Can SSD models help assessing interspecific competition impact on organisms' tolerance against chemical stress?

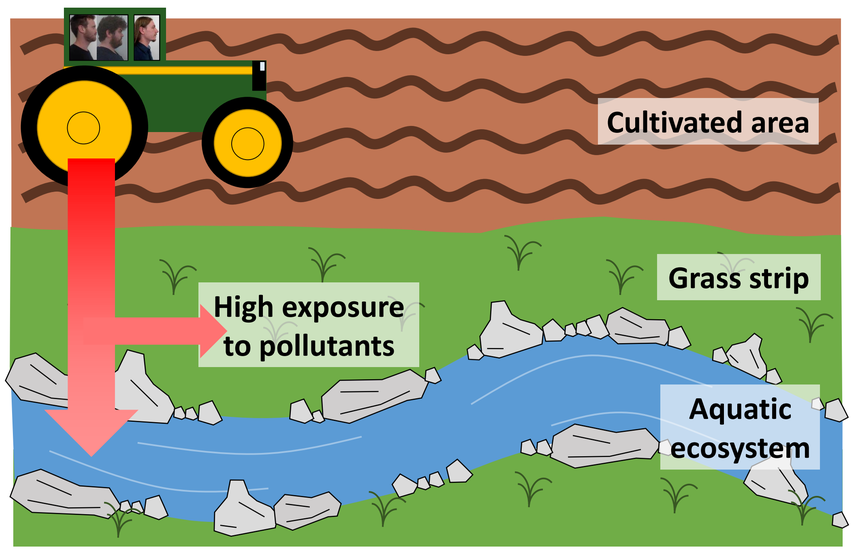
Vincent Baillard, Cécile Sulmon, Anne-kristel Bittebière, Cendrine Mony, Simon Devin, Elise Billoir

Interspecific competition impact on organism responses to chemical stress : an SSD-based approach.

Vincent BAILLARD[1], Cécile SULMON[2], Anne-Kristel BITTEBIERE[3], Cendrine MONY[2], Simon DEVIN[1], Elise BILLOIR[1]

Contact : vincent.baillard@univ-lorraine.fr

1 : LIEC, CNRS UMR 7360, Université de Lorraine, France
2 : ECOBIO, CNRS UMR 6553, Université de Rennes 1, France
3 : LEHNA, CNRS UMR 5023, Université de Lyon 1, France

