

RESIDUAL HERBICIDES – A FARMING SYSTEMS COMPLICATION

Graham Charles

New South Wales Department of Primary Industries, ACRI, Narrabri, NSW

graham.charles@dpi.nsw.gov.au

SUMMARY

This season's results show the potential for damage to cotton crops from residues of Hussar[®], Intervix[®], Spinnaker[®] and Lontrel[®], with reductions in plant stand, seedling vigour, crop development and yield recorded. Cotton growers need to ensure the recommended plant-back periods for these and other residual herbicides are observed.

INTRODUCTION

With high cotton prices and abundant water, back-to-back cotton production or a cotton-wheat rotation are attractive options. With constraints such as limited land, low cotton prices or water shortages, however, a more complex farming system can be attractive, potentially making better use of limited resources, maximising production from limited water and taking advantage of fluctuating commodity prices. The dryland farming system, particularly, commonly uses a complex farming system to take best advantage of prices and planting opportunities.

A more complex farming system can also be an advantage for weed management, allowing a wider range of herbicides to be used, so that all weeds are managed at some point in the system, without the system degenerating to rely on only a few options, as has happened with back-to-back wheat, where many summer weeds are only being controlled by glyphosate, leading to the breakdown of this system.

However, herbicide residues and plant-back periods remain the bane of short cropping

rotations, with many products having plant-back periods to cotton of months and sometimes years, greatly limiting or precluding the option of using these herbicides in double cropping situations.

Over the last 5 seasons, I have examined the effects of 18 alternative herbicides on cotton production, including 9 herbicides with prolonged plant-back periods. The results of this work are published in the **Herbicide Damage Guide for Cotton**, Section J in **WEEDpak – a guide to integrated weed management in cotton**, available on the web at: <http://www.cottoncrc.org.au/industry/Publications/Weeds>

The residual impacts of these herbicides varied from no observable effect and no yield loss from simazine at 1.5 kg a.i./ha, to around 25% yield loss for the Group B herbicides and one of the Group I combinations (Table 1). While these results are not definitive, being from a single site and season, they highlight the potential losses from residues of these herbicides. Actual losses in any particular field and season could be greater or less than those in the table, as both the rate of herbicide breakdown and the level of herbicidal activity are influenced by soil moisture levels. Plant rooting patterns also affect the extent of herbicide take up. No yield losses were recorded in these experiments for atrazine, for example, but there have been plenty of examples over the years of cotton yield losses due to atrazine residues, especially following dry periods, when atrazine break-down is delayed.

Table 1: A summary of the cotton damage observed from herbicide residues. These herbicides were applied at 10% and 50% of a typical field rate immediately prior to the cotton being planted. The full data sets are available in the **Herbicide Damage Guide for Cotton**.

Herbicide	Group	Half-life ¹	Plant-back period	10%		50%		Visual damage observed
				Rate (a.i./ha)	Yield loss	Rate (a.i./ha)	Yield loss	
chlorsulfuron	B	28 - 42 days	≥2 years	1.5 g	-	7.5 g	26%	yes
imazapic	B	120 days	2 years	4.8 g	-	24 g	25%	yes
metasulfuron-methyl	B	7 - 42 days	≥2 years	0.42 g	8%	2.1 g	23%	yes
atrazine	C	60 days	≥ 1 - 2 years	200 g	-	1 kg	-	-
simazine	C	55 - 186 days	1 year	300 g	-	1.2 kg	-	-
isoxaflutole	H	1 - 2 days	7 months	7.5 g	-	37.5 g	-	yes
2,4 D + picloram	I	90 - 200 days ²	1 year	30 + 7.5 g	-	150 + 37.5 g	24%	some
MCPA + picloram	I	90 - 200 days ²	1 year	42 + 2.6 g	-	210 + 13 g	-	some
triclopyr + picloram	I	90 - 200 days ²	NS ³	15 + 5 g	7%	75 + 2.5 g	18%	some

Note¹. Senseman (2007).

Note². The half-life of picloram, the time over which ½ the chemical will breakdown in the soil.

Note³. No plant-back period to cotton was specified on the label.

Note. This information is indicative only. Always refer to the pesticide label for up-to-date information.

These herbicides have a wide range of break-down rates, as indicated by the half-lives, varying from only 1 - 2 days for isoxaflutole (Balance[®]) to 120 days for imazapic (Flame[®]). Soil activity, however, is a combination of a number of aspects, including break-down rate, break-down products, soil moisture, soil temperature and soil pH. Soil activity is also affected by soil movement and plant sensitivity.

