Relative tolerance of aquatic organisms to fungicides

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Introduction

Fungicides are routinely used in intensive agriculture to treat a wide range of plant pests and microbial pathogens. These compounds may reach aquatic ecosystems by spray-drift, leaching and runoff, posing a potential threat to aquatic organisms. **In this study we evaluated the relative tolerance to fungicides of aquatic animals and plants as compared to that of the standard test species used for the aquatic effect assessment of pesticides as proposed by the European Food Safety Authority aquatic guidance document** [1].

Methodology

Toxicity data mining

- Fungicide list: fungicide names and MoA from the Fungicide Resistance Action Committee list [2].
- Data sources: ECOTOX database [3] and DAR reports [4]
- Toxicity data selection criteria: see Table 1.
- Final toxicity database: 1965 data entries for 143 fungicides, representing 12 MoAs.

Table 1. Toxicity data selection criteria

	Primary producers	Invertebrates		Vertebrates	
		Acute	Chronic	Acute	Chronic
Endpoint	EC50	EC50	EC10 or NOEC	LC50	EC10 or NOEC
Measured effect	Growth rate (preferred), yield	Mortality, immobilization	Growth rate, feeding rate, reproduction, mortality, immobilization	Mortality	Growth rate, development, behavior, mortality, immobilization
Test duration (d)	3-5 (algae), 7-28 (macrophytes)	2-4	>7	2-21	>21

The geometric mean was calculated when more than one toxicity value was reported for the same test duration and the same endpoint of a given taxon. When one taxon was represented by several endpoints, the value corresponding to the most sensitive endpoint was selected.

Relative tolerance

Sensitivity differences were assessed following the relative tolerance (Trel) approach i.e., by calculating the logarithm of the toxicity value of the non-standard test species divided by the toxicity value of the standard test species. Trel values were calculated using toxicity data of standard test species in the Tier-1 acute (*Daphnia magna, Oncorhynchus mykiss*) and chronic (*Pseudokirchneriella subcapitata, D. magna, O. mykiss*) effect assessments.

Results

Figure 1. Trel values (mean ± SEM) of non-standard vs standard test species of primary producers (*P. subcapitata*), invertebrates (*D. magna*) and fish (*O. mykiss*).
a: number of taxa within each taxonomic group; b: number of fungicides included for the calculations within each taxonomic group.

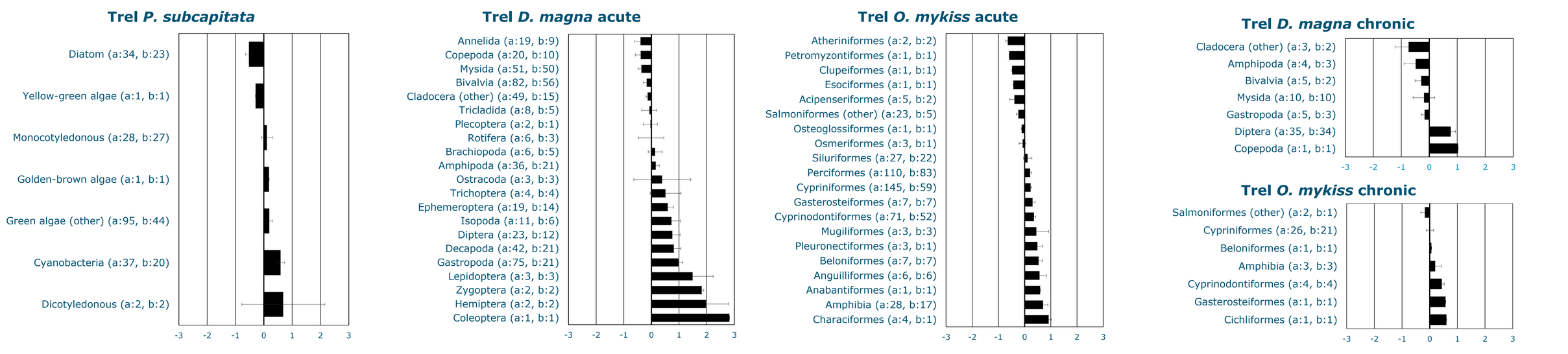

Table 2. *Trel values obtained by dividing the toxicity data of the non-standard test species with that of the standard test species. Trel values lower and greater than one indicate a greater and lower sensitivity of the non-standard test taxa as compared to the standard test species to a given fungicide. n: number of comparisons.*

Trel	n	<1	>1	<0.01	0.01-0.1	0.1-1	1-10	10-100	>100
P. subcapitata	219	46%	54%	2%	6%	37%	34%	15%	6%
D. magna **acute**	465	50%	50%	2%	6%	42%	28%	13%	9%
D. magna **chronic**	63	38%	62%	2%	6%	30%	33%	22%	6%
O. mykiss **acute**	449	33%	67%	0%	1%	31%	58%	8%	1%
O. mykiss **chronic**	38	39%	61%	0%	0%	39%	58%	3%	0%

Conclusions

The assessment factors applied in the Tier-1 aquatic effect assessment for fungicides generally encompass the sensitivity range of non-standard test species under laboratory conditions

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[3] US EPA ECOTOX database: https://cfpub.epa.gov/ecotox/quick_query.htm
[4] DAR reports: http://dar.efsa.europa.eu/dar-web/provision