

ROUNDUP READY – (RR) SOYBEAN AND ITS BANNING IMPACT IN ROMANIA

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ABSTRACT

Roundup Ready – RR soybean (GTS-40-3-2, variety of glyphosate - tolerant soybean produced by Monsanto, had been cultivated in Romania since 1999. When Romania joined European Union (1st of January 2007) the cultivation of this kind of soybean has been banned in order to comply with European Union regulation. The impact of the banning of RR soybean are scientifically argued by several researchers and Romanian farmers demand the right to crop this kind of soybean again. However, the European Union policy in this domain is totally against unauthorised crops.

INTRODUCTION

Over the past decades, biotechnology has seen significant progress as a result of findings related to the functioning mechanism of nucleic acids (DNA and RNA) and investigations in the field of molecular genetics.

The primary method used for the introduction of recombinant DNA molecules (transfer) in a host cell genetic transformation. Transgenesis is the process of modifying the genome of an organism as a result of the introduction of new genes "of interest", or due to changes in expression of a / some genes already present in the cell. The organisms thus obtained are called genetically modified organisms (GMOs) or transgenic (Bonea, 2013).

The soybean is one of the most important species from the leguminosae group due the chemical compositions of seeds, rich in proteins and fat substances, and due the multiples use: in human alimentation, animal husbandry, in industry, etc (Matei *et al.* 2008).

Soybean has received various names over time, related to its various uses and it is considered as "golden plant" of humanity, "miracle plant" or "plant of the future" (Ion, 2010).

The success of GM soybean can be explained by the ease of cropping due to GM trait in countries with large fields, particularly for farmers for whom weed management and soil erosion have always been an issue (Berthean and Davison, 2011).

This paper summarizes the impact of the ban on RR soybean cultivation in Romania, due to European legislation, which approved its import for use as food and feed, but not commercial cultivation of RR soy (according to Decision 96/281/EC of 3 April 1996).

Worldwide overview of RR soybean

Genetically modified (GM) soybean has been introduced in 1996, nowadays (2012), it is cultivated in 11 countries (U.S., Brazil, Argentina, Canada, Paraguay, South Africa, Uruguay, Bolivia, Mexico, Chile, and Costa Rica).

Due to its important protein content and the increasing demand for proteins in relation with the intensification of livestock production, the soybean surfaces have dramatically increased in several South American countries, such as Brazil, Paraguay,

Argentina, Bolivia and Uruguay when compared to the surfaces of soybean in the USA, and at a less extent in Canada (James, 2011).

The main exporting countries of GM soybean are USA, Brazil and Argentina (table 1). Worldwide, the European Union imports the largest quantity of soybean meal and China imports the largest quantity of vegetal oil from GM soybean.

However, at a global scale, for soybean there have been approved 22 transformation events in 24 countries, for import, food and fodder. The GTS-40-3-2 event which means tolerant to herbicide has received 48 approvals for reglementation (in 24 countries + EU) (James, 2012).

Table 1

Soybeans and products trade 2011/2012 (millions tonnes)

Country	Meal soybean	Oil soybean	Oilseed soybean
<i>Exports</i>			
Canada	185	66	2.700
United States	8.346	544	36.333
Argentina	28.280	4.145	7.800
Brazil	14.300	1.725	36.700
Paraguay	900	180	3.100
India	4.500	1	20
<i>Imports</i>			
EU -27	21.900	530	11.000
China	150	1.200	57.000
Japan	2.250	20	2.700
Taiwan	58	0	2.250
Mexico	1.550	160	3.400
Thailand	2.500	1.975	2.000

Sources: USDA (2012)

After Brookes and Barfoot (2012), the economic benefits of herbicide-tolerant soybeans for the period 1996-2010 exceed \$ 28 billion. Most revenue was made by USA, Argentina and Brazil (table 2).

Table 2.