As a personal observation, I suspect that with the ever-increasing yields being achieved in cotton, many of the older plant-back recommendations may underestimate the potential to cause yield losses in cotton. Growers would be wise to add a further safety margin for potentially high yielding irrigated cotton crops.

HUSSAR[®], INTERVIX[®], SPINNAKER[®] AND LONTREL[®]

New to the **Herbicide Damage Guide for Cotton** this year will be idosulfuron + mefenpyr diethyl (Hussar), imazamox + imazapyr (Intervix), imazethapyr (Spinnaker) and clopyralid (Lontrel), herbicides more commonly used in the southern farming system. These herbicides have soil half-lives that range from very short (1 – 10 days) for Hussar, up to 142 days for Intervix, and plant-back periods for cotton that extend to nearly 3 years for Intervix (Table 2). A plant-back period of this duration makes it difficult to see how this herbicide can fit into a cropping system that includes cotton, and creates a temptation to cut some corners in the hope that the plant-back period really isn't that long, or the consequences of shortening the plant-back that great.



Undamaged



Hussar @ 100 g/ha



Intervix @ 375 ml/ha



Spinnaker 700 WDG @ 70 g/ha



Lontrel 750 SG @ 60 g/ha

Photos 1 – 5. The reduction in plant stand and seedling size from residual herbicides applied at 50% of the recommended rate at the time of cotton planting. Photos were taken on 16th December 2011, 60 days after emergence. Some plants appear relatively unaffected, while others were severely affected.

Table 2. A summary of the cotton damage observed last season (preliminary 2011/12 data). These herbicides were applied at 10% and 50% of a typical field rate immediately prior to the cotton being planted.

Herbicide	Group	Half-life ¹	Plant-back period	10%		50%	
				Rate (a.i./ha)	Yield loss	Rate (a.i./ha)	Yield loss
idosulfuron + mefenpyr diethyl	B	1 - 10 days	1 year	1 g	9%	5 g	23%
imazamox + imazapyr	B	25 - 142 days	34 months	2.5 + 1.1 g	2%	12.4 + 5.6 g	44%
imazethapyr	B	60 - 90 days	18 months ²	9.8 g	29%	49 g	51%
clopyralid	I	12 - 70 days	6 months	9 g	12%	45 g	24%

Note¹. Senseman (2007).

Note². This plant-back period extends out to 22 months in a dryland cropping situation.

Note. This information is indicative only. Always refer to the pesticide label for up-to-date information.

Preliminary analysis indicates that residues of these herbicides caused substantial damage to the cotton when present at planting, with large reductions in the plant stand and delays in seedling development (photos 1 – 5).

All aspects of plant development were affected by these residual herbicides throughout the season, from leaf initiation and development, to square initiation and boll development and retention, as seen in Figure 1, although to some extent, the impact of the herbicides may have been masked by the late February flooding event, which limited plant size and yield on the undamaged treatment.

