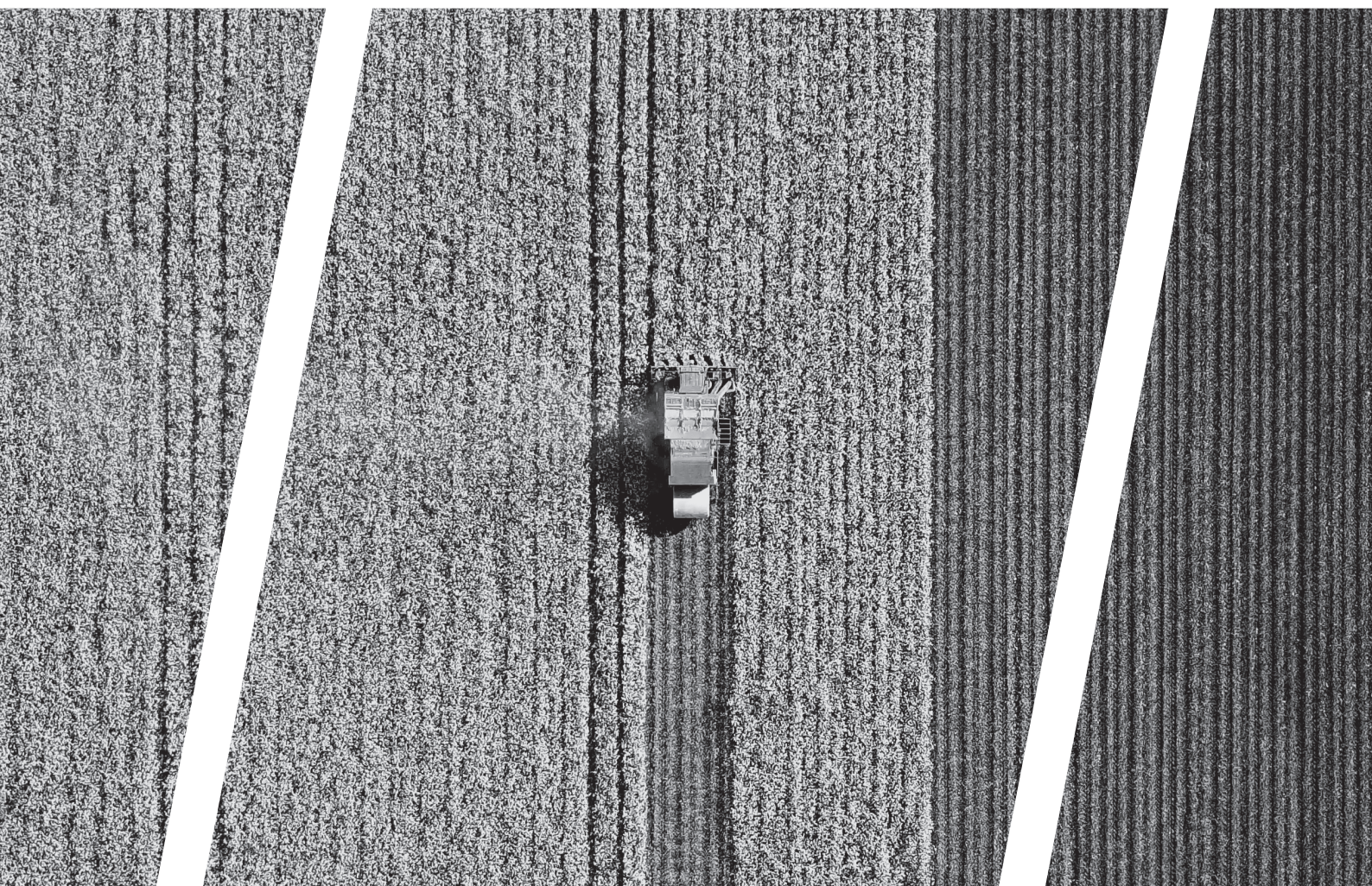




BOLLGARD[®] 3

RESISTANCE MANAGEMENT PLAN (RMP)

FOR NORTHERN AUSTRALIA



Bollgard[®] 3

Developed by Monsanto Australia Proprietary Limited and the Transgenic and Insect Management Strategy (TIMS) Committee of Cotton Australia Limited.

The resistance management plan is based on three basic principles: (1) minimising the exposure of *Helicoverpa* spp. to the *Bacillus thuringiensis* (Bt) proteins Cry 1Ac, Cry 2Ab and Vip3A; (2) providing a population of susceptible individuals that can mate with any resistant individuals, hence diluting any potential resistance; and (3) removing resistant individuals at the end of the cotton season. The three principles are supported through the implementation of 5 elements that are the key components of the Resistance Management Plan. These elements are:

1. Planting timing restrictions;
2. Refuge crops;
3. Control of volunteers and ratoon cotton;
4. Trap crops/Pupae destruction; and
5. Spray limitations.

