



Sprayer decontamination.



Broadarea farming systems in Western Australia are generally based on crop rotations of cereals (mainly wheat) with either pulses (mainly lupins), canola, and/or legume pastures. Herbicides used in one crop type are often not safe to use in another. Thus there is a serious risk of damage from traces of herbicide left in the sprayer after treating the previous crop.

Not all herbicides are likely to cause such problems. Tank residues are unlikely to amount to more than one per cent of the original rate applied to the target crop. Simazine or atrazine residues of one per cent (15 - 20 mL/ha) would have no effect on wheat, nor would 2 - 5 per cent/ha of the grass-selective herbicides used in lupins (for example, fluazifop, quizalofop, haloxyfop etc).

The herbicides that need to be scrupulously removed from the sprayer are those capable of causing damage at low concentrations. These are the sulfonylureas (chlorsulfuron, metsulfuron, triasulfuron) and hormone type herbicides such as 2,4-D, MCPA and picloram. One per cent of the recommended rate of these herbicides will definitely cause damage to lupins, canola and pasture legumes. It has been shown that even a 0.05% rate of triasulfuron (15 mg/ha) will severely affect canola.

The damage to lupins caused by trace amounts of chlorsulfuron in the spray is greater in the presence of grass-selective herbicides. The xylene in the grass-selective formulation probably acts as a spraying oil, and increases the uptake of the sulfonylurea herbicide. (See the later diagram for pot trial results showing this fact.) A similar situation exists with the spraying of atrazine + oil onto TT canola crops. Traces of triasulfuron in the spray equipment have devastated some canola crops.

Since the time schedule at the start of the season dictates that post-emergence grass herbicides be sprayed on to lupins, or atrazine on to canola, immediately after sulfonylureas have been applied to wheat paddocks, such damage is a real possibility. Where possible, a selective grass herbicide, such as diclofop, Topic® or Wildcat®, should be sprayed through the boom onto wheat before moving onto legume crops.

Immediately after using either sulfonylureas or hormone herbicides, the sprayer should be thoroughly cleaned using the appropriate method. There are two common methods of cleaning, each being effective for one type of chemical.

Preliminary cleaning.

The spray unit should always be cleaned in an area where the water used can be run to waste without causing any environmental damage. Ideally, a soak pit should be provided to collect the runoff and hold it until soil organisms degrade any chemicals it contains. If this is not possible, a site should be chosen where washings will soak into the ground without running away. The site should not be close to any vegetation that could be damaged, and there should be no chance of subsoil seepage reaching water courses or wells or dams.

The following procedure is recommended for the preliminary cleaning of spraying equipment:

1. Hose down the outside of the unit. Otherwise any herbicide adhering to the outside could re-contaminate the unit after it has been cleaned.
2. Remove and thoroughly scrub all filters. Nozzles also should be removed and cleaned. Particles of sulfonylurea have been known to collect on filters when the initial dispersion in the tank has not been complete.



Sprayer decontamination.



3. Wash down the inside of the tank, and flush out all lines and pumps. The nozzles may have to be replaced to do this. Care should be taken to wash out any indentations or ledges in the tank where herbicide could be deposited.
4. Carry out the special chemical cleaning detailed below if necessary. Enough water should be added to the tank to fully flush all lines with cleaning solution.

Chlorine bleach cleaning

This method should be used to remove sulfonylureas and most other pesticides from sprayers.

Chlorine is a powerful oxidising agent, and will decompose most organic molecules. The most convenient source of chlorine is from liquid household bleach, liquid pool chlorine, or from solid swimming pool chlorine granules. Household bleach contains about 4 per cent available chlorine, liquid pool chlorine about 12.5 per cent, both as sodium hypochlorite, while solid pool chlorine contains 65 per cent available chlorine as calcium hypochlorite. When added to water, hypochlorite reacts with the water to form free chlorine. Solid pool chlorine also produces a sediment of calcium oxides.

The procedure is as follows.

