



YOUR POCKET SIZED USERS GUIDE FOR BOLLGARD WITH ROUNDUP READY® COTTON (STACKED GENE COTTON)


- Stacked gene cotton is tolerant to Roundup Ready® herbicide and contains the Bollgard gene which provides built in protection against bollworms.
- This cotton does not provide protection against other insect pests or diseases
- Stacked gene cotton is only registered for use with Roundup Ready® herbicide. **No guarantees or warranties are offered for any other herbicides, including any other Monsanto glyphosate products or any other glyphosate products produced by other companies, which are not specifically recommended for use on the Roundup Ready® herbicide label.**
- Only cotton cultivars which contain the Roundup Ready® gene are tolerant to Roundup Ready® herbicide. **Cotton not containing the Roundup Ready® gene will die or be seriously injured when sprayed with Roundup Ready herbicide**
- **NB This guide does not replace the Roundup Ready herbicide label**
- **Roundup Ready® herbicide is not registered for aerial applications**
- Possession, use or trade of the seed contained in this bag is illegal without a Monsanto Technology Agreement signed by the user and the patent holder.

Bollgard with Roundup Ready® cotton and Roundup Ready® herbicide are registered trademarks of Monsanto SA (Pty) Ltd, P O Box 69933, Braynston, 2021, Tel (011) 790 8200, and the technologies are protected by South African and US patent laws.



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Thank you for supporting this technology. By doing this, you are supporting a commitment to continued biotechnology research by innovative companies such as Monsanto, which are committed to creating sustainability on our planet.

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1. LEGISLATION

The GMO Act, Act 15 of 1997, the Act which regulates the use of genetically modified crops, the Plant Improvement Act, Act 53 of 1976, and the Plant Breeders Rights Act, Act 15 of 1976, all regulate the use of Bollgard with Roundup Ready® cotton. Consequently it is an infringement of the law to:

- plant Bollgard with Roundup Ready® cotton without a valid, signed licence agreement with the patent holder, Monsanto South Africa (Pty) Ltd
- be unaware of the licence conditions, nor to disregard with these conditions (Please take note of the penalty clauses contained in the licence agreement, which may be applied should the agreement conditions not be met)

2. BOLLGARD WITH ROUNDUP READY® COTTON

The cotton seed in this bag also contains both the **Bollgard®** gene, which provides protection against bollworms, and the **Roundup Ready®** gene, which makes this cotton tolerant to Roundup Ready® herbicide. Each of these technologies will be dealt with separately in this guide.

2.1 BOLLGARD TECHNOLOGY

2.1.1 *Bacillus thuringiensis* (Bt)

Bollgard cotton produces an insecticidal protein which is also produced by *Bacillus thuringiensis*, a commonly occurring soil bacterium. This protein controls

American bollworm	<i>Helicoverpa armigera</i>
Red bollworm	<i>Diparopsis castanea</i>
Spiny bollworms	<i>Earias insulana</i> and <i>Earias biplaga</i>

- This protein has also been used for many years as an environmentally friendly insecticide on several crops against bollworms and other caterpillar pests. It is harmless to humans and other animals
- **During severe bollworm infestations, it may be necessary to apply supplementary insecticides, especially when local bollworm thresholds are exceeded.**
- The Bollgard® gene **does not protect cotton against any non-target pests**, such as aphids, whitefly, red spider mite, thrips, jassids (leafhoppers), stink bugs, cotton stainers, beetle pests of cotton, cutworms (*Agrotis* spp.), other lepidopteran insects and other sucking insects. Lesser armyworm may be suppressed, but survival of this insect is high. **Normal insect control practices must be applied for these non-target insects.** The gene does not negatively affect beneficial insects such as predators and parasites.

2.1.2 COMPULSORY RESISTANCE MANAGEMENT

Bollworms are capable of developing resistance to chemical insecticides. Research has also shown that, under specific conditions, bollworms may also develop resistance to the insecticidal protein produced by *Bacillus thuringiensis* (and Bollgard cotton plants). It is important to ensure that a proportion of the bollworm population is not exposed to the Bt protein, so that susceptibility can be maintained in these populations

Consequently, legislation (GMO Act) requires growers to apply a refuge option on their farms.

Growers may choose between Option A and Option B

Option A 80/20 (20%)

The compulsory planting of a **20% refuge** of cotton not containing the Bollgard gene, **which may be sprayed with bollworm controlling insecticides**. For example, for every **80 hectares** of Bollgard cotton planted, at least **20 hectares** of non-Bollgard cotton must also be planted. This 20 hectares may be treated with insecticides (excluding Bt products) which are registered in South Africa for the control of American bollworm (*Helicoverpa armigera*), Red bollworm (*Diparopsis castanea*) and Spiny bollworms (*Earias* spp.)

