

## Daniel B. Szymanski

### Address

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### Education

University of Illinois	Ph.D.	1995	Plant Biology
University of Michigan	B.S.	1989	Natural Resources

### Professional Appointments

2010–	Professor, Purdue University, Departments of Botany and Plant Pathology, Agronomy
2009–	Adjunct Faculty, Purdue University, Biological Sciences
2004-2010	Associate Professor, Purdue University, Department of Agronomy
1999-2004	Assistant Professor, Purdue University, Department of Agronomy
1995-1999	Research Associate, University of Minnesota, Genetics and Cell Biology
1990-1995	Research Assistant, University of Illinois, Department of Plant Biology

### Honors and Awards

2022	Plant Cell Biology International T-shirt contest winner (major lab award)
2019	McMasters Fellowship CSIRO Australia
2017	Elected Fellow of the American Society of Plant Biologists
2009, 2010, 2011-2014	NSF review panelist
2013, 2014	NASA Space Biology panelist
2010, 2011, 2012	Purdue Millionaire Grant Award
2008-2010	Chair, PULSe Graduate Program
2009	Purdue College of Agriculture Research Award
2008	Purdue International Travel Award
2006	Study in a Second Discipline, Purdue University
1998-1999	NSF Cytoskeleton Training Grant Fellowship
1998	3-D Microscopy of Living Cells Course Study Award
1995	NSF Integrative Research in Plant Biology Fellowship
1994	Francis M. and Harlie M. Clark Research Support Grant
1992-1993	Cell and Molecular Biology Training Grant Fellowship
1990-1992	McKnight Fellowship in Plant Biology

### Professional Activities

#### Society Membership:

American Association for the Advancement of Science  
American Society of Cell Biology  
American Society of Plant Biology

#### Associate Editor:

Plant Physiology  
Frontiers in Plant Cell Biology

## Excellence in Discovery

### Publications

#### Refereed Journal Articles

1. Gawienowski, M.C., Szymanski, D., Perera, I.Y., Zielinski, R.E. Calmodulin isoforms in *Arabidopsis* encoded by multiple divergent mRNAs. **1993** *Plant Mol Biol* 22:215-225.
2. Szymanski, D.B., Liao, B., Zielinski, R.E. Calmodulin isoforms differentially enhance the binding of cauliflower nuclear proteins and recombinant TGA3 to a region derived from the *Arabidopsis* Cam-3 promoter. **1996** *Plant Cell* 8:1069-1077.
3. Oppenheimer, D.G., Pollock, M.A., Vacik, J., Szymanski, D.B., Ericson, B., Feldmann, K., Marks, M.D. Essential role of a kinesin-like protein in *Arabidopsis* trichome morphogenesis. **1997** *Proc Natl Acad Sci USA* 94:6261-6266.
4. Szymanski, D.B., Klis, D.A., Larkin, J., Marks, M.D. *cot1*: a regulator of *Arabidopsis* trichome initiation. **1998** *Genetics* 149:565-577.
5. Szymanski, D.B., Marks, M.D. *GLABROUS1* overexpression and the *TRIPTYCHON* gene regulate the *Arabidopsis* cell cycle and trichome cell fate. **1998** *Plant Cell* 10:2047-2062.
6. Szymanski, D.B., Jilk, R., Pollack, S., Marks, M.D. Control of the *GLABROUS2* gene expression in *Arabidopsis* leaves and trichomes. **1998** *Development* 125:1161:1171.
7. Szymanski, D.B., Marks, M.D., Wick, S.M. Organized F-actin is essential for normal *Arabidopsis* trichome morphogenesis. **1999** *Plant Cell* 11:2331-2347.
8. Szymanski, D.B. *Arabidopsis* trichome morphogenesis: a genetic approach to studying cytoskeletal function. **2001** *J Plant Growth Regulation* 20:131-140.
9. Qiu, J.L., Jilk, R., Marks, M.D., Szymanski, D.B. The *Arabidopsis* *SPIKE1* gene is required for normal cell shape control and tissue development. **2002** *Plant Cell* 14:101-118.
10. Le, J., El-Assal, S.E.-D., Basu, D., Saad, M.E., and Szymanski, D.B. Requirements for *Arabidopsis* *ATARP2* and *ATARP3* during epidermal development. **2003** *Curr Biol* 13:1341-1347.
11. El-Assal, S.E., Le, J., Basu, D., Mallery, E.L., Szymanski, D.B. **2004** *DISTORTED2* encodes an ARPC2 subunit of the putative *Arabidopsis* ARP2/3 complex. *Plant Journal* 38:526-538.
12. El-Assal, S.E., Le, J., Basu, D., Mallery, E.L., and Szymanski, D.B. **2004** *Arabidopsis* GNARLED encodes a NAP125 homologue that positively regulates ARP2/3. *Curr. Biol.* 14:1405-1409.