Growers of Bollgard 3 cotton are required to practice preventative resistance management as set out below. Compliance with the Resistance Management Plan is required under the terms of the Bollgard 3 Technology User Agreement and under the conditions of registration (*Agricultural and Veterinary Chemicals Act, 1994*).

Scope: This RMP pertains to cotton planting in all areas North of the latitude 21.15 degrees south in Queensland, Northern Territory and Western Australia.

1. PLANTING TIMING RESTRICTIONS

All Bollgard 3 crops and cotton refuges are to be planted into moisture or watered-up in a twelve-week window between November 15 to May 15 for the Leichhardt, Leichhardt West, Flinders, Normanby River, Gilbert and Wiso regions and December 1 and May 30 in the Ord River Region. For all other valleys, Bollgard 3 crops are to be planted into moisture or watered-up in an eight-week window between November 15 and May 15. It is preferable for all regions, that all refuge is planted in the 2-week period prior to planting Bollgard 3. Valley boundaries will be determined by Monsanto and TIMS. Within each valley, the start date of the planting window will be determined by Monsanto and TIMS in consultation with local growers and reflected in a regionally amended “Bollgard 3 Planting Window Variation Notice” issued by Monsanto.

2. REFUGES

Growers planting Bollgard 3 cotton will also be 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 proteins Cry 1Ac, Cry 2Ab and Vip3A. These unselected moths are expected to dominate matings with any survivors from Bollgard 3 crops and thus help to maintain resistant alleles to the Bt proteins Cry 1Ac, Cry 2Ab, and Vip3A at low frequencies.

All refuge options are based on the requirement of a 7.5 or 5% unsprayed cotton refuge or its equivalent as determined by the relative production of *Helicoverpa* spp. from each of the refuge types as described in Tables 1 - 4 below.

For each area of irrigated Bollgard 3 cotton planted, a grower is required to plant a minimum of one, or a combination of, the following:

Table 1: Irrigated Bollgard 3 cotton refuge options for the Ord, Leichhardt, Leichhardt West, Flinders, Normanby River, Gilbert and Wiso regions

Crop	Conditions	% of Bollgard 3	Regions permitted
Conventional Cotton	Irrigated, unsprayed conventional cotton	7.5	Ord, Leichhardt, Leichhardt West, Flinders, Normanby River, Gilbert and Wiso regions
Pigeon pea	Fully irrigated, unsprayed	3.75	Ord, Leichhardt, Leichhardt West, Flinders, Normanby River, Gilbert and Wiso regions

Table 2: Dryland Bollgard 3 refuge options for the Ord, Leichhardt, Leichhardt West, Flinders, Normanby River, Gilbert and Wiso regions

Crop	Conditions	% of Bollgard 3	Regions permitted
Conventional Cotton	Dryland or irrigated, unsprayed conventional cotton	7.5	Ord, Leichhardt, Leichhardt West, Flinders, Normanby River, Gilbert and Wiso regions
Pigeon pea	Dryland or fully irrigated, unsprayed. Dryland pigeon peas can only be planted with an approved plan from Monsanto Australia.	3.75	Ord, Leichhardt, Leichhardt West, Flinders, Normanby River, Gilbert and Wiso regions

Table 3: Irrigated Bollgard 3 cotton refuge options for the Burdekin, Mareeba/Dimbulah, Katherine, Douglas/Daly regions

Crop	Conditions	% of Bollgard 3	Regions permitted
Conventional Cotton	Irrigated, unsprayed conventional cotton	5.0	Burdekin, Mareeba/Dimbulah, Katherine, Douglas/Daly regions
Pigeon pea	Fully irrigated, unsprayed	2.5	Burdekin, Mareeba/Dimbulah, Katherine, Douglas/Daly regions

Table 4: Dryland Bollgard 3 refuge options for the Burdekin, Mareeba/Dimbulah, Katherine, Douglas/Daly regions

Crop	Conditions	% of Bollgard 3	Regions permitted
Conventional Cotton	Dryland or irrigated, unsprayed conventional cotton	5.0	Burdekin, Mareeba/Dimbulah, Katherine, Douglas/Daly regions
Pigeon pea	Dryland or fully irrigated, unsprayed. Dryland pigeon peas can only be planted with an approved plan from Monsanto Australia.	2.5	Burdekin, Mareeba/Dimbulah, Katherine, Douglas/Daly regions

Note: Unsprayed means not sprayed with any insecticide that targets any life stage of *Helicoverpa* spp.

Bt products must not be applied to any refuge.

