

RAVISHANKAR PALANIVELU

Associate Professor, School of Plant Sciences, University of Arizona, Tucson

A. Professional Preparation.

Graduate Institution: University of Georgia, Athens, Georgia; Ph.D. in Genetics. 1998.

Postdoctoral Institution: University of Chicago, Chicago, Illinois. 1999-2004.

B. Appointments.

2012-present Associate Professor, School of Plant Sciences, University of Arizona.

2006-present Member, BIO5 Institute, University of Arizona

2007-present Adjunct Faculty, Molecular and Cellular Biology, and Interdisciplinary Graduate program in Genetics, University of Arizona.

2006-2012 Assistant Professor, School of Plant Sciences, University of Arizona.

2004-2005 Research Professional, Daphne Preuss lab, University of Chicago.

C1. Publications.

Johnson M.A., Harper J.F., **Palanivelu, R.** (2019). A Fruitful Journey: Pollen Tube Navigation from Germination to Fertilization. *Annu Rev Plant Biol.* 70: 809–37.

Jones DS, Liu X, Willoughby AC, Smith BE, **Palanivelu R**, Kessler SA. (2018). Cellular distribution of secretory pathway markers in the haploid synergid cells of *Arabidopsis thaliana*. *Plant J.* 94, 192–202. doi: 10.1111/tpj.13848. PMID: 29385641.

Zhao, L., Cai, H., Su, Z., Wang., Huang, X., Zhang, M., Chen, P., Dai, X., Zhao, H., **Palanivelu, R.**, Chen, X., and Qin, Y. (2018). KLU suppresses megasporocyte cell fate through SWR1-mediated activation of WRKY28 expression in *Arabidopsis*. *PNAS* 115(3): E526-E535. doi: 10.1073/pnas.1716054115.

Wang, Y., Tsukamoto, T., Noble, J.A., Liu, X., Mosher, R.A., and **Palanivelu, R.** (2017). *Arabidopsis* LORELEI, a Maternally-expressed Imprinted Gene, Promotes Early Seed Development. *Plant Physiology* 175: 758-773.

Zhao, D., Chong, K., **Palanivelu, R.**, eds. (2017). *Molecular and Cellular Plant Reproduction*. Lausanne: Frontiers Media.

Liu, X., Castro, C., Wang, Y., Noble, J., Ponvert, N., Bundy, M., Hoel, C., Shpak, E., and **Palanivelu, R.** (2016). The Role of LORELEI in Pollen Tube Reception at the Interface of the Synergid Cell and Pollen Tube Requires the Modified Eight-Cysteine Motif and the Receptor-Like Kinase FERONIA. *Plant Cell.* 28 (5):1035-52.

Leydon, A. R., Tsukamoto, T., Dunatunga, D., Qin, Y., Johnson, M. A., and **Palanivelu, R.** (2015). Pollen tube discharge completes the process of synergid degeneration that is initiated by pollen tube – synergid interaction in *Arabidopsis*. *Plant Physiology* 169: 485-496.

Qin, Y., Yadegari, R., and **Palanivelu, R.** (2015). ACTIN-RELATED PROTEIN 6 regulates DISRUPTED MEIOTIC cDNA 1 gene expression in *Arabidopsis thaliana* ovules. *Molecular Reproduction and Development.* 82 (7-8): 499.

Guang-Hui Yu, G-H., Zou, J., Feng, J., Peng, X-B., Wu, J-Y., Wu, Y-L., Palanivelu, R., and Sun, M-X. (2014). Exogenous γ -aminobutyric acid affects pollen tube growth via modulating putative Ca²⁺-permeable membrane channels and is coupled to negative regulation on glutamate decarboxylase. *J. Exp. Bot.* 65 (12): 3235-48. doi: 10.1093/jxb/eru171.

