Reliable plant transpiration test system for phytotoxicity testing of xenobiotics

B. Schoenmuth¹, D. Schenke², T. Scharnhorst³, C. Büttner¹, W. Pestemer
1) Humboldt University of Berlin, Division Phytomedicine, Lentzeallee 55/57, D-14195 Berlin
2) Julius Kuehn Institute – Federal Research Institute for Cultivated Plants, Koenigin-Luise-Str. 19, D-14195 Berlin
E-mail: berndsschoenmuth@yahoo.de

Background
Phytotoxicity may not only be a problem concerning fertilizers or plant protection products but is also of interest regarding an abiotic influence of environmental hazardous chemicals on plants.

Many phytotoxicity test systems, currently used, suffer from the problem, that the time course of phytotoxic effects cannot be displayed without high expense parallel plant tests. Often endpoint parameters like fresh mass, dry mass, shoot, and/or root elongation are measured. Where the test time period is sufficiently set, e.g. two to six weeks, sometimes misinterpretations of transient effects, like temporarily occurring hormesis are observed. In some standard phytotoxicity test systems environmental chemicals are mixed into soil or other growth substrates. Here, binding to the soil humic matrix and absorption to clay minerals may bring about some difficulties for interpretation since nominal concentration applied and effective concentration may differ. Thus, bioavailability of the xenobiotic tested is often not assessable.

Cress transpiration test (CTT)
Application of bioavailable, aqueous solutions of xenobiotics to eight-days old cress is performed via glass fibre wicks every three days with freshly prepared solutions. Gravimetric measurement of evapotranspiration and evaporation of unplanted quartz sand is commonly conducted in three-days intervals.

The Ten Main Features of CTT
1. CTT – is primarily designed as a contemporary acute phytotoxicity test (absolute and control dependent relative transpiration rate, cumulative transpiration).
2. CTT – is independent from the season and CTT is a low-budget method.
3. CTT – is applicable for different solid growth substrates with sorption dependent decreasing sensitivity: glass fibre filter sheets > (vermiculite) > quartz sand > soil.
4. CTT – is usable for water-dissolved chemicals and for soil leachates.
5. CTT – is adoptable to other herbaceous plants like Brassica rapa rapa, Avena sativa and to broadleaf trees (Populus, Salix) or even coniferous trees (Pinus, Picea).
6. CTT – freshly prepared xenobiotic may be applied repeatedly and time dependent application mass as well as the actual nominal concentration of the xenobiotic are quantifiable.
7. CTT – single pulse application and xenobiotic removal from storage vessels is possible (time-limited application).
8. CTT – meets the requirements of the OECD Guideline 208.
9. CTT – biocentrifugation factors (BCF) for the repetitive xenobiotic are assessable.
10. CTT – may be extended to a chronic phytotoxicity test (e.g. grain yield).