

# INTEGRATED WEED MANAGEMENT

## Introduction

The advent of insecticide resistance precipitated a radical change in insect management for Australian cotton growers. A major change was the adoption of an Integrated Pest Management (IPM) approach to managing insects. Similarly, an Integrated Weed Management (IWM) approach will need to be adopted if growers are to prevent herbicide resistance becoming a major issue in cotton. However, IWM is about more than just preventing herbicide resistance developing, it is about using multiple methods of weed control in synergy to achieve a superior outcome. The results of implementing IWM will be to reduce the reliance on herbicides, minimise the development of species shift and herbicide resistance, and reduce the impact of herbicides on the environment. An overriding theme throughout WEEDpak is the concept of IWM and how important this approach will be in the future.

The aim of this section is to introduce the concepts of IWM in detail and provide an overview of the weed management principles available for cotton production.

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## B2 Managing Weeds in Cotton

A comprehensive overview of the management of weeds in cotton. This document describes the impact of weeds on the crop, common problems with weed identification and a description of the management tools that might be used for weeds in the Australian cotton system. There are summary tables on:

- Re-cropping intervals for many of the herbicides used in rotation crops,
- Residual herbicides and the weeds they control,
- Post-emergent grass herbicides, and
- Re-cropping intervals for the cotton herbicides.

A range of non-chemical management tools are also discussed. The article leads into the issue of herbicide resistance, while reiterating the importance of developing an integrated weed management system for cotton farms.

## B3 Integrated Weed Management (IWM) Guidelines

This document introduces the concept of managing weeds in the cotton production system using an Integrated Weed Management (IWM) approach. It provides an understanding of why IWM will be important for the future management of weeds in Australian cotton and the importance of this concept with herbicide tolerant cotton. A summary table of weeds that have developed herbicide resistance is included, along with a table of the weeds that have developed resistance to the herbicide glyphosate. A description of the components of IWM is provided. This document will encourage cotton growers to evaluate their farm practices, review these practices in light of the IWM principles and adapt their systems to achieve improved outcomes.

### B4.1 The Critical Period Weed Sampling Sheet

This sampling sheet is used to estimate weed density in the field and determine the optimum timing of weed control using the weed control threshold developed from the critical period for weed control concept. The table of weed control thresholds and examples of weeds in the “large broad-leaf” group are shown on the reverse side. An explanation of how to use the sheet is given in section B4.7.

### B4.2 Understanding the Critical Period for Weed Control

This document explains the theory behind the weed control threshold developed using the Critical Period for Weed control. It discusses the establishment of the economic threshold and the approach used to quantify the yield loss caused by the weeds.

A strength of the critical period for weed control concept is that it clearly defines the period during which weed control is required, and conversely, the periods during which weeds cause insufficient yield loss to justify their control. However, weeds might still need to be controlled to avoid seed production, harvesting difficulties and weed problems in later seasons.

This information is especially important for the management of relatively clean fields where weed control decisions can be difficult to make, as it may be unclear whether a weed density is sufficient to justify control.

### B4.3 Applying the Critical Period for Weed Control in the Field

The critical period for weed control is a concept that relates the yield reduction caused by weed competition to an economic threshold. It establishes a period at the start of the season when weeds do not need to be controlled as they cause no economic loss, and a period at the end of the season when weeds again cause no economic loss. These periods define the middle, critical period for weed control, in which weeds must be controlled to reduce yield losses.

The relationships which define the critical period are affected by weed species, weed density and the economic threshold chosen.

This document develops this concept in the field, using real data and establishes a preliminary weed control threshold for cotton. It goes on to discuss the need to ensure that all weed control management inputs are focussed not only on maximizing crop yields but also on avoiding species shift and herbicide resistance.

## B4.4 Using the Critical Period for Weed Control in Roundup Ready Flex<sup>®</sup> Cotton

The weed control threshold developed using the critical period for weed control approach were tested on relative dirty cotton fields at Narrabri using climatic data from the 2004/5, 2005/6 and 2006/7 seasons, using both fully irrigated and dryland scenarios. The findings from this analysis were:

- Applying the CPWC and controlling weeds within a few days of germination will minimize yield losses from weeds, while not leading to excessive herbicide use.
- Weeds that emerge after the CPWC still have to be controlled, but timing is not critical provided they are controlled before they set seed.
- Fields that have significant populations of troublesome weeds should always be treated with residual herbicides before or at planting.
- Alternative weed management tools such as inter-row cultivation and chipping can reduce the pressure on Roundup applications.
- Include a directed layby residual herbicide, incorporated with inter-row cultivation in the system.
- Consider an early layby herbicide application if seasonal conditions lead to excessive early season weed pressure.

## B4.5 Using the Critical Period for Weed Control in the 2007/8 Season

The weed control threshold developed using the critical period for weed control approach were tested on clean, average and dirty cotton fields at Narrabri in the 2007/8 season, using fully irrigated and dryland scenarios. The conclusions from this analysis were:

- Using Roundup Ready Flex cotton without pre- or at-planting residual herbicides can be a sound weed management strategy in low weed pressure fields.
- Including alternative weed management tools in the system, such as inter-row cultivation, can reduce the pressure on Roundup applications.
- Including a directed layby residual herbicide, incorporated with inter-row cultivation, in the system can assist with the management of later emerging weeds and reduce the risk of species shift and herbicide resistance.
- If seasonal conditions lead to excessive early season weed pressure, an early layby herbicide application may be a valuable investment for reducing the pressure on glyphosate.
- Fields with significant populations of glyphosate tolerant or hard-to-control weeds should always be treated with residual herbicides before or at planting.

## B4.6 Managing Weeds Using the Critical Period for Weed Control

This document explores the same data set as the previous document, but with an updated threshold. The threshold was changed in response to a large jump in herbicide and fuel costs during the season, necessitating the adoption of a higher economic threshold.

Data from the 2007/8 season was used to test the practicality of applying the critical period for weed control for irrigated (higher yielding) and dryland (lower yielding) cotton crops. The critical period was applied to weedy, average and clean Roundup Ready Flex<sup>®</sup> fields.

Applying the spraying threshold required that weed control began soon after crop emergence, while weeds were still small. A lighter herbicide rate would be appropriate for these weeds. The threshold was reached later in the dryland crop. The duration of the critical period depended on the density of weeds present.

All weed flushes were controlled using Roundup during the critical period within the constraints of the Roundup Ready Herbicide label, with an inter-row cultivation or early layby available as an additional management tool.

The results show that ensuring weeds are controlled soon after emergence is a practical approach to weed control which will help maximize crop yields. The approach can be equally applied to irrigated and dryland crops using Roundup Ready Flex, Liberty Link<sup>®</sup> or conventional cotton varieties.

#### **B4.7 Sampling Methods for the Critical Period for Weed Control**

A sampling method to estimate the weed population in a field is described and the system for using the sampling sheet is explained. In summary, the system is:

- Use a drive-by survey to identify patches of heavier weeds in the field
- Assess weeds in 3 - 5 of the more weedy areas (depending on field size)
- Estimate the weed type and density on a 250 m strip into the field at each assessment point
- Use these assessments to determine the Critical Period for Weed Control for this crop.
- Organise to control weeds as soon as practical if the weed flush is within the Critical Period
- If not, monitor the weeds and control them before they set seed.