



Unsprayed Cotton Refuge for Bollgard II[®] Cotton

GROWERS OF BOLLGARD II COTTON ARE REQUIRED TO PRACTISE PREVENTATIVE RESISTANCE MANAGEMENT.

The resistance management plan is based on two basic principles:

- (1) minimising the exposure of *Helicoverpa spp.* to the *Bacillus thuringiensis* (Bt) proteins and
- (2) providing a population of susceptible individuals that can mate with any resistant individuals and hence dilute any potential resistance.

HOW CAN WE GENERATE A POPULATION OF SUSCEPTIBLE MOTHS?

Each grower is required to grow a refuge crop that is capable of producing large numbers of *Helicoverpa spp.* moths which have not been exposed to selection with Bt. These will dominate the matings with any survivors from Bollgard II crops and thus help to maintain Bt resistance at low levels.

WHY CHOOSE UNSPRAYED COTTON?

Unsprayed cotton refuge must be planted at 10% of the Bollgard II area.

For example for every 100 hectares of Bollgard II cotton a grower will need to plant 10 hectares of unsprayed cotton. This applies to both irrigated and dryland cotton situations.

100 Hectares Bollgard II = 10 Hectares Unsprayed Cotton

If growers choose to use Roundup Ready Flex[®] or Roundup Ready[®] cotton varieties as their refuge, they have the added benefit of being able to control in-crop weeds with Roundup Ready[®] herbicide throughout the season.

Sprayed cotton refuge acts as a host for other *Lepidoptera spp* such as Rough Bollworm.

GENERAL CONDITIONS FOR UNSPRAYED COTTON REFUGES:

1. Unsprayed cotton must be planted and managed so that the refuge is attractive to *Helicoverpa spp.* during the entire growing period of the Bollgard II cotton variety.
2. Unsprayed cotton must be planted within two weeks of planting the Bollgard II cotton.
3. If cultivation is required in the unsprayed cotton refuge, the Bollgard II cotton should also be cultivated at the same time.
4. Unsprayed cotton refuge must be planted within the farm unit growing the Bollgard II cotton.
5. All reasonable effort should be taken to plant the refuge either on one side of, or next to, a Bollgard II cotton field.
6. All Bollgard II fields must be within 2 km of the nearest unsprayed cotton refuge.
7. If the Bollgard II variety planted is stacked with Roundup Ready cotton or Roundup Ready Flex, up to 200 metres of buffer between the refuge and the Bollgard II is allowed in order to prevent herbicide drift (if the unsprayed cotton refuge is not glyphosate tolerant).



8. If sprayed cotton is planted on a farm unit all unsprayed cotton refuges must be at least 48 metres wide. If no sprayed cotton is planted on farm, unsprayed cotton refuges must be at least 24 metres long and 24 metres wide.

CONTROL OF VOLUNTEER AND RATOON COTTON:

Volunteer and ratoon cotton within fields may impose additional selection pressure on *Helicoverpa spp.* to develop resistance to the Bt proteins produced by Bollgard II cotton.

Ensure that the field the unsprayed cotton is to be sown into is clean of volunteer or ratoon cotton prior to planting.

Unsprayed cotton refuges must be kept clean of volunteer and ratoon cotton for the entire growing period.

SPRAY LIMITATIONS IN THE UNSPRAYED COTTON REFUGE:

1. No Bt sprays are allowed for the full season.
2. Food sprays cannot be used.
3. Trichogramma or any other biological control agent cannot be released.
4. Secondary pests can be controlled in the refuge as long as the product has no activity on *Helicoverpa spp.*

UNSPRAYED COTTON DEFOLIATION AND HARVEST:

Defoliation of the unsprayed cotton refuge cannot commence until defoliation of the Bollgard II cotton has commenced.

PUPAE DESTRUCTION IN UNSPRAYED COTTON REFUGES:

To ensure maximum emergence of late pupae from the cotton refuge, soil disturbance in the refuge should not occur until after the pupae busting in the Bollgard II cotton is complete.

Ideally the unsprayed cotton refuge should be left uncultivated until the following spring.

Remember: the more susceptible moths that emerge from the refuge the more genetic dilution of resistant survivors can occur.

Direct drilling winter crops into unsprayed cotton refuge is allowed.

SIMPLE STEPS TO CREATING AN EFFECTIVE UNSPRAYED COTTON REFUGE:

Field Selection:

1. Where possible, avoid planting cotton into last year's cotton field.
2. Do not plant unsprayed cotton refuge into cotton stubble that has not been root cut effectively.

Planting seed quality:

1. Always perform a germination test prior to sowing.
2. Adjust the sowing rate to ensure a plant stand equivalent to the Bollgard II cotton is achieved.

Weed management:

1. Apply a residual herbicide for long term weed control.
2. Choose a conventional Roundup Ready Flex® cotton variety as the refuge, to improve your weed control options.
3. Remember: don't let this years refuge generate next years weeds.

Irrigation management:

1. Unsprayed cotton refuges should be irrigated the same as Bollgard II fields.

UNSPRAYED COTTON REFUGE FOR DRYLAND COTTON:

The field history of the refuge and the Bollgard II cotton must be similar. This is to ensure similar stored moisture levels are available for both crops.

®Bollgard II, Roundup Ready and Roundup Ready Flex are registered trademarks of Monsanto Technology LLC

