Crop Management.
Case Study: Romanian Soybean Production

Silvius STANCIU [1]

Abstract

Soy is a plant adapted to the soil and climatic conditions of Romania, which may bring important benefits for the farmers, animal breeding sector and food industry in Romania. The paper proposes an analysis of the soy domestic sector in European and international context, from the perspective of the crop management. Although Romania has the necessary natural resources, qualified personnel and tradition in soy cultivation, the domestic farming sector cover only part of the internal demand, and more than 70% of the market needs are ensured by imports from partners outside the EU Community. A high percentage of the imported products destined to food come from transgenic soybean cultures, forbidden in the European agriculture. The commercial balance of Romania's soybean foreign trade was strongly misbalanced in the last years, being dominated by import of soy products for animal fodders. The application of national strategies on crop management, meant to support soybean production and processing could reduce the dependency on imports and assure Romania an important position on the European an international market.

Keywords: *soybean, market, crop management, Romania.*

JEL classification: Q16, M21.

Introduction

The soybean production represents an important sector of world agriculture, as soy is considered one of the plants with the widest use in human food, food industry and livestock breeding, being a solution for the future meant to ensure food security and to cover the global energy needs (Luca, 2012). Soy belongs to the genre *Glycine L*. Family *Leguminosae*, sub-family *Papilionoidae*, with more than 25 species cultivated and grown. In our country we encounter especially the variety *Glycine Maxim.max.(L), Merrill.* Soy is one of the oldest cultivated plants in the world. It originally comes from China, where it was known as back as the year 2838 b.C. (Serban, 2008). It has been found references about soy cultivation in Europe in the period 1712-1740, and in the American agriculture starting with 1765 (Gibson and Benson, 2005). Soybean represents an important component of people's diet in

[1] **Silvius STANCIU,** Dunărea de Jos University of Galati, E-mail: sstanciu@ugal.ro

China and other Asian countries (Berk, 1992). In Romania soybeans crops were registered in 1876 in Transylvania, being considered a plant less pretentious and demanding from the viewpoint of crop rotation and rotation duration compared to other vegetal cultures (Luca, 2012). Nowadays, soybean is one of the most widely used raw materials in the world for manufacturing vegetal fats, and the soy extraction residues/ grit constitute the most important protein source for livestock fodder feeding (Thoenes, 2007). Considering the composition, soybeans contain over 30% protein substances and around 17-25% fats, supplying a high quantity of energy for the human metabolism (table 1). The soy proteins are superior to cereal proteins due to a high content of essential amino acids (lysine, methionine, tryptophan etc.). Beside protein, soy seeds contain significant quantities of fatty substances, mineral salts (phosphorus, potassium) and vitamins (the B complex, and C, D, F). According to Deutsche Forschungsanstalt für Lebensmittelchemie (1991), 100 grams of soy seeds could furnish valuable mineral substances to the human organism (Sodium 4 mg, Potassium 1740 mg, Magnesium 245 mg, Calcium 255 mg, Iron 8.6 mg, Phosphorus 590 mg), important quantities of vitamins form the carotenoids group (380 μg), E (1500 μg), K, B1-B6, essential amino acids and non-saturated fatty acids.

Table 1. Composition and energy value of soybeans (dried seeds)/100 g

Energy 1364 kJ (322 kcal)	Lipids 18.1 g
Water 8.5 g	Carbohydrate 6.1 g
Protein 33.7 g	Minerals 4.7 g

Source Deutsche Forschungsanstalt für Lebensmittelchemie, 1991

By processing soybeans are obtained soy flour (used in food industry as soy milk, tofu cheese, soy flakes, coffee assortments with substitutes, chocolate, macaroni, biscuits, or as meat substitute in meat products), soy oil (used for manufacturing margarine, soap, lecithin etc.) or soy extraction residues/grit, resulted from the oil processing (used as livestock fodder). Soybean has compositional characteristics which make it essential in preparing combined fodders, characterized by a high content of proteins (of which 44% digestive proteins), low cellulose (6%), a balanced amino acid composition, rich in lysine, whereas the anti-nutritional factors are on a low level. Soybean may be easily process under the form of pellets and is poor in fibres. A great advance for the animal breeding industry is represented by the relatively low price for a rich protein content.

