Persistence of the herbicide clopyralid in EP soils during the 2019 season

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Location
Minnipa Ag Centre, paddock N7
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2019 Total: 254 mm
2019 GSR: 234 mm
Soil type
Red loam
Soil test
Table 2
Paddock history
2019: Spartacus CL barley
2018: Chief CL wheat
2017: Stingray canola
Plot size
12 m x 2 m 3 replicates

Key messages

- **Carryover of clopyralid (~30%) and imazamox/ imazapyr (~30-50%) at low levels detected from June 2018 to March 2019.**
- **Estimatated half-life of clopyralid at Minnipa during the 2019 season was ~35 days.**
- **Ongoing analysis will determine carryover of imidazolinone and clopyralid herbicides in multiple soil types and seasons, and develop crop damage thresholds to inform soil test results.**

Why do the trial?

The overall aim of this work is to determine the persistence of imidazolinone and clopyralid herbicides over multiple seasons in different soil types and whether soilborne residues will injure subsequent crops.

Herbicides are a valuable tool for controlling weeds and reaching crop yield potential, but herbicide residues in soils can limit crop performance if not managed correctly. The recently concluded GRDC project DAN00180 (Rose *et al*. 2019) found that between 5-15% of surveyed paddocks (n=40) contained residues of sulfonylureas or trifluralin that could lower seedling vigour of some crops, but damage was avoided in most cases by growing tolerant crops (e.g. cereals or tolerant legumes in paddocks with SU residues). Growers also identified imidazolinone (group B) and clopyralid (group I) residues as potentially damaging to crops or constraining rotation options. However, the exact loss of productivity due to herbicide residues as a soil constraint has not been accurately determined due to the lack of tools to measure herbicide residues and quantify herbicide damage. It is difficult for growers and advisors to know whether herbicide residues will cause issues beyond the "label" plant-back period, because the persistence and behaviour of these residues depends on numerous site-specific factors, including soil (chemistry, organic matter, microbial activity) and climatic conditions.

As part of a national Soil CRC project (4.2.001 Developing knowledge and tools to better manage herbicide residues in soil), we undertook a field experiment at Minnipa to investigate this further.

How was it done?

Herbicide residues in soil were monitored under standard farming practice at the site. All previous in-crop, fallow and pre-emergent herbicide applications were recorded (Table 1). Spartacus CL barley was sown on 12 May 2019 at 65 kg/ha with Granulock Z® fertiliser (N:P:S:Zn 11:22:4:1) at 70 kg/ha. Soil samples were taken prior to and after application of clopyralid (Lontrel Advanced®) on 25 June 2019 at 1, 7, 21, 42 and 84 days after application. Soils (0-10 cm and 10-30 cm depths) were analysed for group I (including clopyralid) and imidazolinone herbicides using mass spectrometry methods developed at NSW DPI Wollongbar.

What happened?

Baseline topsoil samples (0-10 cm) taken on 15 March 2019, prior to sowing Spartacus barley, contained an average of 8 ng/g (nanogram/gram) of clopyralid. This is equivalent to approximately 0.025 L of Lontrel Advanced (600 g/L). The previous application of clopyralid had occurred on 24 July 2018 (0.075 L of Lontrel Advanced), suggesting approximately two-thirds of the herbicide had dissipated from the topsoil since the previous season.

Table 1. Paddock herbicide inputs during 2018-2019.

Timing of herbicide spray	Product (Active Concentration in g/L or g/kg)	Rate (L or kg/ha)
25 June 2019	Lontrel Advanced (Clopyralid 600)	0.075
12 May 2018	Ester 680 LVE (2,4-D ester 680) TriflurX (Trifluralin 480) Roundup DST (470) Goal Tender (Oxyfluorfen 480)	0.035 1.6 1.2 0.04
24 July 2018	Lontrel Advanced (Clopyralid 600) Intervix (Imazamox 33; Imazapyr 15) Polo 570 LVE (MCPA Ester 570)	0.075 0.50 0.45

