

Efficacy and environmental fate of fluroxypyr on Swedish railways

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Main findings

- Mixing glyphosate (1080 g ae ha⁻¹) with fluroxypyr (360 g ae ha⁻¹) generally improves weed control efficacy over the use of only glyphosate (1800 g ae ha⁻¹) but some weed species are still more or less unaffected by the treatment.

- Fluroxypyr degrades relatively rapidly and the main portion of the herbicide does not appear to move through the railway embankment.
- However, trace concentrations of fluroxypyr and its degradation product can be detected in the groundwater beneath the track after spraying.

Results

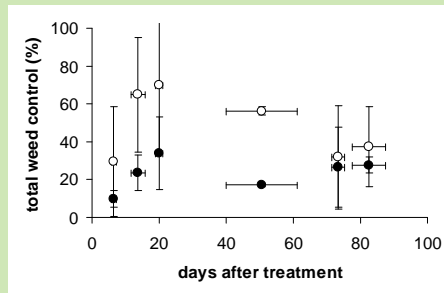


Fig 1. Weed control efficacy of a mixture of glyphosate at 1080 g ae ha⁻¹ + fluroxypyr 360 g ae ha⁻¹ (○) compared to glyphosate sprayed at a rate of 1800 g ae ha⁻¹ (●). Composite from 5 different field experiments conducted on railways between 2002-2008 ± standard deviations.

The weed control efficacy was highly variable between years but the tested mix of glyphosate and fluroxypyr consistently and significantly improved weed control over the use of only glyphosate at 1800 g ae ha⁻¹. However, after 3 months only minor differences between the treatments could be seen (Fig 1).

The mixture controlled the problem weed *Equisetum arvense* transiently but did not prevent the regrowth of *Equisetum* shoots. Fluroxypyr did not improve the control of Norway spruce (*Picea abies*) or Scots pine (*Pinus sylvestris*) where these were present (data not shown).

Fluroxypyr degraded relatively rapidly with an average DT50 of 14 ± 2.1 days in most of the studied railway embankments. The kinetics appeared to be two-phased with a first phase where degradation followed first order kinetics and a second phase where a small percentage of the fluroxypyr (4-5 %) remained for a longer time period (Fig 2). The formation of metabolites was not analysed in these studies

Background

Weeds need to be removed from railways in order to maintain the quality of the track bed and to ensure safe railway traffic. The only herbicide in use for railway weed control in Sweden today is glyphosate (Roundup Bio) used at a rate of 1800 g ae ha⁻¹. However, after several years of spraying with only one herbicide it is clear that several weed species remain largely unaffected and are able to spread in the railway environment.

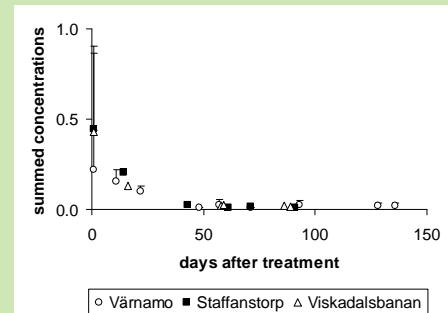


Fig 2. Concentrations of fluroxypyr (µg (g dry wt)⁻¹ summed for all sampled depths) in three different railway embankments after spraying with fluroxypyr at 360 g ae ha⁻¹. The heights of the bars indicate the size of the standard deviations.

The main part of the fluroxypyr remained in the top 30 cm of the railway embankments (Table 1). However, preliminary analyses indicate that fluroxypyr as well as its metabolite 4-amino-3,5-dichloro-6-fluoropyridin-2-ol can be detected in concentrations up to 2 µg l⁻¹ in groundwater samples from beneath the railway track (data not shown).

Table 1. Basic soil characteristics, mobility and persistence of fluroxypyr

Railway line	Sampling depth (cm)	pH	Loss on ignition (%)	Fluroxypyr maximum conc. a (µg (g dry wt) ⁻¹)	DT50 (days)
Värnamo 1999 and 2001	0-10	5.7	1.25	0.67	13.7
	10-20	5.3	0.63	0.03	
	20-30	5.6	0.34	<0.01	
	30-40	5.8	0.32	<0.01	
	40-50	5.5	0.73	<0.01	
Staffanstorp 2002	0-10	7.9	1.26	1.1	11.9
	10-20	8.4	0.93	0.17	
	20-30	8.4	0.95	0.01	
	30-40	8.5	0.86	trace conc.	
	40-50	8.5	0.9	trace conc.	
Viskadalsbanan 2002 and 2003	0-10	5.7	0.71	1.24	16.9
	10-20	5.7	0.58	0.12	
	20-30	5.7	0.64	0.04	
	30-40	5.6	0.58	0.04	
	40-50	6.3	0.59	trace conc.	
	50-60	6.1	0.73	<0.002	

a Maximum concentration found at some point in time after spraying (LOD 0.01 µg (g dry wt)⁻¹ for Värnamo and 0.002 µg (g dry wt)⁻¹ for the two other railways.

Materials and methods

We assessed the efficacy of a mixture of glyphosate and fluroxypyr herbicides for weed control on railways in field experiments conducted between 1999-2008. Herbicides were sprayed in 25x3 m randomly distributed plots and weed control efficacy was visually assessed as a percentage of wilting or dead weeds. The degradation and mobility of fluroxypyr in the railway embankment was monitored by collecting soil samples and on one occasion groundwater samples from beneath the track. Fluroxypyr and metabolites were analyzed by GC-MS.



BANVERKET

This work was funded by the Swedish Rail Administration