

ASPECTS REGARDING THE INFLUENCE OF IRRIGATION REGIME, FERTILIZATION AND BIOLOGICAL MATERIAL ON THE VITAMINS CONTENT IN SOYBEAN CROP IN THE TRANSYLVANIAN PLAIN CONDITIONS

Luca Laura Cristina¹⁾, M. Dirja²⁾, E. Luca²⁾, Cecilia Roman¹⁾, R. Vasiu²⁾, Simona Bârsan¹⁾, Lăcrimioara Șenilă¹⁾, Păunița Boancă²⁾

¹⁾ *Research Institute for Analytical Instrumentation Cluj-Napoca, Romania, Donath Street, no. 67 CP 717, OP 5, 400293 Cluj-Napoca, Romania; lauraluca@yahoo.com*

²⁾ *University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Calea Manastur, 3-5, 400372 Cluj-Napoca, Romania; eluca@usamvcluj.ro;*

Abstract. This paper presents the results of researches regarding the influence of some technology elements on the vitamins content at the irrigated soybean crop, in the Turda area conditions. As a result of the research was shown that irrigation and fertilization applied to the soybean crop had great influence on the content of vitamins C, B6 and B9 in grains, average of the years 2009-2011, leading to an increased content in these vitamins. Of the three varieties tested on the content of vitamins, the best results were obtained at the variety Eugen created at SCA Turda.

Keywords: irrigation, fertilization, genotypes, soybean, quality, vitamins content

INTRODUCTION

Soy is one of the plants with broad uses that can provide future solutions for food but also for the evolution of the planet's energy. Soy is the first in the group of vegetables used for beans due to the high content of protein, fat, lecithin, vitamins and enzymes. It is very hard to find another plant that within such a short growing season, to be able to synthesize such a large amount of valuable substances. In addition to the many uses in the field of energy, food industry and animal husbandry, soy has therapeutic-curative effects, and especially preventive ones, having a good influence on the human body.

Given the importance of the soybean crop prospects and the perspectives that this culture can have in the Transylvanian Plain conditions, we initiated, together with the staff from the disciplines from the Department of Science and Land Measurements from the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, a series of experiences that bring new technological solutions for the area, for the soybean crop. The experiences organized in the Viișoara - Turda, Cluj County, during 2009 - 2011 were analyzed both for quantity and quality, with a particular emphasis on vitamin content in soybeans in relation to the irrigation regime, agrofund and experienced biological material (Giosan și colab., 1986; Mureșanu, 2003; Luca, Budiu, Ana Ciotlăuș, 2008; Luca Laura, 2012; Luca Laura and col., 2013).

MATERIAL AND METHOD

During the experiments organized between 2009-2011 at Viișoara Turda were studied three soybean varieties, widespread in the plains of Transylvania: Onix, Eugen and

Felix. All three varieties were created at the Agricultural Research and Development Station Turda. Onix variety, approved in 2002, is one of the most important achievements of the Agricultural Research and Development Station Turda in soybean improvement.

Eugen variety was approved in 2002, as the Onix variety. It belongs to the genus *Glycine max.* (L) Merril. Its genealogy is *Maple Arrow x Evans*. Eugen variety, created in the same year as the Onix variety, represents significant progress in improving soy, demonstrating both the possibility of increasing the production potential in the group of early adulthood and lifting the insertion point of the first basal pods at a level that provides safety in the case of loss at harvest.

Felix variety, registered in 2005 is the youngest variety at the Agricultural Research and Development Station of Turda. It belongs to the genus *Glycine max.* (L) Merril. Experiences that led to this paper were organized in 2009-2011 and placed in the experimental field of the SC NORA LY AGROSERV SRL Viișoara area-Turda, Cluj County, on a fertile and microrelief uniform land.

The method for placing the experiences was the divided parcels one, with three repetitions ($n = 3$), the number of the tested variants- 18 ($v = 2 \times 3 \times 3$), resulting 54 experimental plots ($N = 18 \times 3$).

During the experimental period were made rigorous tests and observations: *meteorological parameters* - temperature, precipitation, solar radiation, other observations; *soil parameters* - soil type, specific physical and hydro indexes; *plant parameters* - the date of the main phenophases, the date for maintenance works, plant disease and pest resistance, grain yield, etc. Experimental factors studied in experiments conducted during 2009 - 2011 in the Viișoara - Turda area, as well as their graduations, are presented in Table 5.1., variations resulting from combinations of the three factors studied were: Factor A, Irrigation regime, with two graduations - a_1 - non- irrigated, a_2 - irrigated at 50% active moisture range (IUA); Factor B, Fertilization, with three graduations - b_1 - basic fertilization, b_2 - basic fertilization + additional fertilization, b_3 - organic fertilization.

