B1 VITAMIN AND AMINO-ACID CONTENT IN WHEAT GRAINS AFTER DIFFERENT TYPES OF FERTILIZATION

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Abstract. *The research was conducted in the experimental fields of the Soil Sciences discipline, which is located in B.U.A.S.M.V. "King Michael I of Romania" in Timișoara Didactic Station from Timișoara and after that in the research laboratory of the Agrochemistry Department from the Faculty of Agriculture. This paper aims to observe specific variations in the measurable values of amino acids and vitamin B1 in wheat grain following differentiated fertilization with essential minerals: nitrogen, phosphorus and potassium. The experiments had a factorial design with two factors, with maize – sunflower – wheat rotation. Each plot was sub-divided in four replicates, linear, with the size of 10 x 3 m (30 m^2). The type of wheat used was the Alex Variety, which is zoned for the western part of Romania (West Plain). In order to obtain optimal results, a balance was maintained between mineral fertilisation and analytic agrochemical control, including various agrophytotechnical measures, thus yielding increased efficiency. The experiment took place in the agricultural years 2014 – 2015 and 2015 – 2016, during which the climate was variable, with higher temperatures and slightly less rainfall comparing to the annual average.*

Keywords: *experiment, chemical fertilizers, vitamin B1, amino acids, wheat.*

INTRODUCTION

Plants accumulating nutrients is nor a mere process of summation, as the amount of each nutrient within the plant is in close relation to the plant's metabolism, depending on its biochemical and physiological roles.

Each nutrient plays a specific part in a plant's life and is irreplaceable. The main component of wheat grains is starch, which should have a high concentraion (at least 65-70%). Other components are fermentable sugars, such as sucrose and maltose. They all are of paramount importance for the plant's energy.

Wheat is rich in proteins (7-22%), namely glutenin (35-40%), provitamins (35-45%), globulins (15-20%) and albumin (2-5%). These are vital for the normal development of the human body, having both an energetic and a biocatlaytic role. Almost all essential aminoacids can be found in wheat, but the amount of tyrosine, threonine, lysine and methionine is insufficient for human needs.

Out of all agricultural crops, the most important species is and probably always will be wheat, thus accounting for the majority of cereal cultivation.

MATERIALS AND METHODS

The experience has a two factorial design (4x5) with four replicates, and is placed in sub-divided plots.

Factor fertilization with phosphorus and potassium fertilizer (annually)

a_1 -P_0K_0 - Martor

a_2 -$P_{50}K_{50}$ - (P_2O_5 kg/ha, K_2Okg/ha)

a_3 - $P_{100}K_{100}$ - (P_2O_5 kg/ha, K_2O kg/ha)

a_4 - $P_{150}K_{150}$ - (P_2O_5 kg/ha, K_2Okg/ha)

Factor B -fertilization with nitrogen (annually)

b_1 - N_0 - Martor

b_2 - N_{50}- (N kg/ha)

b_3 - N_{100}- (N kg/ha)

b_4 - N_{150}- (N kg/ha)

b_5 - N_{200}- (N kg/ha)

Fertilizers used in the experiments are complex mineral fertilizer and ammonium nitrate 15:15:15.

Once fertilised, the plants were kept under close observation, with careful attention for changes occurring in the plant itself, as well as sampling for laboratory analysis, in order to detect differences in the grain's components.

The laboratory analysis methods were those commonly used in agricultural chemistry laboratory work:

- the determination of aminoacids was made after hydrolysis with 6M HCl by ion chromatography with an HPLC apparatus DIONNEX;.

- the determination of vitamin B1 was made with liquid chromatography using HPLC-MS Schimadzu.

RESULTS AND DISCUSSIONS

Following fertilisation research in the agricultural year 2015-2016 on experimental wheat crops, we have found the following:

Table 1.

The influence of chimical fertilisers on aminoacid content from wheat grain, 2015-2016 agricultural year

Variant		*Arginine*	*Histidine*	*Isoleu-cine*	*Leucine*	*Lyzine*	*Methio-nine*	*Phenil-alanine*	*Trypto-phan*	*Valine*
Unfertilized		3,4	1,7	2,9	3,6	2,3	0,3	3,6	0,2	3,0
P_{50} K_{50}	N_{50}	3,8	1,9	3,2	3,9	2,7	0,4	3,8	0,2	3,1
	N_{100}	4,0	2,1	3,3	4,1	2,5	0,3	3,9	0,3	3,3
	N_{150}	4,4	2,3	3,3	4,2	2,3	0,5	4,2	0,5	3,4
	N_{200}	4,5	2,4	3,5	4,6	2,2	0,7	4,3	0,4	3,5
$P_{100}K_{100}$	N_{100}	4,4	2,5	3,4	4,5	2,3	0,4	4,2	0,4	3,3
	N_{150}	4,6	2,7	3,6	4,7	2,2	0,6	4,3	0,6	3,5
	N_{200}	4,8	2,8	3,8	4,9	2,0	0,7	4,5	0,4	3,7
$P_{150}K_{150}$	N_{150}	5,0	2,8	3,7	5,0	1,9	0,6	4,6	0,6	3,8
	N_{200}	5,1	3,0	3,9	5,2	1,8	0,7	4,7	0,4	3,9

The aminoacids found in the highest amounts were leucine, arginine and phenylalanine. Those found in the lowest amounts were tryptophan and methionine.

