	%	q/ha	%	
b_1 – unfertilized	26.14	100.00	Mt	-	
$b_2 – N_{60}$	33.02	126.32	6.88	26.32	***
$b_3 – N_{100}$	37.38	143.00	11.24	43.00	***
$b_4 – N_{150}$	42.43	162.32	16.29	62.32	***
$b_5 – N_{200}$	36.95	142.35	10.81	42.35	***

$Dl_{5\%}$ = 0.796 q/ha; $Dl_{1\%}$ = 1.079 q/ha; $Dl_{0.1\%}$= 1.445 q/ha

Concerning the influence of organic fertilization on wheat production (Table 4) at the same level of mineral nitrogen fertilization, there can be seen that the application of 30 t/ha manure resulted in very significant production boosts at all mineral fertilization levels in comparison with the unfertilized treatments. Compared with the treatments with no organic fertilization, the application of 40t/ha sugar beet leaves and crowns resulted in statistically insured production boosts only when under no chemical fertilization and at the dose of N_{100} while at the dose of N_{150} there was a distinctly signficant decrease.

The comparison between the fertilization with 30 t/ha manure and 40 t/ha sugar beet leaves and crowns clearly favours the application of manure, at all mineral fertilization levels, the production differences indicating manure application is better.

Mineral nitrogen valuation. Regarding the values of nitrogen valuation coefficient through the amount of wheat produced/kg a.s. nitrogen (Table 5) there can be seen that under *no organic fertilization* valuation slightly decreases from the dose of N_{60} to the doses of N_{100} and N_{150} an obvious decrease being recorded at the dose of N_{200}.

Under 30 t/ha manure, the mineral nitrogen valuation coefficient had the highest value at the dose of N_{60} with 1238 Kg wheat/kg a.s. N, with a slight decrease at the dose of N_{100}, after which its values drop when the nitrogen dose increases. Under 40t/ha sugar beet leaves and crowns, nitrogen valuation was weak, between 328 kg wheat/kg a.s. N at the dose of N_{200} and 781 Kg wheat/kg a.s. N at the dose of N_{60}.

Table 3

Influence of nitrogen mineral fertilization on winter wheat production on reddish preluvosoil (Moara Domneasca, 2009)

F_A – organic fertilization F_B – fertilization with mineral N	The influence of mineral nitrogen fertilization on winter wheat production at:								
	a_1 – unfertilized organically			a_2 – 30 t/ha manure			a_3 – 5 t/ha sugar beet leaves and crowns		
	Production (q/ha)	Difference (q/ha)	Significance	Production (q/ha)	Difference (q/ha)	Significance	Production (q/ha)	Difference (q/ha)	Significance
b_1 – unfertilized	26.14	Mt		31.92	Mt		31.77	Mt	
$b_2 – N_{60}$	33.02	6.88	***	39.35	7.43	***	34.40	2.63	***
$b_3 – N_{100}$	37.38	11.24	***	43.33	11.41	***	39.58	7.81	***
$b_4 – N_{150}$	42.43	16.29	***	46.35	14.43	***	40.18	8.41	***
$b_5 – N_{200}$	36.95	10.81	***	41.41	9.49	***	38.34	6.57	***

$Dl_{5\%}$ = 1.379 q/ha; $Dl_{1\%}$ = 1.869 q/ha; $Dl_{0.1\%}$= 2.503 q/ha

Table 4

Influence of organic fertilization at the same level of mineral nitrogen fertilization on winter wheat production on the reddish preluvosoil (Moara Domneasca, 2009)

Mineral nitrogen fertilization	The influence of organic fertilization on winter wheat production at the same level of mineral nitrogen application					
	$a_2 – a_1$		$a_3 – a_1$		$a_3 – a_2$	
	Difference (q/ha)	Significance	Difference (q/ha)	Significance	Difference (q/ha)	Significance
b_1 – unfertilized	5.78	***	5.63	***	- 0.15	
$b_2 – N_{60}$	6.33	***	1.38		- 4.95	000
$b_3 – N_{100}$	5.95	***	2.20	**	- 3.75	000
$b_4 – N_{150}$	3.92	***	-2.25	00	- 6.17	000
$b_5 – N_{200}$	4.46	***	1.39		- 3.07	000

$Dl_{5\%}$ = 1.439 q/ha; $Dl_{1\%}$ = 2.047 q/ha; $Dl_{0.1\%}$= 3.021 q/ha.

Table 5

Influence of organic and mineral fertilization on nitrogen valuation in wheat cultivated on reddish preluvosoil (Moara Domneasca, 2009)

F_B – mineral N fertilization	a_1 – organically unfertilized		a_2 – 30 t/ha manure		a_3 – 5 t/ha sugar beet leaves and crowns	
	Production difference (kg/ha)	Nitrogen valuation coefficient (kg wheat/ kg as N)	**Production difference** (kg/ha)	Nitrogen valuation coefficient (kg wheat/ kg as N)	**Production difference** (kg/ha)	Nitrogen valuation coefficient (kg wheat/ kg as N)
b_1 – unfertilized	Mt	-	Mt	-	Mt	-
$b_2 – N_{60}$	688	11.47	743	12.38	263	4.38
$b_3 – N_{100}$	1124	11.24	1141	11.41	781	7.81
$b_4 – N_{150}$	1629	10.86	1443	9.62	841	5.61
$b_5 – N_{200}$	1081	5.40	949	4.74	657	3.28

CONCLUSIONS

1. Organic fertilization brought very significant production boosts of 5.78 q/ha under 30 t/ha manure and 5.63 q/ha under 40 t/ha sugar beet leaves and crowns;
2. Mineral fertilization with no organic fertilization generated the highest production of 42.43 q/ha at the dose of N_{150};
3. The highest production in the experiment, 46.35 q/ha, was reached when applying 30 t/ha manure with N_{150} fertilizer;
4. The best nitrogen valuation of 1238 kg wheat/kg a.s. N was reached when applying 30 t/ha manure at the dose of N_{60}.

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