Berichte aus der Umweltwissenschaft

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DEVELOPMENT AND APPLICATION OF HYDROPONIC LIKE TEST SYSTEMS FOR THE DETERMINATION OF PLANT UPTAKE FACTORS (PUF) OF XENOBIOTICS TO BE USED AS PARAMETER IN ENVIRONMENTAL FATE MODELS

Shaker Verlag
Aachen 2017

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at http://dnb.d-nb.de.

Zugl.: Koblenz/Landau, Univ., Diss., 2017

Printed in Germany.

ISBN 978-3-8440-5308-1
ISSN 0946-7173

Shaker Verlag GmbH • P.O. BOX 101818 • D-52018 Aachen
Phone: 0049/2407/9596-0 • Telefax: 0049/2407/9596-9
Internet: www.shaker.de • e-mail: info@shaker.de

Environmental monitoring and bioremediation programs require the description of the environmental fate of specific compounds. In the context of modern agricultural treatments, mathematical models are used to describe the environmental exposure, distribution and accumulation. These are established upon the interaction between "sink" compartments. In this study, the *plant* compartment was more specifically investigated, via the plant uptake. The aim of the study, as there is presently no universally accepted experimental approach to estimate this uptake, was to develop a test protocol which could be standardized for the investigation of extended ranges of compounds, crops properties and soil pH conditions.

The plant uptake was estimated in terms of Plant Uptake Factor (i.e. PUF), which can be used as parameter for environmental models. This factor was calculated based on the compounds depletion in an artificial soil solution which was available for root uptake. In this contest, both the concentration and the transpiration volume were investigated. The test system consisted of intact plants incubated in treated solutions. Two successive versions of the protocol were investigated, mainly diverging in terms of plant cultivation and properties of the solution.

The range of investigation consisted of different crop types (tomato, wheat and oilseed rape), pH levels (5.5, 6.5 and 7.5) and compounds (×9, $\log K_{ow}$ = {-3.2 to 3.9}). First of all, despite some senescence, all crop species developed new tissue and led to sufficient transpiration. Overall, the uptake behaviour differed significantly between crop types. Secondly, the target pH conditions were achieved using adapted buffers. There was however no significant influence of the pH level on the uptake. Finally, most of the chosen compounds were adapted for investigation. On the one hand, the depletion of compound in solution led to a mean plant uptake factor value of 1.01 (n = 189, SD < 25 %), corresponding to a relative unrestricted passive uptake within the transpiration stream, independent from the lipophilicity of the compounds. One the other hand, when restricted to the shoots, the plants uptake was inversely linear with the lipophilicity.

Six experimental recommendations could finally be given for the establishment of an adapted standardized protocol. First of all, (1) the presented test protocol is primarily adapted for the investigation of water soluble and low sorbing compounds. However, it can be adapted for the investigation of high sorbing compounds with (2) the implementation of a relevant equilibration period with the treated solution. Furthermore, (3) it is recommended to use non-buffered nutrient solutions to ensure optimal plant conditions. Yet, for dissociating compounds, simplified and controlled solutions (e.g. defined nutrients, buffer systems) can eventually be used. Moreover, (4) it is recommended to cultivate the plants under hydroponics conditions. Notwithstanding, if the use of soil media cannot be avoid, the root integrity should be ensured before treatment. Additionally, (5) for representative uptake results, the duration of the treated incubation period should be primarily chosen regarding coherent water consumption volumes. Finally, (6) it is recommended to use a continuous aeration in solutions in order to ensure optimal plant cultivation conditions.