

**Angelina J. Duggan, Ph.D.**  
**Senior Managing Scientist**

**Professional Profile**

Dr. Duggan has more than 25 years of experience in pharmaceutical and chemical product development, project management, product stewardship, and Toxic Substances Control Act (TSCA) and Federal Insecticide and Fungicide and Rodenticide Act (FIFRA) regulatory support. She specializes in a multidisciplinary approach to risk assessment that uses chemistry, toxicology, biomonitoring, and metabolism, and has provided support for industrial chemicals, pesticides, surfactants, fragrances, and environmental contaminants. She also has experience with FDA bulk pharmaceutical applications and biocompatibility medical device toxicology testing.

Dr. Duggan's regulatory consulting has included applying chemistry, Structure Activity Relationships (SAR), cluster analysis, and read-across, for TSCA High Production Volume and Premanufacturing Notifications, FIFRA EPA petitions, and REACH. She has also applied her academic and industrial background in synthetic natural products chemistry and pharmaceutical process chemistry to successfully address intellectual property and patent infringement cases and challenges.

Before joining Exponent, Dr. Duggan provided scientific guidance for Washington DC trade associations, as well as pesticide and chemical manufacturers and formulators, regarding EPA and state regulations, and human health science and policy. EPA also appointed her to provide science and policy expertise for endocrine disruption and children's health. She served on advisory committees, the Endocrine Disruption Screening and Testing Advisory Committee (EDSTAC), and the Children's Health Protection Advisory Committees. She has also provided technical leadership for task forces and project teams to address endocrine disruption, cancer risk assessment, farm family risk, worker exposure, pesticide human testing, and chemical surfactant tolerance reassessment.

Dr. Duggan can effectively communicate risk assessment issues and complex technical issues to scientists and non-scientists, and is capable of serving as a credible technical expert. She has presented and provided written public comments at EPA workshops and to Science Advisory Panels and Boards. Dr. Duggan has also authored and organized the submission of numerous technical and regulatory science policy papers to EPA's Public Docket. Her project management experience includes multi-disciplinary litigation teams, discovery research and development, process chemistry, and global registration and product stewardship. She has also presented safety product profiles to EPA, Latin American, European, and Asian regulators and provided guidance for the development and implementation of biotechnology and discovery strategic plans.

## **Academic Credentials and Professional Honors**

N.I.H Postdoctoral Fellow: Natural Products Synthesis, Isolation and Structure Elucidation, Cornell University, 1976  
Ph.D., Marine Natural Products, Synthetic Organic Chemistry, Rutgers University, 1974  
N.I.H. Predoctoral Fellow, Rutgers University, 1972–1974  
M.S., Organic Chemistry, Rutgers University, 1972  
B.A., Biology and Chemistry Rutgers University (with honors), 1967

## **Patents**

Duggan AJ, Engel JF, Lutomski KA. Benzoheterocyclyl ketone hydrazone insecticides. U.S. Patent No. 4,895,871, 1989.

Duggan AJ. Pyrazoline insecticides. U.S. Patent No. 4,767,779, 1988.

Duggan AJ. Vinyl Phenylthiocarbonate. U.S. Patent No. 4,622,408, 1986.

Duggan AJ, Webb RL. New process for preparing hydroxyphenylpyridazinones. U.S. Patent No. 4,272,440, 1978

## **Publications**

Duggan A, Snedeker S, Zambrone F. Sessions on the toxicology of agricultural exposures and cancer. *Scandinavian J Work Environ Health* 2005; 31:119.

Charnley G, Chukwudebe A, Chen W, Duggan A, Hawk R, Krieger RI, Ross J, Yarborough C. Di-alkyl phosphate biomonitoring data: Assessing cumulative exposure to organophosphate pesticides. *Regul Toxicol Pharmacol* 2003; 37:382.

Cardona R, Duggan A, Gordon E, Stevens E, Tobia A. ACPA perspective on EPA's cancer risk assessment policy in light of the proposed 1996 guidelines for carcinogen risk assessment. *Risk Policy Report*, September 22, 2000.

Hughes PR, Wood HA, Breen JP, Simpson SF, Duggan AJ, Dybas JA. Enhanced bioactivity of recombinant baculovirus expressing insect-specific spider toxins in lepidopteran crop pests. *J Invertebrate Pathol* 1997; 69:112.

Duggan AJ, Grabowski EJJ, and Russ WK Jr. Phase—Transfer mediated heteroaromatic nucleophilic substitution: Introduction of a beta-adrenergic blocking moiety. *Synthesis* 1981; 573.

