THE INFLUENCE OF CROP ROTATION AND NUTRITION REGIME ON THE FINAL CONTENT OF N, P, K, AND RAW PROTEIN OF SEEDS IN WINTER WHEAT CULTIVATED ON THE LUVOSOL

Bandici Gheorghe, Ardelean Ileana*

[*]University of Oradea, Faculty of Environmental Protection, 26 General Magheru St., 410048 Oradea,Romania, e-mail: gbandici@yahoo.com

Abstract

The quality of production is related to a series of physical and chemical characteristics of plants which gives a positive mark to the applied agrotechnical methods for the correlation of the latter ro the production obtained on the surface unit.

Key words:crop rotation**,** forerunner plant, nutrition regim, fertilization level, nitrogen**,** phosphorus, potassium, raw protein, seeds, winter wheat.

INTRODUCTION

The research performed in this field made clear the fact that quality is conditioned by the species and the cultivated hybrid, the climatic conditions of the cultivating year and also by the technology applied to the agricultural plants (Dincă, 1971). To justify some of these aspects with consequences regarding the quality of the final production, we make some references to the specialised scientific literature, i.e. Hera Cr. and her team (1986) underline the importance of nitrogen for the increase of the protein content, wet and dry gluten and for the improvement of the quality indicators of gluten. The authors also mention the importance of the ameliorative plant (the pea) for the quality indicators of the wheat. Boldea Eleonora and her team (1986) also mention the importance of the new species of wheat for the quality of raw protein and gluten.

The production quality is related to a series of physical and chemical characteristics of the plants which gives a positive mark to the agrotechnical applied measures for the correlation of this with the production obtained for the surface unit (Domuţa and all., 2007, 2008;Munteanu, Cernea, Morar et al., 2008).

Some analyses have been made to establish the quality of the final product regarding the content of N, P, K in wheat seeds and raw protein (Oproiu, Cernescu, 1970; Bandici, Domuţa, Ardelean, 2003).

The main component of the chemical composition of the seeds is represented by the glucides (62-75 %) of the fresh wheat grain mass, the proteins 10-16 %, lipids 1.8-2.6 %, cellulose 2-3.5 % and mineral

substances 1.5-2.3 % (Hera, 1986). A series of analyses of the N, P, K and raw protein content in the wheat grains has been made in order to specify the quality of the final product (Zăhan, Zăhan, 1989; Soltner, 1990; Bandici, 1997; Salisbury, Ross, 1995; Bandici, Gus, 2001).

MATERIAL AND METHODS

The experiment was made at S.C.D.A. Oradea, on the luvosol, in the period 2010-2011. For "Delia" winter wheat grains a series of chemical test were made regarding the content of N, P, K and raw protein accordind to the crop rotation and the nutrition regim. The nitrogen was determined using the *Kjieldahl method*, the phosphorus was determined *by colorimetry with ammonium molybdite* and tin chloride reduction. The potassium was determined *through flame photometry* and the raw protein was determined through calculation (Nt x 5.7 %).

RESULTS AND DISCUSSION

Analysing the data in *Table 1*, regarding the influence of the crop rotation and nutrition regim on the total N content in the wheat seeds, we can see that both the forerunner plant and fertilization level influenced the content of this element in seeds. Therefore, comparing the wheat monoculture with wheat cultivation that was preceded by corn = maize or pea (3 and 4 years crop rotation) the latter induces an increased production of 22.4-53.8 %.

As an ameliorative plant, pea determined the increase of N content in the crop as a consequence of its symbiotic particularities. Compared to the unfertilized type, with a value of 1.37 g/100 g.d.w. (grains of dry substance = wheat), mineral and organo-mineral fertilization determine important increase of N, i.e. 38.7 % and 62 %.

