

# Weed management

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## Developing an IWM strategy for your farming system



### What is IWM?

Integrated Weed Management (IWM) is the development and implementation of a plan that is made up of a range of weed management tactics. IWM aims to manage today's weed problems in a manner that reduces the potential for weed problems in the future.

The main principle underlying IWM is preventing weeds from setting seed by:

- Knowing the weed spectrum and considering the interaction between weeds and the farming system (plan).
- Regularly examining the weed problem and the success or failure of recent practices (monitor).
- Assessing the weed management system and developing economic and sustainable solutions (evaluation).
- Implementing alternative management strategies to deal with any problems (response).

An IWM program uses a range of methods of weed control in combination, so that ALL weeds are controlled by at least one tactic in the weed management system.

## BE AWARE OF

- Use a range of weed management tactics to avoid future weed problems.
- Know your weeds.
- Know your risk of resistance considering your farming system.
- Ensure your cotton fields are identified on the Cotton Map to assist with reducing phenoxy drift.
- For further information and support when implementing your integrated weed management strategy, refer to the IPM – insect, weeds and diseases module in *myBMP*.
- Check and monitor weeds that survive a control and be vigilant in regards to monitoring for resistance.
- Decontaminating spray rigs and tanks is VERY important for RoundUp Ready Flex cotton.

In short, IWM is about NOT relying on only one or two methods of weed control alone, and in particular it does not involve relying only on herbicides.

When developing an IWM program, think strategically about how you can best utilise all available weed control methods in cotton, in rotation crops and in fallows. A short term approach to weed management may reduce costs for the immediate crop or fallow, but may not be cost effective over a five or ten year cropping plan.

Over this duration, problems with species shift and the development of herbicide resistant weed populations are likely to occur where weed control has not been part of an integrated plan. Herbicide resistant weed populations are increasingly common in NSW and Queensland.

### Why use IWM in cotton systems?

Effectively managing weeds using an integrated program for the entirety of the cropping rotation will reduce:

- rate of shift in weed spectrum towards more herbicide tolerant weeds
- risk of selecting herbicide resistant weeds and so prolong the useful life of each herbicide
- future weed control costs by reducing the number of weed seeds in the soil seed bank
- competitiveness of weeds and improve crop productivity each year.

Although all of these outcomes are important, reducing the risk of developing herbicide resistant weeds is critical. Throughout the world 185 weed species have developed resistance to different herbicides. Thirty-six weeds have developed resistance to herbicides in Australia.

In northern NSW populations of 3 common grass weeds – awnless barnyard grass, liverseed grass and annual ryegrass (also occurring in southern NSW) – have resistance to glyphosate. Weeds with resistance to multiple herbicides are also occurring more frequently.

The following tactics should be used to develop an integrated weed management strategy for your farm to help prevent the development of herbicide resistance.

### IWM tactics in cotton

#### Key weeds are identified

Ensure that weeds are correctly identified before deciding upon a response. Refer to CRC Weed Identification Tool ([/www.cottoncrc.org.au/content/Industry/Publications/Weeds/WeedIdentificationTools.aspx](http://www.cottoncrc.org.au/content/Industry/Publications/Weeds/WeedIdentificationTools.aspx))

#### Scouting

Scouting fields before weed control is implemented, enables the best control option to be used. Scouting should be repeated to assess efficacy post treatment.

For IWM strategies to be effective in preventing resistance, weeds that survive a herbicide must be controlled by another method before they set seed. Weeds may need to be closely examined, as some are capable of setting seed while very small.

# Prevent whiteflies from infesting your next cotton crop by controlling their alternative host plants.



Volunteer Cotton.  
4 Days after application



Peach vine.  
3 Days after application



Dwarf Amaranth.  
4 Weeks after application



Bellvine.  
4 Days after application

**PLEDGE**  
HERBICIDE  **500 WG**

For more information visit  
[www.sumitomo-chem.com.au](http://www.sumitomo-chem.com.au)



Identify and closely monitor areas where machinery such as pickers and headers breakdown. Weed seeds are often inadvertently released when panels are removed from machines for repairs.