Adams MA, Duggan AJ, Smolanoff J, Meinwald J. The total synthesis of (+/-) pederamide. *J Am Chem Soc* 1979; 101:5374.

Duggan AJ, Roberts FE. A facile preparation of a VOC reagent, vinyl phenylthiocarbonate. *Tetrahedron Lett* 1979; 595.

Adams MA, Duggan AJ, Meinwald J. Synthesis of ethyl 1,3,6-trioxaspiro-(4.5) decane-4-carboxylate derivatives from *delta*-lactones (preparation of 2-methoxy-2-glycolamide-tetrahydro-2H-pyran; elaboration of pederamide side chain). *Tetrahedron Lett* 1978; 4327.

Adams MA, Brynes PJ, Duggan AJ, Meinwald J. Reaction of enolate anions with lactones. *Tetrahedron Lett* 1978; 4323.

Duggan AJ, Hall SS, Weber GF. Relative reactivity of substituted 2-alkoxy and 2-phenoxy-3,4-dihydro-2H-pyrans with tert-butyl hypochlorite: Effect of substituents on reactivity and products. *J Org Chem* 1978; 43:667.

Duggan AJ, Hall SS. Addition of tert-butyl hypohalites to 3,4-dihydro-2H-pyran and its 2-alkoxy 6-methyl derivatives in hydroxylic solvents. *J Org Chem* 1977; 42:1057.

Duggan AJ, Eisner T, Kinnel R, Meinwald J, Miura I. Panacene: An aromatic bromoallene from a sea hare (*Aplysia brasiliiana*). *Tetrahedron Lett* 1977; 3913.

Adams MA, Duggan AJ, Meinwald J. An adventitious synthesis of pederolactone. *Heterocycles* 1977; 7:989.

Duggan AJ, Hall SS. 3-Alkoxy-2-oxanorcaradienes: synthesis of cyclopropanes from labile olefins using an improved lithium ammonia reduction procedure on the dichlorocarbene adducts. *J Org Chem* 1975; 40:2238.

Duggan AJ, Hall SS. The chemistry of 2-alkoxy-3,4-dihydro-2H-pyrans III: synthesis and solvolysis of the dichlorocarbene adducts 3-alkoxy-2-oxa-7,7-dichloro-norcaradienes. *J Organ Chem* 1975; 40:2234.

Duggan AJ, Hall SS. The Chemistry of 2-alkoxy-3,4-dihydro-2H-pyrans II: addition of dimethyl acetylenedicarboxylate. *J Org Chem* 1974; 39:3432.

Borer R, Duggan AJ, Muller R, Rosenberger M, Saucy G. Steroid total synthesis part 8; (+/-) - Estr-4-ene-3,17-dione. *Helvetica Chimica Acta* 1972; 55:2663.

Duggan AJ, Rosenberger M, Saucy G. Steroid total synthesis part 7; (+/-) -Estr-4-ene-3, 17-dione and (j) 13-ethyl-gon-4-ene-3, 17-dione. *Helvetica Chimica Acta* 1972; 55:1333.

Rosenberger M, Andrews D, DiMaria F, Duggan AJ, Saucy G. Synthesis of delta-lactones from gluteraldehyde. *Helvetica Chimica Acta* 1972; 55:249.

## **Book Chapters**

Duggan A. Putting the toxicology and risk assessment of approved organic pesticides in perspective. American Chemical Society Symposium Series 947: Crop Protection Products for Organic Agriculture, Environmental Health and Efficacy Assessment, 2006.

Duggan AJ. Endocrine issues update: pesticide formulations and application systems. 18<sup>th</sup> Volume, ASTM STP 1347, Monograph of the proceedings American Society for Testing and Materials, Pesticide Formulations and Application Systems San Diego, CA, October 1997.

## **Recent Published Abstracts**

Duggan A. Applying cluster analysis to pesticide inert tolerance reassessment. American Chemical Society National Meeting, San Francisco, CA, March 2010.

Duggan A, Messina J. The Joint Inerts Task Force (JITF), an effective task force model. American Chemical Society National Meeting, San Francisco, CA, March 2010.

Duggan AJ, McIntosh LJ. Challenges in Applying Computational Structure-Activity Relationship (SAR) modeling for predicting toxicological endpoints for risk assessment. 46<sup>th</sup> Annual Society of Toxicology Meeting, Salt Lake City, UT. Abstract 190, The Toxcologist. 114(1):41.

Duggan AJ, McIntosh LJ. Challenges in applying computational, Structure-Activity Relationship (SAR) modeling in predicting toxicology for risk assessment. EPA The First ToxCast Data Analysis Summit, Research Park, NC, May 2009.

