BIOGRAPHICAL SKETCH

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NAME: Beronda L. Montgomery

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POSITION TITLE: MSU Foundation Professor of Biochemistry & Molecular Biology and Microbiology & Molecular Genetics

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Washington University in St. Louis	A.B.	1994	Biology
University of Central Arkansas	M.S.	1996	Biology
University of California, Davis	Ph.D.	2001	Plant Biology
Indiana University	Postdoctoral	2001-2004	Microbiology

A. Personal Statement

Dr. Beronda Montgomery completed doctoral studies at the University of California, Davis and was a National Science Foundation (NSF) funded postdoctoral fellow at Indiana University. She is an MSU Foundation Professor in the Departments of Biochemistry & Molecular Biology and Microbiology & Molecular Genetics at Michigan State University. Dr. Montgomery's laboratory investigates the mechanisms by which organisms such as plants and cyanobacteria which have limited mobility are able to monitor and adjust to changes in their external environment. The ability of these largely immobile organisms to adapt their patterns of growth and development to fluctuations in external environmental parameters increases their survival and maximizes their growth and productivity. In addition to her core research and teaching efforts, Dr. Montgomery is actively involved in efforts to promote the inclusion and success of individuals from groups underrepresented in the sciences. In addition to the hands-on training of undergraduates, graduate students and postdoctoral scholars, broader goals of Montgomery's research have been to incorporate instructional and training methods that enhance students' critical thinking skills, scientific literacy, technical proficiency, and professional development (e.g., Montgomery, BL, 2011, Bioscience Educ.) and to promote the success of individuals from groups underrepresented in STEM. During her tenure at Michigan State University (MSU), Dr. Montgomery has trained 7 Ph.D. students, 3 M.S./Diploma students, and served on the guidance committees of 45 graduate students. Dr. Montgomery's variety of science education and mentoring efforts are aimed at supporting the comprehensive development of students as experimentalists, scientific thinkers and future independent scientists. As a part of her efforts to promote research excellence and sustained mentoring of scientists, particularly those individuals from groups underrepresented in academe, Dr. Montgomery chaired the steering committee of a NSF-funded mentoring effort with the American Society of Microbiology and currently serves as a national mentor training specialist and consultant on issues related to mentoring diverse graduate students, postdoctoral scientists and faculty. Dr. Montgomery also conducts scholarly inquiry into effective mentoring practices for supporting students from diverse backgrounds.

B. Positions and Honors

Positions and Employment

1994-1996 Research Assistant, Biology, University of Central Arkansas
1996-2001 Research Assistant, Molecular and Cellular Biology, College of Biological Sciences, University of California, Davis

2001-2004 Research Associate, Biology, Arts and Sciences, Indiana University, Bloomington
2004-2010 Assistant Professor, Plant Research Laboratory and Department of Biochemistry and Molecular Biology, College of Natural Science, Michigan State University
2010-2015 Associate Professor, Plant Research Laboratory and Department of Biochemistry and Molecular Biology, College of Natural Science, Michigan State University
2015-2016 Professor, Plant Research Laboratory and Department of Biochemistry and Molecular Biology, College of Natural Science, Michigan State University
(since 2016 jointly appointed with Department of Microbiology and Molecular Genetics)
2016-present MSU Foundation Professor, Plant Research Laboratory/Department of Biochemistry and Molecular Biology/Department of Microbiology and Molecular Genetics, College of Natural Science, Michigan State University
2016-present Assistant Provost for Faculty Development – Research, Academic Advancement Network, Office of the Provost, Michigan State University

Other Experience and Professional Memberships

1996-present Member, American Society of Plant Biologists
2002-present Member, American Society for Microbiology
2002-present Elected Member, Sigma Xi, The Scientific Research Society
2006-present National Science Foundation (NSF), *ad hoc* reviewer and panelist
2007-2016 Member, Committee on Minority Education, Education Board, American Society for Microbiology (Chair, Robert D. Watkins Graduate Research Fellowship Program and Professional Development Programs)
2009-present Member, Minority Affairs Committee, American Society of Plant Biologists
2010 Member, Committee of Visitors for the Plant Genome Research Division, NSF
2013-present Member, American Society for Biochemistry and Molecular Biology
2013-present Reviewing Editor, Journal of Biological Chemistry

