
Gaurav D. Moghe

Assistant Professor in Biochemical Genomics
Plant Biology Section, School of Integrative Plant Sciences, Cornell University

Research in the Moghe lab @Cornell

We are interested in understanding how plant metabolic diversity evolves, what purpose it serves in a plant's natural environment and how can we better use it for agriculture, nutrition and medicine? Towards these goals, we utilize a wide range of approaches including mass spectrometry, enzymology, molecular biology, phylogenomics and computational biology to address fundamental and applied questions.

Contact information

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Appointments

Assistant Professor (2017-current)

Plant Biology Section, School of Integrative Plant Sciences, Cornell University
Member, Computational Biology Field, Cornell University

Postdoctoral Research Associate (2013-2017)

Dept. of Biochemistry and Molecular Biology, Michigan State University, USA
Advisor: Dr. Robert Last

Lecturer, Masters Course in Bioanalytical Sciences (2006-2007)

Dept. of Bioanalytical Sciences, Ramnarain Ruia College, University of Mumbai, India

Education

Doctor of Philosophy, Genetics and Quantitative Biology (2007-2013)

Dept. of Plant Biology, Michigan State University, USA
Advisor: Dr. Shin-Han Shiu

Dissertation title: *Gene Content Evolution in Plant Genomes: Studies of Whole Genome Duplication, Intergenic Transcription and Expression Evolution in Brassicaceae and Poaceae Species*

Master of Science, Biochemistry (2004-2006)

Dept. of Biochemistry, The Maharaja Sayajirao University of Baroda, India

Bachelor of Science, Microbiology and Biotechnology (2001-2004)

Dept. of Microbiology, Ramnarain Ruia College, University of Mumbai, India

Awards and scholarships

- 2018 Early Career Award, The American Society of Plant Biologists

- 2017 BMB Postdoctoral Independent Career Potential Award, MSU
- 2016 13th Annual Solanaceae Meeting Travel Award (Speaker)
- 2016 Gordon Research Seminar on Plant Molecular Biology Speaker Award
- 2013 Outstanding Genetics Graduate Student Award, MSU
- 2013 Dissertation Completion Fellowship, MSU
- 2012 Dissertation Continuation Fellowship, MSU
- 2009 Research Fellowship, Quantitative Biology Program, MSU
- 2008 Research Fellowship, Gene Expression in Development and Disease, MSU
- 2006 Research Fellowship, Council for Scientific and Industrial Research (CSIR), India
(*similar in scope to NSF Graduate Research Fellowship*)
- 2006 Research Fellowship, General Aptitude Test in Engineering (GATE), India

Publications

Peer reviewed publications ([Google Scholar link](#))

