MANAGING WEEDS USING THE CRITICAL PERIOD FOR WEED CONTROL

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Weeds can compete strongly with cotton, reducing yields. Weeds can also harbour pests and diseases, interfere with water flow and picking and contaminate lint. This heavy infestation of Australian bindweed is far more serious than it may appear.

The critical period for weed control

The critical period for weed control is a concept that relates the yield losses caused by weed competition to an economic threshold. It establishes an initial period when weeds are small and do not need to be controlled as they cause no economic loss, and a period later in the season when the cotton plants are relatively large and small weeds again cause no economic loss. These periods define the middle, critical period for weed control, in which weeds must be controlled while still small to avoid significant yield losses. Weeds which emerge after the critical period may still need to be controlled to avoid harvesting difficulties and lint contamination and should not be allowed to set seed, as this will lead to increased weed problems in later seasons. These weeds can also harbour pests and diseases. However, the timing of this control is flexible, provided seed set is prevented, and can be delayed to minimise the number of spray applications required over the season.

In practice, the critical period is defined by the type and density of weeds, potential crop yield, the cost of weed control and the economic threshold the cotton grower chooses. The critical period is defined in Table 1 for large and medium sized broadleaf and grass weeds in high yielding, fully irrigated cotton, and lower yielding or rain-fed crops. Earlier articles defined a critical period based on lower thresholds. The increased thresholds reflect the jump in the glyphosate prices late last year.

To show how the critical period would have worked last season, we applied it to irrigated and dryland cotton crops, using climatic data from Narrabri. We used weedy, average and clean fields, with mixed populations of large and medium broadleaf and grass weeds.

The discussion focuses on the management of Roundup Ready Flex cotton crops because the critical period is readily adapted to the Roundup system and this is the most common cropping option used. The concept can be equally applied to conventional and Liberty Link crops.

***Table 1**. The predicted start and end of the critical period for weed control for a range of weed types and densities. Examples of weeds in each category are: thornapples and noogoora burrs (large broad-leaf weeds); bladder ketmia and Chinese lantern (medium broad-leaf weeds); and barnyard grass (grass weed). The minimum weed densities needed to trigger the critical period are also shown.*

Weed density (no./m²)	Start and end of the critical period for weed control (day degrees since planting)											
	Irrigated (high yielding) cotton						Dryland (low yielding) cotton					
	Broad-leaf weeds						Broad-leaf weeds					
	Large		Medium		Grasses		Large		Medium		Grasses	
	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
0.1	145	189	145	172	-	-	-	-	-	-	-	-
0.2	144	275	144	244	-	-	254	229	-	-	-	-
0.5	143	447	143	387	-	-	251	368	-	-	-	-
1	141	600	141	514	-	-	246	498	246	319	-	-
2	139	738	139	627	-	-	238	620	238	421	-	-
5	131	862	131	729	129	174	215	735	215	537	-	-
10	121	915	121	771	127	248	184	785	184	595	152	206
20	106	944	106	795	125	357	142	812	142	631	147	290
50	87	962	87	810	119	531	93	830	93	654	134	431
Min. density	0.06		0.07		2.5		0.24		0.59		5.4	

The critical period in irrigated cotton

The crops were watered-up on 8th Oct. No residual herbicides were applied before or at planting.

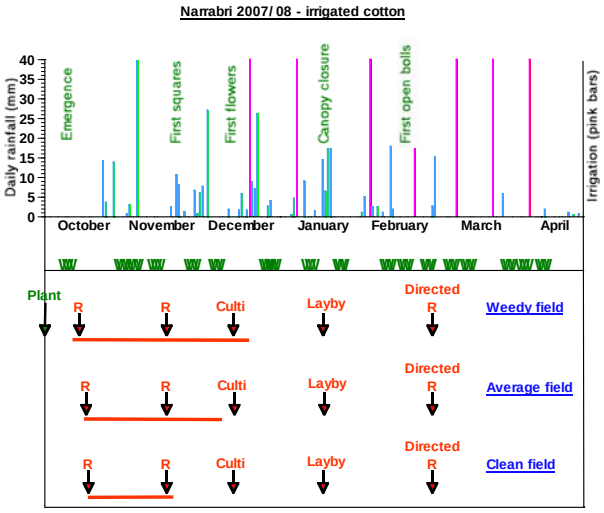

***Figure 1**. How the critical period for weed control could have been used in the 2007-8 season at Narrabri for weedy, average and clean fields. Symbols are: (top section) rainfall (**vertical blue bars**) and irrigations (**vertical pink bars**); (middle section) periods of peak weed emergence, **W**; and (bottom section) the critical period for weed control, **horizontal lines**; and planting and weed control inputs, **arrows**. Symbols used on arrows are: planting, **Plant**; Roundup Ready Herbicide sprays, **R**; inter-row cultivation passes, **Culti**; and application and incorporation of a residual herbicide, **Layby**.*

The start of the critical period was relatively insensitive to weed density, provided there were enough weeds to trigger the critical period. Given that the threshold weed density was reached, the first Roundup application was required soon after crop emergence (106 – 141 day degrees after planting, Figure 1). The end of the critical period was strongly influenced by weed type and density, rising from 514 day degrees post-planting in the clean field, to 862 day degrees in the weedy field.