Honors

1996-2001 Plant Cell Biology Training Grant Fellowship, Plant Biology, University of California, Davis, Sponsored by National Science Foundation (NSF)
2000-2001 Ford Foundation Dissertation Fellowship, Plant Biology, University of California, Davis, Sponsored by National Research Council (NRC) - USA
2001 Individual National Research Service Award, NIH Postdoctoral Fellowship, Indiana University Bloomington, Declined, Sponsored by National Institutes of Health (NIH)
2001-2004 Postdoctoral Fellowship, Microbial Biology, Indiana University Bloomington, Sponsored by NSF
2002 Elected, Member of Sigma Xi
2007 CAREER Award, Michigan State University, Sponsored by NSF
2012 Featured Scientist, “Inspired Minds: African Americans in Science and Technology” Exhibition, Charles H. Wright Museum of African American History, Detroit, MI
2014 Finalist, Howard Hughes Medical Institute (HHMI) Professors Competition
2014-2015 Fellow, Committee on Institutional Cooperation Academic Leadership Program
2015 Nominee, Michigan State University Nominee, Council for Advancement and Support of Education (CASE) U.S. Professor of the Year Award
2016 Appointed, Michigan State University Foundation Professor
2017-2019 Appointed, American Society for Microbiology Distinguished Lecturer
2018 Elected Member, American Academy for Microbiology

C. Contribution to Science

1. In studies aimed at understanding resource allocation and regulation of dynamic molecular processes used by photosynthetic organisms to adapt to changes in the external environment, my group investigates the photoregulation of pigmentation, photosynthetic efficiency, photoprotection and growth/development in the model plant *Arabidopsis* and the cyanobacterium *Fremyella diplosiphon*. These processes are controlled by phytochrome-family photosensors in plants and cyanobacteria. In *F. diplosiphon* which modifies its light-harvesting complexes and morphology due to changes in the prevalent wavelengths of light and nutrient availability, we showed that phytochrome-related photoreceptor RcaE plays a central role in the light-dependent genetic and cell biology responses. Apart

from its prior recognized role in regulating pigmentation, we linked RcaE to distinct aspects of photoregulation of morphology that had been known for ~ 50 years. We recently provided evidence that RcaE regulates the expression of bacterial morphogenes, including bacterial actin MreB and regulator BolA, contributing significantly to understanding the molecular basis of this process in *F. diplosiphon* and more broadly to the emerging field of cell shape determination in prokaryotes. Additionally, RcaE controls responses to nutrient availability, particularly iron availability that is linked to organismal adaptation and fine-tuning of fitness and productivity.

a. Bordowitz, JR, Montgomery, BL (2008). Photoregulation of Cellular Morphology during Complementary Chromatic Adaptation Requires Sensor-Kinase-Class Protein RcaE in *Fremyella diplosiphon*, Journal of Bacteriology, 190: 4069–4074. PMCID: PMC2395048
b. Singh SP, Montgomery, BL (2014). Morphogenes *bolA* and *mreB* Mediate the Photoregulation of Cellular Morphology During Complementary Chromatic Acclimation in *Fremyella diplosiphon*, Molecular Microbiology, 93(1): 167–182.
c. Pattanaik, B, Busch, AUW, Hu, P, Chen, J, Montgomery, BL (2014). Responses to Iron Limitation are Impacted by Light Quality and Regulated by RcaE in the Chromatically Acclimating Cyanobacterium *Fremyella diplosiphon*. Microbiology, 160(5): 992–1005. (Featured-Editor's Choice)
d. Busch, AUW, WareJoncas, Z, Montgomery, BL (2017). Tryptophan-Rich Sensory Protein/Translocator Protein (TSPO) from Cyanobacterium *Fremyella diplosiphon* Binds a Broad Range of Functionally Relevant Tetrapyrroles. Biochemistry, 56(1): 73-84.
e. Rohnke, BA, Singh, SP, Pattanaik, B, Montgomery, BL (2018). RcaE-Dependent Regulation of Carboxysome Structural Proteins has a Central Role in Environmental Determination of Carboxysome Morphology and Abundance in *Fremyella diplosiphon*. mSphere, 3(1): e00617-17