2. Material and methods

The data concerning the soy production and consumption were selected from the databases of the National Institute of Statistics (NIS), Ministry of Agriculture and Rural Development (MADR), international statistics (FAOSTAT, EUROSTAT) and from relevant press releases. The selected data were statistically analysed and graphically plotted. The results were further interpreted and compared with other items of information from the relevant literature.

3. Soybean world production and crops

In September 2016, the estimations forwarded by Global Soybean Production.Com (2016) based on the data from the United States Department of Agriculture USDA, predicted a yield level for the 2016/2017 season of around 330.43 million MT, with an increase of 17.45 million tons (a percentage of 5.58%) compared to the previous year, when the global harvested quantity was of 312.97 million tons. Approximately 75% of soybean production are used for animal feed. The main soy producers in the world are the USA, Brazil, Argentina and China, areas concentrating almost 90% of the world crops (Thoenes, 2007). China remains world's largest soybean importer, covering 61% of total imports (or 55 million tons) and the country is expected to yearly increase its soy imports (only soybeans) by 5% and buy 50% more by 2020/21, reaching 110 million MT of soybeans imports. In this last period, the main zones from where China has imported soybean were Brazil (top destination, with more than 40% of total Brazilian exports) and Argentina (from where one accounted circa 25% of the total exports). Soybean imports to Asia are expected to grow from approximately 75 million MT in 2009 to 130 million MT in 2019. Meanwhile, imports to non-Asian countries will only grow slightly during the same period (Bunge unpublished data, 2012, quoted by Global Soybean Production.Com. 2016).

The surfaces cultivated with soybean in the world have known a constant positive evolution, increasing by almost 27 million ha in 2007-2014 (figure 1).

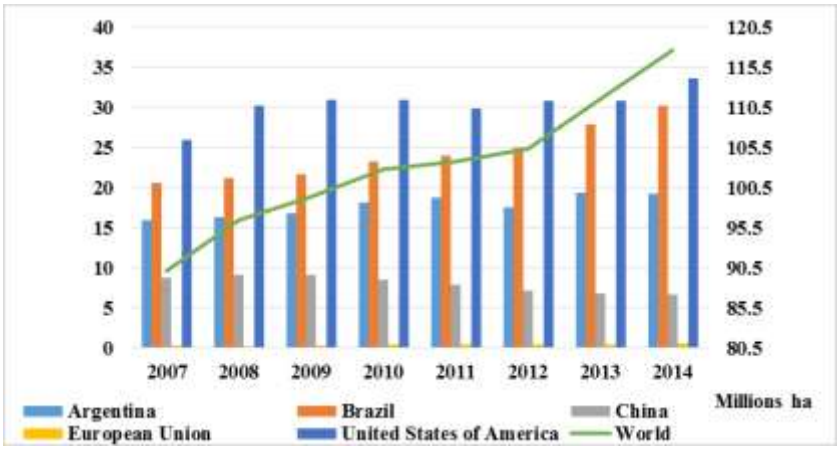

Figure 1. Soybean crop areas in the world (million ha)
Source Author, by using FAOSTAT data (2016)

In the analysis period, the most important growth of agricultural surface allocated to soybean production were recorded in Brazil (by more than 9 million ha), in the USA (7.65 million ha) and in Argentina (3.27 million ha). China is the only area undergoing a drop of the farming surfaces allotted to soy cultures. European Union (EU) is not included in the top of the world producers, having

only 575 thousand ha of soy crops in 2016 (0.4% of the world total) and a total yield of 1,854,598 MT, representing 0.6% of the world crop (Faostat, 2016). The evolution of the world output is presented in figure 2. According to World Atlas estimations (Economic, 2016), in 2016 the largest soybean outputs were obtained in the United State of America USA (114.332 million MT), followed by Brazil (101 million MT) and Argentina (57 million MT).

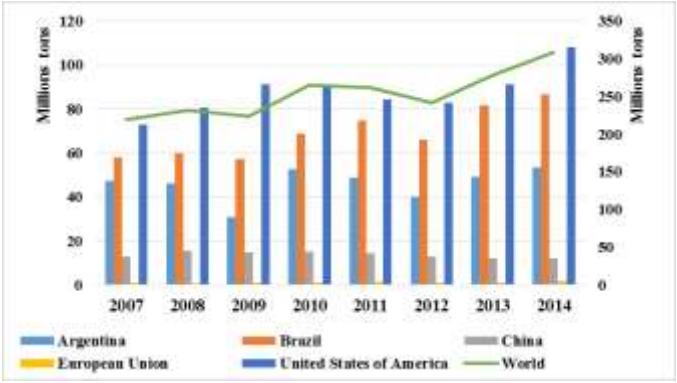

Figure 2. World soybean output by countries (million tons)
Source Author, by using FAOSTAT data (2016)

China (12.5 million MT), India (9.7 million MT) and Paraguay (9.17 million MT) complete the top, and in the last ranked positions we find Canada (5.83 million MT), Bolivia (3.3 million MT) and Uruguay (3.2 million MT).

