

CURRICULUM VITAE

Dr. Philipp Zerbe

Professor, University of California-Davis

Phone: (530) 746-1441 | e-mail: pzerbe@ucdavis.edu | website: zerbelab.weebly.com

RESEARCH FOCUS

My group integrates functional genomics, metabolomics, protein biochemical and genetic approaches to study the diversity and function of plant terpenoid metabolism in plant-environment interactions in food and bioenergy crops with the long-term goal to advance approaches for optimizing crop traits and bioproduct engineering.

APPOINTMENTS

7/2024-present	Professor, Dept. of Plant Biology, University of California at Davis, USA
7/2019-6/2024	Associate Professor, Department of Plant Biology, University of California at Davis, USA
7/2014-6/2019	Assistant Professor, Department of Plant Biology, University of California at Davis, USA
1/2011-5/2014	Research Associate, University of British Columbia, Vancouver, Canada
2/2008-12/2010	Postdoctoral Fellow, University of British Columbia, Vancouver, Canada

ACADEMIC EDUCATION

2004-2007	Ph.D. in Plant Physiology at Ruhr-University Bochum, Bochum, Germany
2003-2004	Diploma in Biology at Ruhr-University Bochum, Bochum, Germany

SELECTED ACADEMIC ACCOMPLISHMENTS

Training (since 2015) 9 graduate students, 7 postdoctoral scholars, 3 junior specialists, and more than 50 undergraduate students. My past trainees have obtained positions in the biotech industry and academia. Three postdoctoral scholars have secured faculty positions in the USA, China, and the Netherlands.

Major Grant Funding (past 5 years)

- 2023-27: USDA-SCRI: A GIFT SEED - Accelerated Genetic Improvement of Fir Through Sequencing, Economics, Extension, & Diagnostics. (Co-PI, \$7,5M)
- 2024-27: USDA-NIFA BARD: Understanding terpene synthase catalytic specificity toward improving pathogen defense mechanisms in maize. (PI, \$310,000)
- 2023-27: NSF-TrTech PGR: Establishing a one-stop-shop for plant metabolism annotations and launching a plant enzyme function consortium. (Co-PI, \$3M)
- 2018-24: NIH-R01: Synthetic biology tools for scalable production of medicinal plant terpenes. (Co-PI, \$3.4M)
- 2020-22: California Strawberry Commission (CSC): Development of aroma-enhanced strawberry varieties by identifying the genetic drivers of aroma metabolism in benchmarking cultivars. (PI, \$576,000)
- 2018-23: DOE Early Career Program: Improved Biofuel Production through Discovery and Engineering of Terpene Metabolism in Switchgrass. (PI, \$760,000)
- 2017-22: NSF-PBI: Modular biochemical networks of maize anti-pathogen defense defined by integrating synthetic biochemistry, genetics and physiological function. (Co-PI, \$856,000)
- 2015-27: 3 awards through the DOE Joint Genome Institute Community Science Program (PI)

Awards

- Elsevier-Phytochemical Society of North America (PSNA) Young Investigator Award (2018)
- Hellman Fellowship awarded by the Hellman Fellows Fund (2016)
- Arthur Neish Young Investigator Award, Phytochemical Society of North America (2015)

SELECTED PUBLICATIONS (2015-present)