Quality analyzes were performed at the Research Institute for Analytical Instrumentation, ICIA Subsidiary, Cluj-Napoca. In addition to the normal tests, regarding the soy protein content of the samples belonging to variations experienced during the period 2009 - 2011 Viișoara – Turda, was also determined the content in the main metals, as well as amino acids, vitamins and lecithin. In order to determine amino acids, vitamins and lecithin LC-MS/MS method was used.

RESULTS AND DISCUSSION

The results regarding the content of vitamin C in the culture soybeans, realized between 2009-2011 are presented in Figure 1. Analysis of the results on the content of vitamin C in soybeans highlights the following aspects for the three studied varieties.

- *Onix variety*. Was determined the amount of vitamin C in soybeans from 0.0549 mg/kg, the experimental variant $a_1 \times b_1 \times c_1$ (considered the control of the experiments) to 0.0598 mg/kg in the experimental variant $a_2 \times b_2 \times c_1$. According to the values obtained can be said that irrigation and fertilization applied during the growing season lead to a contribution of 8.9%. It is noted that the application of fertilization in graduation b_2 leads to superior results than graduation b_3 .
- *Eugen variety*. Compared to the control $a_1 \times b_1 \times c_2$, through irrigation and fertilization applied during the growing season, Eugen variety registered an increased content of vitamin C. Thus, to 0.037 mg/kg (control), was achieved a

28,4% increase, which characterizes the experimental variant $a_2 \times b_3 \times c_2$ (that is 0.0475 mg/kg). According to the results, both irrigation and fertilization applied during the growing season by contributing to the development of culture leads to increased vitamin C content in the studied soybean variety.

- *Felix variety*. Felix variety also registered the same attitude towards the application of irrigation and fertilization in the determined optimal time. Thus, the comparative analysis to the control chosen for this experiment, $a_1 \times b_1 \times c_3$, the content of vitamin C, of 0.0365 mg/kg with additional fertilizer and irrigation are achieved high values of this parameter, 34.24%, meaning 0.0490 mg/kg recorded by the experimental variant $a_2 \times b_2 \times c_3$.

The results regarding the content of vitamin B6 in the culture soybeans, carried out during the period studied, 2009 to 2011, are shown in Figure 2. Recorded results show the following:

- *Onix variety*. It was determined a content of 0.00166 for control variant chosen for this experiment, graduation $a_1 \times b_1 \times c_1$. The content of vitamin B6 varies in the range of 0.00166 mg/kg - 0.00198 mg/kg in the case of non-irrigation but basic fertilized and in the area of 0.00189 mg/kg - 0.00256 mg/kg for irrigated and extra fertilized variants. Concomitant irrigation and fertilization further lead to increased content of vitamin B6, the best results being recorded in the experimental variant $a_2 \times b_2 \times c_1$ (0.00256 mg/kg).

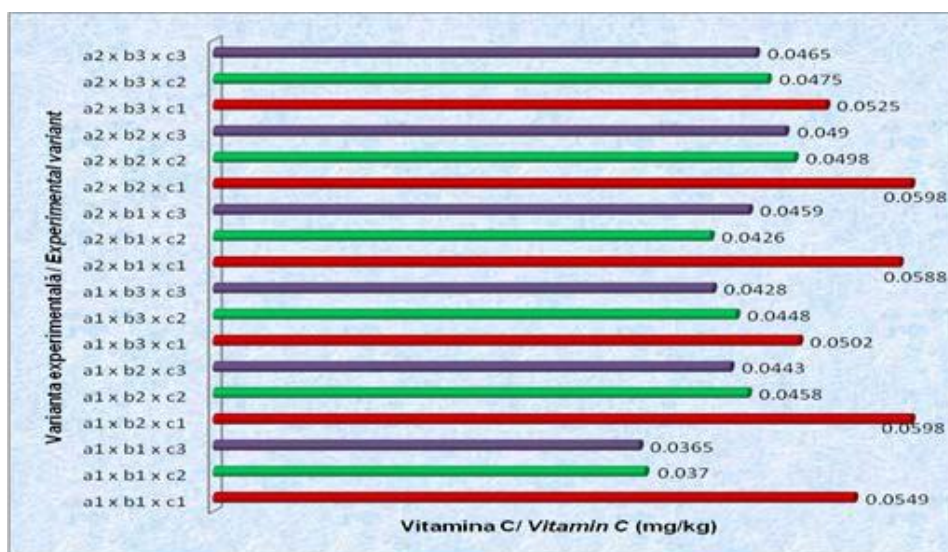


Fig. 1. Vitamin C content in soybeans, the average of the years 2009-2011, realized in the conditions of Viișoara – Turda

- *Eugen variety*. The content of vitamin B6 in the soybean at Eugen variety ranges from 0.00262 mg/kg to 0.0032 mg/kg (experimental variant $a_1 \times b_1 \times c_2$ chosen as the control of the experience. Compared to the control values recorded, the best results were obtained with the experimental variant $a_1 \times b_2 \times c_2$ - 0.0032 mg/kg (22,13%). Application of fertilization in non-irrigation conditions, leads to a variation in the content of vitamin B6- 0.00262 - 0.00275 mg/kg as compared to

application of fertilization in irrigation conditions with variations of 0.00289 - 0.0032 mg/kg.