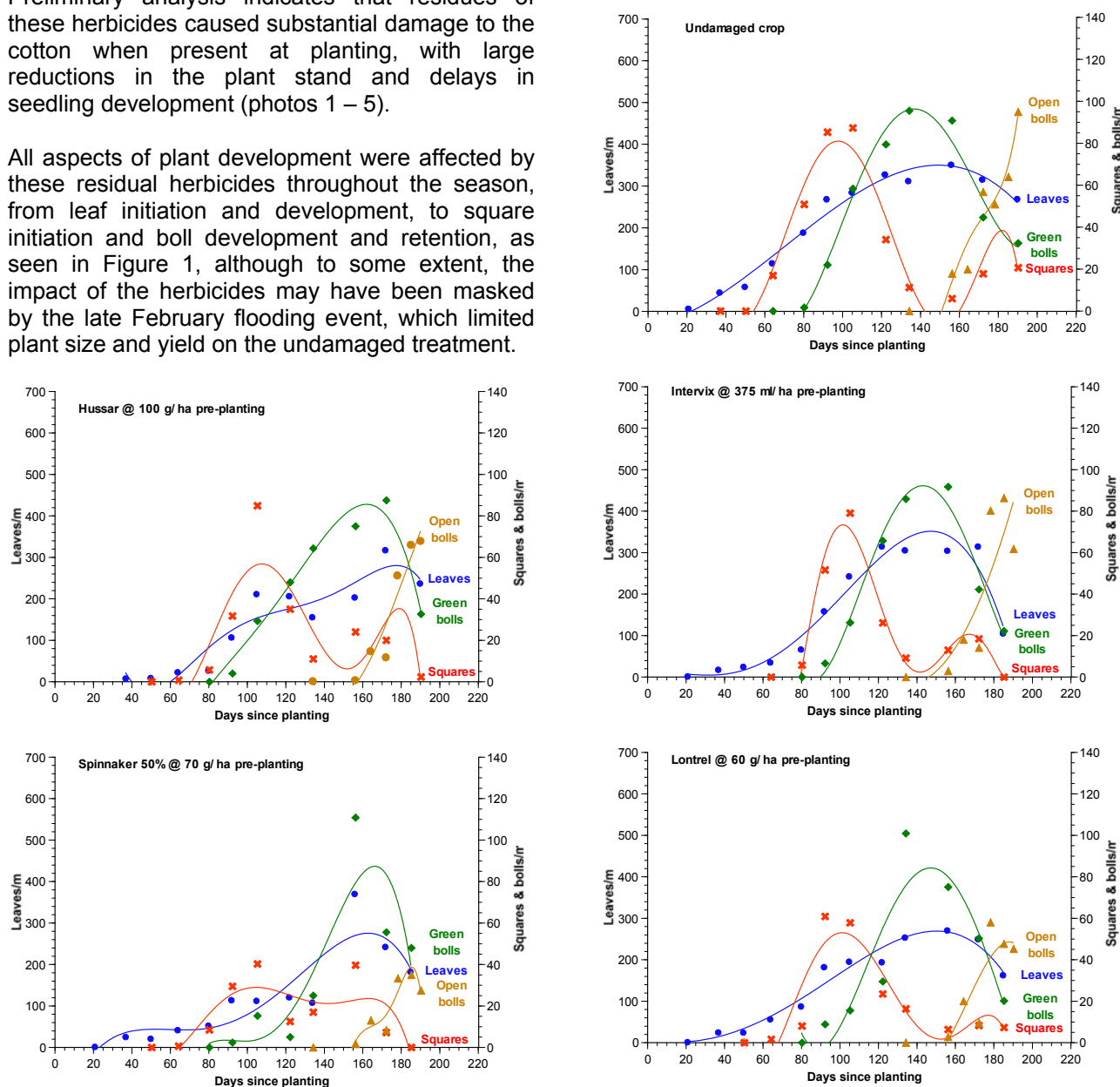


Figure 1. The impact of herbicide residues on plant growth and development last season (preliminary 2011/12 data). Herbicides were applied at 50% of a typical field rate prior to cotton planting. The marked drop in square production beyond 100 days post-planting was related to the prolonged rainfall, water logging and flooding that occurred at the end of February 2012.

The impacts on plant development were still apparent at the end of the season and resulted in appreciable yield losses (Table 3).

It can be concluded from this data that potential cotton growers shouldn't consider cutting the recommended plant-back periods for these herbicides, no matter how attractive this option may appear, as they will run the risk of substantial yield reductions. Fields where Intervix has been applied can't be considered for cotton production within 3 years of the application.

Post-emergence applications of these herbicides also caused high levels of damage, with yields reduced by up to 97%, showing the need to ensure inadvertent drift to cotton doesn't occur and emphasising the need to ensure spray rigs are properly decontaminated and pesticide drums are well labelled and physically separated where possible to avoid the possibility accidentally applying any of these herbicides.

Table 3. The impact of herbicide residues on aspects of plant growth and development. Herbicides were applied at 50% of a typical field rate prior to cotton planting. Data from 17 April 2012, 190 days after planting. Percentage reductions are shown below each line of data.

	undamaged comparison	idosulfuron + mefenpyr diethyl	imazamox + imazapyr	imazethapyr	clopyralid
Plants/m	10.8	5.0 54%	6.7 38%	5.7 48%	8.8 18%
Height (cm)	77.7	79.0 -	84.7 -	99.6 -	55.2 29%
Nodes	23.9	22.0 8%	22.8 4%	27.4 -	20.8 13%
Leaves	267	236 12%	104 61%	181 32%	161 40%
Leaf area	6144	7543 -	3277 47%	5890 4%	3999 35%
Wet weight/m	1787	1814 -	1435 20%	1685 6%	999 44%
Total bolls/m	127	100 21%	109 15%	83 35%	68 47%
Mature bolls/m	95	68 29%	86 9%	35 63%	48 50%
Boll weight	5.2	6.3 -	5.7 -	5.8 -	5.1 1%
Lint	1948	1497 23%	1088 44%	954 51%	1481 24%

REFERENCE

Senseman SA (ed), 2007. Herbicide Handbook, Weed Science Society of America, 9th Edition, Lawrence, Kansas.