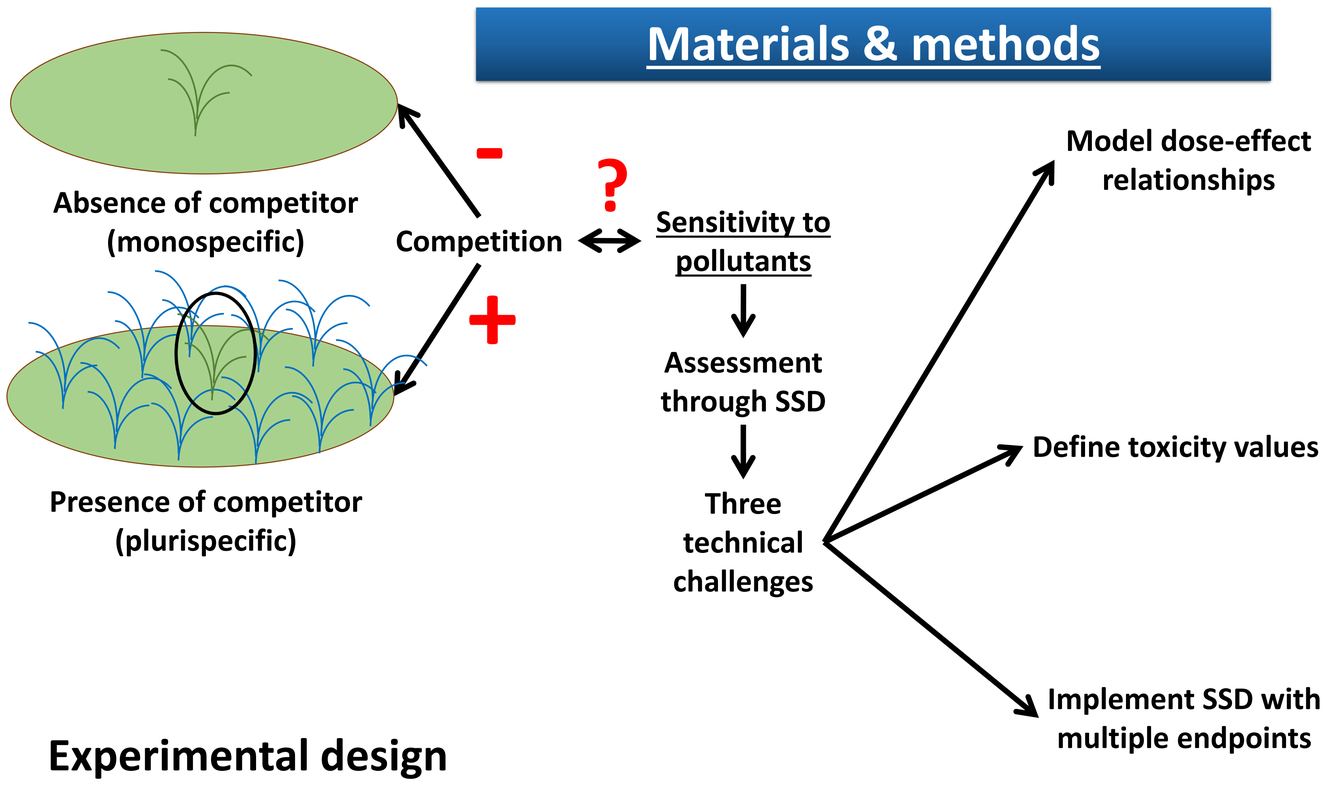


Introduction and objectives

Grass strips are vegetated areas that act as buffer strips against agricultural pollutants flows towards streams. They present a community of plant species that are simultaneously exposed to various pollutants → interactions between competition and chemical stress responses is an important topic. The objective of this study is to :

- assess whether interspecific competition modifies tolerance of herbaceous plants to the herbicide isoproturon
- evaluate SSD, a tool widely used in risk assessment that permits to integer data from monospecific tests to produce a theoretical sensitivity distribution of the community.

Materials & methods



Modelling process (see also comm' WE474 and WE368)

- Selection of endpoints for each species (quadratic model)
- Model fitting (linear, exponential, Hill, Gaussian and log-Gaussian)
  Best-fit selected according to AIC values
- Calculation of toxicity values
  - $IC_{10 \text{ and } 50}$ (x% change compared to the control)
  - $EC_{10 \text{ and } 50}$ (x% effect, calculated only with Hill model)
  - BMD_{sd} (You don't know that one? Ask me for explanations!)
- SSD building (3 scenarios)
  - S1 : Most sensitive endpoint for each sp.
  - S2 : Geometric mean of endpoints for each sp.
  - S3 : Only total dry mass for each sp.

Experimental design

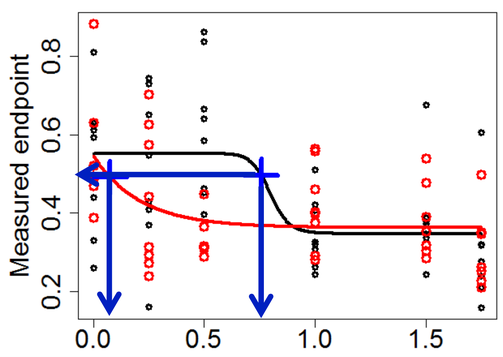
- 6 herbaceous grass species (3 isoproturon tolerance levels * 2 competitiveness levels),
- *Bromus erectus* as model competitor
- 25-days exposure to 6 isoproturon concentrations, from 0 to 1.75 µM, in presence and absence of *Bromus erectus* (8 replicates).
- measurement of 12 endpoints expected to respond to isoproturon and/or competition stress (linked to biomass, photosynthesis, resource allocation…).

		Isoproturon tolerance		
		Low	Medium	High
Competitiveness	Low	*Poa trivialis*	*Poa pratensis*	*Trisetum flavescens*
	High	*Arrhenatherum elatius*	*Lolium multiflorum*	*Dactylis glomerata*

