

Additional Resources

Cereal and coarse grains

Management Principles for Residual Herbicides and Water Quality

<http://www.grdc.com.au/uploads/documents/mgtprinciples.pdf>

Pesticides in Catchments (PIC) - A pesticide risk assessment tool

<http://www.grdc.com.au/uploads/documents/pestcatch.pdf>

Sugarcane

Best Management Practice for the Sugarcane Industry: Smartcane Riparian and Wetland Areas on Cane Farms

<http://www.canegrowers.com.au/docs/BMP%20wetlands.pdf>

Canola

Triazine-Tolerant Canola Stewardship Program – contact the Syngenta Product Advice Line on 1800 067 108

Forestry

Pesticides in Plantations: the use of chemical pesticides by the Australian plantation forest industry (general information)

<http://www.plantations2020.com.au/assets/acrobat/FWPpestreport.pdf>

General references

Herbicides: Guidelines for use in and around water

<http://www.weedscrc.org.au/>



The last word ...

The off-target movement of crop protection products in surface runoff can inflate chemical bills, reduce product efficacy and to put at risk crop safety, waterways and the environment.

Through taking into account three key factors that influence runoff risk, namely product, placement and timing, and undertaking a paddock level risk assessment, it is possible for applicators to identify potential risks and put in place practical and effective strategies to help ensure products remain within their intended application area.

For more information

For more information on strategies to minimise the off-target movement of crop protection products in runoff please contact your local Syngenta representative or the Syngenta Product Advice Line on 1800 067 108.

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Minimising the Off-target Movement of Crop Protection Products in Runoff



The off-target movement of crop protection products in surface runoff has the potential to reduce product efficacy, inflate chemical bills and put at risk crop safety and the environment.

While in most cases the concentrations of crop protection products leaving farms in runoff are extremely low and therefore unlikely to negatively impact on the environment, from both a legal and product stewardship perspective it is important that applicators take measures to ensure products remain within their intended application area.

In addition to following product label instructions, applicators can minimise risks through understanding the factors which contribute to off-target movement in runoff and using this knowledge to undertake a localised paddock level runoff risk assessment.

This risk assessment should be undertaken prior to commencing a spray program and should take into account three key factors:

1. **Product**
What product is being applied?
2. **Placement**
Where is the product being applied?
3. **Timing**
When is the product being applied?

This Product Stewardship Technote considers how these factors can be taken into account in a paddock level runoff risk assessment and explores other practical strategies to minimise the risk of products moving off-target in surface runoff.

Undertaking a paddock level runoff risk assessment

1. Product - what product is being applied?

In assessing the risk of off-target movement in runoff, it is firstly important to understand the characteristics of the **product** being applied and how it behaves in the environment.

The two characteristics of a product that have the greatest influence over its ability to move off-target in runoff are its **persistence and mobility**.

The **persistence** of a product represents the period of time it remains in an active form in the environment. **Persistence** is reflected in the soil half life of a product, which equates to the timeframe it takes for half of the concentration of a product to break down in the soil (Table 1). The greater the **persistence** of a product, the longer the timeframe over which it may be at risk of off-target movement in runoff. Given the length of persistence is determined by the amount of product applied, it is important that applicators do not exceed the maximum label rate for a product (or any annual limits on total application).

The **mobility** of a product is represented by its soil partition coefficient or Kd value (Fig. 1). For products with a high Kd value (e.g. SPRAY.SEED, GRAMOXONE) the majority of the active ingredient is bound rapidly to soil following application, reducing its **mobility** and in turn the risk of it moving off-target in runoff.

In contrast, products with a low Kd value (GESAPRIM, GESATOP) tend to remain available in the soil water (i.e. not bound to soil), increasing both **mobility** and the risk of off-target movement in runoff (Table 1).

Where mobile and persistent products are being applied and a heightened runoff risk exists, applicators should take particular care to minimise runoff risk through ensuring the correct **placement** of the product and **timing** of application.



$$Kd \text{ value} = \frac{\text{herbicide adsorbed (mg/kg)}}{\text{herbicide dissolved (mg/L)}}$$

Figure 1: The adsorption equilibrium

2. Placement - where is the product being applied?

In addition to the inherent characteristics of a **product**, **placement** can also have a major bearing on potential runoff risk.

In undertaking a runoff risk assessment, applicators should consider **placement** at both the target site and whole farm scale.

