

MARION L. BRODHAGEN, PH.D.

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Activities initiated since joining WWU in blue

EDUCATION AND TRAINING

- 2003 - Ph.D.** Molecular and Cellular Biology Program, Oregon State University
1998 - M.S. Botany and Plant Pathology Department, Oregon State University
1992 - B.S. (cum laude), Biology Department, University of Wisconsin - Oshkosh

PROFESSIONAL EXPERIENCE

- 2013 – present.** Associate Professor, Western Washington University, Bellingham, WA.
2011 –2013. Assistant Professor, Western Washington University, Bellingham, WA.
2010 – 2011. Research Microbiologist, USDA-ARS Forage Seed and Cereal Research Unit, Corvallis, OR.
2006 –2010. Assistant Professor, Western Washington University, Bellingham, WA.
2004 – 2006. Postdoctoral Fellow, Department of Plant Pathology, University of Wisconsin - Madison. Dr. N. P. Keller, mentor.
2003 – 2004. Postdoctoral Fellow, Department of Microbiology, University of Washington. Dr. E. W. Nester, mentor.
1998 – 2003. Graduate Research Associate, Molecular and Cellular Biology Program, OSU. Dr. J. E. Loper, advisor.
1995 – 1998. Graduate Research Associate, Botany and Plant Pathology Department, OSU. Dr. R. G. Kelsey and Dr. K. Lajtha, co-advisors.
1994 – 1998. Graduate Teaching Assistant, Botany and Plant Pathology Department, OSU.
1992 – 1994. Research Specialist, Horticulture Department, University of Wisconsin-Madison. Dr. D. D. Ellis, supervisor.

SELECTED FELLOWSHIPS, HONORS, AND AWARDS

- 2016.** Foundational Annual Scholarship, WWU, honored by recent graduate by a donation to the Senior Giving Campaign
2015. Academy Award, Teaching-Learning Academy, WWU, in recognition of contribution to reducing barriers to life-long learning across disciplines and communities.
2006. USDA-NRI Postdoctoral Fellowship, Biology of Plant-Microbe Associations program. (Declined offer to accept tenure-track position at WWU.)
2004 – 2006. Postdoctoral Traineeship, NIH National Research Service Award
2003 – 2004. Postdoctoral Fellowship, NIH National Research Service Award
2002. Scholarship to attend **Advances in Genome Technology and Bioinformatics** course at Marine Biological Laboratory, Woods Hole, MA
2001. Scholarship to attend **Protein Purification and Characterization** course at Cold Spring Harbor Laboratory, Cold Spring Harbor, NY
2000 – 2003. Graduate Research Fellowship, EPA Science to Achieve Results program

TEACHING

COURSES TAUGHT – WWU

BIOL 205, Intro. to Cellular and Molecular Biology
BIOL 324, Methods in Molecular Biology
BIOL 345, Fundamentals of Microbiology
BIOL 346, Microbiology Laboratory
BIOL 405/545, Microbial Ecology
BIOL 445/545P, Chemical Ecology
BIOL 497/597, Host-Microbe Interactions in Health and Disease
BIOL 395, 400, 494, 495, 498

MENTORING - WWU

Undergraduate students: I have mentored 40 undergraduate researchers, six interns, and numerous undergraduate TAs at WWU.

Graduate students: I am currently advising one master's student and co-advising two master's students. I served as co-advisor for a master's student who received her MS from Washington State University in December of 2012. I have served on the committee of six WWU graduate students.

AWARDS TO RESEARCH STUDENTS

2015. WWU Research and Creative Opportunities for Undergraduates grant: \$250 (J. Levy)
2015. WWU Biology Chair Research Award: \$200 (A. Batson)
2014. WWU Research and Creative Opportunities for Undergraduates grant: \$494 (A. Batson)
2013. WWU Research and Creative Opportunities for Undergraduates grant: \$353 (M. Harris)
2013. WWU Advanced Materials Science and Engineering Center: \$4500 (M. Harris and K. Healy; co-mentored by Mark Peyron, Chemistry)
2013. WWU Research and Creative Opportunities for Undergraduates grant: \$350 (K. Kinloch)
2013. WWU Research and Creative Opportunities for Undergraduates grant: \$350 (M. McSharry)
2013. WWU Research and Creative Opportunities for Undergraduates grant: \$350 (J. McCollum)
2013. WWU Biology Chair Research Award: \$200 (M. McSharry)
2008 – 2009. American Phytopathological Society Frank L. Howard Undergraduate Fellowship Award: \$1,000. One of **two awards nationwide** was given to R. Blumhagen for her research project.
2008 – 2009. American Society for Microbiology Undergraduate Research Fellowship: \$2,500. One of **~30 awards nationwide** was given to R. Blumhagen for her research project.
2007 – 2008. American Society for Microbiology Undergraduate Research Fellowship: \$5,000. One of **34 awards nationwide** to K. Fowler for his research project.
2007 – 2008. WWU Foundation Program in Support of Undergraduate Research and Scholarship Excellence: \$1,000 (K. Fowler) and \$2,000 (self).