13. Basu, D., El-Assal, S.E., Le, J., Mallery, E.L., and Szymanski, D.B. **2004** Interchangeable functions of Arabidopsis PIROGI and the human WAVE complex subunit SRA-1 during leaf epidermal morphogenesis. *Development* 131:4345-4355.
14. Basu, D., Le, J., El-Essal, S.E., Huang, S., Mallery, E., Koliantz, G., Staiger C.J., Szymanski, D.B. **2005** DISTORTED3/SCAR2 is a Putative Arabidopsis WAVE Complex Subunit that Activates Arp2/3 Complex and is Required for Epidermal Morphogenesis. *Plant Cell* 17:502-524.
15. Le, J., Mallery, E.L., Zhang, C., Brankle, S., Szymanski, D.B. **2006** Arabidopsis BRICK1/HSPC300 is an essential subunit of the WAVE complex that selectively stabilizes the Arp2/3 activator SCAR2. *Curr. Biol.* 16:895-901.
16. Zhang, C., Mallery, E. L., Schlueter, J., Huang, S., Fan, Y., Brankle, S. Staiger, C.J., and Szymanski, D.B. **2008** Arabidopsis SCARs function interchangeably to meet ARP2/3-activation thresholds during morphogenesis. *Plant Cell* 20:995-1011.
17. Basu, D. , Le, J., Zakharova, T., Mallery, E.L., and Szymanski, D.B. **2008** A SPIKE1 signaling complex controls actin-dependent morphogenesis through the WAVE and ARP2/3 complexes. *PNAS USA* 105:4044-4049.
18. Kotchoni, S.O., Zakharova, T., E.L., M., Le, J., El-Assal, S.E., and Szymanski, D.B. **2009**. The association of the Arabidopsis actin-related protein (ARP) 2/3 complex with cell membranes is linked to its assembly status, but not its activation. *Plant Physiol.* 151:2095-2109.
19. Zhang, C., Kotchoni, S.O., Samuels, A.L., Szymanski, D.B. **2010** SPIKE1 signals originate from and assemble specialized domains of the endoplasmic reticulum. *Curr. Biol.* 20:2144-2149.
20. Zhang, C., Halsey, L., Szymanski, D.B. **2011** The development and geometry of shape change in *Arabidopsis thaliana* cotyledon pavement cells. *BMC Plant Biology* doi:10.1186/1471-2229-11-27.
21. Zhang, C., Mallery, E., Reagan, S., Boyko, V.P., Kotchoni, S.O., and Szymanski, D.B. **2013**. The endoplasmic reticulum is a reservoir for WAVE/SCAR regulatory complex signaling in the Arabidopsis leaf. *Plant Physiol* 162:689-706.
22. Zhang, C., Mallery, E., and Szymanski, D.B. **2013**. ARP2/3 localization in Arabidopsis leaf pavement cells: a diversity of intracellular pools and cytoskeletal interactions. *Frontiers in Plant Biology* 4:1-16.
23. Jimenez-Lopez, J. C. *et al.* Heterodimeric capping protein from Arabidopsis is a membrane-associated, actin-binding protein. **2014**. *Plant Physiol* 166:1312-1328, doi:10.1104/pp.114.242487.
24. Cai, C., Henty-Ridilla, J. L., Szymanski, D. B. & Staiger, C. J. **2014**. Arabidopsis myosin XI: a motor rules the tracks. *Plant Physiol* 166:1359-1370, doi:10.1104/pp.114.244335 (2014).

25. Aryal, U.K. , Xiong, Y., McBride, Z., Kihara, D., Xie, J., Hall, M.C., and Szymanski, D.B. **2014** A Proteomic Strategy for Global Analysis of Plant Protein Complexes. *Plant Cell* 26:3867-3882.
26. Yanagisawa, M., Desyatova, A.S., Belteton, S., Mallery, E. M, Turner, J.A., Szymanski, D. B. **2015** Patterning mechanisms of cytoskeletal and cell wall systems during leaf trichome morphogenesis. *Nature Plant* 1:15014.
27. Delbaltov, D., Gaur, U., Kim, J., Kourakis, M., Newman-Smith, E., Belteton, S., Smith, W., Szymanski, D.B., Manjunath, B.S., **2016** CellEct: Cell Evolution Capturing Tool, *BMC Bioinformatics* 17:88-96.
28. Wu, T.-Z., Belteton, S., Lunsford, J., Szymanski, D.B., Umulis, D.B. **2016** Quantitative image analysis of pavement cell morphogenesis with LobeFinder. *Plant Physiol.* 171:2331-2342.
29. Uma, A., McBride, Z., Chen, D., Xie, J., Szymanski, D.B. **2017** Analysis of protein complexes in Arabidopsis leaves using size exclusion chromatography and label-free protein correlation profiling, *Journal of Proteomics.* 166:8-18.
30. McBride, Z., Chen, D., Reick, C., Xie, J., Szymanski, D.B., **2017** Global analysis of membrane-associated protein oligomerization using protein correlation profiling. *Mol Cell Proteomics.* 16:1972–1989.
31. Belteton, S., et al. **2018** Reassessing the roles of PIN proteins and anticlinal microtubules during pavement cell morphogenesis. *Plant Physiol.* 176:432-449. 10.1104/pp.17.01554
32. Yanagisawa, M., Alonso, J.M., and Szymanski, D.B. **2018** Microtubule-dependent confinement of a cell signaling and actin polymerization control module regulates polarized cell growth. *Current Biol* **28**, 2459-2466.
33. McBride, Z., Chen, D., Lee, Y., Aryal, U., Xie, J., Szymanski, D.B., **2019** A label free mass spectrometry method to predict endogenous protein complex composition. *Mol Cell Proteomics.* 18: 1588-1606.
34. Wong, J.H., Kato, T., Belteton, S.A., Shimizu, R., Kinoshita, N., Higaki, T., Sakumura, Y., Szymanski, D.B., and Hashimoto, T. **2019** Basic Proline-Rich Protein-Mediated Microtubules Are Essential for Lobe Growth and Flattened Cell Geometry. *Plant Physiol* 181, 1535-1551.
35. Jiang, J., Kao, P.-Y., Belteton, S.A., Szymanski, D.B., and Manjunath, B.S. **2019** Accurate 3D Cell Segmentation using Deep Feature and CRF Refinement. In *IEEE international conference on image processing (Taipei, Taiwan: IEEE Signal Processing Society)*.
36. Lee, Y., and Szymanski, D.B. **2021** Multimerization variants as potential drivers of neofunctionalization. *Science Advances* 7: no. 13, DOI: 10.1126/sciadv.abf0984.

