Simultaneous Analysis of Multiple Toxicity Data Sets

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INTRODUCTION

Ecotoxicity tests are expensive and require test organisms. Therefore, it is important to extract the maximum amount of information. Tests are usually analysed by hypothesis testing (NOECs) or empirical curve fitting (LC50, EC*x*, etc.). These methods are not based on underlying processes, thereby ignoring natural links between various endpoints.

DEBtox offers a process-based framework in which the endpoints are linked in a logical manner (Fig. 1). This helps to understand how toxicants affect organisms, which facilitates extrapolation to populations in the field. Furthermore, sources of information (e.g. different endpoints) can be combined, thereby making optimal use of the information contained in the data.

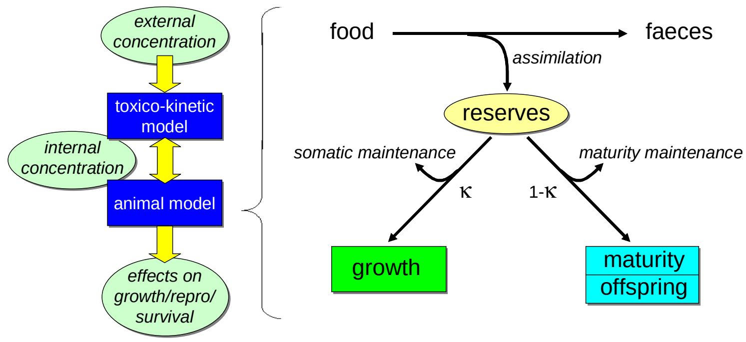

Figure 1. Schematic outline of DEBtox

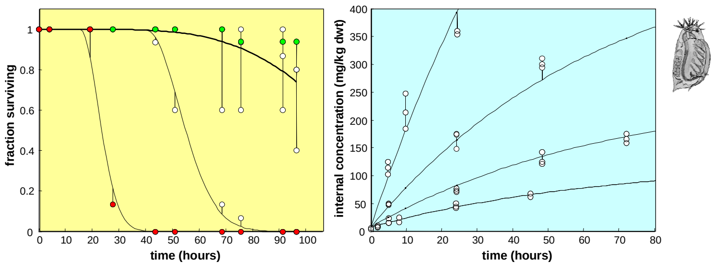

Figure 2. Survival data and body residues for Daphnia magna *exposed to different concentrations of cadmium (0-1 mg/L). DEBtox fit is based on the simultaneous analysis of both endpoints.*

INTERNAL CONCENTRATIONS AND EFFECTS

Effects are caused by internal concentrations. If measured body residues are available, they should be analysed together with the effects data. An example is given in Figure 2 (Heugens *et al*., 2003).

LIFE-CYCLE TOXICITY TESTS

Growth and reproduction are not isolated processes, but are governed by energetic constraints (Fig. 1). Different life-cycle traits should thus be analysed together. In the example of Fig. 3, the data reveal that carbendazim affects the assimilation of energy from food. The model results can subsequently be used to predict population consequences.

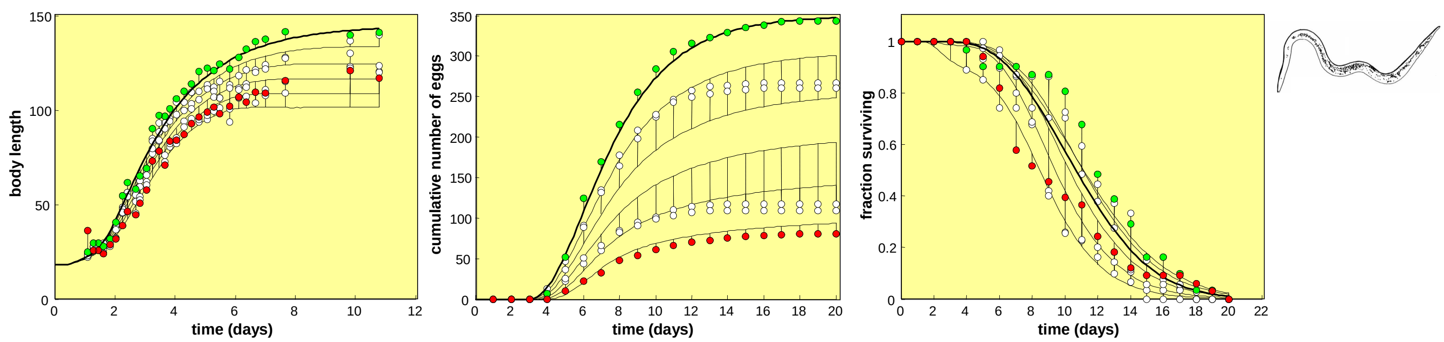

Figure 3. Life-cycle toxicity test with sexually reproducing Caenorhabditis elegans *exposed to carbendazim. Control is indicated by green dots, highest concentration by red dots. Fit is based on simultaneous analysis of all three endpoints.*

CONCLUSIONS

Using process-based approaches such as DEBtox, existing data sets may be combined to obtain consistent high-quality information. This has been demonstrated already in several papers (Table 1).

Such efficiency is of particular importance in view of the developments in EU regulations (REACH), where there is a need to obtain the maximum amount of information, with the minimum use of test animals.

More information:
http://www.bio.vu.nl/thb/deb

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Table 1. Published examples of simultaneous analyses with DEBtox.

Type of data	Example	Reference
Sets of same type under different test circumstances	Different temperatures/ food levels	Jager *et al.* (2005), Func. Ecol. 19:136. Jager *et al.* (acc.), Soil. Biol. Biochem.
	Different modes of reproduction (sexual and hermaphrodite)	Alda Álvarez *et al.* (acc.), Func. Ecol.
Different endpoints of the same animal	Growth, reproduction and survival	Jager *et al.* (2004), Environ. Sci. Technol. 38:2894 Alda Álvarez *et al.* (acc.) Func. Ecol.
	Survival and internal concentrations	Heugens *et al.* (2003), Environ. Sci. Technol. 37:2145
Different chemicals with same mode of action	Survival for a series of organophosphate esters	Jager & Kooijman (submitted).