OR

Option B 95/5 (5%)

The compulsory planting of a **5% refuge** of cotton not containing the Bollgard gene, which **may not be treated with insecticides**. For example, for every **95 hectares** of Bollgard cotton planted, at least **5 hectares** of non-Bollgard cotton must be planted. This 5 hectares **may not be treated** with any insecticides which are registered in South Africa for the control of American bollworm (*Helicoverpa armigera*), Red bollworm (*Diparopsis castanea*) and Spiny bollworms (*Earias* spp.)

NB Conventional cotton and single gene Roundup Ready cotton are forms of “Non Bollgard” cotton

Refugia must be planted as close as possible to the Bollgard fields. Refugia must be **separate blocks** of cotton which are **not mixed** with Bollgard cotton. The mixing of Bollgard and non-Bollgard seed planted in the same block will lead to a situation where young bollworm larvae can develop to a stage where the Bollgard protein no longer provides adequate control. With the exception of insect control, refugia should be managed in exactly the same manner as Bollgard cotton, so as to provide a suitable, season long host to ensure that bollworms remain susceptible to the Bollgard protein. It is recommended that refugia should not be further than 500 meters away from Bollgard fields.

Due to the importance of preventing the development of resistance in bollworms to Bollgard cotton, absence of refugia, or the poor management of refugia, may lead to the cancellation or withdrawal of the Monsanto technology Agreement. Should this occur, the sale of Monsanto's transgenic technologies to infringing growers may be disallowed.

2.1.3 HOW DOES BOLLGARD COTTON WORK?

Bollworm control in Bollgard cotton is obtained through the activity of the insecticidal protein produced in *Bacillus thuringiensis* sub species *kurstaki* (Btk), which is also produced in Bollgard cotton by the Bollgard gene. When young bollworm larvae feed on Bollgard cotton plants, the Btk protein protects the plants against injury. The protein works by affecting the permeability of the digestive tract of bollworm larvae, which cause the larvae to stop feeding and die. The need for both preventative and / or corrective chemical control actions against bollworms in Bollgard cotton is largely reduced and may even be eliminated.

Research and commercial experience shows that Bollgard provides excellent season long control of American, Red and Spiny bollworms. Under most situations, cotton production efficiencies are improved by the use of Bollgard. However, experience has also shown that it may be necessary **to apply supplementary insecticides** to control bollworms during periods where bollworm population levels reach damaging proportions, such as during peak flowering. In order to ensure optimum profitability, Monsanto recommends the use of

suitable, supplementary insecticide applications when local economic thresholds are exceeded (See Scouting and control thresholds, page 9)

Since the use of broad spectrum insecticides should be reduced with the use of Bollgard, populations of beneficial insects in cotton production systems should increase. Many studies have shown that beneficial insects make a considerable contribution to the suppression and control of secondary cotton pests, which further reduces the need to use insecticides.

2.1.4 RECOMMENDED MANAGEMENT PRACTICES FOR BOLLGARD WITH ROUNDUP READY COTTON

Agronomic management - As with any cotton variety, using the best agronomic management practices with cotton containing the Bollgard gene will yield the greatest benefits. Use the seeding rate and planting technologies appropriate for your area. (As a rule of thumb, under irrigated conditions, do not plant more than 1.5 ha to a bag of seed, and under rain fed or dryland conditions, it is recommended that not more than 3.5 ha be planted to a bag of seed.) A final plant population in the order of 70-80 000 plants/ha (irrigated) and 35 - 40 000 plants/ha (dryland) is recommended. Manage for early maturity and early harvest using fertilizer, irrigation scheduling and growth regulators (when required) under irrigation practices. The cautious and judicious use of growth regulators is recommended, since it does appear that the superior boll retention of Bollgard cotton

tends to limit vegetative growth. Excessive use of growth regulators may result in Bollgard cotton not realising its full potential. Under dryland or rain fed practices, the use of techniques promoting soil water conservation is recommended. In general, do everything possible to avoid plant stress.