37. Chin, S., Kwon, T., Khan, B.R., Sparks, J.A., Mallery, E.L., Szymanski, D.B., and Blancaflor, E.B. **2021** Spatial and temporal localization of SPIRRIG and WAVE/SCAR reveal roles for these proteins in actin-mediated root hair development. *Plant Cell* *33*, 2131-2148.
38. Lee, Y., Okita, T.W., and Szymanski, D.B. **2021** A co-fractionation mass spectrometry-based prediction of protein complex assemblies in the developing rice aleurone-subaleurone. *Plant Cell* *33*, 2965-2980.
39. Belteton, S., Lee, W., Hatam, F.A., Quinn, M.I., Szymanski, M.R., Marley, M., Turner, J.A., and Szymanski, D.B. **2021** Real-time conversion of tissue-scale mechanical forces into an interdigitated growth pattern. *Nature Plants* *7*, 826-841.
40. Lee, W., Keynia, S., Afshar-Hatam, F., Szymanski, D.B., and Turner, J.A., Protocol for mapping the spatial variability in cell wall mechanical bending behavior in living leaf pavement cells. *Plant Physiology* **2021** *188*, 1435–1449.
41. Keynia, S., Davis, T.C., Szymanski, D.B., and Turner, J.A. **2022** Cell twisting during desiccation reveals axial asymmetry in wall organization. *Biophysical Journal* *121*, 932-942.
42. Mallery, E.L., Yanagisawa, M., Zhang, C., Lee, Y., Robles, L.M., Alonso, J.M., and Szymanski, D.B. **2022** Tandem C2 domains mediate dynamic organelle targeting of a DOCK family guanine nucleotide exchange factor. *J Cell Sci* *135*.
43. Yanagisawa, M., Keynia, S., Belteton, S., Turner, J.A., and Szymanski, D.B. **2022** A conserved cellular mechanism for cotton fibre diameter and length control. *in silico Plants* *4*.
44. Jiang, J., Khan, A., Shailja, S., Belteton, S.A., Goebel, M., Szymanski, D.B., and Manjunath, B.S. **2023** Segmentation, tracking, and sub-cellular feature extraction in 3D time-lapse images. *Sci Rep* *13*, 3483.
45. Jing, L., Szymanski, D.B., and Kim, T.-Y. **2023** Probing stress-regulated ordering of the plant cortical microtubule array via a computational approach. *BMC Plant Biol* *23*, 308

### Review articles

46. Szymanski D.B., Lloyd A.M., Marks D.M. Progress in the molecular genetic analysis of trichome initiation and morphogenesis in *Arabidopsis*. **2000** *Trends Plant Sci* *5*:214-219.
47. Szymanski, D.B. **2002** Tubulin folding cofactors: Half a dozen for a dimer. *Curr. Biol.* *12*: R767-R769.
48. Szymanski, D.B. **2005** Breaking the WAVE complex: the point of *Arabidopsis* trichomes. *Curr. Opin. Plant Biol.* *8*:103-112.
49. Szymanski, D.B. **2009** Plant cells taking shape: new insights into cytoplasmic control. *Curr. Opin. Plant Biol.* *12*:735-744.

50. Szymanski, D.B., and Cosgrove, D.J. **2009** Dynamic coordination of cytoskeletal and cell wall systems during plant cell morphogenesis. *Curr. Biol.* 19:R800-R811.
51. Yanagisawa, M., Zhang, C., and Szymanski, D.B. **2013**. ARP2/3-dependent growth in the plant kingdom: SCARs for life. *Frontiers in Plant Science* 4:1-12.
52. Szymanski, D. B. **2014** The kinematics and mechanics of leaf expansion: new pieces to the Arabidopsis puzzle. *Curr. Opin. Plant Biol.* 22C:141-148, doi:10.1016/j.pbi.2014.11.005.
53. Szymanski, D.B. **2016** Math plus biology: building a knowledge base to engineer plant traits *Scientia* 109.
54. Szymanski, D. B., et al. **2018** Cellular dynamics: cellular systems in the time domain." *Plant Physiol* 176: 12-15.
55. Szymanski, D. B. and C. J. Staiger **2018** The actin cytoskeleton: functional arrays for cytoplasmic organization and cell shape control. *Plant Physiol.* 176: 106-118.
56. Li, J., Kim, T., and Szymanski, D.B. **2019** Multi-scale regulation of cell branching: Modeling morphogenesis. *Dev Biol* 451, 40-52.

### **Refereed Book Chapters**

57. Szymanski, D.B. The role of actin during *Arabidopsis* trichome morphogenesis. In: *Actin: A Dynamic Framework for Multiple Plant Cell Functions* (Staiger, C.J. et al., eds.) Kluwer **2000** pp. 391-410.
58. Szymanski, D.B. *Arabidopsis thaliana*: The premiere model plant. In: *Encyclopedia of Genetics* (Brenner, S. and Miller, J.H., eds.) Academic Press **2001** pp. 87-90.
59. Beilstein, M., and Szymanski, D. Cytoskeletal requirements during *Arabidopsis* trichome development. In: *The Plant Cytoskeleton in Cell Differentiation and Development* (Hussey P., ed.) Blackwell, Oxford, UK, **2004** pp. 265-289.
60. Ritchie, R., Szymanski, D.B., Wiley, H, and Nielsen, N. Targeting induced local lesions in genomes-TILLING, in *Legume Crop Genomics*. (Brummer, C. and Wilson, R.F., eds.) AOCS Press, Champaign, IL. **2004** pp. 105-129.
61. Szymanski, D.B. *Arabidopsis thaliana*: The premiere model plant. In: *Encyclopedia of Genetics* 2<sup>nd</sup> edition (Brenner, S. and Miller, J.H., eds.) Academic Press **2012** pp. 87-90.
62. Xiong, Y., Szymanski, D., Kihara, D. Characterization and prediction of human protein-protein interactions. In: *Biological Data Mining and its Applications in Health Care*. (Li. X.-L., Ng, S.-K., and Wang, J.T.L., eds) Elsevier **2012** pp. 81-103.

