Residual herbicides – the hidden cost!!

By Graham Charles, Weed Scientist, Industry & Investment NSW, Cotton Catchment Communities CRC & CRDC

Finally it has happened. We look like going into the best season for many years, with water in the dams and a full profile of soil moisture.

Now is the time to make those last-minute decisions about how much cotton to plant and which fields to plant, but make sure you avoid the pitfalls.

One of the least obvious pitfalls is residual herbicide, applied to a previous crop or fallow some time in the last few months or even the last few years, depending on the herbicide. Some of the residual herbicides (such as atrazine, Tordon®, Ally® & Glean®) can remain active in the soil for well over a year, even though they are having no obvious effect, but they can still have a nasty effect on cotton!

Plant-back periods for residual herbicides are something we are all aware of, but in the past, have not always taken too seriously. However, recent research undertaken by my team at ACRI, Narrabri, clearly shows that these herbicides can be causing far more damage than we previously realized.

Many of you may be familiar with the herbicide damage data sets (generated by my team) that are now available on the Cotton CRC website at:

www.cottoncrc.org.au/content/Industry/Tools/Herbicide_Damage_Identification.aspx

These data sets show the type of damage to cotton which could be expected from drift or accidental exposure from a range of herbicides, with damage from different rates and stages of crop growth. Each set of pages shows visual symptoms of the herbicide damage, the impact on leaf, square and boll production, and the final impact on boll distribution, crop maturity and yield, as shown in the example pages for Starane® at a 10% rate at 11 nodes.

Herbicide damage guide for cotton

Photographs & material by: Graham Charles, Industry & Investment NSW

Herbicide:	fluroxypyr
Rate:	36 g a.i./ha
% of typical field rate	10%
Date of exposure:	5th Dec (9 weeks post-emergence)
Growth stage at exposure:	11 nodes

Damage key:

Leaf loss	
Leaf distortion	x
Petiole distortion	x
Plant stunting	x
Square shedding	x
Boll shedding	x

Herbicidal action

Herbicide group:	I
Translocation:	readily moves to the plant growth points
Mode of action:	an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production.
Residual activity:	limited
Soil half-life:	11 - 38 days in moist soil

Starane® 300 applied broadcast at 120 ml/ha to 11 node cotton. Photo taken on 11th Dec, 6 days after exposure.

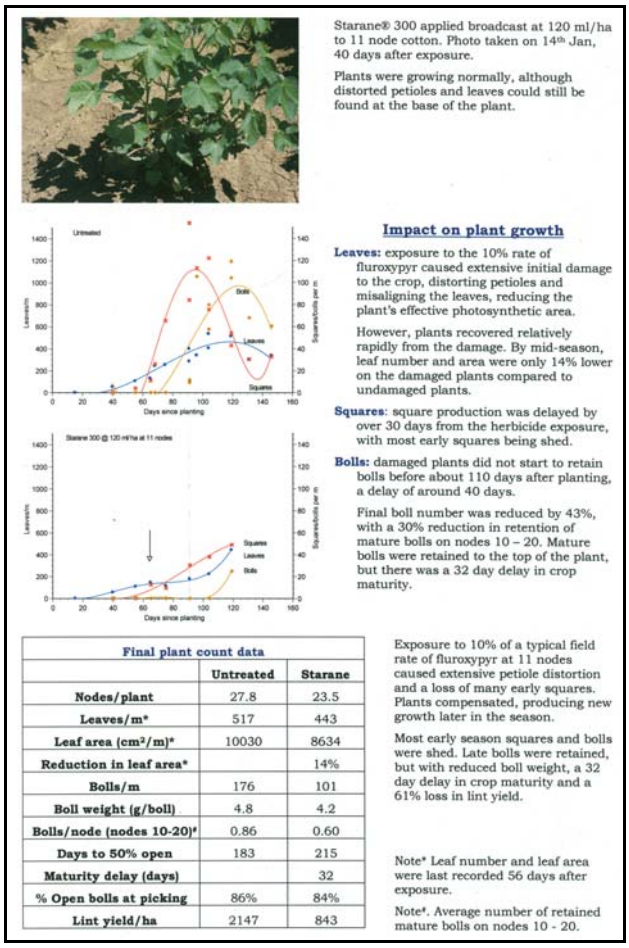
Initial symptoms of fluroxypyr damage were apparent after only a couple of days, with reddening of the stems, petiole twisting and bending, leaf cupping and some leaf discolouration and burning.

Starane® 300 applied broadcast at 120 ml/ha to 11 node cotton. Photo taken on 21st Dec, 16 days after exposure.

Initial symptoms of fluroxypyr damage were still very apparent 16 days after exposure, with reddening of the stems, petiole twisting and bending and some necrotic spots.

Starane® 300 applied broadcast at 120 ml/ha to 11 node cotton. Photo taken on 2nd Jan, 28 days after exposure.

Plants had resumed 'normal' growth 28 days after exposure. The more typical signs of phenoxy damage with leaf distortion etc. were not apparent at any stage.



Starane® 300 applied broadcast at 120 ml/ha to 11 node cotton. Photo taken on 14th Jan, 40 days after exposure.

Plants were growing normally, although distorted petioles and leaves could still be found at the base of the plant.

Impact on plant growth

Leaves: exposure to the 10% rate of fluroxypyr caused extensive initial damage to the crop, distorting petioles and misaligning the leaves, reducing the plant's effective photosynthetic area.

However, plants recovered relatively rapidly from the damage. By mid-season, leaf number and area were only 14% lower on the damaged plants compared to undamaged plants.

Squares: square production was delayed by over 30 days from the herbicide exposure, with most early squares being shed.

Bolls: damaged plants did not start to retain bolls before about 110 days after planting, a delay of around 40 days.

