Is the chronic Tier 1 effect assessment for herbicides protective for higher tier microcosm and mesocosm studies?

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Aim

Validating the standard first-tier in the aquatic effect assessment for herbicides (Tier 1-Regulatory Acceptable Concentration (Tier 1-RAC)) with results of higher-tier micro-/mesocosm studies (Ecological Threshold Option (ETO-RAC)).

Materials and Methods

- Tier-1 data (i.e. NOEC, EC_{10} (preference over NOEC) and EC_{50} values) from single-species laboratory tests with standard test species (a green alga, a non-green alga and a macrophyte (*Lemna* sp. or *Myriophyllum* sp. or *Glyceria maxima*)). Sources: DARs, EPA-ECOTOX data base, PPDB data base.
- Micro-/mesocosm studies: sources Draft Assessment Reports (DARs) and open literature.
- Algae test durations 72 – 96 h; macrophyte test duration 7 - 14 d;
- Lowest toxicity value of an acceptable measurement endpoint (e.g. number of cells and biomass for algae; number or biomass of fronds for *Lemna*; shoot length and shoot biomass for rooted macrophytes) was chosen. Chronic Tier-1 RACs derived with AF of 10.
- Effect Concentrations for growth rate (r) compared with those for biomass or yield (b).
- ETO-RACs were derived as explained in Table 1.

Results and Conclusions

- Tier-1 RAC for herbicides protective for aquatic communities as based on the higher-tier ETO-RAC for most herbicides included in this analysis.
- Two of the ten herbicides above the line 1:1 in Option 1 (Fig A)
- Three of the twelve herbicides above the line 1:1 in Option 2 (Fig B).
- NOEC/EC10 is always protective (Fig. C and D)
- Exceedance of the line 1:1 seems not to be dependent on the regulatory endpoint considered (Fig. E).
- Our analysis shows that protection is maintained if 'growth rate' instead of 'biomass/yield' is taken as the regulatory endpoint with an AF of 10.

Table 1. : Effect Class system (EFSA, 2013) applied to classify the effects in the micro-/mesocosm studies and safety factors for derivation of ETO-RACs. (Source: EFSA, 2013)

Effect Class Available	Definition	Safety Factor
Effect Class 1	No treatment related statistical and/or ecological effects.	2
Effect Class 2	Slight, quantitatively restricted and short-term responses at individual samplings only	3
Effect Class 1 and Effect Class 2		(Effect Class 1)/2

Table 2. : Herbicides used in the present study and data availability for the comparison of the chronic Tier-1 RAC and the ETO-RACs.

	Tier-1 RAC Options				ETO-RAC	References
	1	2	3	4		
Herbicide group and compound	**Lowest ErC_{50}**	**Lowest EC_{50}**	**Lowest NOErC / ErC_{10}**	**Lowest NOEC / EC_{10}**		
Photosynth. inhibition						
Atrazine	X	X	X	X	X	2-4
Glufocinate-amm.	-	-	X	X	X	1
Lenacil	X	X	X	X	X	1
Metribuzin	X	X	-	-	X	1-3; 5
Metamitron	X	X	X	X	X	1; 2; 5
Simazine	X	X	-	-	X	1; 3; 6
Terbuthylazine	-	X	-	-	X	1; 3
Cell division inhibition						
Acetochlor	X	X	X	X	X	1
Metazachlor	X	X	-	-	X	1; 3; 7
Propisochlor	X	X	X	X	X	1
PPO inhibition						
Bifenox	X	X	-	-	X	1; 3
Flumioxazin	-	X	-	-	X	1 - 3
Amino acid synth. inhibitor						
Metsulfuron-methyl	X	X	X	X	X	1 -3; 8

1: EU Draft Assessment Report; 2: EPA data base; 3: PPDB data base; 4: Solomon et al. 1996; 5: Brock et al. 2004; 6: Vervliet-Scheebaum et al. 2010; 7: Mohr et al. 2007; 8: Arts et al. 2010.