### **Educational Book**

Koliantz, G., Szymanski, D.B. 2006 Genetics: A Laboratory Manual ed: K. Barbarick, ASA editor in chief, American Society of Agronomy Inc. and Crop Science Society of America, Inc., Madison, WI

## **Research Grants and Awards**

### **Current**

**NSF Transitions to excellence: Creating a trans-disciplinary approach to discover multiscale control mechanisms of plant morphogenesis** \$749,000. P.I. D. Szymanski, coPI C. Davis; 01/2022-12/31/2024

**NSF/ PGRP-A systems biology approach to enable cotton fiber engineering** \$2,753,000 P. I. D. Szymanski (Collaborative grant with Dr. Jonathan Wendel and Dr. Olga Zabolina, ISU); 7/1/2020-6/01/2025.

### **Past**

**NSF/ An Integrated Experimental and Computational Approach to Discover Biomechanical Mechanisms of Leaf Epidermal Morphogenesis** \$1,219,636 P.I. D. Szymanski (Collaborative grant with Dr. Joe Turner, U. Nebraska-Lincoln, Dr. Tae-Yoon Kim, Purdue University) 7/1/2017-7/2/2023. \$865,000 to D.B.S.

**NSF/ Deciphering the Role of RNA Binding Proteins in RNA Transport, Localization and in Post-transcriptional Processes** (Collaborative grant with Tom Okita), 5/31/2015-6/1/2020, \$630,000 to D.B.S. for mass spectrometry technology development.

**Purdue AgSEED/ Creation of single-cell phenotyping and manipulation platform to enable cotton fiber engineering**, 6/1/2018-5/31/2020, \$50,000.

**NSF Plant Cell Biology International Conference Proposal, Conference travel awards for students and post docs to attend Plant Cell Biology International, Crete, June 1-6, 2020, December 22, 2019.** P.I. Georgia Drakaki, co.PI. Dan Szymanski and others. 1/31/2020-2/1/2021, \$50,000.

**NSF/ SPK1-ROP Signaling at the ER surface: Implications for ERES Assembly and Morphogenesis** \$1,100,000 (Collaborative grant with Dr. Robert Stahelin, IU Medical School South Bend, Notre Dame, Department of Biochemistry) 8/31/2011-9/1/2018. \$960,000 to D.B.S.

**NSF/ Novel Quantitative Proteomic Methods to Discover and Localize Endogenous Protein Complexes.** \$1,709,000. (Collaborative grant: Lead PI: Daniel B. Szymanski, Co-PIs: Mark C. Hall, Daisuke Kihara, Jun Xie); 10/31/2012-11/1/2018, \$1,200,000 to D.B.S.

**NSF/ Midwest Plant Cell Biology, meeting support.** \$12,000. June 24, 2017, Madison, Wi., Meeting organizers: Dan Szymanski, Sebastian Bednarek, Marisa Otegui, Simon Gilroy.

**DOE-ERFC/ C3BIO: The center for direct catalytic conversion of biomass to biofuel.** \$25,000,000 (9/1/2009- 8/31/2014). PI, Dr. Maureen McCann, D. Szymanski (coPI, scientific leadership board).

**NSF EAGER/** *Novel micromechanical and computational approaches to discover the mechanisms of symmetry breaking and polarized growth in dicot pavement cells.* \$299,993. (Collaborative Grant: Lead PI: Dan Szymanski, Dr. David Umulis, Purdue University, Dr. Joe Turner, University of Nebraska).

**DOE/** *The Arabidopsis WAVE complex: Mechanisms of localized actin polymerization.* \$515,000 (9/1/05- 12/31/09)

**NSF/** *SPIKE1: novel mechanisms of ROP activation and actin-based morphogenesis.* \$575,976 (3/1/07-2/29/10)

**NSF/** *Mechanisms of plant cell morphogenesis: ARP2/3 function and trichome distortion in Arabidopsis.* \$270,000 (8/1/04-7/31/06)

**USDA/** *A functional approach to understanding SPK1 signaling, cytoskeletal dynamics, and morphogenesis.* \$130,000 (9/1/02- 12/31/04)

**NSF/** *A genetic approach to understanding cellular morphogenesis.* \$341,000 (8/1/01- 7/31/04)

**DOE/** *A functional analysis of actin-dependent growth in plant cells.* \$300,000 (10/1/02- 9/30/05)

**USDA/** *Regulation of F-actin during leaf epidermal development.* \$216,000 (12/15/99- 12/31/02)

**Purdue College of Agriculture Ross Fellowships/** *Soybean improvement through genomics.* \$66,000 (8/15/03-8/14/05)

**NSF/** *Undergraduate research supplement: Screen for distorted trichome mutants and fine mapping of the DISTORTED4 and GNARLED genes.* \$11,000 (6/1/02- 5/31/03)

### **Equipment grants**

**Purdue VPR/** *Yokagawa XI spinning disk head.* 2014, \$100,000

**NSF/** *Ultracentrifugation and plant cell fractionation.* 2010, \$29,750

**NSF-Multi-User Instrumentation/** *A cryo-field emission scanning electron microscope.* \$ 400,000

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Dr. Szymanski a Co-P.I. (Dr. Ken Robinson, P.I.; Co-P.Is. Dr. David Asai, Dr. Chris Staiger) on a successful equipment proposal to obtain an ultrasensitive wide-field fluorescence microscope. *Wide field fluorescence microscopy of living cells* (NSF, MUI grant, amount \$210,000).

