ABSTRACT

The soybean is a crop with a special food value both for the human beings and for the animals. It is important as a food product and in the same time it contributes to the improving of the soil's fertility.

The chemical composition of the seeds, the completely mechanized cultivation technology, the varieties with different vegetation periods have determined the expansion of the soybean all over the world to almost 100 million hectares, out of which 29 million in the United States of America. Due to its special nourishing value, the soybean has been called "the plant of the future" or "the golden crop".

In order to emphasize the economic importance of the soybean crop, it is enough to mention the fact that the world soybean exports amounted to 65.1 million tons in 2003, bringing a total income of 15.6 million U.S. dollars to the exporting countries (according to FAO Statistics, 2005). The greatest soybean exporting countries are: the USA (31.0 million tons), Brazil (19.9 million tons) and Argentina (8.7 million tons). The exports of soybean cake amounted to about 10 billion dollars, that is almost 50 million tons, and the exports of soybean oil amounted to 5.3 billion (10 million tons).

In the same year (2003) Romania exported about 25 thousand tons of soybean seeds and imported 54 thousand.

Glycine max (L.) Merr comes from the wild species Glycine ussuriensis Regel et Maark. The country of origin of soybean is Northern and Central China.

The word ”soybean” comes from the Chinese word ”shiang-yu” which is pronounced ”shoyu” in Japanese. It refers not to the whole plant, but to the soybean sauce. Later on the word changed to so-ya in Japan, and then it was adopted by the countries where the plant was introduced, and the term refers to the whole plant.

The doctor's degree paper contains eight chapters, with x pages, x tables and x pictures. The thesis has two distinct parts.

The first part is a synthesis of the scientific literature regarding the theme of the doctor's degree paper, the natural habitat and the climate conditions during the experiencing years, the material and the methods of research. This part contains x pages, x tables and x pictures.

The second part contains the results of my own research and has 323 pages, 137 tables and 62 pictures.

The experiences took place during three years (2004-2006) on the territory of the Agricultural Society MOLDOVA Tiganasi, the Farm no: 2, Carniceni.

In order to determine the effect of the radicle and extra-radicle fertilizing were installed two trifactorial experiences of the type 6A x 2B x 3C x 4R for the classic and genetically modified soybean. Only the soils used in the two experiences were different, as it follows:

A. FACTOR – radicle fertilizing with six graduations:

- a_1 – N_0P_0
- a_2 – $N_{16}P_{48}$
- a_3 – $N_{32}P_{48}$
- a_4 –$N_{48}P_{48}$
- a_5 –$N_{32}P_{96}$
- a_6 – $N_{48}P_{96}$

B. FACTOR – The variety with two graduations to the classic soybean:

- b_1 - Triumf
- b_2 – Columna

The variety with two graduations to the genetically modified soybean:

- b_1 – AG – 0801- RR
- b_2 – S – 2254 – RR

C. FACTOR – The extra-radicle fertilizing with three graduations:

- c_1 – not fertilized
- c_2 - Folifag 4 litres per hectare
- c_3 – Basfoliar 36 Extra 4 litres per hectare

The experiences were installed according to the method of subdivided parcels, in 4 repetitions, being sowed in lanes of two 30 cm rows, with 70 cm between the lanes and a depth of 4 cm.

For the foliar fertilizing each repetition was divided into three segments, on the whole length, by achieving the C Factor with the c1, c2 and c3 graduations.

The total surface of the experience was 5,760 square metres.

The width of the protection band was of 8 metres, and the width of the access road was of 2 metres.

The sowing was done mechanically with the KLEIN sower / seeder. The applied technology was recommended for the soybean in the region where it was experienced, for the classic soybean and for the genetically modified soybean. During the vegetation period there were made phenological observations and biometrical measurements.

The size of the classic soybean plant increased simultaneously with the increase of NP doses significantly from $N_{48}P_{48}$, the small doses not having a significant effect and inducing the annual fluctuations.

The number of pods on the plant increased more than the size of the plants when increasing the NP doses, beginning with $N_{32}P_{48}$, but in the case of $N_{48}P_{48}$ it recorded annual fluctuations with amplitude of 25 pods on a plant. There were maximum values at the phosphor (P_{96}) and nitrogen (N_{48}) doses.

Under the influence of the NP radicle fertilizers, the correlation between the height of the stem and the number of pods on the plant is positive, parabolic, but the coefficient is not significant.

The size of the plants was insignificantly greater for the variety Columna than for the variety Triumf, but the number of pods on the plant for the variety Columna is not significantly greater for the variety Triumf, by recording smaller annual fluctuations.

The foliar fertilizers increased both the size of the plants and the number of pods on the plants. The product Basfoliar 36 Extra had the best effect, especially regarding the number of pods on the plant.

When the three factors interacted, the greatest height of the stem was obtained with N48P96 x Columna x Basfoliar 36 Extra, and the greatest number of plants on a pod was recorded for the same doses for the variety Triumf x Basfoliar and Columna x Folifag. The correlation between the height of the stem and the number of pods on the plant stayed positive and significant.