Product	Active	Soil Mobility**	Persistence**	Half life in soil (DT50***)
AXIAL	Pinoxaden	Medium	Low	<1 day
BOXER GOLD	Prosulfocarb s-metalochlor	Medium*	Low-Moderate*	12-49* days
CADENCE	Dicamba	High	Low	<14 days
DUAL GOLD	S-Metolachlor	Medium	Low	11-30 days
ENVOKE	Trifloxysulfuron-sodium	High	Low-Moderate	49-78 days
FUSILADE	Fluazifop-P	Low	Low	<1 day
Gesagard	Prometryn	Low	Moderate	50 days* (14-158d)
Gesapax Combi 500 SC	Atrazine, Ametryn	High*	Moderate*	41 days* (16-77d)
GESAPRIM	Atrazine	High*	Moderate	16-77 days
Gesatop	Simazine	Low	Moderate	49 days* (27-102d)
GRANDSTONE	Paraquat	No mobility	Low	<1 hour
Krismat	Ametryn Trifloxysulfuron-sodium	High*	Low*	<1 day*
logran	Triasulfuron	High	Low	19 days
logran 3 POWER	Triasulfuron Butafenacil	High*	Low*	19 days*
PRIMEXTRA GOLD	Atrazine S-Metolachlor	High*	Moderate*	41 days* (16-77d)
REGLONE	Diquat	No mobility	Low	<1 week
SPRAXSE	Paraquat, Diquat	Low*	Low*	<1 hour*
Topik	Clodinafop-propargyl	Low	Low	<2 hours
TOUCHDOWN HI TECH	Glyphosate	Low	Moderate	Variable

Table 1: The mobility and persistence of a range of Syngenta herbicide products in soil.

* Where products have multiple actives values reflect the most mobile and most persistent active.
 ** Persistence = low <30 days, moderate 30-100 days, high >100 days
 *** Half life values reflect median values. DT₅₀ values can vary considerably depending on soil type, pH, moisture and temperature.

Placement at the target site

The risk of a product moving off-target in runoff can be considerably reduced through ensuring its appropriate **placement** at the target site scale. This can be achieved through:

- the proper incorporation of a product (through either moisture or mechanical incorporation)
- accurate spray application; and
- ensuring mixing and loading sites are suitably located

Proper placement in the soil profile through effective incorporation



The effective incorporation of soil applied products (e.g. BOXER GOLD, GESAPRIM, GESATOP etc.) reduces the concentration of product remaining on the soil surface, thereby minimising the amount of chemical potentially available to be moved off-target in surface runoff. Australian field studies indicate that effective incorporation can reduce soil applied herbicide runoff by as much as 50%.

The product labels on Syngenta's soil applied herbicides contain detailed instructions on how to enhance product performance and reduce runoff risk through effective incorporation.

Proper placement through accurate spray application

Accurate application can also greatly reduce runoff risk. Proper equipment setup, calibration and the use of GPS technology and/or marker dye or foam can reduce spray overlap, helping to ensure that excessive concentrations of a product do not build up in areas of a paddock.

Similarly, the use of modern spray technology, such as banded sprayers or shielded sprayers, can assist in ensuring the accurate placement of a product, significantly reducing the concentration of chemical applied at the whole paddock scale (Fig. 2).

Proper placement of mixing and loading sites

Although it is preferable for crop protection products to be mixed and loaded on a specially designed containment pad, in cases where products are mixed in the field, applicators should take care to ensure this task is performed at varying locations. It is also important to avoid mixing and loading on tracks or compacted areas which may be prone to runoff. Through rotating mixing and loading sites and avoiding areas prone to runoff it is possible to avoid products accumulating at high concentrations at any single location within the farm landscape, thereby reducing runoff risk (*for specific advice please refer to Syngenta's Mixing and Loading Technote*).

Placement at the whole farm scale

In addition to target site considerations, the risk of a crop protection product moving off-target in runoff is greatly influenced by where it is applied in the farm landscape.

A paddock level runoff risk assessment should consider the placement of a product in relation to:

- sensitive areas within the farm or surrounding landscape; and
- the topography (slope) of a paddock.

Placement in relation to sensitive areas

Both the risks and consequences of off-target movement in surface runoff are heightened if products are being applied near sensitive areas such as drainage lines, streams, channels or dams.

