What to do if Bollgard II volunteers are present in refuge crops

If volunteers are present in small numbers in the refuge crop, cultivation and manual chipping of the plants must occur.

If volunteers are present in numbers too large to manually remove, growers must notify their Technology Service Providers as soon as possible. In this situation, a Resistance Risk Management Plan (RRMP) will be developed by Monsanto.

The purpose of an RRMP is to provide the grower with strategies to mitigate the risk resultant from the non-compliance with the Resistance Management Plan. Compliance with any issued RRMP is a regulatory requirement and forms part of the Technology User Agreement (TUA) Terms and Conditions.

RRMPs implemented as a result of the presence of Bollgard II volunteers in refuge crops may require growers to destroy refuge and implement additional risk mitigation strategies, such as planting additional refuge in the following season.

Cotton Bunchy Top

Cotton ratoons and volunteers are an obvious host for Cotton Bunchy Top (CBT). It is crucial these overwintering hosts are removed as soon as possible, and resistance management plans are followed, not only within cotton and fallow fields but also along roadsides, head ditches, tail drains, riparian zones and the like.

Cotton Bunchy Top (CBT) is a viral disease that is spread by the cotton aphid (Aphis gossypii) which can have a substantial impact on cotton yield. The annual disease surveys conducted during the 2010/11 season by industry plant pathologists have shown that CBT is highly prevalent in many cotton crops and volunteers late in the season. Levels of up to 70% infestation have been reported, which result in a severe yield reduction.

One of the management considerations for controlling this disease is to eliminate plant hosts during the winter fallow period. CBT can only survive on a living plant host. If we can introduce a break in the presence of these plant hosts between this cotton season and the next, the risk of CBT surviving will be significantly reduced.

Controlling volunteers and ratoons will alleviate the problem but it may also force the virus-carrying aphids onto other plant hosts. Some of the key weed hosts for the cotton aphid include:

- Milkthistle
- Turnip weed
- Marshmallow
- Deadnettle.
Stewardship

The Bollgard® Resistance Management Plan (RMP) has been designed to reduce the rate of development of resistance to the two Bacillus thuringiensis (Bt) proteins expressed by Bollgard II cotton plants. To achieve this, the components of the RMP are aimed at minimising the frequency in the pest population of individuals carrying the resistance genes to either or both proteins (Cry L and Cry 2Ab).

**Volunteer control is critical**

The control of Bollgard II volunteers and ratoon cotton is a key component of the RMP. These weeds or plants from the previous crop that have survived spraying, cultivation and/or the winter will germinate and regrow in the following season. Unless they are controlled and removed, volunteer and ratoon cotton plants may impose additional selection pressure on Helicoverpa spp. to develop resistance to the Bt Cry 1Ac and Cry 2Ab proteins. Any large larvae subsequently moving to adjacent Bollgard II plants will be less affected by the Bt proteins and more able to survive. This may result in damage to the Bollgard II crop as well as additional selection pressure on cultivation to the Bt proteins.

**Volunteer cotton in refuge crops**

The presence of volunteer Bollgard II cotton plants within a cotton or pigeon pea refuge crop results in further selection pressure for resistance to the Bt proteins. Larvae emerging from eggs laid on these conventional plants could survive. Any larger larvae subsequently moving to adjacent Bollgard II plants will be less affected by the Bt proteins and more able to survive. This may result in damage to the Bollgard II crop as well as additional pressure on selection to the Bt proteins.

**Implement appropriate cultural methods**

The best way to avoid the presence of Bollgard II volunteers in refuge crops is not to plant refuge into fields that were planted to Bollgard II the previous season. If this is unavoidable then proactive control methods must be in place before planting:

- Aim to plant refuge crops into fallow areas, or rotation fields that have not been planted to cotton in the previous season. Reducing the amount of viable seed left in fields and surrounding areas by using herbicide options and cultural practices will reduce the number of volunteers that germinate.
- Cultivation of broadacre fields in fallow areas will act as a control method for volunteers of differing sizes, from seedlings to plants.
- Manual removal of plants (chipping) can also be effective in low density situations. Cultivation is also useful to manage other weeds present in the field.

**Develop appropriate herbicide strategies**

If refuge crops are planted into a Bollgard II field from the previous season, ensure appropriate control mechanisms are available and can be implemented in a timely fashion.

### Most herbicide options work well on seedling volunteers.

Once plants are established, control becomes increasingly difficult. Pre-wetting is a method used to establish volunteers prior to planting a refuge into moisture. This allows a window for appropriate herbicide control of seedling volunteers prior to the emergence of the refuge crop. Table 1 shows herbicide options registered for control of cotton volunteers.

<table>
<thead>
<tr>
<th>Active</th>
<th>MOA</th>
<th>Stage &amp; Application</th>
<th>Ategrity Stage</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alar®</td>
<td>28S</td>
<td>1-4 leaf</td>
<td>1-4 leaf</td>
<td>Apply in 300-500L/ha. For best results, apply during canopy of cotton to enhance kill.</td>
</tr>
<tr>
<td>Buctril®</td>
<td>60S</td>
<td>1-4 leaf</td>
<td>1-4 leaf</td>
<td>Apply in 500-750L/ha. For best results, apply during canopy of cotton to enhance kill.</td>
</tr>
<tr>
<td>Butixone®</td>
<td>30S</td>
<td>1-4 leaf</td>
<td>1-4 leaf</td>
<td>Apply in 500-750L/ha. For best results, apply during canopy of cotton to enhance kill.</td>
</tr>
<tr>
<td>Deltamethrin®</td>
<td>60G</td>
<td>1-4 leaf</td>
<td>1-4 leaf</td>
<td>Apply in 500-750L/ha. For best results, apply during canopy of cotton to enhance kill.</td>
</tr>
<tr>
<td>Glufosinate</td>
<td>200G</td>
<td>1-4 leaf</td>
<td>1-4 leaf</td>
<td>Pre-emergent</td>
</tr>
<tr>
<td>Imazapyr</td>
<td>20G</td>
<td>1-4 leaf</td>
<td>1-4 leaf</td>
<td>Pre-emergent</td>
</tr>
<tr>
<td>Orthosilicic Acid</td>
<td>50G</td>
<td>1-4 leaf</td>
<td>1-4 leaf</td>
<td>Pre-emergent</td>
</tr>
<tr>
<td>Paraquat</td>
<td>20G</td>
<td>1-4 leaf</td>
<td>1-4 leaf</td>
<td>Pre-emergent</td>
</tr>
<tr>
<td>Trifluralin</td>
<td>50G</td>
<td>1-4 leaf</td>
<td>1-4 leaf</td>
<td>Pre-emergent</td>
</tr>
</tbody>
</table>