Table 1

The influence of crop rotation and nutrition regim of the final content of *N* of the seeds in wheat cultivated on luvosoils, Oradea, 2010-2011

Observated factor	Total g/100 g.d.w.	Nitrogen %	Difference +/-
a. Crop rotation			
Wheat – Monoculture (M_t)	1.43	100	-
Maize (W-M)	1.75	122.4	+0.32
Pea (P-W-M)	2.20	153.8	+0.77
Pea (P-W-M-M)	1.95	136.4	+0.52
b. Nutrition regime			
N_0P_0	1.37	100	-
$N_{120}P_{80}$	1.90	138.7	+0.53
$N_{120}P_{80}$+10 t/ha manure	2.27	162.0	+0.85

In point of the factors interactin: crop rotation x nutrition regim *(Table 2)*, we note that no matter the crop rotation used, mineral or organo-mineral fertilization increase by 12.1-86.7 %. The lowest values of total N content can be found in the wheat monoculture (1.24-1.65 g/100 g.d.w.) compared to short wheat – maize rotation (1.27-2.07 g/100 g.d.w) or to 3 and 4 year wheat – pea crop rotation – (1.70-2.78 g/100 g.d.w. and 1.28-2.39 g/100 g.d.w.).

Table 2

Influence of the factors interaction: crop rotation x nutrition regime on the final content of *N* of the seeds in wheat cultivated on luvosoils, Oradea 2010-2011

Nutrition regim	Total g/100 g.d.w.	Nitrogen %	Difference +/-
a. Wheat – Monoculture (M_t)			
N_0P_0	1.24	100	-
$N_{120}P_{80}$	1.39	112.1	+0.15
$N_{120}P_{80}$+10 t/ha manure	1.65	133.1	
b. Maize (W-M)+0,41			
N_0P_0	1,27	100	-
$N_{120}P_{80}$	1.90	149.6	+0.63
$N_{120}P_{80}$+10 t/ha manure	2.07	163.0	+0.80
c. Pea (P-W-M)			
N_0P_0	1.70	100	-
$N_{120}P_{80}$	2.13	125.3	+0.43
$N_{120}P_{80}$+10 t/ha manure	2.78	163.5	+1.08
d. Pea (P-W-M-M)			
N_0P_0	1.28	100	-
$N_{120}P_{80}$	2.18	170.3	+0.90
$N_{120}P_{80}$+10 t/ha manure	2.39	186.7	+1.11

Concerning the total raw protein content (Nt x 5.7), in the *Table 3 and 4* we note the direct link between the N content and raw protein.

In this case, the crop rotation and the nutrition regim in the process induce important raw protein increase, which, in case of 3 year wheat-pea crop rotation may rise up to 12.58 g/100 g.d.w., compared to monoculture of 8.15 g/100 g.d.w. The highest values of raw protein increase were established in the organo-mineral fertilization process of 12.58g/100 g.d.w., compared to the witness (N_0,P_0) 7.92 g/100 g.d.w. In the case of raw protein, no matter what the precursory was, the organo-mineral fertilization determined the highest values of raw protein content which varied between 9.43 g/100 g.d.w., in wheat monoculture and 15.84 g/100 g.d.w., in pea (3 year crop rotation).

Table 3

The influence of crop rotation and nutrition regim on the final content of *raw protein* of the seeds in wheat cultivated on luvosoils, Oradea 2010 – 2011

Observated factor	Raw g/100 g.d.w.	Protein %	Difference +/-
a. Crop rotation			
Wheat – Monoculture (M_t)	8.15	100	-
Maize (W-M)	9.96	118.5	+1.81
Pea (P-W-M)	12.58	154.3	+4.43
Pea (P-W-M-M)	11.23	137.8	+3.08
b. Nutrition regim			
N_0P_0	7.92	100	-
$N_{120}P_{80}$	10.84	136.9	+2.92
$N_{120}P_{80}$+10 t/ha manure	12.68	160.1	+4.76

Table 4

Influence of the factors interaction: crop rotation x nutrition regime on the final content of *raw protein* of the seeds in wheat cultivated on luvosoils, Oradea 2010-2011

Nutrition regime	Raw protein g/100 g.d.w.	Raw protein %	Difference +/-
a. Wheat – Monoculture (M_t)			
N_0P_0	7.07	100	-
$N_{120}P_{80}$	7.95	112.4	+0.88
$N_{120}P_{80}$+10 t/ha manure	9.43	133.3	+2.36
b. Maize (W-M)			
N_0P_0	7.26	100	-
$N_{120}P_{80}$	10.83	149.2	+3.57
$N_{120}P_{80}$+10 t/ha manure	11.79	162.4	+4.53
c. Pea (P-W-M)			
N_0P_0	9.72	100	-
$N_{120}P_{80}$	12.17	125.2	+2,45
$N_{120}P_{80}$+10 t/ha manure	15.84	163.1	+6.12
d. Pea (P-W-M-M)			
N_0P_0	7.62	100	-
$N_{120}P_{80}$	12.43	163.1	+4.81
$N_{120}P_{80}$+10 t/ha manure	13.65	179.1	+6.03

Regarding the total content of phosphorus in the wheat seeds, in *Table 5* and *Table 6* we note that neither crop rotation, nutrition regim, nor their interaction led to significant differences, regardless of the quality of the forerunner plant or organo-mineral fertilization, except the pea (3 year crop rotation) when the mineral or organo-mineral ferrtilisation determined more than 10 % increase of the total content of phosphorus.