Syngenta product labels contain a section on *The Protection of Wildlife, Fish Crustaceans and Environment* providing clear instructions on the use of products around sensitive areas.

In cases where a product is assessed by the Australian Pesticides and Veterinary Medicines Authority (APVMA) as posing a particular runoff risk, product labels specify mandatory buffer zones which must be left around sensitive areas of the farm landscape. It is a legal requirement for applicators to adhere to these label instructions. Table 3 provides details on the specific runoff-related instructions contained on different Syngenta product labels.

Although not all product labels contain mandatory recommendations relating to buffer zones, many industry best practice guidelines encourage applicators to leave a buffer or no spray zone around sensitive areas as a routine measure when spraying.

Where spray contractors are being employed, it is also imperative that landowners/managers provide a clear and detailed map (and written instructions) highlighting sensitive areas in or around the application area.

Placement in relation to the topography or slope of a paddock

A paddock level risk assessment should also take into account the potential influence of slope in increasing the risk of runoff.

Sloping land not only increases the risk of surface runoff through accelerating the flow of water, but also heightens the risk that products bound to soil particles may be moved through the forces of erosion.

Given these risk factors, applicators should take particular care when applying products in sloping paddocks and where possible should seek to minimise the risk of erosion through maintaining good vegetative cover on the soil surface (greater than 30% cover). Farming strategies such as minimum tillage in broadacre cropping, or green trash blanketing in cane production can play an essential role in maintaining this surface cover, substantially reducing runoff risk.

3. Timing - when is the product being applied?

The **timing** of application of a crop protection product can have a significant influence on the risk of off-target movement in runoff.

Timing applications to avoid high-risk periods

Surface runoff generally occurs under two scenarios:

- when the soil profile is saturated, resulting in any additional rain or irrigation flowing over the soil surface as runoff; or alternately
- when the amount of rain exceeds the capacity of the soil to absorb water resulting in surface flow.

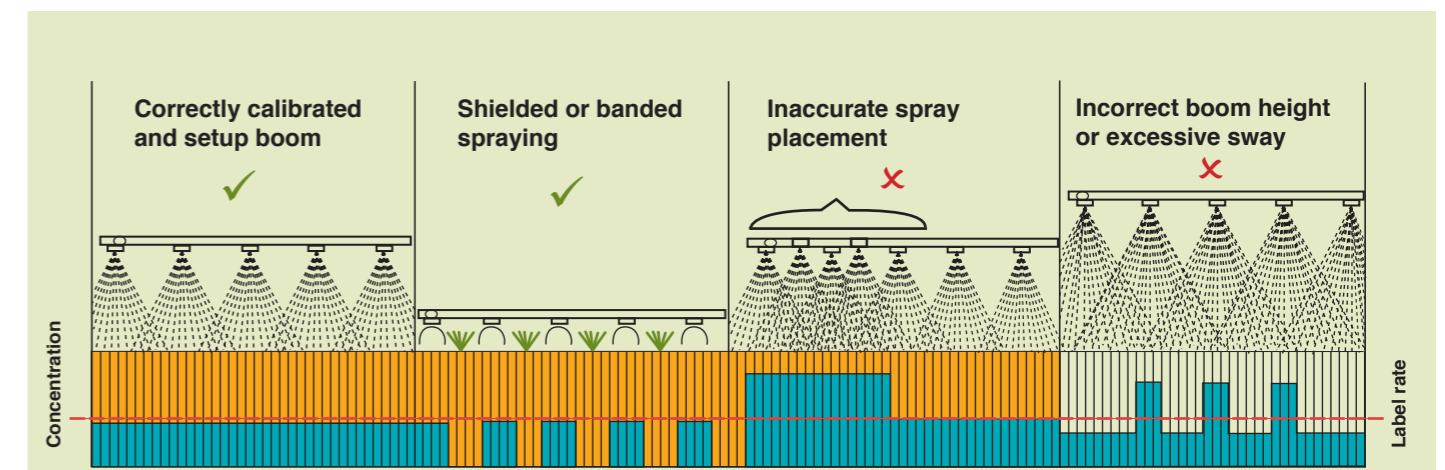


Figure 2: The influence of spray set-up and placement on the concentration and distribution of product on the soil surface.

Taking these factors into account, through avoiding applying products in periods when the soil profile is saturated or waterlogged and/or when heavy rains are forecast, the risk of off-target movement in runoff can be greatly reduced.