If the viability of an unsprayed refuge is at risk due to early or late season pressure by *Helicoverpa* spp., or any other caterpillar species, contact Monsanto Australia immediately. With prior approval from Monsanto Australia, a non-Bt larvicide can be applied.

An unsprayed refuge should not be planted in the same field as any crop sprayed with a rate of insecticide that is registered for *Helicoverpa* spp, with the exception of Bollgard 3 unless a sufficient buffer is in place to prevent insecticide drift.

Sprayed crops and unsprayed refuges that are planted in adjacent fields must also be separated by sufficient distance to minimise the likelihood of insecticide drift onto the unsprayed refuge.

For the purposes of this Resistance Management Plan, conventional cotton includes any cotton varieties that do not have Bt proteins in the plant that control *Helicoverpa* spp. larvae.

General conditions for all refuges:

- (a) Refuge crops are to be planted and managed so that they are attractive to *Helicoverpa* spp. during the growing period of the Bollgard 3 cotton varieties.

All regions: It is preferable that all refuge is planted within the 2 week period prior to planting Bollgard 3. If this is not possible, refuge planting must be completed within 3 weeks of the first day of sowing of Bollgard 3. At this time, sufficient refuge must have been planted to cover all of the Bollgard 3 cotton proposed to be planted for the season (including Bollgard 3 already planted and any that remains unplanted). Should additional Bollgard 3 be planted after this date, which is not already covered by refuge, additional refuge must be planted as soon as possible and no more than 2 weeks after sowing of the additional Bollgard 3.

- (b) Group J legume inoculant should be used to treat pigeon pea planting seed just prior to sowing to ensure effective root zone colonisation by nitrogen fixing rhizobium bacteria
- (c) All refuges should preferably be planted into a fallow or rotation field that has not been planted to Bt cotton in the previous season to avoid volunteer and ratoon cotton. See Refuge Management Guide for all unsprayed refuges,
- (c) Once the Bollgard 3 cotton begins to flower the corresponding refuge must not be cultivated and ideally should begin to flower.
- (d) Insecticide preparations containing Bt may be used on Bollgard 3 cotton throughout the season BUT NOT on any refuge crops.
- (e) All refuges are to be planted within the farm unit growing Bollgard 3 cotton. Subject to clause (f) below, all reasonable effort should be taken to plant the refuge either on one side of, or next to, a Bollgard 3 cotton field, and all Bollgard 3 fields must be no more than 2 km from the nearest Bollgard 3 refuge. For any cases where it may not be possible to plant the refuge within 2 km from the associated Bollgard 3, approval must be sought from Monsanto.
- (f) To minimise the possibility of refuge attractiveness being affected by herbicide drift, non-herbicide tolerant refuges should be separated from herbicide tolerant Bollgard 3 cotton crops by a sufficient distance to minimise such drift, but no more than 2 km from the Bollgard 3 cotton.
- (g) To account for possible insecticide drift, Bollgard 3 refuge crops must be at least 24 metres wide and each refuge area must be a minimum of 0.5 hectares. Different unsprayed refuge options may be planted in the same field as a single unit.

- (h) Destruction of refuges must only be carried out after the Bollgard 3 has been harvested. Soil disturbance of refuge crops must only occur when the trap crop is being destroyed (refer to section 4 Trap crop)
- (i) Refuges for Bollgard 3 crops must be planted in the same row configuration as the Bollgard 3 crop.

3. CONTROL OF VOLUNTEER AND RATOON COTTON

Volunteer and ratoon cotton may impose additional selection pressure on *Helicoverpa* spp. to develop resistance to the Bt proteins Cry 1Ac, Cry 2Ab and Vip3A produced by Bollgard 3 cotton.

As soon as practical after harvest, Bollgard 3 cotton crops must be destroyed by cultivation, root cutting or herbicide so that they do not continue to act as hosts for *Helicoverpa* spp.

Growers must ensure that volunteer and ratoon plants are removed prior to flowering from all fields, including fallow areas, Bollgard 3 crops, conventional cotton crops and all refuges. **The presence of Bollgard 3 volunteers/ratoon cotton in any refuge will diminish the value of the refuge and must be removed as soon as possible.**

Note: The refuge should preferably be planted into fallow or rotation fields that have not been planted to cotton in the previous season.

4. END OF SEASON PIGEON PEA TRAP CROP

An end of season pigeon pea trap crop must be planted. The planting configuration of the trap crop should be the same as that of the Bollgard 3 crop. Table 3 shows the requirements for the pigeon pea trap crop.