4. European soy production and commerce

With an annual average yield estimated at 1.6 million tons, Europe does not represent an important soy producer on the international market. The increase of demand for the soy products, especially for the soy flour destined to live stock fodders, leads to the realisation of significant imports especially from the North- and South-American market. EU import approximately 13 million tons of soybean and almost 18 million tons of soybean meal. In 2007, when one reached the maximum level of European soy product imports, we witnessed the penetration to the EU Community market of 24.8 million tons of soy meal, 15.5 million tons of soybeans and almost 1 million tons of soy oil. Compared to 2015, in 2016 the USDA estimations for the European market, quoted by IndexMundi (2016), foresee an increase by around 4.5% of the imports of soy meal (expected to reach 21.7 million tons), a stagnation of soy oil imports (250 thousand tons) and a drop by around 5% of the soy seeds imports (12.6 million tons) (figure 3). In compliance with the European farming policy, the tariffs for livestock fodders are lower than those applied for many other farming products, so that the unit prices for the imported soy flour are relatively low. The demand for soy flour has increased as a result of the interdictions imposed by the manifestation of the epidemics of

spongiform bovine encephalopathy (1990) and due to the fact that fish flour, another potential fodder for animals, is used more and more in fish breeding (World Wide Fund for Nature, 2016). The main suppliers of soy products for the European market are Argentina (for soy extraction residues/grit), Brazil (for soybean), the USA and more recently Paraguay (Martin, 2015).

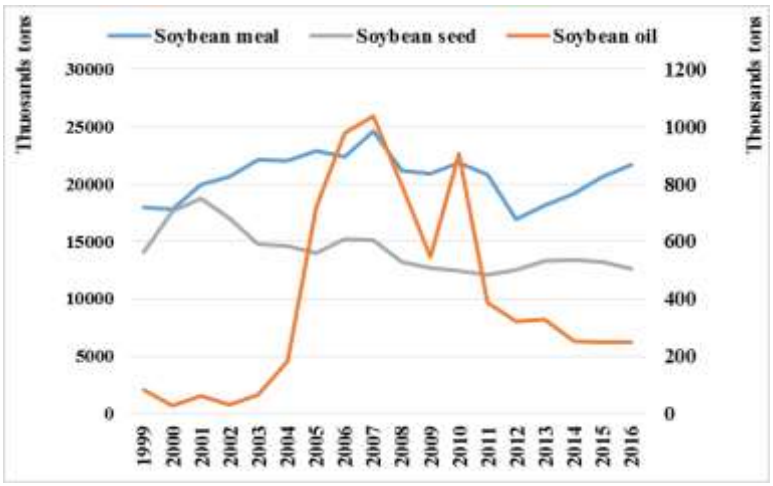

Figure 3. European soy products imports
Source Author, by using IndexMundi data (2016)

In order to reduce the dependency of the European market of imports, the Community Agricultural Policy (CAP) resorted to the promotion of certain programmes of financial support for the conventional soy producers, which led to the increase of the surfaces and soy quantities yielded on the EU (figure 4).

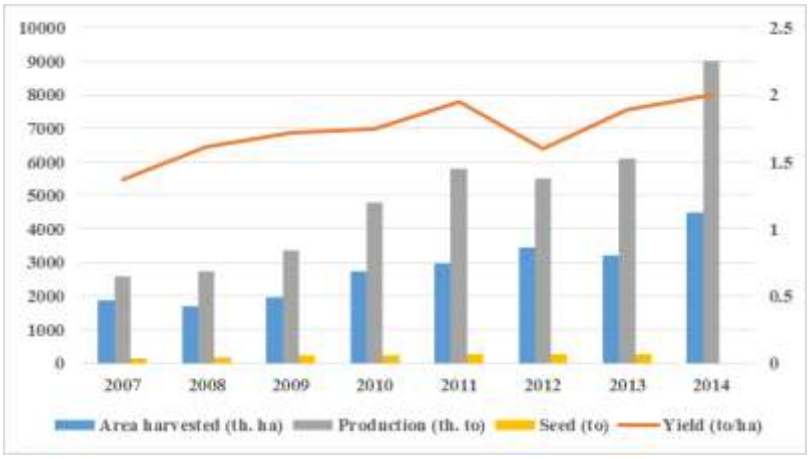

Figure 4. European Soybean Production: Area Harvested, Yield, and Productiveness
Source Author, by using FAOSTAT data (2016)