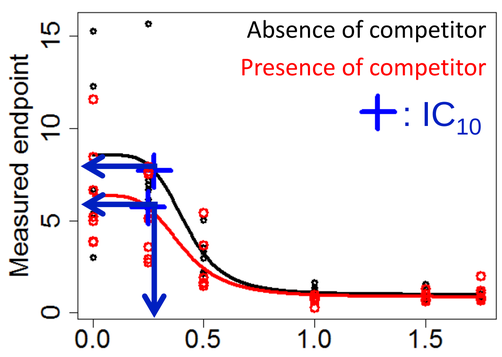
Results and discussions

Examples of fit

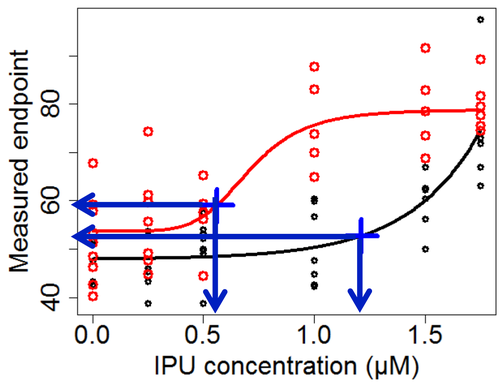
Toxicity effect

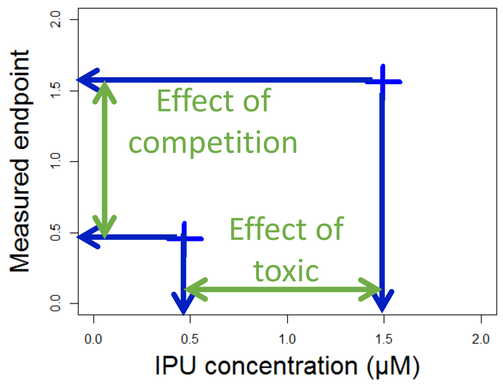


Competition effect



Both

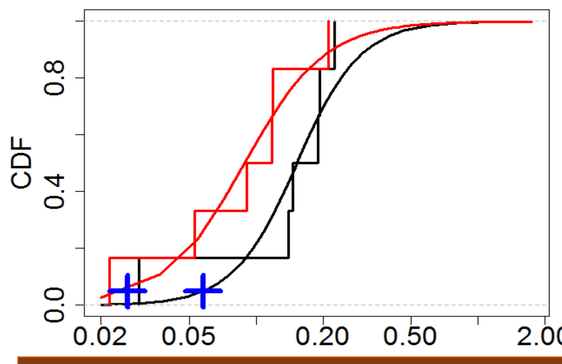




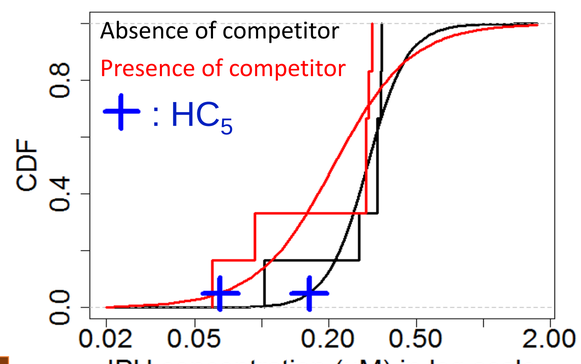
Depending on species and endpoints, fitted curves present **competition effect** (differences at intercept) and/or **toxicity effect** (differences in toxicity values).

SSD examples (IC10 values)

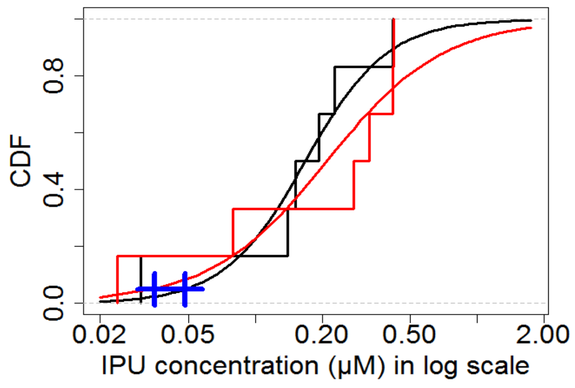
S1



S2



S3



In every case, **HC_5** values derived with BMDsd, $IC_{10 \text{ or } 50}$ and $EC_{10 \text{ or } 50}$, used in every different SSD types used are **1,04 to 7,21 times lower** for organisms **in presence of the competitor**.

The choice of toxicity value used and the handling of multiple toxicity values for a same species can result in important changes in final HC_5 values and their differences between situations with and without interspecific competition.

Conclusion

Interspecific competition → decrease in tolerance to isoproturon → impact on obtained SSD models.
Toxic value choice & processing of multiple toxic value for each species → changes in HC_5 values and their modification by competition.
It seems important to assess in the future whether this ecological interaction, and others, should be further highlighted in risk assessment.
Other experiments are actually in progress to define if these conclusions can be applied to metabolomic data and to complex assemblages of tested species.