NSW DPI

Herbicide Residues in Soil and Water

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SMARTtrain Chemical Notes 3

Half-life in soil

The half-life of a herbicide in soil is the time it takes for 50% of the chemical to degrade or break down. From the table, it can be seen that metribuzin has an average half life of 60 days. So, after 60 days, only half of what was applied will remain. After 120 days, this 50% of the original amount will have decreased by half again, only 25% will remain. And so on.

Soil half-lives are only an indicative guide. Half-life varies with soil type. There are not data for all soil types and the half-life may be expressed as a range or an average. Within soil types, half-lives are affected by pH, temperature, moisture content, sunlight and concentration of active ingredient. Higher temperatures, greater soil moisture, high bacterial activity and high levels of organic matter tend to accelerate degradation; dry and cold conditions tend to lengthen degradation. In Australia, dry or drought conditions are the main factor in causing herbicide residues to persist longer than normal.

Some herbicides with persistent soil residues, like hexazinone, do not have agricultural uses but are restricted to industrial and forestry uses instead.

Even if a herbicide is persistent, it may not affect following crops if it is not available to be taken up by the plant, e.g. glyphosate.

Some herbicides have a long residual. The residual is NOT the same as the half-life. Although the amount of chemical in the soil may break down to half the original amount rapidly, what remains can be persistent for long periods, e.g. sulfonylureas (group B). This is shown in the table where known. Herbicides with long residuals can affect subsequent crops, especially if they are effective at low rates of active, like the sulfonylureas. On labels, this will be shown by plant back periods, which are usually listed under a separate plant back heading or under the 'Protection of crops etc' heading in the General

Prepared by Mark Scott

Instructions section of the label. Herbicides with label plant back periods are identified in the table.

Specific plant back periods are usually shown on the label in a table like the one below. These recommendations are made for herbicides which are used to control weeds in crops and pastures. When adopting a crop or pasture rotation, selection of a herbicide needs to take into account following crops as well as the crop and weed to which the herbicide is applied. Obviously, the selection of the herbicide is made upon grounds such as efficacy, resistance management and integrated weed management. However, as many herbicides are residual, the label needs to be checked for this as well. It is no good selecting a herbicide that gives good weed control only to find its residues in the soil mean you can't plant the following crop you intended.

Following crops	Rate (mL/ha)	Plantback interval
Clover, chickpea, faba bean, field pea, lentils, lupins, medics and vetch	Up to 300	9 months
	300-500	12 months
	> 500	24 months
Barley, canola, wheat, oats	All label rates	1 week

Herbicides that are used for woody weed control and environmental weed control have more general warnings if their residues in soil are persistent, e.g. 'Picloram, the active constituent in this product remains active in the soil for extended periods, depending on rate of application, soil type, rainfall, temperature, humidity, soil moisture and soil organic matter'. These warnings let the applicator know the product can damage existing nearby valuable vegetation or can harm crops or pastures that may be planted in the ground if it is cleared.

The fact that many herbicides are soil residual is just one reason why it is helpful to keep accurate application records. Rainfall records, which most

Sulfonylurea damage on chickpeas (Tony Cook)

farmers keep, are also useful. By looking at what herbicide was applied, its rate and when, and then looking at when rain fell and how much, you can work out whether or not the residue left by the herbicide will have decayed away or still be present. If the land use changes, then knowing what herbicide residues may be in the soil is essential information. A common example is tree and vine crops, e.g grapes, that are going to be established in land that was once used for cropping.

Close-up of sulfonylurea damage on chickpeas (Tony Cook)

(Definition of half-life sourced from, James Altland, 'Herbicide residues in field soils', http://oregonstate.edu/dept/nursery-weeds/feature_articles/herbicide_carryover/herbicide_carryover.htm, accessed 6.11.07)

Half-life in water

Half-lives in water are similarly affected by pH, temperature, depth, organic matter and other factors. In addition, some herbicides readily adsorb to sediments and are consequently 'lost' to solution. Herbicides that persist in water are of concern if they are toxic to aquatic life or if they exceed legislated limits in potable (drinking) water. Herbicides that have these properties will be identified under either Restraints or under the Protection of the environment heading in the General Instructions section of the label, e.g. 'DO NOT apply to water which will be used for crop irrigation, for livestock watering or for human consumption' or 'Dangerous to fish'. Herbicides with restrictions on use near water or possessing aquatic toxicity are identified in the table. This information is product specific, as so-called inert ingredients in the formulation may be toxic to aquatic life rather than the active ingredient itself, e.g. glyphosate.

For herbicides that are toxic to aquatic life or adversely affect potable water, the preferred solution

(from the hierarchy of controls) is to eliminate them, i.e. select another herbicide that will control the weed(s) but which does not affect aquatic life or water quality. This is not always possible.

There are two main risk management approaches to preventing or reducing movement of herbicides into nearby water bodies. At the time of application, off-target movement of the herbicide can be reduced by good calibration (including release height, speed of the application equipment, spray pressures and water volumes) and spraying under better weather conditions (including consideration of temperature, relative humidity, wind speed and direction), together with use of low drift nozzles. After application, off-target movement (either by drift or run-off/leaching) can be reduced by use of farm structures such as buffers (especially ones that are grassed and planted out with trees and shrubs) and contour banks.