Crop destruction

All Bollgard 3 crops must be slashed or mulched and controlled to prevent regrowth within 4 weeks of harvesting. In Northern Valleys, varying seasonal conditions could mean slashing or mulching alone will not be enough to prevent Bollgard 3 from ratooning or re-growing. Wherever relevant growers must implement additional cultural and/or registered chemical control measures to ensure Bollgard 3 does not ratoon post-harvest. Irrespective of sowing date, all Bollgard 3 crop destruction activities (including slashing, mulching plus any additional cultural and/or registered chemical control measures) must be completed by the 1st of October except for the Ord River Regions where it must be completed by 15th of October with no cotton present until the following planting window opens.

End of season management of refuges/trap crops

A late summer trap crop (pigeon pea) must be planted for all Bollgard 3 cotton grown in Northern Australia. The planting configuration of the trap crop should be the same as that of the Bollgard 3 crop. Irrigated Bollgard 3 must have an irrigated trap crop. Table 5 shows the requirements for the late summer pigeon pea trap crop. **Dryland Bollgard 3 growers who do not have any irrigated cotton on their farm should contact Monsanto Australia for alternative options.**

Refuge and late summer trap crops have different purposes. Where a pigeon pea refuge is utilised, the full pigeon pea refuge area must be managed to become the late summer trap crop. If unsprayed cotton is used as the refuge, an additional area of 1% pigeon pea must be planted as the late summer trap crop. Requirements for late summer trap crops are detailed in Table 5 below.

Table 5: Late summer pigeon pea trap crop requirements in Northern Australia

CRITERION	TRAP CROP*
Minimum area & dimension (Requirement)	<p>A minimum trap crop of 1% of planted Bollgard 3 cotton crop is required (if the full refuge is not utilised).</p> <p>If sprayed conventional cotton is grown on that farm unit: the trap crop must be at least 48 m x 48 m.</p> <p>If no sprayed conventional cotton is grown on that farm unit: the trap crop must be at least 24 m x 24 m.</p>
Planting time	<p>The trap crop should preferably be planted 4 weeks after the associated Bollgard 3. Note: if growers choose to plant their trap crop to coincide with the planting of pigeon pea refuges, they must manage the trap crop in such a way that it remains attractive to <i>Helicoverpa</i> spp. 2-4 weeks after final defoliation.</p>
Planting rate **	<p>35 kg/ha (recommended establishment greater than 4 plants per metre)</p>
Insect control	<p>The trap crop can be sprayed with virus after flowering, while avoiding insecticide spray drift, except where a pigeon pea refuge is converted to a trap crop. In this case the full 2.5% pigeon pea refuge area managed to become the late summer trap crop can only be sprayed with virus after the first defoliation of Bollgard 3 cotton.</p>
Irrigation	<p>The refuge/trap crop must be planted into an area where it can receive the additional irrigation required to keep the trap crop attractive to <i>Helicoverpa</i> spp. until after the cotton is defoliated.</p>
Weed control	<p>The trap crop should be kept free of weeds and particularly volunteer Bollgard 3 cotton. When using the full pigeon pea refuge area as the trap crop, weed control must not be carried out by cultivation once flowering of the associated Bollgard 3 cotton crop has commenced.</p>
Crop destruction	<p>The trap crop must be destroyed 2-4 weeks (but not before 2 weeks) after final defoliation of the associated Bollgard 3 cotton crop, (slash and pupae bust – full soil disturbance to a depth of 10 cm across the entire trap crop area).</p>

*A pigeon pea trap crop is to be planted so that it is attractive (flowering) to *Helicoverpa* spp. after the cotton crop has cut out, and as any survivors from the Bollgard 3 crop emerge. Planting pigeon pea too early (e.g. before November) or too late (e.g. mid December) is not adequate for cotton crops planted during September through to October.

**The planting rate is a recommendation based on a minimum of 85% seed germination.

5. SPRAY LIMITATIONS

Insecticide preparations containing Bt may be used on Bollgard 3 cotton throughout the season BUT NOT on any refuge crops.

An unsprayed refuge should not be planted in the same field as any crop sprayed with a rate of insecticide that is registered for *Helicoverpa* spp. with the exception of Bollgard 3. Sprayed crops and unsprayed refuges that are planted in adjacent fields must be separated by sufficient distance to minimise the likelihood of insecticide drift onto the unsprayed refuge,

If the viability of an unsprayed refuge is at risk due to early or late season pressure by *Helicoverpa* spp., or any other caterpillar species, contact Monsanto Australia immediately. With prior approval from Monsanto Australia, a non-Bt larvicide can be applied.

NB: If any grower encounters problems in complying with the Resistance Management Plan please contact Monsanto Australia.

For further background information on the various components of this plan see the "Preamble to the Resistance Management Plan for Bollgard 3" in the current Cotton Pest Management Guide.



QUESTIONS?

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