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THE POTENTIAL ECONOMIC IMPACT OF THE WESTERN CORN ROOTWORM RESISTANT GM VARIETY ON MAIZE PRODUCTION IN HUNGARY

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Abstract: The paper examines that how the application of the MON88017 GM maize variety could influence the profitability of maize production in Hungary. The most important benefit of this biotech crop lies in its reduced need for chemical use and the additional yield comparing to conventional varieties. Among the economical disadvantages there is the uncertain market of GM products in the EU. After weighing all these factors the results conclude that the farmers could reach an income surplus by growing this GM variety. Although, this surplus is significant only if a similar positive yield impact is achieved under the Hungarian conditions as in the USA.

Key words: GMOs, MON88017, Roundup herbicide

Introduction

The use of genetically modified organisms (GMOs) has seen a rapid development around the World over the last 15 years. The expansion of biotech varieties has been outstandingly fast in North- and South America. But the new technology gains ground in other regions as well.

The only exception is Europe where there is still a strong aversion to the use of biotech crops. Only two GM varieties are approved for cultivation in the EU and their area accounts for less than 0.01% (94.750 ha) of the total arable land (*James*, 2010). This reluctance towards biotech varieties is mainly explained by the fact that European consumers have no trust in the safety of GM products.

Recent studies (*Brookes* 2010, *NAS* 2010, *James* 2010) report great economic benefits delivered by the application of biotech varieties worldwide. These economic advantages are mainly caused by the reduced chemical use and the additional yields of GM plants. Many argue that the EU misses out on much of these gains by refusing the new technology.

This paper aims at studying the economic effects of the lack of GM varieties in Hungary. The report focuses on maize production and examines the potential impact of the MON88017 GM variety. This biotech variety bears the greatest relevance to the Hungarian farmers of all that are expected to receive green light for cultivation within the EU in the foreseeable future.

Objectives

The report aims to assess the possible on-farm economic impact of MON88017 in Hungary. More specifically that how the use of MON88017 could influence the costs and profit of maize production comparing with the conventional technology.

For this purpose the paper identifies all the cost and revenue factors that differ concerning the two technologies. Accordingly, the following elements are examined in the analysis:

1 Price of the technology (extra GM seed cost);
2 Pest management (less chemical use for GM maize)
3 Weed management (less chemical use for GM maize);
4 Administration costs (caused by the special regulation on GMOs)
5 Yield benefits (enhanced productivity of GM crops);
6 Selling price (negative market perception of GM products);
7 Non-pecuniary factors; (benefits of GMOs that are hard to quantify)

Finally, the quantifiable cost and revenue items are added up in a calculation to find out the potential profit impact of the GM technology.

Data on the performance of GMOs is very poor in the EU. Given this limitation the aim of the report is to get an overall picture and weigh the costs and benefits without calculating the exact numbers.

Method

The paper is based on a simple mathematical calculation. To compute the per-hectare extra profit of the GM variety $\Delta\pi_{gm}$ over the conventional technology the model add together the total cost savings ΔC_{gm} and the additional revenue ΔR_{gm} that are caused due to the application of the GM technology:

$$\Delta\pi_{gm} = \Delta C_{gm} + \Delta R_{gm}$$

For the calculation of the total costs C of the technologies (t) the model takes into account only the variable costs that differ concerning the GM technology (t = gm) and the conventional technology (t = k). Accordingly, the paper counts with the seed c_s, weed management c_w, pest management c_i and administration costs c_a. The paper assumes that all the fix costs and the variable costs that are not included in the calculation are constant regarding the two varieties.

$$C_t = c_s + c_w + c_i + c_a$$

To get the variable costs savings ΔC_{gm}, the model simply subtracts the total amount of the differing cost items of the GM technology C_{gm} from these costs of the conventional technology C_k.

$$\Delta \mathbf{C_{gm}} = C_{gm} - C_k$$

The additional revenue of the GM technology ΔR_{gm} is attained through taking the per-hectare revenue of the conventional maize R_k from the per-hectare revenue of the GM maize R_{gm}.

$$\Delta \mathbf{R_{gm}} = R_{gm} - R_k$$

The revenue of either technology R_t is calculated by multiplying the per-hectare yield Y_t and the price P_t of the maize.

$$R_t = Y_t * P_t$$

For the additional yield of MON88017 there is limited data in the EU. Hence the paper needs to rely on research results from the USA where the growing conditions differ from that of the EU. To overcome these limitations in the methodology the model outlines three different scenarios for the size of the additional yield of MON88017 in the EU: a "no yield impact", a "limited yield impact", and a "full yield impact" scenario.

