

RESULTS OF THE RESEARCH ON THE INFLUENCE OF IRRIGATION REGIME, FERTILIZATION AND BIOLOGICAL MATERIAL, REGARDING THE CONTENT OF METALS ON SOYBEANS, IN THE CONDITIONS OF VIIȘOARA-TURDA

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Abstract. Average production for the entire period, 2009 – 2011, the irrigated variants reached the level of 3269.85 kg / ha and the non-irrigated variants, 2565.15 kg/ha. Registered production growth due to irrigation, the interval 2009 - 2011, was 704.70 kg / ha (27.5%), highly statistically significant difference. Irrigation and fertilization applied on the soybean culture greatly influenced the content of lecithin, vitamins and metals in grains, during the period of research, 2009-2011. Best reaction at the two factors had variety Felix, and then, variety Eugen. Also, the price of soybeans is dictated by the intrinsic quality of grain quality characteristics given above. In the present research has been conducted content analysis on the following metals: sodium (Na), magnesium (Mg), calcium (Ca), manganese (Mn), iron (Fe), copper (Cu) and zinc (Zn) in soy beans for each variant culture conditions experienced in the Viișoara - Turda, the results refer to the average production years 2009-2011.

Keywords: soybeans, production quality, metals in grains

INTRODUCTION

The first particulars of soybeans are in "Pen Ts'ao Kong Mu" which dates from 2838 BC and was written by Chinese emperor Sheng-Hung (MORSE, 1950, quoted by GIOSAN et al., 1986). There is evidence that in our country soybean crop was introduced to the late nineteenth century, being reported since 1876, in some gardens as an ornamental plant (in Transylvania). Given the growing culture in the Transylvanian Plain, here are cultivated with priority soybean varieties developed at the Research and Development Station Turda (VALUȚĂ, 1943; DENCESCU și POPA, 1982; GIOSAN și colab., 1986; MUREȘANU, 2003).

Soybean, compared to other cultures, is considered less demanding in rotation and rotation length (ROBINSON, 1966 quoted by GIOSAN et al., 1986; BEATLY and ELDRINGE quoted by GIOSAN et al., 1986, 1979; GIOSAN, NICOLAE, SIN, 1986). Extensive research on the soy crop technology were developed to ICCPT Fundulea and SCDA Turda, but also to other research stations in the country (DENCESCU et al., 1982). Results obtained at Fundulea chernozems in non-irrigated crop and at Valu lui Traian under irrigation conditions highlights the wheat crop very good as a preceding culture to soybean, lower production being obtained after beet and soybean (DENCESCU et al., 1982; GIOSAN, NICOLAE, SIN, 1986).

MATERIAL AND METHOD

Experimental field was located in the unincorporated village Viișoara, Cluj County, on the left bank of the river Aries, near Câmpia-Turzii town (about 2 km from it), and the european road E60. Overall, 2009 was a warm year, monthly average was $1,3^{\circ}\text{C}$ above average multiannual and in terms of rainfall, the year 2009 is characterized as very dry, but the whole dry periods are alternating very dry and excessively dry with periods of rainy, very rainy and excessively rainy. The year 2010 was characterized as a warm one, with a monthly annual average of $9,7^{\circ}\text{C}$, superior with $0,8^{\circ}\text{C}$ to the multiannual average. 2010 was an excessively rainy year. 2011, as a whole, can be characterized as a normal year. In terms of rainfall, the year 2011 is characterized as very dry, but the whole normal periods are alternating with the dry and the rainy ones.

Soybean crop technology was applied as recommended by the research team of the Research Station - Development Turda. For basic fertilization were administered every year 60 kg / ha N, 30 kg / ha P_2O_5 and 30 kg / ha K_2O and the additional fertilization was done on the seeds with Nitragin to stimulate the formation of the nitrogen fixing nodules on the roots. Organic fertilization was achieved by applying 40 tons of manure on the prior corn crop in a rotation ready for environmental certification of three cultures, namely wheat, corn and soybeans.