Kaetzel RS, Teta MJ, Wagner LM, Duggan A, Sweeney L, Gargas M. An evaluation of early-life susceptibility and exposures to ethylene oxide. 46<sup>th</sup> Annual Society of Toxicology Meeting, Charlotte, NC. Abstract 1617. The Toxcologist; 96(1):334.

Bloemen L, Duggan A. Lessons for the European pilot project from biological monitoring programs in the chemical industry. BIOmonitoring (ESBIO) Lisbon, Portugal, April 2006.

Duggan A. Regulatory science and risk assessment of endocrine-active substances. Presented at the IUPAC–KSPS International Workshop on Pesticides 2003, Seoul, Korea, October 2003.

Duggan A. Putting the toxicology and risk assessment of approved organic pesticides in perspective. American Chemical Society National Meeting, New Orleans, LA, March 2003.

Duggan A. To what extent have we known about endocrine disruption chemicals? 3<sup>rd</sup> International Symposium on Environmental Endocrine Disruptors co-sponsored by the Japan Society of Endocrine Disrupter Research (JSEDR) and the Japan Environment Agency (JEA) Yokohama, Japan, December, 2000.

## **Selected Presentations**

Duggan A. Applying cluster analysis to pesticide inert tolerance reassessment. American Chemical Society Meeting, San Francisco, CA, March 2010.

Duggan A. Biocompatibility: Risk analysis and safety evaluations, a risk assessor's perspective. Drexel University, Philadelphia, PA, May 2008, May 2009 and May 2010.

Duggan A. Historical perspective of the endocrine disruption issue, EDSTAC and validation. Chair Session One: Background on the Endocrine Screening (EPA's EDSP Tier I), International Society of Regulatory Toxicology and Pharmacology, NIH Bethesda, MD, February 2008.

Duggan A. Consortia/Task Forces/SIEFS: Challenges in participation and organization. Personal Care Products Council REACH Symposium, Washington, DC, February 2008.

Duggan A. Interpreting biomonitoring in the context of risk assessment and liability. NJ Chapter of Society of Woman Environmental Professionals, Newark, NJ, January 2008.

Duggan A. Biocompatibility: Risk analysis and safety evaluations, a risk assessor's perspective. Drexel University, Philadelphia, PA, June 2007.

Duggan A. Interpreting biomonitoring in the context of risk assessment, introductory remarks. Presented at Society of Risk Analysis, Baltimore, MD, December 2006.

Duggan A. Regulatory science and risk assessment of endocrine-active substances. Presented at the IUPAC –KSPS International Workshop on Pesticides 2003, Seoul, Korea, October 2003.

Duggan A. Putting the toxicology and risk assessment of approved organic pesticides in perspective. Presented at the American Chemical Society National Meeting, New Orleans, LA, March 2003.

Duggan A. Toxicology rappateur. International Symposium on Agricultural Exposures and Cancer. Presented at Oxford University, Oxford, UK, November 2002.

Duggan A. The value of human data in conducting safety assessments. Presented at Chemicals Manufacturers and Distributor Association (CPDA) Annual Meeting, Washington, D.C., February 2001.

Duggan A. What are the actual risks to children and EPA regulation of pesticides. Presented and moderated expert panel discussion on children's health issues at the Responsible Industry for a Sound Environment (RISE) Annual Meeting, Palm Springs, FL, September 2001.

Duggan A. FQPA science and policy implications. Presented to the Agricultural Company and Banana Company Task Force, San Jose, Costa Rica, May 2000.

Duggan A. Industry perspective: To what extent have we known about endocrine disruption chemicals? Presented and participated on panel discussion, 3<sup>rd</sup> International Symposium on Environmental Endocrine Disrupters, co-sponsored by the Japan Society of Endocrine Disrupter Research (JSEDR) and the Japan Environment Agency (JEA), Yokohama, Japan, December, 2000.

Duggan A. US and EU endocrine disruption policy—Implications for Japan and children's health initiatives: Potential emerging global policy issue. Presented to the Japanese Chemical Industry Association (JCIA) Tokyo, Japan, December 2000.

Duggan A. Endocrine Disruption Screening and Testing Committee (EDSTAC) update on priority setting. Presented at Chemical Manufacturers Association (now known as the American Chemistry Council, ACC) Endocrine Issues Science Forum, November 1999.

Duggan A. Evaluation of the endocrine disruption theory. Presented at University of Hawaii, Honolulu, Hawaii, July 1998.

Duggan A. Evaluation of the endocrine disruption theory. Presented Rutgers University New Brunswick, NJ, April 1998.

