MON 531

Bollgard® Cotton

Insect protection

Key facts

Monsanto EMEA

May 2015

MON 531 - Bollgard® 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 US[1]. In the EU, cotton is commercially grown in Italy, Spain and Greece.

What is MON 531 cotton?

Monsanto Company has developed the Bollgard® cotton product (hereafter referred to as MON 531) through *Agrobacterium tumefaciens*-mediated transformation. MON 531 expresses an insect control protein (Cry1Ac) derived from the naturally occurring soil bacterium, *Bacillus thuringiensis* subsp. *kurstaki* (*B.t.k.*). Production of the Cry1Ac protein in the MON 531 cotton plant provides effective season-long protection against key Lepidopteran insect pests.

MON 531 expresses the Cry1Ac protein, which provides protection against key Lepidopteran insect pests, including tobacco budworm, pink bollworm and cotton bollworm. MON 531 also contains the *neomycin phosphotransferase II* (*nptII*) gene which provides a plant selectable marker; and the *3'(9)-O-aminoglycoside adenylyltransferase* (*aad*) gene, a bacterial selectable marker. The *cry1Ac* and *nptII* genes are expressed in the plant; the *aad* gene-product is not produced in the plant as this gene is under the control of a bacterial promoter.

MON 531: mode of action

Insecticidal activity of the Cry1Ac protein requires that the protein is ingested. In the insect gut, the protein is proteolytically cleaved to the active core of the protein. The core protein binds to specific receptors on the mid-gut of lepidopteran insects, inserts into the membrane and forms ion-specific pores. These events disrupt the digestive processes and cause the death of the insect. The digestive tract tissues of non-target *e.g.* insects, mammals, birds and fish do not contain receptors that bind the Cry1Ac protein. Therefore, the Cry1Ac protein cannot disrupt digestion and is non-toxic to species other than lepidopteran insects.

The Cry1Ac protein produced in Bollgard cotton is nearly identical in structure and activity to the Cry1Ac protein found in nature and in commercial *B.t.k.* microbial formulations. Microbial formulations of *Bacillus thuringiensis* that contain the Cry1Ac insecticidal protein have been safely used for control of lepidopteran insect pests for more than 40 years.

Worldwide plantings and regulatory status of MON 531 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 531 has received regulatory approvals for cultivation in Argentina, Australia, Brazil, China, Colombia, India, Mexico, Republic of South Africa and the US and additional import approvals in Canada, China, Colombia, EU, Korea, New Zealand, Mexico, the Philippines, and Singapore[2]. MON 531 is also part of stack applications. The first commercial plantings of MON 531 cotton were in the US in 1996.

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.

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 531 cotton in the EU

Foods and food ingredients

On 24 July 2002, Monsanto notified to the European Commission the placing on the market of foods and

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

[2] http://www.biotradestatus.com/ - Accessed 13 April 2015

food ingredients derived from MON 531, specifically cottonseed oil, according to Article 5 of Regulation (EC) No 258/97 on novel foods and food ingredients, on the basis of an opinion of substantial equivalence delivered by the UK Advisory Committee on Novel Foods and Processes (ACNFP). On 19 December 2002, the Commission forwarded the notification to the Member States and, this date can be considered as the date on which these foods and food ingredients were first placed on the EU market. As such, oil and its constituents produced from MON 531 have been lawfully placed on the market according to Articles 8(1)(a) and 20(1)(a) of Regulation (EC) No 1829/2003.

Feed materials, feed additives and food additives

Feed materials, feed additives and food additives produced from MON 531 were first placed on the market in the EU in 1996, following the commercial introduction of MON 531 varieties in the US in 1996. Foods produced from cotton MON 531 (food additives) were authorised under Directive 89/107/EEC, while feed produced from cotton MON 531 (feed materials and feed additives) were subject to Directive 70/524/EEC.