Weed scouting in non-crop areas of the farm is a valuable source of information for planning future weed management strategies.

### Field records

For all fields, maintain records of weed control methods and their effectiveness after every operation. Consider the records from past years in this year's decisions, particularly in relation to rotating herbicide modes of action. Repetitive use of the same mode of action group over time is closely associated with the evolution of herbicide resistance. In addition records are useful in terms of crop rotations and plant back periods. For symptoms of suspected herbicide damage refer to CRC website [www.cottoncrc.org.au/content/Industry/Tools/Herbicide\\_Damage\\_Identification.aspx](http://www.cottoncrc.org.au/content/Industry/Tools/Herbicide_Damage_Identification.aspx)

### The spring tickle

The spring tickle uses shallow cultivation in combination with a non-selective, knockdown herbicide. The aim of the spring tickle is to promote early and uniform germination of weeds prior to sowing to ease weed pressure in-crop. Some weed species are more responsive to the spring tickle than others. Highly responsive weeds include bellvine and annual grasses – liverseed grass and the barnyard grasses.

### Double knock

The double-knock technique is a fallow weed control tactic that is being used widely in southern states to manage hard to control weeds such as herbicide resistant annual ryegrass.

When executed well, the double-knock tactic will provide 100% control. In cotton systems there are several ways the technique can be applied to improve control of weeds such as flaxleaf fleabane and simultaneously reduce the risk of resistance developing in other key weed species such as liverseed grass and awnless barnyard grass.

More recently the double-knock has come to be the use of two herbicides. When using two herbicides, the basis of the double-knock is to apply a systemic herbicide, allow sufficient time for it to be fully translocated through the weeds, then return and apply a contact herbicide, from a different mode of action group, that will rapidly desiccate all of the above ground material, leaving the systemic product to completely kill the root system.

Most commonly glyphosate is followed with a Group L product. The optimum time between the treatments is dependent on the weed targets. Small, rapidly growing grasses respond best when the second application occurs 3–5 days after the first. When slightly larger fleabane is the target, separate the applications by 7–10 days.

### Encourage insect predation

Insect predation can contribute significantly to natural mortality in the weed seed bank. Seed theft by ants commonly causes failure of pasture establishment, so it is feasible that weed seed banks can be decreased by encouraging ants.

In Bollgard II® cotton and unsprayed refuges feeding by the Datura leaf beetle, *Lema trivittata*, can prevent thornapples from setting seed.

### Herbicide tolerant crops are grown according to licence requirements

Herbicide tolerant cottons allow the use of non-selective herbicides for summer weed control in-crop. Incorporating this tactic into the IWM strategy allows for more responsive, flexible weed management. Weeds need only be controlled if and when germinations occur, meaning herbicide application can be timed to have maximum impact on weed populations. In relatively clean fields the reliance on residual herbicides for in-crop management is reduced. In fields known to have heavy weed burdens, using the non-selective together with residual herbicides can achieve very high levels of control. Avoid using the same herbicide to control successive generations of weeds. Use the weed calculation tool to assist with timing of Roundup Ready application (see web address below) [http://www.cottoncrc.org.au/content/Industry/Tools/Agronomy\\_Tools/Field\\_Record\\_Forms.aspx](http://www.cottoncrc.org.au/content/Industry/Tools/Agronomy_Tools/Field_Record_Forms.aspx)

### Prevent weed establishment

Where cotton is grown in rotation with crops such as winter cereals or maize, retain stubble cover from these rotation crops for as long as possible. Stubble cover reduces weed establishment and encourages more rapid breakdown of weed seed on the soil surface.

### Protect yield potential

Young cotton is not a strong competitor with weeds. The critical times when weed competition can cause yield loss are provided in the Cotton Pest Management Guide for a range of weed densities and weed types. Irrespective of the type of weeds, early season control is critical to prevent yield loss. The higher the weed population, the longer into the season weed control is required.

### Control survivors and late germinations

Use a range of selective controls – inter-row cultivation, lay-by herbicide, chipping and spot spraying – to prevent seed set in weeds that survived early season tactics or have germinated late.