GM crop farm income benefits 1996–2010 selected countries: USD million (\$)

Countries	GM HT soybeans	GM HT maize	GM HT cotton	GM HT canola
USA	12,109.00	2,225.00	875.4	225.5
Argentina	11,217.30	314.2	68.6	N/a
Brazil	3,888.30	17.8	36.4	N/a
Paraguay	655	N/a	N/a	N/a
Canada	163.3	57.7	N/a	2,418.90
South Africa	7.2	3.2	2.7	N/a
China	N/a	N/a	N/a	N/a
India	N/a	N/a	N/a	N/a
Australia	N/a	N/a	31.5	13.4

HT - herbicide tolerant

N/a – not applicable

RR soybean in Romania

In Romania, the legislation governing the use of products improved through biotechnology was adopted since 2000 (Oțiman *et al.* 2008).

National Biological Safety Commission, established under the provisions of Government Ordinance no. 49/2000, has officially approved in 2000 the commercial cultivation (for 3 years) Roundup Ready soybean - RR glyphosate - tolerant, the year

when it was cropped on 32 200 ha. However, transgenic soybean was approved for marketing in 1999, when there were cropped 15 500 ha.

Since 2003, the same commission (now National Biosafety Commission - NBC, according to Law 214/2002) has renewed approval for cultivation (for another 3 years) for commercial cropping of transgenic soybean.

Transgenic Roundup Ready soybeans is tolerant to the herbicide active ingredient glyphosate due to gene *cp4epsps* transfer from *Agrobacterium tumefaciens*, this gene determines the synthesis of CP4EPSP enzyme which is insensitive to glyphosate.

In the Official Catalogue of Varieties of Culture in Romania, since 2003, there were written ten varieties of RR soybean and in 2004, 2005 and 2006 there were included fourteen RR varieties (Table 3).

According to data presented by the Information Center GMO, in 2004 (www.infomg.ro/), RR soybean occupies an area of about 50 523 ha in 2005, an area of 87 600 ha and in 2006, an area of 137 275.5 ha (Table 3).

Table 3.

List of RR soybean varieties grown commercially and culture area (2003-2006)

No.	Year			
	2003	2004	2005	2006
1	AG0801 RR	AG0801 RR	AG0801 RR	AG0801 RR
2	AG1602 RR	AG1602 RR	AG1602 RR	AG1602 RR
3	KPG23930 RR	KPG23930 RR	KPG23930 RR	KPG23930 RR
4	PR92B05 RR	PR92B05 RR	PR92B05 RR	PR92B05 RR
5	PR92B21 RR	PR92B21 RR	PR92B21 RR	PR92B21 RR
6	PR92B71 RR	PR92B71 RR	PR92B71 RR	PR92B71 RR
7	S0994 RR	S0994 RR	S0994 RR	S0994 RR
8	S1484 RR	S1484 RR	S1484 RR	S1484 RR
9	S2254 RR	S2254 RR	S2254 RR	S2254 RR
10	SP9191 RR	SP9191 RR	SP9191 RR	SP9191 RR
11		DKB 08-01	DKB 08-01	DKB 08-01
12		DKB 14-01	DKB 14-01	DKB 14-01
13		DKB 20-01	DKB 20-01	DKB 20-01
14		DKB 24-01	DKB 24-01	DKB 24-01
Total area	35 000 ha	50 523 ha	87 600 ha	137 275.5 ha

Sources: www.infomg.ro/

The Treaty of Accession to the European Union, Romania has undertaken to respect European legislation. Since the European Union agreed to import but not cultivate RR soybean, our country had to prohibit the cultivation of this species.

Until 2007, Romania was the third country in Europe (after Russia and Ukraine) largest growing transgenic soybeans and ninth largest country in the world.

Following the ban on GM- soy, most Romanian farmers have abandoned soybean cultivation in general, considering that the instituted subsidies system of remuneration is not enough to compensate for the lack of competitiveness of conventional soybean varieties (Dinu *et al.* 2011).

Since then, there has been a drastic decrease in the area that was cultivated by soybean (table 4), from 190 800 hectares (in 2006) to 48 800 hectares (in 2009) and 70 600 ha in 2011.

Total production fell from 344 900 tonnes (in 2006) to 84 300 tonnes in 2009 and 150 800 tonnes (in 2011).