SCHOLARSHIP

RESEARCH GRANTS, INTERNAL

- 2016. Fraser Endowment Fund award:** \$3,000. “Effect of volatile plant metabolites on *Aspergillus*”
- 2016. Co-PI with Ben Miner. WWU Research and Sponsored Programs Pilot Project Award:** \$4,000. Testing alternative hypotheses for the cause of sea star wasting disease
- 2015. Fraser Endowment Fund award:** \$7,000. “Effect of volatile plant metabolites on *Aspergillus*”
- 2014. Co-PI with Dr. Tommaso Vannelli. WWU Research and Sponsored Programs Pilot Project Award:** \$3992. “Pyoverdine as a Trojan Horse: ironing out antimicrobial photodynamic therapy”
- 2013. Co-PI with Dr. Mark Peyron. WWU AMSEC Seed Grant for Interdisciplinary Research in Materials Science:** \$4500. “Mycotoxin production during fungal breakdown of pure biodegradable plastic polymers” Supported two undergraduate summer research students, and supplies.
- 2011 – 2012. WWU Research and Sponsored Programs Pilot Project Award:** \$4,000. “Characterization of aflatoxin-inhibiting plant natural products”
- 2007 – 2008. WWU Research and Sponsored Programs Project Development Award:** \$43,904. “Development of rapid, affordable aflatoxin screening”
- 2007 – 2008. WWU Foundation’s Mentoring Undergraduates grant:** \$4,000. Program in Support of Undergraduate Research and Scholarship Excellence.

RESEARCH GRANTS, EXTERNAL

- 2014-2016. Washington Research Foundation:** \$25,857. “Predictive aflatoxin testing via loop-mediated isothermal amplification”
- 2009 – 2012. Co-PI. USDA Specialty Crops Research Initiative (SCRI) Standard Research and Extension Projects grant:** \$1,999,002 (\$57,566 to Brodhagen/WWU). “Biodegradable Mulches for Specialty Crops Produced Under Protective Covers”
- 2008 – 2009. Co-PI. USDA SCRI planning grant:** \$100,000 (\$9,808 to Brodhagen/WWU). “Project Planning for Specialty Crop Covers that Use Degradable Materials”
- 2007 – 2009. USDA-NRI AREA Award:** \$100,000. “A tool to characterize fungal receptors of plant signals that affect mycotoxin production during *Aspergillus*/seed interactions”
- 2007. Co-PI. NSF Major Research Instrumentation Award:** \$208,067. “MRI: Acquisition of instrumentation supporting quantitative spectral and image analysis”
- 2007-2010. NSF (unpaid collaborator):** \$738,577. Funded summer internship for WWU student R. Blumhagen. Sequencing and comparative analysis of seven *Pseudomonas* spp.

PEER-REVIEWED PUBLICATIONS

WWU undergraduate authors underlined

¹*Joint first authorship*

- 2015. Brodhagen, M., Peyron, M., Miles, C., and Inglis, D.A.** Biodegradable plastic agricultural mulches and key features of microbial degradation. *Applied Microbiology and Biotechnology* **99**(3): 1039-1056. DOI 10.1007/s00253-014-6267-5
- 2014. Moore-Kucera, J., Cox, S.B., Peyron, M., Bailes, G., Kinloch, K., Karich, K., Miles, C., Inglis, D.A., and Brodhagen, M.** Native soil fungi associated with compostable plastics in three contrasting agricultural settings. *Applied Microbiology and Biotechnology* **98**(14): 6467-6485. DOI: 10.1007/s00253-014-5711-x