Stacked gene cotton has excellent vegetative tolerance for Roundup Ready herbicide, which makes it possible to apply **early season**, over the top herbicide treatments. The incomplete tolerance in the flowering parts of the cotton plant requires that **only between the row, post directed applications are made after the four leaf stage**. A Roundup Ready weed control programme, combining over the top and between the row, post directed applications after the four leaf stage, usually provides that greatest advantages. Consult the section: HINTS FOR THE APPLICATION OF ROUNDUP READY HERBICIDE (page 11) and the ROUNDUP READY HERBICIDE label for more details. Should a residual herbicide be included in the weed control programme, only one application is recommended. The residual may be applied pre or post crop emergence, or pre harvest. Consult a Monsanto representative or local Monsanto distributor to determine the best option.

Begin with a clean, well prepared seedbed, and keep the crop weed free **throughout the season**. Production practices, **such as pre-plant spraying**, which conserve soil moisture, offer the best opportunity for optimal crop production. Spray with **Roundup CT®** at least one to two weeks before planting, or remove weeds by mechanical tillage actions, to ensure a weed free seed bed. Use

normal planting practices to plant **Bollgard with Roundup Ready cotton**, applying correct planting rates for optimum production under dryland or irrigation conditions.

Good weed control is essential in order to maximize the advantages of Bollgard with Roundup Ready cotton. It is very important to ensure that no alternative host plants for bollworms are present in your cotton fields. Since Bollgard is only effective against young larvae, the presence of alternative host plants in the field provides larvae with the opportunity to survive to an advanced stage, whereupon they may migrate to Bollgard plants and inflict damage.

The presence of ratoon or stand over cotton (especially where dryland production is practiced) represents a potential danger for newly planted cotton in the following season, in that it provides an over wintering habitat for insect pests. Ratooned Bollgard and **Bollgard with Roundup Ready cotton** offers increased exposure of bollworms to the Btk protein. This increases the risk that resistance may develop. For this reason, cotton containing the Bollgard gene should not be allowed to stand over or be ratooned, and the removal of cotton residues should occur as soon as harvesting has taken place.

2.1.5 SCOUTING AND CONTROL THRESHOLDS

Regular scouting of your fields is recommended when you plant **Bollgard with Roundup Ready cotton**. Field inspections and the use of supplementary insecticides should be based on the fact that larvae must hatch and feed before the Btk protein will have any effect. Scouting once a week from about 6-7 weeks after emergence is recommended, and during peak bloom or flowering, twice weekly scouting should be undertaken. Scouting should continue up until about 18 weeks after emergence. With **Bollgard with Roundup Ready cotton**, spray decisions should not be based on target insect egg counts, since Bollgard is only effective once small larvae have fed. **Larvae greater than 6-8 mm in length can generally be regarded as survivors that will be difficult to control with Bollgard alone**. Apply supplemental insecticides if there is a high proportion of larvae greater than 6-8 mm in length, or plant damage warrants treatment. A suitable recommendation would be to apply supplemental insecticides when the number of larvae larger than 6-8 mm equals or exceeds the economic threshold (See Table 1 for bollworm thresholds). Changes to these recommendations may be required under certain circumstances ; consult your local crop advisor, or Monsanto representative.

TABLE 1 CONTROL THRESHOLDS FOR TARGET PESTS	
Pest	Control threshold
American/Cotton bollworm	12 eggs or 5 larvae/24 plants
Red bollworm	6 eggs or 2 larvae/24 plants
Spiny bollworms	2 larvae/24 plants
Bollworm complex	5 larvae/24 plants

Managing non-target insects - Although stacked gene cotton with Bollgard targets the most damaging cotton pests, many **other** potentially damaging pests may also occur, just as they do on conventional or non- Bollgard cotton. **These insects should be monitored and treated where necessary using recommended thresholds and insecticides.** Where possible, 'soft" insecticides should be used so as to preserve populations of beneficial species (predators and parasites), and to encourage integrated pest management.

2.2 ROUNDUP READY TECHNOLOGY

Cotton which contains the Roundup Ready gene, such as the Bollgard with Roundup Ready cotton seed in this bag, possesses the ability to tolerate Roundup Ready herbicide. This places cotton producers in a position to make early season Roundup Ready herbicide applications, and provide excellent weed control in cotton.

2.2.1 HINTS FOR THE APPLICATION OF ROUNDUP READY HERBICIDE

1. NB Carefully read the WARNINGS and PRECAUTIONS in the herbicide label before handling

2. DIRECTIONS FOR USE USE ONLY AS DIRECTED

USE OF ROUNDUP READY HERBICIDE IN ACCORDANCE WITH LABEL DIRECTIONS IS EXPECTED TO RESULT IN NORMAL GROWTH OF BOLLGARD WITH ROUNDUP READY COTTON. HOWEVER, VARIOUS ENVIRONMENTAL CONDITIONS, AGRONOMIC PRACTICES AND OTHER FACTORS MAKE IT IMPOSSIBLE TO ELIMINATE ALL RISKS ASSOCIATED WITH THIS PRODUCT, EVEN WHEN APPLICATIONS ARE MADE IN CONFORMANCE WITH THE LABEL SPECIFICATIONS. IN SOME CASES, THESE FACTORS CAN RESULT IN UNANTICIPATED RESULTS INCLUDING YIELD LOSS.