Although the increase of the surfaces allotted to soy cultures has led to increase of the output, the needs of the food industry and mainly the demand from the part of the zoo-technical sector maintained the European imports at high levels, which exhibited a slightly ascendant trend after the global economic crisis (figure 5).

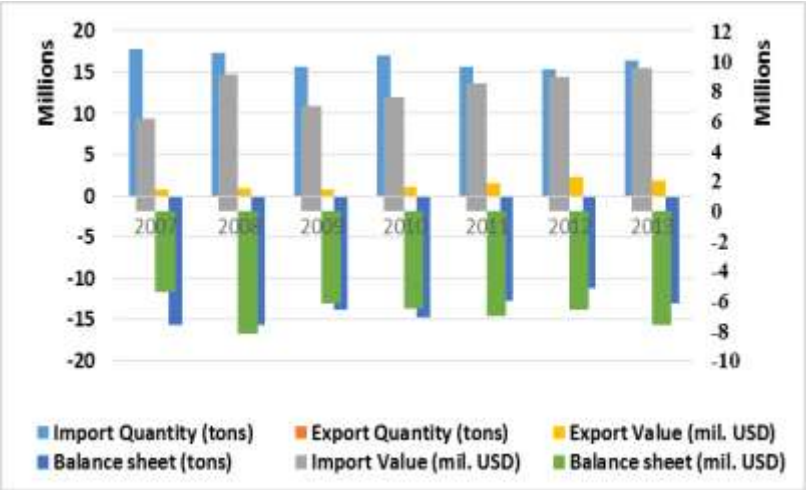

Figure 5. The European soybean market
Source Author, by using FAOSTAT data (2016)

In the analysed period the European commercial balance in the soybean transactions has been permanently misbalanced both from the quantity and from the value points of view. The low percentage on the international market, the preferential customs tariffs for the fodder imports, the increasing demand from the part of the animal breeding sector or the non-uniform European legislation favoured the development of European imports and the neglecting of the domestic sector.

The European countries refuse to cultivate generality modified soy plants, although the imports are made preponderantly from the north- and South-American areas, where they cultivate almost exclusively GM Soybean (Stanciu and Sârbu, 2015). The EU is fundamentally dependent on the genetically modified soybean production, taking into account the imports of vegetal protein for the production of fodders (which supplies approximately 95% of the annual consumption need).

5. Romania's soy production and trade

Romania has natural potential and tradition in soybean culture. At present, the domestic market of soy crops is low, situated at an average annual value ranging between 40 and 75 million euros (State, 2015). Before 1989, Romania was the main soybean producer in Europe, with a surface of around 500,000 hectares allotted to soybean cultures. After the change of the political regime, our country lost this position because of the drastic reduction of its cultivated surfaces, which

reached an all-time minimum level of 43,000 hectares in 2001, followed by period with slight increases, with maximum levels of approximately 133,000 ha (2001-2007), and 128,000 tons respectively (2014-2015) (table 1). The domestic yield is not sufficient to cover internal consumption, and the demand being largely supplied from imports. Romania does not grow GM soybean, the cultures of transgenic plants being forbidden when Romania joined the EU, but the European legislation is permissive as regards its use in livestock fodder feeding, under the form of extraction residues and grit. By the integration into the EU community space, our country lost around 300 million euros annually, representing the exports made with transgenic soybean (Stanciu and Sârbu, 2015). The specialists' opinions related to the growing of GM plants on the territory of Romania are divergent. The first commercial cultures of genetically modified plant (MG) were introduced in Romania in 1998, being represented by genetically modified soy plants (Monsanto). At present the Romanian farmers have grown only genetically modified corn, approved on the European level, but on very low surfaces in these past years. According to the opinion of the Romanian Academy, quoted by Stanciu and Sârbu (2015), there are no important environmental risks associated with transgenic cultures. If the domestic producers were to resume the growing of genetically modified soybean, we could register a 4% economic grow and Romania could become the main soybean trader in the European area (Vârlan, 2015).