In recognising these principles, label instructions on certain products posing a runoff risk incorporate specific restraint statements instructing applicators not to apply products during periods of heightened runoff risk (eg: DO NOT APPLY TO WATERLOGGED SOILS). Table 3 (page 6-7) contains runoff-related restraint statements on different Syngenta product labels.



Syngenta's innovative, web-based AgriCAST system provides a powerful tool to assist growers and applicators in planning spray programs and to minimise the risk of crop protection products moving off-target in surface runoff.

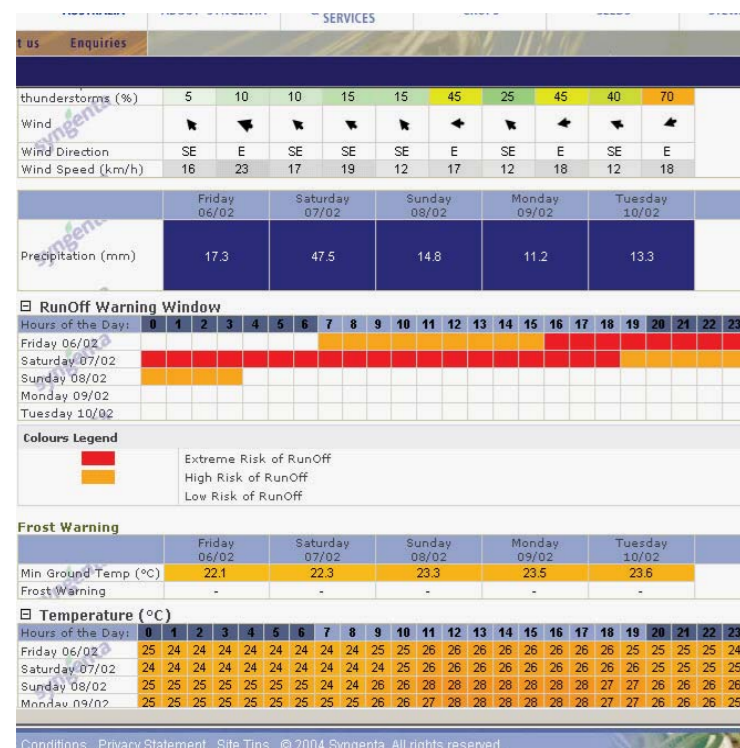
The AgriCAST system provides accurate five-day forecasts of local weather and spraying conditions based on data from around 600 weather stations across Australia. Updated every six hours, AgriCAST forecasts incorporate predicted temperature, rainfall and storm events, relative humidity, wind direction and wind speed.

Syngenta has also incorporated a new runoff warning feature into AgriCAST, which on the basis of predicted soil moisture and the likely duration and intensity of forecast rainfall events, provides a clear warning of periods of heightened surface runoff risk.

Although AgriCAST predictions should only be seen as a guide and actual weather and soil conditions should be reviewed in line with label instructions prior to application, the AgriCAST runoff warning feature is likely to prove a valuable input into paddock level runoff risk assessments.

AgriCAST is also a valuable tool in helping growers to minimise the potential for off-target movement in spray drift, providing a detailed 5-day forecast on the suitability of conditions for ground and aerial spraying and the predicted Delta-T conditions.

For more information on how to access the AgriCAST Spray Window Forecasting Tool please contact your local Syngenta representative or the Syngenta Product Advice Line on 1800 067 108.



Adjusting timing to minimise the concentration of available product

Runoff risk can also be effectively mitigated through adopting application strategies which seek to minimise the amount of product available in the soil during periods of high runoff risk. For instance, through adopting a split application strategy when applying atrazine in sugarcane or sorghum (e.g. pre-sow plus an early post-emergent application), the concentration of atrazine in the environment at any single time can be substantially reduced, thereby minimising the amount of product potentially available to move off-target.

Minimising risks through farm or landscape design

Although the risk of off-target movement can be greatly reduced through carefully considering the three key factors (**product**, **placement** and **timing**), growers can further reduce this risk and safeguard themselves against unforeseen rainfall and runoff events through redesigning their farm to incorporate landscape features capable of minimising and retaining paddock runoff on farm.

Table 2 (page 5) outlines a range of landscape design options capable of reducing the risk of sediments, nutrients and crop protection products moving off-target and off-farm in surface runoff.

