

MON 88913

Genuity[®] Roundup Ready[®] Flex Cotton

Second-Generation Herbicide Tolerance

Key facts



Monsanto EMEA

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MON 88913 - Genuity® Roundup Ready® Flex cotton

Cotton

Worldwide, four *Gossypium* species are collectively known as cotton and are grown commercially. These include two diploid species ($2n=2x=26$) *G. arboreum* L. and *G. herbaceum* L., which evolved in Africa and the Middle East, and two allotetraploid species ($2n=4x=52$) *G. barbadense* and *G. hirsutum*, which evolved in the Americas. The major type of cotton being grown commercially around the world is the upland cotton *G. hirsutum*. *G. herbaceum* and *G. arboreum*, are of regional agronomic importance, mostly in areas not suited for *G. hirsutum* or *G. barbadense* (Southeast Asia and the dry, unproductive areas of India and Pakistan) and they comprise less than 4% of the total cotton produced globally. There are no close wild relatives of cotton in the EU.

The fiber, or lint, is used to make cloth—for towels, clothes, sheets, etc. The cottonseeds from the plant are crushed into cottonseed oil, which can be used in everyday items such as cooking oil and salad dressing, and into hulls and meal, which are used for livestock feed.

In 2013/2014 season, the major cottonseed oil, meal and oilseed producing countries in the world were China, India, Pakistan, Brazil and the USA¹. In the EU, cotton is commercially grown in Italy, Spain and Greece.

What is MON 88913 cotton?

Monsanto Company has developed a glyphosate-tolerant cotton product through *Agrobacterium tumefaciens*-mediated transformation. Roundup Ready® cotton (hereafter referred to as MON 88913). The introduces *cp4 epsps* gene in MON 88913 cotton results in expression of the 5 enolpyruvylshikimate-3 phosphate synthase (EPSPS) protein from *Agrobacterium tumefaciens* sp. strain CP4 (CP4 EPSPS), which confers tolerance to glyphosate, which is the active ingredient in Roundup® agricultural herbicides.

MON 88913 cotton expresses the 5 enolpyruvylshikimate-3 phosphate synthase (EPSPS) protein from *Agrobacterium tumefaciens* sp. strain CP4 (CP4 EPSPS), which confers tolerance to glyphosate, which is the active ingredient in Roundup® agricultural herbicides. It is the second-generation glyphosate-tolerant cotton product from Monsanto Company, designed to provide growers with improved weed control through tolerance to higher rates of glyphosate and greater flexibility for glyphosate herbicide application. MON 88913 cotton utilizes chimeric promoter sequences to drive two CP4 EPSPS expression cassettes.

MON 88913 cotton: mode of action

Roundup® herbicides contain the active ingredient glyphosate, a broad spectrum herbicide that acts via inhibition of the protein EPSPS. EPSPS is found

naturally in all plants, fungi and bacteria and is important in the production of essential aromatic amino acids. Inhibition of EPSPS by glyphosate blocks the production of these amino acids, interfering with growth and ultimately leading to plant death (see Figure 1).

MON 88913 cotton plants contain a glyphosate tolerant EPSPS, isolated from the CP4 strain of the common soil bacterium *A. tumefaciens*. The presence of the glyphosate tolerant EPSPS ensures the continued function of the aromatic amino acid pathway, even in the presence of the herbicide glyphosate (see Figure 1). As a result of this genetic modification, MON 88913 cotton is tolerant to glyphosate, allowing its over-the-top use for selective weed control in the crop.