WARNING: MONSANTO RECOMMENDS THIS PRODUCT ONLY FOR POST EMERGENT USE OVER-THE-TOP OF OR DIRECTED ONTO IMPROVED COTTON VARIETIES THAT ARE DESIGNATED AS CONTAINING THE ROUNDUP READY GENE. SEVERE INJURY OR DEATH OF COTTON WILL RESULT IF ANY VARIETIES NOT PROPERLY DESIGNATED AS HAVING THE ROUNDUP READY GENE ARE SPRAYED WITH THIS PRODUCT.

GENERAL INFORMATION

- Roundup Ready herbicide is not volatile, because it has the same characteristics as water, and will not drift in a vapour form from target plants to other plants, if **it is applied correctly**. Correct nozzles, spray pressure and spray height will ensure that the herbicide will not drift from target to non-target plants.
- The herbicidal action is only visible after 4 days onwards for annual weeds and 7 days for perennials, after application (depending on growing conditions, weed stage and cultural conditions).
- Apply ROUNDUP READY post-emergence to actively growing weeds, directed on the foliage.
- DO NOT spray whilst weeds are wet, dormant or under stress nor when covered in a layer of dust or damaged by frost.
- Heavy rainfall or irrigation shortly after application may reduce efficacy and a repeat application may be necessary.
- There are **no rotational crop restrictions** due to herbicide activity following applications of this product.

3. MIXING INSTRUCTIONS

(Consult the label for more details concerning the mixing instructions and spray concentrations for knapsack sprayers)

A minimum concentration of 1.5% ROUNDUP READY herbicide must be maintained in the spray mixture. If necessary, spray volumes must be adjusted in order to ensure a minimum concentration of 1.5%

4. APPLICATION INSTRUCTIONS

(Consult the label for more details concerning application)

4.1 GENERAL

- ROUNDUP READY herbicide must be applied in a water volume of between 100 to 125 l/ha.
- Ensure that spray equipment is clean and free of rust, dust and sediment from other pesticides.
- Always use clean water. Avoid the use of brack or muddy water, or water with a high colloid content derived from soils high in organic matter.
- Correctly calibrate all sprayers under field conditions.
- It is recommended to use low pressures of 100 to 150 kPa with the appropriate nozzles to deliver the required water volume and dosage rate per ha.
- Do not spray when wind speed exceeds 10km/h.
- Do not spray when relative humidity is less than 40%
- Ensure a fine, even droplet distribution and thorough coverage without runoff from the target weeds.

- NOTE: **ROUNDUP READY herbicide is not registered for aerial application**

4.2 BROADCAST APPLICATION

BROADCAST (OVER THE COTTON) APPLICATION ON ROUNDUP READY COTTON AND **BOLLGARD WITH ROUNDUP READY COTTON** CAN ONLY BE APPLIED FROM THE GROUND CRACKING STAGE UP TO THE 4TH TRUE LEAF/NODE COTTON GROWTH STAGE. THIS IS REACHED WHEN THE **FIRST PLANTS** IN A FIELD HAVE REACHED THE 4 LEAF/NODE STAGE. **BROADCAST APPLICATION AFTER THIS TIME COULD RESULT IN BOLL LOSS, DELAYED MATURITY AND/OR YIELD LOSS.** Where sequential applications are necessary to control specific weed species (e.g. *Cyperus esculentus*) the second application should not occur within 10 days of the first application. If by this time the cotton is beyond the 4 leaf/node stage a post directed (see below) application will be necessary. No more than two broadcast applications must be made between cracking and the 4-leaf/node stage and the cotton must have at least two nodes of incremental growth between applications.

4.3 POST DIRECTED OR HOODED APPLICATION.

In addition to the over-the-top applications, ROUNDUP READY herbicide may be applied as a post-directed or hooded application to **BOLLGARD WITH ROUNDUP READY cotton**. These application methods are essential after the cotton has reached the **4 leaf/node stage** to avoid the possibility of damage to the crop. Equipment should be used which directs the spray into the lower crop canopy so that weeds in the row are covered with minimal spray contact on the

cotton foliage. For best results, make applications while weeds are small (less than 100mm). Sequential in-crop applications must be at least 10 days apart from any other in-crop application of this product. No more than two applications should be made from the fifth leaf/node to the 15th node stage and the cotton should have at least two nodes of incremental growth between applications.