2014. Li, C.H., Moore-Kucera, J., Lee, J., Corbin, A., **Brodhagen, M.**, Miles, C., and Inglis, D. Effects of Biodegradable Mulch on Soil Quality. *Applied Soil Ecology* **79**: 59-69.
2013. Bailes, G¹., Lind, M¹., Ely, A¹., Powell, M¹., Moore-Kucera, J., Miles, C., Inglis, D., and **M. Brodhagen**. Isolation of native soil microorganisms with potential for breaking down biodegradable plastic films used in agriculture. *Journal of Visualized Experiments*, <http://www.jove.com/video/50373>
2012. Affeldt, K.J., **Brodhagen, M.**, and Keller, N.P. *Aspergillus* oxylipin signaling and quorum sensing pathways depend on G protein-coupled receptors. *Toxins* **4**(9): 695-717. *Invited for special issue: Mycotoxins in Food and Feed*, http://www.mdpi.com/journal/toxins/special_issues/mycotoxins-food/
2009. Gao, X¹., **Brodhagen, M¹**., Isakeit, T., Horowitz Brown, S., Göbel, C., Betran, J., Feussner, I., Keller, N.P., and Kolomiets, M. Inactivation of the lipoxygenase *ZmLOX3* increases susceptibility of maize to *Aspergillus* spp. *Molecular Plant-Microbe Interactions* **22**(2): 222-231.
2007. **Brodhagen, M¹**., Tsitsigiannis, D.I¹., Hornung, E., Goebel, C., Feussner, I., and N.P. Keller. Reciprocal oxylipin-mediated cross-talk in the *Aspergillus* - seed pathosystem. *Molecular Microbiology* **67**(2): 378–391.
2006. **Brodhagen, M.**, and N.P. Keller. Signaling pathways connecting mycotoxin production and sporulation. *Molecular Plant Pathology*, **7**(4): 285-301.
2005. **Brodhagen, M.**, Paulsen, I., and Loper, J.E. Reciprocal regulation of pyoluteorin production with membrane transporter gene expression in *Pseudomonas fluorescens* Pf-5. *Applied and Environmental Microbiology* **71**(11): 6900-6909.
2004. **Brodhagen, M.**, Henkels, M. and Loper, J.E. Positive autoregulation and signaling properties of pyoluteorin, an antibiotic produced by the biological control organism *Pseudomonas fluorescens* Pf-5. *Applied and Environmental Microbiology* **70**(3): 1758-1766.
2001. Loper, J.E., Whistler, C.A., Henkels, M.D., Stockwell, V.O., **Brodhagen, M.**, and N. Chaney. Molecular approaches for elucidating the *in situ* activities of bacterial biological control agents. *In*: S.H. De Boer (ed.). *Plant Pathogenic Bacteria*. Kluwer Academic Publishers. The Netherlands. pp. 56-59.
1996. Ellis, D., Zeldin, E., **Brodhagen, M.**, Russin, W., and B. McCown. Taxol production induced in *Taxus* spp. nodule cultures. *Journal of Natural Products* **59**(3): 246-250.
1995. Russin, W., Ellis, D., Gottwald, J., Zeldin, E., **Brodhagen, M.**, and R. Evert. Immunocytochemical localization of taxol in *Taxus cuspidata*. *International Journal of Plant Science* **156**(5): 668-678.
1993. Ellis, D., Zeldin, E., Russin, W., **Brodhagen, M.**, and B. McCown. Immunological localization and taxane production in shoot cultures of *Taxus* spp. *In*: Proceedings of the International Yew Resources Conference.

BOOK CHAPTERS AND OTHER PUBLICATIONS

2013. Miles, C., **Brodhagen, M.**, Hayes, D., Inglis, D., and Wszelaki, A. Comments to the USDA regarding AMS-NOP-13-011; NOP-13-01PR; RIN 0581-AD32; Section 205.2 and 205.601 NOP Proposed Amendments to the National List of Allowed and Prohibited Substances (Crops and Processing)
2011. Miles, C., Hayes, D., **Brodhagen, M.**, Lee, J., Wszelaki, A., Moore-Kucera, J., Wallace, R., Marsh, T., and D. Inglis. Plastic mulches, biodegradeable alternatives, China and US *In*: Steenbergen, F. van, Tuinhof A., and L. Knoop (eds.) *Transforming Landscapes, Transforming Lives: The Business of Sustainable Water Buffer Management*. Wageningen, The Netherlands: 3R Water Secretariat

INVITED TALKS

WWU undergraduate students underlined.