- Hawkins C, Xue B, Farida Y, Wyatt G, Zerbe P, Rhee SY (2024) Plant Metabolic Network 16: expansion of underrepresented plant groups and experimentally supported enzyme data. *Nucleic Acids Res.* doi:10.1093/nar/gkae991
- Cowie AE, Pereira JH, DeGiovanni A, McAndrew RP, Palayam M, Peek JO, Muchlinski AJ, Yoshikuni Y, Shabek N, Adams PD, Zerbe P (2024) The crystal structure of *Grindelia robusta* 7,13-copalyl diphosphate synthase reveals active site features controlling catalytic specificity. *JBC.* doi:10.1016/j.jbc.2024.107921
- Murphy KM, Dowd T, Khalil A, Char SN, Yang B, Endelman BJ, Shih PM, Topp C, Schmelz EA, Zerbe P (2023) A dolabralexin-deficient mutant provides insight into specialized diterpenoid metabolism in maize. *Plant Physiol.* 192:1338.
- Tiedge K, Li X, Merrill AT, Davisson D, Chen Y, Yu P, Tantillo DJ, Last RL, Zerbe P (2022) Comparative transcriptomics and metabolomics reveal specialized metabolite drought stress responses in switchgrass (*Panicum virgatum*). *New Phytol.* 236:1393-1408.
- Muchlinski A, Jia M, Tiedge K, Fell JS, Pelot KA, Chew L, Davisson D, Chen Y, Siegel J, Lovell JT, Zerbe P (2021) Cytochrome P450-catalyzed biosynthesis of furanoditerpenoids in the bioenergy crop switchgrass (*Panicum virgatum* L.). *Plant J.* 108:1053-68.
- Karunanithi PS, Berrios DI, Wang S, Davis J, Shen T, Fiehn O, Maloof JN, Zerbe P (2020) The foxtail millet (*Setaria italica*) terpene synthase gene family. *Plant J.* 103:781-800.