After the date of entry into force of the Regulation (EC) 1829/2003, the products mentioned above were notified to the European Commission according to Articles 8(1)(a), 8(1)(b) or 20(1)(b) of this Regulation and subsequently included in the Community Register of GM food and feed.

Renewal application for use of food additives, feed material and feed additives

On 17 April 2007, Monsanto submitted a renewal application for use of food additives, feed material and feed additives produced from MON 531 cotton as any other cotton under Regulation (EC) No 1829/2003 to European Food Safety Authority (EFSA) via the European Commission. On 16 June 2011, Monsanto added also the use of existing foods (oil) to the scope of the requested authorization.

The application received the reference number EFSA-GMO-RX-531 and was declared valid on 11 June 2008. 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 positive scientific opinion on 16 September 2011 (adopted 7 September 2011)(EFSA, 2011), in which the EFSA concluded that "*cotton MON531, as described in this application, is as safe as its conventional counterpart and is unlikely to have adverse effects on human and animal health and the environment in the context of its intended uses*".

On 16 March 2015, the European Commission presented the Draft Commission Implementing Decision authorizing the placing on the market of products produced from genetically modified cotton MON 531, to the Standing Committee on Pants, 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 31 March 2015, 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 (EU 2015/689) (Commission Decision, 2015), 43 months after the EFSA opinion.

Traceability, labeling, unique identifier

Operators importing, handling or using MON 531 derived foods and feeds in the EU should be informed of the legal obligations regarding traceability and labeling, laid down in Regulation (EC) No. 1830/2003. The unique identifier of MON 531 cotton is MON-00531-6.

The validated methods, as well as the validation report for MON 531, prepared by the Community Reference Laboratory (CRL) in collaboration with the European Network of GMO Laboratories (ENGL), were published on June 10, 2008 at the CRL website[3]. 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 531 cotton

Food and feed safety

The food and feed safety of MON 531 cotton was established through:

- A detailed molecular characterization of the inserted DNA,
- An assessment of the toxic and allergenic potential of Cry1Ac and NPTII, based upon their long history of safe use, their rapid digestibility and their lack of toxicity or allergenicity, 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 531 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,
- An assessment showed that the intake resulting from consumption of foods derived from MON 531 cotton do not raise nutritional concerns.

Further details on the safety of MON 531 are available in a product safety summary on Monsanto's website[4].

Environmental safety

The environmental safety of MON 531 was established through extensive field trials conducted in 1992, 1998 and 1999 in the US. All these field trials demonstrated that MON 531 poses negligible risk to human health or to the environment.

Results showed that there are no unexpected changes in the phenotype or ecological interactions indicative of increased pest or weed potential of MON 531 compared to the conventional cotton control. 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 531 and that MON 531 is not

[3] http://gmo-crl.jrc.ec.europa.eu/StatusOfDossiers.aspx - accessed February 26, 2015

[4] http://www.monsanto.com/products/documents/safety-summaries/bollgard_pss.pdf. Accessed February 27, 2015.

different in its phenotypic and agronomic behaviour relative to conventional cotton.

Moreover, considering the scope of the application, potential interactions of cotton MON 531 with non-target organisms and the abiotic environment were not considered to be an issue by the EFSA, due to the low level of exposure. Also, there are no close wild relatives of cotton in the EU.

In their scientific opinion on MON 531, the EFSA concluded that "*cotton MON 531 and its derived products obtained through seed processing are unlikely to have any altered potential to induce adverse effects on human and animal health as compared to conventional cotton in the context of their intended use*."

MON 531 cotton, the benefits

In countries where MON 531 cotton is grown, a number of benefits for both farmers and the environment are expected. These include:

- reduced insecticide use, improved control of target insect pests,
- improved yield, reduced production costs and improved opportunity to grow cotton, resulting in improved economics for the cotton growers,
- secondary benefits associated with the reduction in insecticide use, which include enhanced populations of beneficial insect and wildlife populations, reduced potential runoff of insecticides, and improved safety for farm workers by reducing potential exposure.

Further reading

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