PROJECT GUIDELINES INTEGRATED PEST MANAGEMENT IN SUGAR BEET

Environmental fate and risk assessment of herbicide strategies in sugar beet crop in Germany

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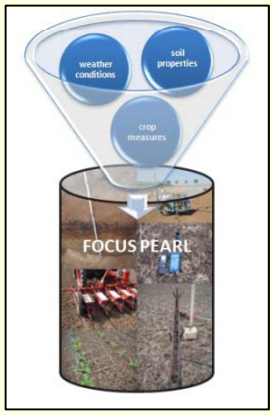
Introduction

The aim of this study was to model the concentration of the active ingredients of formulations in different herbicide strategies in representative soil horizons in sugar beet crop based on measured agronomic and environmental conditions. Furthermore, the ecological risk of each herbicide strategy was calculated for the indicator 'earthworm' by the parameter Toxic Unit.

Materials & Methods

- modelling of three herbicide strategies (Table 1) with 100 %, < 50 % and ≤ 35 % of authorized application rate was conducted with FOCUS PEARL for 0.01, 0.025 and 0.1 m soil depth in a ploughing and mulching tillage system at 19 field trials in 2008 and 2009
- time frame of modelling: day of 1st post-emergence treatment (pet) until the end of the year
- input data: measured site conditions and cultivation practices (e.g., precipitation, global radiation, soil texture, pH, bulk density, coverage of sugar beet and weeds)
- ecological risk assessment for indicator 'earthworm' by Toxic Unit (TU)

$$TU = \frac{\text{concentration of active ingredient } (\textit{in situ})}{LC_{50} \text{ of active ingredient } (\text{laboratory})}$$ → if 1, lethal effect arises for 50 % of organisms



Results & Discussion

Firstly, environmental fate of active ingredients was similar in the tillage systems. The shown results represent only the mulching system. Generally, active ingredient concentrations increased with each herbicidal treatment with a maximum after the third post-emergence treatment (> 300 µg/kg) in 0.01 m soil depth and strongly decreased until the end of the year (Fig. 1). There was a obvious pattern of penetration of herbicide strategies within given soil depth. The main share of concentrations (< 95 %) over modelled time frame and among herbicide strategies was computed for 0.01 m and 0.025 m soil depth, respectively (Table 1). The distribution of active ingredient concentrations in 0.1 m soil depth was low with < 5 %.

The TU was highest at the days of herbicide treatments and showed increased values from 1st pet to 2nd and 3rd pet (Fig. 2A). In addition, differences in TU between herbicide strategies were observed independent of pet with lowest values for the strategy with low dosage rates (hs 3), whereas all TU are minor in respect to the threshold of lethal effects for earthworms (Fig. 2B). Consequently, the ecological risk of the tested herbicide strategies in sugar beet crop is negligible small.

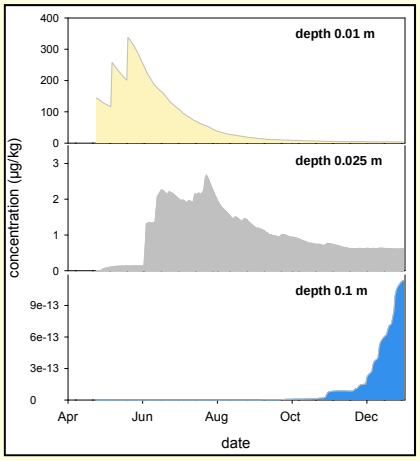


Fig. 1: Distribution of desmedipham (hs 1) in soil for an examplary site.

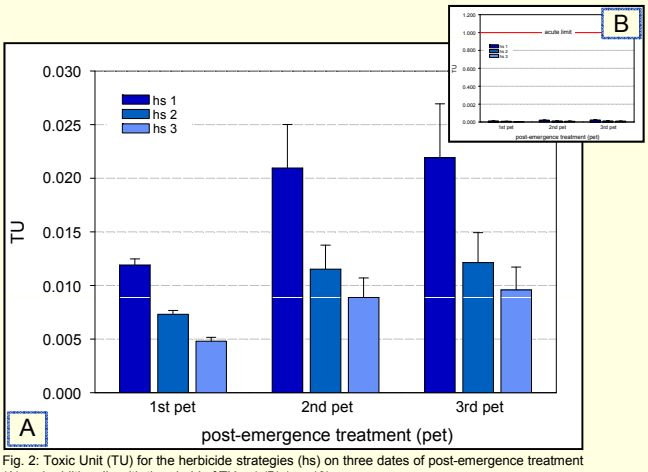


Fig. 2: Toxic Unit (TU) for the herbicide strategies (hs) on three dates of post-emergence treatment (A) and additionally with threshold of TU = 1 (B) (n = 19).

Table 1: Distribution of active ingredients and herbicide strategies in different soil depths.

hs	herbicide	active ingredient	share in soil depth (%)*			mean share (%)		
			0.01 m	0.025 m	0.1 m			
1	Betanal Expert	desmedipham	96.38	3.62	3.58e-09	69.87	26.53	3.60
		ethofumesate	53.75	37.11	9.14			
		phenmedipham	67.85	31.95	0.21			
	Goltix 700 SC	metamitron	61.51	33.43	5.06			
2	Betanal Expert	desmedipham	96.80	3.20	1.31e-09	72.25	23.43	4.32
		ethofumesate	54.24	37.28	8.47			
		phenmedipham	69.23	30.65	0.12			
	Goltix 700 SC	metamitron	62.09	33.55	4.36			
	Rebell	chloridazon	77.21	18.88	3.91			
		quinmerac	73.94	16.99	9.07			
3	Betanal Expert	desmedipham	96.94	3.05	9.01e-10	74.48	21.38	4.13
		ethofumesate	54.43	37.33	8.23			
		phenmedipham	69.76	30.14	0.09			
	Goltix 700 SC	metamitron	62.78	33.19	4.02			
	Rebell	chloridazon	77.79	18.83	3.37			
		quinmerac	75.41	16.03	8.55			
	Spectrum	dimethenamid-p	81.54	15.57	2.88			
	Debut	triflusulfuron-methyl	70.79	25.39	3.82			
	Lontrel 100	clopyralid	80.92	12.91	6.17			

* for the time frame of the first post-emergence treatment until the end of the year

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