1. To each 100 L of water in the tank, add either 300 mL of 4 per cent bleach, 100 mL of 12.5 per cent or 6 g of 65 per cent pool chlorine. Agitate and circulate solution through all lines. The sprayer must be run briefly to fill the boom.
2. Let the unit stand for at least 30 minutes but preferably longer, then drain.
3. Repeat step 1. The solution may be left to soak overnight for an especially thorough cleaning.

Remember that the spray lines have a relatively small volume, and if chemical has settled in them there may not be enough chlorine in one flush to destroy this. That is the reason for the repeat flushing/cleaning cycle.

Alkaline cleaning.

This method is recommended after using acidic chemicals such as 2,4-D, MCPA, dicamba, picloram, and triclopyr. The alkaline solution can dissolve these herbicides and, if they were ester formulations, strong alkali is able to hydrolyse the molecules, converting them to a water soluble form that is more easily removed. Ester formulations are particularly bad contaminants, because they penetrate rubber and plastic seals and hoses. From there they can be gradually released into subsequent sprays, and cause damage especially to canola. Using solvent grade plastic hosing and Viton® seals and diaphragms will minimise problems.

Water soluble amine formulations.

Generally, these will clean out quite adequately with a simple flushing with water. For extra surety, use an alkaline additive as per step 1.

1. Add either 800 mL of household ammonia, 250 g of sodium carbonate (washing soda), or 200 g of sodium hydroxide (caustic soda) to each 100 litres of water in the tank. Agitate and circulate the solution through all lines. Run the sprayer briefly to fill the boom.
2. Let the unit stand for two to three hours, then drain.
3. Repeat step 1. The solution may be left to soak overnight for an especially thorough cleaning.



Sprayer decontamination.



Ester formulations (emulsifiable concentrates).

Proceed as above, but use sodium hydroxide for preference, washing soda at a pinch, but not ammonia. 200 mL of wetting agent should also be added.

Precautions

Chlorine bleach should never be mixed with ammonia. Chlorine reacts with ammonia, destroying the cleaning power of both. Volatile, acrid nitrosamines are formed, which can cause eye irritation.

Caustic soda solution will corrode aluminium, brass and galvanised parts. These should be removed or isolated from cleaning solutions of caustic soda. Ammonia solutions at the concentrations recommended will not affect these metals.

It should be noted that sulfonylureas may be difficult to remove from damaged or cracked fibreglass tanks. Tanks should be repaired and cleaned thoroughly before the start of the spraying season.

During the off season, it may be worthwhile to strip down the boom system, and note any dead pockets within the plumbing where herbicide residues have accumulated. If these can be eliminated by some modification, there will be less chance of damage in future. If the system cannot be modified, it may be possible to open it at the trouble spots and manually clean out any residues as part of the decontamination procedure.

Actual trial data to show the level of residues that produce damage.