During the experimental research was aimed the interaction influence of the experimental factors A- irrigation regime, and B – fertilization, applied during the time of culture vegetation on the quality of soybeans in the conditions of Viișoara - Turda, during the studied period. It is noted that the results presented refer to the average production for 2009-2011. Thus, measurements were made to establish the content of the grains in lecithin, in vitamins (C, B6 and B9), the main amino acids (LSL Alanine, LSL Tyrosine, LSL histidine, glutamic acid, LSL phenylalanine, aspartic acid and glycine) and metals - sodium (Na), magnesium (Mg), calcium (Ca), manganese (Mn), iron (Fe), copper (Cu) and zinc (Zn).

Quality analysis were performed at the Institute for Research and Analytical Instrumentation (ICIA) Cluj-Napoca. Besides the accustomed analysis, the protein content of soybean samples belonging to the variations experienced during 2009 - 2011 at Viișoara - Turda was also determined the main metal, amino acids, vitamins and lecithin content.

To determine the metal was used ICP-MS method. Mass spectrometry involves separation of ions using electric fields and/ or magnetic ones, based on the ratio mass/ electric charge. Elan DRC II (Figure 5.4.) is a mass spectrometer (ICP-MS) with the plasma that is coupled with a quadrupole, which means that, unlike magnetic sector instruments, in this case selection is varying and oscillating electrical parameters of a core set of four bars. Ions are created by an inductively coupled plasma, hence the name of the tool. The first instrument of this type was first marketed in 1983 by Perkin-Elmer company; so far in the world there are about 4000 such instruments.

RESULTS AND DISCUSSION

In the present research has been conducted content analysis on the following metals: sodium (Na), magnesium (Mg), calcium (Ca), manganese (Mn), iron (Fe), copper (Cu) and zinc (Zn) in soy beans for each variant culture conditions experienced in Viișoara - Turda, the results refer to the average production years 2009-2011.