1. (*in alphabetical order*) Stacey Smith, Ruthie Angelovici, Karolina Heyduk, Hiroshi Maeda, [Gaurav Moghe](#), Chris Pires, Joshua Widhalm, Jennifer Wisecaver (2019) The renaissance of comparative biochemistry. ***American Journal of Botany***, 106(1): 3-13 doi: 10.1002/ajb2.1216
2. [Gaurav Moghe](#) and Lars Kruse (2018) The study of plant specialized metabolism: Challenges and prospects in the genomics era ***American Journal of Botany***, 105(6): 1-4 doi:10.1002/ajb2.1101
3. Haiyang Xu, [Gaurav Moghe](#), Krystle Wiegert-Rininger, Anthony Schillmiller, Cornelius Barry, Robert Last, Eran Pichersky (2018) Identification of dehydrogenases involved in the biosynthesis of the monoterpene moiety of pyrethrin ***Plant Physiology*** doi: 10.1104/pp.17.01330
4. [Gaurav Moghe](#) and Stacey Smith (2018) The push and pull of plant specialized metabolism underlies a long-standing, colorful mystery. ***New Phytologist***, 217(2) doi: 10.1111/nph.14914
5. [Gaurav Moghe](#), Bryan Leong, Steven Hurney, A. Daniel Jones, Robert Last (2017) Evolutionary routes to biochemical innovation revealed by integrative analysis of a plant-defense related specialized metabolic pathway. ***eLife***, 6:e28468
 - [New study sheds light on mysterious plant compounds](#). *Cornell Chronicle*
 - [Tomatoes' crystal ball reveals evolutionary secrets](#). *MSU Today*
 - [Tomato hair holds clues to evolution](#). *Futurity*
6. Pengxiang Fan, [Gaurav Moghe](#), Robert Last (2016) Comparative biochemistry and *In Vitro* pathway reconstruction as powerful partners in studies of metabolic diversity. ***Methods in Enzymology***, Synthetic Biology and Metabolic Engineering in Plants and Microbes Part A. vol. 575. (Book chapter)
7. [Gaurav Moghe](#), Robert Last (2015) Something old, something new: Conserved enzymes and the evolution of novelty in plant specialized metabolism. ***Plant Physiology***, 169 (3):1512-1523
 - [The genesis of plant languages: How plants evolve new metabolic pathways from existing ones](#). *Invited article, Atlas of Science*
8. Melissa Lehti-Shiu, Sahra Uygun, [Gaurav Moghe](#), David Hufnagel, Hannah Jasicki, Vivian Fang et al. (2015) Molecular evidence for functional divergence and decay of a transcription factor derived from whole genome duplication in *Arabidopsis thaliana*. ***Plant Physiology***, 168(4):1712-1734
9. Jing Ning, [Gaurav Moghe](#), Bryan Leong, Jeongwoon Kim, Itai Ofner et al. (2015) A feedback insensitive isopropylmalate synthase affects acylsugar composition in cultivated and wild tomato. ***Plant Physiology***, 169(3):1821-1835

10. John Lloyd, Alexander Seddon, [Gaurav Moghe](#), Matthew Simenc, Shin-Han Shiu (2015) Characteristics of plant essential genes allow for within-and between-species prediction of lethal mutant phenotypes. *The Plant Cell*, 27(8):2133-2147
11. Anthony Schillmiller, [Gaurav Moghe](#), Pengxiang Fan, Banibrata Ghosh, Jing Ning, A. Daniel Jones, Robert Last (2015) Functionally divergent alleles and duplicated loci encoding an acyltransferase contribute to acylsugar metabolite diversity in *Solanum* trichomes. *The Plant Cell*, 27(4):1002-1017
12. [Gaurav Moghe](#), David Hufnagel, Haibao Tang, Yongli Xiao, Christopher Town, Ian Dworkin et al. (2014) Consequences of whole genome triplication as revealed by comparative genomic analyses of the wild radish *Raphanus raphanistrum* and three other Brassicaceae species, *The Plant Cell*, 26(5):1925-1937.
 - o Featured as a [Research Highlight](#) in Nature Reviews Genetics (July 2014), doi:10.1038/nrg3774
13. [Gaurav Moghe](#), Shin-Han Shiu (2014) The causes and molecular consequences of polyploidy in flowering plants. *Annals of the New York Academy of Sciences*, 1320: 16-34
14. Michael Campbell, MeiYee Law, Carson Holt, Joshua Stein, [Gaurav Moghe](#), David Hufnagel, et al. (2014) MAKER-P: a tool-kit for the rapid creation, management, and quality control of plant genome annotations. *Plant Physiology*, 164 (2): 513-524
15. [Gaurav Moghe](#), Melissa Lehti-Shiu, Alexander Seddon, Shan Yin, Yani Chen, Piyada Juntawong, et al. (2013) Characteristics and significance of intergenic polyA transcription in *Arabidopsis thaliana*. *Plant Physiology*, 161(1):210-224
16. Rebecca Davidson*, Malali Gowda*, [Gaurav Moghe](#), Haining Lin, Brieanne Vaillancourt, Shin-Han Shiu et al. (2012) Comparative transcriptomics of three Poaceae species reveals patterns of gene expression evolution. *The Plant Journal*, 71(3):492-502.
17. Haining Lin, [Gaurav Moghe](#), Shu Ouyang, Shin-Han Shiu, Xun Gu, C. Robin Buell (2010) Comparative analyses reveal distinct sets of lineage-specific genes within *Arabidopsis thaliana*. *BMC Evolutionary Biology*, 10:41.

