Scientific Papers. Series A. Agronomy, Vol. LIX, 2016
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

INFLUENCE OF FERTILIZATION ON RYE PRODUCTION IN THE SANDY SOILS CONDITIONS FROM SOUTHERN OLTENIA

Iulian DRĂGHICI, Reta DRĂGHICI, Mihaela CROITORU

Research - Development Center for Agricultural Plants on Sands, Dabuleni, Dolj County, Romania

Corresponding author email: iuliandraghici54@yahoo.com

Abstract

The research was conducted during 2012-2014 to the crop of rye, in the sandy soils condition from southern Oltenia, and focused radicular and foliar fertilization effect on the quantity and quality of production of rye. Rye crop was located on a sandy soil, poorly stocked as nitrogen (0.06 to 0.07%), well stocked in extractable phosphorus (65 ppm and 81 ppm) and low to medium stocked in exchangeable potassium (37 ppm and 131 ppm). The results obtained to rye, about the quantity and quality of grain yield at harvest, highlights the experimental variant in which was applied a radicular fertilized with $N_{150}P_{80}K_{80}$ + two foliar fertilizations with Green Plant, which is composed N_9-P_{45}-K_{15} + 6 microelements (first treatment - early spring at the beginning of vegetation in concentration of 0.5% and the second treatment during the formation of the straw, in concentration of 1%), where there was a maximum production of 4278 kg / ha and a content balanced in grain protein (12, 3%) and gluten (26.7%). The radicular fertilization with NPK, has determined to obtain a production increase of 113.5%, compared to unfertilized and the foliar fertilization has led to increased production by 23%, compared to foliar unfertilized.

Key words*: radicular and foliar nutrition, productivity, quality.*

INTRODUCTION

The recent climate changes have led to the agricultural drought in the sandy soils, with negative implications on growth and development of plants. Therefore, finding solutions to counteract the negative effects of drought is absolutely necessary, and in this regard the cultivation of plants adapted to a specific area, can be successfully a measure of economic growth. Research conducted to the crop of rye, emphasizes plant resistance to drought and very good pretability for sandy soils (Márton, 2002; Gheorghe et al., 2008; Rahnavard, 2009), compared to the wheat. The results obtained in Latvia in terms of fertilization on rye cultivated in conditions of luvisol cambic showed the nitrogen role in increasing production by 66.6 to 70.4%, compared to unfertilized (Nedzinskiene and Asakavičiūte, 2008). The application of fertilizers on irrigated sandy soils presents specific features, determined by soil properties including: complex clay - humic poorly formed and physical and physicochemical capacity reduced for retaining the fertilising substances (Rauta et al., 1979; Hera, 1984). For reducing nitrogen losses by levigating into the groundwater as a nitrate it is necessary to apply nitrogen dose fractionated (Gheorghe et al., 2003). In order to reduce the negative impact which these poor qualities deficient soil have on the plant rye, was followed optimization of fertilization by using radicular and foliar nutrients.

MATERIALS AND METHODS

The investigations were carried out during the culture of rye 2012-2014 in the conditions of sandy soils from southern Oltenia. The study aimed the radicular and foliar fertilization effect on the quantity and quality of rye grain yield, by studying two factors: Factor A - radicular fertilization with 3 graduations and foliar fertilization B- Factor 5 graduations. Experimental factors are shown in Table 2. Phosphorus and potassium fertilizers were administered autumn under plowing base and the nitrogen were administered divided into two stages: one third of the dose at sowing + 2 thirds of the dose in the vegetation (early spring). The foliar fertilization was applied in two stages of plant vegetation (first treatment - early spring at the beginning of vegetation in concentration of 0.5% and the second treatment

during the formation of the straw, in concentration of 1%). Determinations were carried out on experimental laboratory chemical characteristics of the soil, the determination of total nitrogen, phosphorus mobile exchangeable potassium, organic carbon and soil reaction. In vegetation were performed the biometric determinations of the plant and the ear, and the harvest was determined and the total protein production of the device Perten grain (grain quality analyzer). The results were interpreted in statistically by analysis of variance and using mathematical functions.