Qin, Y.Q., Zhao, L., Skaggs, M.I., Andreuzza S., Tsukamoto, T., Panoli, A., Wallace, K.N., Smith, S., Siddiqi, I., Yang, Z., Yadegari, Z., and **Palanivelu, R.** (2014). ACTIN-RELATED PROTEIN6 Regulates Female Meiosis By Modulating Meiotic Gene Expression in Arabidopsis. *Plant Cell* 26 (4): 1612-1628.

Cheung, A. Y., **Palanivelu, R.**, Tang, W-H., Xue, H-W., and Yang, W-C. (2013). Pollen and Plant Reproduction Biology: Blooming from East to West. *Mol. Plant.* 6 (4): 995-997.

Leydon, A.R., Beale, K.M., Woroniecka, K., Castner, K., Chen, J., Horgan, C., **Palanivelu, R.**, and Johnson, M.A. (2013). Three MYB transcription factors control pollen tube differentiation required for sperm cell release. *Current Biol.* 23 (13): 1209-1214.

Bashir, M. E. H., Lui, J. H., **Palanivelu, R.**, Naclerio, R. M., and Preuss, D. Pollen Lipidomics: Lipid Profiling Exposes a Notable Diversity in 22 Allergenic Pollen and Potential Biomarkers of the Allergic Immune Response. (2013). *PLoS ONE* 8 (2): e57566.

Veerappan. V., Wang, J., Kang, M., Lee, J., Tang, Y., Jha, A.K., Shi, H., **Palanivelu, R.**, and Allen, R.D. (2012). A novel HSI2 mutation in Arabidopsis affects the PHD-like domain and leads to derepression of seed-specific gene expression. *Planta.* 236 (1): 1-17.

Palanivelu, R., and Tsukamoto, T. (2012). Pathfinding in angiosperm reproduction: pollen tube guidance by pistils ensures successful double fertilization. *WIREs Dev Biol.* 1:96-113.

Palanivelu, R. (2011). Targeted growth of pollen tubes to ovules prior to completing fertilization. *Molecular Reproduction and Development.* 78 (12): 893.

Qin, Y., Wysocki, R.Y., Somogyi, A., Feinstein, Y., Franco, J.Y., Tsukamoto, T., Dunatunga, D., Levy, C., Smith, S., Simpson, R., Gang, D., Johnson, M.A., and **Palanivelu, R.** (2011). Sulfenylated Azadecalins act as functional mimics of a pollen germination stimulant in Arabidopsis pistils. *Plant J.* 68 (5): 800-815.

Brau, E., Barnard, K., **Palanivelu, R.**, Dunatunga, D., Tsukamoto, T., and Lee, P. (2011). A generative statistical model for tracking multiple smooth trajectories. *Proceedings of the IEEE Computer Vision and Pattern Recognition.* 1137-1144. doi:10.1109/CVPR.2011.5995736.

Yetisen, A.K., Jiang, L., Cooper, J.R., Qin, Y., **Palanivelu, R[#]**, and Zohar, Y[#]. (2011). A microsystem-based assay for studying pollen tube guidance in plant reproduction. *Journal of Micromechanics and Microengineering.* ([#] co-corresponding authors). 21 (5): 054018.

Renault H, El Amrani A, **Palanivelu R**, Updegraff EP, Yu A, Renou JP, Preuss D, Bouchereau A, Deleu C. (2011). GABA Accumulation Causes Cell Elongation Defects and Decrease in Expression of Genes Encoding Secreted and Cell Wall-related Proteins in Arabidopsis thaliana. *Plant Cell Physiology.* 52(5): 894-908. PMID: 21471118.

Tsukamoto, T., and **Palanivelu, R.** (2010). Loss of LORELEI function in the pistil delays initiation but does not affect embryo development in *Arabidopsis thaliana*. *Plant Signal Behav.* 5(11): 1487-1490.

Tsukamoto, T., Qin Y., Huang, Y., Dunatunga, D. and **Palanivelu, R.** (2010). A role for LORELEI, a putative glycosylphosphatidylinositol-anchored protein, in *Arabidopsis thaliana* double fertilization and early seed development. *Plant J.* 62 (4) 571-588.