Dr. Szymanski was a Co-P.I. (Co-P.Is: Dr. Clint Chapple, Dr. Joe Ogas, Dr. Jeanne Romero-Severson, Dr. Lauren McIntyre) in a successful grant to establish microarray technology at Purdue. *Establishment of Arabidopsis microarray tools* (School of Agriculture seed grant, amount \$25,000).

Dr. Szymanski was the lead P.I. (Co-P.Is. Dr. Cliff Weil, Dr. Scott Jackson, Dr. Niels Nielsen) in an interdisciplinary project that utilizes both metabolic and gene expression profiling to identify



important genes in sterol synthesis in seeds. *Correlative gene expression and metabolic profiling of soybean accessions* (School of Agriculture Ross Fellowships, 2 students, 2 years of support for each, \$66,000).

### **Invited Plenary Lectures and International Meetings**

- *Cell shape mutants offer insight into cytoskeletal function*. 11<sup>th</sup> International Conference on Arabidopsis Research, Session chair, Madison, WI, June 2000.
- *Plant and Fungal Cytoskeleton*. Gordon Research Conference, Andover, NH, August 2000.
- *A genetic approach to understand morphogenesis*. American Society of Plant Biology National Meeting, Denver, CO, August 2002.
- *Arabidopsis DISTORTED1 encodes a plant actin-related protein ATARP3*. 14<sup>th</sup> International Conference on Arabidopsis Research, Session chair, Madison, WI, June 2003. Plenary Symposium Speaker, Session chair.
- *Distorted insights into ARP2/3 and WAVE Complex Functions in Plants*, Plant and Fungal Cytoskeleton. Gordon Research Conference, Andover, NH, August 2004. Plenary Symposium Speaker.
- *WAVE and ARP2/3 Complexes Control Actin-dependent Growth in Arabidopsis*, Chicago Cytoskeleton, Northwestern Medical School, Chicago, IL, November 2004.
- *SPIKE1 and ARP2/3 in the morphogenesis of the epidermis*, Plant and Fungal Cytoskeleton, Andover, NH, August 20-25, 2006.
- *Molecular modules controlling actin polymerization and morphogenesis*, 10<sup>th</sup> Plant and Fungal Cytoskeleton Meeting, Barga, Italy, August 2008.
- *Rac signaling scaffolds and the cellular control of actin filament nucleation*, Chicago Cytoskeleton, Chicago, IL, October 2008.
- Session chair: *Integration of endomembrane trafficking and cytoskeleton functions by the ROP-GEF SPIKE1*, Donald Danforth Fall Research Symposium Cellular Signaling: Advances and Applications, St. Louis, MO, September 2009 (session chair).
- *Integration of ROP signaling with cytoskeletal and cell wall systems during Arabidopsis trichome morphogenesis*. Keystone Conference on Plant Signaling Breckenridge, CO, February 8, 2014.
- *Computational and experimental approach to discover how cytoskeletal and cell wall systems control cell morphogenesis*, ASPB 2014 Minisymposium invited speaker: Hot topics/emerging science: Cell Biology, Portland, OR, July 29, 2014.
- *Integration of ROP signaling with cytoskeletal and cell wall systems during Arabidopsis trichome morphogenesis*, Keystone Symposium on Plant Signaling, Keystone, CO, Feb 5-9, 2014.
- *Computational and experimental approach to discover how cytoskeletal and cell wall systems control cell morphogenesis*, ASPB 2015 Minisymposium invited speaker: Minneapolis, MN, July 27, 2015.
- *An integrated computational and experimental approach to discover systems-level controls of morphogenesis* Cell wall meeting, Symposium invited speaker, Chania, Greece, June 14-18, 2016.
- *Computational Modeling of Cytoskeletal and Cell Wall Systems during Cell Morphogenesis*

Plant Synthetic Biology and Bioengineering, Symposium invited speaker, Miami Beach, FL, December 16-18. 2016.

- *Feedback mechanisms among cytoskeletal and cell wall systems during polarized cell expansion*, Fourth Midwest Membrane Trafficking and Signaling Symposium, Purdue University, October 27, 2017.
- *Coordination of Cytoskeletal and Cell Wall Systems during Cell Morphogenesis*, Invited speaker, Cytoskeletal Organization, Dynamics and Function, Gordon Conference, Andover, NH, August 12-17, 2018.
- *Creating a knowledge base to engineer cotton fiber traits* Cotton Scientists of Australia Annual meeting, University of New England, Armidale, AU, October 29, 2019.
- *A computational and systems-level analysis of epidermal morphogenesis*, Australian Society of Plant Scientists, LaTrobe, AU, November 27, 2019.
- *Real-time conversion of tissue-scale mechanical forces into an interdigitated growth pattern*, ASPB national meeting: developmental biology concurrent session, virtual, July 30, 2020
- *A combined experimental and biomechanics modeling approach to engineer leaf morphogenesis* 7th International Conference on Plant Cell Wall Biology in Sapporo, Japan. June 21-July 1, 2021 (virtual).
- *A conserved mechanism for cotton fiber diameter and length control*. IX Cell Wall Research Conference, June 13-17, 2022.
- *Machine learning and validated golden standards for protein complex prediction using co-fractionation mass spectrometry*. 8th International Caparica Conference on Analytical Proteomics 2022, July 18-21 2022.
- *The central role of the cell-cell interface during tissue morphogenesis: local integration of wall stress and microtubule-encoded cell wall anisotropy*, 10th International Plant Biomechanics conference, Lyon, France August 24, 2022 (virtual).
- *Meeting organizer: Plant Cell Biology International*, Crete, August 1-5, 2022.
- *Keynote speaker: Tensile forces pattern the microtubule cortical array and symmetry breaking during leaf epidermal morphogenesis*. International symposium on plant structure optimization Nara, Japan November 19-20, 2022.
- *Keynote speaker: Conserved mechanisms for cotton fiber diameter and length control*, 2023 Society for Engineering Science Annual meeting, October 11, 2023, Minneapolis, MN
- *Microtubules and cell wall force sensing during plant morphogenesis*, Chicago Cytoskeleton October 20, 2023
- *A Systems Biology Approach to Enable Cotton FiberEngineering NSF PGRP 26th Annual Awardee Meeting*, Sept. 7, 2023, Alexandria, Va.