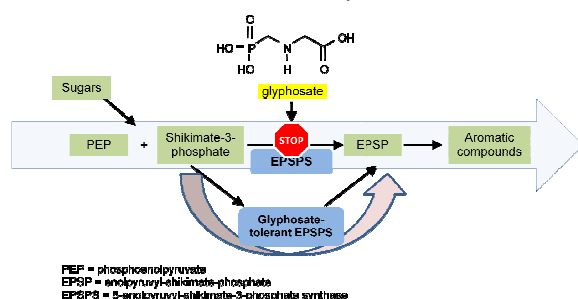


Figure 1: Schematic of the mode of action of the genetic modification in MON 88913

Worldwide plantings and regulatory status of MON 88913 cotton

In 2014, biotech cotton was planted to 25.1 million hectares, which is 68% of the 37 million hectares of global cotton (James, 2014). MON 88913 cotton has received regulatory approvals for cultivation in Australia, Brazil, Colombia, Mexico, Republic of South Africa and the USA and additional import approvals in Canada, China, Colombia, Japan, Korea, Mexico, New Zealand, the Philippines and Singapore². MON 88913 cotton is also part of many stack applications. The first commercial plantings of MON 88913 cotton were in the USA in 2006.

A stringent regulatory system for genetically modified crops in the EU

In the EU, the regulatory system for GM crops comprises several regulations and directives, including Directive 2001/18/EC for deliberate release of genetically modified organisms (GMOs) in the environment (repealing Directive 90/220/EEC) and Regulation (EC) No. 1829/2003 on genetically modified food and feed (replacing Regulation (EC) No. 258/97 on novel foods and novel food ingredients for GM products).

Regulation (EC) No 1829/2003 includes procedures for the authorization of deliberate release (cultivation and/or import and processing), in addition to Food and Feed use, according to the "one door, one key" principle.

¹Source: Foreign Agricultural Service, Official USDA Estimates. <http://apps.fas.usda.gov/psdonline/psdQuery.aspx>

² Genuity, Roundup and Roundup Ready are registered trademarks of Monsanto Technology LLC.

²<http://www.biotradestatus.com/> - accessed 13 April 2015

A regulation on traceability and labeling of GMOs and products produced from GMOs (Regulation (EC) No. 1830/2003) entered into force on 18 April 2004. A regulation laying down the methods of sampling and analysis for the official control of feed as regards presence of genetically modified material for which an authorization procedure is pending or the authorisation of which has expired (Commission regulation (EU) No. 619/2011) entered into force on 24 June 2011.

Regulatory status of MON 88913 cotton in the EU

On 28 February 2007, Monsanto submitted an application for import for food and feed use of MON 88913 cotton as any other cotton (excluding cultivation) under Regulation (EC) No 1829/2003 to European Food Safety Authority (EFSA) via the UK Competent Authority.

The application received the reference number EFSA-GMO-UK-2007-41 and was declared valid on 19 October 2007. EFSA evaluated the application as well as Monsanto's additional information, scientific comments submitted by the Member States and relevant scientific publications. The EFSA published a partially inconclusive scientific opinion on 29 July 2013 (adopted 3 July 2013) (EFSA, 2013), due to incomplete bioinformatics.

Upon provision of an updated bioinformatic analysis, on 13 March 2014 (adopted 26 February 2014) (EFSA, 2014), the EFSA published a complementing statement, resulting in a full positive opinion on MON 88913 cotton, in which the EFSA concluded that MON 88913 cotton "*is as safe and nutritious as its conventional counterpart and commercial cotton varieties with respect to potential effects on human and animal health and the environment in the context of its intended uses*".

On 24 October 2014, the European Commission presented the Draft Commission Implementing Decision authorizing the placing on the market of products containing, consisting of, or produced from genetically modified MON 88913 cotton, to the Standing Committee on Plants, Animals, Food and Feed (PAFF) for a vote. Since no qualifying majority was reached, the draft decision was passed to the Appeal Committee who met for a vote on 28 November 2014, again without reaching a qualified majority. The Appeal Committee forwarded the draft decision to the European Commission. The authorization was finally granted by the European Commission on 24 April 2015 (Commission Decision, 2015), 13 months after the EFSA opinion.

Traceability, labelling, unique identifier

Operators importing, handling or using MON 88913 cotton grain and derived foods and feeds in the EU should be informed of the legal obligations regarding traceability and labelling, laid down in Regulation (EC) No. 1830/2003. The unique identifier of MON 88913 cotton is MON-88913-8.