Palanivelu, R., and Johnson, M.A. (2010). Functional genomics of pollen tube-pistil interactions in *Arabidopsis*. *Biochem. Soc. Trans.* 38 (2) 593–597.

Qin, Y., Leydon, A. R., Manziello, A., Pandey, R., Mount, D., Denic, S., Vasic, B., Johnson, M. A. and **Palanivelu, R.** (2009). Penetration of the Stigma and Style Elicits a Novel Transcriptome in Pollen Tubes, Pointing to Genes Critical for Growth in a Pistil. *PLoS Genet* 5(8): e1000621.

*Denic, S.Z., Vasic, B., Charalambous, C.D. and **Palanivelu, R.** (2009). Robust control of uncertain context-sensitive probabilistic Boolean networks. *Systems Biology, IET*, 3 (4): 279-295.

*Geitmann, A. and **Palanivelu, R.** (2007). Fertilization Requires Communication: Signal Generation and Perception During Pollen Tube Guidance. *Floriculture and Ornamental Biotechnology* 1(2): 77-89.

Nikolova, N[#], **Palanivelu, R**[#], King, E., Copenhaver, G., and Drews, G. N. (2007). Synergid Cell Death in *Arabidopsis* is Triggered Following Direct Interaction With the Pollen Tube. *Plant Physiology*, 144: 1753-1762. (# equally contributing authors).

Palanivelu, R., and Preuss, D. (2006). Distinct short-range ovule signals attract or repel *Arabidopsis thaliana* pollen tubes *in vitro*. *BMC Plant Biology* 6:7.

Palanivelu, R., Brass, L., Edlund, A., and Preuss, D. (2003). Pollen tube growth and guidance is regulated by POP2, an *Arabidopsis* gene that controls GABA levels. *Cell* 114:47-59.

Palanivelu, R., and Preuss, D. (2000). Pollen tube targeting and axon guidance: parallels in tip growth mechanisms. *Trends in Cell Biol.* 10:517-524.

Palanivelu, R., Belostotsky, D. A. and Meagher, R. B. (2000). Conserved expression of *Arabidopsis* poly (A) binding protein 2 (PAB2) in distinct vegetative and reproductive tissues. *Plant J.* 22:199-210.

Palanivelu, R., Belostotsky, D. A. and Meagher, R. B. (2000). *Arabidopsis thaliana* poly (A) binding protein 2 (PAB2) functions in yeast translational and mRNA decay processes. *Plant J.* 22:187-98.

C2. Patents.

Palanivelu, R., Brass, L. and. Preuss, D. Regulation of plant fertility by modulation of GABA levels in flowers. US patent application was filed in 2002 (#: 10/177,717), published in 2004 (Publication Number: 2004-0177398 A1), and awarded an U.S. Patent (#: 7,109,149) to The University of Chicago on September 19, 2006.

Preuss, D., **Palanivelu, R.**, Vigh, K., Cummings, M., and Bashir, M. Methods and compositions for diagnosis and immunotherapy of pollen allergy. U.S. (11/530,627), International (PCT/US2006/035123), Canadian, and European patent applications filed in 2006 and published in 2007 (Publication Numbers: US 2007-0183978 A1, WO2007/030748, CA 2621439, and EPO1922332 (A2) respectively).

Qin, Y., **Palanivelu, R.**, Wysocki, R.Y., Somogyi, A., and Feinstein, Y. Pollen tube stimulants from *Arabidopsis* pistils. U.S. patent application filed in 2010 (12/732,938), published in 2011 (Publication Number: US 2011/0111959 A1), and a U.S. patent was awarded to the Board of Regents, University of Arizona (#: 8,389,728) on March 5, 2013.