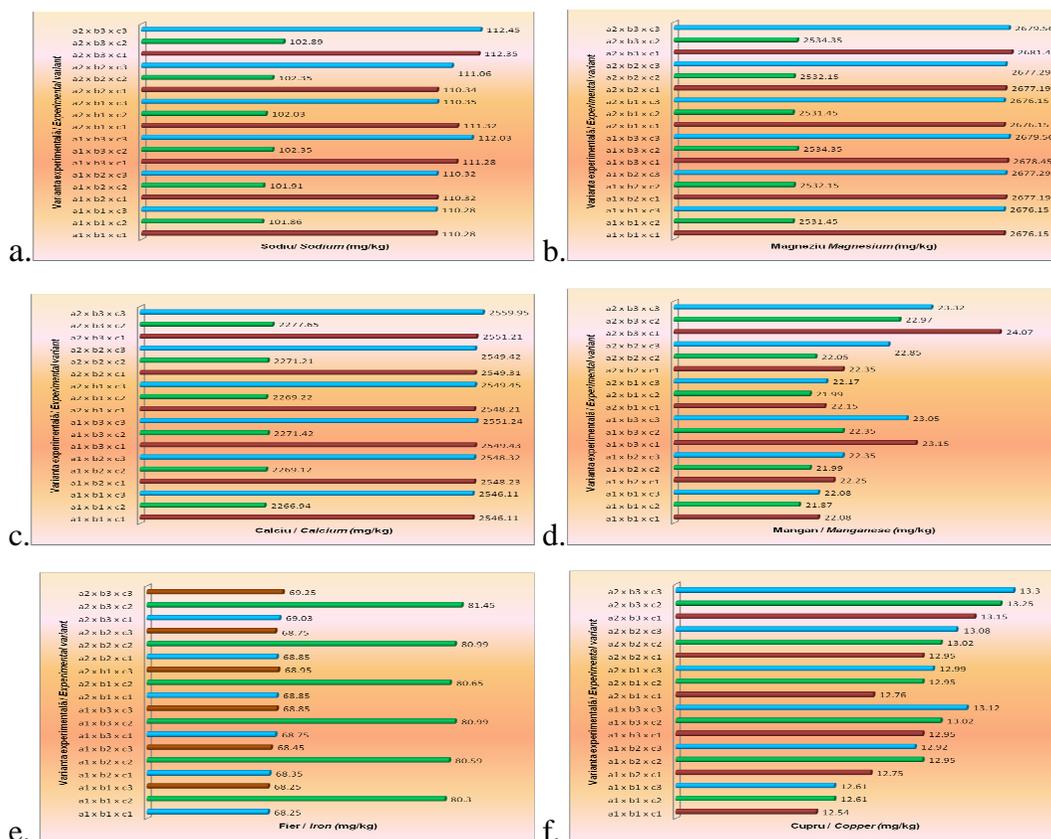


Fig. 1. Content of Sodium (Na) (a), Magnesium (Mg) (b), Calcium (Ca) (c), Manganese (Mn) (d), Iron (Fe) (e), Copper (Cu) (f), in soybeans, the average of the years 2009-2011, realised in the conditions of Vișoara – Turda

Na content in soybeans varies in the range 110.28 mg/ kg (experimental version a1 x b1 x c1) - 112.35 mg/ kg (experimental version a2 x b3 x c1). It is noted an increase in Na content after applying organic fertilizer on both irrigated and non-irrigated crops - 112.03 mg/ kg for the a1 x b3 x c1 version and 112.35 mg / kg, for the experimental version a2 x b3 x c1. Through irrigation and organic fertilization Na content increased by 1.8%.

Eugen variety shows the same trend for sodium content. Thus there is an increased sodium content in experimental variant a2 x b3 x c2 (102.89 mg / kg) compared with control variant chosen a1 x b1 x c2 (101.86 mg / kg).

Considering as a control version for this experiment the variant a1 x b1 x c3 (c3 - variety Felix) has been determined Na content of 110.28 mg/ kg, after fertilization type B3 recorded 110.32 mg/ kg in non-irrigation conditions and a content of 112.45 mg/ kg under irrigation application (corresponding to an increase of 1.9%).

Fig.1. b shows the results for the magnesium content of soybean obtained for the experimental variants that were realized. Analysis results indicate the following.

- *Onix variety*. Determination of Mg in the variety Onix soybeans showed an increase in its fertilization obtained for type B3 applied during the growing season crop irrigation indifferent applied, compared to the control type chosen graduation a1 x b1 x c1 (2676,15 mg/kg). a1 x b3 x c1 version recorded a value of 2678.45 mg/ kg and experimental variant a2 x b3 x c1 recorded a content of 2681.45 mg/ kg.
- *Eugen variety*. In experiments performed, similar trends were observed at Eugen variety. Achieved a high content of experimental variant a2 x b3 x c2 (2534.35 mg / kg) compared to the control chosen in graduation a1 x b1 x c2 (2531,45 mg/kg).
- *Felix variety*. Mg content varies between 2676.15 mg/ kg - 2679.56 mg/ kg (but not applying fertilizer under irrigation) and 2679.15 mg/ kg - 2679.56 mg/ kg (in terms of fertilization and application of irrigation).

Analyzing the results obtained for the years 2009-2011 on average calcium content of soybeans stands next evolution in cultural variants tested. (Fig. 1 c).

- *Onix variety*. Considering the experimental version control variant a1 x b1 x c1 graduation as determined Ca content of 2546.11 mg/ kg for all other experimental variants were recorded significantly higher values. The largest are those obtained in the experimental variants a1 x b3 x c1 (2551.24 mg / kg) and a2 x b3 x c1 (2551.21 mg / kg).
- *Eugen variety*. Compared with control variant chosen, a1 x b1 x c2 (2266.94 mg / kg) Eugen variety showed high values, between all other types of culture experienced, and the highest values of Ca content was obtained at graduation a2 x b3 x c2 (2277.65 mg / kg).
- *Felix variety*. For Ca content in beans, variety Felix values were obtained from 2546.11 mg/ kg (considered version control) pointing out its contents slight increase with the application of irrigation and fertilization type B3 (2559.95 mg/ kg).

Analyzing the results presented in Fig. 1 d, are showed the following aspects of Mn in soybeans in terms of its output in Viișoara-Turda.