2. We recently began analyses of photoadaptive responses in *F. diplosiphon* and other cyanobacteria under fluctuating light conditions. We initiated studies to assess the responses of cells to dynamic light conditions. In these studies, we identified a role for the regulation of cellular responses to oxidative stress and the induction of photoprotective mechanisms, including induction of Orange Carotenoid Protein (OCP) accumulation. Additionally, we identified complex regulation of metabolic modules, including carbon concentration mechanism, photorespiration and photomorphogenesis.
   a. Singh, SP, Miller, HL, Montgomery, BL (2013). Temporal Dynamics of Changes in Reactive Oxygen Species (ROS) Levels and Cellular Morphology are Coordinated During Complementary Chromatic Acclimation in *Fremyella diplosiphon*. Photosynthesis Research, 118(1-2): 95–104.
   b. Agostoni, M, Lucker, BF, Smith, MAY, Kanazawa, A, Blanchard, GJ, Kramer, DM, Montgomery, BL (2016). Competition-Based Phenotyping Reveals a Fitness Cost for Maintaining Phycobilisomes Under Fluctuating Light in the cyanobacterium *Fremyella diplosiphon*. Algal Research, 15: 110–119.
   c. Montgomery, BL, Lechno-Yossef, S, Kerfeld, CA (2016). Interrelated Modules in Cyanobacterial Photosynthesis: The Carbon Concentrating Mechanism, Photorespiration and Light Perception, Journal of Experimental Botany, 67(10): 2931–2940.
   d. Montgomery, BL (2016). Mechanisms and Fitness Implications of Photomorphogenesis during Chromatic Acclimation in Cyanobacteria. Journal of Experimental Botany, 67(14):4079-4090.
   e. Bao, H, Melnicki, MR, Pawlowski, EG, Sutter, M, Agostoni, M, Lechno-Yossef, S, Cai, F, Montgomery, BL, Kerfeld, CA (2017). Additional Families of Orange Carotenoid Proteins in the Photoprotective System of Cyanobacteria. Nature Plants 3: 17089. [cover article]

3. We have also uncovered photoregulation of the second messenger c-di-GMP as important for photoadaptive responses in *F. diplosiphon* and other cyanobacteria. Cylic di-GMP is a second messenger well known for regulating responses in pathogenic bacteria, but has only recently been investigated in photosynthetic bacteria, including cyanobacteria. We reported the first successful quantification of *in vivo* levels of c-di-GMP in cyanobacteria. We have also begun to elucidate the function of this molecule, and additional dinucleotide second messengers, in cyanobacterial strains and engineer strains in which we regulate the levels in vivo to allow control of physiological responses including cell deposition and/or floating that have implications for the use of these engineered strains in biotechnological and bioproduction applications. These studies are providing significant insight into the role of this second messenger, as well as additional second messengers that we are investigating, in regulating life styles and evolution of cyanobacterial strains and providing tools for use in biotechnological or optogenetic applications.

a. Agostoni, M, Koestler, BJ, Waters, CM, Williams, BL, Montgomery, BL (2013). The Occurrence of Cyclic di-GMP Modulating Output Domains in Cyanobacteria: An Illuminating Perspective. mBio, 4(4): e00451-13 PMCID: PMC3747582
b. Montgomery, BL (2014). The Regulation of Light Sensing and Light Harvesting Impacts the Use of Cyanobacteria as Biotechnology Platforms. Frontiers in Bioengineering and Biotechnology 2:22. doi: 10.3389/fbioe.2014.00022. PMCID: PMC4090899
c. Agostoni, M, Waters, CM, Montgomery, BL (2016). Regulation of Biofilm Formation and Cellular Buoyancy Through Modulating Intracellular Cyclic di-GMP Levels in Engineered Cyanobacteria. Biotechnology and Bioengineering, 113: 311–319.
d. Agostoni, M, Logan-Jackson, AR, Heinz, ER, Bruger, E, Waters, CM, Montgomery, BL (2018). Homeostasis of Second Messenger Cyclic-di-AMP is Critical for Cyanobacterial Fitness and Acclimation to Abiotic Stress. Frontiers in Microbiology 9: 1121.