7. Ding Y, Weckwerth PR, Poretsky E, Murphy KM, Sims J, Saldivar E, Christensen SA, Char SN, Yang B, Tong AD, Shen Z, Kremling KA, Buckler ES, Kono T, Nelson DR, Bohlmann J, Bakker MG, Vaughan MM, Khalil AS, Betsiashvili M, Dressano K, Köllner TG, Briggs SP, Zerbe P, Schmelz EA, Huffaker A (2020) Genetic elucidation of interconnected antibiotic pathways mediating maize innate immunity. *Nat Plants* 6:1375-1388.
8. Murphy KM, Chung S, Fogla S, Minsky HB, Zhu KY, Zerbe P. (2019) A Customizable approach for the enzymatic production and purification of diterpenoid natural products. *J Vis Exp*. doi: 10.3791/59992.
9. Muchlinski A, Chen X, Lovell JT, Köllner TG, Pelot KA, Zerbe P, Ruggiero M, Callaway L 3rd, Laliberte S, Chen F, Tholl D (2019) Biosynthesis and Emission of Stress-Induced Volatile Terpenes in Roots and Leaves of Switchgrass (*Panicum virgatum* L.). *Front Plant Sci*. 10:1144.
10. Ding Y, Murphy KM, Poretsky E, Mafu S, Yang B, Char SN, Christensen SA, Saldivar E, Wu M, Wang Q, Ji L, Schmitz RJ, Kremling KA, Buckler ES, Shen Z, Briggs SP, Bohlmann J, Sher A, Castro-Falcon G, Hughes CC, Huffaker A, Zerbe P, Schmelz EA (2019) Multiple genes recruited from hormone pathways partition maize diterpenoid defences. *Nat Plants*. 5:1043-56.
11. Tiedge K, Muchlinski A, Zerbe P (2020) Genomics-enabled analysis of specialized metabolism in bioenergy crops: Current progress and challenges. *Syn Biol*. 5: ysaa005.
12. Karunanithi PS, Berrios DI, Wang S, Davis J, Shen T, Fiehn O, Maloof JN, Zerbe P (2020) The foxtail millet (*Setaria italica*) terpene synthase gene family. *Plant J*. 103:781-800.
13. Murphy KM, Zerbe P (2020) Specialized diterpenoid metabolism in monocot crops: Biosynthesis and chemical diversity. *Phytochemistry* 172:112289.
14. Wang JZ, Lei Y, Xiao Y, He X, Liang J, Jiang J, Dong S, Ke H, Leon P, Zerbe P, Xiao Y, Dehesh K (2020) Uncovering the functional residues of Arabidopsis isoprenoid biosynthesis enzyme HDS. *Proc Natl Acad Sci USA* 117:355-61.
15. Murphy KM, Chung S, Fogla S, Minsky HB, Zhu KY, Zerbe P. (2019) A Customizable approach for the enzymatic production and purification of diterpenoid natural products. *J Vis Exp*. doi: 10.3791/59992.
16. Karunanithi PS, Zerbe P (2019) Terpene synthases as metabolic gatekeepers in the evolution of plant terpenoid chemical diversity. *Front Plant Sci*. 10:1166.
17. Muchlinski A, Chen X, Lovell JT, Köllner TG, Pelot KA, Zerbe P, Ruggiero M, Callaway L 3rd, Laliberte S, Chen F, Tholl D (2019) Biosynthesis and Emission of Stress-Induced Volatile Terpenes in Roots and Leaves of Switchgrass (*Panicum virgatum* L.). *Front Plant Sci*. 10:1144.
18. Ding Y, Murphy KM, Poretsky E, Mafu S, Yang B, Char SN, Christensen SA, Saldivar E, Wu M, Wang Q, Ji L, Schmitz RJ, Kremling KA, Buckler ES, Shen Z, Briggs SP, Bohlmann J, Sher A, Castro-Falcon G, Hughes CC, Huffaker A, Zerbe P, Schmelz EA (2019) Multiple genes recruited from hormone pathways partition maize diterpenoid defences. *Nat Plants*. 5:1043-56.
19. Ma LT, Lee YR, Tsao NW, Wang SY, Zerbe P, Chu FH (2019) Biochemical characterization of diterpene synthases of *Taiwania cryptomerioides* expands the known functional space of specialized diterpene metabolism in gymnosperms. *Plant J*. 100:1254-1272.
20. Karunanithi PS, Dhanota P, Addison JB, Tong S, Fiehn O, Zerbe P (2019) Functional characterization of the cytochrome P450 monooxygenase CYP71AU87 indicates a role in marrubiin biosynthesis in the medicinal plant *Marrubium vulgare*. *BMC Plant Biol*. 19:114.
21. Amini H, Naghavi MR, Shen T, Wang Y, Nasiri J, Khan IA, Fiehn O, Zerbe P, Maloof JN (2019) Tissue-Specific Transcriptome Analysis Reveals Candidate Genes for Terpenoid and Phenylpropanoid Metabolism in the Medicinal Plant *Ferula assafoetida*. *G3 (Bethesda)* 9:807-16.
22. Murphy KM, Ma LT, Ding Y, Schmelz EA, Zerbe P (2018) Functional Characterization of Two Class II Diterpene Synthases Indicates Additional Specialized Diterpenoid Pathways in Maize (*Zea mays*). *Front Plant Sci*. 9:1542.
23. Pelot KA, Hagelthorn DM, Hong YJ, Tantillo DJ, Zerbe P (2019) Diterpene Synthase-Catalyzed Biosynthesis of Distinct Clerodane Stereoisomers. *Chembiochem* 20:111-7.
24. Lancaster J, Khirimi A, Young S, Lehner B, Luck K, Wallingford A, Ghosh SKB, Zerbe P, Muchlinski A, Marek PE, Sparks ME, Tokuhisa JG, Tittiger C, Köllner TG, Weber DC, Gundersen-Rindal DE, Kuhar TP, Tholl D (2018) De novo formation of an aggregation pheromone precursor by an isoprenyl diphosphate synthase-related terpene synthase in the harlequin bug. *Proc Natl Acad Sci USA* 115:E8634-41.
25. Pelot KA, Chen R, Hagelthorn DM, Young CA, Addison JB, Muchlinski A, Tholl D, Zerbe P (2018) Functional diversity of diterpene synthases in switchgrass (*Panicum virgatum*). *Plant Physiol*. 178:54-71.
26. Mafu S, Ding Y, Murphy KM, Yaacoobi O, Addison JB, Wang Q, Shen Z, Briggs SP, Bohlmann J, Castro-Falcon G, Hughes CC, Betsiashvili M, Huffaker A, Schmelz EA, Zerbe P (2018) Discovery, Biosynthesis and Stress-Related Accumulation of Dolabradiene-Derived Defenses in Maize. *Plant Physiol*. 176:2677-90.
27. Mafu S, Zerbe P (2017) Plant diterpenoid metabolism for manufacturing the biopharmaceuticals of tomorrow: prospects and challenges. *Phytochem Rev*. 17:113.