### **Interdisciplinary programs: Seminar Series Speaker**

- *Signaling to the WAVE and Arp2/3 complexes during epidermal morphogenesis in Arabidopsis*, Colorado State University, Cell and Molecular Biology program, December 1, 2005.
- *Arabidopsis trichome morphology mutants: DISTORTED insights into novel and evolutionarily conserved cytoskeleton control mechanisms*, Ohio State University, Molecular Cellular and Developmental Biology Program, April 3, 2006.

- *Model plant systems and discovering the linkages between protein machines and important traits*, Purdue College of Agriculture Research Award Presentation, May 14, 2009.
- *The unexpected cellular deployment of signaling and cytoskeletal complexes during leaf epidermal morphogenesis* Institute of Microbiology, China Agricultural University, Beijing, China May 8, 2011.
- *Cellular deployment of conserved signaling and cytoskeletal protein complexes during plant cell morphogenesis*. The Center for Genomics and Computational Biology Seminar Series, Oregon State University, October 18, 2011.
- *The cellular and mechanical control of growth in plant cells*. Practical Summer Workshop in Functional Genomics. Ohio State University, June 16-18, 2014.
- *Experimental and computational approaches to cell shape control in plants*, Special Topic Seminar Umea University, Umea Plant Science Center, May 17, 2015.
- *Integration of cytoskeletal and cell wall systems during cell morphogenesis*. Gordon research conference: Plant and microbial cytoskeleton, session chair/ invited speaker, Andover, NH, August 14-19, 2016.
- *Spatial integration of cytoskeletal and cell wall systems during cell morphogenesis* Roy J. Carver Lecture, Dept. of Biochemistry, Biophysics & Molecular Biology, Iowa State University, Sept. 8, 2016.

### Seminar Series Speaker

- *An integrated approach to study cytoskeleton function in Arabidopsis*. Purdue University, Department of Chemistry, November 19, 1999.
- *Trichome development and morphogenesis genes*. Indiana University Purdue University Indianapolis, March 31, 2000.
- *The cytoskeleton and plant morphogenesis*. Cold Spring Harbor Laboratory, July 20, 2001.
- *Actin-dependent morphogenesis in plant cells*. North Dakota State University, Department of Botany, March 1, 2001.
- *Live cell imaging in plant cells*. University of Illinois, McKnight Program Lecture, February 3, 2001.
- *Trichome development and morphogenesis genes*. University of Illinois, Department of Agronomy, April 18, 2001.
- *Distorted group mutants and actin-dependent growth in plants*. Chicago Cytoskeleton Group, Northwestern Medical School, November 15, 2002.
- *Trichome morphology mutants and signaling to the cytoskeleton*. Danforth Plant Sciences Center, May 15, 2002.
- *SPK1 may encode a novel ROP GEF*. University of Michigan, Department of Molecular, Cellular, and Developmental Biology, April 18, 2002.
- *Growth control mechanisms in plants*. Purdue University, Department of Botany and Plant Pathology, January 29, 2003.
- *WAVE-ARP2/3 Pathway Controls Epidermal Morphogenesis*, Purdue Biochemistry Department, Purdue University, September 2004.
- *Trichome distortion in Arabidopsis: functional insights into actin-dependent morphogenesis*. Chicago Cytoskeleton Group, Northwestern Medical School, November 19, 2004
- *A SPIKE1-WAVE-ARP2/3 Pathway Controls Epidermal Morphogenesis*, Indianapolis University Medical School, IUPUI, February 2005.

- *Cell shape control in plants: spatial organization of small GTPase signals and actin cytoskeleton responses*, BGSU, Dept. of Biology Seminar series, September 2008.
- *Pulled by the hairs: from microscopy to mutants and back again* Midwest Microscopy Consortium Annual Meeting, Ann Arbor, MI, December, 2008.
- *Protein machines controlling actin-based morphogenesis* University of Minnesota, Department of Plant Biology, Minneapolis, MN, October 12, 2010.
- *Rop small GTPases and cell shape control in Arabidopsis* University of Wisconsin, Madison, WI, November 18, 2010.
- *Systems biology of plant growth control*, Purdue University, Department of Biological Sciences, March 7, 2012
- *Information flow and proteins machines that control plant cell morphogenesis*, Washington University St. Louis, Department of Biology, April 16, 2012.
- *Interactions between cytoskeletal and cell wall systems during plant cell morphogenesis* NC State University, Department of Botany, October. 21, 2014.
- *Interactions between cytoskeletal and cell wall systems during plant cell morphogenesis* University of Georgia, Department of Plant Biology, September. 23, 2014.
- *Computational modeling of cell morphogenesis*, Department of Chemistry, Purdue University, February 2, 2015.
- *Multiscale analyses of protein complex function during cell and tissue morphogenesis*, Department of Biology, McGill University, October 2, 2017.
- *Multiscale computational modeling and proteomic analyses of protein complex function in plants*, Institute of Biological Chemistry, Washington State University, August 30, 2018.
- *Systems level analyses of protein complexes that are central to plant growth and development*, University of British Columbia, September 11, 2018.
- *Cell diameter control in plant cells: translating knowledge from Arabidopsis leaf hair biology to cotton biotechnology* CSIRO Black Mountain, Ag and Food Seminar series, Canberra, AU, August 27, 2019.
- *Systems-level analyses of protein complex phenotypes using proteomics and protein correlation profiling*, CSIRO Black Mountain, Ag and Food seminar series, Canberra, AU, September 17, 2019.
- *An experimental and computational approach to analyze epidermal morphogenesis*, November 1, 2019, University of Newcastle,
- *A proteomic strategy to analyze the assembly, composition and evolution of protein complexes*, U of Plant Sciences Dept. LaTrobe, LaTrobe, AU, November 25, 2019.
- *A proteomic strategy to analyze the assembly, composition and evolution of protein complexes* U. of Plant Biology, Adelaide Waite Campus, Adelaide, AU, November 20, 2019.
- *An experimental and computational approach to discover morphogenesis control mechanisms* Department of Biology, Melbourne, Melbourne AU, November 22, 2019.
- *Microtubules convert tensile force into an interdigitated growth pattern in the leaf epidermis*, School of Integrated Plant Science, Ithica, NY, February 28, 2020.
- *Real-time conversion of tissue-scale mechanical forces into an interdigitated growth pattern*, Penn State University, Huck Institutes of Life Sciences, virtual, August 31, 2020.
- *Developing a knowledge base to enable cotton fiber engineering*. Bayer Crop Sciences, online, June 24, 2021