For a range of reasons, situations will occur when some weeds escape control by herbicides:

- Missed strips due to poor operation of equipment;
- Insufficient coverage due to high weed numbers;
- Applying the incorrect rate; and,
- Interruptions by rainfall are just a few reasons why weeds escape control.

If herbicide resistant individuals are present, they will be amongst the survivors. It is critical to the longer term success of the IWM strategy that survivors not be let to set seed.

### Inter-row cultivation

Inter-row cultivation can be used to prevent successive generation of weeds from being targeted by post-emergent herbicides. Cultivating when the soil is drying out is the most successful strategy for killing weeds and will reduce the soil damage caused by tractor compaction and soil smearing from tillage implements.

### Manual chipping

Manual chipping is ideally suited to dealing with low densities of weeds, especially those that occur within the crop row. Whilst this is an expensive option, perhaps it should be costed not just to this crop, yet also to subsequent crops.

### Spot spraying

Spot sprayers may be used as a cheaper alternative to manual chipping for controlling low densities of weeds in crop. Ideally, weeds should be sprayed with a relatively high rate of a herbicide from a different herbicide group to the herbicides previously used to ensure that all weeds are controlled.

### Crop rotations

Rotation crops enhance IWM by:

- Introducing herbicide options not available in cotton.
- Producing stubble loads that reduce subsequent weed germinations (important to remember stubble loads and their impact on emerging cotton plants).
- Varying the time of year non-selective measures can be used and the time of year that crop competition suppresses weed growth.

Rotation between summer and winter cropping provides opportunities to use cultivation and knockdown herbicides in-fallow at all times of the year.

### Bury seed of surface-germinating species

Use strategic cultivation to bury weed seeds and prevent their germination. Some weed species, such as common sowthistle (milk thistle) and flaxleaf fleabane, are only able to germinate from on or near the soil surface (top 20mm).

### Good farm hygiene is practiced

To minimise the entry of new weeds into fields, clean down boots, vehicles, and equipment between fields and between properties. Pickers and headers require special attention. Eradicate any new weeds that appear while they are still in small patches. Monitor patches frequently for new emergences.

Irrigation water can be a source of weed infestation with weed seeds being carried in the water. While it is not practical to filter seeds from the water, growers should

be on the look out for weeds that gain entry to fields via irrigation. Control weeds that establish on irrigation storages, supply channels and head ditches.

## Critical success factors in IWM

### Timely implementation of tactics

Often the timeliness of a weed control operation has the largest single impact on its effectiveness. Herbicides are far more effective on rapidly growing small weeds, and may be quite ineffective in controlling large or stressed weeds. Cultivation may be a more cost-effective option to control large or stressed weeds, but additional costs can be avoided through being prepared and implementing controls at the optimum time.

### Rotate herbicide groups

All herbicides are classified into groups based on their mode of action in killing weeds. Rotate herbicide groups whenever possible to avoid using the same group on consecutive generations of weeds. When this is unavoidable, use other methods of weed control in combination with the herbicide and ensure no weeds survive to set seed. The cotton industry is very fortunate to have registered herbicides in the majority of the mode of action groups.

### Herbicides applied according to label directions

Herbicides are a principal component of most IWM strategies so it is important that they are used in the most effective manner possible. When reading the herbicide label check;

- Rate you are about to use is right for the growth stage of the target weeds.
- Whether a wetter or crop oil is required to maximise herbicide performance.
- Application set up you are about to use is consistent with the label – water volume, droplet spectrums, operating pressure.
- For additional, specific information regarding appropriate weather conditions for spraying.

### Consider other aspects of crop agronomy

Most agronomic decisions for cotton have some impact on weed management. Decisions such as cotton planting time, pre-irrigation versus watering-up, methods of fertiliser application, stubble retention and in-crop irrigation management all have an impact on weed emergence and growth. The influence of these decisions should be considered as part of the IWM program. r herbicide resistance in cotton farming systems

## Resistance

There are currently no reported cases of herbicide resistant weeds in cotton farming systems. However the increasing use of glyphosate associated with Roundup Ready™ technologies may increase the risk of resistance developing.