Duggan A. Progress report on the Endocrine Disruption Screening and Testing Committee (EDSTAC). Presented to Illinois EPA and Illinois Chemical Manufacturers Association, Chicago, IL, June 1997.

Duggan AJ. Endocrine issues update: pesticide formulations and application systems. Presented at American Society for Testing and Materials, Pesticide Formulations and Application Systems, San Diego, CA, October 1997.

Duggan A. Industry perspective on the endocrine disruption theory. Presented and participated in a panel discussion at the Responsible Industry for a Sound Environment (RISE) Annual Meeting, Washington, D.C., September, 1997.

Duggan A. Endocrine disruption screening and testing advisory committee update. Presented at the American Crop Protection Association (now known as CropLife America, CLA) Spring Conference, May 1997.

## **Prior Experience**

Human Health Science and Policy Leader and Director Science Policy, CropLife America (formerly America Crop Protection Association), 1999–2005

Global R&D Development and Regulatory Affairs Manager, FMC Corporation Agricultural Products Group, 1994–1999

Discovery Manager External Resources and Screening, FMC Corporation Agricultural Products Group, 1991–1994

New Leads Discovery Manager, FMC Corporation Agricultural Products Group, 1988–1991

Synthesis Manager, Insecticides, FMC Corporation Agricultural Products Group, 1985–1988

Senior Discovery Research Chemist, FMC Corporation Agricultural Products Group, 1983–1985

Process Research Senior Chemist, Merck, 1977–1983

Process and Medicinal Research Senior Chemist, Smith Kline French/Beecham, 1976–1977

Associate Chemist, Hoffmann-La Roche, 1967–1972

## **Project Experience**

Provided regulatory support to prepare Endocrine Disruption Screening and Testing Program (EDSP) Tier 1 Other Scientifically Relevant Information (OSRI) submissions to EPA for pesticide products.

Served as Technical Project Manager for the Joint Inerts Task Force to fulfill data requirements under the Food Quality Protection Act. This 3-year project successfully met the EPA tolerance reassessment requirements for pesticide surfactants (inert ingredients). Regulatory and management responsibilities required organizing cluster groupings for various chemicals and overseeing the preparation of more than 18 data development plans and petitions for the chemically-diverse classes of surfactants used in pesticide formulations.

Developed and applied read-across strategies, organizing chemical cluster groups and structure-to-activity analyses in support of data development plans for FIFRA, TSCA, and REACH regulatory applications.

Provided intellectual property technology assessment evaluations and written expert declarations for multiple pharmaceutical and chemical process chemistry and manufacturing patents that have resulted in successful defenses and appeals.

Evaluated human health issues related to performance and biocompatibility of various medical devices.

Serving on Exponent Institutional Review Board to evaluate protocols, ethical (informed consent and questionnaires), and safety considerations, for observational studies involving human participants.

Successfully responded to toxicology and chemical polymer degradation issues raised in expert witness testimony in dental device manufacturing litigation.

Provided project management of multi-disciplinary technical support for chemical toxic tort litigation and contributed to the development of expert witness ethylene oxide technical summaries.

Experienced in issues management and preparation of submission to various regulatory agencies governing TSCA Pre-manufacture Notices (PMNs), High Production Volume (HPV) testing, and REACH.

Developed strategies and work plans to address regulatory issues for Toxic Substances Control Act (TSCA) 5e PMN from EPA Office of Pollution Prevention and Toxics (OPPT).

Experienced in conducting FIFRA and TSCA regulatory support and human health risk assessments for pesticide, industrial chemicals and fragrance chemical ingredients.

Experienced in preparing FDA applications for the manufacture of pesticide products as bulk pharmaceuticals, and similar applications for the UK Veterinary Medicines Directorate (VMD) for animal health use.

Provided FIFRA human health risk assessment science and policy guidance for Washington DC trade pesticide association composed of more than 50 member companies (basic and generic manufacturers), formulators, and distributors regarding crop and non-crop uses of pesticide products at both the federal and state level.

Developed risk communications strategies and prepared documents on a broad array of EPA science and risk assessment regulations and policy: Food Quality Protection Act; human testing; cancer risk assessment; endocrine issues; developmental neurotoxicity testing (DNT); environmental exposure and disease links; children's health; and farm family exposure issues.

Experienced in media relations and providing interviews and written documents to trade publications and the general press.

Managed science and regulatory projects related to human testing and cancer risk of chemicals and pesticides.

Conducted due diligence for toxicology and product chemistry regulatory studies.

Provided chemical assessment expertise to support environmental forensics for 1,2,3-trichloropropane.

