



# PLANTS

for Toxicity  
Assessment

Wang/Gorsuch/Lower  
editors



STP 1091

STP 1091

# *Plants for Toxicity Assessment*

*Wuncheng Wang, Joseph W. Gorsuch, and William R. Lower,  
editors*



ASTM  
1916 Race Street  
Philadelphia, PA 19103

## Library of Congress Cataloging-in-Publication Data

Plants for toxicity assessment / W. Wang, J. W. Gorsuch, and W. R.

Lower, editors

p. cm.—(STP; 1091)

Papers from the First Symposium on Use of Plants for Toxicity Assessment, held in Atlanta, Ga., Apr. 19–20, 1989, and sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate and its Subcommittee E47.11 on Plant Toxicity.

“ASTM publication code number (PCN) 04-010910-16”—T.p. verso.

Includes bibliographical references and index.

ISBN 0-8031-1397-8

1. Plants, Effect of pollution on—Congresses. 2. Plant indicators—Congresses. 3. Toxicity testing—Congresses. 4. Biological monitoring—Congresses. I. Wang, Wuncheng. II. Gorsuch, J. W. (Joseph W.), 1947–. III. Lower, W. R. IV. Symposium on Use of Plants for Toxicity Assessment (1st: 1989: Atlanta, Ga.) V. ASTM Committee E-47 on Biological Effects and Environmental Fate. Subcommittee E47.11 on Plant Toxicity. VI. Series: ASTM special technical publication; 1091. QK750.P56 1990

615.9'07—dc20

90-40925

CIP

Copyright © 1990 by the AMERICAN SOCIETY FOR TESTING AND MATERIALS. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher.

### NOTE

The Society is not responsible, as a body,  
for the statements and opinions  
advanced in this publication.

### Peer Review Policy

Each paper published in this volume was evaluated by three peer reviewers. The authors addressed all of the reviewers' comments to the satisfaction of both the technical editor(s) and the ASTM Committee on Publications.

The quality of the papers in this publication reflects not only the obvious efforts of the authors and the technical editor(s), but also the work of these peer reviewers. The ASTM Committee on Publications acknowledges with appreciation their dedication and contribution of time and effort on behalf of ASTM.

## Foreword

The First Symposium on Use of Plants for Toxicity Assessment was held in Atlanta, Georgia, on 19–20 April 1989. ASTM Committee E-47 on Biological Effects and Environmental Fate and its Subcommittee E47.11 on Plant Toxicity sponsored the event.

The symposium chairmen were: Wuncheng Wang, Illinois State Water Survey; Joseph W. Gorsuch, Eastman Kodak Company; and William R. Lower, University of Missouri. They have also served as editors of this volume.

# Contents

<b>Overview</b>	1
REGULATORY PERSPECTIVES	
<b>Keynote Address: Plants—Keystone to Risk Assessment—F. BENENATI</b>	5
<b>Development of Guidelines for Testing Pesticide Toxicity to Nontarget Plants for Canada—K. FREEMARK, P. MAC QUARRIE, S. SWANSON, AND H. PETERSON</b>	14
COMPARATIVE TOXICOLOGY	
<b>Use of Algae versus Vascular Plants to Test for Chemical Toxicity— J. S. FLETCHER</b>	33
<b>Comparison of Short- and Long-Term Toxicity Test Results for the Green Alga, <i>Selenastrum capricornutum</i>—D. J. VERSTEEG</b>	40
<b>Chemical Effects on the Germination and Early Growth of Terrestrial Plants— J. W. GORSUCH, R. O. KRINGLE, AND K. A. ROBILLARD</b>	49
<b>Comparison of the Seagrass <i>Thalassia testudinum</i> and Its Epiphytes in the Field and in Laboratory Test Systems—J. R. CLARK AND J. M. MACAULEY</b>	59
<b>Multispecies Methods of Testing for Toxicity: Use of the <i>Rhizobium</i>-Legume Symbiosis in Nitrogen Fixation and Correlations Between Responses by Algae and Terrestrial Plants—C. T. GARTEN, JR.</b>	69
PLANTS AND XENOBIOTIC UPTAKE	
<b>Characterization of Xenobiotic Uptake Utilizing an Isolated Root Uptake Test (IRUT) and a Whole Plant Uptake Test (WPUT)—M. A. KRSTICH AND O. J. SCHWARZ</b>	87
<b>Bioaccumulation of Mercury Compounds in Two Aquatic Plants (<i>Elodea densa</i> and <i>Ludwigia natans</i>): Actions and Interactions of Four Abiotic Factors— F. RIBEYRE AND A. BOUDOU</b>	97