Out of all the usual fertilisers, we found that nitrogen was most influential in terms of variation of protein content and composition. Table 1 shows how a higher dose of nitrogen fertilisers increases the content of aminoacids, without being influenced by potassium of

phosphorus fertilisers. However, there was one exception: lysine content was decreased as the dose of nitrogen fertiliser increased.

Although phosphorus is less effective than nitrogen in terms of aminoacid content, it not only supports the effect of nitrogen, but also attenuates its negative influence in high doses with regard to the amount of amino acids, resulting in the absorbtion of better metabolic forms of nitrogen.

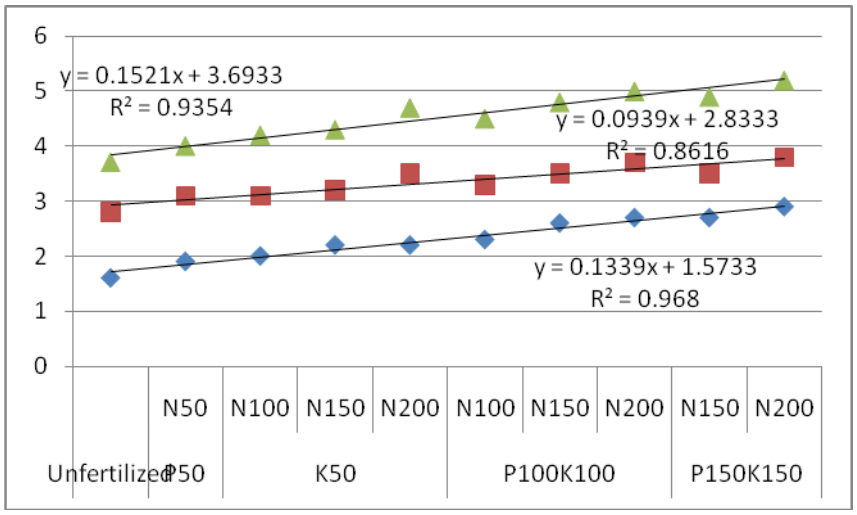

Figure 1. The response curve of histidine, leucine and isoleucine content after application of mineral fertilisers.

Of the three amino acids shown in Figure 1, one can notice that histidine content was most influenced by higher fertiliser doses (97.%), while isoleucine was less influenced (87.67%).

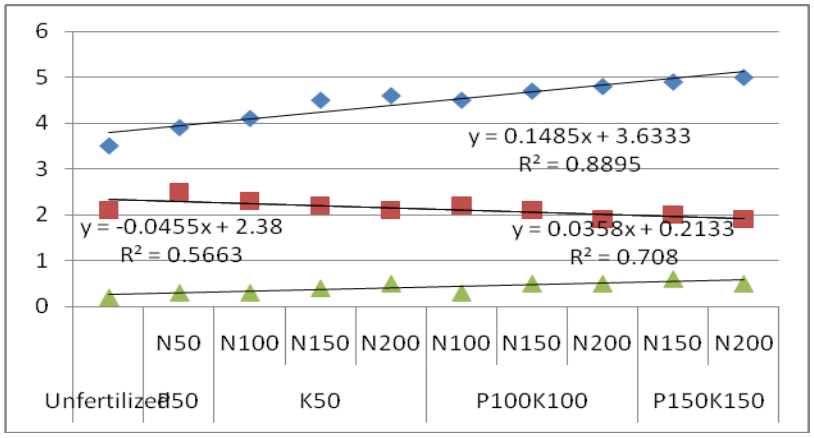

Figure 2. The response curve of arginine, methionine and lysine content after application of mineral fertilisers

Figure 2 shows the upward trend in arginine content (88.9%), with increasing doses of fertiliser.

Lysine content showed a descending trend after application of mineral fertilizers, while the correlation coefficient is had lowest value (0.5663).

Methionine content in wheat grain remained reduced, as the application of complex mineral fertilizers modified it only by 70.8%.