Table 5

Influence of the crop rotation and nutrition regim on the final content of *Phosphorus* of the seeds in wheat cultivated on luvosoils, Oradea 2010-2011

Observated factor	Total g/100 g.d.w.	Phosphorus %	Difference +/-
a. Crop rotation			
Wheat – Monoculture (M_t)	0.36	100	-
Maize (W-M)	0.36	100	-
Pea (P-W-M)	0.40	111.0	+0.04
Pea (P-W-M-M)	0.36	100	-
b. Nutrition regim			
N_0P_0	0.36	100	-
$N_{120}P_{80}$	0.37	102.8	+0.01
$N_{120}P_{80}$+10 t/ha manure	0.38	105.5	+0.02

Table 6

Influence of the factors interaction: crop rotation x nutrition regim on the final content of *Phosphorus* of the seeds in wheat cultivated on luvosoils, Oradea 2010-2011

Nutrition regim	Total g/100 g.d.w.	Phosphorus %	Difference +/-
a. Wheat – Monoculture (M_t)			
N_0P_0	0.36	100	-
$N_{120}P_{80}$	0.37	102.8	+0.01
$N_{120}P_{80}$+10 t/ha manure	0.36	100	-
b. Maize (W-M)			
N_0P_0	0.36	100	-
$N_{120}P_{80}$	0.36	100	-
$N_{120}P_{80}$+10 t/ha manure	0.37	102.8	+0.01
c. Maize (P-W-M)			
N_0P_0	0.36	100	-
$N_{120}P_{80}$	0.40	111.1	+0.04
$N_{120}P_{80}$+10 t/ha manure	0.44	122.2	+0.01
d. Pea (P-W-M-M)			
N_0P_0	0.35	100	-
$N_{120}P_{80}$	0.36	102.8	+0.01
$N_{120}P_{80}$+10 t/ha manure	0.37	105.7	+0.02

Regarding the total content of potassium in the wheat seeds, in *Table 7 and 8* under the individual influence of both the observed factors and their interactions, we could notice significant difference.

Table 7

Influence of the crop rotation and nutrition regim on the final content of *Potassium* of the seeds in wheat cultivated on luvosoils, Oradea 2010-2011

Observated factor	Total g/100 g.d.w.	Potassium %	Difference +/-
a. Crop rotation			
Wheat – Monoculture (M_t)	0.64	100	-
Maize (W-M)	0.67	104,7	+0.03
Maize (P-W-M)	0.64	100	-
Pea (P-W-M-M)	0.63	98,0	+0.01
b. Nutrition regim			
N_0P_0	0.67	100	-
$N_{120}P_{80}$	0.63	94.0	-0.04
$N_{120}P_{80}$+10 t/ha manure	0.63	94.0	-0.04

Table 8

Influence of the factors interaction:crop rotation x nutrition regim on the final content of *Potassium* of the seeds in wheat cultivated on luvosoils, Oradea 2010-2011

Nutrition regim	Total g/100 g.d.w.	Potassium %	Difference +/-
a. Wheat – Monoculture (M_t)			
N_0P_0	0.62	100	-
$N_{120}P_{80}$	0.65	104.8	+0.03
$N_{120}P_{80}$+10 t/ha manure	0.65	104.8	+0.03
b. Maize (W-M)			
N_0P_0	0.75	100	-
$N_{120}P_{80}$	0.65	86.7	-0.10
$N_{120}P_{80}$+10 t/ha manure	0.65	80.0	-0.15
c. Maize (P-W-M)			
N_0P_0	0.65	100	-
$N_{120}P_{80}$	0.65	100	-
$N_{120}P_{80}$+10 t/ha manure	0.63	96.9	-0.02
d. Pea (P-W-M-M)			
N_0P_0	0.66	100	-
$N_{120}P_{80}$	0.64	97.0	-0.02
$N_{120}P_{80}$+10 t/ha manure	0.58	87.9	+0.08

CONCLUSIONS

A more intense accumulation of the phytomass which determines an intensification of the photosynthesis positively influences the chemical composition of the final product – the grains.