Under review/In preparation

1. John Lloyd, Megan Bowman, Christina Azodi, [Gaurav Moghe](#), Kevin Childs, Shin-Han Shiu (*submitted*) Evolutionary characteristics of intergenic transcribed regions indicate widespread noisy transcription in the Poaceae
2. Elizabeth Mahood, [Gaurav Moghe](#) (*in preparation*) Prediction of lipid types from monoisotopic mass and molecular formula using machine learning
3. Steven Hurney, [Gaurav Moghe](#), Rob Last, A. Daniel Jones (*in preparation*) Nuclear Magnetic Resonance spectroscopy of metabolites from *Salpiglossis sinuata* trichome extracts reveals novel acylsugars in Solanaceae.
4. Christopher Miller, [Gaurav Moghe](#)*, Noellia Carrasquilla, Robert Last, Patricia Bedinger* (*co-first author, corresponding author, in preparation*) RAD-sequencing reveals evolution of biochemical and reproductive phenotypes across *Solanum habrochaites* natural accessions

Talks and posters

Talks (invited; as faculty):

- *American Society of Plant Biologists Annual Meeting (Presidential Session) (July 2019; invited)*
- Plant metabolic diversity: Evolution and Applications. **Plant Breeding and Genetics Section, Cornell University (Feb 2019; invited)**
- The evolution of novelty in plant metabolism. **Plant Biology Department, University of Massachusetts Amherst (Oct 2018)**
- *Botanical Society of America meeting, Rochester, MN (July 2018; invited)*
- Teasing apart the complexity of plant metabolic networks using integrative approaches. **Computational Biology field, Cornell University (2018)**
- All in the family: The emergence of biochemical novelty in plant specialized metabolism. **Boyce Thompson Institute annual symposium (2017)**

Talks (invited; pre-faculty):

- Phylogenetics meets biochemistry: Unraveling plant specialized metabolism using multi-omic strategies. **Cornell University (job talk; 2017)**
- High-throughput approaches and the study of natural metabolic variation in plants. **iCER NextGen talks, MSU (2015)**
- Plant molecular evolution in the genomics era: How omic strategies can inform evolutionary studies of biological phenomena. **Indian Institute of Science, Education & Research (IISER), Pune, India (2015)**
- An early look at the genome of wild radish *Raphanus raphanistrum* genome. **iCER NextGen talks, MSU (2012)**
- Intergenic Dark Matter transcripts: Insights from the analyses of the *Arabidopsis thaliana* transcriptome. **Genetics Retreat*, MSU (2011)**

Talks (contributed):

- Acylsugar biosynthesis and the evolutionary dynamics of specialized metabolic pathways. **Cold Spring Harbor Plant Biotechnology symposium (2017)**
- Comparative biochemical genomics of Solanaceae acylsugars illustrates the mechanisms of evolutionary diversification in plant specialized metabolism. **13th Annual Solanaceae Conference, UC-Davis (2016)**
- The emergence of biological complexity: An investigation of acylsugar biosynthesis using comparative biochemical genomics. **Gordon Research Seminar on Plant Molecular Biology, Holderness School (2016)**
- All in the family: The origins and evolution of acylsugar biosynthesis in Solanaceae. **PRL Tuesday noon seminar, MSU BEACON seminar (2016)**
- Insights into genome evolution post-polyploidization in Brassicaceae using the newly sequenced genome of Wild Radish (*Raphanus raphanistrum*). **American Society of Plant Biology Conference, Austin, TX (2012), MSU-BEACON Centre (2013)**
- Characteristics and significance of intergenic polyA transcripts in *Arabidopsis thaliana*. **Great Lakes Bioinformatics Conference, Ann Arbor, MI (2012)**
- Discovery and analyses of novel RNA genes in *Arabidopsis thaliana*. **Genetics Forum, MSU (2010), Society for Molecular Biology and Evolution Conference, Iowa City (2009)**

Posters:

- A family that sticks together: The origins and evolution of acylsugar biosynthesis in Solanaceae. **Gordon Research Conference on Ecology and Evolution**, University of New England (2015).
- Characteristics and Significance of Intergenic PolyA RNA Transcription in *Arabidopsis thaliana*. **MSU Summer Symposium on Transcriptional Dynamics**, MSU (2011).
- Strand-specific transcription in *Arabidopsis thaliana* T87 suspension culture cells. **International Conference on Arabidopsis Research**, University of Wisconsin-Madison (2011)
- Can *cis*-regulatory mutations affect fitness? **MSU-BEACON conference**, MSU (2010)

Teaching, mentoring and academic service

Teaching:

As faculty:

- **PLBIO 4000/6000: Concepts and techniques in computational biology (4 credits; Spring 2019)**
- Guest lecture: Current topics in plant biology (Spring 2018, 2019)
- Guest lecture: Introduction to mass spectrometry: Data acquisition and analysis (Fall 2018)
- Guest lecture: Introduction to research literature in plant biology (Spring 2018)

Pre-faculty:

- Guest lecture: Next generation sequencing approaches for transcriptome sampling (PLB856, MSU, 2015-2017)
- TA, Theories and Practices in Bioinformatics (Dept. of Plant Biology, MSU, 2011, 2013)
- Guest lecture: Differential expression analysis using edgeR (Cold Spring Harbor Laboratories, 2013)
- TA, Frontiers in Plant Sciences (Cold Spring Harbor Laboratories, 2010, 2013)
- Guest lecture: Introduction to Python Programming (Theories and Practices in Bioinformatics, 2011)
- TA, Fundamental Genetics (Dept. of Zoology, MSU, 2009)
- Instructor, Masters in Bioanalytical Sciences (Ramnarain Ruia College, Mumbai, 2006)
- Instructor, Diploma in Molecular Biology (Ramnarain Ruia College, Mumbai, 2006)

Mentoring:

As faculty:

- Lab technicians: Alexandra Bennett (2017-)
- Postdoctoral researchers: Lars Kruse (2017-)
- Graduate students: Elizabeth Mahood (2018-)
- Undergraduate students: Chenab Khakh (2017-), Se Jin Park (2018-)
- Rotating graduate students: Arielle Johnson (2018), Gordon Younkin (2019), Nicole Szeluga (2019)
- Undergraduate visitors: Elena Lazarus (2018)
- Postgraduate visitors: Anna-Lena Sprick (2018)
- Postdoctoral visitors: Kai Fan (2018-)

Pre-faculty:

- Graduate students: Christina Azodi, Bryan Leong (collaborative/supervisory role)
- REU undergraduate: Nicholas Karavolias (Cornell), Ashley Wright (Jackson State University)
- MSU undergraduates: Noah Last, Grady Colnon, Alex Seddon, David Hufnagel
- High school students: Meiyi Cheng (Honolulu, HI), Andy Lin (Okemos, MI)

The contributions of David and Alex resulted in two publications. Several of these students are currently enrolled in or planning to enroll in graduate study programs.

Committees:

As faculty:

- *Ex-officio* member, ASPB Early Career Award Committee (2019)

- Member, Cornell Institute of Biotechnology Metabolomics Advisory Board (2017-)
- Faculty co-founder, Cornell Ents Club (monthly plant biology journal club)

Pre-faculty:

- Member, Biochemistry Department Awards Committee (2015)
- President of Genetics Student Organization (2012)
- Member of Genetics Director Search Committee (2012), Genetics Program Executive Committee (2012), Genetics Student Organization (2011), Genetics Admissions Committee (2010)
- Representative for Dean's Student Advisory Council and Faculty Advisory Council (2011)

Other service:

- Member, Editorial Board, Plant Direct (An ASPB+SEB journal)
- Grant reviewer – NSF CAREER, NSF-Binational Foundation
- Manuscript reviewer – PNAS, Nature Plants, Plant Physiology, Molecular Biology and Evolution, New Phytologist, PLoS ONE, BMC Genomics, BMC Evolutionary Biology, Gene, Frontiers in Plant Sciences, 3Biotech, Ecology and Evolution, Phytochemistry, Molecular Phylogenetics and Evolution
- Member, AAAS (2010-12, 2013-2014), ISCB (2012), ASPB (2012, 2015)
- Advisor, Wiley Science Advisors (2012-2015)
- Founder – BiodiversityOfIndia.org

Professional references

Available upon request