The seeds production level of the classic soybean was generally high, with great variations from one year to another. On the average during the three years it was strongly influenced by the NP doses in a positive way, but the differences between the doses increased less favourably in the climatic year.

The production profits obtained with the NP doses were big and increased up to $N_{48}P_{48}$, but decreased insignificantly for the greater doses. The greatest production was generally obtained for another dose in different years, which means that there is a strong interaction between the climatic conditions and the applied NP doses.

On the average during the three years, the two varieties had practically equal productions. But the variety Columna surpassed significantly the variety Triumf only in 2006.

The greatest productions were obtained for the variety Triumf with $N_{48}P_{48}$ x Folifag doses, and for the variety Columna with $N_{32}P_{96}$ x Folifag doses. The content of the seeds in oil depended equally on the climatic conditions of the year and on the applied NP doses. The interaction between these two factors became positive and significant from the $N_{48}P_{4}8$ doses, the greatest value being obtained with $N_{48}P_{96}$ during the three years.

In the case of genetically modified soybean the interaction of the NP doses with the varieties, they reacted in a different way regarding the height of the stem which for the variety AG0801-RR increased only for the $N_{48}P_{96}$ dose, and for S-2254-RR it increased constantly with the increase of the NP doses, very significantly from $N_{48}P_{48}$. The number of pods on the plant increased for both varieties when increasing the NP doses, but more for the variety S-2254-RR, for the N48P48 dose.

For both varieties, both products determined the formation of a great number of pods on the plant, but only Basfoliar 36 Extra had a significant effect for S-2254-RR and very significant for AG0801-RR.

For the variety S-2254-RR the interaction of the NP doses with foliar fertilizers was much stronger than for AG0801-RR, leading to a very significant increase of the plant's stem for the last three doses. Folifag was much more efficient for $N_{48}P_{48}$, and for the big ones Basfoliar. The number of pods on the plant increased beginning with the dose of $N_{32}P_{48}$, generally more with Basfoliar.

The variety AG 0801-RR had the greatest production (3946 kg per hectare) while interacting $N_{48}P_{48}$ x Folifag, and S-2254-RR when interacting $N_{48}P_{96}$ x Basfoliar. The difference from $N_{48}P_{48}$ x Folifag for this variety was of 17 kg per hectare only, therefore the last combination is preferable.

The genetically modified soybean by the great seed production and the high percent of oil and proteins can achieve great productions of oil and proteins: about 800 kg per ha for oil and about 1600 kg per ha for proteins. But they were very much influenced by the fertilizers with the applied NP doses and less by the used varieties.

Starting from the results obtained within this doctor's degree paper, we shall make the following recommendations:

If we take into account only the production results obtained for the two varieties (referring to the seeds production and to the oil and protein production), there is a clear conclusion that the genetically modified soybean is superior to the classic soybean, which it surpasses with 13.2 % for the seed production and 17.1 % for the oil and protein production.

A producer's option for the genetically modified soybean will have to take into account its evolution under the aspect of being accepted or not on the market of the food products.

The genetically modified soybean could be the first option for the producers who do not have financial reserves to purchase fertilizers with nitrogen and phosphor, for those who can apply small doses ($N_{16}P_{48}$), but also for those who practise a more intensive radicle fertilising, with $N_{48}P_{96}$ doses, situations in which the genetically modified soybean surpassed very significantly the classic soybean.

The classic soybean can, in its turn, be the first option when there are bacteria treatments being made and there can be applied $N_{32}P_{48}$, $N_{48}P_{48}$ and $N_{32}P_{96}$ doses which practically have as great productions as those of the genetically modified soybean. Their utilization is safe and the price is increasing, considering the existing protein and oil deficit.

When applying the foliar fertilizing, the two types of varieties reacted weakly after the radicle fertilizing, but there is a significant difference between them favouring the genetically modified soybean (275 kg per ha- 8.5 %). It shows that if choosing the genetically modified soybean, in order to obtain maximum seed, oil and protein productions, the foliar fertilizing is absolutely necessary with any of the two products – Folifag or Basfoliar 36 Extra.

For the classic soybean, but also for the genetically modified one, the interaction between the radicle fertilisers applied in different NP doses and the foliar ones. Therefore their combination is good and its result is always an increase of the seed, oil and protein production, regardless of the NP dose.

The applying of the foliar fertilizers on a radicle not fertilized soil was very favourable and had a good effect on the genetically modified soybean which, after the applying of Basfoliar, surpassed the classic soybean with 629 kg per ha for the seed production and 25-27% for the oil and protein production.

For the $N_{16}P_{48}$ dose without foliar fertilizing, the genetically modified soybean surpassed the most the classic soybean, the positive differences remaining very high when it was combined with Folifag or Basfoliar, although for this dose the classic soybean used well the foliar fertilizers, too but vice versa, better Basfoliar than Folifag.

The greatest production of seeds and the slightest difference between the two kinds of varieties were recorded when associating the $N_{48}P_{48}$ dose with Folifag, combination to which the genetically modified soybean surpassed the classic soybean for the oil and protein production with 3.1 and 7.2 %.