4. In related studies in plants, we pioneered studies of the spatiotemporal regulation of plant photoresponses using an innovative biochemical approach for removing functional phytochrome photoreceptors in specific cells or tissues by targeted transgenic expression of a gene encoding a phytochrome chromophore-degrading enzyme biliverdin IXα reductase (BVR). Although the physiological bases of spatial specific light responses have been long identified, means for assessing the underlying molecular genetic mechanisms for such responses have required new tools, including the tissue-specific regulation of phytochrome accumulation that my lab pioneered. This approach allows local control of phytochrome levels that cannot be achieved easily using classic mutant analyses or RNAi approaches. These studies yielded a methodological breakthrough for studying spatiotemporal phytochrome responses in plants that led to insights into tissue-specific and organ-interactive phytochrome functions and are facilitating the unraveling of underlying signaling pathways responsible for distinct photoregulation of growth and developmental responses.
   a. Warnasooriya, SN, Montgomery, BL (2009). Detection of Spatial-Specific Phytochrome Responses using Targeted Expression of Biliverdin Reductase in *Arabidopsis thaliana*, Plant Physiology 149: 424–433. PMCID: PMC2613748
   b. Costigan, SE*, Warnasooriya, SN*, Humphries, BA, Montgomery, BL (2011). Root-Localized Phytochrome Chromophore Synthesis is Required for Photoregulation of Root Elongation and Impacts Root Sensitivity to Jasmonic Acid in *Arabidopsis thaliana*, Plant Physiology, 157(3): 1138–1150. (*authors contributed equally) PMCID: PMC3252167
   c. Oh, S*, Warnasooriya, SN*, Montgomery, BL (2013) Downstream Effectors of Light- and Phytochrome-Dependent Regulation of Hypocotyl Elongation in *Arabidopsis thaliana*. Plant Molecular Biology, 81(6): 627–640. (*authors contributed equally) PMCID: PMC3597320
   d. Oh, S, Strand, DD, Kramer, DM, Chen, J, Montgomery, BL (2018). Transcriptome and Phenotyping Analyses Support a Role for Chloroplast Sigma Factor 2 in Red-Light-Dependent Regulation of Growth, Stress, and Photosynthesis. Plant Direct Journal 2(2): e00043-1– e00043-17.
   e. Oh, S, Strand, DD, Kramer, DM, Chen, J, Montgomery, BL (2018). Transcriptome and Phenotyping Analyses Support a Role for Chloroplast Sigma Factor 2 in Red-Light-Dependent Regulation of Growth, Stress, and Photosynthesis. Plant Direct Journal 2(2): e00043-1– e00043-17.

5. I am actively involved in efforts to promote the inclusion and success of individuals from groups underrepresented in the sciences, including scholarly investigations into effective approaches for mentoring and the practical training of individuals as mentors.
   a. Montgomery, BL, Dodson, JE, Johnson, SM (2014). Guiding the Way: Mentoring Graduate Students and Junior Faculty for Sustainable Academic Careers. SAGE Open 4(4): doi:10.1177/2158244014558043.
   b. Whittaker, JA, Montgomery, BL (2014). Cultivating Institutional Transformation and Sustainable STEM Diversity in Higher Education through Integrative Faculty Development. Innovative Higher Education, 39(4): 263–275.
   c. Whittaker, JA, Montgomery, BL, Martinez Acosta, VG (2015). Retention of Underrepresented Minority Faculty: Strategic Initiatives for Institutional Value Proposition Based on Perspectives from a Range of Academic Institutions. The Journal of Undergraduate Neuroscience Education, 13(3): A136-A145.