- *New functional looks into the proteome using LC/MS and protein correlation profiling*, ITQB Nova, Oeiras, Portugal, July 1, 2022
- *Feedback controls among tensile forces, microtubules, and cell wall properties during plant morphogenesis*, Indiana University, Dept. of Biology, Feb. 6, 2023
- *Feedback controls among microtubules, cell wall properties, and tensile forces during plant morphogenesis*, Washington State University, September 25, 2023
- Protein correlation profiling and systems-level measurements of functional protein properties, INARI Nov. 11, 2023, online seminar

## **Student Awards**

### *Post-doctoral fellow:*

Uma Aryal, Minisymposium speaker; ICAR, Vancouver, BC, 2014.

### *Graduate:*

S. Belteton Midwest Plant Cell Dynamics/Plant Cell Biology International t-shirt contest winner, ICAR travel award, International Conference for Arabidopsis Research 2016, Seoul, S. Korea.; Midwest Plant Cell Dynamics Travel award, St. Louis, MO, 2016, Midwest Plant Cell Dynamics Travel award, Madison, WI, 2015.

Youngwoo Lee, Best poster winner, 2022, International Cell Wall Meeting, ASPB travel award, ASPB annual meeting, Honolulu, Hawaii 2017, Midwest Plant Cell Dynamics Travel award, Madison, WI, 2017. PULSe travel award American Society of Mass Spectrometry, Indianapolis, IN, 2017 .

Zach McBride, Midwest Plant Cell Dynamics Travel award, Madison, WI, 2015, PULSe travel award American Society of Mass Spectrometry, SanAntonio, TX 2016 .

Dipanwita Basu: 2006 Dept. of Agronomy, Graduate Student Research Award, Departmental student travel award, ASPB travel award, Best Poster: Donald Danforth Plant Sciences Center, Honorable Mention: Purdue Life Sciences poster competition.

### *Undergraduate:*

Liz Corbett: Best undergraduate poster, Purdue University Undergraduate Science Competition

Keyntissha Jefferson, ASPB travel award

Steven Brankle: ASPB travel award

## **Graduate Research Training: Dr. Szymanski, advisor**

### *Graduated:*

Nita Basu, Ph.D. 2006, Agronomy, *Identification of new spike1 mutant alleles and SPIKE1-binding proteins.*

Don Livingstone Ph.D. 2006, co-advisor, *Identification, characterization, and modification of differentially expressed genes from soybean*

Chunhua Zhang, Ph.D. 2009, Plant Biology Program, *Comparative analyses of cotton fiber and Arabidopsis trichome morphogenesis.*

Samuel Belteton, Ph.D. 2020, *Cellular mechanisms of shape change in trichomes and leaf hairs*

Zach McBride, Ph.D. 2019, PULSe, *Mass spectrometry based profiling of protein complexes and lipids in the Arabidopsis leaf endomembrane system*

Youngwoo Lee, Ph.D. 2020, *Mass spectrometry-based profiling of protein complexes in the rice endosperm*

### **Undergraduate Research Training since 2001**

Anika Sood, *Image quantification of cellulose microfibril networks in cotton fibers*, 2022-present.

Elena Yu, *Image quantification of cellulose microfibril networks in cotton fibers*, 2022-present.

Marisa Plagens, *Reverse genetics of the Arabidopsis MRS complex*. 2021-present.

Carly Allington, *A forward genetic screen to discover new components of the ARP2/3 networks*, 2021-2022.

Andrew Reed, *A forward genetic screen to discover new components of the ARP2/3 networks*, 2020-2022.

Margaret Szymanski, *Using pectinase to alter cell wall stress profiles in developing pavement cells*, 2019-2021

Matt Marley, *Using fiducial marks to measure subcellular strain patterns in pavement cells* 2019-2021.

Madeline Quinn, *Automated image segmentation and quantification for pavement cells* 2018-2020

Danielle Klawiter, *A suppressor screen for SPK1-interacting genes*, 2016-2018

Lindsay Forbes, *The proteomic response to metabolic stress*, 2017-2019

Madalyn Alm, *Engineering ROPGEF signaling modules*, 2017-2018

Sarah Carver, *Cell wall composition and pavement cell lobing*, 2017-2019

Cody Thorson, *Pavement cell phenotyping* 2014-2017

Christy Reich, *Proteomic analysis of protein complexes*, 2014-2017

Andrew Kluttz, *ROPGEFs in cotton fibers and leaf hairs*, 2014-2017

Sean McCabe, Stat/Math, *Proteomics data analysis pipeline development*, 2013-2014

Sarah Mendoza, Biology, *PCR-based genotyping*, 2013-2014

Nathan Wilson, Food Science, *PCR-based genotyping*, 2013-2014

Adam Fesenden, Biochemistry, *Live cell imaging methods*, 2012-2015

Sung-Min Lee, Biochemistry. *Cytosol proteomics*, 2012 - 2014

Austin Blackwell *PCR-based genotyping* 2012-2014

Michael Kuhn 2012 *PCR-based genotyping*

John Roesel: *Computational modeling of pavement cell morphogenesis* 2011

John Mason: *Finite element analysis models for pavement cell growth*. 2011

Sammy Belteton: *Sucrose storage in the maize stem*, 2011, 2012.