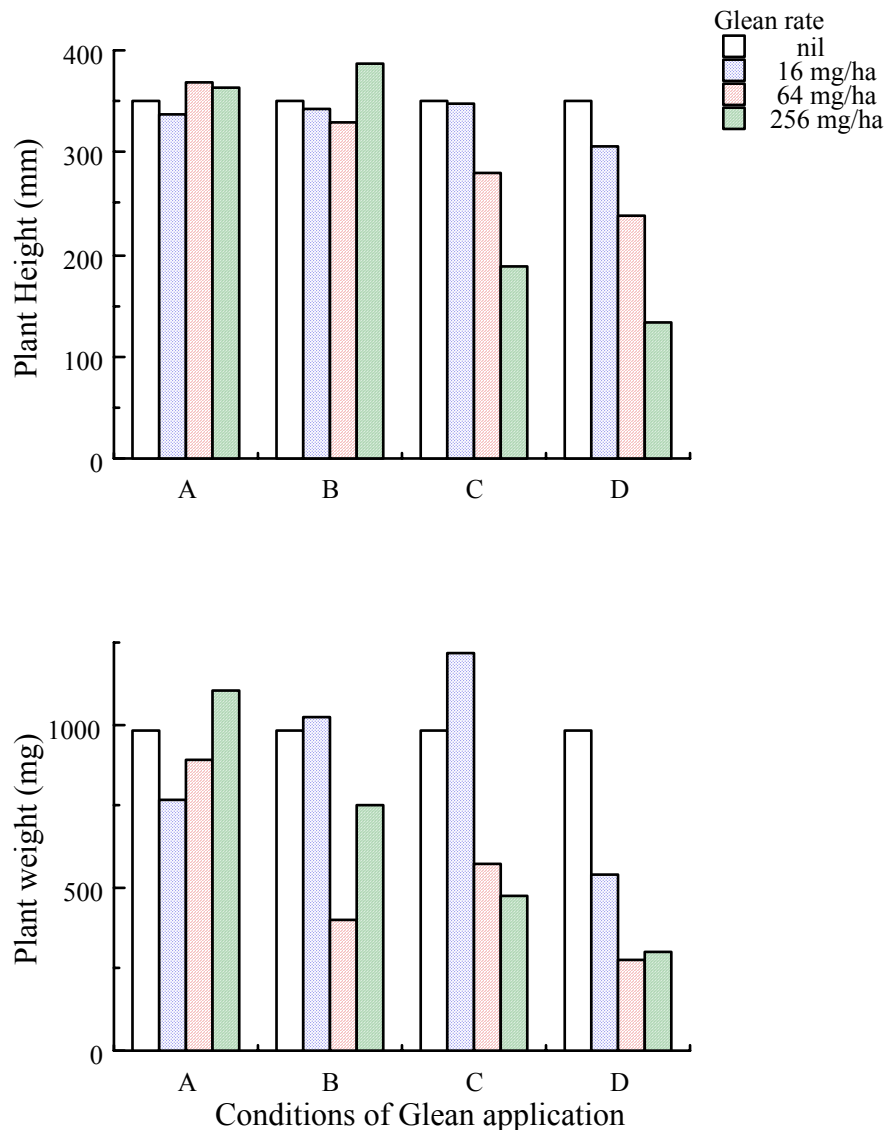
The following results are from Department of Agriculture, Western Australia trials carried out by the author. The trials were conducted some 15 years apart, both in response to problems current in the field.

Lupins were first damaged by chlorsulfuron (Glean® was the only product then) residues activated by diclofop-methyl (Hoegrass® was the only product then) in the mid 80's. Similar problems were encountered in the late 90's when atrazine + oil carried triasulfuron (Logran®) residues on to TT canola.

Interestingly, the minimum residue levels for damage were about the same in both cases – around 15 mg/ha.

For chlorsulfuron this represents 1/1000th of the application rate, for triasulfuron it is 1/2000th. Cleanliness is paramount.

Lupin damage from chlorsulfuron applied in different ways.



The effects of trace levels of Glean® on lupin survival and growth. The lupins were grown in pots and Glean® applied as:

- A immediately before seeding, incorporated to 5 cm.
- B sprayed 40 days after emergence, on 3 - 4 leaf seedlings.
- C as B. with 0.25% wetting agent added.
- D as B. with 1.0 l/ha Hoegrass added.

Soil incorporated Glean® has no effect at 256 mg/ha, a foliar spray affects seedling weight but not height at 64 mg/ha while adding wetting agent worsens this effect and reduces plant height. The presence of Hoegrass® lowers the response threshold by a factor of four, to give gross damage at 16 mg/ha. The probable explanation is that the additives increase penetration of Glean® into the lupin leaves.

Effects of trace levels of triasulfuron on canola

Triasulfuron was added to atrazine + oil applied early post-emergence to canola to establish the levels at which damage would occur.

Triasulfuron rate mg/ha	Visual symptoms	yield (% of control)
0	nil	100
5	very slight yellowing	113
10	slight yellowing	97
20	leaf distortion	55
40	gross leaf distortion, some death	36
80	much growth reduction, many deaths	21
160	ca 80% plant death	1

The canola recovered from rates up to 10 mg/ha with no yield penalty. This rate may possibly change with different growing conditions and soil pH, but it is probable that the visual symptoms vs yield effects will remain roughly constant, and that is of most interest in assessing options after a contamination incident.