- 2015. Brodhagen, M. and Peyron, P. (co-presenters)** Biodegradable mulch films in agriculture as a potential source of terrestrial microplastic. 17th International Symposium on Toxicity Assessment, Bellingham, WA
- 2013. Brodhagen, M.** Native soil fungi associated with compostable plastics. American Society for Microbiology Northwest Division meeting, Seattle, WA.
- 2013. Brodhagen, M.** The (chemical) language of plants: the sequel. October monthly meeting, Master Gardeners Association of British Columbia, Vancouver, BC, Canada.
- 2013. Brodhagen, M.** The (chemical) language of plants. Spring Seminar, Master Gardeners Association of British Columbia, Burnaby, BC, Canada.
- 2013. Brodhagen, M.** Tainted food: the story of aflatoxin. Science and the UniverCity community science lecture series, College of Science and Technology, Western Washington University. City Hall, Bellingham, WA.
- 2012. Brodhagen, M.** Espionage and counter-intelligence in *Aspergillus* and aflatoxin. American Society for Microbiology Northwest Division meeting, Seattle, WA.
- 2012. Brodhagen, M.** The chemical language of plants. Whatcom County 18th Annual Master Gardener Advanced Training, Bellingham, WA.
- 2011. Brodhagen, M.** *Aspergillus*, aflatoxins, and oxylipins: adventures of a cereal killer. Guest lecture in graduate course "Plant-Microbe Interactions, College of Forest Resources, University of Washington, Seattle, WA.
- 2011. Brodhagen, M.** *Aspergillus*, aflatoxins, and oxylipins: adventures of a cereal killer. Biology Department, University of Puget Sound, Tacoma, WA.
- 2011. Brodhagen, M.** *Aspergillus*, aflatoxin, and oxylipins. Invited seminar, Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR.
- 2010. Brodhagen, M.** *Aspergillus*, aflatoxins, and oxylipins. American Society for Microbiology Northwest Division meeting, Seattle, WA.
- 2010. Brodhagen, M.** Host-pathogen crosstalk: *Aspergillus*, aflatoxin, and oxylipins. Invited seminar, Texas A&M University, Department of Plant Pathology, College Station, TX.
- 2008. K. Fowler, C. Lappala, N. P. Keller, and M. L. Brodhagen.** Characterization of Oxylipin Perception in *Aspergillus flavus*. American Society for Microbiology 108th General Meeting, June 1-4, Boston, MA. (*Invited student talk*)
- 2007. Brodhagen, M.** Oxylipins act as signaling molecules and mediate the *Aspergillus*-seed dialogue. 2007 NCCC-173 meeting: "Genetics and Biochemistry of Plant-Fungal Interactions," Friday Harbor, WA.
- 2007. Brodhagen, M.** Oxylipin signals mediate cross talk in the *Aspergillus*-seed pathosystem. Department of Plant Pathology, Washington State University.
- 2007. Brodhagen, M. and N.P. Keller.** Oxylipin signals mediate cross talk in the *Aspergillus*-seed pathosystem. 107th General Meeting of the American Society for Microbiology, Toronto, Ontario
- 2005. Brodhagen, M., Tsitsigiannis, D., and N.P. Keller.** Eavesdropping on the conversation: *Aspergillus*-seed cross talk mediated by oxylipins. American Phytopathological Society Annual Meeting, Austin, Texas.
- 2004. Brodhagen, M., Tsitsigiannis, D., and N.P. Keller.** Role of dioxygenases in fungal sporulation. 2nd International Symposium on Fusarium Head Blight, Orlando, FL.

CONFERENCE PROCEEDINGS

WWU students underlined.

