What is new in the cropping world?

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Avoiding the penalties of spray drift with a practical look at glyphosate

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Causing off-target damage when spraying herbicides and in particular with glyphosate is a serious risk for cropping farmers. It is also illegal in Victoria with heavy penalties for causing injury to plants, stock or soil; including causing contamination.

Complaints of injury to crops have led the Department of Primary Industries to investigate poor spraying practices and to the prosecution of two ground and two aerial operators for spray drift since 2000. The operators have also faced significant civil claims for damages from affected crop owners.

One property owner was fined $20 000 for spraying that resulted in damage and loss of organic status to a neighbour's 70 hectare linseed crop. The magistrate summed up the case by describing the use of a misting machine by the defendant to spray glyphosate while knowing about the nearby crop as extremely negligent. The chemical was found to have drifted a distance of over 300 metres to the linseed crop that was flowering at the time causing a poor seed set and reduced yields.

In another case a farmer was found to have applied glyphosate through a boom spray during an average wind speed of 22 km h^{-1} with gusts to 39 km h^{-1} blowing directly towards a newly emerged barley crop in the next paddock. Damage was caused for a distance of 150 metres into the crop.

Cereal crops are particularly sensitive to glyphosate drift as shown when two oat crops were destroyed on the same winter morning during aerial spraying in hilly terrain. A witness described the weather as ideal for spraying as there was almost no wind. However the climatic conditions were almost certainly too stable and there was insufficient wind turbulence to allow capture of fine spray droplets within the target area. The hilly topography made it further difficult to determine the direction of any likely drift. Within 10 days of the spraying telltale yellow plumes of dying crop indicated that clouds of fine droplets had wafted more than 400 metres off-target.

The following year a further oat crop on one of these same properties was damaged by drift from another aerial spraying operation. Although the pilot was aware of the previous incidents and the location of the sensitive crop adjacent to the target area he proceeded to spray with a 17 km h^{-1} wind blowing directly towards the crop.

Glyphosate is the most extensively used herbicide by a wide margin. It is most commonly used as a knockdown spray prior to establishing a crop or pasture and this accounts for many drift incidents. Other factors contributing to this risk are that glyphosate is a non-selective herbicide and has a systemic mode of action that does not require a thorough coverage of the target plants to be effective. Unfortunately this means that even a small exposure to drift is almost certain to cause severe damage to highly sensitive plants such as young cereal crops.

The above investigations did not reveal any startling new information about drift as labels on glyphosate products carry specific warnings on the risk of spray drift including:

- DO NOT apply treatments under very light (<4 km h^{-1}) or inversion conditions or where wind speeds exceed 12 km h^{-1}.
- DO NOT apply treatments by aircraft in situations where drift onto sensitive crops or pastures is likely to occur.
- DO NOT apply treatments with spraying equipment or under weather conditions which are likely to cause drift onto nearby susceptible crops, pastures or other sensitive plants.

Glyphosate drift generally only occurs when spray droplets are fine enough to be carried down wind until gravity or turbulence allows them to settle or be captured on a leaf surface. However superfine droplets can be suspended like a fog and carried in almost still air conditions and in unpredictable directions until evaporated or deposited by turbulence.

The relationship between the size of spray particles and the potential for transport by wind is shown in Table 1. This is a simple model for describing droplet sizes and should not be used for predicting drift

Table 1. Movement of spray particles.

Droplet diameter (microns)	Size classification (ASAE equiv.)	Time required to fall 10 feet	Lateral movement in 3 mph wind
5	Fog	66 minutes	3 miles
20	Very fine	4.2 minutes	1100 feet
100	Very fine	10 seconds	44 feet
240	Fine/medium	6 seconds	28 feet
400	Coarse	2 seconds	8.5 feet
1000	Extremely coarse	1 second	4.7 feet

Source: Akesson and Yates, Annual Review of Entomology, 1964.

Figure 1. Incorrect sprayer settings that produce excessive fine droplets are one cause of drift.

due to the many factors influencing spray droplet behaviour.

Fine/medium sized droplets are preferred for glyphosate application under good spraying conditions and are determined mainly by the type and size of spraying nozzle used.

Manufacturers of spraying nozzles produce charts that assist in the selection of nozzles suitable for various uses. Several produce low drift nozzles that have features such as air induction orifices to assist in creating uniform larger sized droplets. These nozzles are not much more expensive than the standard flat fan nozzles supplied with boom sprayers and should be routinely used for glyphosate application.

It must be noted that all types and size of nozzles produce a spectrum of droplet sizes and that a particular droplet size output is given as a volume median diameter (VMD). This means that for a given VMD, 50% of the spray volume will consist of smaller droplets and 50% will be larger. The better nozzles produce more consistent sized droplets with less fog and very fine sizes that are more likely to drift.

While adjustments can be made to spraying equipment (see Figure 1 demonstrating poor sprayer adjustment) the most important factors in avoiding drift are wind speed and direction to sensitive areas. If the conditions are not favourable then do not spray.

The incidence of glyphosate drift damage (Figure 2) is already too high however there is an even greater potential for drift when glyphosate tolerant crops are grown in Australia. A combination of increased use of glyphosate, more aerial application and use post-emergence will mean a greater drift exposure for neighbouring crops.

Figure 2. Oat crop samples eight weeks after exposure to glyphosate drift. Distance from target area L to R: 500 metres (unaffected), 200 metres (stunted), 100 metres (dead).

The Agricultural Pesticide and Veterinary Medicines Authority is proposing new registration requirements in relation to managing spray drift risk. It is hoped that further practical standards are soon required on glyphosate labels that minimize the impact of off-target drift.