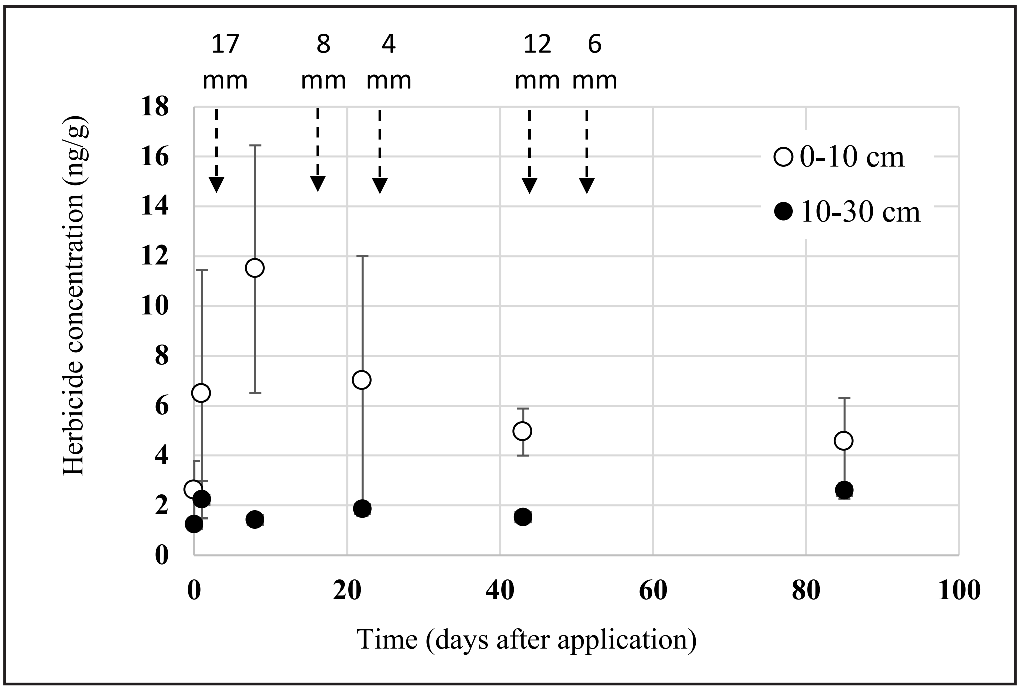

Figure 1. Concentration of clopyralid in 0-10 cm and 10-30 cm soil profile prior to (Time=0 d) and after (Time=1-84 d) application of 75 ml Lontrel Advanced on 25 June 2019. Rainfall timing and amount (mm) are indicated at the top of the figure by dashed arrows.

By the time of the 2019 in-crop application of clopyralid (0.075 L of Lontrel Advanced), topsoil residue concentrations had fallen to~3 ng/g (Figure 1). After a fresh application of clopyralid on 25 June 2019, and subsequent rain on 29-30 June, the concentration of clopyralid in topsoil increased from 3 to ~12 ng/g (Figure 1). Dissipation of the clopyralid from the top 0-10 cm occurred between 7-42 d after application, but slowed after this time. A minimal amount of clopyralid appeared to move into the subsoil, with only a slight increase in clopyralid concentration in the 10-30 cm layer over the monitoring period (Figure 1). The half-life of clopyralid at this site during the monitoring period (to date) was estimated to be approximately 35 d, which is similar to the commonly reported clopyralid half-life values of 5-65 d (Lewis *et al*. 2016; Congreve and Cameron 2018) and less than the longer half-lives (57-161 d) we observed in Birchip, Victoria, 2019. As with many herbicides this would be a function of moisture and in particular microbial activity leading to biodegradation of the herbicide. However, of interest is that the dissipation appears to slow down over time and a small amount of residual clopyralid that could be resistant to degradation – in this case, about 2-3 ng/g. A similar occurrence was observed in a paddock soil from Birchip, analysed as part of the larger current Soil CRC project (4.2.001). This residual amount could be strongly bound to soil minerals or organic matter, and may not be available to plants under normal circumstances. Ongoing analysis until sowing in 2020 will identify the total carryover to the following season.

What does this mean?

One of the most interesting results to date from this work was the concentration of herbicides in soil prior to the 2019 clopyralid spray. Clopyralid (8 ng/g), 2,4-D (33 ng/g), imazamox (5 ng/g) and imazapyr (5 ng/g) were detected in baseline topsoil samples taken in March 2019 before sowing. Those herbicide concentrations demonstrate some carryover from 2018 (clopyralid, imazamox/imazapyr in July 2018) – representing about 50% carryover of imazapyr and 30% carryover of clopyralid and imazamox.

To date there are very few crop thresholds values available to indicate the soil concentrations of herbicides at which crop damage may occur. Although we have previously found a 20% shoot biomass reduction in lupins exposed to 50 ng/g clopyralid in a sandy soil (Rose et al. 2019), the growth of cereals (as occurred this season) would not have been impacted. However, other legumes such as lentil, field pea and faba bean may be more sensitive than lupins and the presence of an additional herbicide of the same mode of action (2,4-D) may have additive effects if legumes were sown. The detected imidazolinone residues would also not have affected the Imi-tolerant Spartacus barley grown in the 2019 season. Although these residues levels may have affected non-tolerant crops, sowing occurred within the 10-month plant-back window specified on the label for sensitive crops, which means such crops should not have been sown.

Ongoing monitoring until sowing in 2020 will determine how much carryover of all herbicides has occurred through the entire year. Other ongoing work in this project will generate representative damage thresholds for different crops in different soil types, to provide growers with guidance as to potential effects of a known residue concentration if a soil herbicide analysis is undertaken. This will help to increase confidence in crop selection, timing of sowing and herbicide management to ensure soil and crop performance are not limited by herbicide residues. Importantly, this project aims to prevent major crop damage due to herbicide residues and give farmers greater flexibility in crop rotations to further build soil health.

References

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