- 2016. Brodhagen, M.,** Young, J.C., Kelsey, R., Batson, A., Levy, J., McCollum, J., and Kinash, B. Volatile signals from non-host plants deter growth and aflatoxin production by the fungus *Aspergillus*. XVII International Congress for Molecular Plant-Microbe Interactions, Portland, OR.
- 2015. Brodhagen, M.,** DeSitter, T., Batson, A., Levy, J., Cranny, Z., Lahman, M., and J.C. Young. Phenylalanine ammonia lyase pathway components contribute to resistance of *Arabidopsis thaliana* seeds to *Aspergillus* infection. 2015 American Society for Phytopathology Annual Meeting, Pasadena, CA.
- 2014. Brodhagen, M.** Native soil fungi associated with compostable plastics. American Society for Microbiology Annual Meeting, Boston, MA.
- 2012.** Peterson, E., Kelsey, R., Shaw, D., Manter, D., and **M. Brodhagen.** Moisturin and plant extracts reduce infection and sporulation of *Phytophthora ramorum* on rhododendron. 2012 Western International Forest Disease Work Conference, Tahoe City, CA.
- 2012.** Schmitt, K.J., **Brodhagen, M.,** and N.P. Keller. An *Aspergillus nidulans* GPCR, GprD, responds to oxylipin signals. Keystone Symposia meeting on Fungal Pathogens: From Basic Biology to Drug Discovery, Santa Fe, NM.
- 2011.** Moore-Kucera, J., Davinic, M., Fultz, L., Lee, J., Miles, C.A., **Brodhagen, M.,** Cowan, J., Wallace, R.W., Wszelaki, A., Martin, J., Roozen, J., Gundersen B., and D.A. Inglis. Biodegradable Mulches: Short-term degradability and impacts on soil health. HortScience 46(10):S68.
- 2010.** Griffith, S.M., Whittaker, G.W., Mueller-Warrant, G.W., Banowetz, G.M., and **M. Brodhagen.** An integrated landscape approach to resolving land management decisions. The Fourth Interagency Conference on Research in the Watersheds, Fairbanks, AK.
- 2010.** Inglis, D., Miles, C., Belasco, E., **Brodhagen, M.,** Corbin, A., Espinola-Arredondo, A., Hayes, D., Jones, R., Lee, R., Leonas, K., Liu, H., Marsh, T., Moore-Kucera, K., Wadsworth, L., Wallace, R., Walters, T., and A. Wszelaki. Biodegradable mulches for specialty crops produced under protective covers. HortScience 45(8):S208-S209.
- 2009.** Stevenson M.J., Mosher M.J., Schanfield M.S., and **Brodhagen M.** The evolutionary ecology of seed and nut allergies. American Journal of Human Biology 21(2): 270.
- 2009.** Miles, C., Beus, C., Corbin, A., Wallace, R., Wszelaki, A., Saez, H., Walters, T., Leonas, K., **Brodhagen, M.,** Hayes, D. and D. Inglis. Research and extension priorities to ensure adaptation of high tunnels and biodegradable plastic mulch in the U.S. Proc. Agric. Plastics Congress, College Station, PA.
- 2007.** Kolomiets, M., Gao, X., Christensen, S., Park, Y.-S., Isakeit, T., Betran, J., Mayfield, K., Shim, W.-B., Engelberth, J., Göbel, C., **Brodhagen, M.,** Feussner, I., and N.P. Keller. Maize lipoxygenases govern production of conidia and mycotoxins by *Aspergillus flavus* and *Fusarium verticillioides*. Multi Crop Aflatoxin/Fumonisin Elimination and Fungal Genomics Workshop, Atlanta, GA.
- 2007.** Tsitsigiannis, D.I., **Brodhagen, M.,** and N.P. Keller. Oxylipins act as signaling molecules and mediate the *Aspergillus*-seed dialogue. XIII International Congress for Molecular Plant-Microbe Interactions, Sorrento, Italy.
- 2006.** Gao, X., Isakeit, T., Betrán, J., Ni, X., Starr, J., Göbel, C., **Brodhagen, M.,** Feussner, I., Keller, N., Engelberth, J., Tumlinson, J., and M. Kolomiets. A maize 9-lipoxygenase is required for resistance to aflatoxin contamination, insects, and nematodes. 6th Annual Fungal Genomics Workshop; 7th Annual Fumonisin Elimination Workshop, and 19th Annual Aflatoxin Elimination Workshop. Fort Worth, TX.
- 2003. Brodhagen, M.,** Henkels, M.D., and J.E. Loper. Regulation of the antibiotic pyoluteorin in *Pseudomonas fluorescens* Pf-5 includes positive autoregulation, and repression by 2,4-diacetylphloroglucinol and pyrrolnitrin. American Phytopathological Society Annual Meeting, Charlotte, NC.