28. Pelot KA, Hagelthorn DM, Addison JB, Zerbe P (2017) Biosynthesis of the oxygenated diterpene nezukol in the medicinal plant *Isodon rubescens* is catalyzed by a pair of diterpene synthases. *Plos One* 12:e0176507
29. Mafu S, Karunanithi PS, Palazzo TA, Harrod BL, Rodriguez SM, Mollhoff IN, O'Brien TE, Tong S, Fiehn O, Tantillo DJ, Bohlmann J, Zerbe P (2017) Biosynthesis of the microtubule-destabilizing diterpene pseudolaric acid B from golden larch involves an unusual diterpene synthase. *Proc Natl Acad Sci USA* 114:974-9.
30. Mafu S, Fischer E, Addison JB, Riberio Barbosana I, Zerbe P (2016) Substitution of two active-site residues alters C9-hydroxylation in a class II diterpene synthase. *Chembiochem* 17:2304-7.
31. Wu X, Chen X, Dan J, Cao Y, Gao S, Guo Z, Zerbe P, Chai Y, Diao Y, Zhang L (2016) Characterization of anti-leukemia components from *Indigo naturalis* using comprehensive two-dimensional K562/cell membrane chromatography and in silico target identification. *Sci Rep.* 6:25491.
32. Andersen-Ranberg J, Kongstad KT, Nielsen MT, Jensen NB, Pateraki I, Bach SS, Hamberger B, Zerbe P, Staerk D, Bohlmann J, Møller BL, Hamberger B (2016) Expanding the landscape of diterpene structural diversity through stereochemically controlled combinatorial biosynthesis. *Angew Chem Int Ed Engl.* 55:2142-6.
33. Chen R, Li Q, Tan H, Chen J, Xiao Y, Ma R, Gao S, Zerbe P, Chen W, Zhang L (2015) Gene-to-metabolite network for biosynthesis of lignans in MeJA-elicited *Isatis indigotica* hairy root cultures. *Front Plant Sci.* 6:952.
34. Zerbe P (2015) Small molecules with big impact: terpenoid phytoalexins as key factors in maize stress tolerance. *Plant Cell Environ.* 38:2193-4.
35. Zerbe P, Rodriguez SM, Mafu S, Chiang A, Sandhu HK, O'Neil-Johnson M, Starks CM, Bohlmann J (2015) Exploring diterpene metabolism in non-model species: transcriptome-enabled discovery and functional characterization of labda-7,13E-dienyl diphosphate synthase from *Grindelia robusta*. *Plant J.* 83:783-93.
36. Zerbe P, Bohlmann J (2015) Plant diterpene synthases: exploring modularity and metabolic diversity for bioengineering. *Trends Biotechnol.* 33:419-28.
37. Zerbe P, Bohlmann J (2015) Enzymes for synthetic biology of ambroxide-related diterpenoid fragrance compounds. *Adv Biochem Eng Biotechnol.* 148:427-47.

The full publication record can be accessed at [Google Scholar Citations](#) profile

SELECTED INVITED PRESENTATIONS (past 5 years)

01/2025 American Chemical Society Seminar Series, Berkeley, CA, USA
 07/2024 aBIOTECH conference “Advancing Agriculture through Metabolic Engineering. Kunming, China
 04/2024 Iowa State University, Ames, IA, USA
 03/2024 University of Utah, Salt Lake City, UT, USA
 12/2023 aBIOTECH Seminar series, Beijing, China (remote)
 08/2023 Organizer and speaker TERPNET International meeting, Davis, USA
 01/2023 Michigan State University, East Lansing, USA
 08/2022 IKIAM Regional Amazon University, Tena, Ecuador
 07/2022 American Society of Plant Biologists annual meeting, Portland, OR USA
 03/2022 Plant Science Symposium University of Manitoba (remote)
 01/2021 Academia Sinica, Taipei, Taiwan (remote)
 01/2021 Osaka University, Osaka, Japan (remote)
 07/2020 Joint Genome Institute Engagement Webinar (remote)
 03/2020 Iowa State University, Ames, IA, USA