Lower than maximum label rates would have been suitable for Roundup applications to young weeds, as weeds are more easily controlled while they are small, provided they have sufficient leaf area to catch the spray. Rates of 0.8 to 1 kg/ha should be sufficient to control susceptible weed seedlings, reducing cost and maintaining late-season options (the product label precludes the use of maximum label rates for all applications if the maximum number of in-crop Roundup applications is used).

An alternative input, such as a cultivation and light chip, may have been required to remove surviving weeds after this application, as required by the Roundup Ready Flex Crop Management Plan. The need for this input is determined by the in-crop survey of weed survivors. Controlling surviving weeds is essential to avoid species shift and herbicide resistance.

Reasonable rain fell over late spring and summer, in a relatively long, cool season. This resulted in multiple weed germinations, with later germinations triggered by irrigations. A 2nd Roundup application was required on all fields in early-November to control a flush of weeds after rain in late-October. A fall of 40 mm delayed this application till mid-November.

No further weed control in the critical period was required on the clean or average fields, but all fields were inter-row cultivated in early- to mid-December prior to the first irrigation. This cultivation was undertaken to facilitate water movement and would also have controlled most weeds present. A supplementary Roundup application and/or chipping may have been required in the weedy field.

A large number of weeds emerged following further rain in December and January, necessitating treatment by Roundup or the use of an incorporated residual herbicide in mid-January. An additional directed Roundup application could have been made in late-February, and a pre-harvest application could also have been used to prevent late-season weeds setting seed if sufficient weeds were present to justify these inputs.

The critical period in dryland cotton

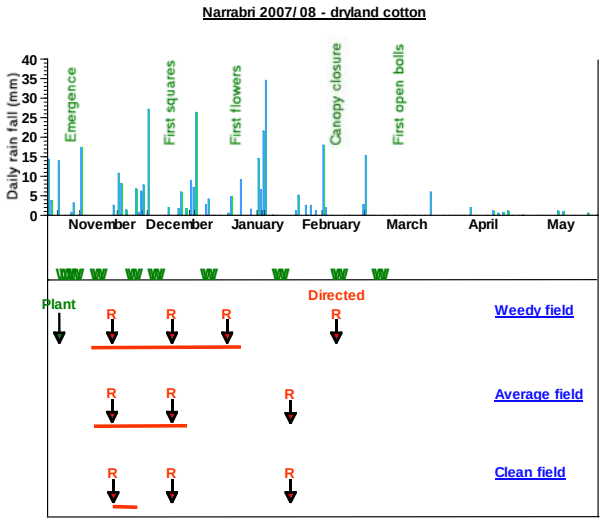

Figure 2. *Using the critical period for weed control in dryland cotton in the 2007-8 season at Narrabri. Symbols are explained in the caption to Figure 1.*

The crops were planted on 28th Oct, following rain on the 25th. No residual herbicides were applied before or at planting.

The start of the critical period was again relatively insensitive to weed density, provided there were enough weeds to trigger the critical period. Given that the threshold weed density was reached, the first Roundup application was required soon after crop emergence (241 day degrees after planting, Figure 2). The end of the critical period was strongly influenced by weed type and density, rising from 368 day degrees post-planting in the clean field, to 735 day degrees in the weedy field.

A 2nd Roundup application was required on the average and weedy fields in early-December to control a flush of weeds after rain in late-November. An application may have also been used on the clean field to control weeds before they set seed.

No further weed control in the critical period was required on the clean and average fields, but a Roundup may have been used in late-January, again to control weeds before they set seed. A Roundup was required at the start of January on the weedy field.

An alternative treatment, such as a cultivation and light chipping, may have been used to remove surviving weeds after the Roundup applications in mid-December, as required by the Roundup Ready Flex Crop Management Plan. The need for this input is determined by the in-crop survey of weed survivors.

An experiment using a naturally occurring weed population to test the application of the critical period for weed control in cotton at ACRI last season.

Observations from the 2007/8 season

Using the critical period for weed control approach in this season didn't encounter any difficulties for either irrigated or dryland cotton production.

The main difference for crop management with this approach is that weed control is focussed on the critical period, soon after crop emergence, with all inputs during this period necessarily occurring on small weeds. This contrasts with a more common philosophy, that glyphosate applications to Roundup Ready Flex crops can be delayed to maximise the efficiency of each spray, minimising the number of sprays and ensuring that the maximum number of weeds are controlled with each input. Many cotton growers have concluded that since they are no longer constrained to the 4-node over-the-top glyphosate application window, glyphosate applications can be delayed to about 6 nodes, with a 2nd application at 10 to 12 nodes giving good weed control. While this approach is valid, the science of the critical period has shown that to avoid yield losses, the first glyphosate application may need to occur soon after crop emergence, with further applications following closely after successive weed germination events. This strategy of controlling very small weeds may require more Roundup applications, but can utilize lower herbicide rates and maintains the potential for higher crop yields.

In seasons where the early season weed pressure is excessive (possibly requiring more Roundup applications than are permitted by the product label), an alternative herbicide or early layby application of residual herbicide could be used to replace a Roundup application and reduce weed pressure. Prometyrn (Gesagard) or fluometuron (Cotoran), for example, can be applied as an early layby to cotton as small as 15 cm high and control a wide range of small emerged weeds, as well as giving residual control, reducing weed pressure. An alternative residual, such as diuron, could be applied later in the season as a standard layby application if necessary.

Summary

Data from last 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® 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® or conventional cotton varieties.