Database

The database for GM maize production relies on various data sources and literature. Of the most important are the following:

- Experimental data on the yield impact of WCR-resistant GM maize in the USA (*Estes* et al. 2005; Mitchell, 2002; *Rice* and *Oleson*, 2005; *Sankula*, 2006; *Johnson* at al., 2008; *Ma* et al., 2009) – used for determining the additional yield of MON88017;
- The results of a poll on the experience of farmers with MON810[1] maize in the Czech Republic (*Kristková*, 2010) – mainly used for assessing the market perception of GM maize;
- A case study on the production of GM maize in Spain (*Brookes*, 2003) – used for calculating the expected technology costs and selling price of biotech maize;
- Personal communication with specialist on GMOs from Monsanto (*Monsanto,* 2010); – used for finding out the possible weed and pest management costs of MON88017.

The underlying data on the conventional maize production in Hungary is based on the sources below:

- Farm Accountancy Data Network (FADN) of AKI (Hungarian Research Institute of Agricultural Economics) – used for calculating the seed cost, yield and selling price of the conventional maize;
- Sales data and personal communication with specialists of relevant companies (e.g.: KITE, Monsanto); – used for finding out the representative practice and costs of weed and pest management of the Hungarian maize producers.

Results

Firstly, the paper gives a short insight in the importance and main characteristics of the MON88017 GM maize variety. Afterwards, all the differing cost and revenue factors are examined one by one according to the structure indicated in the objectives of the report.

MON88017 maize

The specific importance of MON88017 lies in its resistance against one of the most troublesome pests in Hungary: Western corn rootworm[2] (WCR) is responsible for significant yield losses on the maize fields in Hungary and the protection against it entails heavy costs on the farmers. MON88017 could provide an alternative to safeguard effectively the yield against WCR in Hungary. Besides, MON88017 combines the feature of WCR-resistance with glyphosate tolerance. This means that the maize allows the use of the wide-spectrum Roundup[3] herbicide. (Monsanto, 2009)

On the one hand, these underlying characteristics of MON88017 offer many advantages like improved pest and weed management as well as greater and more stable yields. On the other hand, the application of GM crops involves disadvantages, too, mostly in the case of the EU. The special EU regulations on the cultivation of biotech crops narrow the scope for growing GM plants in the member states. Furthermore, many European consumers hold reservations about buying GM products.

All the on-farm economic benefits and drawbacks are to be extensively examined in the following.

Technology cost

The development or the licence fees of GM varieties entails heavy cost for the seed manufacturers. To offset these expenditures the technology suppliers charge a premium for GM seeds over conventional varieties.

[1] MON810 GM variety is currently the only biotech maize that is commercialized for cultivation in the EU. It was developed by biotechnology to be resistant to European Corn Borer (Ostrinia nubilalis).

[2] *Diabrotica virgifera virgifera LeConte*

[3] ***Roundup*** is a trade mark of Monsanto. It contains the active ingredient glyphosate.

Seed expenses regarding the two technologies:

MON88017: There are three sources on which the report base the expected extra seed costs of MON88017 maize:

- The report of the Ministry of Agriculture of the Czech Republic (*Kristkova*, 2010) reveals that the price premium for MON810 GM seed was 36 €/ha[4] (28.5% more than the normal seed price) in 2007.
- GM price premium for Bt maize varieties in Spain was reported to be about 35 €/ha in 2005. (*Brookes*, 2010)
- The regulatory manager of Monsanto Hungaria Ltd. predicts (Monsanto, 2010) the additional price cost of the MON88017 seed at 30–40 €/ha in Hungary.

Based on these data, this report calculates for MON88017 with an **additional 10.000 Ft/ha** (≈35 €/ha) technology cost over the normal seed price.

Conventional: The report uses the FADN database (AKI, 2010) on Hungarian farms for the calculation of the normal technology costs. The value is based on the average seed costs of the Hungarian maize producers in the 5-year term of 2005–2009.

Accordingly, the analysis calculates with a **23.000 Ft/ha** (≈82 €/ha[5]) technology cost (seed cost) for the conventional maize producing practice.

Seed cost:

Conventional	**MON88017**
23.000 Ft/ha	33.000 Ft/ha

Pest management

Controlling strategy against insects significantly differs between MON88017 and conventional maize varieties. These differences appear in the management costs.