RESULTS AND DISCUSSIONS

The results obtained concerning soil quality, emphasizes a reduced fertility, soil is poorly stocked nitrogen (0.06 to 0.07%), well stocked in extractable phosphorus (65 ppm and 81 ppm) and low to medium stocked in exchangeable potassium (37 ppm and 131 ppm). Reserves of nutrients which them available to plants they are closely related with parental rocks and somewhat proportional with the volume of soil explored by their roots. The variation of climatic conditions can lead to changes in accessibility and potassium uptake by plants. Moisture deficit recorded at a time in the soil requires increased fertilizer application of potassium to combat the decreased accessibility. Organic carbon, presented values in the range 0.29 % - 0.56 %, and the pH of the soil ranged from 5.85 to 6.50, value showing a moderate acidic to neutral reaction. Croitoru Mihaela and Şoimu T., 2001 shows the presence of nitrates in groundwater on different types of soil, in the south-west of the country, over AML 50 mg / l provided to national and international. To preserve and enhance the soil fertility, for his protection and water against pollution with nutrient, is necessary that fertilization to be under supervision so as to ensure the optimum use by the crop nutrient from the soil and to those coming from mineral and organic fertilizers applied. As to the of plant nutrition, pH of the soil has direct implications for mobility and accessibility of soil nutrients (Table 1). The nutrition regime of the plants significantly influence development of the plant rye and the production obtained (Table 2). The application radicular of $N_{150}P_{80}K_{80}$ dose and foliar of two treatments with foliar fertilizer, Green Plant , which is composed N_9-P_{45}-K_{15} + 6 microelements increased the degree of twinning by 2 brothers / plant and plant height by 24.8 cm, compared with unfertilized, which recorded two brothers / plant and plant height 84.7 cm. Also, a balanced fertilizer with macro and micronutrients resulted in increases in of 2.8 cm of ear length and by 14.5 grains / spike, compared to unfertilized. It is observed distinct significant positive correlations between productivity elements (ear length and number of grains per ear) and grain yield obtained from rye (Figures 1 and 2). Maximum production of 4278 kg / ha was obtained in the variant in which the biometric determinations were maximum values.

The results on the quality of the grain rye highlight the influence of fertilization, especially nitrogen dose applied on the content of protein and gluten (Figure 1).

Table 1. The chemical characteristics of sandy soil

Experimental variant	Depth in the soil (cm)	Total nitrogen %	Extractable phosphorus (P-AL) ppm	Extractable potassium (K-AL) ppm	Organic carbon %	pH in water
$N_0P_0K_0$	0-20	0.06	65	70	0,31	6,50
	20-40	0.07	65	54	0,42	6,16
$N_{150}P_0K_0$	0-20	0.07	67	131	0,56	6,17
	20-40	0.09	68	51	0,24	6,03
$N_{150}P_{80}K_{80}$	0-20	0.07	68	37	0,53	5,95
	20-40	0.07	81	70	0,29	5,86

Table 2. Influence of radicular and foliar fertilization on the research results obtained from rye, under the conditions of sandy soils

Nr. var.	Experimental variant			Nr. brothers / plant	Plant height (cm)	Ear length (cm)	No. grains per ear	Grain yield	
	Radicular fertilization (A Factor)	Foliar fertilization (B Factor)						Kg / ha	The difference compared to the control
		Foliar fertilizer name	Content foliar fertilizer (N-P-K + microelements)						
1	$N_0P_0K_0$	Unfertilized	-	2	84.7	10.7	29.4	1510	control
2		Green Plant	26-5-12+Zn	2.3	71.1	11.5	30.5	1855	345
3		Green Plant	20-20-20+microelem.	2.6	88.8	12	36.15	1978	468
4		Green Plant	9-45-15+6 microelem	2.3	88.4	11,75	34.9	1983	473
5		Timasol	15-15-30+13 microelem	2	88.8	12.05	36.5	2033	523*
6	$N_{150}P_0K_0$	Unfertilized	-	2.6	87.95	11.25	35.5	2006	control
7		Green Plant	26-5-12+Zn	3	90.3	12	36,5	2305	299
8		Green Plant	20-20-20+microelem.	2.6	98.25	12.15	41.4	2578	572*
9		Green Plant	9-45-15+6 microelem	3.3	96.2	12.35	41.75	2697	691**
10		Timasol	15-15-30+13 microelem	3.6	100.25	12.25	42	2655	649**
11	$N_{150}P_{80}K_{80}$	Unfertilized	-	3.3	94	11.8	41.8	3630	control
12		Green Plant	26-5-12+Zn	3,6	96	12.5	42.5	3977	347
13		Green Plant	20-20-20+microelem.	3.6	103.3	12.8	43.8	3989	359
14		Green Plant	9-45-15+6 microelem	4	109.5	13.5	44.3	4278	648**
15		Timasol	15-15-30+13 microelem	3.6	106	13	44.5	4111	481*
Correlation: Length ear x Grain yield			Y = 1142.5x - 11060; r = 0.831**						
Correlation: Number of grains per ear x Grain yield			Y = 171.74x – 3885.6; r =0.880**						
LSD 5%									475
LSD 1%									645
LSD 0.1%									864