Figure A

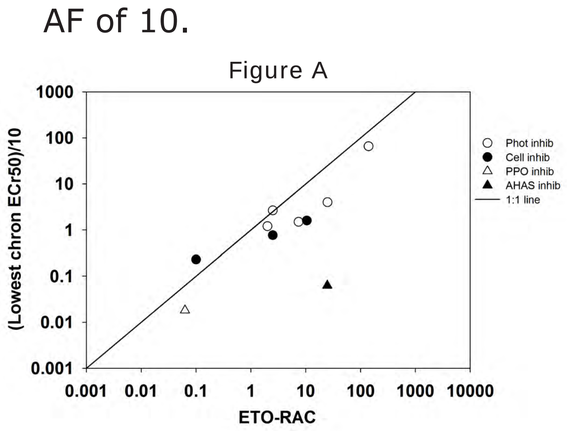


Figure B

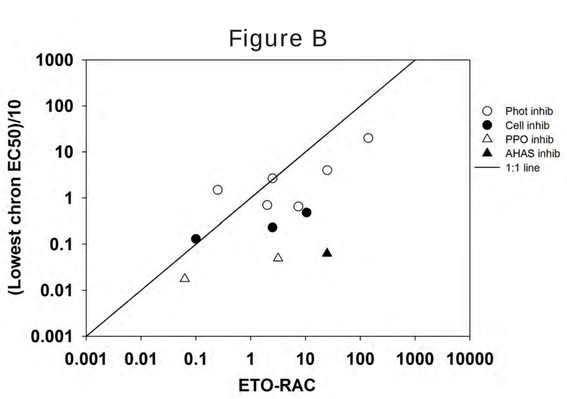


Figure C

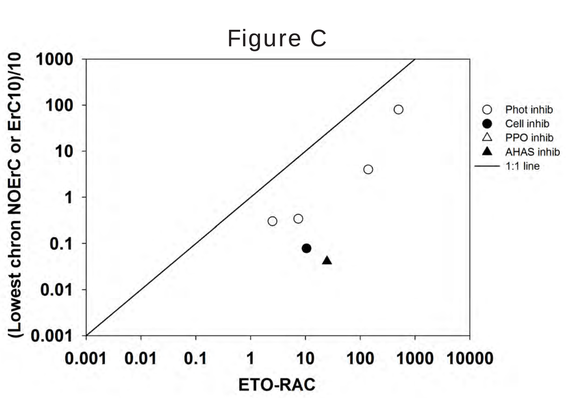
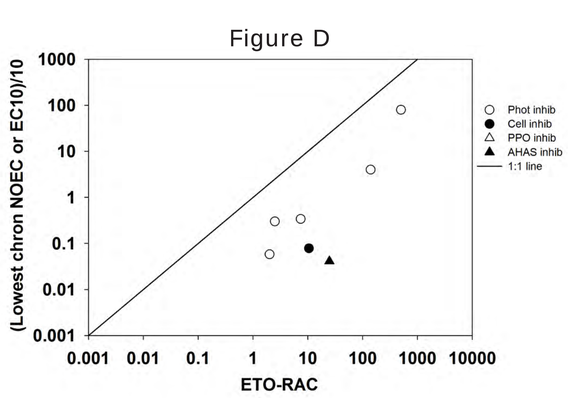


Figure D



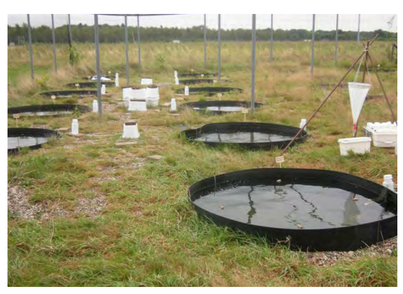
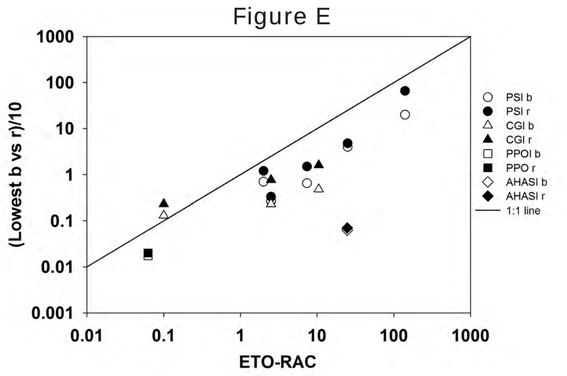


Figure E



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