The total content of N in the winther wheat grains was influenced by the crop rotation and the nutrition system. The raw protein content follows the natural way similarly to nitrogen total content being influenced mainly by the crop rotation and the fertilization level.

There weren't observed any essential changes of the total P and K content under the influence of the crop rotation and the nutrition regime.

REFERENCES

1. Bandici, G., E., 1997, Contribuţii la stabilirea influenţei premergătoarei şi a fertilizării asupra dinamicii acumulării biomasei, la grâul de toamnă, cultivat pe soluri cu exces temporar de umiditate, în centrul Câmpiei de Vest a României. Doctoral thesis. University of Agriculture Sciences and Veterinary Medicine Cluj-Napoca, Romania [in Romanian], p.158.
2. Bandici G., E., C., Domuţa, Ileana, Ardelean, 2003, The influence of the forerunner plant, fertilisation level and climatic conditions on the total wet and dry gluten content of winter wheat seeds cultivated on brown luvic soils in the Western Plain of Romania, Lucrări ştiinţifice USAMVB., Seria B, vol. XLV, Bucureşti p. 281-284, p.300.
3. Bandici, G.,,E., P., Guş, 2001, Dinamica acumulării de biomasă la grâul de toamnă. University of Oradea Press, p.107.
4. Boldea, Elena, 1986, Însuşirile de panificaţie a unor soiuri de grâu raionate şi linii de perspectivă, Probleme Agricole, nr.7, p.27-32, p.50.
5. Dincă, D., 1971, Influenţa rotaţiei asupra producţiei, valorificării îngrăşămintelor şi calităţii biologice a recoltelor de grâu şi porumb pe solul brun roşcat de pădure, Probleme agricole, nr.9, p.56-59, p.70.
6. Domuta C**.**, Bandici Gh., Ciobanu Gh., N. Csep, Ciobanu Cornelia, Samuel Alina, Bucurean Elena, Sandor Maria, Borza Ioana, Bunta Gh., Ileana Ardelean, Cr. Domuta,, 2007, "*Asolamentele în Câmpia Crisurilor"*. Editura Universitatii din Oradea, ISBN 978-973-759-350-4, pag. 254.
7. Domuta C**.** , Bandici Gh., Ciobanu Gh. Ciobanu Cornelia, Samuel Alina, N. Csep, Bucurean Elena, Borza Ioana, Sandor Maria, Bunta Gh., Ileana Ardelean**,** Cr. Domuta., 2008, "*Asolamentele in sistemele de agricultur*a*"*, Editura Universitatii din Oradea. ISBN , pag. 297.
8. Hera, C., 1986, Influenţa fertilizării asupra unor indici calitativi ai recoltelor de grâu, Probleme de agrofitotehnie teoretică si aplicată, nr.2, vol.VIII, p.71-76, p.100.
9. Hera, C., 1986, Influenţa unor factori tehnologici asupra calităţii grâului, Cereale şi plante tehnice, nr.7, p.47-52, p.88.
10. Muntean, L.S., S., Cernea, G., Morar, et al., 2008, Fitotehnie, Academic Pres Printing House, Cluj-Napoca, p.83-135, p.224.
11. Oproiu, E., L., Cernescu, 1970, Influenţa îngrăşămintelor chimice asupra calităţii grâului, Probleme agricole, nr.9, p.33-38, p.70.
12. Salisbury F.B., C.W. Ross, 1995 - *Fisiologia vegetale*. Seconda edizione italiana condota sulla quarta edizione americana. Editura Zanichelli..
13. Soltner D., 1990, „*Phytotechnie speciale*", Colection sciences et Techniques Agricoles, Angers.
14. Zăhan, P., R., Zăhan, 1989, Cercetări privind acumularea biomasei vegetale radiculare şi calitatea recoltei obţinute, sub influenţa plantei premergătoare şi a fertilizării la grâul cultivat pe soluri podzolice cu exces temporar de umiditate din Câmpia de Vest a ţării (II). Probleme de agrofitotehnie teoretică şi aplicată, nr. 1, vol. XI, p.237-240, p.300.