PLANTS AND AIR POLLUTION

- Use of Native and Cultivated Plants as Bioindicators and Biomonitorers of Pollution Damage**—L. H. WEINSTEIN, J. A. LAURENCE, R. H. MANDL, AND K. WÄLTI 117
- Ecological Effects Evaluation of Two Phosphorus Smoke-Producing Compounds Using Terrestrial Microcosms**—D. A. TOLLE, M. F. ARTHUR, K. M. DUKE, AND J. CHESSON 127
- Use of Physiological and Biochemical Markers for Assessing Air Pollution Stress in Trees**—C. J. RICHARDSON, T. W. SASEK, AND R. T. DIGIULIO 143
- A Bioindicator System Assessing Air Quality Within Minnesota**—K. W. KROMROY, M. F. OLSON, D. F. GRIGAL, P. S. TENG, D. R. FRENCH, AND G. H. AMUNDSON 156
- The *Vicia* Leaf Tip Cell-Micronucleus Bioassay and Air Pollution Monitoring**—CHEN GUANGRONG, JIN BO, LI MING, AND WENG XINGGUO 170

GENERAL PHYTOTOXICOLOGY

- Seed Germination and Root Elongation Toxicity Tests in Hazardous Waste Site Evaluation: Methods Development and Applications**—G. LINDER, J. C. GREENE, H. RATSCH, J. NWOSU, S. SMITH, AND D. WILBORN 177
- Survey of Rocky Mountain Arsenal for Phytotoxic Substances**—D. L. SIROIS 188
- Protocol for Evaluating Soil Contaminated with Fuel or Herbicide**—T. H. LILLIE AND R. W. BARTINE 198
- Effects of Chromium in Freshwater Algae and Macrophytes**—M. BASSI, M. G. CORRADI, AND M. A. FAVALI 204
- Evaluation of Protocols for the Assessment of Phytotoxicity**—D. L. SIROIS 225
- Time-Dependent Toxicity Assessment of Herbicide Contaminated Soil Using the Green Alga *Selenastrum capricornutum***—M. W. THOMAS, B. M. JUDY, W. R. LOWER, G. F. KRAUSE, AND W. W. SUTTON 235
- Use of *Thalassia* and Its Epiphytes for Toxicity Assessment: Effects of a Drilling Fluid and Tributyltin**—J. M. MACAULEY, J. R. CLARK, AND A. R. PITTS 255
- A Plant Toxicity Test with the Moss *Physcomitrella patens* (Hedw.) B.S.G.**—E. L. MORGAN, YUEH-CHIN A. WU, AND R. C. YOUNG 267
- Millet Root Elongation in Toxicological Studies of Heavy Metals: A Mathematical Model**—WUNCHENG WANG AND G. ELSETH 280

NEW APPROACHES

<b>The Role of Chlorophyll Fluorescence as a Bioassay for Assessment of Toxicity in Plants—D. MILES</b>	297
<b>Chlorophyll Fluorescence of a Higher Plant as an Assay for Toxicity Assessment of Soil and Water—B. M. JUDY, W. R. LOWER, C. D. MILES, M. W. THOMAS, AND G. F. KRAUSE</b>	308
<b><i>Tradescantia</i> Sister-Chromatid-Exchange (SCE) Bioassay for Environmental Mutagens—YAN PENG AND TE-HSIU MA</b>	319
<b>Activation of Promutagens by a Unicellular Green Alga—K. R. SAUSER AND S. J. KLAINÉ</b>	324
<b>Some Approaches to Rapid and Pre-Symptom Diagnosis of Chemical Stress in Plants—R. R. VELAGALETI, D. KRAMER, S. S. MARSH, N. G. REICHENBACH, AND D. E. FLEISCHMAN</b>	333
<b>Image Analysis System for Rapid Data Processing in <i>Tradescantia</i>-Micronucleus Bioassay—JIANHUA XU, WENJIE XIA, XUDONG JONG, WEICHI SUN, GUANGHENG LIN, AND TE-HSIU MA</b>	346
<b>Author Index</b>	357
<b>Subject Index</b>	359



ISBN 0-8031-1397-8