SELECTED PROFESSIONAL SERVICE

Editorial Boards (current)

Associate Editor “*Phytochemistry*”
 Associate Editor “*BMC Plant Biology*”

Scientific Advisory Boards (current)

Phytochemical Society of North America (PSNA)
 UC Davis Global Affairs Global Education for All Program
 UC Davis Biotechnology Program
 DOE Joint Genome Institute DNA Synthesis Program
 ChemTalk (non-profit organization for chemistry education and outreach)

Curriculum Development & Teaching

Since 2015: BIS103 - Bioenergy & Metabolism (undergraduate; 220-330 enrollment)
 Since 2022: PLB111 - Plant Physiology (undergraduate; 100-150 enrollment)
 2015-2022: PBI298 - Plant Specialized Metabolism (graduate; 6-15 enrollment)
 2017-19, 22: Course-based Undergraduate Research Experience (CURE) (undergraduate; 16-19 enrollment)
 2020-2022: Co-developed new Systems & Synthetic Biology major at UC Davis
 Since 2022: Project Amazon Link, an international student networking initiative

Select University Service (current):

Co-Chair UC Davis Committee for the development for a new undergraduate biology laboratory curriculum
Faculty Advisor UC Davis Plant Biology Major
Chair UC Davis Plant Biology Graduate Group Admissions Committee
Member UC Davis Plant Biology Graduate Group Curriculum Committee
Member Executive Committee UC Davis Plant Biology Graduate Group
Member Strategic Committee UC Davis Global affairs – Global Education 4 All initiative
CBS Liaison, Global Affairs for international initiatives
Faculty Lead UC Davis-University of Osaka (Japan) student engagement initiative
Member, Undergraduate Academic Advising Committee
Member, UC Davis Campus Global Strategy Advisory Committee
Faculty Trainer UC Davis Designated Emphasis in Biotechnology (DEB) Graduate Training Program
Faculty Trainer UC Davis Molecular Chemical Biology T32 Graduate Training Program
Faculty Trainer UC Davis Chemical Biology T32 Graduate Training Program
Faculty Trainer and advisory board member Bioindustrial Engineering for a Sustainable Tomorrow (BEST) Program
Faculty Trainer UC Davis Advancing Diversity by Educating the Professors of Tomorrow (ADEPT) Program
Faculty Trainer UC Davis Bridges to the Baccalaureate (B2B) Program

Select Public Service & Outreach (since 2015):

Treasurer Phytochemical Society of North America (PSNA)
Co-Organizer 2023 TERPNET international meeting (held at UC Davis)
Member organizational Committee Phytochemical Society of North America annual meeting
Review Panelist DOE EPSCoR Program and Plant Biosystems Design Program
Review Panelist DOE Joint Genome Institute Community Science Program and DNA Synthesis Program
Review Panelist German Research Foundation (DFG, Germany)
Review Panelist Biotechnology and Biological Sciences Research Council (BBSRC, UK)
Review Panelist Dutch Research Council (NWO) ALWOP program (Netherlands)
Review Panelist Natural Sciences and Engineering Research Council of Canada (NSERC, Canada)
Reviewer for several peer-reviewed journals, including *Nature Plants*, *Nature Chemical Biology*, *PNAS*, *New Phytologist*, *Plant Physiology*, *Plant Journal*, *BMC Plant Biology*, *BMC Genomics* etc.
Developed and hosted “Walking in the Woods with Chemistry” exhibition and guided tours on plant natural products at the UC Davis Arboretum open to all members of the public.
Co-developed art exhibit at the 2015 Art Silicon Valley Exhibit in San Francisco, CA, USA
Co-Chair, Vision of challenges and Opportunities for UC Davis 2065 committee