Romania complies at present with the European policies in the domain of soybean cultivation, attempting the mitigation of imports by financial support granted to the farmers who cultivate conventional soybean. The national subsidies, starting from 325 euros/ha in 2015, will exhibit an average annual increase of 10 euros/ha, being expected to reach 375 euros/ha in 2020, according to PNDR (Ministry of Agriculture and Rural Development MADR, 2016a).

Table 1 Area Harvested, Yield, Productiveness, and Romanian Farm gate price for soybean

Year	Area harvested (thousand ha)	Output (thousand tons)	Yield (tons/ha)	Average price on the domestic market (RON/ ton)
2007	133.2	136.1	1.021	780
2008	49.86	90.6	1.817	970
2009	48.83	84.3	1.726	960
2010	63.95	149.9	2.345	1230
2011	72.06	142.6	1.980	1300
2012	79,79	104.3	1.308	1710
2013	67.67	149.9	2.216	1830
2014	79.91	202.9	2.539	1430
2015	128.14	262.0	2.062	-

Source Author, by using MADR (2016b) and NIS data (2016)

The quantities of soybean traded by Romania in the period 2007- 2015 according to MADR statistics (2016b) are presented in table 2. Although the increase of the surface cultivated with soybean by 60 % in 2015 was rapidly

reflected in the growth of exports by almost 132%, the commercial balance still remained misbalanced, as Romania imported more than 75 thousand tons of soybean last year (table 2). Except the period 2010-2012, the domestic market was permanently dependant on the soy imports, realised especially from Brazil, Argentina or the USA.

Table 2. Romania's international soybean trade (to)

Year	Export (tons)	Import (tons)	Balance sheet (tons)
2007	22091.12	68558.67	-46467.6
2008	38988.63	94360.25	-55371.6
2009	10445.12	20761.9	-10316.8
2010	36941.9	15626.9	21315.0
2011	72715.6	34387.3	38328.3
2012	89510.3	63324.4	26185.9
2013	38853.5	117276.1	-78422.6
2014	40088.1	102658.5	-62570.4
2015	92944.55	168381.6	-75437.0

Source Author, by using MADR (2016b) and NIS data (2016)

The soy extraction residues/grit used especially for feeding poultry and pigs, represent the main product imported on the national level. The soy product imports realised by Romania in 2014 represent the equivalent of the crop harvested from more than 390 thousand ha cultivated (figure 6).

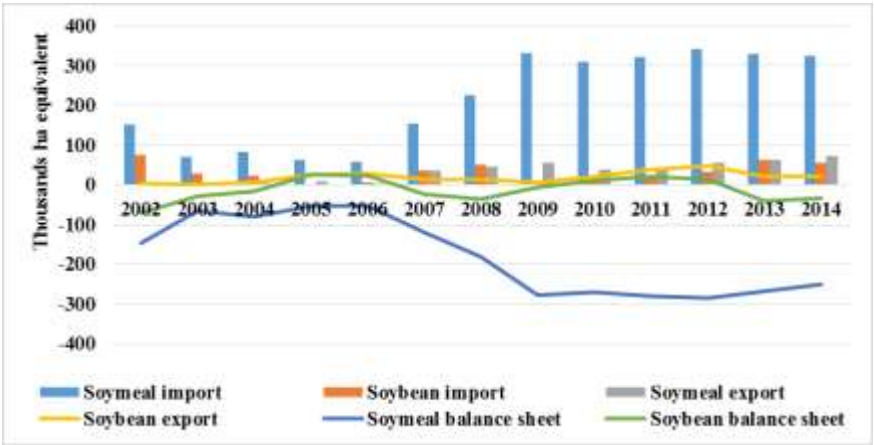

Figure 6. Soybean Market in Romania
Source Author, by using AgroInteligenta data (2015)

The requirements of the fodder in the animal breeding for the period 2015-2020 will lead to a national demand equal to the output from 500 thousand ha, of which only 20-30% ca be covered from the domestic yield (AgroiInteligenta,

2015). The commercial balance in Romania's transactions with soy products is strongly misbalanced, as has recorded losses estimated at 25 and 45 million euros in the last period (figure 7).