Table 1: Half-life in soil and water for common herbicides

Active ingredient	Product	½ life in soil	½ life in water
2,4-D	Surpass (PB)	< 7 days	1 – several weeks
2,4-DB	Buttress	7 days	
MCPA	MCPA 500	14 - 31 days (3 – 4 months residual)	2 - 5 weeks
acifluorfen	Blazer	59 days	4 days
ametryn	Primatol (W)	70 – 250 days	
amitrole	Amitrole T	14 days (up to 28 days)	40 days
atrazine	Gesasprim (PB) (W)	60 - > 100 days (up to 1 year if dry)	55 days (range 10 – 105 days)
bromoxynil	Bromicide (W)	10 – 14 days	
clethodim	Select	3 days	128 days (unlikely to be found in surface waters unless oversprayed)
clopyralid	Lontrel (PB)	2 - 94 days	
cyanazine	Bladex	2 – 14 weeks	
dicamba	Banvel	1 – 4 weeks	
dichlobenil	Casoron (W)	1 – 6 months	
diclofop-methyl	Hoegrass	10 – 30 days (sandy – clay)	
diflufenican	Brodal Options	15 – 30 weeks	
diquat	Reglone	> 1000 days (remains in top 25 mm)	< 2 days
diuron	Diuron (PB)	90 days (range 1 month – 1 year)	
fluazifop-p-butyl	Fusilade (W)	< 1 week	
flumetsulam	Broadstrike (PB)	1 – 2 months	
fluometuron	Cotoran (W)	85 days (range 12 – 171 days, longer if dry)	110 – 144 weeks
flupropanate	Taskforce	persistent	
fluroxypyr	Starane (PB) (W)	5 – 9 days	2 – 5 hours
glufosinate	Basta	7 – 20 days	2 – 30 days
glyphosate	Roundup Dry (W)	47 days (range 3 – 130 days) – no pre-emergent activity	35 – 63 days
haloxyfop	Asset (W)	14 days (range 9 – 20.5 days)	few hours – 33 days (depending on pH; alkaline less, acid more)
hexazinone	Velpar L (W)	90 days (range < 30 – 180 days)	> 56 days
imazapyr	Onduty (PB)	6 months – 2 years residual (temperate); 3 – 6 months (trop)	
imazethapyr	Spinnaker (PB)	1 – 3 months	
ioxynil	Totril	10 days	

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Active ingredient	Product	½ life in soil	½ life in water
metolachlor	Clincher (PB)	114 days (range 15 – 132 days)	97 – > 200 days (alkaline – acid)
S-metolachlor	Dual Gold (PB) (W)	11 – 30 days	
metribuzin	Lexone (PB)	60 days (range 30 – 120 days)	7 days
metsulfuron	Ally (PB) (W)	30 days (range 14 – 180 days)	29 – > 84 days (increasing with concentration)
oryzalin	Surflan	20 days (up to 128 days)	
oxadiazon	Ronstar (W)	3 – 6 months	
oxyfluorfen	Goal (W)	30 – 40 days	adsorbed by sediments
paraquat	Gramoxone (W)	> 1000 days (adsorbed by soil & organic matter – not available to plants)	30 days – 23 weeks (mostly adsorbed by sediment)
pendimethalin	Stomp (PB) (W)	40 days (persists for 3 – 4 months)	
picloram	Tordon Granules (PB)	90 days (range 20 – 300 days increasing with applic rate)	2.6 days
prometryn	Gesagard (PB)	1 – 3 months (12 – 18 months residual for multiple seasonal applics)	persistent
propachlor	Ramrod (W)	4 days (4 – 6 week residual)	
propaquizafop	Correct (W)	15 – 26 days	
propyzamide	Kerb	30 days (2 – 6 months residual)	
quizalofop-p-ethyl	Targa	60 days	
rimsulfuron	Titus (W)	10 – 20 days (less in acidic and alkaline soils)	
sethoxydim	Sertin	5 – 25 days	40 days
simazine	Gesatop (PB) (W)	60 days (range 28 – 149 days; 1 year residual in high pH soils)	30 days
sulfometuron-methyl	Oust (W)	20 – 28 days	1 day – 2 months
sulfosulfuron	Monza (PB)	24 days (range 11 – 47 days)	
tebuthiuron	Graslan (PB) (W)	12 – 15 months (longer in drier areas, soils with higher organic matter)	> 33 days
tepraloxydim	Aramo	2 – 21 days	
terbacil	Sinbar (PB) (W)	50 – 180 days	persistent
terbutryn	Igran (PB)	14 – 28 days (3 – 10 weeks residual)	adsorbed by sediment
triallate	Avadex (PB) (W)	8 – 11 weeks	3 – 15 days
triasulfuron	Logran (PB)	19 days	
triclopyr	Garlon (PB) (W)	46 days (range 30 – 90 days)	0.5 – 3.5 days
trifluralin	Treflan (PB)	57 – 126 days (6 – 8 months residual)	
tralkoxydim	Achieve (PB) (W)	2 – 21 days	

Note: '(PB)' after a product indicates there are plant back restraints or recommendations on label; '(W)' after a product indicates there are restraints upon using near water or that the product is toxic to aquatic life; where there is a blank in the table, no information was available.

Sources: Tomlinson, C D S, ed, *The Pesticide Manual,* 12th ed, Farnham, British Crop Protection Council, 2000; *Extoxnet,* http://extoxnet.orst.edu/, accessed 6.11.07; California Dept Pesticide Regulation *Environmental Fate Reviews,* http://www.cdpr.ca.gov/docs/emon/pubs/envfate.htm, accessed 6.11.07

Herbicide residues exercise

You are using Stomp Xtra as a post-planting pre-emergence herbicide in a carrot crop. Referring to the label, answer the following questions.

1. What plant back recommendation is made under Restraints?

2. After 5 months, name 3 following vegetable crops that can be sown?

a.
b.
c.

3. What instructions are given about spray drift?

4. Referring to the MSDS, answer the following question. Why is it important to prevent Stomp Xtra from contaminating water?

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