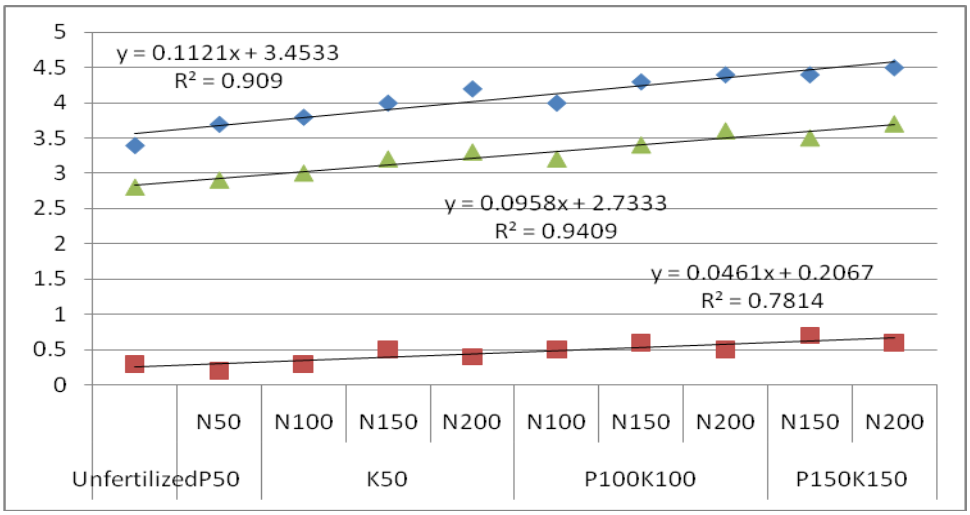

Figure 3. The response curve of phenylalanine, valine and tryptophan content after application of mineral fertilisers

Phenylalanine and valine showed response curves with an increasing trend, as well as correlation coefficients with close values, respectively 0.909 for valine and 0.9409 for phenylalanine.

Wheat grain showed a small amount of tryptophan, as its content was modified at a rate of 78.14% by fertilisation with increasing doses of fertilisers.

Table 2.

Vitamin B1 content of wheat grain after mineral fertilisation

Variant		***B1 mg/100g product***
Unfertilized		0,392
$P_{50}K_{50}$	N_{50}	0,398
	N_{100}	0,402
	N_{150}	0,408
	N_{200}	0,409
$P_{100}K_{100}$	N_{100}	0,423
	N_{150}	0,427
	N_{200}	0,442
$P_{150}K_{150}$	N_{150}	0,474
	N_{200}	0,491

Vitamin B1 content in wheat grain after applying the fertilisation complex varied between 0.392 mg / 100g (unfertilized variant) and 0.491 mg / 100g (fertilised with 200 kg N / ha and 150 kg P2O5 and K2O / ha). The content was higher with increasing doses of fertiliser.

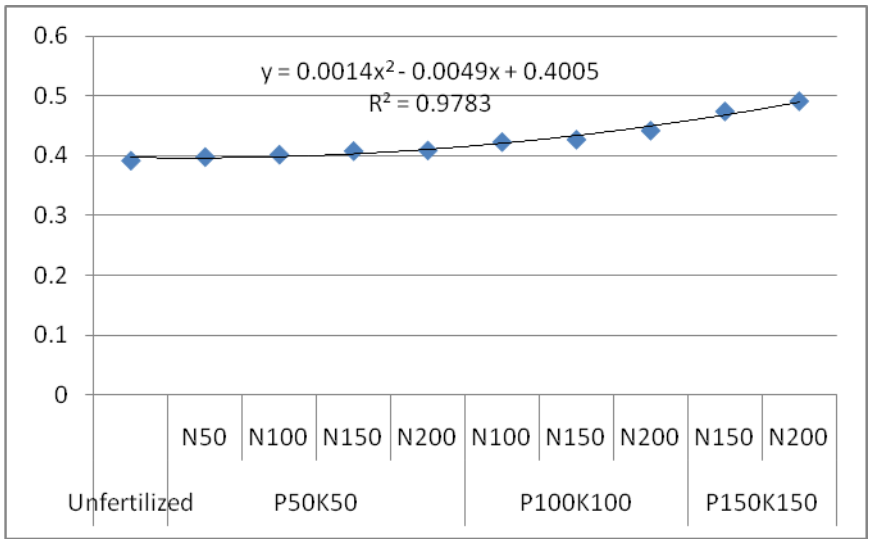

Figure 4. Vitamin B1 content in wheat grain after mineral fertilisation

On the given fertiliser base of phosphorus and potassium, the response curve reveal an upward trend, the correlation coefficient aspiring to 1. The vitamin B1

The correlation ratio of 97,83% shows how a higher dose of nitrogen fertilisers increases the content vitamin B1.

CONCLUSIONS

This study on the influence of mineral fertilisation on wheat cultures has delivered the following conclusions:

Methionine and tryptophan were the aminoacids found in the lowest values, while leucine, arginine and phenylalanine were highest.

Increasing the dose of nitrogen fertilisers will increase the content of aminoacids, while fertilisation with potassium and phosphorus shown no effect. Lysine was the only aminoacid found to decrease as the dose of nitrogen fertilisers increased.

Phosphous is not as effective as nitrogen on the amount of aminoacids directly, but it does have beneficial properties: supporting the effect of the nitrogen itself, as well as attenuating its potential toxicity in higher doses, thus helping the absorbtion of better metabolic forms of nitrogen.

Increasing the dose of nitrogen fertilisers leads to a growth in vitamin content, while potassium and phosphate fertilisers lead to its decrease.

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