Crucial features and expenses of the pest management regarding the two technologies:

MON88017: The resistance against corn rootworm enables the GM variety to be planted without any spray of chemicals against western corn rootworm. However, this resistance affects only WCR and MON88017 needs thus a supplemental seed treatment against other insects that threat the maize yield (e.g.: cutworms, wireworms and white grubs).

This supplemental seed treatment costs around **10.000 Ft/ha.** (KITE, 2010)

Conventional: Although, the most effective and simple means of controlling WCR within the conservative pest management practices is the annual rotation of corn, the rotated fields account for only 30–35% of the total maize areas in Hungary (*Kleffmann,* 2010). The explanation stems from the high profitability of maize production relative to the other plants in the rotation.

The farmers rather tend to grow the maize in monoculture and employ chemicals against WCR. The most effective and wide-spread management practice in Hungary is the soil-applied insecticide treatment with Force[6]. The advantage of Force versus MON88017 is that this chemical kills not only WCR but other soil insects as well.

The pest management with Force costs around **24.000 Ft/ha** (KITE, 2010).

Pest management cost:

Conventional	**MON88017**
24.000 Ft/ha	10.000 Ft/ha

Weed management

Unwanted plants in maize areas are also controlled with different techniques concerning the analyzed technologies.

Key elements and costs of the different ways of weed managements:

MON88017: The feature of glyphosate tolerance of the GM plant provides the farmer with the possibility to treat the GM maize field with the non-selective, broad-spectrum Roundup herbicide. This weed management tool requires less chemical and gives the grower more flexibility.

Monsanto's information (*Monsanto,* 2010) serves as basis for the existing weed management practices and costs for the Roundup technology (see in Appendix).

On the average of these costs we can conclude that the weed treatment with MON88017 makes up around **12.000 Ft/ha**.

Conventional: The figures on weed management costs of conventional practice (see in Appendix) are based on the sales data of the most widespread herbicides in Hungary (KITE, 2010) and the experience of weed management specialists of KITE zRT. which is the leading company with a 35% share on the herbicide market in Hungary.

Based on these figures the report calculates with a **17.000 Ft/ha** cost for conventional weed management.

Accordingly, the farmers could save around 5000 Ft/ha with the GM variety on weed management. This cost difference closely corresponds with the research results of the NCFAP[7] (*Johnson*, *Strom* 2008). The National Center points out to a similar ≈20$/ha (≈4200 Ft/ha[8]) cost save to the advantage of the herbicide tolerant GM maize in its report based on various case studies and interviews with experts in the USA.

[4] The seed cost in the original report was denominated in Czech koruna. It has have been converted to Euro at the annual average exchange rate in 2007 (European Central Bank).
[5] **EUR/HUF exchange rate:** 280.45 (European Central Bank – 01/12/2010)
[6] **Force** is a trademark of Syngenta. Its active ingredient is tefluthrin.
[7] **NCFAP** – National Center for Food and Agricultural Policy
[8] **USD/HUF exchange rate:** 217,76 (Hungarian National Bank – 30/11/2010)

Weed management cost:	
Conventional	**MON88017**
17.000 Ft/ha	12.000 Ft/ha

Administration costs

Every member states have to design its own legislation on the production of GMOs in accordance with the Directive 2001/18/EC[9]. This regulation intends to set conditions for co-existence[10] between GM and non-GM technologies. The law requires farmers to take stringent extra measures. This can put severe constrain on the cultivation of biotech varieties. The most critical elements of the Hungarian co-existence regulation (Act XXVII/1998 on Gene Technology Activities) include:

- **Isolation district around GM field** – allowing for at least 400 meters of field space from the next conventional planting to avoid cross-pollination;
- **Permission of the neighbours** – gaining written approval from all the owners of the adjacent lands for planting GM varieties;

Further actions are advised to take in order to avoid the presence of GM traits in conventional commodities along the whole food chain. These recommendations consist of the followings.

- Reserving machinery and storage facilities exclusively for GM crops;
- Cleaning machinery and storage facilities every time mixing can occur;
- Taking into consideration prevailing wind directions;
- Planting cultivars with different flowering times;
- Planting strips of conventional varieties surrounding GM fields;

Among the recommendations there is to provide refuges for target species with planting non-Bt varieties in or adjacent to the GM fields. The purpose of the refuge is to minimize the possibility of WCR developing resistance to Bt maize.