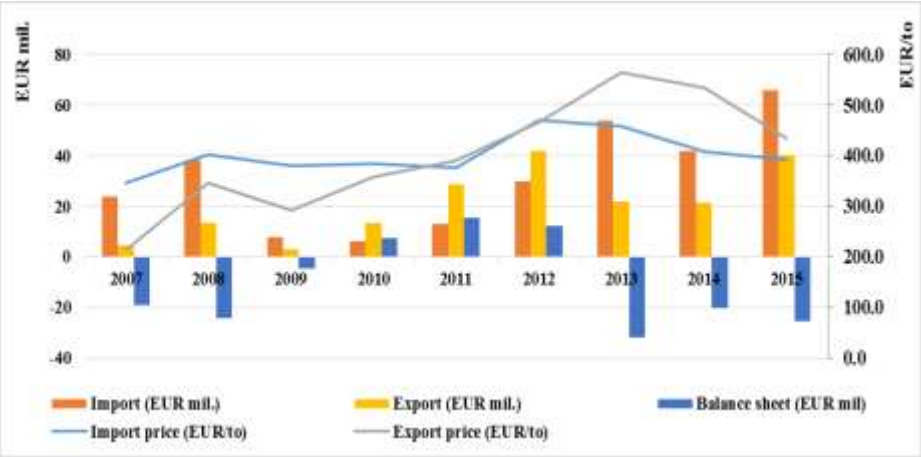

Figure 7. Romania's Trade Balance in Soybean
Source Author, by using NIS data (2016)

The reduction of Romania's commercial deficit in the international trade is a long-term aim for the Romanian authorities, which must be accomplished by a coherent policy of support granted to the domestic producers.

Conclusions

Soybean represents a valuable plant for livestock fodder feeding, food industry and bio fuel manufacture. The soy demand on the international market is continually increasing, taking into consideration the development of human consumption and the need for fodders from the animal breeding sector. The domestic and community consumption of soybean is satisfied mainly from extra-EU community imports from the South - and North-American zones, characterised by the growing of transgenic plants. Although Romania has sufficient natural resources, expertise and qualified personnel, and recorded in the past year important growths of the surfaces cultivated with soybean, the internal demand, due especially to the animal breeding sector, can be covered only in low proportions by the internal crops. The management of programmes destined to the support for the domestic producers or the possibility of cultivating genetically modified soy plants may lead to important economic benefits for Romanian farmers. Romania could benefit from his large agricultural surfaces, from the favourable climate for soy growing, the increase of the demand manifested on the local market, or the reluctance of EU member states related to the transgenic crops. By applying flexible management systems, adapted to international market, Romania could become again one of the main soy-supplying countries in the EU.

REFERENCES

1. AgroiInteligenta, 2015, Study on the fodder import in Romania: The soy surface is limited by the cultures rotation and lack of irrigations. With conventional soy – maximum 29% of the necessary quantity (in original in Romanian), Agro Inteligența (July 29, 2015), [online], Available at: < http://agrointel.ro/37019/ studiu-despre-importul-de-furaje-din-romania-suprafata-cu-soia-este-limitata-de-rotatia-culturilor-si-lipsa-irigatiilor-cu-soia-conventionala-putem-acoperi-cel-mult-29-din-necesar/> [Accessed 01.09.2016].
2. Berk, Z, 1992, Technology of production of edible flours and protein products from soybeans, Food and Agriculture Organization of the United Nations, FAO Agricultural Services Bulletin No. 97/1992, online] Available at :<http://www.fao.org/docrep/t0532e/ t0532e00.HTM > [Accessed 02 September 2016].
3. Faostat, 2016, Statistics division of Food and Agriculture Organization of The United Nations FAO, (August, 2016) [online], Available at: <http://faostat3.fao.org/home/E> [Accessed 02.09.2016].
4. Garching bei München (ed), Der kleine "Souci-Fachmann-Kraut" Deutsche Forschungsanstalt für Lebensmittelchemie, 1991, Lebensmitteltabelle für die Praxis Der kleine "Souci-Fachmann-Kraut" Lebensmitteltabelle für die Praxis, Garching bei München (ed), WVG, Stuttgart Lebensmitteltabelle für die Praxis, WVG, Stuttgart, [online], Available at: <http://www.food-allergens.de/symposium-vol1(2)/data/ soy/soy-composition.htm > [Accessed 01 September 2016].
5. Gibson, L., Benson, G., 2005, Origin, History, and Uses of Soybean (Glycine max), [online], Available at: <http://agron-www.agron.iastate. edu/Courses/agron212/Readings/Soy_history.htm> [Accessed 30.07.2016].
6. Global Soybean Production.Com, 2016, Global Soybean Production (September 2016), [online], Available at: <http://www.globalsoybean production.com> [Accessed 02.09.2016].
7. IndexMundi, 2016, Agriculture. Soybean meal, Soybean oil, Soybean seeds. (August, 2016) [online], Available at: <http://www.indexmundi. com/agriculture/?country=eu&commodity=soybean-oil&graph= imports > [Accessed 03.09.2016].
8. Luca, L.C., 2012, Research on the influence of some technological elements on the level and quality of the irrigated soy yield, in the conditions of the Turda area, Abstract of the PhD Thesis (in original in Romanian), University of Agricultural Sciences and Veterinarian Medicine Cluj-Napoca, Available at: < http://www.usamvcluj.ro/files/ teze/2012/luca.pdf > [Accessed 30.08.2016].
9. Martin, N., 2015, *Domestic soybean to compensate the European protein deficit: illusion or real market opportunity?* OCL 2015, 22(5) D502.