The cotton growing regions are closely aligned with the northern grains region. Across this area, there are 16 weed species that have developed resistance to at least one herbicide mode of action. Most recently, liverseed grass with resistance to glyphosate has been confirmed for the first time.

Development of herbicide resistant weed populations has been most strongly associated with cropping systems where there is minimal or no use of tillage and where there is only limited rotation between summer and winter cropping. The weeds considered to be at highest risk of developing resistance in the north are barnyard grass, liverseed grass, wild oats and sow thistle. These weeds are all able to germinate and establish over a wide range of temperatures and have very high capacities for seed production, meaning more than one generation can be exposed to herbicide selection pressure each season.

It is essential that the growers follow the industry's best management practices and are proactive in preventing the development of herbicide resistance.

Refer to [www.myBMP.com.au](http://www.myBMP.com.au)

### Looking for the early signs of resistance

Herbicide resistance is normally present at very low frequencies in weed populations before the herbicide is first applied. Using the herbicide creates the selection pressure that increases the resistant individuals' likelihood of survival. The underlying frequency of resistant individuals within a population will vary greatly with weed species and herbicide mode of action.

Self Assessment – for possible herbicide resistance: Y/N	
1.	Was the rate of herbicide applied appropriate for the growth stage of the target weed?
2.	Are you confident you were targeting a single germination of weeds?
3.	Were the weeds actively growing at the time of application?
4.	Having referred to your spray log book, were weather conditions optimal at the time of spraying so that herbicide efficacy was not compromised?
5.	Are you confident the suspect plants haven't emerged soon after the herbicide application?
6.	Is the pattern of surviving plants different from what you associate with a spray application problem?
7.	Are the weeds that survived in distinct patches in the field?
8.	Was the level of control generally good on the other target species that were present?
9.	Has this herbicide or herbicides with the same mode of action been used in the field several times before?
10.	Have results with the herbicide in question for the control of the suspect plants been disappointing before?
<b>IF you suspect herbicide resistance and require further information please refer to the Cotton Pest Management Guide, available on the Cotton CRC website or discuss with your agronomist.</b>	

Resistance can begin with the survival of one plant and the seed that it produces. Early in the development of a resistant population, resistant plants are likely to occur only in small patches. This is the critical time to identify the problem. Options are much more limited if resistance is first diagnosed over large areas.

Many of the symptoms of herbicide resistance can also be explained by other causes of spray failure. Evaluate the likelihood of other possible causes of herbicide failure. Start by taking the self assessment (below). The more questions to which you have confidently answered 'Yes', the more a further investigation of possible resistance is warranted. If you have answered 'Yes' to most of these questions, including questions 8–10 on field history, take action;

- Collect samples and send for testing.
- Remove surviving plants from the field to limit the amount of seed going into the soil seed bank.
- Develop a management plan for continued monitoring of the sites and the use of alternative weed control strategies.

### Phenoxy

Cotton is extremely sensitive to phenoxy via off target application and through a poorly sterilised boom. To assist with reducing drift it is essential that you identify your cotton fields on the cottonmap website. This map will be used by spray contractors, resellers, agronomist and neighbours to identify crops.

Decontaminating spray rigs and tanks is VERY important for RoundUp Ready Flex cotton.

These guidelines are a brief version of the Integrated Weed Management Guidelines for Australian Cotton II. For more details on any of the following pages please refer to the CRC website.

#### Further information:

**WEEDpak** – <http://www.cottoncrc.org.au/content/Industry/Publications/Weeds/WEEDpak.aspx>

**Weed Identification Web Tool** – <http://www.cottoncrc.org.au/content/Industry/Publications/Weeds/WeedIdentificationTools.aspx>

**Herbicide Damage ID Web Tool** – [http://www.cottoncrc.org.au/content/Industry/Tools/Herbicide\\_Damage\\_Identification.aspx](http://www.cottoncrc.org.au/content/Industry/Tools/Herbicide_Damage_Identification.aspx)

**myBMP** – [www.mybmp.com.au](http://www.mybmp.com.au)

**Cotton Map** – <http://www.cottonmap.com.au/>