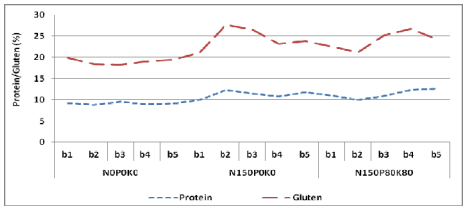

Figure 1. The quality of the production of rye, depending on the regime of plant nutrition

The percentage of protein has presented values ranging from 8.8 to 9.5% in the version without chemical fertilizer, but treated foliar and values between 10.8 to 12.3% in variants fertilized with $N_{150}P_{80}K_{80}$ and also treated foliar. The foliar fertilization with Green Plant product (N_9-P_{45}-K_{15} + 6 microelements) and Timasol product (N_{15}-P_{15}-K_{30} + 13 microelements), on an agrofond $N_{150}P_{80}K_{80}$, has improved the grain quality, by increasing the percentage of protein with 1.3 - 1.6%, compared to unfertilized. The gluten content is a very important quality indicator for the technological process of obtaining bread, contributing to the characterization of dough, especially processing capacity and the potential for its cooking. In sandy soil conditions, the gluten content was between 18.3% in the variant fertilized radicular with $N_{150}P_{80}K_{80}$ and treated foliar with Green Plant (N_{20}-P_{20}-K_{20} + micronutrients) and 27.7% in the variant fertilized with $N_{150}P_0K_0$ and treated with Green Plant (N_{26}-P_5-K_{12}+Zn). The gluten content in grains of rye is smaller compared to that of wheat grains, which is why rye flour is used in bakery products more for baking bread and less for other bakery products (Croitoru Mihaela et al, 2012). If we analyze the average influence of NPK radicular fertilization on rye, are observed differences of production by 2124.2 kg / ha, statistically highly significant as compared to the unfertilized (Table 3). In pedoclimatic conditions of sandy soils with a humus content of less than 1%, the results obtained to rye shows he can be obtained yield increases statistically assured at unilateral application of nitrogen. As to the of grain quality analysis, compared unfertilized the radicular fertilization resulted in increases in the percentage of 2.1 to 2.26% of protein and 4.96 to 5.46% the percentage of gluten. From the three macronutrients applied to rye, nitrogen has been most good.

Also, foliar fertilizers, applied to the culture of rye, have influenced the the production and quality of the grain rye (Table 4). The biggest production of grain was registered by applying

in the vegetation two foliar treatments with the product Green Plant, which has in its composition N_9-P_{45}-K_{15} + 6 microelements (first treatment - early spring at the beginning of vegetation in concentration of 0.5% and the second treatment during the formation of the straw, in concentration of 1%). Compared with the untreated control, where there was 10.1% protein and 21.2% gluten, the foliar fertilization has led to increase with 0.3 to 1.1% protein percentage of grain and 1.2 to 2.2 % percentage of gluten.