Leah Halsey: *Morphodynamics of pavement cell growth in Arabidopsis*, 2009

Katie Ellis: *Reverse genetic analysis of the ABIL gene family*. 2009

Ada Lee: *Mapping *rnadis1* in Arabidopsis*. 2009

Dori Lin: *Developing molecular markers for mapping in F2 populations* 2007

Jiang Hwang: *Reverse genetic analysis of candidate targets of SPK1 regulation* 2007

Steven Brankle: *Reverse genetic approaches to knock out ARP2/3 genes*: 2006

Kendra Meade, NSF Undergraduate Research Supplement, *Fine mapping of DOUGHBOY* 2006

Keyntisha Jefferson, NSF Undergraduate Research Supplement, *Fine mapping of DISTORTED4*. 2005

Liz Corbette, *A screen for genetic suppressors and enhancers of PIROGI* 2005

Allison Eggert, ASPB Fellowship, Hughes Fellowship, *Fine mapping of DISTORTED1*. 2002

Mercedes Davis, MARC/AIM Fellowship student, *High-throughput identification of T-DNA insertion sites. 2001*

Tanika Spidell, MARC/AIM Fellowship student, *Complementation of the distorted3 mutant. Zhara Khorammi, Molecular mapping of distorted mutants. 2001*

Megan O'Shaughnessey, *Distorted mutant screen and fine mapping of GNARLED. 2001*

### **Post-doctoral Research Training**

#### *Current:*

Youngwoo Lee, *Protein complex prediction and dynamics in developing cotton fibers*

#### *Past:*

Pragya Baruya, *Subcellular proteome analysis of developing cotton fibers*

Samuel Belteton, *Multi-scale analysis*

Makoto Yanagisawa *Cellular and molecular mechanisms of ROP small GTPase signaling in Arabidopsis leaf epidermis*

Uma Aryal, *New proteomic methods for protein complex analysis and discovery*

Chunhua Zhang: *Cellular deployment of the SPIKE, WAVE, ARP2/3 pathway*

Takeshi Fujino: *Cytoplasmic control of cell wall synthesis*

Tsaiya Zhakharova *Biochemical analysis of SPK1, WAVE, and ARP2/3 complexes*

Jie Le, *Cytological analysis of the distorted group trichome mutants.*

Salah El-Din El-Essal, *Map-based cloning of distorted group genes.*

Mike Persans, *Expression pattern of the DISTORTED3 gene.*

Jin-long Qiu, *Cloning and characterization of the SPIKE1 gene.*

### **Advisory Committees**

Helen Law, Botany/Plant Pathology	2022-present
Steven McKenzie/Biochemistry	2020-present
AlHammam Ynazi, Mechanical Engineering	2022-present
Noel Mano, Botany/Plant Pathology	2022 Graduated
Thomas Davis, Botany/Plant Pathology	2000 Graduated
Sufang Wang, Ph.D. Horticulture	2015 Graduated
Lucio Navarro, Ph.D., Entomology	2017 Graduated
Jessica Henty, Ph.D. Biology	2013 Graduated
Matt Waldon, M.S. FNR	2012 Graduated
Youran Fan, Ph.D., Forestry Natural Resources	2008 Graduated
Parul Khurana, Ph.D., Biology	2008 Graduated
Amr Ibrahim, Ph.D. Botany/Plant Pathology	2008 Graduated
Jennifer Verburg, Ph.D. Biology	2008 Graduated
Brooklyne Coulter, Ph.D. Agronomy	2008 Graduated
Taksina Sinlapadech, Ph.D. Biochemistry	2006 Graduated
Faisal Chaudhry, M.S. Biology	2005 Graduated
Woei-Jiun Guo, Ph.D. Horticulture	2005 Graduated
Jen Victor, M.S. Botany/Plant Pathology	2005 Graduated
Hui Chun Li, Ph.D. Biochemistry	2004 Graduated

Cicero Deschamps, Ph.D. Horticulture	2002 Graduated
Griffith Jones, M.S. Agronomy	2002 Graduated
Michael Thompson, M.S. Biochemistry	2002 Graduated
Amber Shirley, Ph.D. Biochemistry (preliminary exam only)	2001 Graduated

## **TEACHING EXPERIENCE**

### **Courses Taught**

AGRY 32000	Genetics
AGRY 32100	Laboratory Experience
AGRY 48000	Advanced Plant Genetics
AGRY 60000	Genomics
AGRY 59800	Advanced Plant Genetics

### **Current courses**

BTNY 59000	Cell Biology of Plants
GRAD 61200	Responsible Conduct of Research.

### **Associate Editor**

Plant Physiology  
Frontiers in Plant Cell Biology

### **Ad-hoc Reviewer for Journals**

Bioessays  
Current Biology  
Development  
Developmental Biology  
Genes and Development  
Plant Biology  
Plant Journal  
Plant Cell  
Plant Molecular Biology  
Plant Physiology  
Protoplasma  
Science  
Trends in Plant Science



## **Ad-hoc Reviewer for Federal Grant Review Panels**

USDA, Plant Growth and Development

Department of Energy, Basic Energy Biosciences

National Science Foundation, Molecular and Cellular Biology

National Science Foundation, Plant and Microbial Genetics