D. Invited research seminar presentations.

- Aug 2019 Plant Biology 2019, Chair & speaker, Mini Symposium – Reproductive Biology, San Jose, CA.
- Sep 2018 Molecular, Cellular, and Developmental Biology department, University of Michigan, Ann Arbor, MI
- Feb 2018 Plant Biology Seminar Series, University of Massachusetts, Amherst, MA.
- Sep 2017 Institute of Experimental Botany, The Czech Academy of Sciences, Prague, The Czech Republic.
- Sep 2017 Workshop on Flower Development, Padova, Italy.
- June 2017 International Council of Arabidopsis Research 2017, St. Louis, MO.
- Mar 2017 Department of Biochemistry and Molecular Biology, University of Nevada, Reno, NV.
- Oct 2016 Department of Biological Sciences, University of Wisconsin-Milwaukee, WI.
- Sep 2016 Department of Plant and Microbial Biology, UC Berkeley, CA.
- Jun 2016 Plant Biology 2016, Mini Symposium – Reproductive Biology, Austin, TX.
- Mar 2016 RISE Workshop, University of Arizona, Tucson, AZ.
- Oct 2015 Department of Plant Biology, University of Minnesota, MN.
- July 2015 5th Annual Pollen workshop, National Science Foundation Pollen Research Coordination Network, University of Minneapolis, MN.
- April 2015 Plant Gene Expression Center, ARS-USDA, Albany, CA.
- April 2015 Department of Botany and Plant Sciences, UC Riverside, CA.
- Nov 2014 Arizona Native Plant Society, Tucson, AZ.
- Nov 2014 Department of Biology, University of New Mexico, Las Cruces, NM.
- July 2014 Plant Biology 2014, Mini Symposium – Fertilization, Portland, OR.
- May 2014 WiNGS symposium, University of North Carolina, Charlotte, NC.
- Nov. 2013 Department of Cell Biology and Molecular Genetics, University of Maryland, MD.
- Oct. 2013 European Frontiers of Plant Reproduction Research, Oslo, Norway.
- July 2013 2013 Gordon Research Conference on Fertilization and Activation of Development, Holderness, NH.
- Mar 2013 3rd Pollen workshop, National Science Foundation Pollen Research Coordination Network, Tucson, AZ.
- Nov 2012 International Symposium on the Mechanisms of Sexual Reproduction in Animals and Plants, Nagoya, Japan.
- August 2012 Institute of Plant Physiology and Ecology, Shanghai Institutes for Biological Sciences, Shanghai, China.
- August 2012 College of Life Sciences, Wuhan University, Wuhan, China.

August 2012 Department of Molecular Biology, Cell Biology and Biochemistry Wuhan University, Wuhan, China.

August 2012 HuaZhong Agriculture University, Wuhan, China.

August 2012 Tamil Nadu Agriculture University, Coimbatore, India.

July 2012 Center for Cellular and Molecular Biology, Hyderabad, India.

Feb 2012 School of Information: Science, Technology and Arts, University of Arizona, Tucson, AZ.

Oct 2011 GIDP Genetics, University of Arizona, Tucson, AZ.

Sep 2011 School of Plant Sciences, University of Arizona, Tucson, AZ.

March 2011 Department of Biochemistry and Molecular Biology, Univ. of Massachusetts, Amherst, MA.

March 2011 Department of Molecular Biology, Cell Biology and Biochemistry, Brown University, RI.

Jan. 2011 Division of Molecular and cellular Biology, Univ. of Missouri, Kansas city, MO.

Oct. 2010 Department of Cell and Systems Biology, Toronto, Canada.

Sep. 2010 Southwest Regional Society of Developmental Biology meeting, Austin, TX.

July 2010 American Society of Plant Biologists, Montréal, Canada.

Nov. 2009 Department of Biology, University of Montréal, Montréal, Canada.

Nov. 2009 Department of Plant and Animal Sciences, Nova Scotia Agricultural College, Truro, NS, Canada.

Sep. 2009 Cell-cell communication in plant reproduction conference, University of Bath, UK.