This decrease in soybean acreage and yields, boosted imports of oilseed, meal and soybean oil from Argentina, Brazil, USA, etc. (table 5), the financial losses being considerable.

Table 4.

Data on area soybean and soybean production in Romania

Specification	MU	2006	2007	2008	2009	2010	2011*
Area	ha	190 800	133 200	49 900	48 800	63 900	70 600
Mean production	kg/ha	1807	1021	1817	1726	2345	2135
Total production	tonnes	344 900	136 100	90 600	84 300	149 900	150 800

Sources: Romanian Statistical Yearbook (2011);

*Data MARD (2012)

Table 5.

The evolution of GM soybean imports in Romania, just after crop banning (2006 -2008)

Year	Oilseed soybean		Oil soybean	
	(to)	(\$)	(to)	(\$)
2006 26 M \$	11 945	4 244 413	81 544	21 851 061
2007 108 M\$	68 600	34 022 346	217 039	74 500 459
2008 210 M\$	94 361	55 512 308	315 012	155 403 943

to: tonnes

Sources: Pamfil and Badea, 2009

If in 2006, imports of soybeans were of \$ 26 million, in 2007 the financial effort has increased to \$ 108 million and in 2008 reached \$ 210 million. After 2008, Romania continued to import soybeans, too (table 6).

Table 6.

The situation on GM soybean imports within 2009-2011 period

Year	(to)	(€)
2009	20 761,90	7 901 100
2010	15 626,9	5 988 300
2011	34 387,3	12 951 400

to: tonnes

Sources: MARD (2012)

The effects of GM soybean crop ban has led to indirect losses to the farmers' profit potential, evaluated by Buzdugan (2011), to € 11,1 million in 2007 and € 19,85 million for the in 2008.

Even though the state subsidies to farmers have increased for cropping conventional soybeans (from € 97/ha in 2007 to € 107/ha in 2008), the economic consequences were dramatic (Otiman *et al.* 2008; Otiman and Ionel, 2011; Dinu *et al.* 2011):

- an additional currency payment of € 60,5 million in 2007 as compared with 2006 (over € 30 million for GM soybean oilseed, almost € 20 million for soybean meal and around € 10 million for soybean oil);

- a supplementary payment of € 117,3 million in 2008, as compared with 2006 (€ 39,3 million for GM soybean oilseed, almost € 58,0 million for soybean meal and € 19,9 million for soybean oil).

The advantages of RR soybean, glyphosate tolerant are (Buzdugan, 2011):

- it allows a wider flexibility to herbicide applying, within a longer period due to lack of risk of plant toxicity;
- three times higher revenue per hectare in comparison with conventional soybean, though the acquisition cost was 15% higher;
- mitigation the production cost and herbicide cost;
- reduction or even eliminating the yield drying and conditioning cost.

The are, also, beneficial effects on the environment consisting of:

- reduction of soil compaction as a result of minimum tillage system;
- diminishing the soil pollution by various herbicides;
- decreasing the fossil fuel consumption and consequently of atmosphere pollution.

After Otiman and Ionel (2011), the GM - RR soybean, besides economical advantages (\$ 11/ton higher income, approximately 10% or \$ 31/ha over conventional soybean), there can be emphasized the following ecological advantages:

- diesel fuel savings of about 20-25 l/ha;
- reduction of CO₂ and burnt gases emissions;
- reduction of soil compaction by eliminating 2-3 passing over the field when apply various herbicides or mechanical hoeing.

CONCLUSIONS

Annually, in Romania there are consumed 400 000 tonnes of meal soybean as fodder but this necessary is only 25% covered by our country. This is why Romania is dependent to importing of proteic fodder for animal husbandry, poultry and pigs. Continuous reducing of surfaces cropped with soybean will determine the increase of imports in the future.

Accounting favorable experience of Romanian farmers with GM RR soybean and, also, the good conditions for cropping this culture, as well as of financial losses because of large imports we should reconsider this kind of crop and reintroduce it for cropping.

By recultivating GM soybean farmers could obtain better income, can easier control weeds and improve soil nitrogen content.

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