- 2002.** Press, C., Adair, N., **Brodhagen, M.**, and J.E. Loper. Comparison of gene expression profiles in the *Pseudomonas fluorescens* antibiotic biosynthetic region using an oligonucleotide macroarray. Oregon State University Center for Gene Research and Biotechnology Annual Fall Retreat, Corvallis, OR.
- 2001.** **Brodhagen, M.**, and J.E. Loper. Positive autoregulation of pyoluteorin production by *Pseudomonas fluorescens* Pf-5. *In: Abstracts of the Pseudomonas Meeting*, Brussels, Belgium, p. PS18.
- 2000.** **Brodhagen, M.**, Chaney, N., Taormina, C., and J.E. Loper. Pyoluteorin Production by *Pseudomonas fluorescens* Pf-5 Requires PltH, a TetR/AcrR Homolog Linked to the Antibiotic Biosynthetic Gene Cluster. Annual Meeting of the American Society for Microbiology, Los Angeles, CA.

PROFESSIONAL AFFILIATIONS

- 2015-present.** Member of the International Society for Molecular Plant-Microbe Interactions.
- 2012-present.** Invited member of Advanced Materials Science and Engineering Center (AMSEC), WWU
- 1998-present.** Member of the American Society for Microbiology
- 1998-present.** Member of the American Phytopathological Society
- 1994-present.** Member of the American Association for the Advancement of Science

SERVICE

DEPARTMENTAL (BIOLOGY DEPT., WWU)

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|-----------------------|---|
| 2016 | Search Committee, Molecular Evolutionary Biologist/Ecologist |
| 2016 | Search Committee, Biology Instructional Lab Technician |
| 2016 | Search Committee, Limited Term Faculty search |
| 2015-present | Mentoring committee (Suzanne Lee) |
| 2014-present | Mentoring committee (Lina Dahlberg) |
| 2014-present | Chair, Limited Term Lecturers committee |
| 2014-present | Core Competencies Committee |
| 2014-present | Assessment committee |
| 2013-present | Biology club co-advisor |
| 2007 – present | Curriculum committee (except for 2010-12) |
| 2006-present | Seminar host (12 speakers) |
| 2014-2015 | Research Associate Review committee |
| 2013 | Search committee, Office assistant |
| 2011-2014 | Limited Term Lecturers committee |
| 2011-2014 | Scholarship committee |
| 2008 | Search committee, Cell/Molecular Biologist |
| 2007 | Search committee, Biology Technician WWU |
| 2006-2013 | Seminar committee |
| 2006-2010 | Library committee |

COLLEGE and UNIVERSITY

- 2015 – present** **Scientific Technology Services Strategic Planning committee. CSE, WWU.**
- 2014 – present** **Committee for Undergraduate Education, WWU.**

2008-present **Scholars Week Committee, WWU**
2015-present **Kaiser-Borsari Scholarship Selection Committee, AMSEC, WWU.**
2013 - 2015 **Transitions Advisor, WWU.**
2008-2010 **Ad hoc Chemistry/Biology committee** to improve shared curricula for Biochemistry, Cellular Biology, and Cellular and Molecular Biology majors.
2006-2007 **Faculty Fellow (Center for Service Learning), WWU**
1998-2002 **Convocations and Lectures Committee, OSU.**

PROFESSIONAL

Peer review: Peer reviewer for 19 articles from eleven journals.
Peer reviewer for cell biology textbook (Essential Cell Biology, 4th Ed., Alberts et al., 2014. Garland Science.)
Peer reviewer for microbiology textbook (Microbiology: An evolving science, 2nd Ed., Slonczewski, JL and Foster, JW. WW Norton and Company, Inc. New York.)

External reviews: Peer reviewer for two senior colleagues in my discipline – one for a lifetime achievement award and one for promotion.

Peer reviewer for the 2015 New Zealand Ministry of Business, Innovation and Employment Investment Round.

Other:

2015 **Consultant** to the PSL Crops Working Group, Canadian Organic Standards, on policies for the use of biodegradable mulches in organic agriculture

2013 **Co-author**, recommendation to the USDA National Organic Program regarding the use of biodegradable mulches in organic agriculture.

2012-2017 **Consultant** for a 5-year US Department of Agriculture CRIS project

2003-2006 **Bacteriology Committee**, American Phytopathological Society