The validated methods, as well as the validation report for MON 88913 cotton, prepared by the CRL in collaboration with the European Network of GMO Laboratories (ENGL), were published on May 06,

2009 at the CRL website³. A report on the validation of the DNA extraction method for cotton seeds was also published on the same date.

Food, feed and environmental safety of MON 88913 cotton

Food and feed safety

The food and feed safety of MON 88913 cotton was established through:

- A detailed molecular characterization of the inserted DNA confirming a single copy to the T-DNA was inserted,
- An assessment of the toxic and allergenic potential of CP4 EPSPS, based upon the long history of safe use of the CP4 EPSPS protein, the rapid digestibility of the CP4 EPSPS protein and the lack of toxicity or allergenicity of the CP4 EPSPS protein, as demonstrated with bioinformatics as well as *in vitro* and *in vivo* safety studies with the protein,
- The compositional and nutritional analyses confirmed that MON 88913 cotton is compositionally and nutritionally equivalent to, and as safe as, those of conventional cotton,
- A large margin of safety resulted from the low dietary exposure to the CP4 EPSPS protein,
- A dietary risk assessment showed that the intake of the introduced CP4 EPSPS protein resulting from consumption of foods derived from MON 88913 cotton do not raise nutritional concerns. The dietary safety of MON 88913 cotton was further confirmed by repeat-dose animal feeding studies in rat and catfish.

Further details on the safety of MON 88913 cotton are available in a product safety summary on Monsanto's website⁴.

Environmental safety

The environmental safety of MON 88913 cotton was established through extensive field trials conducted in 2002, 2004 and 2010 in the USA and laboratory studies. All these field trials demonstrated that MON 88913 cotton poses negligible risk to human health or to the environment. Results of the phenotypic and agronomic assessment showed that there are no unexpected changes in the phenotype or ecological interactions indicative of increased pest or weed potential of MON 88913 cotton compared to the conventional cotton control. Data on environmental interactions also indicate that MON 88913 cotton does not confer any biologically meaningful increased susceptibility or tolerance to specific disease, insect, or abiotic stressors, or changes in agronomic and phenotypic characteristics.

On the basis of these studies, it is possible to conclude that no differences in the mode or rate of reproduction, dissemination, survivability or other agronomic, phenotypic or ecological characteristics are expected in MON 88913 cotton and that MON 88913 cotton is not different in its phenotypic and agronomic behaviour relative to conventional cotton.

³<http://gmo-crl.jrc.ec.europa.eu/StatusOfDossiers.aspx> - accessed December 08, 2014

⁴http://www.monsanto.com/products/documents/safety-summaries/flex_cotton_es.pdf - accessed April 27, 2015.

Moreover, considering the scope of the application, excluding cultivation, potential interactions of MON 88913 cotton with non-target organisms and the abiotic environment were not considered to be an issue due to the low level of exposure. The herbicide tolerance trait in MON 88913 cotton can be regarded as providing only a potential agronomic and selective advantage for this GM cotton plant where and when glyphosate herbicides are applied. Moreover, there are no close wild relatives of cotton in the EU.

MON 88913 cotton, the benefits

In countries where MON 88913 cotton is grown, a number of benefits for both farmers and the environment are expected. These include:

- A new broad-spectrum weed control option in cotton and increased flexibility to treat weeds on an “as needed” basis,
- The opportunity to replace several selective herbicides by a single broad-spectrum herbicide with a favourable human health and environmental profile. The active ingredient glyphosate is non-persistent and has limited mobility as it binds tightly to soil. The compound presents very low toxicity to humans. Furthermore, it does not bioaccumulate and presents minimal risk to terrestrial and aquatic species including fish, birds, mammals and invertebrates,
- Spraying over the top past the fourth-leaf stage, which can reduce dependence on shields or hooded sprayers and enhanced crop safety during sensitive cotton reproductive stages,
- Ability to tailor herbicide applications to weed height or stage instead of the cotton stage of development.

Further reading

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