The classic soybean used very well the combination $N_{32}P_{96}$ x Folifag, having almost the same value as the genetically modified soybean, and for the latter the combination N48P48 x Basfoliar was a second successful option, including towards the classic soybean, considering the quality of the seeds and the production of oil and protein.

For the maximum dose – $N_{48}P_{96}$ without a foliar fertilizing, the genetically modified soybean had seed productions with 286 kg greater than the classic one (8.8 %), but the oil and protein production did not increase equally. The difference between the two varieties for this dose stayed high when applying the foliar fertilizers. On the other hand the genetically modified soybean

increased its quality more than the classic one when applying Folifag.

The expenses related to the electrical power are insignificantly greater for the genetically modified soybean than for the classic one (with 60 Mcal per ha). On the other hand the always increased level of the productions makes it more productive from an energetic point of view than the classic one which it surpasses on an average with 3012 Mcal per ha.

The electrical power is not only more reduced for the classic soybean, but it is also very strongly affected by the applied NP dose, varying from 13869 Mcal per ha (not fertilized) until 23743 Mcal per ha for $N_{48}P_{48}$ and decreasing to $N_{48}P_{96}$ in the same time with the electrical power efficiency which had the smallest values.

The NP dose for the genetically modified soybean (that is the electrical power which was spent) influenced less the electrical power budget than the electrical power production, the budget having values from 17-30 Mcal per ha for N0P0 (24.9 % bigger than the classic soybean) and 24926 Mcal per ha for the $N_{48}P_{48}$ dose, only 5 % more than the classic one.

There are no differences between the two kinds of varieties regarding the electrical power efficiency for the total production and for the main one, for the intermediate doses (from $N_{32}P_{48}$ until $N_{32}P_{96}$), the genetically modified soybean surpassing the classic soybean (not fertilised) more for $N_{16}P_{48}$ and much less 0.41 units) for the maximum dose ($N_{48}P_{96}$). On the average, the electrical power efficiency was with 11.3 % greater for the genetically modified soybean than the classic one, a smaller difference than the budget's which was of 15 %.

For both kinds of varieties the foliar fertilizers had a positive influence not only on the electrical power balance sheet but also on its efficiency, succeeding to reduce the differences between them from 15 % to 9.5 %, thus drawing the conclusion that they were more efficient in this way for the classic soybean more than for the genetically modified one, on a ratio with the radicle ones.

Only the electrical power spent with fertilizers (radicle and foliar) was better used by the classic soybean, for the four out of five doses of applied NP, and especially when applying Basfoliar. The balance sheet and the electrical power efficiency of the genetically modified soybean were inferior to those of the classic one, except the $N_{16}P_{48}$ dose and on the average for the five doses, with 25.4 and 21.2 %.

In order to increase the electrical power efficiency of the radicle fertilizers, it is necessary to apply Basfoliar 36 Extra to the classic soybean and Folifag to the genetically modified soybean.

The variety cultivated for the classic soybean influenced the least the seed production. The variety Columna succeeded to stand out by using better small doses of nitrogen and phosphor, as well as the foliar fertilizers, especially Folifag, with oil and protein productions greater than Triumf and with a better electrical power than it.

For a maximum of productive, electrical and economic efficiency at the same time, the combinations Triumf x $N_{48}P_{48}$ x Folifag or Columna x $N_{32}P_{96}$ x Folifag or Columna x $N_{48}P_{48}$ x Basfoliar are preferable.

The foliar fertilizers together with the radicle ones, depending on the doses and the variety cultivated, have proved very useful to the classic soybean, leading to the increase of the seed production, of their quality of the balance sheet and total electrical power efficiency, in this regard Folifag being more useful, and Basfoliar for the $N_{48}P_{48}$ dose.

For the genetically modified soybean, regarding the level of the seed, oil and protein production, of the balance sheet and of the electrical power efficiency, the variety S-2254-RR proved itself to be superior to the variety AG-0801-RR. Therefore for this kind of variety, the first stage to become efficient is to choose the good variety from the existing ones. It is especially preferable when the level of the radicle fertilization is more decreased.

For the genetically modified soybean the reaction to the increase of the NP doses applied radiculary was weaker and it had great productions (not fertilized) or small doses. But the productive efficiency of each kilo in the big doses increased considerably when applying the foliar fertilizers, especially together with the big NP doses. The foliar product is not important for the variety S-2254-RR, but Basfoliar 36 Extra is preferable for the variety AG-0801-RR.

It is necessary to choose the foliar product depending on the variety and on the NP dose. In order to increase the efficiency when using these doses, Folifag must be chosen for the variety AG-0801-RR, with doses of up to $N_{48}P_{48}$. For the variety S-2254-RR although Folifag is preferable, Basfoliar can be used as well.

The quality of the genetically modified soybean seeds is increased, the percent of oil surpassing 20.0 %, and that of protein 40 %, but is is strongly influenced by the climatic conditions throughout the year, by the radicle fertilizer doses, and less by the variety or by the foliar fertilizers. If there is no radicle fertilizing, then the foliar fertilizers represent a safe way to increase it.