Final boll number was reduced by 43%, with a 30% reduction in retention of mature bolls on nodes 10 – 20. Mature bolls were retained to the top of the plant, but there was a 32 day delay in crop maturity.

Final plant count data

	Untreated	Starane
Nodes/plant	27.8	23.5
Leaves/m*	517	443
Leaf area (cm²/m)*	10030	8634
Reduction in leaf area*		14%
Bolls/m	176	101
Boll weight (g/boll)	4.8	4.2
Bolls/node (nodes 10-20)#	0.86	0.60
Days to 50% open	183	215
Maturity delay (days)		32
% Open bolls at picking	86%	84%
Lint yield/ha	2147	843

Exposure to 10% of a typical field rate of fluroxypyr at 11 nodes caused extensive petiole distortion and a loss of many early squares. Plants compensated, producing new growth later in the season.

Most early season squares and bolls were shed. Late bolls were retained, but with reduced boll weight, a 32 day delay in crop maturity and a 61% loss in lint yield.

Note* Leaf number and leaf area were last recorded 56 days after exposure.

Note#. Average number of retained mature bolls on nodes 10 - 20.

Data sets for the following herbicides are included on the CRC web site:

- 2,4-D amine (Baton®)
- Dicamba (Kamba® 500)
- Fluroxypyr (Starane® 300)
- MCPA (MCPA 500)
- 2,4-D amine + picloram (Tordon® 75D)
- Glyphosate + 2,4-D amine
- MCPA + picloram (Tordon® 242)
- Triclopyr + picloram (Grazon® DS)

- Atrazine (Gesaprim® Granules 900 WG)
- Simazine (Simazine 900DF)
- Glufosinate (Liberty®)
- Glyphosate (Roundup Ready Herbicide®), and
- Paraquat + diquat (Spray.Seed® 250).

But, you may not have looked at all of them in detail, and you may not have noticed that pre-planting (residual) exposure information is now included for atrazine, simazine, Grazon, Tordon 242 and Tordon 75D. (Residual information will be generated this season for Ally, Balance, Flame and Glean, and more could be included in future years).

This residual information is fascinating reading! Fascinating, not so much for the herbicide damage that was seen, but for the damage that was not seen!!

Very little damage was detected at any stage from the residual herbicides used in this experiment and applied pre-planting, with damage recorded in only a small percentage of plants on a few of the treatments (no damage at all was detected from simazine). This damage could easily have been attributed to light phenoxy drift (for the auxin herbicides) or some other cause (atrazine). However, picking showed a very different story, with lint yield reductions of 14 – 22% recorded for the heavier rates of atrazine, Tordon 75D and Tordon 242. Also, this was in a relatively dry season and these residual herbicide could have caused far more damage in a wetter season, like the one we appear to be going into.

So what is the point of the story? The point is that this experiment showed that **residual herbicides could rob you of up to a quarter of your yield even though few obvious symptoms of herbicide damage were apparent, even in a fully irrigated crop in a long season where the crop was able to compensate for early-season damage**!

The traditional approach to herbicide plant-back periods has been to take note of the recommended plant-back period on the product label, and then shave a bit off, because we "all know that the labels are a bit conservative". This approach has probably worked well enough in the past with most herbicides and most growers, but there have been plenty of examples of growers who have been caught, especially following dry years, when the rate of herbicide breakdown is generally reduced.

The second string to the bow has been to take a small risk one season, and if you didn't see any residual damage, you "knew" you would be safe to do the same thing again next season. There have also been far too many examples of growers who got away with a risk for one year, or even for several years, but who eventually came unstuck and sometimes in a big way!

Some labels, such as Dupont's Ally® label, give no recommended plant-back period to cotton, but instead recommend that the "*Tolerance of other crops* [such as cotton] *(grown through to maturity) should be determined on a small scale before sowing into larger areas"*. This recommendation is sound, but has on some occasions been interpreted liberally by growers who have convinced themselves of crop safety after placing soil from the field into pots and then observed the growth of cotton seedlings in these pots in front of the fire. This approach has four main problems.

1. Soil taken from one part of a field may not be representative of the whole field. This is especially true on larger fields which may contain a range of soil types.
2. The main concentration of residual herbicide may be above or below the sampled zone and may not be represented by the soil sample used,
3. Large yield losses (up to 25%) can be incurred without most plants showing symptoms of herbicide damage (as shown by my research). The presence of herbicide damage symptoms definitely shows that a field shouldn't be used for cotton. A lack of visual herbicide damage doesn't necessarily indicate that a field is safe to use. In the case of metsulfuron-methyl (Ally), for example, the safe plant-back period to cotton could be several years, depending on the application rate and frequency, soil type and rainfall following application. In my experiment, over 95% of plants showed no damage symptoms, even when damage was severe enough to cause a 22% yield loss.
4. The label actually allows for the crop to be grown in the season following the successful test, whereas the "pot" approach reduces this plant-back period by 12 months.

So, bottom line. Follow the product label plant-back recommendations and don't cut corners. Always err on the side of caution, especially if conditions have been relatively dry for much of the period since the herbicide was applied. Right now, the potential for damage from residual herbicides is very high!!

If in doubt, don't plant cotton into a field where residual herbicides might still be an issue. This is especially true of irrigated fields where high yields are expected. The higher the yield, the greater the potential yield loss from herbicide damage. A 22% yield loss is likely to be very expensive in a potentially 12 – 15+ bale crop. Conversely, the potential yield loss in a dryland crop might seem comparatively small, but could easily mean the difference between profit and loss.

For more information on herbicide damage and crop response, see the Cotton CRC website at:

www.cottoncrc.org.au/content/Industry/Tools/Herbicide_Damage_Identification.aspx

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