10. Ministry of Agriculture and Rural Development, 2016a, National Programme of Rural Development 2014 - 2020 – 3rd version (20 April 2016), [online] Available at:<http://www.madr.ro/pndr-2014-2020/implementare-pndr-2014-2020/ documente- aprobate.html>, [Accessed 02 September 2016].
11. Ministry of Agriculture and Rural Development, 2016b, Soybean (in original in Romanian), [online] Available at: <http://www.madr.ro/culturi-de-camp/plante-tehnice/soia.html>, [Accessed 02 September 2016].
12. Serban, D., 2008, Cultivation technologies: generalities in soybean culture (in original in Romanian), AgroRomania.ro (28 November, 2008) [online] Available at: <http://agroromania.manager.ro/articole/ stiri/tehnologii-de-cultura-generalitati-in-cultura-de-soia-1268.html> [Accessed 02 September 2016].
13. National Institute of Statistics, 2016, Tempo online, [online] Available at: http://statistici.insse.ro/shop/index.jsp?page=tempo2&lang=ro& context=45 [Accessed 02 September 2016].
14. State, D., 2015, Farmers gather their courage and cultivate soybean starting with this year, Capital (20 March, 2015) [online] Available at:<http://www.capital.ro/fermierii-prind-curaj-sa-cultive-soia-de-anul-acesta.html > [Accessed 02 September 2016].
15. Stanciu, S., Sârbu, R., 2015, "Economic Impacts of GMO"s in the Romanian Food Production", In *Proceedings of the 25th IBIMA conference on Innovation Vision 2020: from Regional Development Sustainability to Global Economic Growth,* Amsterdam, Netherlands (7-8 May 2015), IBIMA Publishing LLC, USA.
16. Thoenes, P., 2007, Soybean International Commodity Profile, World Bank/FAO, [online], Available at: <http://siteresources.world bank.org/INTAFRICA/Resources/257994=1215457178567/Soybean_Profile. pdf> [Accessed 02.09.2016].
17. Vârlan, C, 2015, Romania is getting ready to make a huge-stake decision: do we grow or not genetically modified organisms? There are many advantages, but also several risks (in original in Romanian), *Gândul Financiar* (24 May, 2015) [online] Available at: < http://www. gandul.info/financiar/romania-se-pregateste-sa-ia-o-decizie-cu-o-miza-uriasa-cultivam-sau-nu-organisme-modificate-genetic-exista-multe-avantaje-dar-si-cateva-riscuri-14287124>[Accessed 25 08 2016].
18. World Atlas, 2016, 10 Countries with Largest Soybean Production. Economics (June 8, 2016) [online], Available at: <http://faostat3.fao.org/home/E> [Accessed 02.08.2016].
19. World Wide Fund for Nature, 2016, The market for soy in Europe, WWF Global (September 01, 2016) [online], Available at: <http:// wwf.panda.org/what_we_do/footprint/agriculture/soy/soyreport/the_continuing_rise_of_soy/the_market_for_ soy_in_europe> [Accessed 02.08.2016].