Feature	Description	Role in minimising runoff risk
 <p>Offset areas or buffer zones*</p>	Buffer zones or offset areas are generally grassed or vegetated areas that separate a paddock from a stream, dam or waterway. A buffer can also be achieved through leaving an unsprayed strip of crop around the edge of a paddock.	<ul style="list-style-type: none"> intercepting surface flow through allowing the deposition of suspended soil and chemicals filtering and adsorbing crop protection products from the runoff; and providing a safe zone for spray drift to settle.
 <p>Contour banks*</p>	Contour banks represent banks of earth which run perpendicular to the direction of the slope, serving to slow and direct the flow of surface runoff when farming on sloped land.	<ul style="list-style-type: none"> slowing runoff and promoting the deposition of any soil and chemicals within the contours; and redirecting runoff towards offset areas and buffer zones or sediment detention basins.
 <p>Grass waterways*</p>	Grass waterways are broad shallow channels with a permanent cover of grass or other vegetation.	<ul style="list-style-type: none"> providing a stable channel to capture and redirect concentrated volumes of runoff into an area when it can be safely deposited.
 <p>Vegetative barriers*</p>	Vegetative barriers are narrow and dense strips of grass or other vegetation on perimeter of a paddock designed to provide a continuous barrier for runoff to pass through.	<ul style="list-style-type: none"> directly infiltrating runoff and in doing so reducing pesticides through adsorption and absorption by the plants, soil and other organic matter; and rapidly slowing the flow runoff leading to the deposition of sediments and chemicals.
 <p>Sediment detention basins*</p>	Sediment detention basins are made up of an earth embankment across the slope of a minor watercourse or at the lowest point in a paddock, designed to capture the first flush of sediment and chemical contained in runoff.	<ul style="list-style-type: none"> providing a barrier to capture the first flush of runoff containing high concentrations of herbicide residues; and allowing the deposition of sediments and pesticides within the basin to breakdown or be safely cleaned out.
 <p>Strip cropping*</p>	Strip cropping involves only planting in certain strips within a paddock, with interrow areas being retained as fallow. On flood plains, strips should be oriented at right angles to the normal direction of floodwaters.	<ul style="list-style-type: none"> reducing the velocity of surface flow, reducing the erosion risk and providing an opportunity for deposition.

Table 2: Landscape design options to minimise off-target movement of crop protection products (adapted from Rattray et al, 2007)

* Photo reproduced with permission of Wetlandcare Australia
 * Photo reproduced courtesy of USDA NCRS

Product Stewardship Technote

Minimising the Off-target Movement of Crop Protection Products in Runoff



Product	General instructions		Where products can be applied (placement)								When products can be applied (timing)			
	DO NOT contaminate streams, rivers or waterways with the chemical or used containers	DO NOT dispose of undiluted chemicals on site	DO NOT apply this product within 20m of any waterway, waterbody or other aquatic area.	DO NOT mix, load, or apply this product within 20m of any well, sink hole, intermittent or perennial stream.	DO NOT apply this product within 50m of natural or impounded lakes, dams or waterways.	DO NOT apply this product within 60m of natural or impounded lakes or dams	DO NOT apply in channels and drains	DO NOT apply product to any drainage line. Drainage lines show evidence of the action of periodically flowing water (eg gravel, pebble, rock, or sand, scour hole or nick point) and/or an incised channel at least 30cm deep	DO NOT handle, mix, apply or conduct testing operations in areas susceptible to runoff where drainage results in rapid entry into waterways, particularly where no specific and effective action has been take to prevent runoff into waterways ¹	DO NOT use on slopes >5% if soil erosion measures are not in place.	DO NOT apply to waterlogged soil	DO NOT apply if heavy rains or storms that are likely to cause runoff are forecast within 2 days of application	DO NOT irrigate treated areas within the next 48 hours of application	DO NOT irrigate to the point of runoff for at least 2 days after application
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Table 3: Runoff-related restraint statements on Syngenta product labels (always refer to label for full instructions)

¹ These areas may include areas mounded perpendicular to contour, roads, access tracks, snig tracks and compacted log dumps.

² Where roots of desirable plants may extend.

³ After spraying, the first flush irrigation tailwater or stormwater runoff from land treated with KRISMAT Herbicide should be prevented from entering waterways. Where farms do not have the capacity to retain run-off, DO NOT irrigate to the point of run-off for at least 6 days after application.