4.4 PRE PLANT INCORPORATED AND PRE EMERGENT POST PLANT TREATMENTS

The above recommended ROUNDUP READY herbicide treatments may be applied in cotton varieties which are designated ROUNDUP READY cotton cultivars, such as **BOLLGARD WITH ROUNDUP READY cotton** seed in this bag. When Triflurex 480 EC is applied as a pre plant incorporated treatment, follow the recommendations on the manufacturer's label.

5. APPLICATION DOSAGES

Weed spectrums in cotton are variable and differ by region, soil type and climatic factors which change from season to season. This results in a varied and uneven emergence of a variety of weed species at any one site where one or more species may dominate. In order to compensate for this fact the dosages recommended are aimed at controlling a broad spectrum of weeds provided they are sprayed **before any one of the major weeds reach 100mm in height (generally leaf stages 3 to 4).**

DOSAGES

Consult the ROUNDUP READY herbicide label for the correct dosages for the control of specific annual and perennial grass and broadleaf weeds.

2.3. CONDITIONS OF SALE

- By signing the Monsanto Technology Agreement, growers are able to purchase transgenic seed containing Monsanto traits, from any approved Monsanto distributor
- Growers are only permitted to purchase the number of bags of seed specified on the “ Monsanto Technology Agreement”. Should additional transgenic seed be required, growers should apply for an additional “Monsanto Technology Agreement”
- If a cotton crop containing Monsanto traits is damaged as a result of a natural disaster, and the grower wishes to replant in the same season, he can obtain the amount of seed specified in the Monsanto technology Agreement , **without paying the technology fee again** if he plants within a specified time period (**for Bollgard with Roundup Ready cotton thirty days after planting**).
- In the case where replanting is required, growers must complete a “ Monsanto credit and replant agreement”, obtainable from any approved Monsanto distributor, before the seed may be obtained. Growers must also have destroyed the damaged crop by chemical or mechanical means, **before the seed may be obtained**.
- **In the case where damage to Bollgard with Roundup Ready cotton due to a natural disaster, occurs, and replanting is not possible, and the damaged cotton is destroyed within thirty**

days of planting, growers may apply for a full credit of the technology fee. This can be done achieved when a grower completes the “Monsanto Credit and Replant Agreement” and it is approved. Please note that any damage occurring after thirty days after planting does not qualify for any credit.

NB Standover Bollgard with Roundup Ready cotton will only be permitted under exceptional circumstances. No guarantee of the technologies will be granted. This cotton may only be allowed to standover if a ratoon licence is obtained, and the full technology fee is paid.

BIOTECHNOLOGY PRODUCTS. THIS BAG
 FOLLOWING COLUMNS SUMMARIZES THE

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 COTTON BIOTECHNOLOGY PRODUCTS OF M

	BOLLGARD™ (BT)	ROUNDUP READY® (RR)	BOLLO READ
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	Efficient control of <ul style="list-style-type: none"> American Bollworms Red Bollworms Spiny Bollworms. Encourages integrated pest management (IPM)	<ul style="list-style-type: none"> Over the top control of most annual and perennial weeds. Considerable fuel savings No restrictions on rotation crops 	<ul style="list-style-type: none"> All the and w Do r betwe Integr for sy
	<ul style="list-style-type: none"> Weeds: conventional control, not tolerant to Roundup Ready herbicide Damaging non-target insects for example sucking insects Growth regulators Occasional bollworm sprays when infestations are high 	<ul style="list-style-type: none"> Insect control still required, especially bollworms Growth regulators No residual herbicides Only Roundup Ready herbicide 	<ul style="list-style-type: none"> Damag suckin Bol w infesta No re Round

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	<ul style="list-style-type: none"> • Prices are determined annually • Per bag or per hectare at a fixed rate for irrigation or dryland NB: For per hectare payment, licences must be accompanied by an official map which precisely indicates the areas planted, or a map in which the GPS co-ordinates and areas are given and certified by the distributor 	<ul style="list-style-type: none"> • Prices determined annually • Only a per bag price 	<ul style="list-style-type: none"> • Prices • Per ba rate fo NB: Fo licences an offi indicate map i ordinat certifi

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American Bollworm



Red Bollworm



Spiny Bollworm