Difficult to quantify

These rules entail additional costs for the farmers. However, the amount of these extra expenditures is hard to figure because it depends on circumstantial variables that differ from farm to farm. The factors include

- the size of the fields,
- the parcelling of the lands,
- GM content in seed,
- the directions of the prevailing winds,
- the flowering dates of different varieties,
- climatic and geographic conditions.

Conclusions on administration costs

In general, we can assume that large-scale farms have more scope to meet these liability requirements than small holders. Consequently, bigger farms enjoy advantage over smaller ones in the view of this consideration.

It is crucial to mention that the segregation is relevant only in the case if the market make a distinction between GM and non-GM products. The additional effort on keeping technologies apart loses its significance if GM products can be sold under the same conditions as their conventional counterparts. (see more on market perception of GMOs later on)

Regarding to the above-mentioned uncertain factors these technological costs are not included in the calculation. But we cannot completely abandon this aspect if we want to assess the relative on-farm profitability of the GM technology.

Administration costs:	
Conventional	**MON88017**
0 Ft/ha	+? Ft/ha

Yield benefit

Field experiments from the USA reports significant yield benefits in favour of GM technology compared to non-GM varieties on WCR infected areas. The rate of this incremental output primarily depends on the insect pressure and the weather conditions. (*Estes* et al. 2005; *Mitchell*, 2002; *Rice* and *Oleson*, 2005; *Sankula*, 2006; *Johnson* at al., 2008; *Ma* et al. 2009)

A research of the Iowa State University has conducted field trials with various control strategies against WCR at various locations across the USA for three years. The WCR-resistant GM maize averaged 13–15% more grain than the conventional variety treated with Force. The range of the additional yield embraced a wide spectrum, depending on the various weather conditions. In dry climate, the biotech variety delivers a 28–37% positive yield impact relative to Force. Meanwhile in wet conditions this difference accounts for 5–6%. (*Rice* and *Oleson*, 2005)

Conclusion on yield benefits

It has to be noted that data from the USA are not reasonable to adopt for the Hungarian agriculture without any reservation, as many parameters of maize production differ in the two countries. The differences manifest both in the growing systems and climatic conditions.

To overcome these limitations of the methodology, the report outlines tree different scenario to determine the additional yield of MON8817:

[9] **Directive 2001/18/EC** regulates the authorisation process for releases into the environment of GMOs.
[10] **Co-existence** refers to the term of using GM and non-GM cropping systems in parallel with the minimised possibility of mixing.

1 **"No yield impact" scenario** (+0% additional yield) – assuming that the average positive yield impact measured in the USA does not materialize at all under the Hungarian conditions.
2 **"Limited yield impact" scenario** (+5% additional yield) – assuming that the average positive yield impact measured in the USA materializes only to a smaller degree under the Hungarian conditions.
3 **"Full yield impact" scenario** (+15% additional yield) – assuming that the average positive yield impact measured in the USA completely materializes under the Hungarian conditions.

The yield of the conventional technology is based on the average yield of the Hungarian maize producers in the 5-year term of 2005–2009 in FADN database (AKI, 2010).

Yield:
Conventional MON88017 (Scenario 1, 2 ,3)
7 t/ha 7 t/ha 7.4 t/ha 8 t/ha

Market acceptance of GMOs

In the view of profitability it is key as well as controversial question whether GM maize suffers a disadvantage over conventional commodities in the market.

From one point of view the answer is "yes" because the Europeans hold a strong reservation on products labelled as GMOs due to health concerns. As a result GM products are negatively discriminated by consumers in the EU.

The other approach is that this argument is false in the case of GM maize. This is because the bulk of the maize yield is not directly consumed by humans but used in feed and ethanol industries where health risk is irrelevant. Although, feedstuffs have to be indicated to contain GMOs but processed food, such as meat, eggs and dairy products are exempt from labelling. Accordingly, these products are not labelled even if they originate from animals that were fed on GM maize. And in this way these products do not differ from the conventional ones on the shelves of the supermarkets.

To see the question from a practical view it can be useful to examine the experience with the selling of MON810 GM maize variety in Spain and the Czech Rebuplic.

Positive Spanish experience

Spain is the only country among the 27 member states with relatively broad commercial experience on the cultivation of GM maize. Bt maize was first grown in 1998 and it accounted for approximately 75.000 hectares by 2009, making up 22% of the total Spanish maize area (*James*, 2010). These GM fields are largely concentrated in the two regions of Catalunya and Aragon.