May 2009 Department of Botany and Plant Sciences, University of California, Riverside, CA.

March 2009 Molecular Reproduction conference, Brown University, Providence, RI.

Nov. 2008 Department of Plant Biology, Noble Foundation, Ardmore, OK.

Oct. 2008 Department of Biology, University of Pennsylvania, PA.

April 2008 Department of Biology, Washington University, St. Louis, MO.

March 2008 Department of Biology, University of Texas, Austin, TX.

Jan. 2008 Department of Plant Biology, University of California, Davis, CA.

Oct. 2007 Department of Chemistry, Nagoya University, Nagoya, Japan.

Oct. 2007 Department of Biology, Colorado State University, Fort Collins, CO.

Aug. 2007 Interdisciplinary Plant Group, University of Missouri-Columbia, Columbia, MO.

May 2007 Center for Cellular and Molecular Biology, Hyderabad, India.

May 2007 State Key Laboratory of Plant Physiology and Biochemistry, College of Biological Sciences, China Agricultural University, Beijing, China.

May 2007 Institute of Genetics and Developmental Biology, Beijing, China.

May 2007 College of Life Sciences, Wuhan University, Wuhan, China.

May 2007 Huazhong Agriculture University-University of Arizona Bilateral symposium on crop functional genomics, HuaZhong Agriculture University, Wuhan, China.

April 2007 Department of Molecular and Cellular Biology, University of Arizona, Tucson, AZ.

Feb. 2007 Department of Biological Sciences, Texas Tech University. Lubbock, TX.

Oct. 2006 Department of Biological Sciences, Virginia Tech, Blacksburg, VA.

Sep. 2006 Department of Computer Sciences, University of Arizona, Tucson, Arizona.

Sep. 2006 GIDP Genetics, University of Arizona, Tucson, Arizona.

E. Synergistic Activities.

Undergraduate research mentoring experience

2006-present Research mentor for 16 undergraduate students; 6 are now pursuing doctoral degree
2006 Guided Jamie Jackson to get ASPB summer undergraduate research fellowship (SURF)
2008 Co-advisor for Jill Cooper and Ali Kemal Yetisen (both from Dept. of Aeronautical and Mechanical Engineering; Jill is now a graduate student at Univ. of Colorado)
2007-2008 Honors thesis advisor for Claire Heinitz and Salika Dunatunga (University of Arizona) who are now graduate students at University of California, Davis and University of Pennsylvania, respectively

Broadening the participation of groups underrepresented in science

- a. In collaboration with NASA (Native American Student Affairs), University of Arizona, recruited two minority students (one native American and one Hispanic) to conduct research in my lab (2006)
- b. Hosted high school students—Anthony Garcia, (2006), Fernando Otero (2007) and Courtney Smith (2008)—as part of Summer of Excellence Program (SOE), BioTech Academy, Mesa, Arizona
- c. Career day guest speaker, Desert Sky Middle school, Tucson, Arizona (2007 & 2008)
- d. Hosted Dr. Bob Simpson, Professor, Pima Community College, Tucson, for summer research (2008)
- e. Delivered lecture to high school teachers from Arizona, Computational Thinking in Biology seminar/discussion series, University of Arizona (2008-2012)
- f. Hosted high school students Elle Stuart (2008), Salika Dunatunga (2009), Alyssa Cortez (2010), and Chelsea Hoel (2013) for summer research internship in my lab
- g. Conducted microscopy demonstrations to summer camp middle school students from Tucson area and lectured on the importance of computational thinking in biology (2008-2012)
- h. Hosted Ms. Cheryl Parks, high school teacher from Texas, to do summer research (2009)
- i. Science Fair judge, Mesquite Elementary and Empire High Schools, Tucson, Arizona (2009-present)
- j. Conducted several outreach events to educate and promote and explain the importance of pollen in our lives (2012-present); FunFest, SARSEF, Plant Science Family Night, Imagine Science, Spooktacular, Science City, and science fair day in elementary schools
- k. Recipient, “60 for 60” STEM community leader award from The Southern Arizona Research, Science, and Engineering Foundation, Tucson, Arizona.