- *Felix variety*. For this experiment was chosen as the control variant the experimental variant with the graduation $a_1 \times b_1 \times c_3$ (0.00267 mg/kg). Applying of irrigation during the growing season leads to an increase of 14.23% (0.00305 mg/kg), $a_2 \times b_2 \times c_3$ experimental variant, being the best option in this experiment. In conditions of non-irrigation, but fertilization of the culture, vitamin B6 content ranged from 0.00262 to 0.00275; in terms of irrigation and fertilization the content of vitamin B6 was determined to range between 0.00289 - 0.0032.



Fig. 2. Vitamin B6 content in soybeans, the average of the years 2009-2011, realized in the conditions of Vișoara – Turda

Figure 3. presents the results recorded on the content of vitamin B9 determined in the beans of soy culture, realized during the studied period, 2009-2011.

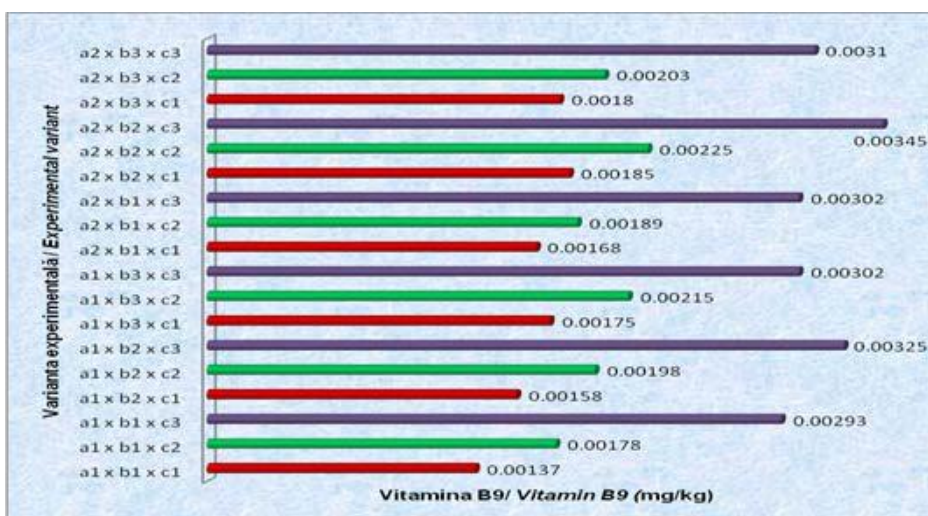


Fig. 3. Vitamin B9 content in soybeans, the average of the years 2009-2011, realized in the conditions of Vișoara - Turda

The content of vitamin B9 in soybeans production on an average of 2009-2011 showed the following trend:

- *Onix variety*. The determined content of vitamin B9 varied in a range of 0.00137 mg/kg - 0.00175 mg/kg in the case of applying fertilization, but in non – irrigation conditions. When applying fertilization and irrigation during the growing period, the content of vitamin B9 ranged between 0.0168 mg/kg - 0.00185 mg/kg. Considering as control variant the variant realized in the graduation $a_1 \times b_1 \times c_1$ (0.00137 mg/kg) it is noticed that the best result is obtained with the variant $a_2 \times b_2 \times c_1$ (0.00185 mg/kg), which means an increase of 35 %.
- *Eugen variety*. Simultaneous application of irrigation and fertilization leads to very good results compared to the control variant chosen for this experiment $a_1 \times b_1 \times c_2$ (0.00178 mg/kg), the best results being obtained with experimental variant $a_2 \times b_2 \times c_2$ (0.00225 mg/kg), meaning an increase of 26.4%.
- *Felix variety*. The content of vitamin B9 varied in the range of 0.00293 mg/kg - 0.00302 mg/kg in terms of non – irrigation of the culture, but applying fertilization. Under irrigation and fertilization conditions this parameter varied in the range of 0.00302 mg/kg - 0.00345 mg/kg. The best variant was obtained with graduation $a_2 \times b_2 \times c_3$ (0.00345 mg/kg) compared to the control variant $a_1 \times b_1 \times c_3$ (0.00293 mg/kg), showing an increase of 17.7% on the content of vitamin B9.

CONCLUSIONS

Irrigation and fertilization applied to soybean crop have a great influence on the content of vitamins C, B6 and B9 in grains, the average of 2009-2011 years leading to an increased content.

The best results were obtained with Eugen variety. The best experimental variant is considered to be $a_2 \times b_2 \times c_2$.

To obtain elevated vitamin content in soybeans is recommended to apply both irrigation and fertilization to the culture in the specific conditions of Viișoara - Turda.

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