d. Montgomery, BL (2017). Mapping a Mentoring Roadmap and Developing a Supportive Network for Strategic Career Advancement. SAGE Open 7(2): doi:10.1177/2158244017710288.
e. Montgomery, BL (2018). From Deficits to Possibilities: Mentoring Lessons from Plants on Cultivating Individual Growth through Environmental Assessment and Optimization. Public Philosophy Journal 1(1): doi:10.25335/M5/PPJ.1.1

D. Research Support

Ongoing Research Support

DE–FG02–91ER20021 C. Benning (PI) 04/01/17-3/31/20 United States Department of Energy (DOE)
Photosynthetic Energy Capture, Conversion and Storage: From Fundamental Mechanisms to Modular Engineering
The goal of this project is to support basic plant biology research in the Plant Research Laboratory institute, particularly in the area of light capture, photosynthesis and energy conversion processes in photosynthetic organisms. In the laboratory of Co-PI Montgomery, specific efforts are geared towards understanding light sensing as it relates to fine-tuning cellular processes to promote energy efficiency and limit light-associated damage. The project also supports the research efforts and professional development training of graduate students and postdoctoral scientists.
Role: Co-PI

IOS-1557324 C.Kerfeld (PI) 03/01/16-02/28/19 National Science Foundation (NSF)
Collaborative Research: Regulatory and Functional Characterization of Modular Photoprotective Proteins in the Context of Cyanobacterial Ecology and Evolution.
National Science Foundation (NSF)
The goal of this project is to investigate the structure and function of a family of OCP and OCP domain paralogs in the cyanobacterium *Fremyella diplosiphon* that are predicted to have roles in photosynthesis and organismal photoprotection against abiotic stress.
Role: Co-PI

MCB-1515002 Beronda L. Montgomery (PI) 08/01/15-07/31/19 NSF
Light Quality and Quantity Inputs Into Phytochrome-Dependent Regulation of Anterograde Signaling, Photosynthesis and Growth During Photomorphogenesis.
The goal of this project is to investigate the role of phytochromes in establishing photosynthetically competent chloroplasts during plant development. The project supports the research efforts and professional development of undergraduates, graduate students and postdoctoral scientists.
Role: PI

MCB-1243983 Beronda L. Montgomery (PI) 1 2/01/12-11/30/17 (with no cost extension) NSF
Regulatory Mechanisms Controlling Photomorphogenesis and Resource Allocation in Cyanobacteria
The goal of this project is to investigate mechanisms for allocating resources to balance the energy demands for photosynthesis with the energy costs of responding to environmental variations in cyanobacteria. In these efforts, our studies represent a unique opportunity for increasing our understanding about organismal responses and resource allocation in response to changes in light, nutrient availability, and/or interactions between light and nutrients. The project supports the research efforts and professional development training of undergraduates, graduate students, postdoctoral scientists and a collaborative Assistant Professor at a minority-serving institution and her students.
Role: PI

Completed Research Support

DE–FG02–91ER20021 M. F. Thomashow (PI) 04/01/14-3/31/17 DOE
Photosynthetic Energy Capture, Conversion and Storage: From Fundamental Mechanisms to Modular Engineering
The goal of this project is to support basic plant biology research in the Plant Research Laboratory institute, particularly in the area of light capture, photosynthesis and energy conversion processes. In the lab of Co-PI Montgomery, specific efforts are geared towards understanding light sensing as it relates to fine-tuning cellular

processes to promote energy efficiency and limit light-associated damage. The project also supports the research efforts and professional development training of graduate students and postdoctoral scientists.
Role: Co-PI

MCB-0643516 Beronda L. Montgomery (PI) 04/01/07-03/31/13 NSF
CAREER: Molecular Genetic and Biochemical Analysis of Biliprotein-Regulated Photomorphogenesis in Cyanobacteria
The goal of this project is to elucidate the components and mechanisms of a regulatory gene network that controls growth and development in response to light in the cyanobacterium *Fremyella diplosiphon*.
Role: PI