- *Onix variety*. Manganese content of cultural variants tested are between limits determined 22.08 mg/ kg (a1 x b1 x c1 control variant) and 24.08 mg/ kg in the experimental variant a2 x b3 x c1, irrigation and fertilization application of B3 causing an increase in the metal content.
- *Eugen variety*. Compared to the control a1 x b1 x c2 containing Mn determined by 21.87 mg / kg, application type b3 fertilization under non-irrigation has led to its increased to 22.35 mg/ kg and under irrigation and fertilization that the same type of 22.97 mg/ kg.
- *Felix variety*. As for the Felix variety, the trend is the same; there is a significant increase in Mn content for type b3 graduation application under non-irrigation (23.05 mg / kg) and 23.32 mg / kg in irrigation conditions compared with its control a1 x b1 x c3 - 22.08 mg / kg.

Looking at Fig. 1.e and results recorded the following findings on the three varieties and associated iron content can be observed:

- *Onix variety*. Determined iron content is low compared to the other metals previously determined. For this experiment was chosen as a control variant a1 x b1 x experimental variant c1 - 68.25 mg / kg. Application during the growing season irrigation and fertilization increase the Fe content. Thus compared to the control, but under non-irrigation fertilization application type B3 recorded a high of 68.75 mg / kg and applying the same type of irrigation and fertilization increase the Fe content up to 69.03 mg / kg.
- *Eugen variety*. Compared to the control selected, graduation a1 x b1 x c2 determined the Fe content of 80.3 mg / kg for variant a1 x b3 x c2 determined content of 80.99 mg / kg and in case of application irrigation and fertilization culture values were recorded in 80.65 mg / kg (graduation a2 x b1 x c2) - 81.45 mg / kg (graduation a2 x b3 x c2).
- *Felix variety*. Felix variety showed a similar pattern with variety Onix. Thus, the control variant (a1 x b1 x c3 graduation) presented a content 68.25 mg / kg and increased to 69.25 mg / kg for graduation experimental variant a2 x b3 x c3.

Fig. 1. f presents the results of measurements on copper Included soybeans for each tested culture variants in the analyzed period, average of the years 2009-2011, in Viișoara – Turda conditions.

Outcomes of copper content of soybeans allow formulation of the following opinions:

- *Onix variety*. Copper content of soybeans ranged in 12.54 mg / kg (a1 x b1 x c1 - version control) - 12.95 mg / kg (graduation a1 x b3 x c1). Application of irrigation and fertilization during the vegetation type b3 increase the Fe content between the values of 12.76 mg / kg (graduation a2 x b1 x c1) and 13.15 mg / kg (graduation a2 x b3 x c1).
- *Eugen variety*. Compared to the control a1 x b1 x c2 with a copper content determined by 12.61 mg / kg, with the application of irrigation and fertilization of the metal content increases so that a2 x b3 x c2 graduation it reaches a value of 13.25 mg / kg.
- *Felix variety*. Felix variety showed a similar behavior with the variety Eugen, with slightly higher values. Compared with the control - graduation a1 x b1 x c3 - 12.61 mg/ kg highest values were obtained for the experimental version x a2 b3 c3 namely x 13, 3 mg/ kg.

CONCLUSIONS

In this thesis, in all three experimental years were used to determine the contents of the following metals: sodium (Na), magnesium (Mg), calcium (Ca), manganese (Mn), iron (Fe), copper (Cu) and zinc (Zn) in soybeans for each variant culture conditions experienced in the Viișoara - Turda.

Following analyzes proved that irrigation and fertilization applied soybean crop large influence on metal content in seeds.

Mainly heavy metal content in grains is due existing heavy metal content in soil. Soil from Vișoara - Turda is a historic soil pollution due to the proximity to Turda, one of the "critical" environmental points of the Transylvanian Plain.

After analyzing the results it is noted that the organic fertilization has an increase of metal content in the grain, so it is recommended that before applying organic fertilization take place in metals from the soil and organic compost to corroborate them.

Eugen and Felix varieties were found to have the highest content in metals compared to Onix variety, averaged over the period 2009-2011.

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