Table 3. Influence of NPK fertilization on the grain yield obtained from rye

Nr. crt.	NPK dose	Grain yield Kg/ha	Protein %	Gluten %
1	$N_0P_0K_0$	1871.8	9.1	19
2	$N_{150}P_0K_0$	2448.2**	11.28	24.46
3	$N_{150}P_{80}K_{80}$	3997***	11.36	23.96
LSD 5%		268.5		
LSD 1%		444		
LSD 0.1%		832		

Table 4. Influence of foliar fertilization on the grain yield obtained from rye

No. var.	Experimental variants		Grain yield Kg/ha	Protein %	Gluten %
	Foliar fertilizer	Content N-P-K + micro			
1	Unfertilized	-	2382	10.1	21.2
2	Green Plant	26-5-12+Zn	2712.3*	10.4	22.4
3	Green Plant	20-20-20 + microelem.	2848.3**	10.6	23.3
4	Green Plant	9-45-15 + 6 microelem	2986***	10.7	23.0
5	Timasol	15-15-30 + 13 microelem	2933**	11.2	22.5
LSD 5%			287		
LSD 1%			371.5		
LSD 0.1%			598.5		

CONCLUSIONS

The radicular fertilization with $N_{150}P_{80}K_{80}$, and two foliar treatments Green Plant, which is composed N_9-P_{45}-K_{15} + 6 microelements (first treatment - early spring at the beginning of vegetation, in concentration of 0.5% and the second treatment during the formation of the straw, in concentration of 1%), have led to increased twinning degree with 2 brothers / plant, of the plant height with 24.8 cm, of the ear length with 2.8 cm and number of grains per ear with 14.5 grains / ear, compared to unfertilized.

Ensuring an optimal nutrition of the plant, the radicular and foliar fertilization has led to obtain a maximum yield by 4278 kg/ha rye grains and at achieving a balanced protein content (12.3%) and gluten (26.7%).

The radicular fertilization with NPK, has led to increased production by 113.5%, compared to radicular unfertilized, and foliar fertilization has led to increased production by 23%, compared to foliar unfertilized.

REFERENCES

Rahnavard A., Ashrafi Z.Y., Alizade H.M., Sadeghi S., 2009. Studies on the effect of fertilizer application and crop rotation on thes in Iran. Journal of Agricultural Technology 2009, V.5(1): 41-50.

Croitoru M., Şoimu T., 2001. Research regarding the evolution of nitrate in soil and water, sandy soils in southern Oltenia. Scientifical works of Symposium "Improvement low productivity soil of Oltenia". Ed. Sitech, Craiova.

Croitoru M., Drăghici R., Drăghici I., Matei Gh., 2012. The effect of chemical fertilizers on wheat grain quality in the conditions of sandy soils in southern Oltenia. Annals of the Research - Development Center for Field Crops on Sandy Soils, Dabuleni, Volume 19th.

Gheorghe D., Draghici I., Draghici R., Ciolacu F., 2003. Phosphorus fertilizers influence upon the production of certain agricultural plants cultivated on sandy soils in southern Oltenia. "Use fertilizers with phosphorus in Romania. Current and perspective aspects" International Symposium on 3-4 October 2002 Caracal, Romania. AGRIS – Agricultural Journals Editorial, Bucharest, p. 391- 398.

Gheorghe D., Răţoi I.,Toma V., Ştefan M., Matei Gh., Bonea D., Constantinescu E., 2008. The influence of fertilization and crop rotation upon rye yield on psamosiols. Scientific Symposium with international participation "SUSTAINABLE AGRICULTURE - AGRICULTURE OF THE FUTURE", Fourth Edition. CRAIOVA 28-29 November, 2008.

Hera Cr., Eliade Gh., Ghinea L., Popescu A., 1984. Ensured necessary nitrogen to crops. Ed. Ceres, Bucharest.

Márton L., 2002. Climate fluctuations and the effects of N fertilizer on the yield of rye (*Secale cereale* L.). CIMMYT Knowledge Center, Production. Vol. 51, No. 2, p. 199-210.

Răuţă C. et al., 1979. Some aspects regarding pollution of the soil and the groundwater with nitrates in the system Sadova - Corabia, Scientific Papers SCCCPN Dabuleni, vol. III.

Nedzinskiene T.L., Asakavičiūte R., 2008. Simplification of winter rye (*Secale Cereale* L.) Growing Technology. Latvian Journal of Agronomy / Agronomija Vestis, Issue 11, p. 262.