PG Economics[11] published a report (*Brookes* and *Barfoot*, 2003) on the economic aspects of the co-existence between GM and non-GM maize in Spain. According to the paper, GM products are sold at normal price and the supply chain does not see a need for segregation. This is mainly due to the fact that the lion's share of the maize is used for feed production and the derivatives of animal products are not required by the law to be labelled.

This view is largely supported by a Greenpeace's campaign paper (*Cipriano* et al., 2006) which lobbies against GMOs. In the study the pressure group criticizes the Spanish government for not treating GM and conventional maize stocks differently but handled as a "single pile". Greenpeace points out that the current labelling requirements do not provide any incentive for segregation and all the maize sold for feed fetch the same price.

This leads us to conclude that GM maize can be sold under normal conditions in Spain.

Negative Czech experience

The Czech Ministry of Agriculture published a report (*Kristková*, 2010) on the cultivation of Bt maize in the Czech Republic. This report includes the results of a questionnaire survey about the experience of farmers with GM maize in the first three years (2005–2007) of commercial use. More than 70 GM maize growers were polled to gain feedback on the performance, advantages and disadvantages of the new technology.

The results of the survey reveal that the farmers often faced difficulties in selling GM products due to general aversion of consumers to GMOs. Moreover, according to the report, many GM growers gave up GM maize due to "problematic" sale and resumed to grow conventional varieties. This is the main reason why the area of GM maize in 2009 dropped after a temporary rise of 3 consecutive years *(Table1)*.

Table. Overviews of GM maize cultivation in the Czech Republic in 2005–2009

GM maize production	2005	2006	2007	2008	2009
Total area (ha)	150	1,290	5,000	8,380	6,480
Year-on-year change (%)	–	760%	288%	68%	-23%
Number of GM growers	51	82	126	167	121
Year-on-year change (%)	–	61%	54%	33%	-28%

(Source: *Kristková*, 2010)

Conclusion on consumer perception

The experience from Spain and the Czech Republic sharply contrast with each other. One sensible explanation for the opposition can be that the growing of GM crops is still in early stages in the Czech Republic and sales of GM products encounter difficulties due to their novelty. But consumer perception on GM products could improve in time, as they gain greater share on the market like in Spain.

[11] PG Economics is an independent advisory and consultancy service in the UK which specific area is to assess the economic and environmental impact of GMOs

This report assumes no consumer discrimination against GMOs in Hungary and calculates with the same selling price for both technologies. However, it is important to note that difficulties with sale could significantly undermine the economic benefits of MON88017.

The selling price is based on the average producer price of 30.000 Ft/t of the Hungarian maize producers in the 5-year term of 2005-2009 in FADN database (AKI, 2010).

Although it is important to note that the price of maize is expected to be higher in the future. According to the data of AKI (AKI PAIR, 2011) the producer price of maize was around 53.000 Ft/t in January 2011 and the outlook report of OECD-FAO (2010) projects the commodity prices to remain high for the next decade.

Producer price:

Conventional	**MON88017**
30.000 Ft/t	30.000 Ft/t

Non-pecuniary factors

The reduced insecticide and herbicide use delivers many benefits in favour of MON88017 that do not appear in the budget but positively affect the farming activity and the environment. The non-pecuniary advantages include the following:

- Reduced exposure of workers to chemicals, ease of use and handling, time and labour savings;
- Using a smaller number of herbicides (this is especially important in the light of the re-assessment of many active ingredients for toxicological and environmental safety under Directive 91/414/EEC);
- Less chemicals released to the environment, which positively affect the quality of water, soil and wildlife;
- Allowing reduced tillage systems linked to resource conservation and less CO2 emission;

Calculation

Below, all the differing variable costs and revenue factors examined in the report are listed and summed up in a calculation.

Differing variable costs:

Cost items	Conservative	MON88017
Seed	23.000 Ft/ha	33.000 Ft/ha
Pest management	24.000 Ft/ha	10.000 Ft/ha
Weed management	17.000 Ft/ha	12.000 Ft/ha
Administration	0	+?
Non-pecuniary factors	0	-?
All differing variable cost:	64.000 Ft/ha	55.000 Ft/ha
Difference in variable costs:	9000 Ft/ha	

Additional net income gained by MON88017 (difference in variable costs + difference in production value):

Revenue factors:

Revenue items	Conservative	MON88017		
		No yield impact scenario	Limited yield impact scenario	Full yield impact scenario
Yield	7 t/ha	7 t/ha	7.4 t/ha	8 t/ha
Producer price	30.000 Ft/t	30.000 Ft/t	30.000 Ft/t	30.000 Ft/t
Production value	210. 000 Ft/ha	210. 000 Ft/ha	222.000 Ft/ha	240.000 Ft/ha
Difference in production value between the normal variety and the MON88017 scenarios		**0 Ft/ha**	**12.000 Ft/ha**	**30.000 Ft/ha**

"No yield impact" scenario:
9.000 Ft/ha + 0 Ft/ha = **9.000 Ft/ha**
"Limited yield impact" scenario:
9000 Ft/ha + 12.000 Ft/ha = **21.000 Ft/ha**
"Complete yield impact" scenario:
9000 Ft/ha + 30.000 Ft/ha = **39.000 Ft/ha**

The results reveal a modest 9.000 Ft/ha income surplus for the MON88017 variety over the conventional technology if the calculation excludes the positive yield impact. However, this premium could amount to 21.000 Ft/ha or even to 39.000 Ft/ha if a moderate or complete yield impact is taken into consideration.

Conclusion

The report focused on the question on how the application of MON88017 could affect the costs and income of maize producers in Hungary compared to the use of conventional maize. The analysis pointed out many differing cost and return parameters for the two technologies. These factors influence the revenue both in positive and negative way. Among them, the following factors have the greatest impact on the relative profitability of MON88017.

- Given the added GM traits, MON88017 allows the farmer to use fewer chemicals and so save money on pest and weed control. As a result, the farmers could cut variable costs by 9.000 Ft/ha with MON88017 despite higher seed price for the GM variety. However, the weightiest positive factor in the calculation is the additional yield of the WCR-resistant GM maize.
- By adding this positive yield impact to the saving in variable cost, the gain could be as high as 39.000 Ft/ha. But this realizes only if the additional yield patterns of the GM variety in the USA are similar to that of Hungary's.
- On the other hand, there are negative aspects of GM maize production that could easily offset a large part of the benefits. Of the most critical of the disadvantages is the negative consumer perception of GMOs in the EU which could create difficulties at the sale of the GM products.
- Other adverse feature of GM plant cultivation is the strict Hungarian co-existence regulation on the production of

GM varieties. It requires rigorous measures from the growers of biotech crops. This regulation affects the small-scale producers more than large ones.

All in all, Hungarian farmers could benefit from the cultivation of MON88017. Though, this benefit is significant only on two conditions:

I. the positive yield impact of the WCR-resistant GM maize measured in the USA materializes in the Hungarian environment;

II. GM maize receives the same market perception as non-GM commodities.

Recommendation

The study points out that there is limited information on consumer perception and the additional yield gain of the GM maize in the EU. Hence, it would be very important to analyse in depth these aspects as it could help to assess the economic effect of MON88017 and other GM crops more accurately.

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Appendix:

MON88017 technology – weed management options (Source: Monsanto):

In case of low weed pressure:

1 3.291–4.388 Ft/ha (Roundup (3-4 l/ha) at 5-6 leaf stage

In case of high weed pressure

1 3.291 Ft/ha (Roundup 3,0 l/ha) at 3-4 leaf stage
2 3.291 Ft/ha (Roundup 3,0 l/ha) at 3-4 leaf stage
or
1 conventional preemergent application
2 3.291–4.388 Ft/ha (Roundup (3-4 l/ha) at 5-6 leaf stage

Machinery and labor costs: 3000-3500 Ft/ha

Conventional technology – weed management options (Source: KITE):

Preemergent treatment:

In case of low weed pressure:

10.000 Ft/ha (Guardian Tetra 3,5 t/ha)

In case of high weed pressure:

12.000 Ft/ha (Adengo 0,4 l/ha);
16.500 Ft/ha (Lumax 4,5 l/ha)

Postemergent treatment:

In case of low weed pressure:

12.000-15.000 Ft/ha Calaris 1,5-2,0 l/ha,
14.000 Ft/ha Stellar 1,0 l/ha

In case of high weed pressure

15.000 Ft/ha (Laudis 2,0 l/ha);
15.000 Ft/ha (Motivell Turbo D 1,0+2,0+0,6 l/ha)
16.000 Ft/ha (Milagro 6 OD 0,75 l/ha +Colombus 1,0 l/ha +Pallos 2,0 l/ha)

Machinery and labor costs: 3000–3500 Ft/ha