Authored and organized numerous science policy and technical papers for the EPA Public Docket relating to the use of human data in risk assessment, FQPA 99.9 percentile of regulation, FQPA aggregate and cumulative risk assessment, children's health, EPA's aging initiative, endocrine disruption (priority setting, screening, and validation), biomonitoring, and cancer risk assessment.

Experienced in developing and optimizing new chemical processes for pilot plant and production manufacturing.

Experienced in pesticide data compensation regulations and registration support including the development of summary spreadsheets and costing of studies.

Managed Agency negotiations to address EPA Developmental Neurotoxicity Testing Data Call-in for more than 30 organophosphate insecticides.

Completed MBA course work and provided technical regulatory and business management support for agrochemical supplier and distributor contracts.

Presented oral and written public comments on EPA regulatory science and policy to the FIFRA Science Advisory Panel, Federal Advisory Committees, EPA Science Advisory Board, and at EPA technical briefings and workshops.

Represented pesticide and chemical industries, and provided presentations, at international symposiums for endocrine disruption, children's health, agrochemical cancer epidemiology and biomonitoring.

Project manager for development of multi-million-dollar FQPA risk assessment software, the Cumulative Aggregate Risk Evaluation System (CARES).

Participated in global pesticide product stewardship and safety audits. Met with international regulators to remediate product-specific human health and environmental safety concerns. Also authored the activity/conditions assessment checklist and criteria to audit U.S. and international formulation/manufacturing plants and product supply/distributor business partners.

Provided project management for global regulatory affairs, product safety and development, including FIFRA 6(A)(2) and international conventions such as FAO Code of Conduct, Prior Informed Consent (PIC), Persistent Organic Pollutants (POPs), and CODEX Alimentarius (FAO and WHO food standards).

Provided product-specific presentations and written communications to U.S. EPA and international government authorities in Australia, Canada, Latin America (Brazil, Costa Rica, Guatemala, and Mexico), EU countries, and throughout Asia (including Korea, North Vietnam, India, China, Pakistan, Philippines, Indonesia, and Thailand) that saved multi-million-dollar product registrations.

Provided project management, work plans, and timelines and negotiated intellectual property agreements for university and industrial partner research and development contracts that included discovery research and pharmaceutical uses of agrochemicals.

Managed strategic planning and implementation of agrochemical biotechnology and research and development discovery screening projects for natural products and synthetic chemicals.

Collaborated with laboratory and field biologists, toxicologists, metabolism and environmental scientists and business development staff to address field efficacy, toxicology, and

environmental safety issues and the economic viability of insecticide, fungicide, and herbicide development candidates.

Secured and managed major contracts to acquire large blocks of chemicals from universities, small companies, and major pharmaceutical and agrochemical companies to support automated high throughput screening laboratory.

Project manager for two \$3 million biotechnology discovery contracts evaluating spider venoms and fermentation broths. Directed research of multi-disciplinary teams of company and external scientists, which resulted in patentable new leads and genetically-engineered (baculovirus) product candidates.

Managed and prepared budgets for more than two dozen scientists, involved in all phases of agrochemical discovery research and product development, which included responsibility for external research programs and robotic high throughput screening, microbiology, NMR, HPLC analysis and chemical synthesis laboratories.

Experienced in the synthesis, isolation/structure elucidation and pharmaceutical and agrochemical screening of natural products derived from marine plants and animals (venoms) and microbial fermentation broths and plants (pharmacognosy).

### **Academic Appointments**

- Adjunct Chemistry Lecturer, Rutgers University Newark, NJ, 1974

### **Consulting and Advisory Appointments**

- International Society of Regulatory Toxicology and Pharmacology Board Councilor (Since 2005)
- ILSI International Biomonitoring Symposium (2004)
- International Life Sciences (ILSI) CARES Steering Committee (2004–2005)
- Children's Health Protection Advisory Committee (2001–2005)
- Harvard Center for Risk Analysis Advisory Committee (2002)
- American Crop Protection Association (now CropLife America) Biotechnology Steering Committee (1997)
- EPA Endocrine Disruption Screening and Testing Advisory Committee (1996–1998)

### **Peer Reviewer**

- Journal of Organic Chemistry
- International Society of Exposure Assessment
- Regulatory Toxicology and Pharmacology
- Synthesis

## **Professional Affiliations**

- American Chemical Society
- American College of Toxicology
- American Public Health Association (2004–2005)
- International Society of Regulatory Toxicology and Pharmacology
- CropLife America
- International Union of Pure and Applied Chemistry
- Phi Beta Kappa
- Sigma Xi
- Society of Risk Analysis
- Society of Toxicology
- Synthetic Organic Chemistry Manufacturers Association