

Using the Duckweed Growth Inhibition Test to detect and evaluate soil contamination

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Besides the classic scope of biotests chemical notification procedures and the control of sewage water- the ecotoxicological analysis of presumably contaminated soils gains more and more interest. The detection of biological available contamination as well as assessing the hazards of contaminated or remediated soil are the main focuses of biotests. To assess any risk in ground and surface water but also just as sensitive, readily available detectors aquatic organisms like algae, daphnids and duckweed are used for soil elutriates. Duckweed can be used in a wide range of pH-values. Even intensively coloured, turbid solutions or even suspensions of solids do not interfere with the test. This makes testing with duckweed more robust and flexible than tests with algae if soils or sediments are to be tested. To maximize sensitivity even organic extracts can be used. The great advantage of the duckweed test over germination and growth tests with e.g. cress or lettuce, often used in testing elutriates lies in the highly homogeneous plant material. While all duckweed plants are clones, in the seeds different charges weight distribution and the general heterogeneity of the genetic make-up leads to large standard deviations of seed. Generally speaking, comparing the sensitivity of different organisms/biotests has to be done with care. Besides, the intrinsic sensitivity of the organism, test duration, growth rate of the control and the growth model underlying the calculation method of inhibition have great influence on the results(see: Comparison of the sensitivity algae vs. Duckweed - A simulation study, LemnaTec 1999).All studies on hand comparing test systems on a rational basis indicate that none of the systems algae, duckweed or cress is more sensitive in all classes of tested toxicants than any other. This is readily explained by the different classification as lower plant, monocotyledon and dicytoledon. Biotest batteries often leave a gap where a fast biotest with higher plants is wanted; duckweed offers efficient possibilities of testing there.

A large number of standards (see below) allow the use of duckweed for soil elutriates. But not in all cases the recommended growth media are suitable. As our experience shows these should not contain organic additives to minimize the growth of bacteria and they should be concentrated enough to minimize hormesis caused by nutrients in the elutriate. Good experience were made by us with the Steinberg-medium which will be the standard medium DIN. Further research on duckweed and soil elutriates is under way at moment. As a part of a larger DBU-project (Deutsche Bundesstiftung Umwelt) „Ecotoxicological test-batteries” the Chair of Biology V of the Technical University of Aachen, supported by LemnaTec, is developing a test procedure adapted to elutriates.

- APHA 1992 Toxicity Part 8000 8-32-8-39 in: standard methods for the examination of water and wastewater 18th ed., APHA, AWWA, WEF, Washington
- ASTM, 1991. Conducting static toxicity tests with Lemna gibba. Guide E 1415-91. Annual book of ASTM standards. Section 11 Water and environmental technology. Vol. 11.04. ASTM, Philadelphia, U.S.
- Environment Canada 1998 Biological test method: test for measuring the inhibition of growth using the freshwater macrophyte lemna minor Report EPS 1/RM/37
- ISO/CD 15799 1999 Soil quality - Guidance on the ecotoxicological characterizations of soil and soil materials
- OECD 1998 Draft OECD test guideline: Lemna growth inhibition test

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