Ranking: leaching into ground water

Protection goal: ground water used as drinking water

Goal: - rank active ingredients
- assess suitability of method, identify pitfalls
- integrate leaching into risk assessment scenarios?

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Ranking: leaching into ground water

Material to work with:

- List of actives, previously derived for ranking risk in surface water
- Meta-model for leaching (Tiktak et al., 2006)
- Physico-chemical properties (K_{om}, pKa, DT_{50} soil) from Pesticides Properties Database (Footprint)

Ranking: leaching potential

Outline of procedure:

- Estimate leaching potential for actives on the basis of standard net soil deposition (1 kg/ha), using the EuroPEARL meta-model

- Rank by:
  - Leaching concentration for 1 kg/ha net soil deposition
  - Compare daily intake to ADI, are toxic effects likely?

- Investigate effect of choice of parameter values for annual rainfall, soil moisture and average soil temperature

- Identify shortcomings and pitfalls

Ranking: leaching potential

The EuroPEARL meta-model

$Ln\ (C_L) = \alpha_0 + \alpha_1 * X_1 + \alpha_2 * X_2$ *(Tiktak et al., 2006)*

C_L : the concentration (µg/L) in leaching water at 1 m depth, given a net soil deposition of 1 kg/ha

α_0 , α_1 , α_2 depend on
- temperature and annual rainfall
- not compound specific, but specific to a region

X1, X2 depend on
- soil properties (organic matter and water content)
- compound properties (K_{om}, DT50 degradation)

Ranking: leaching potential

The EuroPEARL meta-model

Extensive calibration of the model for European soils and a wide range of compounds *(Tiktak et al., 2006)*

A method has been devised to deal with compounds (acids) that undergo dissociation at lower soil pH ($2 \leq pH \leq 8$), necessary because some European soils tend to be charged *negative* at lower pH

Problem: this method is not going to work for tropic soils, which tend to be charged *positive* at lower pH

Ranking: leaching potential

Positive charge of tropic soils at lower pH will result in increased leaching of bases*, i.e. leaching of bases will be underestimated*

There is currently no suitable method to correct for this in an acceptable way

Way out:

- for bases always demand sorption studies with Ethiopian/tropical soils

- or conservative approach: calculate risk assuming no sorption at all, and demand sorption studies for cases where risk is not acceptable (on the basis of C_L / ADI ratio)

- This implies that there should be a reliable way to actually identify bases, i.e. 'which compounds are considered as bases'

Ranking: leaching potential

Is it worth the trouble to treat bases separately, and ask for sorption studies?

Compounds in list of actives:	165
Actual pesticides	144
Of which are bases:	34
Substantial part charged at 4 < pH <7:	24

Assumptions:

- Bases do not sorb at all
- A person of 50 kg drinks 5 liters of water per day
- C_L unacceptably high if Daily_Intake / ADI > 1

Ranking: leaching potential

Result: of the 24 partly charged bases, 10 are estimated to exceed 0.1 ADI when no sorption at all is assumed; pirimifos-methyl exceeds ADI

Pirimifos-m.	1.21	Prochloraz	0.91
Spinosad	0.42	Ametryn	0.30
Carbendazim	0.25	Pirimicarb	0.23
Cyprodinil	0.15	Cyromazine	0.14
Spiroxamine	0.11	Thiabendaz.	0.11

Conclusion: various basic compounds need a better estimate of K_{om} to avoid overestimation of leaching potential.

Ranking: leaching potential

Assumptions during calculation of leaching concentration for neutral compounds

Values within acceptable range for EuroPEARL meta-model:

- Annual rainfall: 1500 mm
- Average soil temperature: 20^{o}C
- Organic matter content: 4.5%
- Soil moisture content: 25%

K_{om}, DT50's taken from Pesticides Properties Database

Calculations were done for non-bases only

Ranking: leaching potential

3 Compounds with Daily Intake > 0.1 ADI

Active	Daily Intake / ADI	K_{om} (L/kg)	DT50 (days)	C_{leach} (µg/L)
Flutriafol	0.86	119	1358	86
Omethoate	0.30	24	14	0.89
Myclobutanil	0.22	300	560	55
Thiamethoxam	0.09	33	50	24
Atrazine	0.02	58	75	4.2
Triadimenol	0.02	435	250	10

Ranking: leaching potential

16 Compounds with C_{Leach} > 0.1 µg/L

Active	C_{leach} (µg/L)	K_{om} (L/kg)	DT50 (days)	Daily Intake / ADI
Flutriafol	86	119	1358	0.86
Myclobutanil	55	300	560	0.22
Dinotefuran	40	15	82	0.02
Thiamethoxam	24	33	50	0.09
Flumetasulam	14	16	45	-
Methoxyfenocide	11	233	146	0.01
Triadimenol	9.8	435	250	0.02
Imidacloprid	8.0	130	191	0.01
Metamitron	4.7	45	30	0.02
Atrazine	4.2	58	75	0.02

Ranking: leaching potential

Results for neutral compounds

3 Compounds with Daily Intake > 0.1 ADI:
Flutriafol (0.86), Omethoate (0.30) and Myclobutanil (0.22)

→ Various compounds show severe leaching potential, some even have concentrations in ground water potentially rendering it hazardous as drinking water

16 Compounds with C_{leach} > 0.1 µg/L, 3 of which had a volume > 1 ton:
Atrazine (40 tons), Triadimenol (7.5 tons) and Propiconazole (6 tons)

→ Concentrations in ground water to be used for drinking water may be significant, and should be considered in regulatory scenarios

Ranking: leaching potential

Effect of the parameter values choosen for annual rainfall and temperature – results not shown in detail

Choosing **800 mm/year and 10°C** instead of 1500 mm/year and 20°C → the same list of compounds with highest leaching potential, although leaching concentrations are somewhat (3-fold) lower

Lowering **soil organic matter** content to 2.5% → same list of compounds, leaching concentrations somewhat (2.5-fold) higher

Changing **soil moisture content** to 0.40 instead of 0.25 L/kg results in the same top-10 for leaching, compounds 11-20 are the same but have slightly changed order

Conclusion: annual rainfall, temperature, soil moisture and soil organic matter have an effect, but are not critical for calculation of the leaching potential

Ranking: leaching potential - Conclusions

Sorption for basic compounds cannot be calculated using the standard procedure → sorption studies are needed, possibly after a first step in the risk assessment (compare C_{Leach} to ADI)

Various compounds on the market show severe leaching potential, potentially rendering ground water hazardous as drinking water → leaching should be considered in scenario calculations

Choice of annual rainfall, soil moisture content, organic matter content and temperature will influence outcome of estimations for neutral compounds, but is not critical

Linking to scenarios is not feasible until scenarios are developed in detail; the EuroPEARL meta-model is not intended for calculation in greenhouses

N.B. 1. If groundwater is used as drinking water for cattle, can ADI be used to perform a risk assessment for cattle ? (Marloes/Carolien)
2. Is ADI sufficiently protective for lighter people (Ethiopians, esp women)