Service to Scientific Community outside of the University of Arizona

2008 Organizer, Third Frontiers of Sexual Plant Reproduction international scientific research conference, Tucson, Arizona (~200 attendees)
2009 Organizer, Annual meeting, Western section of American Society of Plant Biologists, Tucson, Arizona (~60 attendees)
2013 Organizer, 3rd annual workshop, National Science Foundation Pollen Research Coordination Network, Tucson, Arizona (~35 attendees)
2013 Session chair, Communication strategies in pollen-pistil interactions session, 3rd Pollen workshop, National Science Foundation Pollen Research Coordination Network, Tucson, Arizona.
2015 (-present, ongoing) Member, Board of Directors, The Southern Arizona Research, Science, and Engineering Foundation, Tucson, Arizona.
2016 Co-chair, 24th International Congress on Sexual Plant Reproduction, Tucson, Arizona.
2016 (-present, ongoing) Review Editor, in Plant Evolution and Development, part of the journal(s) Frontiers in Plant Science

F. Other Affiliations.

- (i). **Thesis advisor:** Dr. Richard Meagher (University of Georgia)
Postdoctoral mentor: Dr. Daphne Preuss (University of Chicago)

(ii) Graduate advisees/Postdoctorals.

Nicholas James Desnoyer (MS student, 2017-2019; graduated April 2019)
Jennifer Noble (Ph.D. student, 2013-2019; graduated April 2019)
Domenico Aiello (Visiting PhD student, University of Perugia; Jan 2018 – Dec 2018)
Monica Costa (Visiting MS student, Universidade do Porto; Jan 2017 – June 2017)
Dr. Yuan Qin (Post doctoral fellow; 2006-2009)
Dr. Tatsuya Tsukamoto (Post doctoral fellow; 2007-2011)
Dr. Meenakshisundaram Palaniappan (Visiting Scientist, University Grants Commission, Government of India sponsored Raman Fellow, 2013-2014)
Dr. Xunliang Liu (Post doctoral fellow, 2012-2016)
Dr. Yanbing Wang (Post doctoral fellow, 2013-2016)

G. Research Support

Completed Research Support

4. NSF IOS-1146090 Palanivelu (PI) 02/01/12 – 01/31/17
Molecular genetic analysis of LORELEI function in inducing the arrest of pollen tube growth in the Arabidopsis female gametophyte.

The goal of this work is to identify the molecular mechanisms by which Arabidopsis LORELEI, a putative GPI-anchored membrane protein, mediates cell-cell interactions between the pollen tube and the synergid cell in the female gametophyte.

3. NSF IOS-1045314 Palanivelu (PI) 09/15/10 – 09/14/13
Interdisciplinary Collaborative Research: A high throughput, quantitative analysis of Arabidopsis pollen tube guidance using a novel microsystem-based assay.

The goal of this work is to develop and validate a novel microfluidic channel-based assay to monitor and quantify attractive and repulsive interactions between Arabidopsis pollen tubes and ovules and led to the publication of the first microfluidics-based pollen tube growth assay.

2. NSF IOS - 073421 Palanivelu (PI) 08/01/07 – 07/31/11
Characterization of Pollen Tube Repulsion in Arabidopsis thaliana.

The goal of this work was to identify molecular determinants of repulsion in Arabidopsis ovules. This study led to the identification of LORELEI, a putative GPI-anchored membrane protein, and was used to obtain another award from NSF (IOS-1146090).

1. Faculty Small Grants Program, The University of Arizona Palanivelu (PI) 08/01/06 – 07/31/07
Pollen tube signaling network in Arabidopsis.

The goal of this seed grant was to identify the transcriptome of pollen tubes that have interacted with the pistil to understand the molecular mechanisms of pollen tube differentiation, a developmental transition that is essential before it can complete double fertilization.